



Food Harvest 2020

Environmental Analysis Report

Final Report – January 2014



Prepared on behalf of



Environmental Analysis of Scenarios Related to the Implementation of Recommendations in Food Harvest 2020

prepared on behalf of

The Department of Agriculture, Food and the Marine

Final Analysis Report

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- The Agricultural Consultants Association.

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Acronyms/Abbreviations

AA	Appropriate Assessment
AEOS	Agri-Environmental Options Scheme
BQAS	Beef Quality Assurance Scheme
BWI	Bird Watch Ireland
CAP	Common Agricultural Policy
CBS	Convention on Biological Diversity
CGRFA	Commission on Genetic Resources for Food and Agriculture
CSO	Central Statistics Office
DAHG	Department of Arts, Heritage and the Gaeltacht
DAFM	Department of Agriculture, Food and the Marine
DCENR	Department of Communications, Energy and Natural Resources
DECLG	Department of the Environment, Community and Local Government
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EQS	Environmental Quality Standards
ERBD	Eastern River Basin District
FAO	Food and Agriculture Organisation
FAPRI	Food & Agriculture Policy Research Institute
GAEC	Good Agricultural and Environmental Condition
GHG	Greenhouse Gases
GSI	Geological Survey of Ireland
HNV	High Nature Value
IFI	Inland Fisheries Ireland
NBIRBD	Nenagh-Bann International River Basin District
NDP	National Development Plan
NEC	National Emissions Ceiling
NMVOC	Non-Methane Volatile Organic Compounds
NPWS	National Parks and Wildlife Service
RDP	Rural Development Programme
NSS	National Spatial Strategy
NWIRBD	North Western International River Basin District
REPS	Rural Environmental Protection Scheme
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SERBD	South Eastern River Basin District
SHIRBD	Shannon River Basin District
SMR	Statutory Management Requirements
SOC	Soil Organic Carbon
SOM	Soil Organic Matter
SPA	Special Protection Areas
SWRBD	South Western River Basin District
UNFCCC	United National Framework Convention on Climate Change
WFD	Water Framework Directive
WRBD	Western River Basin District

Abstract

This final report assesses the potential environmental impact of the increased food production envisaged by *Food Harvest 2020 – A Vision for Irish Agri-Food and Fisheries*, an industry led initiative, published by the Department of Agriculture, Food and the Marine (DAFM). It assesses the environmental impacts under the characteristics: biodiversity; flora and fauna; water quality including drinking water; soil; air quality; landscape and buildings; and climatic factors including greenhouse gas emissions.

In accordance with Article 6(3) of the EU Habitats Directive this report has carried out an Appropriate Assessment (AA) of Food Harvest 2020 as far as its impacts are measurable at a high level or national basis. The processes in developing this report closely followed those required for a Strategic Environmental Assessment (SEA) and the findings of this report can be used to guide the development of plans, programmes and other measures designed to facilitate the attainment of the Food Harvest 2020 targets.

Agriculture is placed in context within the overall national economy. Agriculture's responsibilities along with other actors such as industry, municipal waste water treatment plants and private septic tanks are noted and highlighted in relation to the protection of the environment. The challenges of accommodating increases in agricultural output alongside environmental protection are recognised.

The report analyses the national impact associated with the changes outlined in Food Harvest 2020. The changes have been modeled by Teagasc (FAPRI Ireland) from the base period of 2007-2009 up to year 2020. At a sectoral level three alternative scenarios were analysed: a low intensity system; a high intensification system; and a system based on best knowledge and technology. Additionally, where appropriate the environmental impact was analysed across regions.

The report finds that when considered at a high or national level basis the changes envisaged under Food Harvest 2020 would lead, before mitigation, to a slight negative impact in the environmental characteristics biodiversity, flora and fauna; water quality; air quality and climatic factors and to a neutral/imperceptible impact on soils and landscape. The FAPRI scenario considered envisages technological improvements over the base period but does not assume best technology available as analysed in the sectoral scenarios.

On a sectoral analysis it is found that the use of high technology and best production methodologies delivered enhanced environmental outcomes. High level mitigation measures have been identified and it is recommended that these measures be implemented. It is noted that if mitigation measures were implemented, in addition to continued adherence to environmental legislation and targets, then negative impacts could potentially be reversed and rendered neutral/imperceptible in most cases and lead to environmental gains in some cases. It is noted that this high technology model is already practiced by the top 10% of producers across the sectors.

A knowledge and skills deficit is identified at both farm advisor and primary producer level. At a sectoral level the adoption of best practice technology is found to deliver the best environmental outcomes. To facilitate the adoption of best technology, with its consequent environmental gains, it is recommended that an up skilling programme be developed for the approximately 570 Approved Farm Advisors and that a structure is put in place to ensure delivery of research findings directly to these advisors.

The procurement of bespoke agri-environmental best practice and high technology plans at individual farm level is deemed to be the most effective mitigation measure available.

***Food Harvest 2020 – An
Industry Plan to achieve
growth...***

Executive Summary

About Food Harvest 2020

Food Harvest 2020 is a roadmap for the Irish food industry, as it seeks to innovate and expand in response to increased global demand for quality foods. It sets out a vision for the potential growth in agricultural output after the removal of milk quotas in 2015. Although Food Harvest 2020 was an initiative of the production and processing sectors of Irish agriculture, the document was published by the Irish Department of Agriculture, Food and the Marine (DAFM).

This is the third in a series of such plans but differs radically from previous plans in that from the outset environmental sustainability has been a central tenet. Food Harvest 2020 is based on three broad pillars – *smart, green, growth* – with each pillar having equal weight and importance. By placing environmental sustainability as a central tenet, the authors of Food Harvest 2020 seek a paradigm shift throughout the industry which will see compliance with environmental regulations becoming a profit centre through market price signals rather than a cost centre through compliance obligations.

Food Harvest 2020 was originated by a representative group drawn from the agri-food industry, the farming organisations, state bodies relevant to Irish agriculture, environmental groups, forestry and fishery industry representatives, food retailers and exporters, academia, and statutory bodies.

Agriculture, already a significant constituent of the Irish economy, has the potential to contribute to economic recovery through growth in output in a non-quota environment. Food Harvest 2020 envisages the agri-food and fisheries industry expanding from its baseline output of €24 billion per annum by increasing the value of primary production by 33%; increasing value-added outputs by 40%; and increasing exports by 42% by 2020.

Food Harvest included specific sectoral growth targets to be achieved between the reference years 2007 to 2009 and 2020. These targets included a 50% volume increase in milk production; a 20% increase in value of beef output; a 50% increase in the value of pig meat production; a 20% increase in the value of sheep meat production; and a 10% increase in the value of poultry production. Food Harvest 2020 also includes recommendations for the development of the cereal; forestry and bio-energy crop; organic production; and horticulture sectors.

Significant progress has already been made towards the achievement of the Food Harvest 2020 objectives under each of the three pillars – *“smart, green, growth”*, as outlined in the DAFM publication *Food Harvest 2020 Milestones for Success 2012 and 2013*. Initiatives by Teagasc and Bord Bia are yielding significant output improvements through *“smarter”* and *“greener”* farm practices. A buoyant world commodities market has also contributed to increased output. As recently reported by Bord Bia the agricultural sector achieved exports of €9.9 billion in 2013 representing significant progress towards the Food Harvest 2020 target of €12 billion. In the scenarios analysed output changes for each sector are derived from assumptions about changes in animal numbers, technology and prices achievable. In fact the output targets called for could be achieved by price movements alone with no changes in animal numbers or technology. Thus, for example, much of the increased output predicted by Food Harvest 2020, for the pig sector, has already been achieved through price changes.

*...stress test the “green”
credentials of Food
Harvest 2020...*

Rationale for Analysis of Scenarios Related to the Implementation of Food Harvest 2020

The recently published Environmental Protection Agency (EPA) State of the Environment 2012 describes Ireland’s environment as being in *“generally good condition overall”*. It notes an overall improvement in water quality. It describes air quality as *“among the best in Europe”*. It identified agriculture, along with industry, local authorities (through the operation of waste water treatment plants), the general population, transport and the owners of private septic tanks as potential contributors to environmental damage. Agriculture’s role in potential water pollution is noted as is the additional potential pressure under Food Harvest 2020. While noting the gaps in available data, soils are considered to be in good condition generally with the exception of peats and the need to protect biodiversity is highlighted. Further improvements to water quality and other environmental characteristics are called for. In this regard this analysis notes the value of strong codes and regulations linked to direct payments under CAP since 2003.

Food Harvest 2020 identifies the positive impacts that growth in the agri-food sector would provide to the Irish economy as a whole, as well as to individual Irish farmers. A recent academic report predicts the creation of up to 25,000 jobs could be achieved through the attainment of the Food Harvest 2020 targets. Food Harvest 2020 also recognises that any planned expansion in agricultural output will undoubtedly impact upon the environment. Food Harvest 2020 does not attempt to quantify this impact.

However, Food Harvest 2020 envisages industry growth that does not jeopardise Ireland’s current *“green”* reputation and which would build on the existing sustainable and environmentally friendly primary production sector. Ireland’s green reputation was presented as a key competitive advantage, stating that *“Ireland can become synonymous with the production of environmentally sustainable and welfare friendly products.”*

In order to realise the vision of Food Harvest 2020, DAFM seeks to involve the various industry stakeholders. To this end, the Department has created a High Level Implementation Committee (HLIC), chaired by the Minister for Agriculture, Food and the Marine, Simon Coveney, TD. The committee members are drawn from DAFM; Bord Bia; Teagasc; Bord Iascaigh Mhara; Enterprise Ireland; Forfas, the EPA; and the Department of Public Expenditure and Reform. In recognition of the need for an environmental analysis of the likely impact of the realisation of Food Harvest 2020 the HLIC established The Environmental Analysis Steering Group comprised of representatives from DAFM and other relevant State Agencies and tasked it with setting the terms of reference and commissioning this report.

Challenges & Opportunities

The concept of increased agricultural output and improved environmental outcomes is sometimes seen as counterintuitive. Nonetheless these two objectives must be reconciled in the face of world population trends demanding a 50% increase in food production by 2030 (70% increase by 2050) and continuing challenges to meet present and future greenhouse gas emission targets. The scale of agriculture within the economy and the scale of grassland farming within agriculture create a unique position for Ireland vis-à-vis its European partners. This has been highlighted by government departments, State agencies and NGOs in commentary on and submissions to this report. Ireland faces challenges in meeting European and international targets for conservation, water quality, air

quality and climate change. Agriculture's contribution in all these areas is recognised, as is the need for additional mitigation measures to help meet Ireland's targets. Attention is drawn to the fact that past agricultural practice has contributed to the status being in a less than good condition in the base period 2007-2009 for some environmental characteristics.

By adopting the objective of smart, green, growth the authors of Food Harvest 2020 reinforced the principle that environmental compliance be placed at the heart of increased output. Already imperatives imposed through marketing schemes (such as origin green) have led progressive farmers to a willing adoption of a market driven approach to environmental compliance by recognising that best environmental practice delivers a direct monetary gain through an ability to supply into the most lucrative markets.

Individual farmers have already demonstrated that output increases beyond those targeted in Food Harvest 2020 can be achieved while adhering to best environmental practices and delivering environmental gains. The challenge of extending this best practice throughout the farming community through the dissemination of best farming practices should not be underestimated. The uptake of best technology on farms with its consequent environmental benefits through improvements in breeding, improved fertiliser and manure application techniques and importantly the elimination of animal diseases will not be achieved without adequate resources being applied to the training and up skilling of the cohort of private and public advisors and a refocusing of the way in which research findings are transmitted to the farming community through these advisors.

In practical terms not all farmers will adopt a high technology approach and it is likely that in the future, as in the past, there will be two tiers of farmers – one highly productive and the other more extensive. It is important that appropriate policies and schemes are developed that recognise these differences and in particular recognise the public goods provided by the cohort of more extensive farmers.

Terms of Reference

The terms of reference for this analysis, as set out by the Environmental Analysis Steering Group, were to undertake an analysis of the likely environmental impacts which might result from Food Harvest 2020. A number of alternative approaches were to be considered and an optimum approach within environmental parameters to achieving the growth targets set out by Food Harvest 2020 was to be formulated. The analysis was to present a number of scenarios for meeting the volume and value targets. In consultation with the Environmental Analysis Steering Group it was decided to adopt the FAPRI-Ireland model as the main scenario for analysis with separate scenarios being generated for each of the principal agricultural sectors.

The baseline chosen for environmental characteristics (average 2007 to 2009) is the same as that for the production targets in Food Harvest 2020. This study aims to assess the predicted changes between the baseline and 2020 as a result of Food Harvest 2020. In proposing mitigation measures it is the intention not only to address predicted changes between the baseline and 2020 but also mitigation measures which could deliver improvements above the baseline status for some environmental characteristics (e.g. biodiversity and climate change).

In August 2012, a draft report was considered by the HLIC. Following consultation with the European Commission (DG Environment), at which the areas for analysis were agreed, it was decided to broaden the terms of reference to include the

*....drawing on
international assessment
guidelines...*

identification of potential areas of risk to the environment and the proposal of appropriate mitigation measures.

Legislative Setting

Because Food Harvest 2020 is an industry vision, rather than a national plan, there is no requirement under Directive 2001/42/EC for a Strategic Environmental Assessment (SEA). Nonetheless the HLIC determined that it was important to undertake an environmental analysis. The processes in developing this report closely followed those for a Strategic Environmental Assessment as set out in Directive 2001/42/EC. In accordance with Article 6(3) of the EU Habitats Directive this study has carried out an Appropriate Assessment (AA) of Food Harvest 2020 as far as its impacts are measurable at a high level or national basis.

Data Sources and Related Studies

...and existing published data sources including work by Teagasc and the EPA....

As no primary research was required to be undertaken, this report has drawn widely on published data from many sources, particularly from Teagasc and the EPA. In April 2012, as part of the National Climate Policy Development Consultation, Teagasc published its *Marginal Abatement Cost Curve for Irish Agriculture* analysis. This submission was prepared by Teagasc's working group on greenhouse gas emissions which integrates the extensive and diverse range of organisational expertise in research and practice associated with greenhouse gases. The analysis was conducted within the context of Food Harvest 2020.

The Teagasc report specifies pathways for the growth of individual sectors of the agri-food industry and includes *inter alia* a target of a 50% increase in the production of milk, a 20% increase in the value of beef production and the interrelated changes in production in other sectors which would result in the achievement of the targets set out in Food Harvest 2020.

The Teagasc document, as its title suggests, concentrates on the area of greenhouse gases and the scope of this study is wider, to include an examination of the implications of the achievement of Food Harvest 2020 on biodiversity, flora and fauna, water quality (including drinking water), soils, air quality, landscape (including buildings) and climatic factors. The Teagasc document does however draw upon its research, knowledge transfer and advisory expertise to bring together a practical and feasible fully-integrated plan for the achievement of the targets set out in Food Harvest 2020 across all sectors.

Developing Scenarios

....to find the best way forward....

This report takes the scenario presented in *A Marginal Abatement Curve for Irish Agriculture* as its first scenario (Scenario A). This FAPRI Ireland Model represents an integrated proposal which could achieve the volume and output targets contained in Food Harvest 2020. Because the volume and output targets could be achieved in other ways three alternative pathways at sectoral level for the achievement of the targets have been generated: Scenario B – a low intensity system; Scenario C – a high intensification system; and Scenario D – a system based on best knowledge and technology. In practice it is anticipated that the achievement of output targets at farm level will be through a combination of the above scenarios.

Assessment Methodology

....adhering to a recognised significance assessment methodology.

Having decided upon the scenarios to be assessed the following methodology was then adopted for the conduct of the study.

i. Establish significance criteria for potential impacts

In order to assess the potential positive or negative impacts across the range of environmental characteristics (biodiversity, flora and fauna,

water quality, soil, air quality, landscape and climatic factors) it was necessary to adopt a uniform and recognised method of assessment.

The significance criteria used in the assessment of potential impacts of Food Harvest 2020 grade the potential impacts as positive, imperceptible/neutral and negative. Positive and negative impacts are further graded as slight, moderate and significant. The criteria have been selected following a review of relevant literature, and on the basis of objective criteria and drawn from the EPA Guidelines (2002).

ii. Define legislative/regulatory parameters

Irish agriculture at farm level is already highly developed and regulated. All relevant EU and National legislation was reviewed in relation to each environmental characteristic to be studied. A desktop study of all relevant regulation and legislation applying to agriculture and each environmental characteristic was carried out.

iii. Define baseline status

The baseline state of the environment under each environmental characteristic was noted, recognising the impact of historic agricultural practices, where appropriate. In this context the fact that output changes envisaged under Food Harvest 2020 would occur within already well-functioning farming systems which are striving for and meeting increasingly more stringent environmental regulations and targets was recognised. A full literature review was carried out for each characteristic.

iv. Identify key agriculture pressures

In order to predict potential environmental impacts the potential changes in pressures from agricultural practices were identified. The potential to reduce or mitigate pressures was noted together with the role already being played by regulation and codes of good farming practice. The state of the existing environment was defined and the role of cumulative pressures was considered.

v. Predict and assess likely impacts

Each predicted impact was examined and assessed under the context of on-going farming systems. A rating of positive, neutral or negative was assigned to the impacts. Consideration has been given to potential significant interactions between all the environmental aspects. Consideration has been given to the influence of other plans and programmes.

vi. Suggest suitable mitigation

In all cases where negative impacts were predicted high level mitigation measures were suggested and monitoring programmes were recommended, which could be refined and evaluated through an iterative monitoring programme which can address regional and farm-scale impacts. It was noted that the impact assessment was pre-mitigation.

Data Gaps and Study Limitations

Data gaps encountered while assembling the baseline data have been highlighted in the report.

Public Consultations

The Department of Agriculture, Food and the Marine facilitated an eight week public consultation on the terms of reference at the outset of this analysis (May-July 2012). The draft final report was made available for public consultation for a period of eight weeks from the 16th September 2013. Twenty five submissions were received as detailed at Appendix I to this report. All submissions received were considered by the authors and helped to inform and improve the final iteration of this report. The authors recognise that the analysis process has been strengthened by the input and comments received through the public consultation process and are grateful to all those who participated in the process.

Assessment Results – Integrated Scenario A

Scenario A represents the integration of the whole agri sector as it changes from the base period (2007-2009) to 2020. Changes in livestock numbers by class of livestock and land use for Scenario A are derived from the FAPRI Ireland projections. Scenario A therefore provides the basis for the assessment of the various environmental indicators discussed in the following sections.

Having assessed the potential impacts of predicted changes as a result of the implementation of changes in farm practice necessary to achieve the targets set out in Food Harvest 2020 it was predicted that a slight negative impact would occur in relation to biodiversity, flora and fauna, water quality (including drinking water), air quality and climatic factors. A neutral/imperceptible impact was predicted for soils and landscape. These predicted impacts are pre-mitigation. The report notes that measures exist or are in development which if applied could help mitigate these negative impacts, in conjunction with adherence to existing legislation and good farming practice.

The report defines slight negative impact as: an impact which causes noticeable changes (negative) in the character of the environment without affecting its sensitivities.

Biodiversity/Flora and Fauna

The maintenance and protection of biodiversity and the promotion and protection of our rich and diverse flora and fauna fall within the same ambit of legislative and pressure frameworks and so have been dealt with together in this study. The principal national legislation and regulations are derived from three EU directives, namely: EU Birds Directive 79/409/EEC; EU Water Framework Directive 2000/60/EC; and EU Habitats Directive 92/43/EEC. The statutory bodies in Ireland with responsibility for implementation of relevant policies are DAFM, Department of Arts, Heritage and the Gaeltacht (principally through the National Parks and Wildlife Service), Department of Environment, Community and Local Government, the EPA, Inland Fisheries Ireland with a key role being played by other state agencies such as Teagasc, The Heritage Council and Local Authorities.

In assessing the baseline 2007-2009 it is recognised that the conservation status of some habitats and species is presently at a lower status than desirable and in some cases has been impacted by historical agricultural practices. The key pressures or pathways by which specific elements of biodiversity and flora and fauna might be impacted were identified.

While noting the increased pressure which might be caused by increased inputs to the environment generally weight was given to the already advanced state of legislation and regulation to control the application of farm wastes and the on-going farm schemes which protect habitats. This report is based on nationally

Ireland enjoys a world important, unique and diverse biodiversity which requires protection...

predicted impacts and it is recognised that through accident or lack of implementation of regulation serious local or regional impacts could occur.

The overall impact of the proposals under Food Harvest 2020 was found to be Slight Negative pre-mitigation. These findings are based on risks associated with projected increases in input of organic and inorganic nitrogen and phosphorous fertilisers. Potential adverse impacts are primarily related to projected expansion of dairying and pig / poultry enterprises with potential loss of semi-natural habitats and ecological features; reduction in the suitability of habitats for a range of species, particularly lowland farmland birds. It is noted that this is a high level study and the overall level of change in concentrate use, fertiliser input and changes in land use patterns are relatively small. Notwithstanding this, it is noted that such changes could be significant at farm or site level. For the sectors assessed stringent legislation is already in place which will inherently act as mitigation, particularly for water quality and protection of Natura 2000 sites.

While the provision of detailed mitigation measures is not possible at this strategic assessment level, high level mitigation is provided, with recommendations for a system of environmental monitoring and reporting within which the impacts of delivering Food Harvest 2020 can be monitored, reported on and farm appropriate advice can then be provided at the single-farm or regional level. The importance of an integrated monitoring and mitigation programme which includes both high level and specific measures acting as indicators of type, level and degree of impacts occurring under the plan, and from which more specific mitigation measures may arise is the key message arising from analysis of biodiversity/flora and fauna.

Natura 2000

The Natura 2000 network is a Europe wide designation of sites which have been selected for protection as they support habitats and/or species which are deemed to be of European importance under the Birds Directive and the Habitats Directive. Natura 2000 sites are governed by the Habitats Directive, which is transposed into Irish law under The European Communities (Birds and Natural Habitats) Regulations, 2011. The National Parks and Wildlife Service (NPWS) is responsible for designating sites. The NPWS sets individual conservation objectives for each Natura 2000 site with Special Areas of Conservation (SACs) being designated to protect habitats and Special Protection Areas (SPAs) being designated to protect birds. Currently there are 423 Natura 2000 sites in Ireland, and seven marine sites are currently in the process of being designated. In Ireland, although SACs have been identified, the designation process is not yet fully completed and many SACs remain as candidates for designation, although they are afforded full protection from the time they were considered for designation.

Geographically, density of Natura 2000 sites tends to be highest in the North-West, West and South-West where Annex habitats such as blanket bogs, semi-natural grasslands and high-quality water dependent habitats are of note. In the East and South-East Natura 2000 sites are concentrated along major river catchments and along the coast.

Agriculture plays an important role in the maintenance of Natura 2000 sites. Entry to the latest round of AEOS was prioritised on the basis of area of land included within a Natura 2000 designation. The draft Prioritised Action Framework for Financing Natura 2000 for the period 2014-2020, issued in January 2013, indicates that for both priority and non-priority Annex habitats, and non-priority annex species, provision of targeted agri-environmental measures is one of the key measures to maintain and improve conservation status; and proposes

*... recognising the role of
Natura 2000 sites....*

development of specific agri-environmental measures for species in poor/bad status.

The current status, based on NPWS (2008), of the majority of habitats and species listed under the Habitats Directive is considered to be ‘poor’ or ‘bad’. The ascribed conservation status are the result of historic declines due to a variety of interacting pressures, including agricultural practices, infrastructure, residential and industrial developments, changes in land use management and socio-economic changes. Therefore, many of the habitats and species assessed have experienced contractions in range and population, and may be at the limits of their ecological tolerances, e.g. freshwater pearl mussel. The key threats identified for the conservation assessment of Natura 2000 sites (NPWS 2008) were direct damage; overgrazing and under grazing; pollution of waters by nutrient or silt; unsustainable harvesting and invasive alien species. Future prospects of these habitats and species, in the absence of Food Harvest 2020, are generally unfavourable as the key threats, including intensification of agriculture in general and more specifically changes in traditional farming practices, in addition to other pressures, are likely to remain a threat in the short and medium term.

Appropriate Assessment (AA)

Article 6(3) of the EU Habitats Directive dictates that any plan or programme which could have a significant effect on a Natura 2000 site should be subject to an Appropriate Assessment. A full screening of Food Harvest 2020 in so far as its effects can be measured at a national level was carried out. This assessment examined projected changes from baseline on Annex habitats and species for which Natura 2000 sites have been designated, and is not an assessment of agriculture *per se* on the Natura 2000 network on a site by site basis. The existing conservation status of Annex habitats and species is recognised, and the assessment focuses on those habitats/species which may come under increasing pressure, either nationally, or where possible to identify, regionally, from the changes predicted under Food Harvest 2020.

At the high level assessment undertaken, the potential pressures on Natura 2000 sites were found to be: change in grazing regime; impact on water quality; nutrient loading of terrestrial habitats; change in land management; off-site impacts; and interaction of impacts from all Food Harvest 2020 sectors and cross cutting of impacts from other disciplines. The screening was carried out across the main agricultural activities of: ruminants; pigs and poultry; and tillage and field crops. The outcome of the screening process was that direct loss of Natura 2000 habitat is not considered as a likely outcome of Food Harvest 2020. However, screening indicates potential for some adverse impacts through alteration in nutrient status for sensitive habitats and species and possibly through changes in farm management. Significant adverse impacts would be those which cause delays or impede progress in reaching conservation objectives of a site. It was concluded on a national basis and at a strategic level of assessment the implications of Food Harvest 2020 on the Natura 2000 network appear to indicate generally non-significant impacts. At local or regional level where significant land use changes or intensification is proposed site level assessment may be required particularly in Natura 2000 sites which have already been identified as having the highest potential to be impacted by changes in farming patterns. It should be noted that 27 catchments have been designated nationally for the protection of freshwater pearl mussels (see also Freshwater Pearl Regulations; S.I. No. 296 of 2009); these therefore place a higher burden of protection on farming practices. In the Border region, where it is predicted there will be an increase in pig and poultry numbers, transboundary impacts on catchments within Northern Ireland are possible and assessments would need to be carried out on a site by site basis.

The following key pressures were identified and key recommendations made for biodiversity and flora & fauna:

Key Pressures	Key Recommendations
<ul style="list-style-type: none"> • Environmental legislation including Water Framework Directive, Habitat and Birds Directives • Continued agriculture related pressure on habitats and species related primarily to changes in nutrient loading • Potential for site-level impact on Natura 2000 network, most specifically water dependent habitats and species • Changes in land use patterns and management: intensification or change of farming systems 	<ul style="list-style-type: none"> • Comprehensive mitigation and monitoring programme, integrated across agricultural sectors and environmental disciplines • Compliance with relevant environmental legislation • Targeted knowledge transfer to farmers • More detailed regional assessment of FH2020, through Appropriate Assessment mechanism and through the iterative monitoring programme • At a broader level, integration of other plans and actions for Natura 2000 network and flora & fauna in general with FH2020 monitoring and mitigation

... water “good quality” status within agreed timeframes in doubt. Mitigation and protection essential...

Water Quality including Drinking Water

National legislation and regulations in relation to water are principally derived from the EU Water Framework Directive 2000/60/EC, the Groundwater Directive (2006/118/EC) and the Nitrates Directive (91/676/EEC). Of particular relevance to the protection of drinking water is the European Communities (Drinking Water) Regulations 2007 (S.I. No. 106 of 2007). Groundwater protection as it is impacted by agricultural activity is regulated at a national level by the European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010). Both surface waters and groundwater are governed by The European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2009 and 2010, the Nitrates Action Plans and the Code of Good Agricultural Practice. Monitoring and enforcement of water regulations is undertaken by the EPA and the Department of the Environment, Community and Local Government (DECLG) through the local authorities. Surface water and groundwater is monitored by the EPA in accordance with commitments under the Water Framework Directive and the EPA reports annually on water quality in Ireland.

Ireland is required to achieve good status for all surface waters under the Water Framework Directive by 2015. Where good status cannot be achieved by 2015 the reasons why must be documented in the relevant River Basin Management Plan. Extended deadlines for certain waters are proposed to 2021 or 2027. These deadlines are reviewed in subsequent planning cycles. Protected areas (including drinking, bathing and shell fish waters, nutrient sensitive areas, protected habitats and species) must without exception satisfy the objectives by 2015.

A full literature review was carried out and having set the baseline status the key pressures were identified as: nutrient enrichment, sedimentation; and acidification of surface waters; and nitrate and phosphate leaching into groundwater; microbiological contamination; contamination from pesticides, herbicides and farm chemicals; and abstraction pressure.

Protection of some drinking water sources was found to be inadequate. The impact analysis was carried out on a regional basis coinciding with the River Basin Districts under the Water Framework Directive. The increased loading of

*...increasing load will
add to existing
groundwater pressures...*

nutrients predicted under Food Harvest 2020 was deemed to be a risk factor although account was taken of the legislative and Good Agricultural and Environmental Condition (GAEC) framework under which individual farmers operate. The overall predicted impact before mitigation was found to be slight negative for water quality. This finding nationally is based on risks associated with projected increases in inputs of organic and inorganic nitrogen and phosphorous fertilisers along with strict adherence to existing legislation and GAEC. With careful implementation of appropriate mitigation and monitoring at an individual farm basis greater regional/localised impacts can be avoided and nutrient thresholds as recommended by the Nitrates Directive, Phosphorus Regulations and the Surface Water Regulations can be met. Adopting an iterative approach to expansion, monitoring and application of best practice will assist in working towards a target of reducing potential impacts below slight negative both nationally and regionally/locally. The following key pressures were identified and key recommendations made:

Key Pressures	Key Recommendations
<ul style="list-style-type: none"> • Achieving “good status” within timeframes specified under Water Framework Directive • Increased use of organic & inorganic fertiliser • Regional groundwater vulnerability • Increased intensification regionally 	<ul style="list-style-type: none"> • Improved on farm nutrient management planning • Improved environmental monitoring & reporting • On-going monitoring of surface water and groundwater bodies • Catchment wide nutrient management planning in sensitive areas • Improved knowledge transfer

Soils

*....soils a major natural
resource requiring
additional legislative
protection...*

As one of our most important national resources there is no European Directive directly addressing the protection of soils although one is in preparation. In so far as is applicable soils are subject to the Planning and Development Acts 2000-2011 and The Environmental Impact Assessment Regulations for On-Farm Development (2011) with the most important regulation being the Statutory Management Requirements under the Single Farm Payment Schemes. The EPA report on the state of Ireland’s soils in their periodic State of the Environment Report. The findings in the assessment in relation to soils are based on existing knowledge and available research.

Having set the baseline status the key pressures were identified as: erosion; preservation of soil organic matter; compaction and soil contamination. The relatively good state of Irish soils was noted and the varying soil characteristics and types were noted on a regional basis. The variation in drainage pattern of Irish soils was noted and the need to complete the soil mapping of Ireland was emphasised. It is noted that this is a high level study and the overall level of change is measured at a national level. Notwithstanding this it is noted that land drainage works could have significant impacts at farm or site level. The need for further research on the impacts of land drainage across all environmental characteristics examined is highlighted. The assessment concluded that the overall impact on Irish soils by the implementation of Food Harvest 2020 would be neutral or imperceptible. The following key pressures were identified and key recommendations made:

*...air quality enjoys
natural advantages but
no room for
complacency.....*

Key Pressures	Key Recommendations
<ul style="list-style-type: none"> • Changes in land use patterns: intensification or abandonment • Incomplete information • Land drainage issues 	<ul style="list-style-type: none"> • Targeted knowledge transfer to farmers • Support for legislative framework for soil protection • Completion of soil surveys and soil mapping • Further research into land drainage issues

Air Quality

Air Quality regulations in Ireland are derived from EU Directive 2008/50/EC which has been transposed into Irish law through the Air Quality Standards Regulations 2011 (S.I. No 180 of 2011) and the EU National Emissions Ceiling (NEC) Directive (2001/81/EC). The EPA carry out air quality monitoring and report on same at a national and European level.

Noting that Irish air quality is of a high standard the key pressure identified was the production of ammonia. The contribution of agriculture to other pollutants was not considered to be significant. The overall air quality impact of the implementation of Food Harvest 2020 relative to the baseline is predicted to be a slight negative. Some mitigation measures are available to reduce ammonia emissions. Mitigation measures are required to reduce ammonia emissions in order for Ireland to meet its EU level commitments. According to the EPA in 2013, limiting NH₃ emissions to below the 2010 ceiling in the future could become an issue. Continued research (which will have benefit to all environmental characteristics) on low emission landspreading techniques and other animal husbandry and manure management strategies is required. The following key pressures were identified and key recommendations made:

Key Pressures	Key Recommendations
<ul style="list-style-type: none"> • Increased livestock numbers • International limits 	<ul style="list-style-type: none"> • Adoption of best available practice • Continued research and knowledge transfer

*....landscape is ever
changing; to work in and
enjoy...*

Landscape and Buildings

The principal legislation governing landscape is contained within The Planning and Development Acts 2000-2001. In addition there are draft landscape and landscape assessment guidelines issued by DECLG. Landscape matters are also regulated under Environmental Impact Assessment Directive 2011/92/EU and under European Communities Environmental Impact Assessment Agriculture Regulations 2011.

Having noted that the Irish landscape has experienced continual change over time and drawing attention to the inextricable links between agriculture and landscape the key pressures were identified as: removal of landscape character through changes in farming practice; and impacts caused by large agricultural buildings. Changes in land use were predicted to be small with no consequent threats to sites and monuments. An assessment was carried out drawing on the potential changes in farming practice anticipated if the predicted changes in Food Harvest 2020 occurred. The overall impact on landscape due to the implementation of Food Harvest 2020 recommendations was found to be imperceptible. The following key pressures were identified and key recommendations made:

Key Pressures	Key Recommendations
<ul style="list-style-type: none"> Changes in land use patterns: intensification or abandonment Increasing scale of farm buildings (particularly in the pig sector) 	<ul style="list-style-type: none"> Targeted knowledge transfer to farmers Compliance with existing legislation

...climate targets biggest challenge; mitigation possible.

Climatic Factors including Greenhouse Gases

Ireland's obligations in relation to greenhouse gas emissions are regulated by the Kyoto Protocol arising from the United Nations Framework Convention on Climate Change and from the EU Climate Change and Renewable Energy Package. The EPA is responsible for and reporting annually to the EU on greenhouse gas emissions from the various sectors including agriculture.

Noting that agriculture contributed approximately 30% of all greenhouse gases in 2011 and 40% of the non-ETS, the fact that emissions from agriculture have been declining steadily since 2005 was highlighted. Having noted the key pressures as: methane emissions from livestock; and emissions from fertiliser application the assessment concluded that the overall impact on climatic factors including greenhouse gases on the implementation of Food Harvest 2020 is predicted to be slight negative. Mitigation measures are available to reduce emissions of CO₂eq. The Climate Change Bill, 2013 requires the Minister for the Environment, Community and Local Government to make, and submit to Government, a National Low Carbon Roadmap, incorporating sectoral roadmaps prepared by the relevant Ministers and approved by Government. This Roadmap will specify policy measures required to ensure compliance with climate related obligations. The following key pressures were identified and key recommendations made:

Key Pressures	Key Recommendations
<ul style="list-style-type: none"> Compliance with targets International measurement system 	<ul style="list-style-type: none"> Adoption of best technology in breeding and inputs Land use change for offsetting Continued research and knowledge transfer

Plotting the best way forward in each agri-sector....

Assessment Results – Alternative Scenarios Considered

40% Increase in the Value of Beef Output

Since the publication of Food Harvest 2020 there has been a significant increase in the ex-farm beef price. Food Harvest 2020 targets a 20% increase in the value of beef output and the FAPRI-Ireland model was prepared assuming a 20% increase. Subsequent to the publication of Food Harvest 2020 The Beef Activation Group called for an increase of 40% in the value of beef output, which envisaged an increase in suckler cow numbers. No specific FAPRI-Ireland model for increased suckler numbers has been prepared and in the absence of a specific FAPRI-Ireland model it has been assumed that a 40% beef output value increase could be achieved by price movements. In these circumstances while a separate analysis has not been undertaken the implications of increased suckler cow numbers have been briefly examined.

Sectoral Scenarios (Scenario B,C & D)

The analysis for Scenarios B, C and D which are examined at enterprise level should be considered as a subset of the main analysis represented by Scenario A. They are designed to give a picture of alternate pathways to achieve a given volume of milk output in the case of dairying, and a given monetary value in the

case of beef, sheep meat and pig meat.

At a sectoral level the following scenarios were evaluated: a Low Intensity System (Scenario B); a High Intensification System (Scenario C); and a High Technology System using the best available knowledge (Scenario D). These three scenarios were compared to a 'reference' system (proxy for enterprises represented by Scenario A) for each of the enterprises considered in Food Harvest 2020 (dairying, beef, sheep, pigs and tillage).

This methodology was chosen because it allows the analysis to be anchored to a very comprehensive analysis of enterprises carried out by Teagasc in relation to the development of roadmaps for each enterprise of the Agri-Food sector (www.teagasc.ie). All the assumptions used for each enterprise and for each scenario are within the legislative framework for Ireland as well as within GAEC. In the case of dairying and tillage (winter wheat), scenarios were compared by reference to their effect for the production of a given volume of output while in the case of beef, sheep and pigs, scenarios were compared by reference to a given value of output.

*...for ruminants
improved technology
will deliver more outputs
for less inputs and
emissions...*

Ruminant Livestock: This sector represents 72% of Agricultural output. All ruminant livestock are considered together because of the strong association of ruminant livestock with land. A high proportion of the feed resource for ruminant livestock is produced on the farm. In addition, there is a combination of ruminant livestock enterprises on many farms. Comparison across enterprises has to be considered on the basis that the dairying target is volume driven while beef and sheep targets are value of output (€) driven. A summary of the major changes and impacts of Scenarios B, C and D relative to Food Harvest 2020 (Scenario A) is presented in the following Table for ruminant livestock:

Enterprise	Some Indicators	Key Scenario B – Low Intensification	Scenario C – Increased Intensification	Scenario D – High Technology
Dairy	Livestock Numbers	Increased	Decreased	Decreased
	Land Requirement	Increased	Decreased	Decreased
	Environmental	Negative	Negative	Positive
Beef	Livestock Numbers	Increased	Increased	Decreased
	Land Requirement	Increased	Decreased	Decreased
	Environmental	Negative	Negative	Positive
Sheep	Livestock Numbers	Decreased	Decreased	Decreased
	Land Requirement	Increased	Decreased	Decreased
	Environmental	Negative	Minor	Positive

In general, Scenario B is associated with increased land requirement and a greater number of livestock units when compared with the Food Harvest 2020 Scenario (Scenario A). In addition, it is associated with increased nutrient requirements and increased greenhouse gas production and presents a greater threat to the environment. It is also associated with lower productivity and a poor use of resources. The main benefit of Scenario C is its reduced requirement for land and the environmental benefit associated with reduced demand for land. It has a negative impact on other environmental indicators due mainly to the high use level of nutrients. Scenario D is the preferred scenario/option due to its reduced demand for land, lower number of animals to achieve targets, lower nutrient loading, and lower greenhouse gas emissions. Systems of production based on increased efficiency (Scenario D) is the preferred option in terms of the environment for all ruminant livestock. It is also the preferred option economically.

Pigs: Pig production ranks third in importance to the agri-economy behind beef and dairying. The vast majority of pig meat in Ireland comes from 290 commercial

...for pigs, efficiency/technology can deliver the Food Harvest 2020 targets with lower GHG emissions....

sow herds with an average of 520 sows per farm. In the case of pigs two scenarios Scenario B (Less Intensive) and Scenario C (Increased Intensification) were compared with the reference system (Scenario A) in relation to the production of a given value (€) of pig output. In Scenario A total pig numbers are expected to increase by 583,000 (39%). The Less Intensive Scenario (B) would require 15% additional sows to deliver on Food Harvest 2020 targets whereas the Increased Efficiency Scenario (C) would require 11% fewer sows. In addition, systems of pig production based on Scenario B would result in an increase of approximately 15% in organic nitrogen, phosphorus and in pig manure output whereas the Increased Efficiency Scenario (C) would result in a reduction of approximately 11% in organic nitrogen, phosphorus and pig manure, respectively. There is little change in greenhouse gas emissions. Scenario C is the preferred option in relation to the environment. It is also the most economic at producer level.

....intensification is best path forward for tillage.

Tillage: The tillage sector represents an important sector of the agricultural economy with an output value of €296 million. Spring barley is the most popular crop grown by farmers. Winter wheat is an important crop on specialised tillage farms and this crop was chosen to consider the impact of alternate scenarios for the tillage sector. The impact of alternate scenarios was assessed by reference to the production of a given volume of wheat. A Less Intensive System (Scenario B) was compared to a Highly Intensive System (Scenario C). Scenario B would require an additional 12% extra land area and this is associated with an increase of approximately 12% in nitrogen, phosphorus and potassium requirements as well as 12 % increase in herbicide, fungicide, pesticide and growth regulator usage for the crop. In addition, it is also associated with 12% increase in greenhouse gas emissions and energy use. In contrast, Scenario C would result in approximately 14% reduction all of the above parameters associated with growing winter wheat. A similar trend would result for these Scenarios would arise for barley. Scenario C is the preferred option in relation to tillage.

The risk to the environment can be further reduced by appropriate regional actions.

Mitigation

Mitigation defined in Directive 85/373/EC as “*measures envisaged in order to avoid, reduce and if possible render insignificant adverse effects*” is an integral part of environmental assessment. The growth targets presented in Food Harvest 2020 are not in conflict with the objective of sustainable development and enhancing the environment. The Irish environment is described by the EPA in *Ireland’s Environment An Assessment 2012* as being “*in generally good condition overall*”. As outlined in this report many of the mitigation measures are within the control of individual farmers and relate to better management of resources and improved management techniques at farm level. Many of the mitigation measures suggested are cross-cutting and will have beneficial effects across multiple environmental characteristics. Since 2003, receipt of direct farm payments is subject to cross compliance which entails adherence to 19 Statutory Management Requirements (SMR) and Good Agricultural and Environmental Condition (GAEC).

Mitigation measures for biodiversity, flora and fauna and water quality are well developed and implemented through cross compliance. Mitigation measures for air quality and greenhouse gases are less familiar to the agricultural community. Teagasc are currently carrying out research in relation to these areas. This report draws heavily on Teagasc research and summarises their classification of mitigation measures on an incentivisation basis.

This report recognised that improved mitigation measures are necessary for all environmental characteristics particularly biodiversity, flora and fauna, water

*Smart, green, growth
using knowledge and
technology to produce
more using less inputs.*

quality, air quality and climate change. The report recommends the strict adherence to existing legislation and protocols. The report calls for improved monitoring in the areas of biodiversity, flora and fauna and water quality and points, as an example, to work undertaken by Teagasc under the Agricultural Catchments Programme.

The key mitigation measure identified is the adoption by as many farmers as possible of best available technology and a targeted environmental up skilling of advisors and a funded knowledge transfer programme is recommended. To this end it is recommended that a future agri-environmental scheme under the RDP 2014 to 2020 should target the procurement on an individual farm basis of best practice environmental and high technology plans.

Conclusions

The table below outlines the findings of the individual environmental assessments carried out on the principal Scenario A. This report has identified a range of mitigation factors and has recommended that mitigation measures be implemented. If mitigation measures were implemented then negative impacts can be reversed and rendered neutral/imperceptible in most cases and lead to environmental gains in some cases.

Environmental Characteristic	Pre-Mitigation Impact	Post Mitigation Impact
Biodiversity & Flora/Fauna	Slight Negative	Negative impact can be reversed and rendered neutral in most cases* and lead to environmental gains in other cases
Water Quality	Slight Negative	
Soils	Neutral/Imperceptible	
Air Quality	Slight Negative	
Landscape	Neutral/Imperceptible	
Climatic Factors	Slight Negative	

*Note: As noted, the risk of more localised or regional impacts on biodiversity and water quality exists. Continuing monitoring in areas of known vulnerability is recommended through the expansion of the agricultural catchments and other monitoring programmes. This will indicate where high level mitigation proposals need to be supplemented by the development of detailed farm and regional level mitigation measures throughout the life of Food Harvest 2020.

Scenario A represents the FAPRI Ireland modelled estimate of prices, technological improvements, livestock numbers and land usage which would pertain in 2020 to enable the output and value targets of Food Harvest 2020 to be achieved. In a sectoral analysis the achievement of these targets was examined using Low Intensification; Increased Intensification and High Technology scenarios. For all sectors examined it was found that the use of high technology and best production methodologies delivered enhanced environmental outcomes. Therefore it is concluded that the most effective mitigation measure available is the adoption of high technology production changes.

Because each environmental characteristic carries equal weighting and all are interrelated and interdependent it is not appropriate to assign an overall impact rating. The following should be noted:

- The predicted impacts for all environmental characteristics are pre-mitigation. The report identifies mitigation factors which if applied could along with strict adherence to good practice work towards reducing any negative impacts to neutral or imperceptible.
- By definition a slight negative impact causes noticeable changes in the character of the environment it does not alter significantly or obliterate the environmental characteristic.
- In all cases the magnitude of the predicted impact on the environment has to be weighed against other relevant criteria such as well-being of

human beings, economic output and job creation.

Recommendations

The attainment of the twin objectives of a sustainable environment and achievement of the targets set out in Food Harvest 2020 are all the more likely considering the following:

- The stature and status of the original committee members who generated the Food Harvest 2020 Report;
- The on-going support and monitoring of Food Harvest 2020 by the HLIC;
- The annual reporting of progress through the publication of *Milestones for Success*;
- The recent establishment of the Agri-Research Expert Advisory Group;
- The current preparation of the Rural Development Programme 2014 – 2020 affords the opportunity to fund targeted measures.

This report makes recommendations many of which are targeted towards mitigation, monitoring and knowledge transfer. Given the Report's findings that:

- Pre-mitigation a slight negative impact in some environmental characteristics will result;
- Mitigation measures exist, which if implemented, could reduce the impact from slight negative to neutral/imperceptible in most cases and in some cases lead to environmental gains; and
- At a sectoral level the adoption of high technology has the potential to yield enhanced environmental outcomes.

The roll out and implementation of mitigation measures at farm level along with the adoption by the majority of farmers of high technology and best farm practice are both highly dependent on effective extension and knowledge transfer systems. There are presently 570 Approved Farm Advisors registered with DAFM (approximately one third with Teagasc and the balance in the private sector).

These advisors require up skilling in environmental matters generally, best technology techniques and mitigation procedures. There are no formal linkages between the Teagasc research unit (which is the primary source of technology advances and mitigation techniques) and the majority of farm advisors. The principal recommendations of this report are therefore:

- Environmental skills of the core of Approved Farm Advisors (approximately 570) be enhanced and harnessed to achieve maximum uptake of high technology and best environmental practice at farm level.
- Creation of formal structure to facilitate the dissemination of research results and technology innovations between Teagasc Research Service and all Approved Farm Advisors.
- Future agri-environmental programmes should be designed to achieve the delivery of targeted environmental advice and best practice at farm level.
- Development of suitable mitigation measures and implementation of monitoring programmes.



Food Harvest 2020

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1 Introduction

1.1 Background

The Food Harvest 2020 Report outlines the broad strategic vision for the Irish agri-food industry through to 2020. The report was prepared by a committee of senior figures from the agri-food sector and has achieved very wide acceptance and support, both within the sector and in the broader economic and political community. The Government established a High Level Implementation Committee (HLIC), chaired by the Minister for Agriculture, Food and the Marine, in order to co-ordinate the state sector response to Food Harvest 2020 and to facilitate state engagement with key private sector actors.

Following approval at the HLIC, this analysis was commissioned by the Department of Agriculture, Food and the Marine (DAFM) in response to a recommendation contained in Food Harvest 2020 that a Strategic Environmental Analysis be carried out on the proposals in that report. In accordance with the terms of reference, the purpose of this study is to inform policy makers of any likely environmental consequences affecting biodiversity, flora and fauna, water quality, air quality, landscape and climate change including greenhouse gases.

In August 2012, a draft report was considered by the HLIC. Following consultation with the European Commission (DG Environment) the areas for analysis were broadened. Included within the terms of reference was the identification of potential areas of risk to the environment and the proposal of appropriate mitigation measures.

Food Harvest 2020 includes specific sectoral targets including:

- 50% increase in milk production;
- 20% increase in value of beef output;
- 50% increase in value of pig meat output.

Food Harvest 2020 contains additional targets relating to increased production in sheep meat, poultry and seafood. It also contains recommendations for the development of the

cereal, forestry, bioenergy, organic production and horticulture sectors.

While Food Harvest 2020 identifies the positive impacts this growth will have for the Irish economy as a whole, and for individual Irish farmers, it recognises that any planned expansion will not occur in isolation and it will undoubtedly impact upon the environment. This analysis report seeks to assess these environmental impacts.

Food Harvest 2020 envisages industry growth that does not jeopardise Ireland's current "green" reputation and builds upon the existing sustainable and environmentally friendly primary production sector. In recognition of the importance of the potential environmental impacts Food Harvest 2020 summarises its key message as *"Smart, Green, Growth"*.

The potential to enhance the value of agricultural production through harnessing Ireland's "green" and environmentally pristine image is recognised in Food Harvest 2020. Environmentally sustainable production underscores all the targets set. Food Harvest 2020 states *"Ireland can become synonymous with the production of environmentally sustainable and welfare friendly products."*

This analysis report considers alternative scenarios to the achievement of the primary production targets set out in Food Harvest 2020 and presents the likely significant effects on the environment of implementing Food Harvest 2020. The report draws on the significant body of existing data and analysis already completed in this area and in particular on data and analysis prepared by the Environmental Protection Agency (EPA) and Teagasc. No additional primary research was conducted as part of this study. The following environmental characteristics are considered:

- Biodiversity and flora & fauna;
- Water, including drinking water;
- Air quality;
- Landscape including buildings;
- Climatic factors including impacts on greenhouse gas emission levels.

The baseline period upon which the majority of output targets were based for Food Harvest 2020 was the average level of production between 2007 and 2009. For consistency the same baseline is used throughout this report.

The remainder of this Analysis Report is structured as follows.

Section 2 provides a background to the environmental analysis process followed. The section details the significance criteria employed in the assessment of impacts and describes the process of scenario development. The rationale for the scenarios chosen for analysis is also discussed. The implications for the environment, in the absence of Food Harvest 2020, are also examined.

Section 3 summarises the baseline environmental conditions in relation to Food Harvest 2020 for biodiversity and flora and fauna. The relevant regulatory authorities are identified and the existing regulatory and legislative framework is explored. Section 3 details the results of the primary environmental analysis undertaken on the integrated Food Harvest 2020 scenario selected with respect to biodiversity and flora and fauna. Key regional variances are identified. In addition, Section 3 presents a high level Appropriate Assessment (AA) in relation to the implementation of Food Harvest 2020 at a national level.

Section 4 to 8 summarises the baseline environmental conditions in relation to Food Harvest 2020 for each of the other environmental characteristics studied (water quality including drinking water; soils; air quality, landscape including buildings, and climatic factors including greenhouse gases). The relevant regulatory authorities are identified; and the existing regulatory and legislative framework is explored. This section also outlines the current status with respect to each environmental characteristic. Sections 4 to 8 detail the results of the primary environmental analysis undertaken on the integrated Food Harvest 2020 scenario selected. Key regional variances are identified.

Section 9 details the interrelationships between the environmental characteristics studied, and

other plans and programmes which may impact on Food Harvest 2020.

Section 10 details the environmental assessment of alternative sectoral scenarios. Alternative scenarios for the achievement of the targets set out in Food Harvest 2020 are explored for the primary agricultural sectors: dairy; beef; sheep; pigs; and tillage.

Section 11 explores potential monitoring and mitigation measures for the management of the environmental pressures identified in the report.

Section 12 provides a summary of the key findings and recommendations.

1.2 Challenges and Opportunities

The concepts of increased agricultural output and improved environmental outcomes are sometimes perceived as counterintuitive. Ireland faces challenges in meeting present and future targets under the Water Framework Directive, the Habitats Directive, climate change targets and air quality targets. This has been highlighted by many agencies including the EPA, the Department of Environment, Community and Local Government (DECLG) and the Department of Arts, Heritage and the Gaeltacht (DAHG) and in commentary and reaction to this report from other agencies and NGOs. In addition, each section of this report identifies the relevant commitments Ireland must adhere to.

The unique scale of Ireland's agriculture sector relative to the rest of the economy and the large proportion dedicated to grassland add further to the challenges in meeting future targets vis-à-vis other European countries. It has been argued that present measurement systems exacerbate these challenges and that on a unit of agricultural production scale Ireland's carbon footprint is among the lowest in the world.

In setting the baseline 2007 to 2009 for the individual environmental characteristics for this report the contribution of past agricultural practices to the less than good status under some environmental characteristics is recognised. It can be argued that maintaining the status quo from the base period to 2020 is not an adequate

response, but that the restoration of good status is required. The risk to the environment through continuing agricultural practices is recognised in this report. These risks include: eutrophication as a result of excessive application of organic or inorganic fertilisers or bad practice in its application; and the loss of habitat or species through changes in farm practice. The evolving relationship between agriculture and the environment is noted and highlighted. Issues include: the loss of some weed species as a result of changes from tillage crops to grassland or increased herbicide use; and the reduction of some lowland bird populations where low intensity grazing patterns were replaced by high intensity grazing patterns.

By adopting the objective of smart green growth, the authors of Food Harvest 2020 reinforce the imperative that environmental compliance be placed at the heart of increased output. Already through imperatives imposed by marketing schemes, like the Origin Green Scheme, leading farmers are willingly adopting a market led approach to environmental compliance and recognising that best environmental practice delivers a direct monetary gain through an ability to supply into the most lucrative markets. Individual farmers have already demonstrated that output increases beyond those targeted in Food Harvest 2020 can be achieved while adhering to best environmental practices and delivering environmental gains. This has been highlighted in Section 10 of this Report and has been shown to represent the most effective mitigation measure and indeed be Ireland's most effective tool in meeting its International targets.

The challenge of broadening this best practice throughout the farming community through the dissemination of best farming practices should not be underestimated. The uptake of best technology on farms with its consequent environmental benefits through a reduction in inputs (such as fertiliser, feed, herbicides and pesticides, improvements in breeding, improved fertiliser application techniques and importantly the elimination of animal diseases) will not be achieved without a change to present policies. New policies will require that adequate resources

be applied to the training and up skilling of the cohort of private and public sector advisors and a refocusing of the way in which research findings are transmitted to these advisors and subsequently through advisors, to the farming community.

A pool of at least 570 Approved Farm Advisors is available through the private and public sector. The opportunity exists to harness this resource through tailoring future agri-environmental schemes specifically towards the dissemination of high technology and best environmental practice such as specific mitigation measures to address climate change commitments. This will also deliver best value for money from a co-funding perspective.

1.3 Irish Agriculture

Agriculture makes up a significant portion of the bio-economy in Ireland. The baseline relative contribution of agricultural sectors to value primary outputs is indicated in Figure 1-1. With fertile soils, a temperate climate and abundant rain water, Ireland has natural advantages for farming the land to produce food, fibre and fuel. Aided by the moderating influence of the Gulf Stream, Ireland's climate is particularly suited for the growth of ryegrass, an excellent and inexpensive feed for livestock. This simple comparative advantage is the basis for much of Ireland's farming sector. Beef and milk production are the two most important farming sectors in Ireland. In Ireland the scale of output from farming is disproportionate to the population with the result that 90% of beef output is exported and 85% of dairy output is exported. It is estimated by Bord Bia that the value of Irish food and drink exports exceeded €9bn for the first time in 2012. The combined value of meat and livestock exports reached almost €3bn in 2012 while the value of Irish dairy and ingredient exports reached €2.66bn¹. It is estimated that the primary food production sector in Ireland currently produces enough food for 36 million people in contrast to the actual population of 4.6 million². Food Harvest 2020 sets out ambitious plans, which if achieved, would increase that production level to the equivalent of an estimated 50 million people with food exports amounting to over €12 bn.

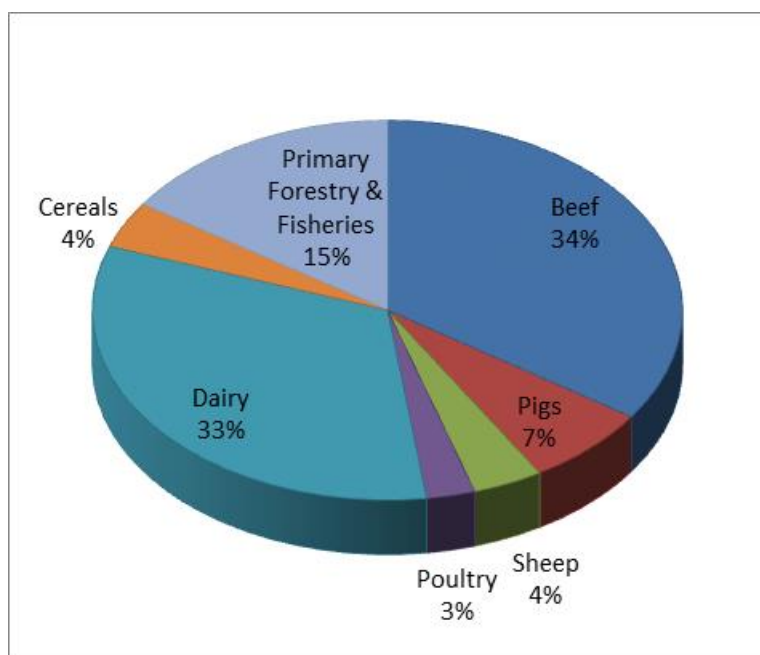


Figure 1-1: Baseline (2007-2009) relative contribution of agricultural sectors to value primary outputs (CSO, DAFM).

The Census of Agriculture 2010 – Final Results³ provides a comprehensive picture of Irish Agriculture proximate to the base period 2007 to 2009.

1.3.1 Number of Farms

The Census reports 139,860 farms in Ireland with an average farm size of 32.7 hectares. Over 42% of farms (59,055) held less than 20 hectares while

just over 3% of farms (4,695) held 100 hectares or more. Farms were smaller in the Border, Midlands and Western (BMW) region where the average farm size was 27.3 hectares, while in the South East (SE) Region the average farm size was 38.6 hectares. At an average of 43 hectares, the Mid-East (ME) region had the largest average farm size of all regions. These results are depicted graphically in Figure 1-2.

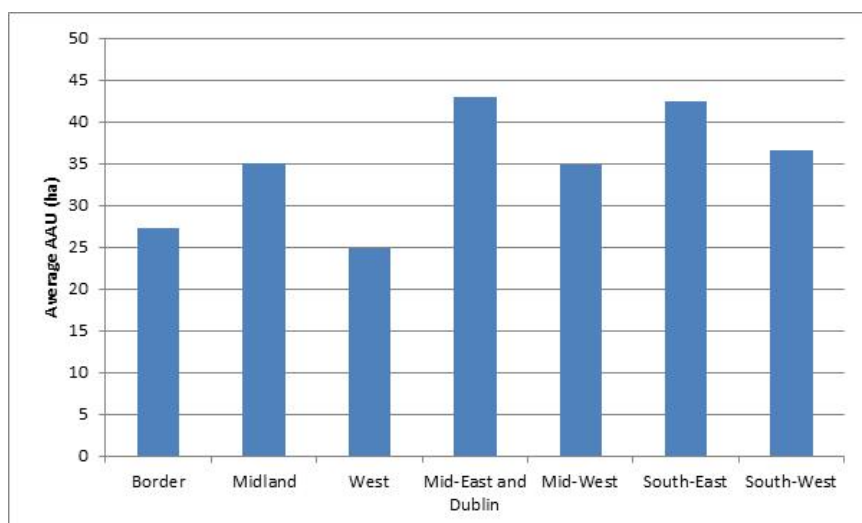


Figure 1-2: Average farm size by region, 2010 (CSO)

1.3.2 Enterprise Type

At a national level, specialist beef production continues to be the dominant type of farming in Ireland with over 55% of farms classified as such. In excess of 11% of farms were classified as specialist dairy and a further 11% were classified as mixed grazing and livestock. Almost 13,600 farms were identified as specialist sheep farms on

a national level, the larger farms were found to be those classified as mixed crops and livestock (56.3 hectares), specialist tillage (56.0 hectares) and specialist dairying (55.3 hectares). The smallest farms were those growing mixed field crops (16.9 hectares). Graphical depictions of the classification of farm type, and the distribution of specialist farm type, are illustrated in Figure 1-3 and Figure 1-4, respectively.

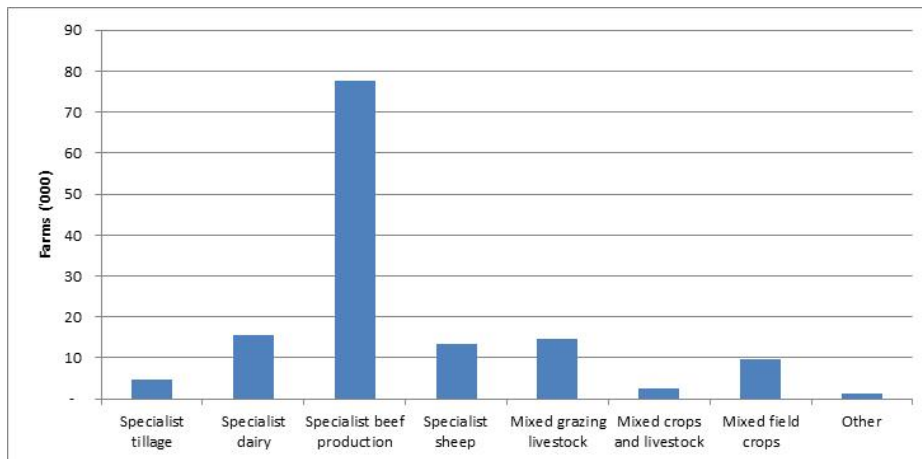


Figure 1-3: Classification of Farm Types, 2010 (CSO)

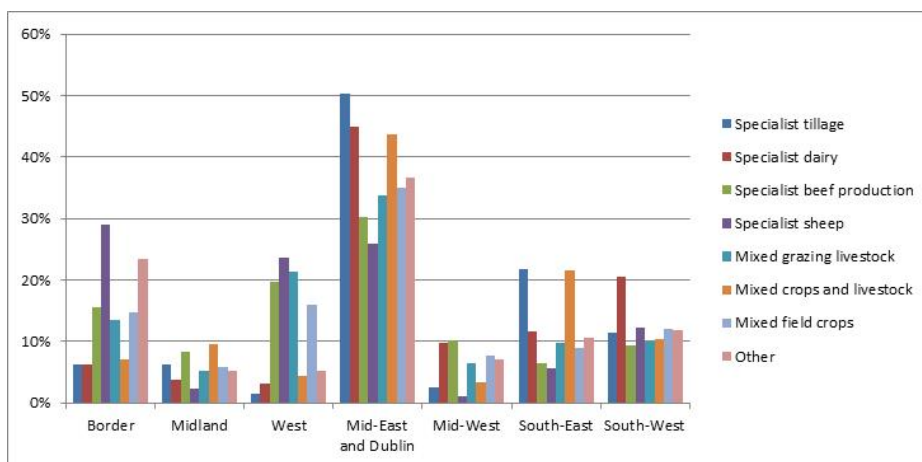


Figure 1-4: Distribution of specialist farm type by region, 2010 (CSO)

1.3.2.1 National Herd

1.3.2.1.1 Cattle

There were 6.6 million cattle in Ireland in 2010 distributed across 111,000 farms, with an average herd size of 60 cattle per farm. In the BMW region, 58,600 farms had a total of nearly 2.6 million cattle (an average of 44 cattle per farm); while in the SE region, a total of 52,400 farms had almost 4.1 million cattle (77 per farm). County Cork had the

greatest proportion of cattle with 991,000 or 15% of the national total. Cattle were mostly held on farms classified as specialist beef production (3.4 million) and specialist dairying (2.2 million). One half of the total number of cattle in Ireland was located on farms of at least 50 hectares and more. These larger farms (22,433) collectively held 3.3 million cattle, with an average herd size of 147 cattle.

1.3.2.1.2 Sheep

There was a total of 4,745,400 sheep in Ireland in 2010 held on 32,100 farms with an average flock size of 148 sheep per farm. Almost two thirds of sheep farms were located in the BMW region. More than a quarter (26.6%) of the national flock was located in the Western region (Galway/Mayo/Roscommon). The average flock size in the SE region (187) was almost 50% greater than the average flock in the BMW region (126).

1.3.2.1.3 Pigs

In 2010, there were more than 1.5 million pigs. More than one fifth of pigs were in Cavan (332,880 pigs) where the average number of pigs per farm was 4,059. Over 17% of all pigs were held on farms in Cork. More than a third (36%) of pig production is carried out on farms of less than 5 hectares. Pig farming continues to be an intensive activity carried out by a small number of specialised producers. In 2010, just 486 farms held more than 99% of the total number of pigs.

1.3.2.1.4 Poultry

There were close to 11 million poultry in Ireland in 2010, of which 7.8 million were table birds. More than half of all poultry was produced in Monaghan, where there were in excess of 5.8 million birds. While the national average flock size was 1,282, in Monaghan the average flock size was 16,613. Poultry farming continues to be an intensive activity carried out by a small number of specialised producers. In 2010, fewer than 700 farms held 98% of all poultry in Ireland.

1.3.2.1.5 Cereals

A total of 273,900 hectares of cereals was grown on 11,374 farms in 2010. Almost 40% of the farms growing cereals were classified as specialist tillage farms (4,375 farms). These farms grew 64% of all cereals in 2010. Cereals were also grown on other farm types including specialist beef (2,165 farms), mixed crops and livestock (2,111 farms), specialist dairying (1,365 farms), although cereal growing was not a dominant activity on these holdings. Of the total land area devoted to cereals, only 20% was located in the BMW region with the remaining 80% grown in the SE region.

1.3.2.1.6 Potatoes

In 2010, there were 1,560 farms growing a total of just under 12,200 hectares of potatoes. The average area under potatoes on these farms was 7.8 hectares. Of the total land area devoted to potatoes, over 75% was located in the SE region.

1.3.2.1.7 Grassland

The total area under grassland was close to 3.8 million hectares. More than 1 million hectares (1,076,400 hectares) of silage were grown in 2010 while less than 200,000 hectares were under hay. More than 66% of the area under grassland was devoted to pasture.

1.4 Agriculture within the Irish Economy

Historically, due in large part to the absence of industrial development and economic growth in other sectors Irish agriculture has accounted for a disproportionate share of both employment and gross domestic product. With the growth of the non-agricultural sector the relative contribution to both employment and Gross Domestic Product (GDP) has been steadily falling since the sixties. It is estimated that primary production (agriculture, fisheries and forestry) accounts for 2.7% of Gross Value Added (GVA) at factor cost (2011), 4.9% of employment (Q4 2012) and 7.2% (2012) of exports. It is estimated that the Agri-Food Sector (comprising primary production, food, beverages and tobacco) accounts for 7.7% of GVA at factor cost (2011), 8.0% of employment (Q4 2012) and 10.8% (2012) of exports⁴.

The contribution of agriculture to both employment and GDP is still exceptionally high in comparison with other developed European economies. This coupled with the fact that over 80% of agriculture production is from grass based systems presents challenges both economically in terms of reductions of European funding for agriculture and environmentally in terms of meeting environmental obligations in relation to greenhouse gases.

1.5 Legislative Framework

All aspects of mainstream agriculture, forestry and the fisheries fall within the ambit of DAFM. There are two separate sections within DAFM dealing with the marine and forestry. In addition DAFM

has separate divisions dealing with policy, finance, the environment and each of the mainstream farming activities (dairy, beef, pigs, sheep, poultry, cereals etc.)

Additionally, various aspects of agriculture falls under the remit of the DECLG, DAHG and the Department of Communications, Energy and Natural Resources (DCENR). DECLG broadly has responsibility for planning and environmental legislation as it effects agriculture. DAHG, through the National Parks and Wildlife Service (NPWS), has responsibility for habitats and conservation. DCENR has responsibility for energy policy which is

becoming ever more important since the introduction of energy crops and land based wind energy.

1.5.1 European Governance

All Agricultural policy falls within the remit of the Common Agriculture Policy (CAP), which is administered by Directorate General Agriculture and Rural Development. In addition, a range of policies central to the achievement of Irish and European objectives are operated by Directorate General Environment (see Figure 1-5).

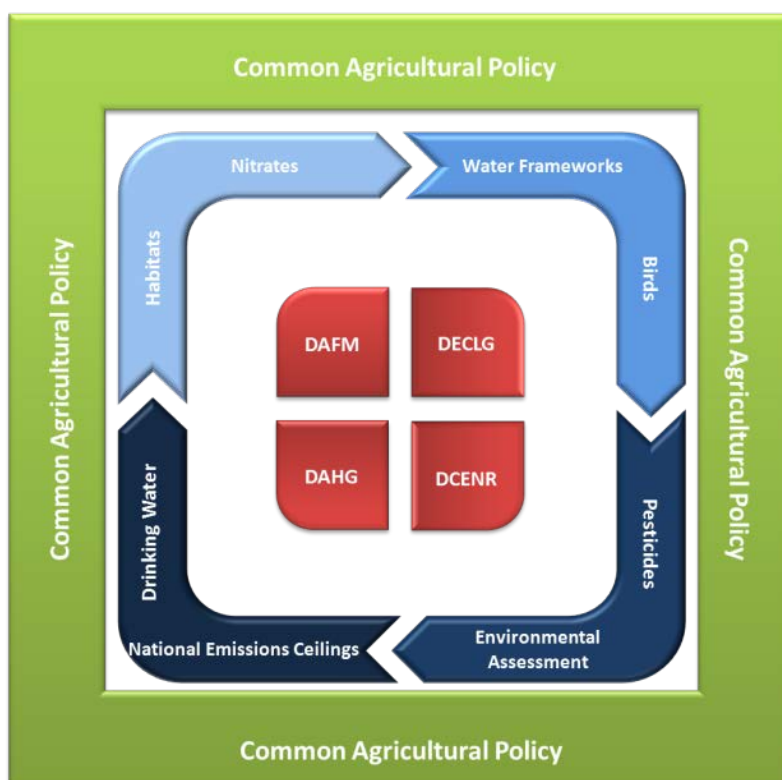


Figure 1-5: Legislative Framework.

1.5.1.1 Common Agricultural Policy (CAP)

The CAP has been of fundamental importance to the operation of the European Union since its inception as the European Economic Community in 1957. The CAP, which essentially is a market intervention mechanism, has over the years used various policies and payment schemes in an attempt to stabilise prices and support farmers' incomes. Until the MacSharry reform in 1992 the CAP operated mainly through price support

mechanisms but this led to the production of surpluses and major distortions in international agricultural commodity trading patterns. From 2000 onwards, the emphasis switched from price supports to direct payments to farmers. In 2003 further reform decoupled all payments from production levels and strengthened the role of rural development programmes.

Further development of the payment structures under CAP is currently underway for the period 2014 to 2020. From the perspective of this report

the most important proposed reform is in relation to the plan that all future direct payments be made conditional on greening.

1.5.1.2 The Greening of CAP

In their proposals for financing CAP in the period 2014 to 2020, the European Commission has made a major statement of intent with regard to the environment through the introduction of a “greening” proposal. Historically, policies aimed at improving the environment were financed through pillar two of the CAP. Pillar one of that policy traditionally was used to finance direct payments to individual farmers, with member states having a degree of latitude as to the conditionality of the direct payment system within their own borders. From 2014 onwards, the European Commission have proposed that Pillar 1 payments be conditional on member states implementing a greening component.

The rationale for introducing environmental conditionality under Pillar 1 is based on the fact that the entire land area of Europe is subject to direct payments and compliance with the regulations for receiving payments is mandatory. Under Pillar 2 only 24% of the land area of Europe is covered and participation in the schemes is on a voluntary basis. It is also perceived that participation in the voluntary schemes has been predominantly on lands of already high environmental status and that the public goods environmentally achieved on these lands could be negated by the much greater area outside a mandatory environmental regime.

At the time of writing under “greening” it is proposed that 30% of direct payments would be contingent upon compliance with a suite of environmental measures (these proposals are liable to change). From a practical point of view each farm unit would be required to:

- i. Identify a minimum of 7% of the land area as Ecological Focus Areas (EFA);
- ii. Participate in crop diversification;

- iii. Maintain existing permanent pasture.

In addition it is anticipated that greater environmental benefits could be achieved through:

- Changes to Good Agricultural and Environmental Condition (GAEC);
- Stricter enforcement of cross compliance;
- Revamp of Pillar 2 environmental measures;
- Defining a stronger role for advisory services to facilitate the delivery of climate change and environmental objectives.

The final details of the “greening” proposal have not yet been finalised. However, there are strong indications that the European Commission and Parliament will insist on a “greening” element in all future direct payment regimes. The proposals are opposed by some interest groups on the basis of lack of effectiveness of such a broad approach while others argue that a much more targeted approach is warranted which could be achieved by diverting funds from Pillar 1 to Pillar 2 agri-environmental schemes.

1.6 Regulatory Framework

Irish Agriculture operates within a comprehensive environmental legislative and regulatory framework. The legislative framework that governs the environment in Ireland is listed in

Table 1-1. This is not an exhaustive list of all legislation rather a compilation of those applicable to areas subject to pressures from agricultural sources. Legislation is controlled by relevant competent authorities. In addition at farm level, Cross Compliance ensures adherence to this regulatory framework.

Table 1-1: Legislation Matrix table.

Legislation	Biodiversity	Flora/Fauna	Water Quality (incl. drinking water)	Soil	Air Quality	Landscape & Buildings	Climatic Factors (incl. GHG)
Transnational Agreements							
United Nations Framework Convention on Climate Change - The Kyoto Protocol (2002)							✓
EU Climate and Energy Package 2008							✓
EU Legislation							
EU Habitats Directive (92/43/EEC)	✓	✓	✓				
Birds Directive (79/147/EU)	✓	✓	✓				
Water Framework Directive (2000/60/EEC)	✓	✓	✓				
Nitrate Directive (91/676/EEC)	✓	✓	✓				
Fresh Fish Directive (78/659/EEC)	✓	✓	✓				
Groundwater Directive (2006/118/EEC)	✓	✓	✓				
Environmental Impact Assessment Directive (85/337/EEC as Amended 91/11/EC; 1007/11/EC; 2003/35/EC & 2009/31/EC)	✓	✓	✓	✓		✓	
EU National Emissions Ceiling Directive (2001/81/EC)					✓		
IPPC Directive (2008/1/EC)	✓	✓	✓				
Sewage Sludge Directive (86/278/EEC)	✓	✓	✓				
Proposed Soil Framework Directive COM (2006/232)				✓			
National Legislation							
The Wildlife Act, 1976, Wildlife (Amendment) Act, 2000	✓	✓	✓				
Local Government (Water Pollution) Act, 1977 & Water Pollution (Amendment) Act, 1990	✓	✓	✓				
The Forestry Act 1946-1988	✓	✓	✓				
Arterial Drainage Acts 1945-1995	✓	✓	✓				
Waste Management Act 1996	✓	✓	✓				
EPA Act, 1992	✓	✓	✓				
Planning & Development Acts 2000- 2011						✓	
Statutory Instruments							
S.I. No. 477 of 2011 - European Communities (Birds and Natural Habitats)	✓	✓					
S.I. No. 296 of 2009 - The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009	✓	✓					
European Communities (Good Agricultural Practice for the Protection of Waters) Regulations (S.I. No. 610 of 2010)			✓				

Legislation	Biodiversity	Flora/Fauna	Water Quality (incl. drinking water)	Soil	Air Quality	Landscape & Buildings	Climatic Factors (incl. GHG)
European Communities Environmental Objectives Groundwater Regulations 2010 (S.I. No. 9 of 2010)			✓				
European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009)			✓				
Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011)					✓		
Environmental Impact Assessment Regulations for On-Farm Development 2011 (S.I. No. 456 of 2011)				✓			
S.I No. 155/12 EC(Sustainable use of Pesticides) Regulations 2012	✓	✓	✓				
Other Relevant Publications							
DOEHLG 2007. National Climate Change Strategy 2007-2012							✓

1.6.1 Cross Compliance

1.6.1.1 Background

In 2003 reform of CAP introduced a new system of payments for farmers and cut the link between support and production. In 2005, the Single Payment Scheme replaced the direct payments to farmers that were previously in place.

Payments to farmers under CAP are now dependent on the achievement and maintenance of baseline standards on environmental and public health, animal and plant health, and animal welfare – otherwise known as cross compliance. There are two key elements to cross compliance:

- **Statutory Management Requirements (SMRs)** – these are existing and already legally binding standards defined by a range of 18 European regulatory requirements covering environmental,

public health, plant health and animal health and welfare standards; and

- Standards consistent with keeping land in **“Good Agricultural and Environmental Condition” (GAEC)** including habitat conservation and soil protection.

In Ireland, compliance with SMRs must be adhered to in order to receive payments or claims under the:

- Single Farm Payment Scheme;
- Disadvantaged Area Scheme;
- Rural Environment Protection Scheme (REPS);
- Agri-Environmental Options Scheme (AEOS).

Table 1-2 lists the SMR farmers must remain compliant with.

Table 1-2: Listing of Statutory Management Requirements SMRs)

Code	Statutory Management Requirement
SMR1	Conservation of Wild Birds
SMR2	Protection of Groundwater against Pollution
SMR3	Protection of the Environment and Soil when Sewage Sludge is used in agriculture
SMR4	Protection of Waters against Pollution caused by Nitrates
SMR5	Conservation of Natural Habitats and of Wild Flora and Fauna

Code	Statutory Management Requirement
SMR6	Animal (Pigs) - Identification and Registration of Animals
SMR7	Framework for the Identification and Registration of Animals
SMR8	Identification and Registration of Bovine Animals regarding the Labelling of Beef & Beef Products
SMR8a	Animal Identification and Registration – Sheep and Goats
SMR9	Authorisation, Placing on the Market, use and Control of Plant Protection Products
SMR10	Concerning the prohibition on the use in stock farming of certain substances having a hormonal or thyrostraic action and of beta-agonists
SMR11	General principles and requirements of food law and laying down procedures in matters of food safety
SMR12	Rules for the prevention, control and eradication of certain transmissible encephalopathies
SMR13	Community measures for the control of foot and mouth disease
SMR14	General Community measures for the control of certain animal diseases and specific measures relating to swine vesicular disease
SMR15	Specific provisions for control and eradication of bluetongue
SMR16	Minimum standards for the protection of Calves
SMR17	Minimum standards for the protection of Pigs
SMR18	Rules concerning the protection of animals kept for farming purposes

Table 1-3 highlights some of the relevant required actions required to remain in compliance with the

SMRs while Table 1-4 summarises the main issues, requirements and standards applicable to GAEC.

Table 1-3: Required actions to remain cross compliant

SMR	Relevant Environmental Characteristic	Required Actions to Remain Cross Compliant
SMR1 – Conservation of Wild Birds	Biodiversity	No unauthorised hunting/shooting/snaring /trapping or poisoning of birds or animals being practiced at any time with regards to protected species or in closed season with regards to other species No “notifiable actions” within Special Protected Areas
SMR 2 – Protection of Groundwater	Ground Water	Farm chemicals and waste oil are stored and managed in a way that prevents pollution Sheep dip is managed and disposed of in a way that prevents pollution
SMR 3 – Sludge	Ground Water Surface Water Soils	Where the farmer uses sewage sludge: Have a nutrient management plan that was prepared within the last 5 years Restrictions on land usage following application of treated sludge are being observed The quantity of treated sludge used does not exceed the amount permitted under the current nutrient management plan
SMR 4 – Nitrates	Ground Water Surface Water Soils	Livestock manures and other organic fertiliser storage facilities are constructed and managed in a way that prevents pollution There is sufficient storage capacity for livestock manure and other organic fertilisers Livestock manures, other organic fertilisers and chemical fertilisers are spread in accordance with the Regulations. Buffer zones from water are maintained when spreading livestock manure and other organic and chemical fertilisers Fertilisers are not spread in prohibited spreading periods Farmyard manure is only stored in the field during permitted spreading periods Green cover is provided where land is ploughed or sprayed with non-selective herbicide after July 1st. Grassland is not ploughed between 16th October and 30th

SMR	Relevant Environmental Characteristic	Required Actions to Remain Cross Compliant
		<p>November</p> <p>Maximum fertiliser rates for nitrogen and phosphorus are not exceeded</p> <p>Soiled water is minimised by ensuring clean water is diverted to a clean water outfall.</p> <p>A maximum of 170kgs/ha of nitrogen from livestock manure is applied in any calendar year or a maximum of 250kgs/ha of nitrogen from grazing livestock where a derogation was applied for.</p>
SMR 5 – Conservation of Natural Habitats and of Wild Flora and Fauna	Flora/Fauna	<p>No removal or damaging of protected plant species or deliberate introduction of non-native species which may damage protected plant species</p> <p>No “notifiable actions” within Special Protected Areas</p>
SMR 9 – Plant Protection Products (Pesticides)	Flora/Fauna	Treatments must be undertaken in conformity with the conditions of their approved uses.

Table 1-4: Summary of the main issues, requirements and standards applicable to GAEC.

Issues	Requirements	Standards
Soil Erosion	Protect soil through appropriate measures	<p>Minimum soil cover</p> <p>Minimum land management reflecting specific conditions</p>
Soil Organic Matter	Maintain soil organic matter levels through appropriate practices	<p>Standards for crop rotation where applicable</p> <p>Arable stubble management</p>
Soil Structure	Maintain soil structure through appropriate measures	Appropriate machinery use
Minimum level of maintenance	Ensure a minimum level of maintenance and avoid the deterioration of habitats	<p>Minimum livestock stocking rates and/or appropriate regimes</p> <p>Protection of permanent pasture</p> <p>Retention of landscape features</p> <p>Avoiding the encroachment of unwanted vegetation</p>

In practical terms compliance with GAEC ensures *inter alia*:

- Minimisation of soil erosion through avoidance of finely tilled soils being sown, severe poaching by livestock, overgrazing of lands, both enclosed and commonage, and sand dunes;
- Minimisation of soil structure being damaged by machinery. For example avoidance of misuse of machinery in waterlogged conditions;
- A minimum level of maintenance is being complied with. For example that the management regime for permanent pasture (grazing, cutting, topping) is adequate to allow agricultural production to take place the following year;
- Tillage crops are grown under normal husbandry conditions;
- Avoidance of damage to habitats designated as Natural Heritage Areas (NHA), Special Protected Areas (SPA) or Special Areas of Conservation (SAC);
- Minimisation of encroachment of invasive species, spread of noxious weeds, burning of growing vegetation between 1st March and 31st August;
- External farm boundaries are stock-proof where stock is present on the holding.

1.7 Food Harvest 2020

Food Harvest 2020 details an ambitious vision for the Irish Agricultural Industry to expand over the

next decade. Figure 1-6 details the baseline value of primary output relative and the Food Harvest 2020 value targets.

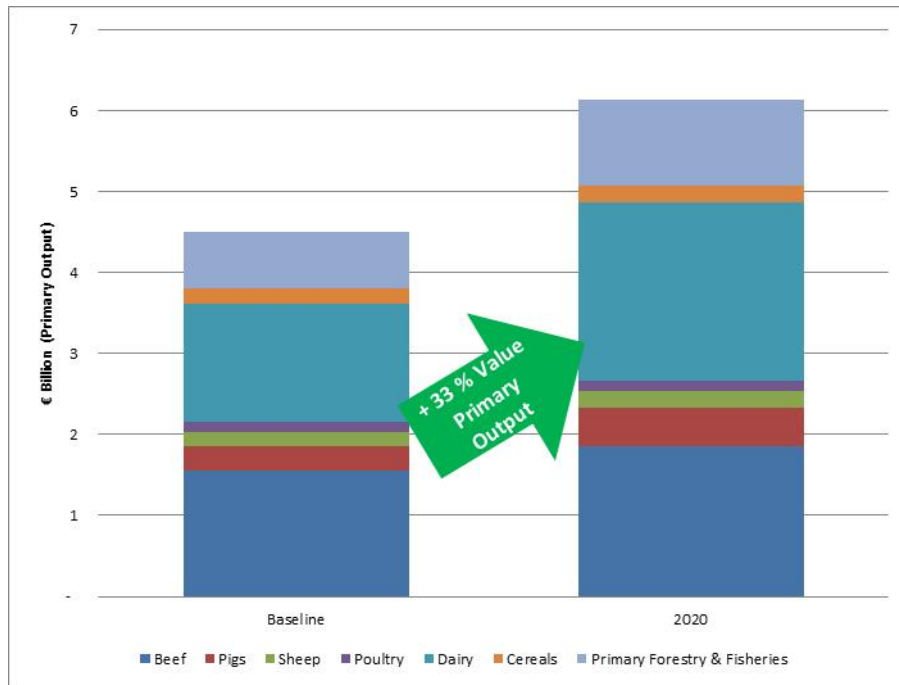


Figure 1-6: Food Harvest 2020 primary output value targets. (Source CSO, DAFM)

The plan envisages the agriculture industry expanding from its current output of €24 billion per annum by:

- A 33% increase in the value of primary agriculture by increasing its value from €4,496 million to €6,125 million,
- An export target of €12billion from the 2007-2009 baseline figure of €8,298 million
- A 40% increase in value-added from the estimated 2008 baseline.

Specific sectoral targets include:

- 50% increase in milk production;
- 20% increase in value of beef output;
- 50% increase in value of pig-meat output;
- 20% increase in value sheep-meat;
- 10% increase in value poultry;
- 78% increase in the value of aquaculture output.

It also contains recommendations for the development of the forestry, bioenergy, organic production and horticulture sectors. Food Harvest 2020 – A Vision for the evolution of agri-food and fisheries up to the year 2020 – was published in 2010. It was published by DAFM who provided secretarial services to a broad based professional, agency and industry grouping which had come together at the behest of the Minister for Agriculture, Food and the Marine. Under its terms of reference the committee was charged with preparing a draft strategy for the medium term development of the agri-food, fisheries and forestry sector for the period up to 2020. The initiation of the preparation of the Food Harvest 2020 report was not the first such initiative undertaken in Ireland for the planning of the agriculture industry. Previous initiatives had included Agri Food 2010 Action Plan and Agrivision 2015 Action Plan. This plan differed radically from the previous plans, which focused largely on growth alone. Food Harvest 2020 has three objectives – Smart, Green, Growth. Thus Food

Harvest 2020 has three pillars all of equal importance.

Growth: To contribute to economic recovery; sustain and increase jobs within the economy; contribute to farm incomes and stability within the rural community; and contribute to Ireland's opportunity to supply a growing demand for quality foods.

Smart: To take advantage of the latest scientific discoveries and harness modern knowledge transfer technology to increase sustainable production in an environmentally fashion.

Green: To achieve growth while contributing to Ireland's already green image within an environmentally sustainable production regime. To achieve environmental gains where possible.

1.8 The Authors of Food Harvest 2020

The committee charged with developing Food Harvest 2020 consisted of representatives from the agri-food industry, the farming organisations, state bodies relevant to agriculture, environmental groups, forestry and fishery industry representatives, food retailers, academia and statutory bodies (refer to Figure 1-7). Secretarial and support services were provided by DAFM, Bord Bia, Teagasc and Enterprise Ireland. Drawn from such a wide base the committee as a unit had available to it the combined knowledge and expertise both in terms of the difficulties faced and opportunities available to all aspects of the industry from primary producers, through agents and purchasers, to manufacturers and distributors, and retailers and exporters.

By broadening the base from which the committee was drawn (to include not only primary production and manufacturing representatives but also representatives of the seafood and forestry industry, representatives of the EPA and the Environmental Pillar), the intention from the outset, was that Food Harvest 2020 should be much broader in scope and range than previous plans. From the start it was recognised that sustainability and environmental protection were key partners in any growth strategy. At the behest of the Minister of Agriculture, Food and the Marine in early 2009 preparatory work was

commenced by DAFM with a secretariat being established and background papers being prepared by DAFM, Teagasc, Bord Bia and the EPA.

<p>Dr Sean Brady Chairperson</p> <p>Jim Bergin, Glanbia plc Dan Brown, Chair, Bord Bia Gary Browne, Group CEO, RMG Target John Bryan, President, IFA Donal Byrne, Cadbury Ireland Jackie Cahill, President, ICMSA Noel Cawley, Chair, Teagasc, & Chair, Seafood Ind. Strategy Review Group Tom Considine, Former Secretary General, Department of Finance John Counsel, Diageo Michael Dowling, Head Agri-Strategy AIB Jim Fennell, Chair, Marine Institute Gabriel Gilmartin, President, ICSA Michael Gowing, President, Macra na Feirme Noel Groome, Chair, Foras Orgánach Jim Hanley, Rosderra Irish Meats John Horgan, Kepak William Keane, 2009 FBD Young Farmer Mary Kelly, Director General, Environmental Protection Agency Brendan Lacey, Irish Timber Growers Association Alan Lauder, Birdwatch Ireland Eamonn Lennon, Abbott Ireland Mike Magan, Chair, AHI, Chris Martin CEO, Musgrave Group Professor Alan Matthews, Professor of Economics, TCD Gerry McCormack, SIPTU Rose McHugh, Chair, BIM Pat McLoughlin, President, ICOS Dan McSweeney, Carbery Lorcain O' Cinneide, CEO, Irish Fish Producers Organisation Larry Murrin, Food and Drink Industry Ireland (FDII), (Dawn Farm Foods)</p>
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Figure 1-7: Food Harvest 2020 Committee Members

Food Harvest 2020 differed from previous industry plans in that from the beginning public consultation was seen as a key element. In opening the planned consultation the Minister posed a series of questions under the following headings: economic and international context; food; innovation; environment and commodities. The specific environment related questions are listed in Figure 1-8, clearly addressing the central role of environmental aspects in Food Harvest 2020.

How best can Irish agriculture contribute to achieving the EU target reduction of 20/30% in greenhouse gas emissions, while maintaining a viable farming sector?

How should Ireland align increased food production for a growing global population with the demands of climate change and the sustainable use of natural resources?

Can forestry (for biomass and timber) offer a viable alternative to beef/sheep, recognising the current level of public support?

Does climate change adaptation offer new possibilities for Irish agriculture?

Figure 1-8: Environment-related questions, Food Harvest 2020 Public Consultation.

In setting about its work the committee had available to it the internal knowledge base of the diverse committee members and organisations represented on the committee; background papers prepared by industry experts covering all the production sectors (dairy, meat, cereals, horticulture, forestry, non-food crops and the marine); and discussion papers covering topics such as the overall context, agricultural commodities, food, sustainability and innovation. These background papers and discussion documents examined the then position of each sector within the industry. They examined the policy framework within which the industry operated, in particular the Health Check on CAP and the World Trade Organisation (WTO) negotiations, together with proposals for post 2013 funding and the removal of milk quotas post 2015. They also outlined the legislative and regulatory framework for each sector and charted the environmental pressures within which each sector of the industry operated. The committee was sub-divided into sub-committees which were tasked with developing the broad vision and action plan for the various sectors and segments of the industry.

1.8.1 Objectives of Food Harvest 2020

Food Harvest 2020 is based on three pillars - Smart, Green, Growth, with each pillar having equal standing in importance.



1.8.1.1 Smart

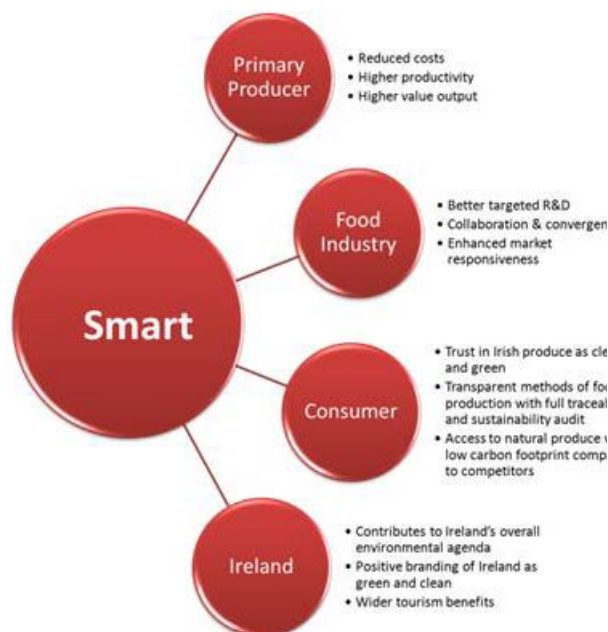
In line with broader government policy for the whole economy the committee called for the agri-food industry to develop in a smart way and thus called on the industry *“to invest in ideas, knowledge and skills, encourage innovation and creativity and recognise new opportunities for collaboration across the food supply chain and with other competitors.”* This demand for smart actions fits well with the cross cutting themes environment, climate change, and innovation, laid down by the European Commission for the development of the Rural Development Plan 2014-2020. Specifically industry players are called upon to priorities research and development, improve skill levels, maximise adoption of best practice, foster creativity and entrepreneurship, rationalise and collaborate at industry level, improve focus on consumer preference and review institutional support and regulatory burden.

At industry level, the report called for improved skills and urged that the best people be attracted to the sector with an enhancement of leadership and management skills.

At institutional level, the report called on Teagasc, the Marine Institute and Universities to improve the dissemination of new knowledge and to enter into partnerships with industry for the purpose of transmitting new knowledge and developing new technology in a science based innovative way that would underpin profitability, sustainability and competitiveness.

At farm level, a range of measures were proposed to increase the skill sets, competitiveness and customer awareness of farmers. These included

improved management training, on-going continuous professional development type schemes for farmers, focus on better farm production methods, establishment of benchmarking and measurement of targets, and coordination by DAFM and other government departments to ensure a favourable taxation and legislative environment to encourage growth.



1.8.1.2 Green

By selecting green as one of the three equal pillars, the authors placed the environment at the centre of the Food Harvest 2020. By placing environmental sustainability as a central plank of the vision, the authors seek to capitalise on Ireland's historic association with the colour green by linking it to the modern use of green to demonstrate a commitment to sustainability and world class environmental practices. The report effectively calls on the industry at all levels for a paradigm shift which would see compliance with environmental regulations becoming a profit centre through improved markets rather than a cost centre through compliance obligations.

Specifically, the industry at all levels is called upon to prioritise environmental protection, capitalise on natural advantage and resources, build environmental credibility through research and actions, develop an umbrella brand Ireland, satisfy consumer requirements and preferences, conserve

biodiversity and align sustainability across the supply chain.

Noting Ireland's key strength in relation to environmental sustainability the report defines required areas of action.

The report then identifies the key environmental issues namely:

- Climate change;
- Protecting water resources;
- Protecting biodiversity;
- Air emissions;
- Renewable Energy

A set of measures and actions are called for across the industry, DAFM and the agencies which will *"enable Ireland to position itself as a world leader in emerging international trends by embracing and promoting environmental sustainability in food production."*



1.8.1.3 Growth

Recognising the key role of primary production in agriculture both to the overall Irish economy and to the maintenance of our traditional rural landscape and family farm structure, the report recognises that there are significant challenges in

relation to farm level profitability. To address this question and to increase the contribution that Irish agriculture can make to the economic regeneration of the Country, the report calls for specific growth target in the various sectors of agriculture.

1.8.1.4 Beef

An overall target of a 20% increase in value beef output at the primary production was initially set. Without prescribing the actual measures to be implemented to achieve the growth target many of the road blocks to achievement were enumerated and constructive solutions were recommended. The key role of knowledge, research, training, knowledge transfer, breed improvement and the centrality of environmental protection were recognised.

Subsequent to the publication of Food Harvest 2020, The Beef Activation Group called for an increase in the value of output of 40% to be achieved through a combination of increased prices, improved management and breeding and additional numbers.

1.8.1.5 Dairy

With the anticipated removal of milk quota restrictions in 2015 a headline target of a 50% increase in milk production volumes was targeted. This target was set to take advantage of Ireland's existing environmental sustainable grass based milk production system. The achievement of this target is recognised to be dependent on a sustainable milk price. The need for increased processing capacity is recognised and there was a call for a smart approach to the financing and provision of this capacity. The key roles of research and knowledge transfer in the areas of breeding and management are highlighted and the centrality of environmental sustainability is emphasised.

1.8.1.6 Sheep

The sheep sector across Europe has experienced a reduction in scale in recent years and a consequent pressure on incomes at farm level. To meet anticipated international demand a target of a 20% increase in sheep meat value has been set. To achieve the projected growth the industry across all levels is called upon to support

investment and encourage the uptake of new technology at farm level. At institutional level DAFM are encouraged to support breed improvement programmes and meat quality initiatives. The processing sector is called upon to match output to capacity, to improve product presentation and packaging and engage in innovative marketing. Bord Bia is called upon to promote home consumption, to target EU funding for promotion of lamb consumption and to leverage the environmental attributes of sheep farming in its marketing effort.

1.8.1.7 Pig meat

With 470 commercial pig production units producing approximately €300 million in output the importance of the pig sector is recognised. Building on projected increases in pork consumption in the period up to 2020, the report calls for increase of 50% in the value of pig meat output. The inter-linkages between the pig meat industry at primary production level and environmental sustainability are recognised and the industry is called upon to continually adapt its producer methods to minimise its environmental effect.

To facilitate growth, DAFM are called upon to facilitate the development of economies and efficiencies with the tillage sector and to improve inspection regimes in terms of costs efficiency. Improvements in herd management facilitated by benchmarking pig herd performance and knowledge transfer are highlighted. The benefits of pig-meat quality assurance schemes, together with the highest disease free status are noted. The report calls for adherence to animal welfare regulations along with the development of alternative waste usage strategies and the developments of new markets for pig meat.

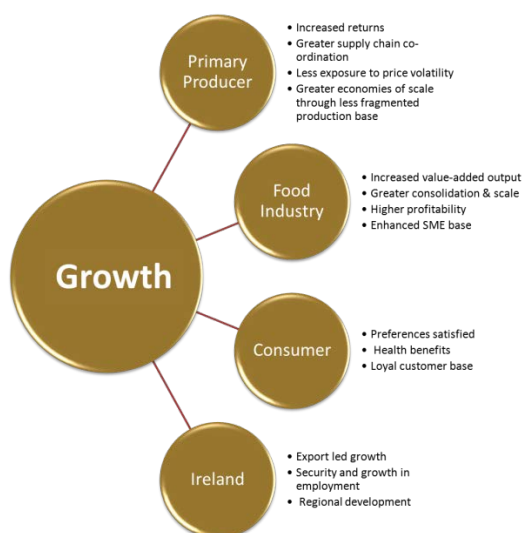
1.8.1.8 Other Sectors

While a 10% increase in output from the poultry sector was called for, other sectors do not have specific output targets set. The potential for increased output however is recognised. In the cereal sector the scale of production is small by international standards but yet produces up to 80% of Ireland's grain needs. In addition, it provides the raw materials for Ireland's brewing,

distilling and part of our flour milling industry. With increased production anticipated in the livestock, dairy and pig sectors it is anticipated that there will be increased demand for cereal production.

Forestry's contribution to the Irish economy is noted as are the existing ambitious targets in place for an increased rate of forestation. Forestry is key role in the protection of biodiversity, the provision of bioenergy as well as potential carbon sequestration and community enhancement through recreation are recognised. The ability of forestry and bioenergy to contribute to government targets in relation to renewable energy are seen as part of that sectors contribution to the achievement of Food Harvest 2020 targets.

Seafood is called upon to increase its sales from €700 million to €1bn, generating a full time employment equivalent of fourteen thousand jobs. Further advances in Research and Development and Market Development are seen as central. The existence of separate current seafood development plans are seen as complementary to the achievement of Food Harvest 2020.



1.9 This Analysis

The Food Harvest 2020 Report outlines the broad strategic vision of the food industry through to 2020. The Government noted the report and,

although it is an industry strategy, a High Level Implementation Committee was established, chaired by the Minister for Agriculture, Food and the Marine, in order to co-ordinate the state sector response to implementation of the targets.

Food Harvest 2020 also contained a recommendation that an environmental assessment on the impact of the recommendations contained the report be carried out. The Minister, in consultation with the members of the Food Harvest 2020 High Level Implementation Committee, set the Terms of Reference for the analysis and appointed the authors of this report to compile a team to complete the analysis.

The Department of Agriculture, Food and the Marine facilitated a preliminary public consultation that ran from May 2012 to July 2012 and all submissions were passed to the authors for consideration. Later in the year, and following discussions with the European Commission, the Department broadened the areas for analysis.

The overall purpose of this analysis is to inform policy makers and industry actors of any likely environmental consequences affecting biodiversity, flora and fauna, water quality including drinking water, air quality, landscape including buildings or climate change including greenhouse gases that might result from the implementation of the proposals contained in Food Harvest 2020. The processes in developing this report closely followed those required for a Strategic Environmental Assessment and, taking account of the timing and expected lag periods for the achievement of actual production changes at farm level referred to in Food Harvest 2020, the findings of this report should achieve this overall purpose and guide the development of plans, programmes and other measures designed to facilitate the attainment of the Food Harvest 2020 targets.

Food Harvest 2020 is a sectoral plan which has national coverage, and impacts directly or indirectly with any number of Natura sites. In accordance with article 6(3) of the EU Habitats Directive this study has carried out an Appropriate

Assessment (AA) of Food Harvest 2020 as far its impacts are measurable at a high level or national basis. The analysis considers the potential for impacts on habitats and species which interact with or are vulnerable to changes in agriculture and associated patterns of land use.

An assessment of the impacts on Natura 2000 network on a site by site basis is outside the scope of the current study due to the absence of information on how Food Harvest 2020 will be implemented on a farm by farm basis. Therefore the current assessment has concentrated on examining potential impacts on Annex habitats and species for which the Natura 2000 network has been established, in regions and areas where the majority of the projected agriculture changes are expected to occur and assumes an integrated pathway as detailed in Section 2. This has facilitated a strategic assessment of potential impacts on Annex habitats and species as a proxy for Natura 2000 sites and has informed mitigation and monitoring proposals (furthermore it allows for consideration of Annex habitats and species in the wider landscape outside the Natura 2000 network). The actions under Food Harvest 2020 will occur across the length and breadth of the agricultural land of Ireland and in many cases have no influence on Natura 2000 sites. Where individual plans or acts are contemplated, which would impact on a Natura site, then all regulatory requirements currently in place will apply and in some instances a specific Appropriate Assessment will be necessary.

This report should prove valuable in informing the potential interaction between the industry vision in Food Harvest 2020 and important national strategies including those outlined below:

- Heads of a Climate Action and low-Carbon Development Bill⁵
- Our Sustainable Future – a framework for sustainable development in Ireland⁶
- 'Actions for **Biodiversity** 2011-2016', **Ireland's 2nd National Biodiversity Plan**⁷
- National Climate Change Adaptation Framework⁸
- Strategy for Renewable Energy 2012-2020⁹
- Second National Energy Efficiency Action Plan¹⁰
- Rural Development Programme 2014 – 2020
- 2013 Review of Nitrates Action Programme

1.9.1 Report Focus

As stated elsewhere dairying, beef, sheep, pig meat, and tillage enterprises account for the vast bulk of agriculture output. This Report concentrates on these areas in its principal examination of scenarios for the achievement of targets contained in Food Harvest 2020. Total output targets however are based on continuing improved outputs from other parts of the broader agriculture industry including forestry, fisheries, bioenergy crops and organic crops. Proposals for increased output in the forestry sector are subject to a parallel process of environmental assessment under the authority of the Forest Service (DAFM). Proposals for increased output in the seafood sector are subject to a parallel process of environmental assessment under the authority DAFM.

1.9.2 Forestry

Forestry, like mainstream agriculture, is a land based activity occupying approximately 730,000 ha, equating to ten per cent of the land area of the Country. It is estimated that approximately 70% of the national forest estate is predominately conifer, with the balance comprised of broadleaves, including native species such as ash, alder, birch and oak. Predominately, forestry occupies lands which would be of only marginal productive value to agriculture, either because of soil quality, topography or elevation.

1.9.2.1 Responsibility for Forestry

The Forest Service is responsible for forestry within DAFM. Their aim is to ensure the development of forestry within Ireland in a manner, and to a scale that maximises its contribution to national socio-economic wellbeing on a sustainable basis that is compatible with the protection of the environment. Its objectives are to:

- i. Foster the efficient and sustainable development of forestry;
- ii. Increase quality planting;

- iii. Promote the planting of diverse species;
- iv. Improve the level of farmer participation in forestry;
- v. Promote research and training in the sector;
- vi. Encourage increased employment in the sector¹¹.

Forestry activities, particularly as they effect the environment, are highly regulated. Afforestation is critically dependent on state aids which are administered through the Forest Service. No planting of new forests or felling of mature forests may take place without the approval of the Forest Service. All forestry activities including forest maintenance between planting and harvesting are subject to inspections and approval by the Forest Service. All forestry activities must operate within the guidelines laid down in the Forestry Schemes Manual which sets out clearly the procedures and operational standards required for the various forestry support schemes as described by the scheme documents. (www.agriculture.gov.ie).

The Forest Scheme Manual directs that all forestry operations must be carried out in accordance with the Code of Best Forest Practice and The National Forest Standard. The Code of Best Practice is designed to ensure forestry activities in Ireland are carried out in a way that meets high environmental and socio-economic standards. While The National Forest Standard outlines the basic criteria and indicators relating to the implementation of Sustainable Forest Management (SFM) in Ireland. It lists a series of qualitative and quantitative measures by which progress towards the achievement of SFM can be monitored under forest conditions. In addition, all forestry operations must be carried out in compliance with Forest Service publications:

- Forestry and Water Quality Guidelines;
- Forestry and the Landscape Guidelines;
- Forestry and Archaeology Guidelines;
- Forestry Biodiversity Guidelines;
- Forest Harvesting and Environmental Guidelines;
- Forest Protection Guidelines.

The Forest Service is a separate section currently located within DAFM (formerly located within the Department of Energy and Communications.) The Forest Service is currently completing a forest sector review including all aspects of forest planting, maintenance and harvesting which are relevant to the environmental characteristics under discussion in this report. The services provided by the Forest Service are principally guided by the Policy Statement *Growing for the Future*.

Subsequent to the publication of Food Harvest 2020 the Minister for Agriculture, Food and the Marine set terms of reference for review of the forestry sector. These terms of reference included *inter alia* terms of reference for a review of forest policy and future actions as they may impact upon the environment. This coincided with the call in Food Harvest 2020 for a forestry review and increased forestry output.

This report does not intend to unnecessarily duplicate the work already undertaken by the Forest Service. However, below the steps taken during the Forest Policy Review are outlined.

1.9.2.2 Forest Policy Review

The terms of reference for the Strategic Review were published by the Minister for Forestry in 2010. In the announcement of the public consultation process, consultees were reminded that Government policy was to increase annual planting to 10,000 hectares. In particular attention was drawn to the role of forestry in the broader environment and specifically in relation to bioenergy and biodiversity. The invitation to the public also contained a reminder that forestry was part of the public consultation process in relation to Food Harvest 2020. As a result of the Minister's announcement the following actions occurred:

- i. Establishment of sub-group within the Forest Service to coordinate the preparation of a Strategic Environmental Assessment;
- ii. Receipt and examination of over fifty submissions in response to a call for public consultation;

- iii. Facilitation of working groups involving all the stakeholders;
- iv. Coordination of response and input from other statutory agencies and government bodies;
- v. Evaluation of Forest Review Group projections for increased afforestation and projected deforestation in light of relevant environmental characteristics.

The results of the Strategic Forestry Review are currently undergoing a strategic environmental assessment and are due for issue for public comment and final publication in 2013.

1.9.3 Aquaculture

1.9.3.1 The Marine

While Ireland may be one of the smallest EU states when measured in terms of its land area, it is one of the largest when measured in terms of its sea area with a sea to land ratio of over 10:1. Despite this vast size the marine sector contributes 1.2% of Ireland's GDP. Contemporaneous with the preparation of Food Harvest 2020, DAFM have facilitated an inter departmental study group which in 2012 published an Integrated Marine Plan for Ireland *Harnessing our Ocean Wealth* (www.agriculture.gov.ie). This plan, which aims to double the marine contribution to GDP to 2.4% by 2020, sets out its vision as – *“Our Ocean Wealth will be a key element of economic recovery and sustainable growth generating benefits for all our citizens, supported by coherent policy, planning and regulation, and managed in an integrated manner”*. The report adopts three goals one of which sets the environment and environmental sustainability as a central plank.

1.9.3.1.1 Goal 1 Thriving Maritime Economy

- Sustainable economic growth of our Maritime Sectors
- Increase the contribution to our national GDP
- Deliver a business friendly yet robust governance, Policy and planning framework

1.9.3.1.2 Goal 2 Healthy Ecosystems

- Protect and conserve our rich marine biodiversity and ecosystems
- Manage our living and non- living resources in harmony with the ecosystem
- Implement and comply with environmental legislation.

1.9.3.1.3 Goal 3 Engaging with the Sea

- Building on our Maritime heritage, strengthen our maritime identity
- Increase our awareness of the value, opportunities and social benefits
- Engagement and participation by all

1.9.3.2 Marine and the Environment

The ambitious growth plans for the Irish Seafood industry outlined in an integrated marine plan for Ireland run in parallel and compliment the growth plans contained in Food Harvest 2020. It is not intended to assess the environmental implications of such growth in this report but it is useful to summarize the legislative and procedural infrastructure already in place to ensure environmental sustainability within the marine sector. Responsibility for environmental sustainability falls within the DAFM and in practice is administered through a rigorous licensing procedure.

1.9.3.3 Legislation

Aquaculture is governed primarily by the provisions of the following legislation:

- Fisheries (Amendment) Act 1997;
- Foreshore Act 1933, as amended;
- Birds Directive 79/409 EEC;
- EU Habitats Directive of 92/43/EEC;
- Environmental Impact Assessment Directives consolidated in Directive 2011/92/EU.

A key feature of aquaculture regulation in Ireland is the fullest compliance with the EU Birds and Habitats Directive. These Directives apply to areas designated SACs and SPAs which have particular relevance for birds. Generally these are known as “Natura 2000” areas. In 2007 the European Court of Justice declared in case C418/04 that by failing to take all measures necessary to comply with

Article 6(3) of the EU Habitats Directives in respect of the authorisation of aquaculture programmes, Ireland had failed to fulfil its obligations under that Directive. In the negotiations to address the judgement a process was agreed with the European Commission. This process includes the following steps:

- A detailed data collection in 91 Bays/Estuaries;
- Detailed analysis of raw data collected;
- Setting of Conservation Objectives by the National Parks and Wildlife Service (NPWS) in respect of each site;
- Carrying out Appropriate Assessments of each licence application/fishery plan against detailed Conservation Objectives set;
- Determination of Licences/Fisheries on the basis of the Appropriate Assessment and other relevant factors.

1.9.3.3.1 Licensing Procedure

All existing aquaculture projects are subject to licence. No new Aquaculture projects may proceed without first applying to and been granted a licence by the Minister for Agriculture, Food and the Marine. This licence application in all cases where relevant must be accompanied by an Appropriate Assessment. In addition all aquaculture projects are subject to EIA screening in Ireland. As part of the general upgrading of the overall licensing process new licensing templates were launched at the end of 2011 and are currently being rolled out as new licences are being issued or renewed. Key new features of the licence templates include:

- A move to Standing Stock Biomass for finfish as the means of measuring production capacity at an aquaculture site;
- Enhanced provisions on environmental monitoring;
- Greater clarity on the requirements for operators in relation to operational conduct and monitoring;

- The possibility for the group- marking of sites for navigational purposes;
- Specific provisions covering company registration/dissolution, tax certificates, payments of fees etc. (www.agriculture.gov.ie).

1.9.3.3.2 Monitoring and Compliance

DAFM as the competent authority operates a dedicated monitoring and compliance unit. The monitoring and control of aquaculture operations are undertaken with the assistance of the Marine Institute. Marine Institute staff visit fish farms and carry out inspections in relation to compliance with licence conditions, lice, and fish health.

In addition, seafood is also subject to various food safety legislation which governs stock traceability (Regulation 178/2002/EC).

1.9.4 Bioenergy

The authors of Food Harvest 2020 recognised that the development of the bioenergy industry was largely dependent upon a favourable outcome to evolving policies particularly with regard to Ireland's plans to meet its commitments to non-fossil fuel energy requirements. While there has been some positive policy developments the facts are that no substantial end user for bioenergy crops has emerged. It is clear that in the absence of a viable end user who is willing and able to pay a price that generates a competitive return to farmers the level of planting of bioenergy crops will remain low. Annual targets for planting bioenergy crops have not been achieved to date. Efforts to increase the areas of energy crops planted can be assisted by policy initiatives involving a range of stakeholders, including Government Departments and Agencies, the commercial State sector and other commercial interests. Planting grants which have been available since 2007 alone will not be sufficient to encourage the large scale uptake of bioenergy crop planting. Experience to date has shown that viable yields will only be achieved when crops are planted in reasonable quality agriculture land. Thus it is likely that any expansion in bioenergy crops will take place in land currently underutilised on beef and sheep farms. Alternatively bioenergy planting is likely to substitute for low margin crops

on tillage farms. Therefore, in circumstances where planting will not take place on semi-marginal lands and the volume of planting is likely to be small no significant environmental effects under any of the characteristics studies are anticipated during the period to 2020.

1.9.5 Organic Farming

The expansion of organic farming involving as it does a reduction in inputs, decreased use of artificial fertilisers and a reduction of stocking rates is generally perceived to be beneficial under all environmental headings studied.

Food Harvest 2020 recognises the small scale of existing organic output, with approximately 1,500 practitioners, despite financial aids to encourage farmers to switch to organic methods, it is still of niche status. The report recognises the potential of organic farming for both increased exports and import substitution.

As any major transfer of enterprises to organic is unlikely, and any such development would have positive environmental consequences, no in depth study of the organic sector was undertaken.

1.10 Public Consultations

As part of the preparation of the Food Harvest 2020 document a public consultation process was undertaken and received submissions were considered by the authors.

As part of this planned analysis of scenarios DAFM facilitated a stakeholder consultation process by seeking written submissions from interested parties. Advertisements were placed in national newspapers on 16th May 2012 and 35 submissions were received prior to the extended closing date of 6th July 2012 (See Appendix I for full list of submissions received).

When the revised terms of reference for the recasting of this report were being drafted they were circulated to the statutory consultees and all comments received were accommodated in the final draft.

1.10.1 Final Public Consultation

The draft final report was made available for public consultation for a period of eight weeks

from the 16th September 2013. Twenty five submissions were received as detailed at Appendix I to this report. All submissions received were considered by the authors and helped to inform and improve the final iteration of this report. The authors recognise that the analysis process has been strengthened by the input and comments received through the public consultation process and are grateful to all those who participated in the process. In addition, DAFM facilitated a series of three meetings (in February 2013, September 2013 and November 2013) between the report's authors and representatives of the membership of the Environmental Pillar to discuss in detail the ongoing analysis process. Where possible errors and omissions highlighted in these submissions and meetings have been changed in the text. In addition increased emphasis has been given to certain elements, already contained within the text, in response to suggestions made.

A number of the submissions called for a revised study methodology with increased and broadened terms of reference. A number of submissions also called for further study and regulatory/legislative changes outside the scope of this report. Some submissions highlighted a perceived lack of compliance with existing regulations and called for increased monitoring and compliance enforcement. The past performance of agriculture in relation to environmental matters was highlighted as was the need for a strategy to address localised high impact incidents. Some submissions questioned the concept of achieving sustainable increased output while other submissions endorsed the concept. There was broad agreement for the need for increased and improved monitoring with sectoral interests favouring emphasis in their own particular areas of interest.

There was broad support (with some caveats) for the adoption of high technology and improved farm practice as the most effective mitigation measures. The up skilling of advisors, roll-out of an effective agri-environmental scheme and the implementation of a bespoke environmental best practice plan on individual farms were favoured in many submissions.

1.11 Limitations

This analysis report is based on the information that was made available at the time of publication. It should be noted that:

- The findings of this report represent the professional opinion of experienced agricultural consultants, environmental scientists and other specialists;
- All work carried out in preparing this report utilised and is based upon the author's professional knowledge and understanding of current relevant European Union and Irish standards and codes, industry practices and legislation;
- Changes in this legislation and guidance may occur at any time in the future and cause conclusions to become inappropriate or incorrect. The authors do not accept responsibility for advising the facts or implications of any such changes;
- This report has been prepared using factual information contained in documents prepared by others. No responsibility can be accepted by the authors for the accuracy of such information. Every endeavour has been made to identify data sources, where appropriate.

1.12 Notes and References

- 1 Export Performance and Prospects Irish Food, Drink and Horticulture – 2012/13 Bord Bia [<http://www.bordbia.ie/industry/services/information/publications/MarketReviews/Documents/Export%20Performance%20and%20Prospects%20for%202012-2013.pdf>]
- 2 CSO Annual Population, Migration Estimates September 2012
- 3 CSO, December 2012 <http://www.cso.ie/en/media/csoie/releasespublications/documents/agriculture/2010/full2010.pdf>
- 4 Fact Sheet on Irish Agriculture March 2013, DAFM, <http://www.agriculture.gov.ie/media/migration/publications/2013/MARCH2013FACTSHEET040313.pdf>
- 5 <http://www.environ.ie/en/Publications/Environment/ClimateChange/FileDownload,32468,en.pdf>
- 6 <http://www.environ.ie/en/Publications/Environment/Miscellaneous/FileDownload,30452,en.pdf>
- 7 Ireland's 2nd Biodiversity Action Plan - <http://www.npws.ie/legislationandconventions/nationalbiodiversityplan/>
- 8 <http://www.environ.ie/en/Publications/Environment/ClimateChange/FileDownload,32076,en.pdf>
- 9 http://www.dcenr.gov.ie/NR/rdonlyres/9472D68A-40F4-41B8-B8FD-F5F788D4207A/0/RenewableEnergyStrategy2012_2020.pdf
- 10 http://www.dcenr.gov.ie/NR/rdonlyres/B18E125F-66B1-4715-9B72-70F0284AEE42/0/2013_0206_NEEAP_PublishedversionforWeb.pdf
- 11 www.agriculture.gov.ie



Analysis Process

Section 2:

Analysis Process

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2 Analysis Process

2.1 Overview of Analysis Process

The following methodology was adopted for the conduct of the study.

- i. **Define the Scenarios to be studied** - This report takes the scenario presented in *A Marginal Abatement Cost Curve for Irish Agriculture*¹² as its first scenario (Scenario A). This FAPRI Ireland Model represents an integrated proposal which could achieve the volume and output targets contained in Food Harvest 2020. Owing to the fact that the volume and output targets could be achieved in several other ways, three alternative pathways at sectoral level for the achievement of the targets have been generated: Scenario B – a low intensity system; Scenario C – a high intensification system; and Scenario D – a system based on best knowledge and technology.

- ii. **Establish significance criteria for potential impacts** - In order to assess the potential positive or negative impacts across the range of environmental characteristics (biodiversity, flora and fauna, water quality including drinking water, soil, air quality, landscape and climatic factors) it was necessary to adopt a uniform and recognised method of assessment.

The significance criteria used in the assessment of potential impacts of Food Harvest 2020 grade the potential impacts as positive, imperceptible/neutral and negative. Positive and negative impacts are further graded as slight, moderate and significant. The criteria have been selected following a review of relevant literature, and on the basis of objective criteria and drawn from the EPA Guidelines (2002)¹³.

- iii. **Define legislative/regulatory parameters** - Irish agriculture at farm level is already

highly developed and regulated. All relevant EU and National legislation was reviewed in relation to each environmental characteristic to be studied.

- iv. **Define baseline status** - The baseline state of the environment under each environmental characteristic was assessed and noted. In this context the fact that output changes envisaged under Food Harvest 2020 would occur within already well-functioning and environmentally sustainable farming systems was recognised. A literature review was carried out for each characteristic.
- v. **Identify key agriculture pressures** - In order to predict potential environmental impacts the potential changes in pressures from agricultural practices were identified. The potential to reduce or mitigate pressures was noted together with the role already being played by regulation and codes of good farming practice.
- vi. **Predict and assess likely impacts** - Each predicted impact was examined and assessed under the context of on-going farming systems. A rating of positive, neutral or negative was assigned to the impacts. Consideration has been given to the influence of other plans and programmes.
- vii. **Suggest suitable mitigation** - In all cases where negative impacts were predicted suitable mitigation measures were suggested. It was noted that the impact assessment was pre-mitigation.

2.2 Significance Criteria

2.2.1 Introduction

1.1.1.1 Significance of environmental effects

This section outlines the methodology used to determine the significance of the environmental

effect on the various aspects of the environment of any actions predicted under Food Harvest 2020. The implementation and achievement of any of the targets set out in Food Harvest 2020 are to be assessed in relation to their potential impacts under the following environmental criteria:

- Biodiversity and Flora and Fauna;
- Water quality including drinking water;
- Soil;
- Air quality;
- Landscape including buildings;
- Climatic Factors including greenhouse gas emission levels.

The achievement of targets under Food Harvest 2020 will be a complex interaction of increase or decreases in volume levels across the various production sectors together with anticipated changes in price levels.

While the milk output target is an increase of 50% in volume production, this will most likely be achieved through a combination of increased cow numbers, increased efficiency and increased intensification. It is likely that the output targets for beef will be achieved through price and productivity improvements, together with a fall in suckler cow numbers. Similarly for other sectors, the output targets contained in Food Harvest 2020 will be achieved through a combination of price movement, enterprise mix adjustment, intensification and productivity gains.

2.2.2 Farming Systems in the Receiving Environment

Behind the gate, farming systems and farming production methods are highly developed and regulated in Ireland. All farm operations are subject to national and international environmental regulations. In particular all farms must operate within strict guidelines laid down in:

- Good Agricultural and Environmental Condition (GAEC)
- Statutory Management Requirements (SMR);
- The Nitrates Directive;
- The Phosphorus Regulation;

- Applicable Agri-environmental schemes (REPS, AEOS etc.)

The targets outlined in Food Harvest 2020 involve complimentary changes within farm systems, not the creation of any new farm systems. Any increases in volume output will arise within already well-structured farming systems, which are already regulated and compliant with environmental regulations. For example, increased volume production targets at national level for the dairy sector will be achieved across thousands of individual farms through changes in productivity and the intensification of production methods together with increasing cow numbers. The farm systems where these increased production levels will occur are already developed, equipped and regulated units. Each individual farm already has well developed animal and crop husbandry systems, animal housing and effluent storage facilities and systems in place for storage and land spreading of organic and inorganic fertilisers. Increases in production in one sector on an individual farm will come at the expense of production decreases in another sector.

The significance of the environmental impacts as predicted under the various environmental criteria will be based on “*Advice Notes on Current Practice in the Preparation of Environmental Impact Statements*”¹⁴

The methodology employed in the listing of potential impacts and the evaluation of the potential significance of those impacts is carried out in accordance with the “Guidelines on the information to be contained in an Environmental Impact Statement”. The report is intended to detail the likely environmental impacts under the environmental headings:

- Biodiversity and Flora and Fauna;
- Water quality including drinking water;
- Soil;
- Air quality;
- Landscape including buildings;
- Climatic Factors including greenhouse gas emission levels.

The analysis of the impacts is undertaken in a universally recognised format. The EPA (2002)

further define the significance of an impact to mean either “*the importance of the environment that is affected (its sensitivity to change) or the importance of the impact (the consequences of the change)*”. The assessment is therefore be based on the EPA’s guidelines and information.

In considering the potential for impacts (either positive or negative) associated with proposed changes, no obvious change is noted to be neutral. While legislation, policy guidance and best practice requires the relative significance of positive or negative impacts to be further distinguished, there is no nationally accepted guidance on how to achieve this distinction, especially for a higher level strategic study such as this. In the absence of such a unified approach to impact assessment in Ireland, a basis for further defining the impact assessment needed to be selected. This has been based upon a review of (but not limited to) the EPA’s Guidelines on the *Information to be contained in Environmental Impact Statements* (EPA 2002); the National Road Authorities *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (NRA 2006)¹⁵; and the Institute of Ecological and Environmental Management’s *Guidelines for Ecological Impact Assessment in the United Kingdom* (currently being adapted for Ireland) (IEEM, 2006)¹⁶; Development of *Strategic Environmental Assessment (SEA) Methodologies for Plans or Programmes in Ireland - Synthesis Report* (EPA 2003)¹⁷ and best practice. Table 2-1 presents a summary of the impact significance criteria to be used.

Table 2-1: Impact assessment matrix (definitions as per EPA 2002).

Impact Category	Description	Significance	Definition of Significance
Not appropriate	In some instances a particular Pressure will not be relevant under the scenario being considered.		
Positive	A change which improves the quality of the environment	Significant	An impact which substantially promotes enhances or otherwise creates / improves sensitive characteristics.
		Moderate	An Impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
		Slight	An impact which causes noticeable changes (positive) in the character of the environment without affecting its sensitivities ¹⁸
Neutral / Imperceptible	A change which does not affect the quality of the environment / impacts capable of measurement, but without noticeable consequences.		
Negative Impact	A change which reduces the quality of the environment	Slight	An impact which causes noticeable changes (negative) in the character of the environment without affecting its sensitivities ¹⁸
		Moderate	An Impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment in a negative fashion.
		Significant	An impact which effectively or actually obliterates sensitive characteristics.

In considering whether an impact is to be positive or negative, other factors to be considered include: - magnitude, extent, duration, reversibility and timing and frequency (EPA 2002, IEEM 2006). Furthermore, confidence in the assessment of impacts must also be considered. IEEM (2006) present the following scale, also adopted by NRA, 2006, which will be followed in this assessment:

- Certain / near-certain: probability estimated at 95% chance or higher;
- Probable: probability estimated at above 50%, but lower than 95%;
- Unlikely: probability estimated above 5%, but less than 50% and;
- Extremely Unlikely; probability estimated at less than 5%.

The range of environmental criteria for assessing the importance of a particular impact and the range of criteria for quantifying the magnitude of impacts are adopted from the NRA guidance document *“Environmental Impact Assessment of National Roads Schemes – A Practical Guide 2008.”*¹⁹

While assigning an impact rating as neutral, slight, moderate or significant recognition is also given to

the status of the environmental characteristic in the baseline period. It should be noted that for an environmental characteristic which is already at a moderate status a slight negative impact could have serious consequences.

2.3 Scenario Development

2.3.1 Introduction

Analysis of a number of scenarios will provide information on a series of approaches to achieving the volume and value targets set out in Food Harvest 2020. Achievement of those targets will necessitate significant changes at farm level and the adoption by farmers of new technology and practices. Total primary agriculture is composed of the production output of approximately 140,000 individual farm units. These farm units are self-contained and decisions taken at farm level contribute to the overall scale and mix of production in Irish agriculture. Total farm production is interrelated and interdependent with increases in the production levels in one sector normally coming at the expenses of decreases in production in other sectors. While individual farmers have tended to specialise in one sector of production, (e.g. dairying, beef, sheep, tillage etc.), nonetheless, few farms are dedicated

solely to one enterprise. Thus, typically a decision to increase the area devoted to tillage crops will be matched by a decision to decrease the area devoted to beef or sheep. A decision to increase the area devoted to dairying will normally be associated with a decrease in the area devoted to beef production.

Overall a return to the livestock numbers pertaining in the 1990's (the historic high level mark for animal numbers) is not envisaged under any of the scenarios assessed. The historic and projected (FAPRI-Ireland model) animal numbers are illustrated in Figure 2-1.

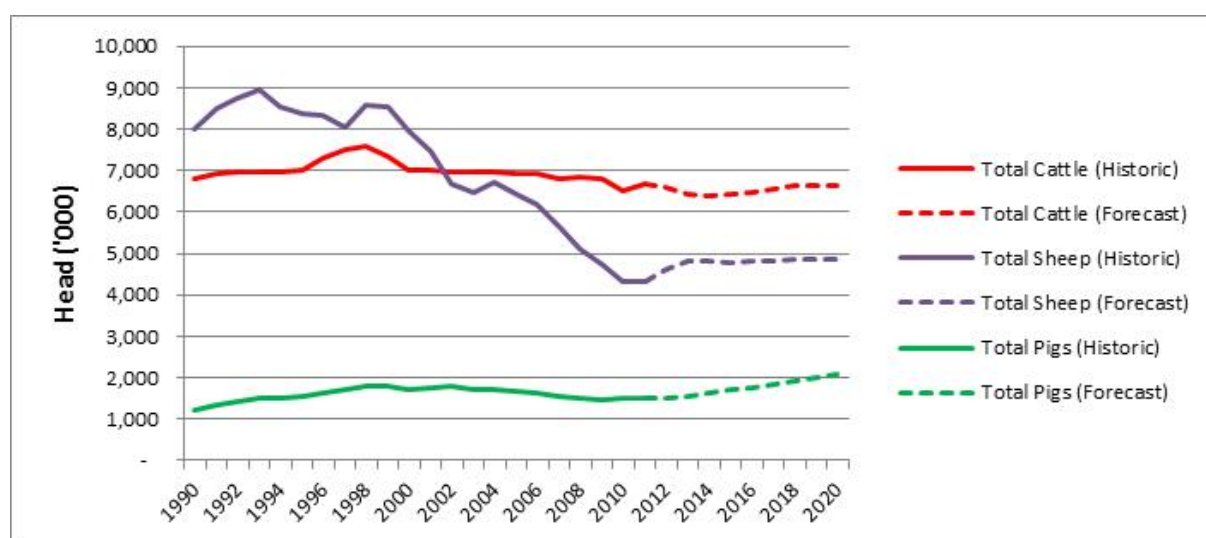


Figure 2-1: Historic and projected animal numbers. Source: CSO, FAPRI Ireland/Teagasc

The total area available for agricultural production is fixed. In Ireland, unlike other countries a very insignificant amount of productive agricultural land lies unutilised. There are, however, opportunities to increase production through changes in enterprise mix, intensification or the use of improved technologies to increase production with the same inputs. While most of the agricultural land in Ireland is utilised for agricultural purposes, much of the land is subject to very low levels of fertiliser input and consequently low stocking rates. Therefore, a marginal increase in fertiliser input and improved management would facilitate an increase in production nationally.

The achievement of targets set out in Food Harvest 2020 does not envisage any new lands becoming available for agricultural production. The historic and projected land usage is illustrated in Figure 2-2. Nor indeed is it envisaged that any land currently used for agricultural production will be abandoned. Changes in production will be in the main interrelated. It is envisaged that the majority of the increase in dairy production will occur on existing dairy farms and as a direct consequence beef production on those farms will decrease. While it is expected that there will be new entrants into the dairy sector, these new dairy farms will arise from already existing beef farms at the expense of beef production on these farms.

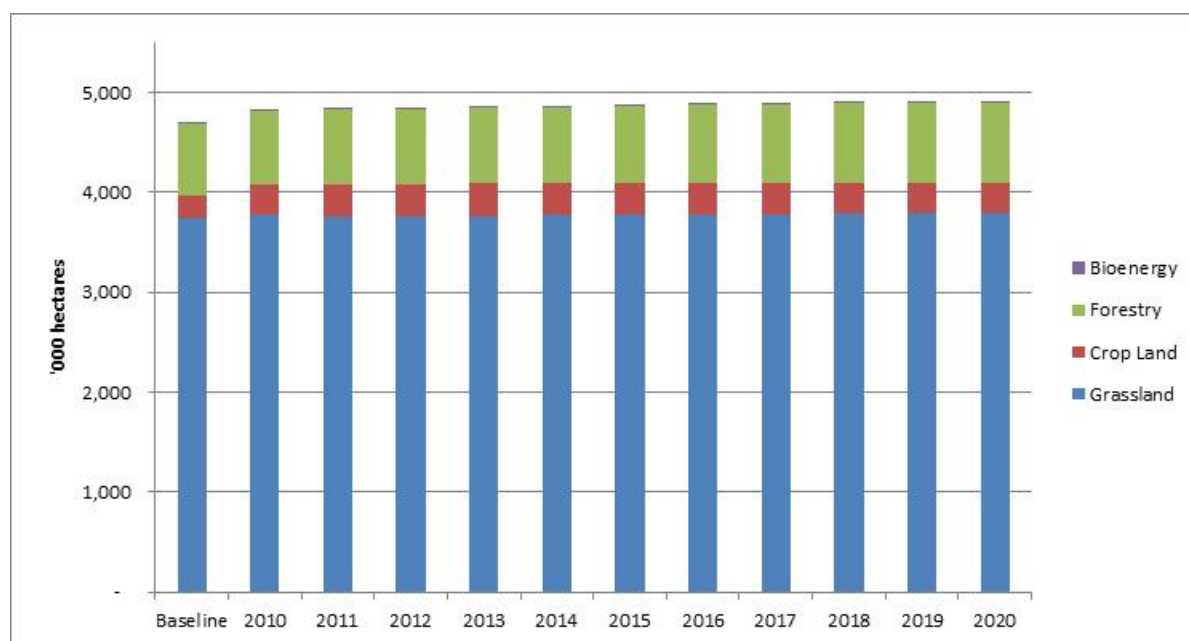


Figure 2-2: FAPRI Ireland projected land usage. Source: CSO, FAPRI Ireland/Teagasc.

2.3.2 The Main Integrated Scenario (Scenario A)

In April 2012, as part of its submission to the National Climate Policy Development Consultation, Teagasc published *A Marginal Abatement Cost Curve for Irish Agriculture*. The data presented by Teagasc at Appendix A (reproduced in this report at Appendix II) was modelled using the FAPRI-Ireland Model. The FAPRI-Ireland model is maintained by the Teagasc Rural Economy Research Centre and has been used extensively in the analysis of agricultural and trade policy in Ireland over the past ten years. The FAPRI-Ireland model is a dynamic partial equilibrium model which is linked both to FAPRI-EU and world modelling systems. Agricultural emission projections used by the EPA in Ireland's Greenhouse Gas Emissions Projections 2011 -2020 (16 April 2012)²⁰ was sourced from FAPRI-Ireland data. In Appendix A of this document, Teagasc presents the most likely enterprise mix and individual enterprise production targets which would achieve the volume and output targets set out in Food Harvest 2020. This scenario provides a fully modelled enterprise mix, which takes account the likely increases and decreases in production at farm level. Increases in cow numbers for milk production at farm level are in part offset by

decreases in beef cattle on the same farms. While the FAPRI model was developed to analyse the impact of Food Harvest 2020 specifically with regard to greenhouse gases, the integrated picture of Irish agriculture it presents at 2020 lends itself to further analysis with regard to other environmental characteristics.

In summary, the data outlines the situation with respect to projected activity levels in Irish Agriculture in the period to 2020 under which all of the value and volume targets set in the Food Harvest 2020 report for the primary agricultural sector are achieved. In association with this, projected 2020 analysis presents details regarding historic levels of livestock numbers, changes in livestock numbers over time, in addition to changes in land-allocation to enterprises and changes in inputs.

The baseline period for Food Harvest 2020 is the average of production for the years 2007 to 2009 inclusive. Table 2-2 details the baseline 2007 to 2009 average activity data for each of the sectors and the variance in activity level relative to 2020 necessary for the achievement of Food Harvest 2020.

Table 2-2: Scenario A (Integrated Scenario)

Food Harvest 2020 Scenario A data	Unit	Baseline (2007-2009)	Scenario A (Integrated Scenario)	Scenario A (Integrated Scenario) variance with Baseline	% Variance with Baseline
Total Dairy and Beef Cattle	000 head	6,818.3	6,649.8	(168.5)	-2%
Dairy	000 head	1,253.0	1,595.3	342.3	27%
Dairy Cows	000 head	1,057.6	1,315.7	258.1	24%
Dairy Heifers	000 head	195.4	279.6	84.2	43%
Land area required *	Ha	695,774	907,548	211,774	30%
Concentrates *	Tonnes	1,305,643	1,662,316	356,673	27%
Inorganic Nitrogen *	Tonnes	102,975	143,635	40,660	39%
Organic Nitrogen *	Tonnes	101,034	127,773	26,739	26%
Organic Phosphorus *	Tonnes	15,312	19,341	4,029	26%
Beef	000 head	5,565.2	5,054.5	(510.8)	-9%
Other Cows	000 head	1,184.0	1,027.3	(156.7)	-13%
Cattle < 1 yrs – male	000 head	944.9	824.9	(120.0)	-13%
Cattle 1 - 2 yrs – male	000 head	833.8	733.0	(100.8)	-12%
Cattle > 2 yrs – male	000 head	495.6	490.1	(5.4)	-1%
Cattle < 1 yrs – female	000 head	984.9	868.8	(116.1)	-12%
Cattle 1 - 2 yrs - female	000 head	667.4	647.2	(20.2)	-3%
Cattle > 2 yrs – female	000 head	221.6	253.6	32.0	14%
Bulls	000 head	54.4	58.0	3.6	7%
Other Heifers	000 head	178.6	151.6	(27.0)	-15%
Land area required *	Ha	2,428,765	2,228,136	(200,629)	-8%
Concentrates *	Tonnes	1,934,678	1,772,059	(162,619)	-8%
Inorganic Nitrogen *	Tonnes	172,442	178,251	5,809	3%
Organic Nitrogen *	Tonnes	269,179	246,846	(22,333)	-8%
Organic Phosphorus *	Tonnes	38,784	35,625	(3,159)	-8%
Total Sheep	000 head	5,162.7	4,876.6	(286.0)	-6%
Ewes Lowland	000 head	2,063.9	2,067.9	4.1	0%
Ewes Upland	000 head	516.0	515.8	(0.1)	0%
Rams lowland	000 head	63.1	62.0	(1.1)	-2%
Rams Upland	000 head	15.8	15.5	(0.3)	-2%
Other Sheep>1 lowland	000 head	108.1	119.2	11.1	10%
Other Sheep>1 upland	000 head	27.0	29.7	2.7	10%
Lambs lowland	000 head	1,895.0	1,609.4	(285.7)	-15%
Lambs upland	000 head	473.8	457.1	(16.6)	-4%
Land area required *	Ha	322,000	307,876.0	(14,124)	-4%
Concentrates *	Tonnes	202,774	203,081.0	307	0%
Inorganic Nitrogen *	Tonnes	23,667	20,936.0	(2,731)	-12%
Organic Nitrogen *	Tonnes	32,180	32,293.0	113.0	0%
Organic Phosphorus *	Tonnes	4,918	4,936.0	18.0	0%
Total Pigs	000 head	1,491.4	2,074.8	583.4	39%
Gilts in Pig	000 head	21.0	20.5	(0.5)	-2%
Gilts not yet Served	000 head	16.4	17.7	1.3	8%
Sows in Pig	000 head	91.8	91.4	(0.4)	0%
Other Sows for Breeding	000 head	26.6	28.9	2.4	9%

Food Harvest 2020 Scenario A data	Unit	Baseline (2007-2009)	Scenario A (Integrated Scenario)	Scenario A (Integrated Scenario) variance with Baseline	% Variance with Baseline
Boars	000 head	1.6	1.8	0.2	16%
Pigs 20 Kg +	000 head	927.1	1,369.5	442.4	48%
Pigs Under 20 Kg	000 head	406.9	544.9	138.0	34%
Concentrates *	Tonnes	925,000	1,348,153	423,153	46%
Organic Nitrogen *	Tonnes	11,659	11,867	208	2%
Organic Phosphorus *	Tonnes	2,323	2,365	42	2%
Total Poultry	000 places	14,348.7	17,158.1	2,809.4	20%
Layer	000 places	1,830.0	2,106.7	276.7	15%
Broiler	000 places	11,821.5	14,615.1	2,793.6	24%
Turkey	000 places	697.3	436.3	(260.9)	-37%
Horses	000 head	95.3	98.1	2.8	3%
Mules	000 head	8.3	8.8	0.5	6%
Goats	000 head	8.8	10.1	1.3	15%
Total Fertiliser					
Fertiliser(N)	Tonnes	312,440	359,787	47,347	15%
Fertiliser(P)	Tonnes	26,332	30,554	4,222	16%
Land Use					
Grassland					
Pasture	000 ha	2,029.1	2,111.7	82.6	4%
Hay	000 ha	233.9	222.6	(11.3)	-5%
Silage	000 ha	1,036.2	1,014.3	(21.9)	-2%
Rough Grazing	000 ha	447.3	441.2	(6.1)	-1%
Total grassland		3,746.5	3,789.8	43.3	1%
Crops					
Wheat Area Harvested	000 ha	90.7	98.9	8.1	9%
Barley Area	000 ha	178.2	148.1	(30.1)	-17%
Oats Area Harvested	000 ha	21.6	18.1	(3.5)	-16%
Potatoes Area Harvested	000 ha	12.2	8.6	(3.6)	-29%
Turnips Area Harvested	000 ha	1.2	1.5	0.3	22%
Maize Area Harvested	000 ha	20.9	20.9	0.0	0%
Forestry **	000 ha	722.3 **	812.0 ***	89.7	12%
Bioenergy ***	000 ha	3.0	14.0	11.0	367%
Sources: CSO; Teagasc/ FAPRI Ireland unless otherwise indicated					
* Consultants calculations					
** CSO Data					
***Consultants Estimate					

The FAPRI model makes certain assumptions with regard to output price movements to 2020. Finished pig prices are assumed to increase by 2.39% from the average 2007 to 2009 baseline price €136.16/100 kg to €139.41/100 kg. Irish R3 cattle prices are assumed to increase 22.35% over the same period from €293.67/100 kg to €359.31/100 kg. Live sheep prices are assumed to

increase 41.64% from €158.22/100 kg to €224.09/100 kg.

Figure 2-3, Figure 2-4, Figure 2-5 and Figure 2-6 detail the evolution of animal numbers (cattle, sheep, pigs and poultry respectively) as projected by FAPRI-Ireland from the baseline to 2020 (source – CSO, FAPRI Ireland, Teagasc).

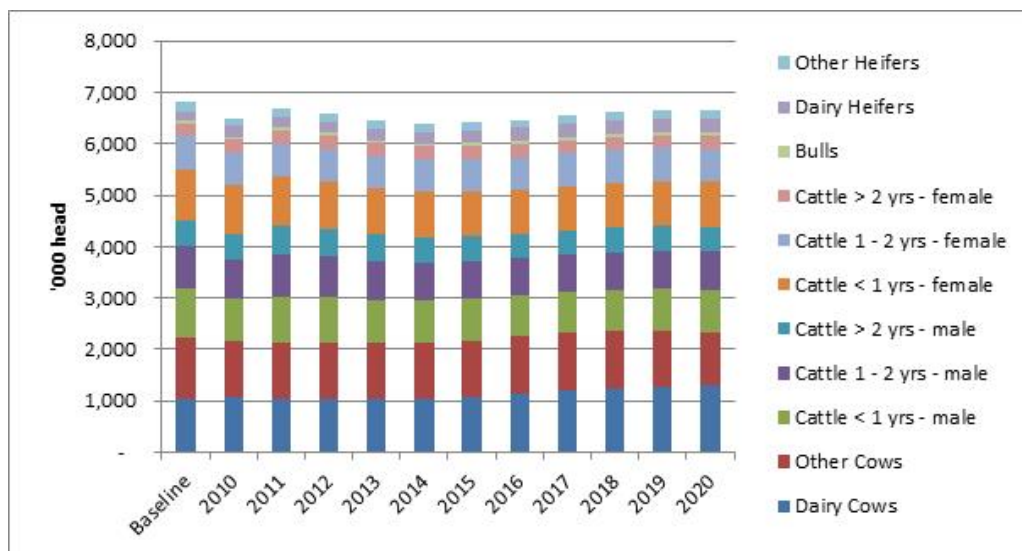


Figure 2-3: FAPRI Ireland projected cattle numbers

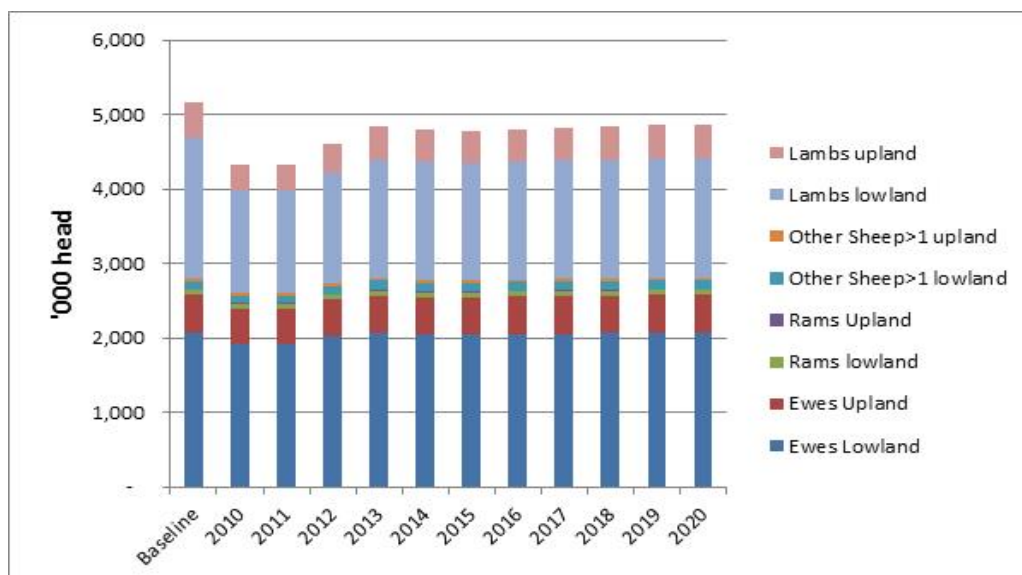


Figure 2-4: FAPRI Ireland projected sheep numbers.

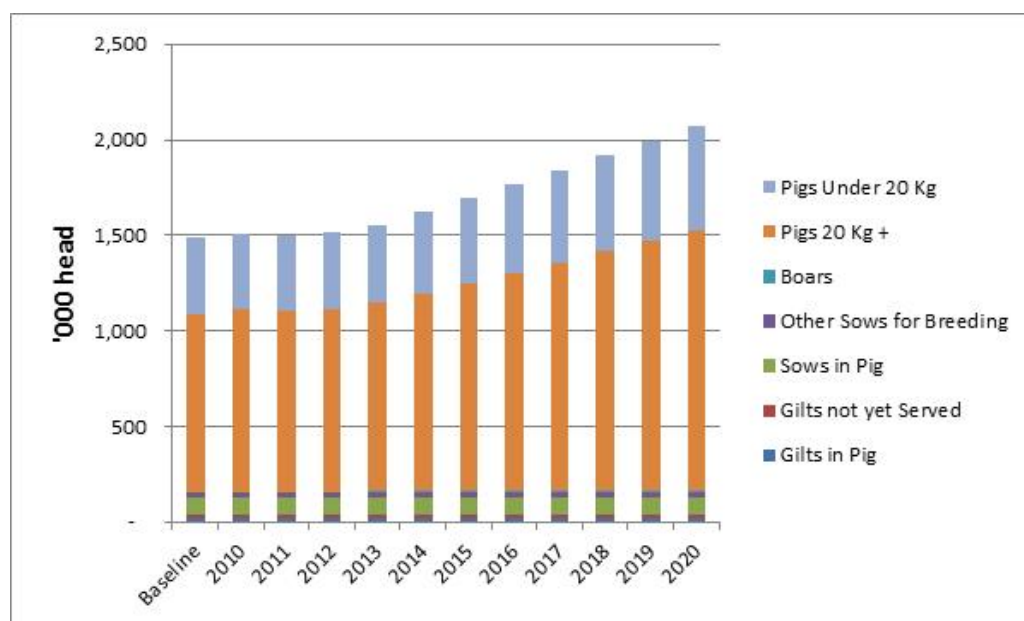


Figure 2-5: FAPRI Ireland projected pig numbers.

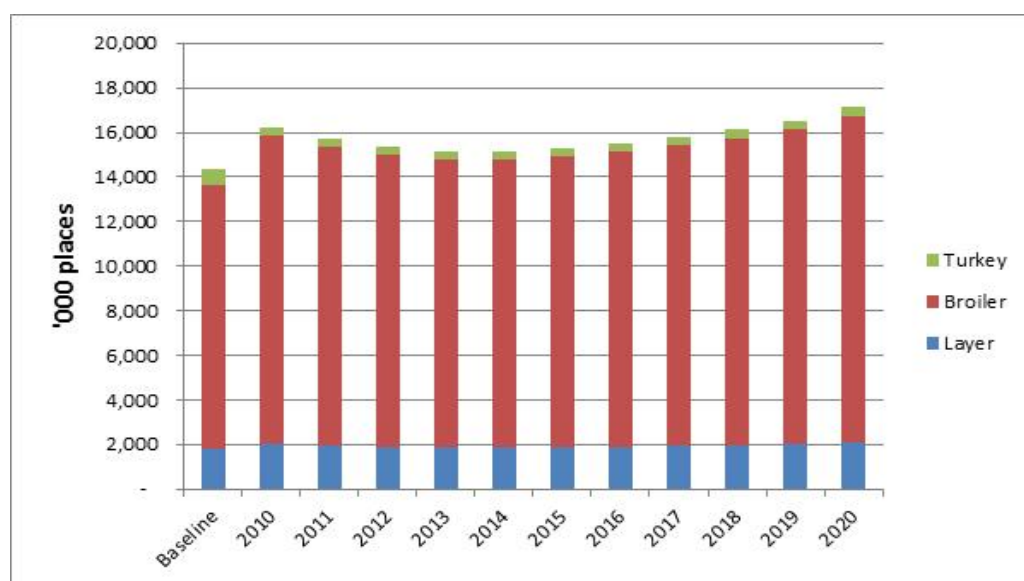


Figure 2-6: FAPRI Ireland projected poultry numbers.

2.3.3 Alternative Sectoral Scenarios

The targets outlined in the above scenario would be achieved through a combination of expansion, intensification and increasing production efficiency. Prices for primary agricultural production are volatile and cyclical. In practice, it is likely that the achievement of increased production targets will not follow exactly the scenario as outlined.

Analysis of a number of scenarios will provide information to policy makers. It was deemed appropriate, therefore, to examine alternative scenarios through which the targets could be met, but which might have varying environmental consequences. This study examines, at sectoral level, three alternative scenarios. The most likely scenarios as suggested by DAFM include expansion/land use change, intensification and

higher production efficiency within an environmental context. It is proposed to consider these three most likely scenarios for the pathway level analysis. These include:

1. **Low Intensification (Scenario B)** – In the case of livestock, by the use of a less intensive system and associated with lower stocking rate. This scenario has a requirement for more land per Livestock Unit.
2. **Increased Intensification (Scenario C)** – In the case of livestock, by increasing stocking rates (with associated higher inputs) and increased concentrate input with associated increase in animal performance.
3. **High Technology (Scenario D)** - i.e., by producing more food without increasing inputs through, for example improved genetics.

In practical terms, increases from the output of the forage sector (dairy, beef and sheep) will be achieved through a combination of expansion, intensification and increased production efficiency. These farms are more diverse in nature and historically have undergone changes both between the sectors and in output terms as outlined above. In Ireland, pig production is a highly specialised sector, with over 90% of the pig meat being produced by less than 300 farmers. It is not practical, therefore, to consider increases in output through expansion. Cereal production is also highly specialised with the top 10% of growers achieving output levels significantly higher than the average. It is not considered realistic that increased output would be achieved through expansion and therefore two scenarios are considered in relation to tillage.

2.4 Change in the Agri-Food Industry in Absence of Food Harvest 2020

In examining the impact of Food Harvest 2020 on the Agri-Food industry, the model used by Teagasc allows for the comparison of the Food Harvest 2020 scenario with a scenario in which there are no new policy changes (Scenario 1). In developing a no-policy change scenario (Scenario 1), a set of agricultural and trade policy assumptions needs to be considered. Typically, this involves “locking in” currently agreed policies and assuming that they continue to prevail to the end of a 10 year projection period. Changes in the Agri-Food industry in the Absence of Food Harvest 2020 outlined in the sections below are based on a recent report from Teagasc (Donnellan and Hanrahan, 2012)²¹.

The no-change agricultural policy assumptions that are used include:

- No CAP +2013 reform;
- No conclusion of the WTO Doha Round;

- No Mercosur-EU bilateral trade agreement;
- Milk quotas are removed in 2015;
- Annual planting rates of 7,500 ha for forestry and 2,000 ha for bioenergy crops;
- The suckler cow welfare scheme and grassland sheep scheme are not renewed beyond their current agreed expiry dates (2012);
- No measures to assure achievement of the Food Harvest targets as might be developed by the Food Harvest implementation body are introduced.

2.4.1 Change in level of output in livestock sector

The projected changes in the Scenario 1 levels of output in the beef, sheep, pig and dairy sectors between the 2007-2009 reference period and 2020 are shown in Figure 2-7. These are contrasted with the targets that are presented in the Food Harvest 2020 Committee’s report (Scenario 2).

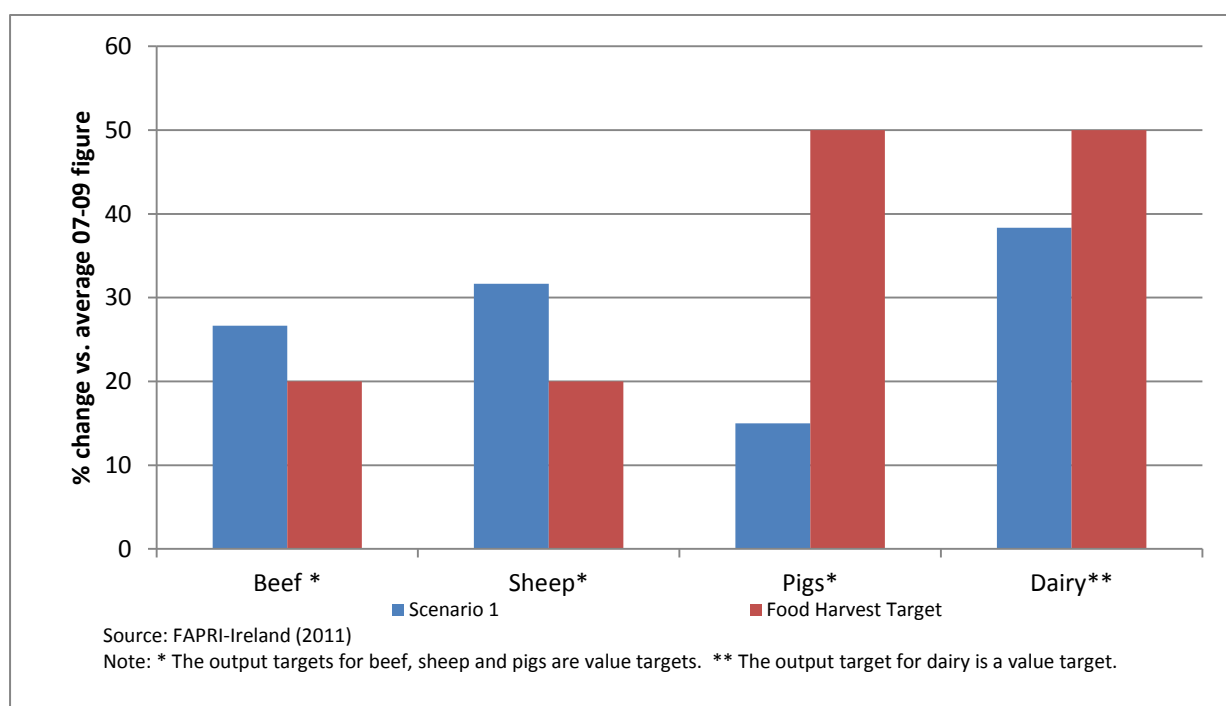


Figure 2-7: Scenario 1 - increase in activity by 2020 and FH2020 targets

Under Scenario 1, the Food Harvest 2020 (Scenario 2) targets are not achieved by 2020. In Figure 2.8, Donnelly and Hanrahan report on the projected level of output under Scenario 1 in Euro for

livestock enterprises. The level of output in 2020 is compared with level of output in reference period (2007-2009).

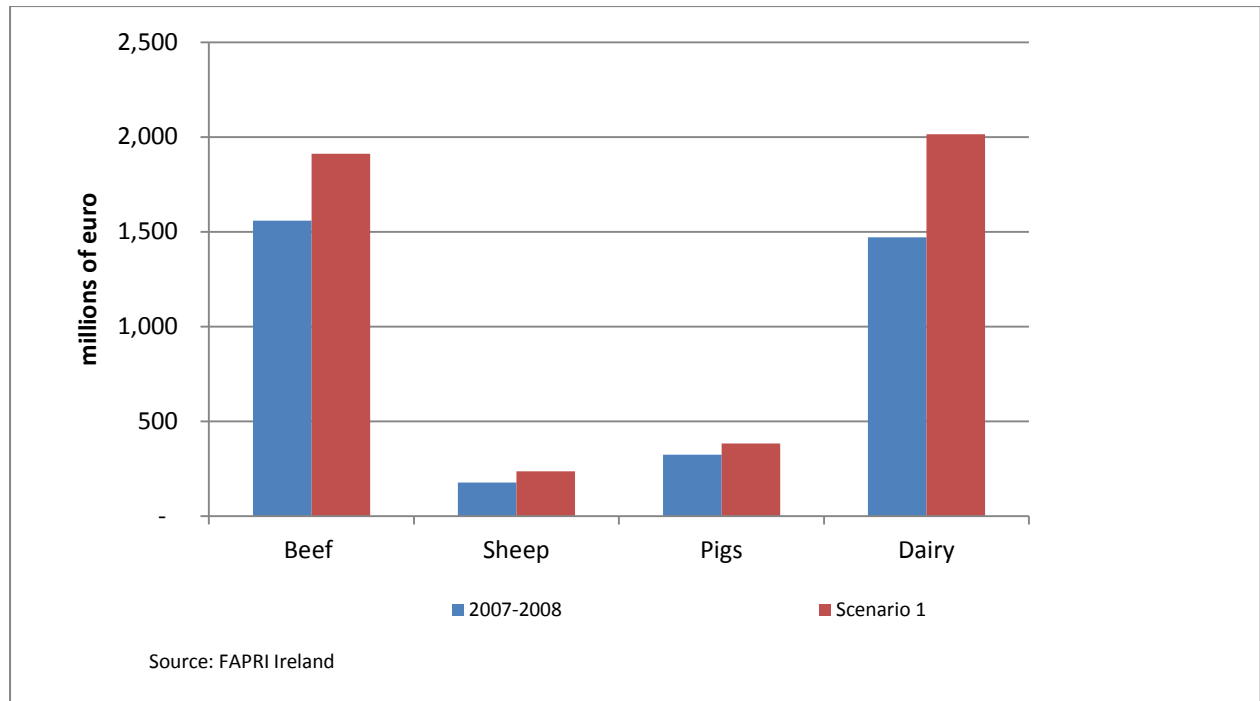


Figure 2-8: Scenario 1 output value by 2020 and FH2020 reference level.

The dominance of beef and dairying is evident in terms of their relative contribution to total Irish agricultural sector output. The value of output from the beef, sheep and pig sectors is projected to increase, but the magnitude of improvement in the value of output projected is significantly lower than the target set for 2020 in the Food Harvest report. Most of the improvement in beef, sheep and pig output value is based on projected increases in the prices of agricultural commodities that are expected over the next 10 years (Donnellan and Hanrahan 2012).

Figure 2-9 shows how the ratio of dairy cow to beef cows is expected to evolve under Scenario 1. The projected changes in milk and beef production have implications for the composition of the Irish cattle herd. The proportion of the overall cattle herd that is the progeny of dairy cows increases, while the share from the beef herd declines over the projection period. By 2020 under Scenario 1, the projected increase in the number of dairy cows and the fall in the number of suckler cows, returns the ratio of dairy cows to beef cows to a level last observed in the mid 1990's.

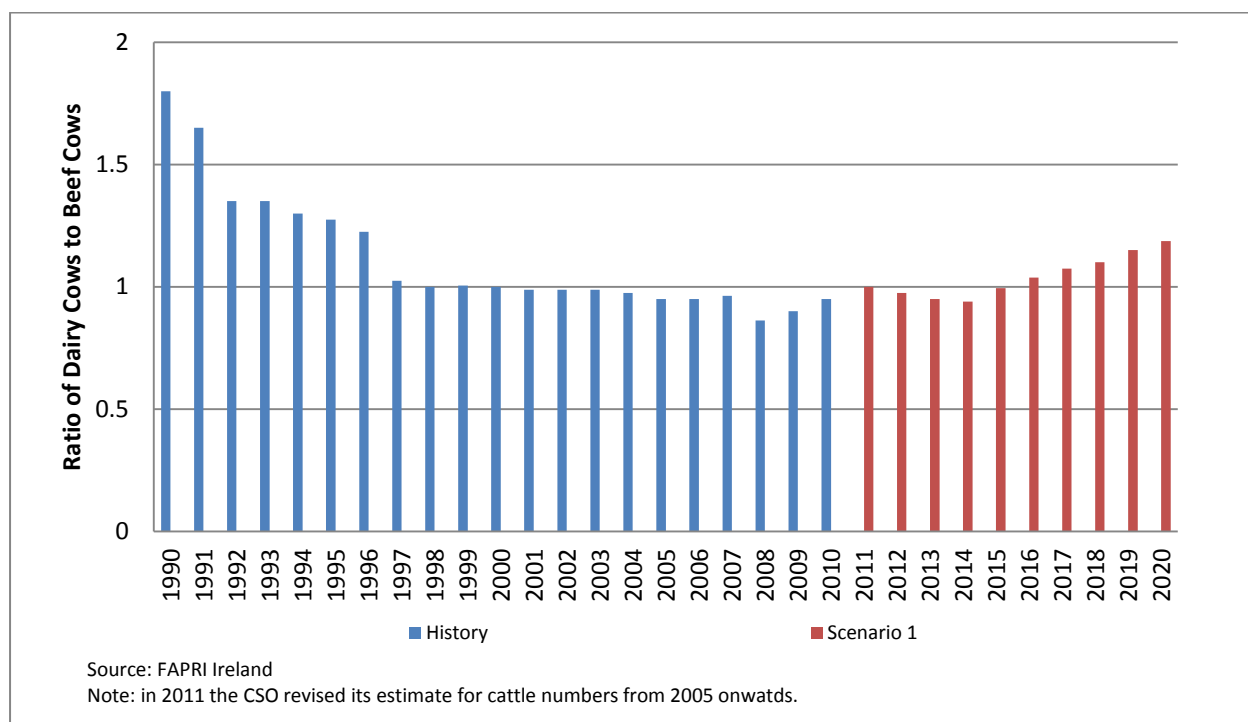


Figure 2-9: Ratio of dairy cows to beef cows in the Irish cattle herd – historical and Scenario 1 projections.

2.4.2 Cereal Sector

Under Scenario 1, total Irish cereal area contracts by 15 % between 2007-2009 and 2020 (Donnellan and Hanrahan 2012). The base period (2007-2009), which was characterised by large cereal areas harvested, explains some of the projected decline though the flat grain prices over the projection period when combined with improving milk prices lead to a decline in area sown with cereals. Yields per hectare are projected to improve over the base period to 2020. However, the expected growth in yields is insufficient to offset the decline in area harvested, and Irish production of cereals under Scenario 1 is projected to decline. The decline in production of barley exceeds the decline in the production of wheat, as the area share of barley contracts and wheat area share expands under Scenario 1.

2.4.3 Agricultural Sector Output, Costs and Income under Scenario 1

Under Scenario 1, Irish agricultural sector output value is projected to increase by 19 % relative to the average level in the base period by 2020. This increase in output value is based on an increase in the value of milk output in particular, and a more modest increase in the value of output from the other main sub-sectors of Irish agriculture. The historical agricultural sector income in Ireland and Scenario 1 projections to 2020 are illustrated in Figure 2-10. Agricultural income is projected to be just over €2,530 million in 2020. This represents a 16 % increase in agricultural sector income over the average of 2007 to 2009.

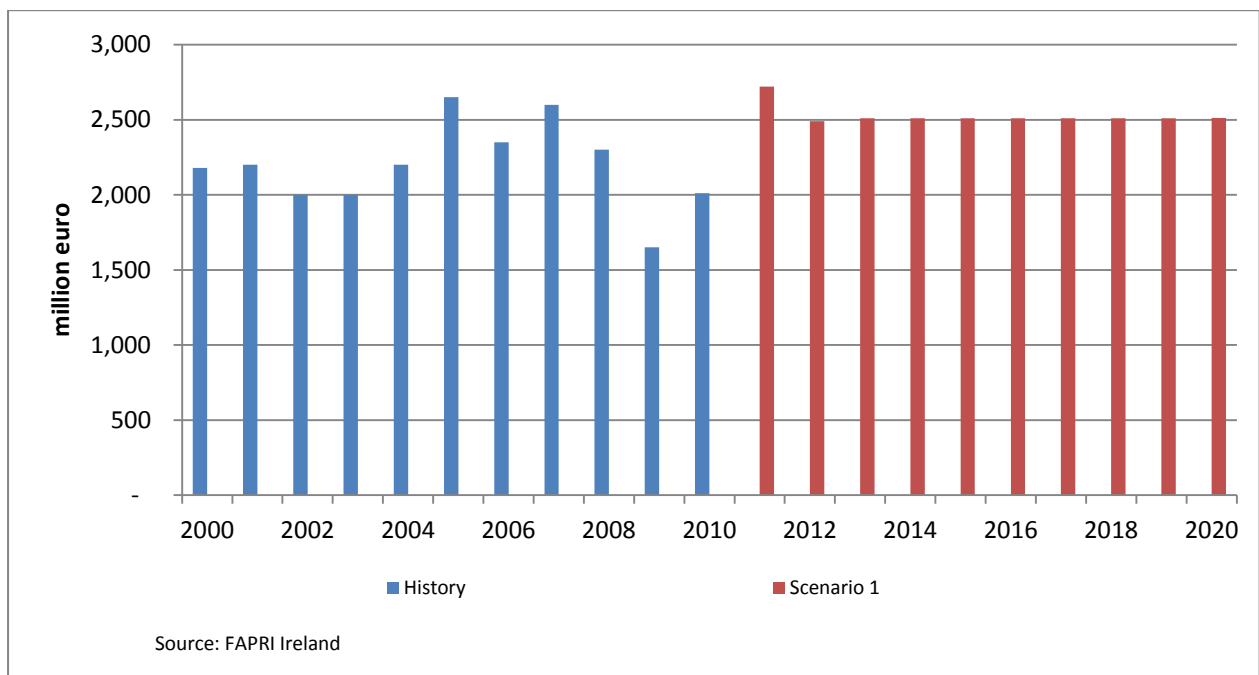


Figure 2-10: Irish agricultural sector income – historical values and Scenario 1 projections.

2.4.4 Greenhouse gas emissions from Irish Agriculture

The activity projections for various sectors of Irish agriculture, including dairy, beef, sheep and pig inventories under Scenario 1 were used by Donnellan and Hanrahan (2012) to calculate the level of greenhouse gas emissions for each year to 2020. These projected greenhouse gas emissions, along with historical emissions since 1990 (Figure 2-11) indicate that over the projection period, aggregate agriculture greenhouse gas emissions exhibit a decline relative to the 2005 level of 2 % by 2020.

However, the relatively flat projections path for the aggregate level of emissions from 2012 forward masks notable changes in terms of the contribution of individual agricultural sub-sectors to total greenhouse gas emissions from the Irish agricultural sector. The contribution of the dairy sector increases as a result of the strong growth of milk production and the associated increases in dairy cow numbers and dairy cow yields as well as the increases in fertiliser applications that are required to increase the intensity of grassland dairy production.

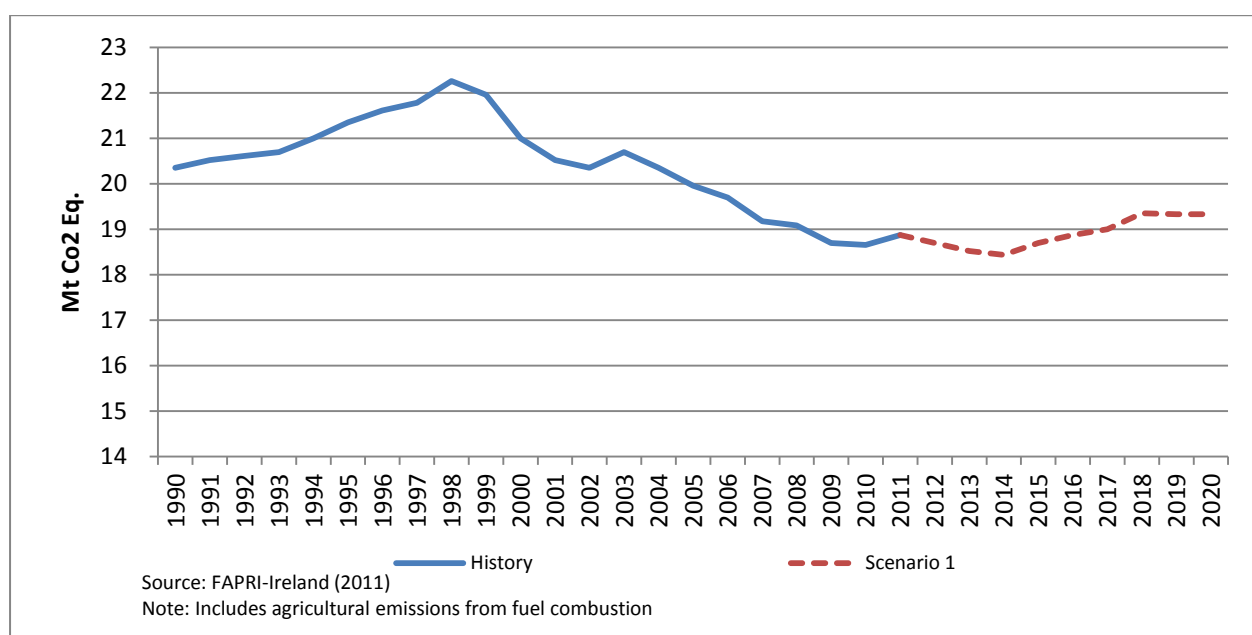


Figure 2-11: Historical and projected Scenario 1 GHG emissions from Irish agriculture.

Over the Scenario 1 projection period, the expansion in milk output of 38%, which is projected to arise following the elimination of the milk quota in 2015, generates an increase in greenhouse gas emissions. These increased emissions are associated with projected increases in dairy cow numbers and dairy cow productivity. However, the projected increase in dairy emissions is offset by the projected contraction in the size of the suckler cow herd. Emissions from sheep are also projected to decline relative to the baseline period as inventories of sheep decline under Scenario 1. The net effect of projected developments under the no-policy change scenario (Scenario 1) is to leave agricultural greenhouse gas emissions in 2020, at just under 19.4 mt CO₂ eq (Donnellan and Hanrahan (2012)).

2.4.5 Environment – Qualitative Effect

Some qualitative environmental effects of changes in the Agri-Food industry up to 2020 in absence of Food Harvest 2020 are given in Table 2-3.

Table 2-3: Qualitative environmental effect by 2020 in a non-FH2020 scenario.

	Change by 2020 in non FH2020 Scenario*	Comment
Biodiversity	Slight-Moderate Negative	Slightly negative impact on both biodiversity and flora/fauna due to continued potential for on-going impacts on sensitive habitats and species, particularly those which are water dependent ²²
Flora/Fauna	Slight-Moderate Negative	
Surface Water	Slightly Negative	Slightly negative impact on both surface water and ground water due to increased use of organic and inorganic fertiliser
Ground Water	Slightly Negative	
Soil	Imperceptible	The relatively good status of Irish soils will be maintained
Air Quality	Imperceptible	Relatively little overall change as increases in some enterprises are offset by decreases in other enterprises.
Landscape	Imperceptible	Little change in land use practices or land abandonment
Climatic Factors	Slightly Negative	Very little change in greenhouse gas in 2020 relative to base period (Figure 2.11)
*Pre Mitigation		

2.4.6 Summary

Under the no policy change scenario (Scenario 1) Irish agricultural sector income is projected by 2020 to be 16 % higher than during base period 2007-2009. This growth in sector income is due largely to increased Irish dairy sector output following the abolition of milk quota in 2015. The main changes in income for other livestock enterprises are mainly due to changes in prices rather than to significant changes in overall livestock numbers. Suckler cow numbers are expected to decline as dairy cow numbers increase. Changes to the key environmental indicators are imperceptible to slightly negative mainly due to enterprise substitution. Detailed statistics in relation to the expected changes in a no policy change scenario are given in the Appendix II.

2.5 Notes and References

- 12 http://www.teagasc.ie/publications/2012/1186/1186_Marginal_Abatement_Cost_Curve_for_Irish_Agriculture.pdf
- 13 http://www.epa.ie/pubs/advice/ea/guidelines/EPA_Guidelines_EIS_2002.pdf
- 14 http://www.epa.ie/pubs/advice/ea/guidelines/EPA_advice_on_EIS_2003.pdf
- 15 <http://www.nra.ie/RepositoryforPublicationsInfo/file,16634,en.pdf>
- 16 http://www.cieem.net/data/files/Resource_Library/Technical_Guidance_Series/EcIA_Guidelines/TGSEcIA-EcIA_Guidelines-Terrestrial_Freshwater_Coastal.pdf
- 17 http://www.epa.ie/pubs/advice/ea/EPA_development_methodology_SEA_synthesis_report.pdf
- 18 Sensitivity or a sensitive aspect of the environment refers to the key indicators being considered; i.e. sites, habitats, species or targets / thresholds (e.g. water quality targets such as those specified for salmonids or freshwater pearl mussel).
- 19 <http://www.nra.ie/Environment/EnvironmentalPlanningGuidelines/EnvironmentalImpactAssessmentofNationalRoadSchemes-DraftGuidelines/>
- 20 <http://www.epa.ie/pubs/reports/air/airemissions/>
- 21 <http://tnet.teagasc.ie/fapri/downloads/pubs2003/luxag/paper3141003a.pdf>
- 22 Based on EPA, 2012 & preliminary NPWS Article 17 reporting.



Biodiversity and Flora & Fauna

Section 3:

Biodiversity
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3 Biodiversity and Flora & Fauna

3.1 Baseline

3.1.1 Introduction

The Irish landscape and culture is one that incorporates agriculture at its core, and it is not surprising that many elements of our biodiversity have developed in tandem. Ireland, like much of Europe has a rural landscapes and associated biodiversity which is currently challenged in certain areas by the intensification of farming, and in other areas by the marginalisation and abandonment of traditional land uses due to underlying economic forces and changes in social expectations. Within a global context Ireland supports a very small diversity of habitats and species, however, they are of value nationally and internationally, with an estimated 10,000 plus species (NBDC, 2010) and 117 habitats (Fossitt, 2000) identified to date. Conspicuous groups with which most people, including farmers and land managers, are familiar – mammals, higher plants,

birds and amphibians - account for a very small proportion of known species (NBDC, 2010). Agriculture has a key role to play in the maintenance of favourable conditions for many habitats and species, and increasingly as part of a multifunctional service which provides not only traditional products, but also delivers ecosystem services such as clean water, good air quality and soil biota, to name a few.

3.1.1.1 Food Harvest 2020 and Key Biodiversity and Flora & Fauna Commitments

The timeframe over which Food Harvest 2020 will be rolled out brings Ireland through a number of key interacting plans and policies which will shape and direct the national, regional and site-specific level response to Food Harvest 2020. A comprehensive list of plans is attached in Appendix III, and the most important targets for biodiversity, flora & fauna and for water dependent habitats and species are summarised in Table 3-1.

Table 3-1: Summary of key interacting Plans, Policies and Legislation over the lifespan of FH2020 with regard to Biodiversity, Flora & Fauna and water-dependent habitats and species.

Plan / Policy	Key Targets and Timeframes
Water Framework Directive	Various targets for maintenance and restoration of waters to high and good status
Relevant European and national legislation	Specifically compliance and enforcement of the EIA and SEA Directives, Habitats and Birds Directives including Appropriate Assessment
National Biodiversity Action Plan (2011-2016)	Biodiversity loss and degradation of ecosystems are reduced by 2016 and progress is made towards substantial recovery by 2020
EPA 2020 Vision	Limiting and adapting to climate change Clean air Protected water resources Protected soil and biodiversity Sustainable use of resources Integration and enforcement
Convention on Biological Diversity – Strategic Plan for Biodiversity 2011-2020	Aichi Biodiversity Targets which set out principles to safeguard biodiversity and the benefits it provides to mankind
EU Biodiversity Strategy to 2020	Sets out six main targets in line with Aichi Targets to protect and enhance biodiversity by 2020
CAP reform	Substantive information on changes to agri-environment schemes and other measures under CAP reform which impact on biodiversity / flora & fauna is not yet available. The final CAP is expected in 2014. However, payments are likely to be linked to greening measures.

Food Harvest 2020 does not sit separately to these plans, and will mould itself towards ensuring the desired and predicted increases in agricultural production and output meet Ireland's commitments to environmental protection.

3.1.1.2 Baseline - Costs and Benefits

The baseline for this study is the average for the periods 2007 to 2009 with the significance of impacts being measures from that base period to 2020. At the base period certain habitats or water bodies may already have been degraded either through: land use changes; removal of habitat; or point source water pollution events. The measurement of the impact at national level could clearly mask the effects of individual or local actions which could have a significant impact at local level. Such impacts are to be avoided through strict adherence to legislation and codes of practice.

The benefits of maintaining the broadest possible biodiversity to human health and wellbeing have been well rehearsed. According to recent EU Commission studies (The Economic Benefits of the Natura 2000 Network Synthesis Report)²³, the benefits that flow from Natura 2000 at an EU level are estimated to be in the order of €200 to €300

billion per annum. These preliminary results show that the economic benefits derived from the Natura 2000 Network compares very favourably to the costs associated with managing and protecting this important resource. In addition there are significant economic costs in terms of penalties for non-implementation of, for example, the Nature Directives.

3.1.1.3 EPA State of the Environment Report

It is useful to have an overview of the current status of the environment as a whole, before considering biodiversity and flora & fauna separately. The *EPA State of the Environment Report 2012* provides an update on environmental conditions since publication of the previous report in 2008. The reports examines key themes which influence environmental condition, including Nature and Biodiversity, Greenhouse Gases and Climate Change, Water and Land and Soil, which are also considered by this Food Harvest 2020 assessment report. As in 2008, the 2012 report finds that Ireland's environment is in general good condition²⁴ but challenges remain towards reaching true sustainability.

Table 3-2 summarises the main challenges identified to maintaining Ireland's environment.

Table 3-2: Summary of the main challenges identified to maintaining Ireland's environment (extracted from EPA State of the Environment Reports in 2008 and 2012.

Main Challenges 2008	Main Challenges 2012
Limiting and Adapting to Climate Change Mitigating the causes and effects of climate change; Adapting to climate change impacts; Improving our understanding of climate change.	Building a Resource Efficient Low-carbon Economy Meeting targets on greenhouse gas emissions is a major task; Domestic mitigation action for greenhouse gas emissions is imperative; Future development to be based on highly efficient processes and improved resource efficiency.
Mainstreaming Environmental Considerations Incorporating environmental considerations into policies and plans; Ensuring environmentally responsible businesses; Changing behaviours.	Putting the Environment at the Centre of Our Decision Making Environmental policies need to be at the centre of policy and decision making at national, regional and local levels; Government, public bodies, business and industry and the public must share the responsibility of achieving development and growth that is sustainable.
Reversing Environmental Degradation Preventing eutrophication and other water pollution; Protecting natural habitats and species populations; Remediation of contaminated land.	Valuing and Protecting our Natural Environment Meeting WFD requirements and protecting water resources is a key challenge; Maintaining clean air and healthy soil requires attention; Protect biodiversity and nature from further loss and damage.
Complying with Environmental Legislation and Agreements Building a culture of environmental compliance;	Implementing Environmental Legislation Ireland faces challenges in meeting obligations on water quality, air

Main Challenges 2008	Main Challenges 2012
Enforcement of legislation at national and local level; Meeting EU and other international obligations	quality, greenhouse gas emissions, for example; Legislation must be implemented in a timely and appropriate manner; Effective enforcement of environmental legislation at national and local levels.

Between the 2008 and 2012 reports, key advances for water quality and biodiversity and nature have included the publication of the River Basin Management Plans and success in virtually eliminating water of bad status; Ireland's second National Biodiversity Action Plan (2011-2016), progress in the designation of Natura 2000 sites and the commitment to halt biodiversity loss by 2020 under the Convention on Biological Diversity. However, the 2012 report notes that further effort is required in a number of areas, particularly effective implementation of the WFD²⁵ and achieving the various water quality targets of this Directive; integration of biodiversity into national and local level plans and policies to promote conservation of biodiversity and flora and fauna; increased progress in the Natura 2000 designation process; and an overall reduction in unsustainable pressures on the natural environment.

Challenges in other sectors relate to reducing greenhouse gas emissions; improving knowledge on soils and land to inform sustainable practices; measures to deal with contaminated land; and meeting air quality standards for PM_{2.5} concentrations by 2020.

The EPA 2012 report concludes that *"based on the bad conservation status of many important habitats and some species, considerable efforts and resources will be required to improve their status, both within and outside protected areas. Climate change may also exert additional pressure on a number of species and habitats"*. It also notes poor public knowledge of biodiversity and the need *"to inform the public and policy makers on the state and trends in biodiversity, pressures on biodiversity and the effectiveness of key policy measures"*.

3.1.2 Regulatory and Legislative setting

Commitments to reaching the targets of Food Harvest 2020 provide for four main scenarios, the

implementation of which may result in neutral, adverse or positive impacts on biodiversity and the wider environment. The scenarios require current and proposed agricultural enterprises to be set within the context of European and national biodiversity legislation, Ireland's commitments to international Conventions and increasingly within expectations of sustainable management of natural resources, as most recently set out in the draft Framework for Sustainable Development.

An extensive background of legislation, policies, statutory bodies and non-governmental organisations is outside of the scope of this report. Detailed information is available from a variety of sources²⁶. This section does, however, give an overview of regulatory bodies, national and European policies and legislation which are relevant to biodiversity. Specific linkages between agriculture and biodiversity are also identified.

3.1.2.1 Regulatory Bodies-Biodiversity/Flora & Fauna

The key government bodies with statutory responsibility for regulating impacts on biodiversity, and flora and fauna to a lesser extent, are the National Parks and Wildlife Service (NPWS) and to a lesser extent, the Environmental Protection Agency (EPA) and Inland Fisheries Ireland. These organisations are prescribed bodies under the Planning and Development Acts and must be consulted by Planning Authorities in relation to proposed developments which could result in adverse impacts on the environment. Each state body has very different roles in protecting biodiversity, each of which is described in Table 3-3. Together these institutions preserve Ireland's biodiversity assets through policies driven by European and national legislation.

Table 3-3: State bodies responsible for the preservation of Ireland’s biodiversity and flora & fauna assets.

Regulatory Body	Roles & Responsibilities
National Parks and Wildlife Service	<p>NPWS is part of the Department of Arts, Heritage and the Gaeltacht. Its primary responsibilities are to: -</p> <p>Secure the conservation of a representative range of ecosystems and maintain and enhance populations of flora and fauna in Ireland through Natura 2000 sites;</p> <p>Implement the EU Habitats and Birds Directives;</p> <p>Designate and advise on the protection of Natural Heritage Areas (NHA) having particular regard to the need to consult with interested parties;</p> <p>Make arrangements for the implementation of National and EU legislation and policies and for the ratification and implementation of the range of international Conventions and Agreements relating to the natural heritage;</p> <p>Manage, maintain and develop State-owned National Parks and Nature Reserves;</p> <p>Scientific research.</p>
Environmental Protection Agency	<p>EPA is an independent public body, sponsored by the Department of the Environment, Community and Local Government plays an important role in protection of biodiversity and flora & fauna.</p> <p>The EPA has a statutory role to protect the environment in Ireland, and specifically it is responsible for regulating and policing activities that may result in pollution. As such, the EPA plays a role in regulating potential impacts on both biodiversity and flora and fauna. The key roles can be sub-divided into a number of sectors:-</p> <p>Licensing – waste facilities, intensive agriculture, Genetically Modified Organisms – to ensure that their operations do not endanger human health or harm the environment;</p> <p>Monitoring, analysing and reporting on the state of the environment;</p> <p>National environmental enforcement - conducting audits and inspections of EPA licenced facilities, prosecutions, and liaison/advise to Local Authorities;</p> <p>Strategic Environmental Assessment – assessing the impact of plans and programmes on the Irish environment;</p> <p>Statutory role to co-ordinate environmental research in Ireland. This is achieved through the STRIVE programme²⁷;</p> <p>Proactive waste management;</p> <p>Environmental planning, education and guidance.</p>
Inland Fisheries Ireland	<p>IFI operates under the aegis of the Department of Communications, Energy and Natural Resources.</p> <p>IFI is the state agency responsible for the protection, management and conservation of Ireland’s inland fisheries and sea angling resources, set to twelve mile limit off the coast. It has a statutory role to undertake the following roles:-</p> <p>Environmental protection of the aquatic environment;</p> <p>Enforce the Water Pollution Acts 1977 & 1990;</p> <p>Enforcement of a range of fisheries legislation, including Fisheries Consolidation Act 1959 & amendments;</p> <p>Monitoring fish populations in connection with the Water Framework Directive;</p> <p>Prosecutions in the case of adverse impacts on water quality and fish stocks;</p> <p>Promote, support, facilitate and advise the DCE&NR on conservation, management, marketing development and improvement of the inland fisheries resource.</p> <p>IFI is proactive in trying to minimise agricultural pollution into aquatic receptors and carries out farm inspections each year as part of this remit.</p>

3.1.2.2 Regulatory Setting of Biodiversity and Flora & Fauna Conservation

The role of the regulatory bodies discussed above is to implement biodiversity legislation in Ireland which has its origins in both national laws and European Directives. It is outside of the remit of this study to provide an exhaustive summary of

legislation and agriculture, but the key instruments outlined in

Table 1-1 in the Section 1 - Introduction (Legislation Matrix) are discussed further here.

3.1.2.3 European legislation – Summary

Since the ratification of the Birds Directive in 1979, a range of European legislation has been developed to legislate potential for development

and plans/projects to impact on biodiversity, including the following Directives of relevance to biodiversity and agriculture: -

- EU Birds Directive 79/409/EEC – transposed as The European Communities (Wildlife Act 1976) (Amendment) Regulations, 1985 (S.I. No. 397 of 1985);
- EU Birds Directive 79/409/EEC – transposed as The European Communities (Wildlife Act 1976) Amendment Regulations 1986 (S.I. No. 254 of 1986);
- EU Birds Directive 79/409/EEC – transposed as The European Communities (Conservation of Wild Birds) Regulations, 1985 (S.I. No. 291 of 1985);
- EU Birds Directive 79/409/EEC (amendments) – transposed as The European Communities (Conservation of Wild Birds) (Amendment) Regulations 1986, 1994, 1994 (No. 2) and 1995 (S.I. No. 48 of 1986, S.I. No. 59 of 1994, S.I. No. 349 of 1994 and S.I. No. 31 of 1995). Under these regulations, special areas of importance to birds are designated as Special Protection Areas (SPAs) (see Council Directive 79/409/EEC (Wild Birds));
- EU Water Framework Directive 2000/60/EC - transposed into Irish law through the European Communities (Water Policy) Regulations, 2003 (S.I. No. 722), as amended; and the Surface Waters Regulations (S.I. No. 272 of 2009); and from which the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations (S.I. No. 296 of 2009) has evolved;
- Freshwater Fish Directive (78/659/EEC – transposed as The European Communities (Quality of Salmonid Waters) Regulations, 1988. S.I. No. 293 of 1988;
- EU Habitats Directive (92/43/EEC) – transposed as The European Communities (Natural Habitats) Regulations, 1997, S.I. No. 94 of 1997. [Habitats Directive];
- EU Nitrates Directive (78/659/EEC) - transposed as European Communities (Good Agricultural Practice for the

Protection of Waters) Regulations 201, S.I. No. 610 of 2010;

- EU EIA Directive (85/337/EEC) and amending Directive (97/11/EC) – transposed as The European Communities (Environmental Impact Assessment) (Amendment) Regulations S.I. No. 93 of 1999 and various amendments through national planning legislation;
- EU Environmental Liability Directive (2004/35/EC) – transposed as The European Communities (Environmental Liability) Regulations S.I. 547 of 2008.
- EU Directives are transposed into Irish law by statutory instruments (S.I.). Ireland has been brought before the EU Court of Justice on a number of occasions for failure to transpose the full requirements of EU Directives into Irish law and has been required to make a number of amendments to existing legislation in order to redress shortcomings, which have now been addressed through Planning and Development (Amendment) Act 2010; the European Communities (Birds and Natural Habitats) Regulations 2011; and European Communities (Environmental Impact Assessment) (Agriculture) Regulations 2011, referred to as the EIA (Agriculture) Regulations).

The key instruments in terms of biodiversity and flora and fauna, namely the Habitats Directive and Birds Directive are discussed below.

3.1.2.3.1 European legislation: Habitat and Birds Directives

The two principle EU Directives which relate to biodiversity are the EU Habitats Directive (92/43/EEC; as amended) and the EU Birds Directive (79/409/EEC). Together, these Directives form the basis for the identification and designation of Natura 2000 sites.

The Birds Directive is the first piece of European nature conservation legislation, which came into effect in 1979, and it aims to provide far-reaching protection for all of Europe's wild birds. Annex I to the Directive identifies 194 species and sub-species as particularly threatened and in need of special conservation measures. EU Member States

are under a general obligation to preserve, maintain or re-establish sufficient habitats and ecosystems to support the conservation of all bird species covered by the Directive. In addition, for certain species that are of conservation concern, of European importance or are important migratory species, Member States must designate protected sites known as Special Protection Areas (SPAs).

The Habitats Directive is an important Directive, and its purpose is to promote and ensure biodiversity *"through the conservation of habitats and of wild fauna and flora in the European Territory"*. The Directive is made up of two major sections, the first dealing with habitat conservation, and the second with species protection. With regard to the first, the Directive requires all Member States to contribute to the establishment of a European network (Natura 2000) of Special Areas of Conservation (SACs) which will enable the natural habitat and species' habitats (listed in the Annex I and II) to be maintained, or if appropriate, restored to a favourable conservation status. Annex I lists natural habitat types of Community interest (200 in all) while Annex II lists animals and plant species whose conservation would require the designation of SACs. Also contained in the annexes are the criteria for selection of SACs (Annex III).

Annex IV of the Habitats Directive lists animal and plant species of Community interest in need of strict protection. The species listed and their eggs must be protected from deliberate killing or disturbance, and destruction or deterioration of their breeding or resting sites is prohibited. Annex IV also lists plants which require strict protection and whose picking, collecting, uprooting or destruction is prohibited. Annex V lists animal and plant species of Community interest whose exploitation may be subject to management measures and, finally, Annex VI lists methods of capture and killing and modes of transport which are prohibited.

In Ireland, the Natura 2000 network of European sites comprises Special Areas of Conservation (SACs, including candidate SACs), and Special Protection Areas (SPAs, including proposed SPAs). SACs are selected for the conservation of Annex I

habitats (including priority types which are in danger of disappearance) and Annex II species (other than birds). SPAs are selected for the conservation of Annex I birds and other regularly occurring migratory birds and their habitats. The annexed habitats and species for which each site is selected correspond to the qualifying interests of the sites; from these the conservation objectives of the site are derived. Member States must take the necessary measures to ensure conservation of their SACs and the Natura 2000 network is periodically reviewed. Under the legislation, the integrity and conservation status of Natura 2000 sites, and the system of protection for the listed species, must not be negatively impacted by development or other activity, except where there are *"imperative reasons of overriding public interest, including those of a social and economic nature"*.

Details on Appropriate Assessment, a requirement under Article 6(3) of the Habitats Directive is located at Section 3.3.

3.1.2.4 National Legislation

The primary piece of national biodiversity legislation is the Wildlife Act 1976 and its amendments. The Act provides for the protection of wild fauna and flora and for the conservation of areas of special importance to wildlife. The Act also specifies the type of firearms which may be used to shoot deer; fixes the hunting seasons for deer and hare and lays down the manner in which they can be hunted; fixes the open seasons for certain wild birds, controls the possession of and trade in protected fauna; and controls the export of wild birds and wild animals and their products. The (Wildlife (Amendment) Act, 2000) has strengthened the restriction on hedgerow cutting during the bird nesting season, and strengthened the protection afforded to Natural Heritage Areas. This amendment also stipulated that Ireland will promote biodiversity, which underpins the commitments to the Convention on Biological Diversity.

The modern basis for Ireland's planning code is the Planning and Development Act, 2000. This Act has consolidated previous planning legislation from 1963 to 1999 into a single piece of legislation. The Act is designed to introduce a sustainable

development ethos into the Irish planning system and to increase the efficiency of the system. It also ensures a strategic approach to land use planning in Ireland. The 2000 Act remains the basis for the Irish planning code, setting out the detail of regional planning guidelines, strategic development zones, regional planning guidance, consolidating EIA requirements and the basic framework for the development management and consent system. The 2000 Act provides the statutory basis for protecting Ireland's natural and architectural heritage. There have been a number of changes to the legislation since it was enacted in 2000 which have consolidated and integrated statutory instruments implementing EU Directives and other amendments, most notably:

- Planning and Development (Strategic Infrastructure) Act, 2006;
- Planning and Development (Amendment), Act 2010.

Some aspects of agricultural development, such as uses of land for agricultural purposes, are exempted from planning. In other cases, such as farmyard development there are certain thresholds applied. Where otherwise exempted developments may interact with other factors such as Natura 2000 sites, other legislation may be relevant such as Appropriate Assessment under the Habitats Regulations. In response to a judgment of the European Court of Justice against Ireland (C-66/06), DAFM has produced a guidance book on the new EIA Agriculture Regulations and this should be consulted for more detail.

3.1.2.5 Other Drivers of Biodiversity and Flora & Fauna Conservation

The draft Framework for Sustainable Development (2011), subsequently finalised by DECLG as Our Sustainable Future²⁸, contains a set of seven principles which aim to focus Ireland's efforts towards 'green growth'. The Respect for Ecological Integrity and Biodiversity theme which states that *"the abundance of wildlife and extent of habitats should be maintained, improved and restored where necessary, through sustainable management"*. In the context of agri-food industry and Food Harvest 2020, the framework recognises that gains have been achieved, but that challenges remain and states that *'further improvements in*

environmental sustainability are key elements of the delivery of the Food Harvest 2020 targets'.

The current National Development Plan (NDP) 2007-2013²⁹ identifies key target areas of investment for development in the areas of health, social and community facilities, roads, education, rural development and industry. The NDP states that *"Ireland's biodiversity, which includes our ecosystems, provides environmental services vital to human welfare. These environmental services include the provision of food, fresh water, clean air and nutrient recycling, all of which are essential to human life. Furthermore, our natural environment is valuable and worthy of protection in its own right"*. The new NDP 2014-2020 is under preparation.

The strategies and funding as set out in the NDP 2007-2013 feed into the National Spatial Strategy 2002-2020 and promote balanced regional development, sustainable economic development and greater social inclusion. In terms of biodiversity, both these documents recognise the value of placing biodiversity at the forefront of governmental decision making.

The Rural Development Programme 2002-2013 (RDP) is consistent with EU strategic guidelines for rural development and also derives from the National Strategy Plan (NSP) for rural development (2007-2013). The RDP has four principal axes, two of which have relevance to biodiversity. The first Axis of the RDP is aimed at improving the competitiveness of farm enterprises through support for restructuring, development and innovation and has included support for awareness raising on Natura 2000 and agri-environmental schemes. The mid-term review³⁰ found that over 70% of farmers indicated the training scheme had made a very significant contribution to improving sustainable land management, including sustainable management of natural resources. Axis 2, Improving the Environment and the Countryside, is directed at preserving and, where possible, enhancing the environment, biodiversity and the amenity value of the countryside. Expenditure under this axis accounts for 80% of the total RDP spend, and provides for compensatory payments to farmers who farm in Less Favoured Areas, Natura 2000

payments in respect of designated Special Areas of Conservation/Special Protection Areas and agri-environment payments under the Rural Environmental Protection Scheme (REPS). However, as a result of the on-going economic crisis, the measures envisaged in the RDP have necessarily been impacted upon, reducing funding available for identified measures. The mid-term review indicates that Axis 2 has provided measurable advances in its targets, although the picture is complex for biodiversity gains.

In addition to the legislative and policy context, reaching scenarios in Food Harvest 2020 has to be undertaken in parallel with other commitments - at farm level in compliance with various agri-environment schemes and nationally to plans and policies and internationally to commitments to treaties and conventions. A summary of other relevant drivers of Ireland's commitment to biodiversity and flora and fauna is outlined in Table 3-4.

Table 3-4: Other relevant drivers of Ireland's commitments to biodiversity and flora & fauna.

Driver	Comments
Agri-environment schemes	<p>REPS (1-4) and the new AEOS scheme set targets for the maintenance and establishment of biodiversity features within the farm as compulsory or optional measures. These are key drivers for agri-food industry to practically meet biodiversity targets on the ground and for raising awareness in the agricultural community of biodiversity issues. Priority for entry to the AEOS scheme has been given to farms with land within a Natura 2000 designation, or non Natura designated commonage, small farms and those located in disadvantaged areas. A Sustainable Management Plan must be drawn up for farms.</p> <p>Under the CAP, farmers must also follow 18 Statutory Management Requirements (SMRs), commonly referred to as Cross-Compliance (see Section 1 for further details). Virtually all farmers are in receipt of the Single Farm Payment and are therefore required to maintain land in Good Agricultural and Environmental Condition and this specifically addresses biodiversity protection.</p> <p>This requirement is implemented through farm inspections related to the environment, public health, animal health, plant health, land maintenance and animal welfare</p> <p>Research has shown mixed results for biodiversity from these agri-environment schemes³¹.</p>
EC Biodiversity Strategy to 2020	<p>The EU Commission published, in 2011, a communication on the new EU Biodiversity Strategy, entitled "Our life insurance, our natural capital: an EU biodiversity strategy to 2020". This Communication identifies 6 Target Areas for action: -</p> <ul style="list-style-type: none"> Full implementation of the nature directives; Maintain and restore ecosystems and their services; Increase the contribution of agriculture and forestry to maintaining and enhancing biodiversity; Ensure the sustainable use of fisheries resources; Combat invasive alien species; Help avert global biodiversity loss.
Convention ³² on Biological Diversity	<p>The CBD requires Ireland and other contracting parties to take measures for the conservation and sustainable use of biological diversity under three main headings:</p> <ul style="list-style-type: none"> The conservation of biological diversity; The sustainable use of its components; and The fair and equitable sharing of benefits arising from the use of genetic resources. <p>One of the key measures of the CBD was that biodiversity losses would be halted by 2010. This target was not met by any EU state including Ireland. New objectives were agreed in Nagoya, Japan, in October 2010 around a strategic plan for the period 2011 to 2020 "Living in Harmony with Nature". The plan sets 20 headline targets for 2020, organised under five Strategic Goals which identify the different aspects of approaching the issue of biodiversity loss. These are: -</p> <ul style="list-style-type: none"> Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society; Reduce the direct pressures on biodiversity and promote sustainable use; Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity; Enhance the benefits to all from biodiversity and ecosystem services; Enhance implementation through participatory planning, knowledge management and capacity building
Other International Conventions	<p>Ireland is a signatory to a number of other International Conventions which impact on biodiversity actions, including the UN Convention on Trade in Endangered Species (CITES), the Bonn Convention (on conservation of migratory species of wild animals), the Bern Convention (on the conservation of European wildlife and habitats, which led to the development of the EU Habitats Directive; and the RAMSAR Convention (on wetlands).</p>

The Actions for Biodiversity 2011-2016 Ireland's 2nd National Biodiversity Plan is the main vehicle by which Ireland aims to meet its commitments under the CBD and the EC Biodiversity Strategy³³. Whilst the focus of the first NBP was the achievement of a defined set of targets, the second NBP has set an ecosystem approach³⁴. The actions and indicators/outcomes within the NBP applicable to agriculture are spread over 102 actions embodied in seven Strategic Objectives

that reflect those in the EC Biodiversity Strategy. The overarching target of the NBP is: -

"That biodiversity loss and degradation of ecosystems are reduced by 2016 and progress is made towards substantial recovery by 2020."

In terms of agriculture, the NBP specifies actions to be undertaken under Target 5 by the government, semi-state bodies and NGO's, farming community to deliver seven identified indicators and outcomes, as set out in Table 3-5.

Table 3-5: National Biodiversity Action Plan-specified actions to deliver identified indicators and outcomes.

OBJECTIVE 4: To conserve and restore biodiversity and ecosystem services in the wider countryside Target 5: Optimise use of opportunities under agricultural, rural development and forest policy to benefit biodiversity.	
ACTIONS 5.1 Develop measures in future rural development programmes for the protection and enhancement of ecosystem services and biodiversity 5.2 Further develop criteria to identify High Nature Value farmland and develop measures to address threats 5.3 Ensure effective implementation of cross-compliance, statutory management requirements and forest service guidelines/requirements to ensure conservation of biodiversity 5.4 Conduct a systematic evaluation process for any agri-environmental schemes delivered, involving a robust ecological monitoring programme 5.5 Review the control of overgrazing and under grazing 5.6 Continue the Burren Farming for Conservation Programme 5.7 Continue to promote the Native Woodland Scheme which features establishment and conservation elements aimed at encouraging the development and conservation of native woodlands 5.8 Consider and develop guidance on alternative forestry management options which aim to deliver additional biodiversity benefits 5.9 Strengthen measures to ensure conservation, and availability for use, of genetic diversity of crop varieties, livestock breeds and races, and of commercial tree species and promote in particular their <i>in situ</i> conservation.	INDICATORS AND OUTCOMES <ul style="list-style-type: none"> • Number and effectiveness of measures developed in the National Rural Development Programme for the protection and enhancement of ecosystem services and biodiversity • Effective system in place for identification and maintenance of High Nature Value Farmland • Compliance rate for Statutory Management Requirements, and Forestry Guidelines/ requirements • Extent of recovery demonstrated from over-grazing and under-grazing • Area covered by the Native Woodland Scheme • Number of crop varieties, livestock breeds and races, and of commercial tree species conserved • Number and area of NPWS farm plan schemes

3.1.3 Current Status

With respect to biodiversity (designated habitats and species) the review of Current Status included (but was not limited to) the following: -

Habitats listed on Annex I of the EU Habitats Directive (92/43/EEC; and as amended);

Species listed on Annex II of the EU Habitats Directive;

Species listed on Annex I of the EU Birds Directive (2009/147/EC); and

Species protected by other legal instruments such as the Wildlife Act, 1977 (as amended 2000); the Flora Protection Order, 1999 (S.I. No. 94/1999) and assorted Red Data Books, etc.

Detailed information and research on the above, and the interaction of the key agricultural sectors analysed here, are included in the Ecology Supporting Information and Literature Review document, attached as an annex to this report.

The information which follows summarises this research, however, the Ecology Supporting Document should be considered an integral part of the assessment process, providing scientific basis for the assessments and conclusions reached in this report.

The baseline period with respect to Food Harvest 2020 is 2007-2009. This sits well with NPWS's review of the current status of biodiversity (i.e. annexed habitats and species) in *The Status of EU Protected Habitats and Species in Ireland* published by National Parks and Wildlife Service in 2008. In this publication the conservation status of habitats and species of European conservation value is assessed; the geographical distribution of these habitats and species is mapped and this in turn allows us to consider both National and Regional level impacts (see below).

It becomes more difficult to assess current status when we come to considering flora & fauna (non-designated habitats and species) in the wider

landscape due to the absence of data in many cases. However, consideration has been given to indicator groups such as lowland farm birds (Lynas *et al.*, 2007); use of data sets such as those hosted by the National Biodiversity Data Centre etc.; as well as considering habitats and species associated with agriculture and thus which might be at greater risk; and considering potential HNV farmland.

The above fits within the Road Map 2018³⁵ produced by Teagasc which sets as targets the need to:

- Restore Annex I habitats and species to favourable conservation status by 2015;
- Recovery of farmland bird populations;
- Identification of HNV farmland.

The review of these elements within the generated Food Harvest 2020 scenarios will assist in highlighting opportunities for combined monitoring, set out in Section 11.

Information on Natura 2000 network is located in Section 3.3.

3.1.3.1 Data Gaps

Ireland's first ever inventory of the Country's biodiversity in a report entitled *State of Knowledge, Ireland's Biodiversity 2010* was recently published by the National Biodiversity Data Centre. The inventory set out to produce an overview of the state of knowledge on Ireland's biodiversity, to detail the current knowledge on what species and habitats occur in Ireland, their distribution, range and population. What is clear from the report is that the biodiversity Ireland supports has yet to be fully documented, with a small number of well-studied groups such as habitats, vascular plants, birds, mammals and some invertebrates (butterflies, beetles, molluscs), and others such as soil flora and fauna, where there are evident gaps in knowledge. The current status of habitats and species in Ireland below takes into account existing information and highlights relevant gaps in knowledge and understanding.

3.1.3.2 Nationally Protected Sites

Natural Heritage Areas (NHA) are nationally important sites designated for nature conservation, or for geology and geomorphology, designated under various legislation³⁶. These sites hold habitats or flora & fauna which are considered to be rare or threatened or geological/geomorphological features of national significance. A total of 148 NHAs have been designated; 75 raised bogs located mainly in the midlands and 73 blanket bogs located mainly in the west. The NPWS indicates that 630 proposed NHAs have been published on a non-statutory basis since 1995, but that these have not yet been statutorily protected or designated and hence are subject to limited protection. NHAs may support species and habitats of European importance and therefore, part or all of an NHA may be designated as a Natura 2000 site. The Geological Society of Ireland has identified a finalised list of potential geological NHAs, but at present none have been statutorily designated.

Ireland currently has six National Parks, which in total approximate 60,000 hectares in area. They are Wicklow Mountains National Park, The Burren National Park, Killarney National Park, Glenveagh National Park, Ballycroy National Park and Connemara National Park. The conservation status of National Parks and Nature Reserves is not regularly monitored, but Annex habitats and species within their boundaries may be monitored.

Statutory Nature Reserves are established by "Establishment Order" under Section 15 of the Wildlife Act 1976 and there are 80 in existence covering 20,000 hectares and most are in State ownership. Upon making a Nature Reserves establishment order, the Minister for Arts, Heritage and the Gaeltacht is obliged to manage the reserve in accordance with general principles for the protection of the natural environment. There are approximately 68 Wildfowl Sanctuaries in Ireland, which are areas that have been excluded from the 'Open Season Order', i.e. shooting of game birds is not permitted.

3.1.3.3 Nationally Protected Flora and Fauna

In addition to European protected species, which are addressed in Section 3.3, a small number of other species protected under the Wildlife Act 1976 and (as Amended 2000), are largely dependent on agricultural land, or associated habitats. The hedgehog, pygmy shrew, badger, smooth newt and common lizard are considered as being of Least Concern, i.e. their populations and ranges are stable and there is a favourable conservation outlook. Status for brown hare populations is not available.

There are approximately 1000 native plant species in Ireland. A total of 56 vascular plant species and 14 moss species, four liverwort species, one lichen species and two stonewort species are listed on the Flora Protection Order 1999. The vascular plants listed were afforded protection largely based on an assessment of their status in the now very out of date Irish Red Data Book: Vascular Plants (Curtis and McGough, 1988)³⁷. National Parks and Wildlife Service have consulted on a new list (Kingston, 2006), but this has not been formally adopted. A list of plants protected under the Flora Protection Order and which are associated with agriculture is included in the Annex document (Ecology Supporting Information and Literature Review). Information on distribution for those species is derived from a number of sources in addition to the Irish Red Data Book, including

Preston *et al.*, 2002³⁸, Kingston, 2012³⁹, and Parnell and Curtis, 2012⁴⁰. Causes of decline of many of the species is complex and still not thoroughly understood, nonetheless intensification of agriculture pre-Food Harvest 2020 baseline assessment period is a contributing factor to the decline of some species. Arable weeds in particular have declined due to changes in farm practices and increased mechanisation and once widespread species are now rare or extinct in Ireland.

3.1.3.4 Birds not listed on Birds Directive

BirdWatch Ireland, in conjunction with RSPB Northern Ireland published 'Birds of Conservation Concern 200-2013' (2008)⁴¹, assigned regularly occurring Irish bird species to three categories - red list (i.e. of most conservation concern); the amber list (generally of unfavourable conservation status); and green list (of least concern) as a measure of their conservation status.

This list was updated by Lynas *et al.*, (2007) and during this recent assessment of the population status of 199 species of the most commonly occurring bird species, 25 were placed on the Red list, 85 on Amber List and 89 on the Green list. The assessment of conservation status is not related to the legal protection afforded to individual species, but rather an assessment of current breeding and population status.

Table 3-6: Criteria for conservation assessment of bird species, after Lynas *et al* (2007).

Red List Species	Amber List Species	Green List Species
Species meet one or more of the following criteria: - Their breeding population or range has declined by more than 50% in the last 25 years; Their breeding population has undergone a significant decline since 1900; They are of global conservation concern.	Species meet one or more of the following criteria: - Their breeding population has declined by 25%-50% in the last 25 years; They are rare or sporadically breeding species; Their breeding or wintering population is internationally important and/or localised; They have an unfavourable conservation status in Europe.	Populations which are not considered threatened

A full list of Red and Amber listed species is located in the Ecology Supporting Information and Literature Review Annex to this Report. Species of particular concern, which are not listed on Annex I of the Birds Directive, include small populations of

breeding waders such as dunlin (now largely restricted as a breeding bird to the machair habitats of northwest Mayo)⁴² and curlew,

breeding common scoter⁴³, grey partridge, red grouse, twite and yellowhammer.

Data from the latest Countryside Bird Survey covered the period 1998 to 2007 (Coombes *et al.*, 2009)⁴⁴. The survey recorded a total of 145 species. Trend analyses were undertaken on 57 species. Some 25 species showed increasing trends over the 10-year period since 1998, nine species declined, while the remaining 23 species remained relatively stable. The significant trends reported are largely consistent with trends reported in the UK and over Europe. Using the Countryside Bird survey⁴⁵ as an indication of future bird prospects, it is apparent that farmland birds continue to show overall declines and it appears that provisional information from the Bird Atlas 2007-2011 confirms this trend⁴⁶. These downwards trends are likely to continue for some farmland bird populations. However, the Countryside Bird Survey also found increased populations recorded for 17 common species such as blackcap and redpoll. Climate change may also impact on bird populations in Ireland, resulting in some migratory species no longer needing to reach Ireland, changes in food availability for seabirds, rising water temperatures impacting on wetland species and changes in weather patterns favouring new migrants^{47,48}. The new Bird Atlas is likely to be published shortly and updated information for species will be available.

3.1.3.5 Red Data Lists

A number of Red Data Books⁴⁹ have been published by the National Parks and Wildlife Service. The Red Lists do not provide a favourable conservation outlook for the species or groups assessed, but they do provide a summary of conservation declines over the individual recording intervals chosen for assessment. A small number of species are protected under the Habitats Directive and are therefore subject to the Favourable Conservation Status (FSC) assessment compiled by NPWS on a six-year basis. Others are listed on the Flora Protection Order 1999 and Wildlife Act 1976 as amended by the Wildlife (Amendment) Act, 2000, which confers legal protection, but no legal requirement to assess conservation status. The presence of a species on the Red List has been assessed using the

International Union for the Conservation of Nature (IUCN) criteria and the main threats are identified.

The Red Lists indicate that more than a third of Irish bee species and non-marine mollusc species are threatened. In addition, over 15% of Irish water beetle species, butterfly species and dragonflies and damselflies are threatened.

Bryophytes: Ireland's humid, oceanic climate has encouraged the development of an extensive and species diverse bryophyte flora, which represents ca. 48% of the European total. In compiling the Red Data List, IUCN threat categories were assessed for a total of 239 liverwort species and 596 moss species (Lockhart *et al.*, 2012)⁵⁰. The majority of species, 59% are of Least Concern, with smaller percentages in the following categories: 12% Near Threatened, 11% Vulnerable, 5% Endangered; 3% Critically Endangered and 1% Near Extinction. A further 4% were Data Deficient. Bryophytes can be temporary colonists and this may explain the threatened status of some of the rarer species in Ireland; other species are assessed as threatened due to loss of habitat and changes in management practices leading to changes in habitat condition. For instance, the loss of a moss species, *Dicranum undulatum* from midland raised bogs is attributed to industrialised peat cutting, whilst other threats identified include overstocking with sheep on the upland corries in the west (affecting the internationally important Northern Atlantic hepatic mat community); inappropriate grazing regimes generally (e.g. affecting coastal and upland species); canalisation, channel maintenance and local pollution (riverine species); development pressures; water abstraction and drainage; natural limitations due to restricted habitat suitability; and stochastic events which have yet to be researched sufficiently including climate change.

Mayflies⁵¹: Ireland has a depauperate mayfly diversity compared to Europe as a result of our isolation from the European mainland, and at present consists of 33 identified species. Mayflies inhabit watercourses and as such as important as indicators of water quality and are used as one of the biotic for the EPA Q-value system. IUCN threat categories for the 33 mayfly species showed that

73% are Least Concern; 6% Near Threatened, 9% Vulnerable; 6% Endangered, 3% Critically Endangered and 3% Data Deficient. The main threats identified in the Red List are the long-term history of eutrophication in Irish rivers; changes in water temperatures; increased sediment loads; and acidification of watercourses.

*Damselflies and Dragonflies*⁵²: Similarly to mayflies, Ireland supports a very small assemblage of dragonflies and damselflies, with 24 resident species assessed for Red Data List. Of these species, 80% are of Least Concern, 4% Near Threatened and 8% Vulnerable and Endangered, respectively. The precise threats to these species are not yet well researched, but the main threats identified in the Red List are the long-term history of eutrophication in Irish rivers; changes in water temperatures and other factors which may result from climate change; and habitat loss.

*Amphibians, Reptiles and Freshwater Fish*⁵³: Of the 15 freshwater fish assessed, one, the European eel, was found to be Critically Endangered and five others (pollan, Arctic char, twaite shad, Killarney shad and Atlantic salmon) Vulnerable whilst the sea lamprey was classified as Near Threatened. Several of these fish are listed on Annex II of the Habitats Directive. The causes of declines in fish populations are both extensive and local in origin; decreased water quality is a consistent threat identified, mainly as a result of diffuse pollution; as are unsympathetic river management; water abstraction; barriers to migration; invasive species; overfishing and potentially climate change in the future. Ireland supports only three amphibian species and two terrestrial reptile species, and the rarest of these, the natterjack toad which is classified as Endangered, is confined to a small area of coastland in Kerry. Habitat loss is identified as the key threat to natterjack toads.

*Butterflies*⁵⁴: Butterflies can be used as an indicator of ecosystem functioning as they are sensitive to changes in their niches, which can be quantified quickly given the short life cycles of butterflies. In Ireland, 33 species are recorded as regularly occurring and of these, 64% are Least Concern; 15% are Near Threatened; 9% are Vulnerable and Endangered respectively and one species, the mountain ringlet, is extinct. The

threats affecting butterflies relate to long-term population declines primarily as a result of range reduction from habitat loss and decline in existing habitat quality, including Annex habitats which can be associated with threatened butterfly species such as marsh fritillary, an Annex II species. Climate change is likely to impact both negatively and positively on the Irish butterfly assemblage, causing some threatened species to decline further whilst creating opportunities for northwards migration of generally more southern based species.

*Terrestrial Mammals*⁵⁵: A total of 26 mammals are considered Irish natives. One species, the grey wolf has been extinct since 1850. The black rat is classified as Vulnerable, whilst three species are Near Threatened; Leisler's bat, otter and red squirrel. Overall, the populations are generally in favourable conservation status although bat species as a group remain at risk as a group due to habitat losses. Other threats to mammals include unsympathetic habitat management, poor water quality, road kill and persecution, whilst future key threats include climate change and alien invasive species.

*Non-marine Molluscs*⁵⁶: The 150 native Irish non-marine molluscs are of international importance, with ten species having a significant proportion of their global population in Ireland and six species are legally protected under the Habitats Directive. Of the total natives, 61% are Least Concern; 4% Near Threatened; 17% Vulnerable; 9% Endangered 3% Critically Endangered and 5% Data Deficient. Two species were evaluated as being Regionally Extinct. Poor water quality, loss of habitat and changes in habitat management are the three key threats to non-marine molluscs, and these threats act on threatened species which may be already at the edge of their climatic ranges. Climate change is an unquantified threat, and there are increasing threats arising from alien invasive species.

*Water Beetles*⁵⁷: Water beetles require a range of good quality water habitats such as fens, rivers, bogs, etc., which have been in historic decline but the Red List recognises that some threat assessments for this group may reflect 'intensity of recording activity as a whole'. Of 244 taxa

assessed, 61% are of Least Concern, 10% are Near Threatened; 9% Vulnerable; 5% Endangered; and 3% Critically Endangered and Regionally Extinct respectively. The Threatened and Regionally Extinct species are generally associated with fen and peat and running water habitats, reflecting habitat loss and water quality issues, and species declines may be exacerbated by climate change in future.

*Irish Bees*⁵⁸: The number of native bees in Ireland stands at 102, and of this number only 36% are of Least Concern whilst 16% are Data Deficient; 12% are Near Threatened; 14% Vulnerable; 10% Endangered; 6% Critically Endangered; 3% Regionally Extinct and 3% Near Extinction. Overall threats are not identified in the report, but species specific threats include trampling of ground nesting bees, loss and decline of habitat, changes in habitat management and intrinsic factors such as small population bases and ranges. For some species no single identifiable factor can be held accountable for recorded declines.

*Vascular Plants*⁵⁹: The Red List for vascular plants is outdated (1988), but more recent surveys and assessments give an indication of the status and prospects of vascular plants- including the assessment of conservation status of Annex II plants (NPWS, 2008) and The New Atlas of the British and Irish Flora (Preston *et al.*, 2002) – see Annex document, Ecology Supporting Information and Literature Review. Key threats to vascular plants include habitat loss; land management change; eutrophication of wetland and terrestrial habitats and unknown factors⁶⁰. The European Red List of Vascular Plants⁶¹ indicates that population trends for plants assessed at European level⁶² shows that 38.4% have declining populations, 21.8% have stable trends, 36.7% have an unknown trend and small percentage (3.1%) have increasing populations. On a European wide basis, the key drivers for declines in vascular plant diversity are intensified livestock farming, recreational activities, tourism and urban development, wild plant collection, invasive alien species, natural system modification and pollution. Population trends for aquatic plants and crop wild relative⁶³ plants at a European level are for the most part unknown or difficult to quantify due to

complexities of reproduction and lack of quantitative data on populations.

3.1.3.6 Other Flora and Fauna

NPWS provides a checklist of protected and rare species in Ireland, many of which have not as yet been addressed by a Red List or other comprehensive survey or monitoring projects. Primary groups outside of the Natura 2000 network and Red List groups which can be considered are lichens, fungi, algae, endemic species and soil biodiversity.

Lichens and lichenicolous fungi: The recent *Lichen Ireland Project* has increased records of lichens and in the near future a Red List for lichens based on the project is likely. As of current estimates, Ireland supports 1,050 lichen taxa, 30% of the European total, which makes the lichen assemblage of international importance, and of that number 34 species are considered to be threatened in Europe (Anon, 2010). One lichen taxa, *Cladonia* subgenus *cladina* is listed in Annex V and is currently assessed as ‘poor’ condition. Air pollution in Ireland is low compared to Europe and this combined suitable climate and habitats such as woodland, parkland, pasture, calcareous grasslands, peatlands, rivers and streams, sand dunes, machair, limestone pavement and splash zones above the high tide mark on coasts (Anon 2010, *Lichen Ireland Project*⁶⁴).

Fungi: No species of fungi of the 3,500 approximate species present in Ireland currently receive legal protection and fungi are generally under-recorded in Ireland⁶⁵. O’Hanlon and Harrington (2011) believe that from preliminary evidence important habitats for mushroom forming fungi (*Agaricomycetes*) in Ireland include native woodland such as oak woodlands and birch woodland on raised bog margins, sand dunes, unimproved grassland and the Burren area. The majority of studies undertaken have tended to focus on grassland fungi, particularly waxcaps, as these are used as bio-indicators of habitat condition. Waxcaps populations and grassland fungi in general are thought to be in decline as a result of loss of semi-natural and unimproved grassland habitat and from nutrient changes

through addition of fertilisers⁶⁶. Loss of woodland habitat and air pollution may also be threats to general fungi conservation (Anon 2010).

Algae: The majority of Irish algae are coastal and marine and numbers of species can only be roughly estimated in the region of 524 species of marine macro-algae, 181 species of marine phytoplankton and 700 species plus of desmids. Causes of decline and threats have not been clearly identified but include excessive UV radiation resulting from atmospheric ozone depletion and water pollution (Anon 2010). Stoneworts are a group of submerged, aquatic algae which are found mainly in calcareous fresh water and in brackish lagoons and which prefer nutrient poor waters. Of the 25 Irish species listed in the Checklist of Protected and Rare Species in Ireland⁶⁷, 2 are Extinct; 3 are Rare; 5 are Vulnerable; 2 are Indeterminate. Threats to stoneworts are loss of habitat and eutrophication (Anon, 2010).

Endemic Species: Ireland has a very low level of endemism within its native flora and fauna and the status of supposed endemics is still being debated. According to McGarrigle and Champ (1999)⁶⁸ *‘the western Irish lakes represent a super-sensitive ecological category requiring particularly strict catchment controls in order to protect the diversity of native flora and fauna including unusual glacial relict species and the unique genetic strains of fish which are present’*. To date, morphological analysis appears to support the ‘unique’ forms of Coomasaharan char⁶⁹ in County Kerry, and other forms of char may also be distinctive particularly those in Lough Melvin, County Leitrim⁷⁰ as may the Killarney shad which is restricted to Lough Leane, County Kerry. Deteriorating water quality, introduction of non-native fish and habitat degradation are the main factors affecting these fish, and some populations of char have become locally extinct as a result of these threats, e.g. those in Lough Corrib. The Nore freshwater pearl mussel a hard-water form of the freshwater pearl mussel and is restricted to lime rich waters of the River Nore, where current threats are poor water quality and siltation. A small number of other invertebrates may be endemic⁷¹, but this remains to be firmly established. Ireland does not appear

to support true endemic vascular plant species, but two endemic subspecies are generally recognised, fringed rockcress and hart’s saxifrage (Curtis and McGeogh, 1988), as are microspecies of the dandelion and hawkweed families. Threats to these plants arise from habitat loss and changes in land management. Three bird species are considered endemic⁷²; the dipper, coal tit (though it is not recognised by all authorities) and Eurasian jay.

Soils: The European Soil Biodiversity Atlas (Jeffrey *et al.*, 2010)⁷³ and the results of the CreBeo project (Schmidt *et al.*, 2005)⁷⁴ give a preliminary indication of the status of soil biota in Ireland. Current information indicates the number of species present it is relatively poor by European standards, which fits with our general spread of biodiversity, as a result of geographic location and climate. The status of known elements of soil biota is poorly understood, but potentially areas of Limerick, Kerry, Cavan and Leitrim show a higher risk to loss of soil biodiversity than other parts of the Republic, whilst soils along the Western seaboard are judged at least risk (Jeffrey *et al.*, 2010).

3.1.3.7 High Nature Value Farmland

The concept of High Nature Value farmland (HNV) recognises the value of inherent value of semi-natural habitats within farmlands, particularly where existing at an extensive landscape scale. Three types of HNV farmland are distinguished (Andersen *et al.*, 2003)⁷⁵:

- Type 1: Farmland with a high proportion of semi-natural vegetation.
- Type 2: Farmland dominated by low intensity agriculture or a mosaic of semi-natural and cultivated land and small-scale features.
- Type 3: Farmland supporting rare species or a high proportion of European or World populations.

Small scale research has been carried out to date on HNV farmland in Ireland, focusing on optimising tools to identify location and types of HNV farmland and the farming practices which maintain those features. Although HNV farmland can

include Annex I habitats, much HNV farmland in Ireland exists outside of designated areas. Whilst the full extent of HNV farmland may not be precisely mapped, it can be closely correlated with low intensity farming such as low stocking density and in areas where natural environmental restrictions have led to less intensive farming practices. These areas exist primarily along the western seaboard and in uplands. Approximately 20-30% of the UAA can be considered as HNV farmland, whilst a further 20-30% may have HNV features, but is not extensive in nature (James Moran, Sligo IT, pers comm). The survival of HNV farming practices are related to maintaining a level of farming subsidy⁷⁶, combined with socio-economic factors, and therefore the future prospects of HNV farmland are unclear and difficult to predict in the short to medium term.

3.2 Environmental Assessment

3.2.1 Introduction

As Food Harvest 2020 is targeting increased productivity and outputs from an extensive farming system, it has potential to interact with the majority of habitats and species in Ireland to a greater or lesser degree. High level assessment therefore necessarily has to focus on key elements of biodiversity and flora and fauna to elucidate potential impacts. The assessment methodology is set out in Section 2.

3.2.2 Key Issues and Pressures

NPWS (2008) states that the key pressures on Ireland's habitats and species are direct habitat damage such as peat cutting, wetland drainage/reclamation and infrastructural development; overgrazing and under grazing; water pollution particularly from nutrients and silt; unsustainable exploitation such as over-fishing and peat extraction; invasive alien species; and recreational pressure.

In order to identify the key pressure points associated with Food Harvest 2020 each of the agricultural sectors which comprise Food Harvest 2020 has been considered. For each sector a review has been undertaken of published and grey literature on the relationship between agriculture

and biodiversity and flora and fauna; in addition to targeted consultation where specific questions arose and is appended as the aforementioned Annex document.

Agricultural pressures acting on biodiversity are complex and have changed over the last decades as a result of changes in land management practices and the tendency towards increased production. Key pressures on biodiversity can be negative, positive or neutral in impact, but generally exist in combination with other externalities. Most farmland in Ireland (ca. 90%) is utilised for livestock, with substantial, but falling, areas under tillage. Biodiversity is a crosscutting theme, and will be influenced by all factors examined for this study – namely climate change, water quality, soils and greenhouse gas emissions. Land use change, pollution and potentially climate change will be the major influencing factors on the Irish landscape over the coming years.

A summary of the key pressures on biodiversity from agriculture is presented below, highlighting both positive and negative impacts. The literature review presented in Annex I should be referred to for substantive background on the summary points listed below.

3.2.2.1 Key pressures common to all or most livestock sectors

Eutrophication from fertilisers and slurry can have a negative influence on both aquatic and terrestrial biodiversity. Eutrophication, from a variety of sources, including but not limited to agriculture, is indicated as a negative factor in the condition of many Natura 2000 sites, and consequently for associated species⁷⁷. The very rare freshwater pearl mussel has been severely affected by eutrophication of rivers. Eutrophication originates from many activities of which agriculture is one; therefore populations and diversity of aquatic and terrestrial invertebrates and plants are at continuing risk from eutrophication despite reductions in volume use and limitations placed on nutrient spreading since introduction of the Nitrates Directive.

Where spread at recommended rates, slurry has the potential to sustain soil organic matter and soil fertility, benefit earthworm and soil biota, which in

turn supports higher trophic organisms. It also reduces the requirement for input of artificial fertilisers.

Inappropriate **grazing** regimes by cattle and sheep, in which habitats are either under or over-grazed, is indicated as possibly the most significant factor in the poor conservation status of many Natura 2000 sites and consequently for dependent Annex I species³¹. Overgrazing by sheep has been a major issue in Irish uplands, leading to loss of habitat structure and function, but this has now been vastly improved since de-coupling and implementation of targeted management.

Appropriate grazing regimes encourage diverse swards, regenerate woodlands, and improve habitat suitability for less competitive plants and for a range of fauna, including invertebrates, small mammals and ground nesting birds. Cattle and sheep grazing, at appropriate stocking densities, is a very useful habitat management tool for grasslands, moorlands, coastal habitats amongst others.

Use of **pesticides, herbicides and veterinary medicines**, e.g. in sheep dip, ivermectins in cattle, have been shown to exert negative impacts on soil biota, terrestrial invertebrates (particularly beetles), aquatic habitats. These in turn have negative impacts on higher trophic species, e.g. birds and bats. Studies in Ireland have focused on impacts of ivermectins on dung beetles⁷⁸ and indicate that pesticides such as sheep dip may be among a number of causes for white-clawed crayfish declines⁷⁹.

3.2.2.2 Dairy

Negative Impacts

- The trend towards intensification over the past 50 years has led to direct loss of semi-natural habitats and reduced plant species diversity, particularly in parts of the east and south-east where dairying is concentrated;
- Intensification over a landscape scale results in fragmented habitats and reduced stepping stones for wildlife into the wider environment;
- Loss of hedgerows impacts negatively on breeding birds, dung beetles, butterflies, invertebrates and small mammals;
- Recommended sward improvements to facilitate increased productivity require planting of rye-grass mixtures which reduce species diversity of semi-improved grasslands;
- Regular silage cuts reduces potential for seed setting and excludes non-competitive plant species;
- Intensively managed systems have lower populations of farmland birds due to lack of nesting sites and reductions in seasonal food sources, e.g. seeds in winter and invertebrates in summer;
- Regular cutting reduces the ability of ground nesting birds to complete nesting cycles;
- Soil compaction and localised poaching of the ground, limiting vegetation regrowth, can result in areas where supplementary feeding is provided or where cattle congregate;
- Drainage of wetlands to improve and extend pasture causes loss of habitat for aquatic invertebrates and plants, amphibians and wading birds;
- Nutrients from urine and slurry can remain in soils and cause localised changes in botanical composition;
- Where pathways exist, excess nutrients from slurry and urine can reach sensitive ecological receptors, particularly wetlands and watercourses, resulting in eutrophication;
- Eutrophication has been indicated as a contributing factor to the poor status of Annex I habitats such as natural eutrophic lakes, turloughs and hard water lakes;
- Eutrophication can lead to reduction in size or integrity in populations of flora and fauna, been indicated as a factor in the poor conservation status of protected species such as white-water crayfish,

freshwater pearl mussel and the plant slender naiad.

Positive impacts

- Appropriate stocking densities can be instrumental in the maintenance of botanical diversity in semi-natural habitats;
- Breeding bird populations may be greater in less intensive dairy farms than on non-dairy farms;
- Some bird species such as swallow, starlings benefit from more intensive grassland management;
- Retained, less grazed, field margins are reservoirs for flowering plants, invertebrates and birds;
- Maintenance of field boundaries, including stone walls and hedgerows, is of benefit for flora and fauna, and act as wildlife corridors;
- Farmland ponds act as reservoirs for aquatic plants and fauna;
- Earthworm populations may benefit from intensive farmland management and as a result assist in retention of soil organic matter;
- Nutrients from urine and slurry can be beneficial to plant growth and soil fertility and to species diversity under appropriate stocking densities;
- Agri-environment schemes potentially have resulted in biodiversity gains (some contradictory results).

3.2.2.3 Beef

Suckler beef and other beef enterprises are combined for this assessment. Many of the same impacts apply to beef enterprises as to dairy, but with some differences due to the fact that these systems tend to be more extensive, and less intensive than dairying.

Negative impacts

- Intensification has led to widespread direct loss of semi-natural habitats and reduced plant species diversity;
- Intensification over a landscape scale results in fragmented habitats and reduced stepping stones for wildlife into the wider environment;
- Intensively managed grasslands have lower botanical diversity than those managed at lower stocking rates and with traditional methods;
- Loss of hedgerows impacts negatively on breeding birds, dung beetles, butterflies, invertebrates and small mammals;
- Nutrients from urine and slurry can remain in soils and cause localised changes in botanical composition;
- Where pathways exist, excess nutrients from slurry and urine can reach sensitive ecological receptors, particularly wetlands and watercourses, resulting in eutrophication;
- Eutrophication has been indicated as a contributing factor to the poor status of Annex I habitats such as natural eutrophic lakes, turloughs and hard water lakes;
- Eutrophication can lead to reduction in size or integrity in populations of protected species such as white-water crayfish, freshwater pearl mussel and the plant species slender naiad;
- Soil compaction and localised poaching of the ground, limiting vegetation regrowth, can result in areas where supplementary feeding is provided or where cattle congregate;
- Drainage of wetlands to improve and extend pasture causes loss of habitat for aquatic invertebrates and plants, amphibians and wading birds;
- Intensive grazing can lead to a decline in vegetation structure and plant diversity, in turn supporting lower diversity of birds, invertebrates, molluscs and pollinators;

- Reduction in numbers of full time farmers with time and expertise to devote to traditional management techniques, resulting in loss of habitats and species, e.g. traditional hay meadows and associated corncrake.

Positive impacts

- Low intensity suckler beef enterprises, particularly in the west and north, are essential in maintaining Natura 2000 sites, e.g. the important limestone grasslands of the Burren;
- Traditionally managed hay meadows are important in an EU context and support a diversity of plant and fauna species;
- Hay meadows can provide good quality nesting sites for birds;
- Cattle grazing can reduce potential spread of scrub, bracken and coarse grasses in grasslands and uplands;
- Maintenance of field boundaries, including stone walls and hedgerows, is of benefit for flora and fauna, and act as wildlife corridors;
- Farmland ponds act as reservoirs for aquatic plants and fauna;
- Higher plant species diversity in appropriately stocked land can support increased pollinator diversity;
- Farmland ponds act as reservoirs for aquatic plants and fauna;
- Earthworm populations may benefit from intensive grassland management;
- Nutrients from urine and slurry can be beneficial to plant growth and soil fertility and to species diversity under appropriate stocking densities;
- Extensive beef systems can be associated with High Nature Value farmland;
- Agri-environment schemes potentially have resulted in biodiversity gains (some contradictory results).

3.2.2.4 Sheep

Negative impacts

- Sheep dip has been shown to result in adverse impacts on invertebrates, including the legally protected white-clawed crayfish;
- Where sheep dip enters the water system, impacts on biodiversity can be noted up to 10km from the diffuse source of pollution;
- Overgrazing of uplands has negatively impacted on moorland, heathland and bog habitats, causing degradation and changes in vegetation composition;
- Overgrazing is partly responsible for on-going declines in upland bird populations through reduction in availability of nesting sites and food sources, e.g. invertebrates;
- Overgrazing can result in loss of habitat for Irish hare and other small mammals;
- High intensity grazing reduces tree regeneration in upland woodlands;
- Reduction in high levels of sheep grazing are only likely to have beneficial effects where deer numbers are low;
- Under grazing of uplands is likely to become an issue in the future and may result in reduced vegetation and plant diversity, with land developing into scrub and upland woodland;
- Supplementary feeding can result in trampling and poaching, reducing heather stand viability;
- Semi-natural vegetation may be especially sensitive to intensive grazing over the winter period, especially heather which is shown to be weakened by continuous grazing;

- High stocking pressure in preferential areas, which may increase adverse impacts on upland habitats;
- Reseeding of semi-improved pasture with cultivated grass mixtures will result in reduced botanical diversity;
- Extended grazing season in low to moderately stocked farms could result in adverse impacts on botanical composition and seed setting in semi-natural grasslands, and on heather viability but needs to be researched more thoroughly;
- Uncontrolled burning of heather can result in adverse impacts on a range of plants and fauna such as common lizard, invertebrates, small mammals etc.;
- Potential impacts from recent requirements to double stocking rates (to 2 sheep/ha) and to retain stock for six months instead of three months for sheep farms in Disadvantaged Areas.

Positive impacts

- Where high levels of grazing are replaced by lower grazing, vegetation structure and diversity recovers, providing increased opportunities for birds, invertebrates and small mammals;
- Appropriate level of sheep grazing is a vital management tool for Annex I habitats such as blanket bog, heathland and acid grassland;
- Maintenance of field boundaries, including stone walls and hedgerows, is of benefit for flora and fauna, and act as wildlife corridors;
- Sheep, in general, cause less adverse impacts on soil structure than cattle and so are more suitable for grazing wet habitats;
- Extensive sheep farming systems can be associated with High Nature Value farmland;

- Burning of heather, when carried out appropriately, can be a valuable tool for regeneration and management of moorland habitat and provide new growth for sheep grazing.

3.2.2.5 Pigs and Poultry

Negative impacts

- As pigs/poultry are predominantly housed, impacts are primarily related to spreading of slurry, which can cause eutrophication and reduce soil biota activity;
- Potential for adverse impacts on lichens/mosses and habitats from ammonia emissions close to pig/poultry housing units (preliminary data);
- Where free-ranging, pigs can denude vegetation resulting in soil erosion and compaction and losses of soil biota, invertebrates, birds and other fauna.

Positive impacts

- Free-ranging poultry and pigs may have a minor positive role to play in assisting woodland regeneration, but this is not significant in an Irish context;
- Pigs may be beneficial in controlling bracken over small areas and for targeted time periods.

3.2.2.6 Tillage and Field Crops

Negative impacts

- Eutrophication from fertilisers has been found to have detrimental impacts on soil biota and on invertebrates, with consequential impacts on other higher organisms;
- Adverse impacts from use of pesticides and herbicides on a range of invertebrates have been recorded, including carabid beetles, sawfly and this will have consequential impacts on higher level organisms such as birds and bats;

- Many pesticides are directly toxic to beneficial insects, birds, mammals, amphibians, or fish. Insecticides, rodenticides, fungicides (for seed treatment);
- Pesticides have indirect effects by reducing the abundance of weeds and insects which are important food sources for many species;
- New harvesting technologies have reduced the potential for autumn/winter food sources, causing reductions in bird populations.

Positive impacts

- Arable margins have potential to support arable weeds;
- Spring sown arable fields support a range of invertebrate and bird species.

3.2.3 Assessment

The assessment of potential impacts on sensitive biodiversity and flora and fauna from the Scenario A Food Harvest 2020 for the dairy and beef sectors has been undertaken on the basis of the above identified changes and assumptions and in line with the methodology and limitations outlined in Section 2. The key ecological receptors which may be affected by the proposed changes under Food Harvest 2020, as identified in Section 2, are identified with a level of significance based on the EPA's 'Guidelines on the Information to be Contained in Environmental Impact Statements' (2002).

3.2.3.1 National Level Changes

At an overall national level, the following key changes are predicted under Scenario A (Integrated Scenario) for the sectors being addressed in this report:-

- Increased pasture requirement – Scenario A predicts a national increase in pasture demand by 2020, i.e. an increase of 82,573 hectares (4.01% increase on the 2007/2009 baseline of 2,029,133ha). The increased demand from pasture will be supplied by land use changes and will be

mainly taken up by increased dairying activity.

- Decreased hay, silage and rough grazing requirement of 39,249ha from the 2007/2009 baseline of 1,717,367ha.
- A decrease in area under tillage/field crops (wheat, barley, oats, potato, turnip and maize) of 28,700ha from the baseline of 324,800ha, a percentage decrease of 9%.
- A very small national 1.14% increase in organic nitrogen⁸⁰ fertiliser of 4,727 tonnes from the baseline figure of 414,052 tonnes. Most of this increase is associated with the dairy sector.
- A very small 1.51% national increase of approximately 930 tonnes of organic phosphate fertiliser production from the baseline figure of 61,337 tonnes, again associated with the dairy sector.
- A national 14% increase in inorganic nitrogen fertiliser use of 43,738 tonnes from the baseline figure of 299,084 tonnes, primarily attributable to predicted changes in the dairy sector.
- An unquantified increase in pesticide and herbicide application.
- A 14% national increase in concentrates of 617,514 tonnes from a baseline of 4,368,095 tonnes. Expansion in the dairy and pig industries account for nearly 50% respectively of the predicted increases.

3.2.3.2 Sectoral Changes

3.2.3.2.1 Beef and Dairy

For the purposes of Scenario A assessment, beef and dairy sectors have been combined. Both sectors are primarily pasture based, and exert similar influences on landscape and biodiversity features.

Scenario A predicts a 24% increase in dairy cows and a 43% increase in dairy heifers which is partly offset by decreases in 0 to over 2 year old cattle (-14%), in other cows (-13%) and in other heifers (-15%). Therefore, it is assumed that any potential

impacts arising from the predicted decreases in beef numbers will be offset by the increase in dairying activity. The additional beef calves from the dairy herd produced as a result of the increase in dairy cows numbers is likely to achieve part of the targeted increase in output in the beef sector. It is also assumed that the projected decrease in the other cattle numbers and projected decreases in within the beef group will occur in the regions where dairy farming is prevalent, as existing dairy farms replace their beef enterprises with increase in dairying as a result of removal of milk quotas.

The main identified changes to agricultural practices in the dairy and beef sectors, due to the implementation of the Food Harvest 2020 through Scenario A, which have the potential to impact on biodiversity and flora/fauna are outlined below.

- A minute increase in grazing pasture – Scenario A predicts a national increase in pasture demand by 2020 for the dairy sector. For the dairy sector a predicted increase of 211,774ha (30% increase on the 2007/2009 baseline of 695,774ha). This is largely offset by the predicted reduction in land required for beef pasture, a reduction of 200,629ha from the baseline of 2,428,765ha. This leaves an imperceptible net increase in grazing land required of 11,145ha (or 0.36% of the combined baseline totals for beef and dairy). The 20% expansion proposed for beef when considered with changes in the scale of other enterprises will not have any significant effect on the current forage area in the Country.
- A slight decrease in areas of land under hay - (-4.8%), silage (-2.1%) and rough grazing (-1.4%) for all ruminants from the 2007-2009 baseline.
- A small overall increase in organic fertiliser application - For the dairy industry, a national increase of 26,739 tonnes or 26% of organic nitrogen from the baseline dairy figure of 101,034 tonnes, and a national increase of approximately 4,029 tonnes or 26% of organic phosphate (dairy cows plus dairy heifers) from the baseline figure of 15,312

tonnes is predicted. This is offset to a large degree by predicted decreases in the organic fertilisers for beef cattle – reduction of 8% for organic nitrogen (minus 22,333 tonnes from a baseline of 269,179 tonnes) and 8% for organic phosphorus (minus 3,159 tonnes from a baseline of 38,784 tonnes).

- An overall increase in inorganic fertiliser application – Scenario A predicts a national increase in the application of inorganic fertiliser (nitrogen) by 2020. An increase in nitrogen of 40,660 tonnes (approximately 39%) from the baseline figure of 102,975 tonnes is predicted for the dairy sector. An increase of 5,809 tonnes from a baseline of 172,442 tonnes is predicted for the beef sector.
- A small overall increase in concentrates – Scenario A predicts an increase in concentrates for dairy sector of 27% (356,673 tonnes) from the baseline. A slight decrease for concentrates for beef sector is predicted of 8% (162,619). This leaves a net increase in concentrates of 194,054 tonnes, or 5.9% of the total combined for dairy and beef.

3.2.3.2.2 Sheep

An overall reduction in sheep numbers is predicted over the assessment period of 286,011 sheep, or a percentage reduction of 5.54% from the baseline. Based on these projections, the existing agricultural practices associated with sheep farming will slightly reduce in intensity over the assessment period. However, it is likely that lowland farms released from sheep grazing may be used to facilitate some of the projected increases in the beef sector for female cattle > 2years. Negligible changes are predicted for inorganic and organic fertilisers or concentrates, and thus are not considered further. Teagasc Road Map for Sheep indicates that compliance with the Nitrates Directive is not an issue for most sheep farms.

The main identified changes to agricultural practices in the sheep sector, due to the implementation of the Food Harvest 2020 through

Scenario A, which have the potential to impact on biodiversity and flora/fauna are outlined below.

- Decrease in sheep numbers - Sheep numbers are predicted to decline from 5,162,650 total sheep in 2007/2009 to 4,876,643 in 2020. Of the total, there is a reduction of 14,424 (5% of total estimated decrease) upland sheep, with the remainder of the reduction, 271,587 (95%) occurring in lowland sheep.
- Decrease in grazing area - Scenario A predicts a small reduction in the overall area required for sheep grazing of 4% (minus 14,124ha from the baseline of 322,000ha). The potential beneficial impacts of the slight reduction in upland sheep numbers is a reduced risk of overgrazing and soil erosion. However, as the reduction in upland sheep numbers is marginal, a noticeable change in the current status of many upland habitats currently under sheep grazing is unlikely from Food Harvest 2020 Scenario A.
- Change in land use from sheep to cattle pasture - The land released from sheep grazing, particularly lowland pasture, is likely to convert to beef cattle pasture, or in some cases to dairy. Cattle are heavier than sheep and exert different influences on vegetation structure and composition through their grazing preferences and higher rate of manure output/livestock unit.

Ruminants

Analysis of overall impacts below combines the beef, dairy and sheep sectors into a ruminants sector to facilitate an integrated approach to impact assessment.

3.2.3.2.3 Pigs and Poultry

Scenario A projection for pigs to 2020 is 39% increase in overall pig numbers and the 2020 projection for poultry numbers is a 20% increase. Whilst layer and broiler numbers are projected to increase, turkey numbers are projected to decrease by 37% by 2020.

The key issue with pigs and poultry is the disposal of waste manure containing organic nitrogen and phosphorus. The environmental impact of the projected increase can be substantially offset improvements in feed formulation. The main changes to practices due to the implementation of the Food Harvest 2020 Scenario A for the pigs and poultry sector group are outlined below.

- Small increase in organic nitrogen and phosphorous fertiliser - Food Harvest 2020 Scenario A predicts an increase of production of 2% each for both organic nitrogen and phosphorous from the pig system baseline, even though there is a high increase in pig numbers by 2020. It is envisaged that concentrates will be chosen which will reduce excreted nitrogen and phosphorus outputs.
- Location of new pig/poultry enterprises - New pig/poultry enterprises may be considered within areas of current low density of production or closer to tillage crops required for feed, to reduce costs involved in transporting manure.
- Increase in concentrates - Food Harvest 2020 Scenario A predicts an increase of 46% (rise of 423,153 tonnes from the baseline of 925,000 tonnes) for the pig system. It is envisaged that part of the production targets for pigs will be met by more efficient use of concentrates. To meet increased demand for concentrates, it is anticipated that there will be an increase in tillage, or that new locations for piggeries will be located close to feed producing areas.
- Unquantified increase in waste manure - The application of pig and poultry manure to land is standard practice, particularly to field and tillage crops. Increases in pig, and to a lesser extent, poultry numbers is likely to result in increased availability of manure for land-spreading.

3.2.3.2.4 Tillage and Field Crops

Scenario A predicts a decrease in area under tillage/field crops (wheat, barley, oats, potato, turnip and maize) of 28,700ha from the baseline of 324,800ha, a percentage decrease of 9%.

For wheat to 2020 there is a predicted 8.97% increase in land area on the 2007/2009 baseline. There is a decrease in the 2020 land area projections for both barley and oats -17% and -16% respectively. There is a decrease in the 2020 land area projection for potatoes also, down 29%. In contrast, there is a 22% increase in the 2020 projection for land area for turnips.

The main changes to practices due to the implementation of the Scenario A are outlined below.

- Decrease in overall land area under tillage
- An overall reduction of 28,700ha from a baseline of 324,800ha under tillage/field crops is predicted.
- Possible decrease in organic and inorganic fertilisers - no data is available for consideration of potential decreases in organic/organic fertilisers associated with the reduction in tillage/crops area.
- Possible decrease in pesticide and herbicide application – no data is available for consideration of potential decreases in pesticide and herbicide applications associated with the reduction in tillage/crops area.
- Possible co-location of pig/poultry enterprises - to reduce transport costs of waste manure, new pig and poultry enterprises may be located in key tillage areas of the south and south-east which are sensitive to further increases in aquatic nutrient loads.

3.2.3.3 Assessment of Impacts on Biodiversity and Flora and Fauna

Impacts have been assessed according to the methodology outlined in Section 2. Biodiversity in this instance are protected habitats and species which exist outside Natura 2000 designations. Detailed impact assessment tables are located in Appendix IV for dairy/beef, Appendix V for sheep, summarised below as ruminants; Appendix VI for pig and poultry and Appendix VII for tillage and field crops.

Table 3-7: Summary of potential National level impacts on biodiversity and flora & fauna outside the Natura 2000 network from the implementation of Scenario A (Integrated Scenario).

Scenario A (Integrated Scenario)	Potential Impact Indicators
Ruminants	Direct loss of habitat Change in grazing regime Impact on water quality Changes in nutrient loading of terrestrial land Change in land management
Pigs & Poultry	Direct loss of habitat Impact on water quality Changes in nutrient loading of terrestrial land
Tillage & Field Crops	Direct loss of habitat Impact on water quality Changes in land management
Cumulative Impacts	Interaction of impacts from all Food Harvest 2020 sectors and cross-cutting of impacts from other disciplines

3.2.3.3.1 Ruminants

3.2.3.3.1.1 Direct loss of habitat

Conversion of semi-natural habitats to more intensive pastoral regimes undoubtedly results in biodiversity losses, the magnitude of which depends on the quality and extent of habitat being replaced. A negligible net increase (0.36%) in permanent pasture will be required to meet Scenario A Food Harvest 2020 dairy targets. This may be met through conversion of existing semi-natural habitats leading to small scale, localised habitat loss. Incremental loss of semi-natural habitat even on a small scale within landscapes, and overall landscape simplification, can have implications for a range of species such as Annex I bird species, invertebrates and small mammals. For example drainage of wetlands has resulted in the loss of habitats and associated species, and loss or fragmentation of farmland ponds may have implications for farm level aquatic flora and fauna. Loss of semi-natural habitat can be noticeable at local, regional or national level. For example, recent habitat mapping for County Cork found a low baseline level of semi-natural habitats in many parts of the county (between 10-20%); levels were influenced in particular by location and the levels of both agriculture and commercial afforestation (O'Donoghue *et al.*, 2008⁸¹; 2012⁸²). Wet grasslands that remain support distinctive plant

communities, and offer opportunities for a number of rare species. Drainage channels themselves can act as refuges for species lost in the wider area through land drainage, such as amphibians, aquatic invertebrates and wetland plants. Impacts at farm level on habitat loss and fragmentation from changes in the ruminant sectors will be clearer as Food Harvest 2020 becomes rolled out.

3.2.3.3.1.2 Change in grazing regime

It is assumed that dairy farming will directly replace beef/suckers in some instances which may lead to changes in type of livestock and changes in stocking densities. Changes in livestock types may have a neutral, negative or positive impact on biodiversity, depending on change and geographical location. Dairy farming is generally more grazing intensive than beef and where landscapes are dominated by intensively managed grassland, declines in farmland bird species, particularly seed-eating species, have been recorded. Invertebrate-eating birds are also negatively affected by agricultural intensification, however, some benefit from shorter swards, for example swallows and starlings. The degree to which dairy replaces beef within the same farm setting, and the degree of expansion of dairy on a landscape scale, will influence these impacts.

3.2.3.3.1.3 [Impact on water quality](#)

Water quality in Ireland generally has been increasing as a result of legislation, implementation of the River Basin Management Plans and improvements in waste water treatment. Continued implementation of the WFD and RBMPs will see further benefits to reduced nutrient loading and potential for diffuse pollution. Currently, diffuse pollution arising from a number of sources, agriculture included, is cited as a key threat to sensitive SCIs (NPWS, 2008; EPA, 2012).

One of the main impacts of Food Harvest 2020 implementation on biodiversity and flora and fauna may be through potential adverse impacts on water quality. The overall prediction for impacts on water quality is slight negative pre-mitigation. Whilst small national increases in organic nitrogen and phosphorus, and inorganic nitrogen are predicted, regional variation in increases may be predicted. Impacts on water quality in one of the regions where dairy farming may increase, the SWRBD, is predicted to be a slight-moderate adverse impact pre-mitigation and it currently supports the highest proportion of rivers and lakes in the High water quality category. Leaching of nitrate and phosphorus to surface water, combined with potential increases in sediment escape have been determined as the main impacts on receiving waters from dairy / beef sectors. Increases in organic and inorganic fertiliser use, even with adherence to existing regulatory controls and good practice, have potential to hinder targets for water quality set under RBMPs. Implications of eutrophication and increased sediment load for sensitive habitats, flora and fauna will likely be concentrated in the south, south-west and east where dairy expansion will occur. Sensitive receptors include fish, aquatic invertebrates, birds associated with riparian corridors and wetlands, river and lake catchments. Increase in sediment loads can lead to increases in turbidity and direct impacts such as on reduced fish spawning and altered food webs.

Water quality is unlikely to be significantly affected as a result of Food Harvest 2020 sheep targets as negligible changes are predicted for organic and inorganic fertilisers and concentrates.

3.2.3.3.1.4 [Changes in nutrient loading of terrestrial land](#)

Neutral grasslands, which form the bulk of pasture in the east and centre of the Country, where dairy in particular is dominant, have seen reductions in plant diversity and other groups such as invertebrates as a result of fertiliser applications and changes in land management. Intensification of fertilisation associated with dairy would potentially replicate this result in areas of dairy expansion. Replacement of tillage with dairy would most likely lead to neutral or slightly beneficial impacts for nutrient status of land, but may reduce landscape heterogeneity and value of these areas for a more mixed flora and fauna community. Localised increases in soil fertility through organic and inorganic fertiliser application or increased manuring as a result of greater stocking density may occur.

3.2.3.3.1.5 [Changes in land management](#)

Although pressures for more productive beef/dairy systems may lead to expansion into the wider countryside and intensification of existing farms, it may potentially result in abandonment of small areas of marginal land with low profit margins, and could be primarily associated with the predicted decrease in sheep numbers. Whilst this is likely to affect a very small land area, potential impacts on biodiversity are mixed; negative impacts include loss of structural diversity, changes in plant communities and scrub encroachment; whilst positive impacts such include less disturbance by poaching and reduced sources of pollution. Food Harvest 2020 predicts a reduction the area required for silage and hay in particular, which may have implications for traditional land management and HNV compatible practices. Livestock production is generally lower on semi-natural grasslands, as the dry matter yield and digestibility is lower per hectare than from improved land. Where the focus is on increased livestock production, reseeding of these less productive swards is common, leading to loss of floristic diversity and consequential impacts on invertebrates and birds.

3.2.3.3.2 Pigs / Poultry

3.2.3.3.2.1 Direct loss of habitat

The majority of pig and poultry enterprises in Ireland are indoors and expansion and intensification of the pig and poultry industry will require construction of housing sheds and associated infrastructure. To meet Food Harvest 2020 targets for pigs, an increase in the breeding sow herd will be required, and new animal welfare regulations require individual sow crates which increase the area required to house herds. Construction of new housing units is highly likely to be on improved pasture or other areas of low ecological importance, therefore direct loss of habitat is not considered significant.

3.2.3.3.2.2 Impact on water quality

The primary impact arising from Food Harvest 2020 targets for pig and poultry industry is the potential impact on water quality, which is predicted to be a slight negative in the absence of mitigation. However, two inherent mitigation measures will place limits on potential impacts; the formulation of concentrates to reduce nitrogen and phosphorus outputs and from January 2013 onwards to January 2017 when there will be phasing out of the transitional arrangements for a derogation with regards to P rates in manure spread.

There is no current quantification of the net increase in nitrogen and phosphorus outputs which can be expected, therefore, it is assumed that some impacts on water quality could occur in the absence of other mitigation. The existing piggery stronghold in the Border region has a high density of surface water and particularly lakes and supports a small number of freshwater pearl mussel catchments. Trans boundary impacts on catchments within Northern Ireland are possible and would need to be established on a project by project basis.

Cork and Tipperary are the other regions where pig farming is concentrated and may expand. Expansion of the pig farming industry into new regions, most likely the dominant tillage growing areas may be favoured. A substantial number of freshwater pearl mussel catchments are located in these regions and these would be very sensitive to

decreases in water quality and cumulatively with any impacts from intensification of dairying. Other sensitive receptors are aquatic invertebrates, fish and other aquatic flora and fauna. The south and south-east areas are considered particularly sensitive to further elevations in nutrient applications, and any increases would have adverse impacts on other water dependent habitats and species in these regions, with cumulative impacts possible from expansion of dairy in the same spatial area.

Poultry manure has high nitrogen availability and is readily leachable from grassland with consequent negative implications for water quality and biodiversity. It is not clear where poultry enterprises may expand, and level of expected increases in organic manure, but some impacts on water quality could be anticipated, pre-mitigation.

3.2.3.3.2.3 Export of manure as land and crop fertiliser

Pig / poultry systems are subject to IPPC licences and as such the treatment and disposal of their waste products are managed. The export of waste manure produced from the pig and poultry industries for use as fertiliser is well established. Whilst it is not clear what additional land may be required to absorb the predicted increased from Food Harvest 2020, post 2017, when the Nitrates Directive derogation ends, it has been estimated that substantial increase in land-spread area will be required when soil test phosphorus will fully limit the use of pig and poultry manure (Buckley and Fealy, 2012)⁸³.

As other technologies for treating pig and poultry manure remain cost ineffective, e.g. anaerobic digestion, solid-liquid separation, manure spreading is likely to continue in the short to medium term although Teagasc are investing in a demonstration anaerobic digester. Finding farm systems with appropriate stocking rates, nutrient load and soil structure for increased quantities of pig slurry may be difficult given restrictions under the Nitrates Directive and end of derogations in 2017. Consequential impacts may be use of pig/poultry slurry on marginal land where which has not reached the limits set by the Nitrates Directive, with potential for impacts on semi-natural habitats, although Buckley and Fealy

(2012) found demand for pig / poultry manure to be strongest amongst arable farmers. Under Food Harvest 2020 tillage/crop areas are predicted to decrease, therefore demand may be lower than level of manure produced. An interconnecting element is cost limitations, where at a certain distance from source and dependent on the nutrient content of the manure, it may not be cost effective to transport and spread waste manure. These factors may be important in determining farm scale and regional impacts of pig and poultry expansion.

3.2.3.3.3 Tillage and Field Crops

Tillage and field crop land area is predicted to fall overall, with small increases in the area under turnips and wheat. Some tillage/ crop land may be converted to pasture to meet small net increase in grassland required to facilitate expanded dairy industry. Other areas which may come out of tillage / crop land may be converted to bioenergy crops, but assessing impacts of bioenergy is outside the remit of this report.

3.2.3.3.3.1 Direct loss of habitat, fragmentation and disturbance

The predicted small increases in the area of tillage (wheat crop) have limited potential to impact negatively on semi-natural grasslands if these are replaced by tillage, but as overall area of tillage and field crops is predicted to fall, impacts from loss of habitat are not likely to be significant. The small increase in wheat production may interact with agri-environment schemes could provide opportunities for arable weeds and for birds through choice of options which encourage measures such as minimum tillage.

3.2.3.3.3.2 Impacts on water quality

The reduction in area under tillage and field crops may be related to a reduction in organic and inorganic fertiliser use and of pesticide and herbicide use, but quantification of this is currently not available. Should reductions in fertiliser/pesticide/herbicide use occur in tillage/crop areas, it is possible that positive impacts on water quality may occur, although it is likely that there would be a lag period before this effect was measureable. However, this would be contingent on the degree of reduction and on the

type and intensity of enterprises replacing tillage/crops. For example if bioenergy crops replaced tillage there may be a requirement for increased use of fertiliser, pesticides and herbicides over the tillage baseline in the initial establishment period, but less fertiliser would be required during the mature phase of bioenergy crops.

3.2.3.3.3.3 Changes in land management

Changes in standard tillage practices such as reduction in small-scale tillage as part of traditional mixed farming, lack of crop rotation, and shift from spring-sown to winter-sown crops have resulted in documented declines in birds and invertebrates. These factors are likely to continue under Food Harvest 2020, although overall area of tillage is predicted to fall.

Small scale conversion of former tillage fields to dairy may be a consequence of the predicted expansion of the dairy industry and could have both beneficial and negative impacts. Where small-scale tillage which had well maintained margins, particularly within an agri-environment scheme, is replaced by improved grassland there may be negative impacts for plants and invertebrates. Benefits may arise locally in improved water quality from reduction in fertiliser/pesticide/herbicide applications. These changes are difficult to elucidate fully as baseline research is absent.

3.2.3.3.3.4 Cumulative Impacts

Cumulative impacts can arise where a series of 'modest' impacts from the implementation of a plan may in-combination produce a net result which could result in significant impact(s). The individual impacts identified above are all possible and may occur separately or in-combination depending on regional and farm gate uptake of Food Harvest 2020 targets plan. In-combination effects have greatest potential to occur with intensification of the dairy industry, which is one of the prime outcomes of Food Harvest 2020 addressed in this report. Implementation of other plans and projects within regions of expansion could result in in-combination impacts, e.g. should afforestation or bioenergy planting occur within areas where dairy expansion is proposed, pre-

mitigation this has potential to interact negatively on water quality. At this strategic level, it is not possible to fully assess potential for in-combination impacts, as impacts will become clearer once plans and projects are brought forward or clarified. A list of potential plans and projects which may interact with Food Harvest 2020 is provided in Appendix III.

Perverse impacts - those which cannot be foreseen, but which may arise from a plan or project, may become apparent through the lifetime of the plan and bring into focus the importance of monitoring and reporting as an integral part of Food Harvest 2020, in association with on-going, possibly targeted, research by Teagasc, NPWS, DAFM, third level institutions and other organisations.

3.2.4 Conclusion

Considering the primary changes in sectors which are detailed above, this assessment concludes that there will be a slight negative impact on both biodiversity and on flora and fauna, without any mitigation. The potential impacts on biodiversity and flora and fauna from dairy, beef and sheep combined (ruminants) and pig/poultry is likely to be slight negative in the absence of mitigation measures, due mainly to potential for impacts on water quality and nutrient load of land. Whilst a fall in sheep numbers is predicted, this will be primarily offset by uptake of released land for female beef cattle >2 years. Other land released

from beef and sheep is likely to be used to partly meet the small net land required as a consequence of increase in dairy numbers. Where small scale tillage is no longer viable, this may be converted to dairying. Overall anticipated impacts for sheep are considered to be neutral/imperceptible, although should intensive cattle enterprises replace lowland sheep systems, this could lead to a change in assessment of significance of impacts from neutral/imperceptible to slight negative at least. The predicted decrease in tillage and associated impacts is difficult to assess due to lack of detail on associated herbicide/pesticide/fertiliser use, but may result in positive benefits which at this stage is assessed as neutral/imperceptible.

Possible mitigation measures to reduce the potential impacts of the Food Harvest 2020 scenario on biodiversity and flora and fauna are outlined in Section 11 and recommendations in Section 12.

3.2.4.1 Predicted Magnitude of Impact of Food Harvest 2020 on Biodiversity and Flora & Fauna

The overall predicted impact of Food Harvest 2020 on biodiversity is slight negative (see Table 3-8; though as noted the risk of increased levels of impact at a local level will be influenced by actual roll out). This is in the absence of any mitigation being implemented.

Table 3-8: Overall predicted impact of Scenario A (Integrated Scenario) on biodiversity (outside of the Natura 2000 network) and flora & fauna.

Farm Group Sector	Biodiversity Magnitude of Impact	Flora & Fauna Magnitude of Impact
Dairy & Beef	Slight negative	Slight negative
Sheep	Neutral/imperceptible	Neutral/imperceptible
Pigs & Poultry	Slight negative	Slight negative
Tillage & Field Crops	Neutral/imperceptible	Neutral/imperceptible
Overall Magnitude of Impact	Slight negative	Slight negative

As Food Harvest 2020 evolves, so too will understanding of how existing pressures are being addressed by implementation of legislation and

projects and where potential pressures may continue or result in cumulative impacts.

3.3 Natura 2000

3.3.1 Evolution and Designation of the Natura 2000 network

The Natura 2000 network, consisting of SACs and SPAs, is a European wide network of sites which have been selected for protection as they support habitats and/or species which are listed in Annexes⁸⁴ as being of European importance in the Birds Directive and the Habitats Directive. Development of the network dates to 1971 and ratification of the Ramsar Convention, which paved the way for the Birds Directive, Berne Convention and significantly, the Habitats Directive, leading to European wide programme for the selection and designation of important sites for biodiversity conservation (Evans, 2012).

The Habitats Directive was transposed into Irish legislation by the European Communities (Natural Habitats) Regulations, 1997 (S.I. No. 94/1997) and subsequently amended in 1998 and 2005. However, in order to address transposition issues raised in judgements of the ECJ against Ireland in 2008 and to clarify the obligations of planning authorities under the Birds and Habitats Directives, the European Communities (Birds and Natural Habitats) Regulations, 2011 were introduced and now provide the legislative framework in Ireland on the protection of designated habitats and species.

The designation process falls under the remit of the NPWS. Many of the SACs and some of the SPAs in Ireland were first designated as Natural Heritage Areas (NHAs) and have overlapping boundaries. In Ireland, although SACs have been identified, the designation process is not yet fully completed and many SACs remain as candidates for designation, although they are afforded full protection from the time they were considered for designation. The EC considers Ireland's list of designated Natura 2000 sites as incomplete (EC, 2010)⁸⁵. NPWS indicates that the process of finalising SAC designation will commence in early 2013 and will be completed by the end of 2014.

NPWS is also tasked with setting individual conservation objectives for Natura 2000 sites, with the aim of ensuring the maintenance of site integrity. Specifically the objectives relate to

targets and measures required to maintain or restore the favourable conservation status or condition of the Annex I habitat or Annex I or II species for which the site has been selected.

For more detailed information on the Annex habitats and species for which Natura 2000 sites have been designated, please refer to the Ecology Ecology Supporting Information and Literature Review Annex to this document.

Irish SACs are selected for the conservation of 59 Annex I habitats (including priority types which are considered to be of key conservation importance) and 25 Annex II species (not including birds, as these fall under the Birds Directive). Ireland holds a large proportion of Annex I blanket bogs, raised bogs, limestone grasslands, dune vegetation and wet species-rich grassland which are included in Natura 2000 designations.

SPAs are selected for the conservation of Annex I birds listed on the Birds Directive and other regularly occurring migratory birds and their habitats including:

- A site regularly supporting 20,000 waterbirds or 10,000 pairs of seabirds;
- A site regularly supporting 1% or more of the all-Ireland population of an Annex I species;
- A site regularly supporting 1% or more of the biogeographical population of a migratory species;
- A site that is one of the 'n' most suitable sites in Ireland for an Annex I species or a migratory species (where 'n' is a variable which is related to the proportion of the total biogeographic population of a species held by Ireland).

Additionally, a Wetland and Waterbird category can be included as a Special Conservation Interest within a SPA designation in recognition of the importance of wetlands to wintering waterbirds, as may other relevant Annex I species or migratory species which are not the prime selection species.

Some SPA's designations overlap with Ramsar sites. Ramsar sites are wetlands of international importance, and signatories to the Convention on

Wetlands, including Ireland, are required to maintain the ecological character of these wetlands, and to ensure sustainable use of all wetlands in their territories. To date, Ireland has 45 Ramsar sites, located primarily along eastern and western coasts and in the midlands.

Currently in Ireland there are 423 SAC sites with a total area of 11,007km² of which 9,529km² is terrestrial, and 153 SPAs. A small number of marine sites are being progressed for designation. Approximately 25 SPAs have boundaries that overlap with SAC designations.

The division of Natura 2000 sites on a county basis, compiled from information available from NPWS is presented in Table 3-9. Some Natura 2000 sites overlap county boundaries and the Northern Ireland border, particularly relevant where river catchments or water dependent habitats or species are included as SCIs, therefore numbers below exceed the totals for SACs/SPAs given above. For more information on Natura 2000 network, the NPWS website, www.npws.ie should be consulted. The maps at Figure 3-1 and Figure 3-2 below detail the location of Ireland's SACs and SPAs.

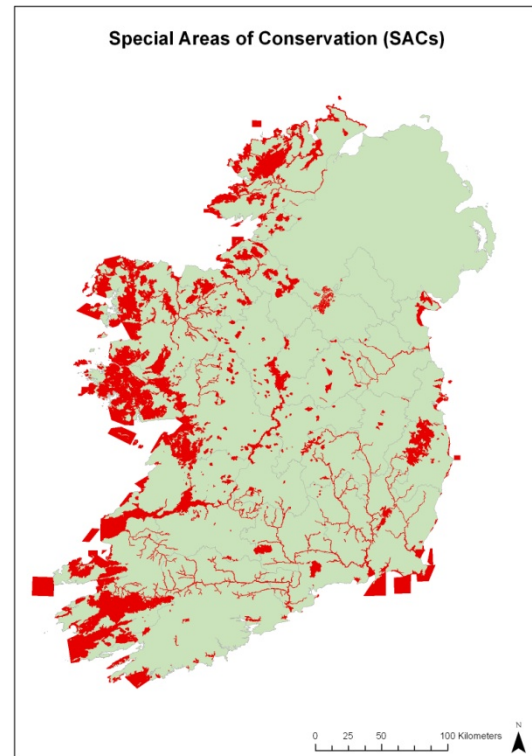


Figure 3-1 Special Areas of Conservation (NPWS)

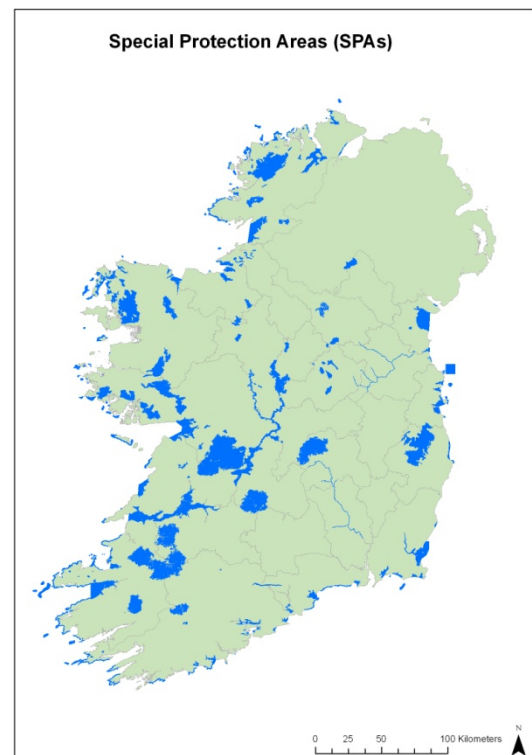


Figure 3-2 Special Protection Areas (NPWS)

Table 3-9: The number of Natura 2000 sites per county per county⁸⁶

County	Number of SACs	Number of SPAs	County Total
Carlow	3	0	3
Cavan	6	3	9
Clare	37	10	47
Cork	30	18	38
Donegal	46	26	72
Dublin	12	11	23
Galway	72	19	91
Kerry	31	14	45
Kildare	7	1	8
Kilkenny	8	1	9
Laois	8	2	10
Leitrim ⁸⁷	8	1	9
Limerick	12	3	15
Longford	6	4	10
Louth	6	5	11
Mayo	52	18	70
Meath	8	4	12
Monaghan	1	1	2
Offaly	17	6	23
Roscommon	27	7	34
Sligo	19	11	30
Tipperary	20	4	24
Waterford	9	6	15
Westmeath	16	10	26
Wexford	16	9	25
Wicklow	13	4	17

Density of Natura 2000 sites tends to be highest in the North-West, West and South-West where, where Annex habitats such as blanket bogs, semi-natural grasslands and high-quality water dependent habitats are located. In the East and South-East Natura 2000 sites are concentrated along major river catchments and along the coast. Counties Galway, Donegal and Mayo have the largest number of Natura 2000 sites, Counties Carlow, Monaghan have by far the lowest. The area covered by Natura 2000 sites per county has not been compiled. A summary of Natura 2000 network on a regional basis is provided in the Annex document, along with other regional biodiversity and flora and fauna characteristics.

3.3.2 Natura 2000 and Land Use

No comprehensive synthesis of land use on Natura 2000 sites exists. Many Annex I habitats depend on agricultural practices for maintenance (Halada *et al.*, 2011)⁸⁸, including hay meadows, species-rich grasslands. Generally, Annex I habitats are associated with less intensive farm practices and traditional land management. Many Annex species are also dependent on agricultural land management to maintain suitable habitat. An estimate of the value of agriculture to Natura 2000, to a certain extent, and flora and fauna is the numbers of farms under agri-environment schemes. In 2009, more than 62,000 farmers were enrolled in REPS, accounting for up to 50% of the National Utilisable Area (Dunford, 2011). Admission to the current AEOS 3 scheme is given on a prioritised basis, with applicants having 0.5ha

of more land within a Natura 2000 designation favoured for entry.

3.3.3 Notifiable Actions

Notifiable Actions are those which are those which require Ministerial consent before implementation on land within Natura 2000 designation. These actions are judged to be those which could damage species or habitats vary between habitats and include a wide range of works from land reclamation to turf and sand extraction. Landowners are sent copies of the Notifiable Actions that are relevant to their lands and are also available from the NPWS website.

Axis 2 of Ireland's RDP contains a Natura 2000 measure which effectively compensates farmers (within REPS/AEOS) for complying with these Notifiable Actions. Notifiable Action consent is not required for activities specified in an NPWS farm plan scheme plan, or for REPS and AEOS plans, where the action is discussed with and approved by NPWS prior to plan approval. Activities not included in approved REPS, AEOS or NPWS plan require separate Notifiable Action consent. Participation in a REPS, NPWS or AEOS plan does not exempt the farmer from cross compliance sanctions or prosecution.

3.3.4 Current Status of the Natura 2000 network

3.3.4.1 Special Areas of Conservation

Under Article 17 of the Habitats Directive, member states are required to report on a six year cycle on the condition of Annex habitats and species and progress towards implementation of the Directive. Condition of habitats and species within and outside of the Natura 2000 network is required. The NPWS published a summary conservation report of Annex habitats and species in 2008 which categorised the conservation status of Annex habitats and species, based on assessments carried out by expert ecologists and screened by NPWS. The format for assessment of conservation status of European habitats and species involves the application of a 'traffic-light' scheme and brings together information on four parameters for each species/habitat being assessed:

Habitat	Species
• Range	• Range
• Area	• Population
• Structure and function	• Area of suitable habitat
• Future prospects	• Future prospects

Each parameter was classified by NPWS as being "favourable" (good), "unfavourable – inadequate" (poor), "unfavourable – bad" (bad) or "unknown" and these are combined to give an overall status assessment. Good status is colour-coded green, poor status is colour-coded amber and bad status is colour-coded red.

A list of habitats and species protected under Annex I and Annex II of the Habitats Directive, and which are considered to be influenced by agriculture, together with current status, pressures and summary of geographical distribution is given in Appendix VIII and Appendix IX respectively.

Overall, of the total 59 habitats in the report, the majority were found to be primarily in unfavourable condition, with 47% deemed bad, 46% deemed inadequate and only 7% of the habitats examined are in good conservation status. Some habitats associated with traditional methods of farming, and less intensive farming enterprises, are currently in unfavourable status, e.g. lowland hay meadow, important for birds such as corncrake and plants such as cornflower, bogs and coastal grasslands. Data collated for the status report indicated that many water dependant habitats were under particular threat, particularly raised bogs. The main threats listed in the status report are in order: direct damage resulting from a variety of sources; over and under grazing; eutrophication and siltation of waters; unsustainable harvesting and alien invasive species.

Approximately 41% of the overall 100 species listed under the Habitats Directive are in a favourable state. However, of the 31 species/bat group which can be assumed to be strongly associated with agriculture, only nine are in favourable condition. The majority, particularly those of wetland and freshwater environments, are in poor or bad conservation status.

NPWS are currently consulting on the draft 3rd Irish Report on the implementation of the EU Habitats Directive. Consultation was due to close on June 21st 2013. Therefore, conservation status for certain habitats and species may change during the immediate life of Food Harvest 2020 and will need to be considered in future monitoring and mitigation developed for Food Harvest 2020 and Natura 2000 network.

Threat Response Plans are being prepared by NPWS as part of Ireland's response to the judgement of the European Court of Justice in case C-183/05 and the requirement to establish a system of strict protection for species listed in Annex IV of the Habitats Directive. To date, Threat Response Plans have been prepared for Kerry slug, vesper bats, otter and Irish cetaceans. Additionally all Ireland Species Action Plans are in place for bats and Killarney fern.

3.3.4.1.1.1 [Freshwater Pearl Mussel](#)

Freshwater pearl mussel is listed in Annex II of the Habitats Directive, and is considered to be in bad conservation status due to factors such as pollution, increased sediment loading and hydrological alterations. The draft Freshwater Pearl Mussel River Basin Management Plans, prepared to provide the programme of measures necessary for favourable conservation status of this species, indicate known populations and water quality data within each freshwater pearl mussel catchment, which nest within defined River Basin Districts⁸⁹. The *Margaritifera* Sensitive Areas map, Figure 3.3 below, shows the catchments of the

known extant populations of the freshwater pearl mussel in the Republic of Ireland.

Four categories of freshwater pearl mussel catchments are mapped:

- Catchments of SAC populations listed in S.I. 296 of 2009. A total of 27 catchments are designated for the protection of freshwater pearl mussel and site-specific conservation objectives are currently being developed by NPWS.
- Catchments of other extant populations, which may include smaller populations within SACs or populations within the wider countryside.
- Catchments with pre-1970 live records (extant populations unlikely, but information insufficient to list as 'extinct').
- Catchments with presumed extinct populations, but further survey required. These catchments are concentrated in the lower Nore and the Barrow main channel.

Outside of the SACs for freshwater pearl mussel, plans or proposals which might have potential to impact on these catchments and their suitability to support freshwater pearl mussel, would need to carefully consider the conservation objectives for this species to ensure compliance with the Freshwater Pearl Mussel (FPM) River Basin Management Plans.

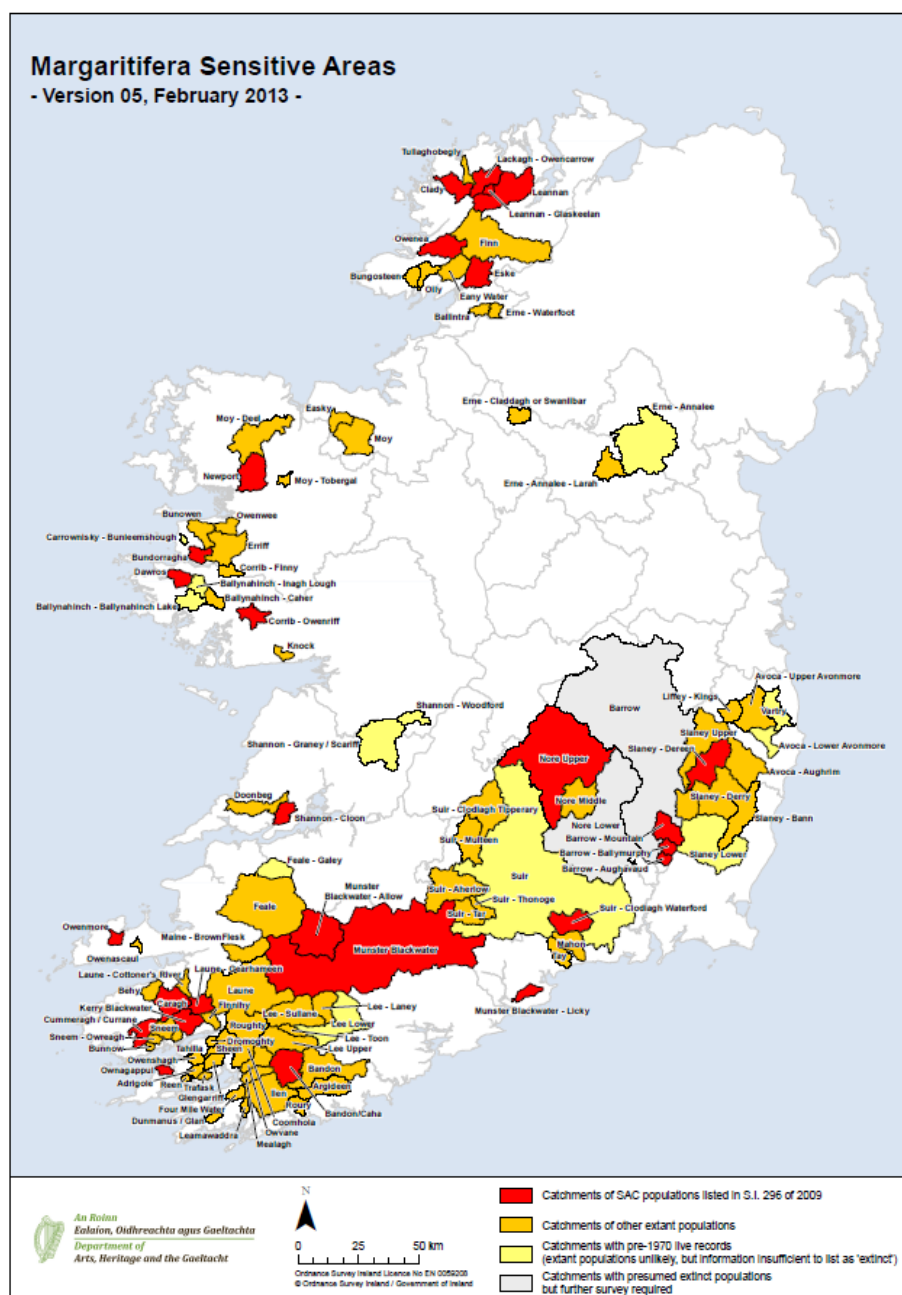


Figure 3-3: Map of the 27 SAC's designated for Freshwater Pearl Mussel in Ireland which have specific FPM sub-basin management plans required for their protection under the Water Framework

3.3.4.2 Special Protection Areas

The EU Birds Directive lists thirty seven species of birds which occur in Ireland and of which twenty five are regularly occurring bird species in Ireland. The conservation status of Annex I bird species within SPA designations is not as readily available as for habitats and species listed on the Habitats Directive. However, Lynas *et al.*, (2007) includes an assessment of the conservation status of the regularly occurring Annex I species, located in Appendix X.

A comprehensive list of migratory Special Conservation Interests (SCI) has not been compiled for this report as the numbers of species which are selected as SCIs for individual SPAs can be lengthy and varies from site to site depending on population size and criteria for designation. Seabird SPAs are generally not strongly correlated with agriculture, and SCIs for these sites variously include species which spend substantial periods at sea such as fulmar, kittiwake and gannets. Migratory species which may occur on SPAs include waders such as shelduck, lapwing, curlew,

knot, oystercatcher and turnstone; geese and ducks. These species are associated with extensive areas of grazing pasture, including improved grassland, and wetlands. Some birds such as lapwing are also associated with higher stocking rates, as they have a preference for short swards, whilst other such as curlew require taller grassland and hence lower stocking densities. Lynas *et al.*, (2007) have assessed four of the characteristic farmland waders as being of conservation concern; lapwing and curlew are Red listed whilst snipe and redshank are Amber listed.

3.3.5 Conservation Objectives of Natura 2000 sites.

Site integrity for Natura 2000 sites is related to their conservation objectives, which '*are intended to ensure that the relevant Annex I habitats and Annex II species present on a site are maintained in a favourable condition (Habitats Directive)*'. Detailed conservation objectives for SPAs⁹⁰ and SACs are in preparation at present and are being determined from the SCIs and additional SCIs of these sites. Draft conservation objectives are available for SACs. It is outside the scope of this document to individual list conservation objectives, where available, for the designated and candidate Natura 2000 sites. However, general conservation objectives for SACs and SPAs are summarised in Table 3-10.

Table 3-10: Summary of conservation objectives for Natura 2000 sites.

SPA*	SAC
<p>Objective 1: To maintain the favourable conservation condition of the Special Conservation Interest species listed:-</p> <ul style="list-style-type: none"> Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis. 	<p>To maintain the Annexed habitats and species for which the SAC has been selected at favourable conservation status.</p> <p>Favourable conservation status for habitats is achieved when:</p> <ul style="list-style-type: none"> The natural range and are covered by the SCI within that range are stable or increasing; The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and The conservation status of its typical species is favourable.
<p>Objective 2: To maintain the favourable conservation condition of the wetland habitat of the SPA as a resource for the regularly occurring SCI species, determined as:</p> <p>Wetland habitat within the SPA should be stable and not significantly less than a given area (site basis) for individual SPAs</p>	<p>The favourable conservation status of a species is achieved when:</p> <ul style="list-style-type: none"> Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and <p>There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.</p>
<p>Where site specific Conservation Objectives are available, the maintenance of SCI favourable conservation status may be further defined by the following (variable) attributes and targets:</p> <ul style="list-style-type: none"> Long-term population trend for the SCI should be stable or increasing No significant decrease in the numbers or range of areas used by the SCI species No significant decrease in the range, timing or intensity of use of areas by the SCI species <p>Site specific targets for Objective 2, favourable conservation status of wetland habitat may also be set and quantified.</p>	<p>Other SACs for which specific Conservation Objectives have not yet been established retain the following general conservation objectives:</p> <ul style="list-style-type: none"> Maintenance of the Annex habitats and species for which the site has been designated at favourable conservation status To maintain the extent, species richness and biodiversity of the entire site. To establish effective liaison and co-operation with landowners, legal users and relevant authorities.

According to the detailed Conservation Objectives currently in preparation by NPWS ‘the maintenance of the ‘quality’ of wetland habitat lies outside the scope of Objective 2. However, for the species of Special Conservation Interest, the scope of Objective 1 covers the need to maintain, or improve where appropriate, the different properties of the wetland habitats contained within the SPA.’

3.3.6 A Format for Prioritised Action Framework (PAF) for Natura 2000 (draft)

The draft *Format for a Prioritised Action Plan for Natura 2000* (NPWS, 2013)⁹¹ establishes measures envisaged to achieve identified management and enhancement priorities for Annex habitats and species over the period 2014-2020.

According to PAF, adequate management of Natura 2000 sites to achieve ‘improved status depends on adequate resources being invested in specific management measures as well as in more general measures such as agri-environmental schemes, stakeholder involvement and monitoring’. Key targets and approaches for both priority habitats and non-priority habitats and species are listed in the document. Specifically in relation to agriculture, the focus is on using targeted agri-environmental schemes and projects to deliver management and conservation gains, as well as implementation of measures to ensure compliance with the Water Framework Directive and undertaking baseline ecological investigations on wetlands. The report also recognises the potential for supporting HNV farming systems under the new RDP.

3.3.7 Appropriate Assessment

Article 6(3) of the EU Habitats Directive states that: “Any plan or project not directly connected with or necessary to the management of the [Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to Appropriate Assessment of its implications for the site in view of the site’s conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national

authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public”. Such an assessment is known as an Appropriate Assessment (AA).

Further guidance on AA is provided by the European Commission (2000) and the Department of the Environment, Heritage and Local Government (DEHLG) (2009). The Guidelines set out how a screening assessment should be structured, which can be broken into four stages.

Stage 1: Screening.

This stage requires a description of plan, which includes determination of whether it is connected with management of the site(s) and therefore excluded from AA requirements. Natura 2000 sites within the zone of influence of the plan are identified and information on their qualifying interests and conservation objectives is compiled. If the plan is considered not likely to have a significant adverse impact on the identified Natura 2000 sites a Finding of No Significant Effects report is compiled. Where significant impacts may occur, or where impacts cannot be ruled out, either alone or in-combination with other plans and projects, assessment moves to Stage 2 Appropriate Assessment.

Stage 2: Appropriate Assessment.

This stage assesses the implications of the plan on the site(s) conservation objectives to determine if there is potential for significant effects on the integrity of scoped in site(s). The integrity of a site is the coherence of the site’s ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified. A range of potential impacts needs to be considered, including; direct and indirect, short and long term, temporary and permanent impacts. This stage can include an assessment of mitigation measures which are aimed at avoiding or minimising negative impacts identified. In-combination effects with other plans and projects must also be considered. Results of this stage are generally presented in a Natura Impact Statement.

Stages 3 and 4: Alternative Solutions and Assessment of Imperative Reasons of Overriding Public Interest (IROPI).

Where a plan/project has potential for significant adverse impacts, an examination of alternative solutions, including methods, to achieve the plan that avoids adverse impacts on the integrity of the Natura 2000 site is undertaken. The Habitats Directive promotes a hierarchy of avoidance, mitigation and compensatory measures. In the first instance, during the plan formulation, the plan should aim to avoid any impacts on European sites by identifying possible impacts early in the plan-making process and writing the plan in order to avoid such impacts. Second, mitigation measures should be applied, if necessary, during the AA process to the point where no adverse impacts on the site(s) remain. If the plan is still likely to result in impacts on European sites, and no further practicable mitigation is possible, then it may proceed to Stage 4. If the assessment concludes that the plan or project will have a negative impact on the site, it may only proceed and be carried out for imperative reasons of overriding public interest as outlined in the Directive and the member state concerned shall take all compensatory measures to ensure that the overall coherence of the Natura 2000 site is protected. The European Commission must be informed where this occurs.

3.3.8 Screening of impacts from Scenario A (Integrated Scenario) on Natura 2000 sites.

An assessment of the impacts on Natura 2000 network on a site by site basis cannot be meaningfully undertaken at this time, in the absence of information on how Food Harvest 2020 will be implemented on a farm by farm basis. A full screening of Food Harvest 2020 in so far as its effects can be measured at a national level was however carried out. Therefore, the assessment

has concentrated on examining potential impacts on Annex habitats and species for which the Natura 2000 network has been established, in regions and areas where the majority of the projected agriculture changes are expected to occur and assumes an integrated pathway as detailed in Section 2.

As previously noted, the assessment examined projected changes from baseline on Annex habitats and species for which Natura 2000 sites have been designated, and is not an assessment of agriculture *per se* of the Natura 2000 network on a site by site basis.

The existing conservation status of Annex habitats and species is recognised, and the assessment focuses on those habitats/species which may come under increasing pressure, either nationally, or where possible to identify, regionally, from the changes predicted under Food Harvest 2020.

Based on the assumptions and premises above, there is potential for adverse impacts on some SCIs of Natura 2000 sites and on protected species to arise from the following outcomes of Food Harvest 2020 (Scenario A integrated assessment and pre-mitigation). These impacts are likely to be regionally specific, concentrated in the regions where targeted Food Harvest 2020 measures will be rolled out. A summary is given in Table 3-11.

Table 3-11: Summary of potential impacts on Natura 2000 network from implementation of Scenario A (Integrated Scenario) pre-mitigation.

Scenario A (Integrated Scenario) Sector	Pressure on Natura 2000 network
Ruminants	Change in grazing regime Impact on water quality Nutrient loading of terrestrial habitats Change in land management Off-site impacts
Pigs & Poultry	Impact on water quality
Tillage and field crops	Impact on water quality
Cumulative impacts	Interaction of impacts from all Food Harvest 2020 sectors and cross-cutting of impacts from other disciplines

The screening of Annex habitats and species based on available information is presented in Appendices XI and XII respectively and for regularly occurring Annex bird species in Appendix XIII.

3.3.8.1 Ruminants

3.3.8.1.1 Change in grazing regime

Overall, taking the replacement of land utilised by beef for increase in dairy herds, a negligible net increase (0.36%) in permanent pasture will be required to meet Food Harvest 2020 dairy targets as envisaged under Scenario A. Notifiable Actions⁹² for Natura 2000 sites may include clearance of scrub, drainage and infilling of wetlands and therefore increased landtake for dairy is likely to be met outside the Natura 2000 network.

Natura 2000 land is often grazed by beef cattle and sheep, and dairy cattle to a much lesser extent, and such grazing is a valuable conservation tool. However, inappropriate grazing regime is a key factor in current 'bad' and 'poor' conservation status for relevant habitats and species. Scenario A for Food Harvest 2020 predicts a decrease in beef cattle numbers in favour of expanding dairy cattle numbers, and it is assumed this will occur primarily in regions where dairy farming is already prevalent. The prime dairy centred areas in the South-West, South-East and Mid-West support SACs which tend to be selected for water dependent habitats and species, and for other habitats where grazing by dairy cattle is not

significant. SPA's in these regions are primarily coastal or montane, and grazing by sheep or beef is prevalent. Overall, expansion of dairy in existing dairy strongholds is unlikely to result in significant impacts on Natura 2000 sites through alteration of grazing regimes, as dairy cattle are not strongly correlated with maintenance of habitats and species in SPA/SACs within these regions. Potential exists for expansion of dairy onto Natura 2000 sites, but would be subject to existing controls through legislation, Notifiable Actions and potentially agri-environment schemes.

Individual sites elsewhere in the Country may be affected by reduction in beef cattle numbers or through localised expansion of dairying.

In upland Natura 2000 sites, the slight reduction in sheep numbers may assist in conservation efforts as many upland habitats had previously been overgrazed, however, the level of decrease in flock numbers is so marginal this impact will be imperceptible. Lowland sheep numbers are predicted to decrease more substantially and potentially be replaced by beef or localised dairy enterprises. Change in livestock type can result in impacts on vegetation structure, suitability of habitats for protected species and cause associated effects such as increased poaching. Again stocking density and other activities would be controlled through legislation and Notifiable Actions, primarily.

3.3.8.1.2 Alteration to water quality

Water quality in Ireland generally has been increasing as a result of legislation,

implementation of the River Basin Management Plans and improvements in waste water treatment. Continued implementation of the WFD and RBMPs will see further benefits to reduced nutrient loading and potential for diffuse pollution. Currently, diffuse pollution arising from a number of sources, agriculture included, is cited as a key threat to sensitive SCIs (NPWS, 2008; EPA, 2012).

Application of fertilisers is strictly regulated on Natura 2000 land and is the subject of cross-compliance for Natura 2000 land within agri-environment schemes. Outside of the network, implementation of Food Harvest 2020 through Scenario A in the dairy sector is predicted to result in net overall increases in fertiliser use; 1.14% and 1.5% for organic nitrogen and phosphorus nationally; and 12.7% increase in inorganic nitrogen. Small net increases in concentrates are predicted of 5.9% from the baseline. The level of net increases in fertilisers and concentrates is very low overall and can be expected to be centred in dairy regions. Continued implementation of good practice and cross-compliance, together with development of new technologies such as slurry spreading techniques, have potential to decrease nutrient run-off from fertilised land.

Leaching of nitrate and phosphate to surface and ground water may be expected from increased fertiliser and concentrate use; and there may be potential for increased soil erosion and siltation near watercourses. Even small amounts of phosphorous can lead to eutrophication and significant losses have been illustrated from intensively grazed grasslands to Irish rivers.

The predicted impact on water quality is considered to be a slight negative nationally before mitigation. These impacts rise to slight-moderate negative for the south-west, where dairying is a major contributor to agriculture and there is the highest proportion of high status water bodies in Ireland, which are considered highly vulnerable to impact (i.e. even slight changes in nutrient loadings can cause a shift in biological water quality). For water dependent sensitive species, potential increases in nutrient load within water bodies, or resultant eutrophication, may have adverse impacts. These impacts may be significant where that

species/habitat is in current poor or bad conservation status or has been subject to significant degradation of conservation status in the past, and where species are at the edge of their tolerances of diffuse aquatic pollution. A number of freshwater pearl mussel catchments are located within the major dairy farming areas, and there is potential for impacts on conservation status of this species given the predicted increase in dairying activity and associated predicted increases, albeit small, in organic and inorganic fertilisers. Potential eutrophication of wetlands could result in adverse impacts on their suitability to host SCI species, although some wetland bird populations could benefit from increased prey availability.

Water quality is unlikely to be significantly affected as a result of Scenario A Food Harvest 2020 sheep targets as negligible changes are predicted for organic and inorganic fertilisers and concentrates.

3.3.8.1.3 Nutrient loading of terrestrial land

Potential changes in vegetation composition as a result of increase in organic/inorganic fertilisers may occur on a localised basis and from increased use of concentrates. This may not have significant impacts on Natura 2000 land as overall increases are small and will not directly affect sites, as fertiliser inputs are controlled through Notifiable Actions. Low level impacts on sensitive habitats and species within adjacent Natura 2000 sites cannot be fully discounted from potential increases in atmospheric nitrogen deposition but may be mitigated by measures already in place such as buffer strips and compliance with Nitrates Directive.

3.3.8.1.4 Changes in land management

Maintenance of traditional land management practices is a vital conservation tool for many Natura 2000 sites, particularly those which have high degree of affinity with HNV farming systems. Food Harvest 2020 aims to increase productivity and output in the ruminant sectors, and this may have implications for the manner in which land within Natura 2000 sites is farmed, although this will be in the context of obligations to legislation, agri-environment schemes, cross compliance and GAEC. As yet this is an unquantified potential

impact of Food Harvest 2020, but may be most closely associated with decreases in sheep numbers, and loss of small-scale beef enterprises.

3.3.8.1.5 *Off-site impacts*

Food Harvest 2020 may result in intensification of agriculture outside of the Natura 2000 network which could have implications for site integrity and favourable conservation status. Loss of connecting wildlife corridors through restructuring of farm holdings to increase productivity; drainage to improve land quality; water abstraction and increases in sedimentation from intensification of grazing near watercourses could have negative impacts on Natura 2000 site integrity. Intensification of existing dairy enterprises could have negative impacts on Annex I bird species within Natura 2000 sites through loss of additional foraging and nesting opportunities.

3.3.8.2 *Pigs / Poultry*

Pigs/poultry farming occurs mainly in the Border region and in Cork and some expansion could be expected to occur in these areas. However, economic forces may direct preference for location of new pig/poultry enterprises in traditional tillage areas, to reduce transport cost of concentrates.

The primary impact arising from Food Harvest 2020 targets for pig and poultry industry on the Natura 2000 network is the potential impact on water quality, which is predicted nationally to be a slight negative in the absence of project specific mitigation.

Spreading of pig/poultry manure collected from commercial piggeries to improve nitrogen and phosphorus levels on grassland and cereal crops is well established. However, implementation of the EU Nitrates Directive has resulted in severe limits on use of the manure, and many of medium to high intensity farms are no longer suitable as the organic nitrogen loading from grazing livestock is already at or approaching the 170 kg/ha limit. From January 2013 onwards to January 2017 there will be phasing out of the transitional arrangements for a derogation with regards to P rates in manure spread, when additional land will be required to uptake waste pig / poultry manure. Whilst Natura 2000 land would not be used for

land spread of waste manure, other farmland within the locality / catchment could uptake manure. The extent and spatial spread of this additional land required for spreading is not clear, potentially arable farms may be favoured (Buckley and Fealy, 2012), but with the predicted decrease in land area under tillage and field crops this may not be a viable option for dealing with increases in waste manure volumes.

Efforts have and continue to be made to minimise nutrient excretion through feed formulation and efficiency of production and efforts to improve these issues are on-going. However, poultry manure has high nitrogen availability and is readily leachable from grassland with consequent negative implications for water quality. There is no current quantification of the net increase in nitrogen and phosphorus outputs which can be expected; therefore it is assumed that some impacts on water quality could occur in the absence of other mitigation.

The Border region has a high density of surface water and particularly lakes and supports a small number of freshwater pearl mussel catchments. Transboundary impacts on catchments within Northern Ireland are possible and would need to be established on a project specific basis.

Cork and Tipperary are the other regions where pig farming is concentrated and may expand. Expansion of the pig farming industry into new regions, most likely the dominant tillage growing areas may be favoured. A substantial number of freshwater pearl mussel catchments are located in these regions and these would be very sensitive to decreases in water quality and cumulatively with any impacts from intensification of dairying.

It is not clear where poultry enterprises may expand, and level of expected increases in organic manure, but some impacts on water quality could be anticipated, pre-mitigation. Depending on location, impacts on Natura 2000 sites could be screened in or out, and will require assessment on a site by site basis in areas of proposed expansion.

3.3.8.3 *Tillage and Field Crops*

The very modest increases for tillage (wheat) and field crops (turnips) will most likely be met outside of the Natura 2000 network as conversion of land

within the network to tillage/crops would be small scale or potentially would not be permissible within a designated boundary.

Predicted increases in pesticide and herbicide use associated with tillage and bioenergy crops may have off-site impacts on the Natura 2000 network. There are significant gaps in current understanding of effects of pesticides and herbicides on biodiversity/flora and fauna in an Irish context. Pesticide and herbicide drift could deliver these chemicals onto adjacent Natura 2000 sites, with the possibility of impacting on non-target species. The retention of hedgerows within tillage and bioenergy areas could act as barriers to the spread of pesticide and herbicide drift.

Predictive data for fertiliser use on tillage and field crops is not available, but given the declines in area of barley, oats and potatoes predicted, and the relatively small increase in wheat, a corresponding decrease can be assumed. These decreases may partially offset increases in fertiliser use for bioenergy crops.

Impacts on water quality from tillage and field crops would be best assessed on a project level basis due to uncertainties in potential for impacts and emerging targeted research.

3.3.9 Screening Outcomes

The outcome of the screening process was that direct loss of Natura 2000 habitat is not being considered as a likely outcome of Food Harvest 2020. However, screening indicates potential for some adverse impacts through alteration in nutrient status for sensitive habitats and species and possibly through changes in farm management. Significant adverse impacts would be those which cause delays or impede progress in reaching conservation objectives of a site.

It was concluded on a national basis and at a strategic level of assessment the implications of Food Harvest 2020 on the Natura 2000 network appear to indicate generally non-significant impacts for many Annex habitats and species. This strategic assessment indicates potential exists for water dependent habitats and species to be at risk of slight negative impacts from implementation of Food Harvest 2020 in the absence of project specific mitigation. Assessment at site level may be

required in areas of intensification or significant land use change, particularly for Natura 2000 sites hosting water dependent habitats and species, which have greatest potential to be impacted by Food Harvest 2020. Intensification of the dairy and pig/poultry industries has potential to act negatively on water dependent habitats and species, and in the pig/poultry of the Border region, transboundary impacts on catchments within Northern Ireland are possible and would need to be established on a project by project basis.

The actions analysed under Food Harvest 2020 will occur across the length and breadth of the agricultural land of Ireland and in many cases have no influence on Natura 2000 sites. Where individual plans or acts are contemplated, which would impact on a Natura 2000 site, then all regulatory requirements currently in place will apply and in some instances a specific Appropriate Assessment may be necessary.

Where Annex habitats and species are spatially restricted, opportunities exist to liaise with NPWS and other relevant bodies to avoid or reduce potential impacts. Impacts on Natura 2000 sites with sensitive habitats and species could arise from eutrophication, alteration of hydrological regime or through as yet unknown pathways. Levels of change in the conservation status may not be highly significant at strategic level, but changes may be more apparent at the site level. Continued improvements in water quality brought about through the Water Services Investment Programme, River Basin Management Plans and legislation could mean that the perceived slight impacts of Food Harvest 2020 on water quality become proportionally more significant over the lifespan of the plan.

In the absence of mitigation, intensification and expansion of dairy and indoor livestock within freshwater pearl mussel catchments could delay or impede progresses towards Favourable Conservation Status for this species. Other water-dependent habitats and species are also vulnerable. Whether these impacts may be significant or not depends on the spatial distribution of Food Harvest 2020 within sensitive

catchments, degree of project mitigation introduced and farm specific conditions.

The next step will be to move to more focused regional and site specific assessment of potential impacts on Natura 2000 network where there is potential for likely significant effects as Food Harvest 2020 continues to be delivered. Implementation of mitigation, monitoring and recommendations as set out in Sections 11 and 12 respectively will help avoid or reduce impacts on the Natura 2000 network. Interaction of proposed measures with schemes and proposals in place or forthcoming over the timeframe of Food Harvest 2020 will be vital. The draft *Prioritised Action Framework for Financing Natura 2000* for the period 2014-2020, indicates that for both priority and non-priority Annex habitats, and non-priority annex species, provision of targeted agri-environmental measures is one of the key measures to maintain and improve conservation status; and proposes development of specific agri-environmental measures for species in poor/bad status. Therefore, specific agri-environmental schemes could be brought forward for Freshwater Pearl Mussel, for instance, and uptake of such schemes could be a valuable conservation tool for Natura 2000 special interests.

3.3.10 Cumulative Impacts

Cumulative impacts can arise where a series of 'modest' impacts from the implementation of a plan may in-combination produce a net result which could result in significant impact(s). The individual impacts identified above are all possible and may occur separately or in-combination depending on regional and farm gate uptake of Food Harvest 2020 targets plan. In-combination effects have greatest potential to occur with intensification of the dairy industry, which is one of the prime outcomes of Food Harvest 2020 addressed in this report. Implementation of other plans and projects within regions of expansion could result in in-combination impacts, e.g., should afforestation or bioenergy planting occur within areas where dairy expansion is proposed, pre-mitigation this has potential to interact negatively on water quality. At this strategic level, it is not possible to fully assess potential for in-

combination impacts, as impacts will become clearer once plans and projects are brought forward or clarified. A list of potential plans and projects which may interact with Food Harvest 2020 is provided in Appendix XIV.

Perverse impacts - those which cannot be foreseen, but which may arise from a plan or project, may become apparent through the lifetime of the plan and bring into focus the importance of monitoring and reporting as an integral part of Food Harvest 2020, in association with on-going, possibly targeted, research by Teagasc, NPWS, DAFM, third level institutions and other organisations.

3.4 Notes and references

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Water

Section 4:

Water

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4 Water

4.1 Baseline

4.1.1 Introduction

This section assesses the potential impacts of Food Harvest 2020 on water quality. Water dependant habitats and species are largely addressed in Section 3 (Biodiversity and Flora and Fauna), but will also be commented on as appropriate in this section. Water is divided into:

- Surface waters (considered as streams, rivers, lakes and transitional water bodies (i.e. estuaries) as defined by the EPA);
- Groundwater.

Key areas to be reviewed and presented in the Food Harvest 2020 report include:

- Summary of regulatory bodies with responsibility/roles in the protection of water;
- Summary of relevant national and EU Legislation;
- Identify key pressures associated with agricultural sectors;
- Summarise the current status of surface waters and groundwaters in Ireland.

4.1.2 Regulatory and Legislative setting

4.1.2.1 Surface water

There is considerable overlap from a legislative and regulatory context between groundwater and surface water. The key legislation governing surface water in agricultural catchments includes the following:

- Water Framework Directive (2000/60/EC);
- Nitrates Directive 91/676/EEC;
- European Communities (Good Agricultural Practice for the

Protection of Waters) Regulations 2010 – SI No. 610 of 2010;

- Surface Waters Regulations (S.I. No. 272 of 2009);
- European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations (S.I. No. 296 of 2009).

4.1.2.2 Groundwater

4.1.2.2.1 [Water Framework Directive 2000/60/EC and SI 722 of 2003 European Communities \(Water Policy\) Regulations 2003 – 2005](#)

The EU Water Framework Directive (WFD) 2000/60/EC came into force on 22nd December 2000, and enacted into Irish legislation through SI 722 of 2003 European Communities (Water Policy) Regulations 2003. The Directive is a significant piece of legislation for water policy, as it provides a co-ordinated approach across Europe for all water policies, establishing a management structure for future water policy. The primary objective is for all waters to achieve 'good' ecological status by 2015. In cases where 'good status' will not be achieved by 2015 good reasons for this must be documented in the River Basin Management Plans. Extended deadlines for certain waters are proposed for 2021 or 2027 in the Plans, and these will be revised during subsequent planning cycles.

Protected areas (including drinking, bathing and shellfish waters, nutrient-sensitive areas, protected habitats and species) must, without exception, satisfy the objectives by 2015.

The Directive 2000/60/EC also promotes the sustainable use of water resources, defines a management and reporting system based on River Basin Districts (RBDs) and sets environmental objectives which take account of the full range of pressures on the aquatic environment (including pollution,

abstraction, flow regulation, habitat impact etc.).

In accordance with the requirements of the Water Framework Directive, a Register of Protected Areas has been compiled by the Environmental Protection Agency. Under this legislation, the Environmental Protection Agency is further required to maintain and update the register as needed. The protected areas are identified as those requiring special protection under existing national or European legislation, either to protect their surface water or groundwater, or to conserve habitats or species that directly depend on those waters.

The criteria for sites included on this list are:

- Waters used for the abstraction of drinking water;
- Areas designated to protect economically significant aquatic species;
- Recreational waters;
- Nutrient sensitive areas;
- Areas designated for the protection of habitats or species.

The Working Group on Groundwater⁹³ has prepared a number of guidance documents covering different aspects of the water environment, including groundwater abstractions, risk assessments, etc.

The Seven River Basin Management Plans and the associated Programmes of Measures for Ireland were published and submitted to the EU in 2010. The plans and programmes describe actions that are proposed to protect water over the coming years. Some of these actions are as follows:

- Controlling the inputs of phosphorus and nitrogen to waters;
- Controlling inputs of oxygen-using matter (e.g. silage, milk waste, sewage);
- Controlling pathogens in water;
- Complete elimination of dangerous substances (priority substances)

and control of specific pollutants to protect aquatic communities and human health;

- Ensuring that there is a sufficient volume of water in all our water bodies;
- Controlling hydro-morphological conditions (physical characteristics of the shape and boundaries of the water body) both in-stream and along riparian zones.

The River Basin Management (RBM) Plans identify the Good Agricultural Practice for the Protection of Water Regulations (the 'Nitrates Regulations' or 'GAPP Regulations') as the primary legislative tool by which to achieve agricultural compliance with the WFD. However, the Plans also state that *"Evidence suggests that they will not be sufficient to fully deliver the requirements of the Water Framework Directive in some areas of the country"* and that *"the need for supplementary measures will arise"* including for 'high status sites'.

4.1.2.2.2 European Communities Groundwater Directives

The existing Groundwater Directive (80/68/EEC) will be repealed by 2013 under the Water Framework Directive but remains in force to prevent or limit pollution from List I and List II substances until then. The existing Directive is to be replaced by the requirements of the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC).

4.1.2.2.3 European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010)

The purpose of the European Communities Environmental Objectives (Groundwater) Regulations (S.I. No. 9 of 2010) is to transpose the requirements of the Water Framework Directive and the Groundwater Directive (2006/118/EC) into National

legislation and provide for transitional arrangements from the existing Groundwater Directive (80/68/EEC).

These regulations:

- Establish a new strengthened regime for the protection of groundwater in line with the requirements of the Water Framework Directive (2000/60/EC) and by the Groundwater Directive (2006/118/EC).
- Establish clear Environmental Objectives, Groundwater Quality Standards and Threshold Values for the classification of groundwater and the protection against pollution and deterioration.
- Introduce the legal basis for a more flexible, proportionate and risk based approach to implementing the legal obligation to prevent or limit inputs of pollutants into groundwater which already exists under the previous Groundwater Directive (80/69/EEC).

4.1.2.2.4 Nitrates Directive 91/676/EEC and associated Nitrates Regulations

The Nitrates Directive (91/676/EEC) – Council Directive of 12 December 1991 concerning the protection of waters against pollution by nitrates from agricultural sources – has the objective of reducing water pollution caused or induced by nitrates from agricultural sources. In accordance with this Directive, each Member State is obliged to put in place a Nitrates Action Programme and to review and if necessary revise their action programme at least every four years.

4.1.2.2.4.1 Ireland's First Nitrates Action Programme

Ireland's first Nitrates Action Programme was given effect through a series of regulations, the most recent of which was the European Communities (Good

Agricultural Practice for Protection of Waters) Regulations 2009, S.I. No. 101 of 2009– commonly known as the Nitrates Regulations.

These regulations provide strengthened statutory support for the protection of waters against pollution from agricultural sources e.g. by phosphorus or nitrogen. They required the avoidance of practices by farmers which create a risk of causing pollution to water courses and provide for inspections by local authorities. They also provided for strengthened enforcement provisions and for better farmyard management. They included provisions relating to times of the year, weather and soil conditions when the application of fertilisers is permitted, the minimum setback distances from water sources for the application of fertilisers and minimum storage capacity for manures.

Local Authorities, under the general supervision of the Environmental Protection Agency, have primary responsibility for the enforcement of these regulations.

Implementation of the Action Programme was supported by an enhanced package of financial supports for farmers by DAFM under the Farm Waste Management Scheme. In 2010, DAFM carried out a certain amount of on-farm inspection on behalf of the Local Authorities in every county.

4.1.2.2.4.2 Ireland's Second Nitrates Action Programme

The Nitrates Action Programme was reviewed in 2010 and a comprehensive public consultation process on the proposed revisions to the Nitrates Regulations was initiated jointly by DECLG and DAFM on 11 June 2010. After a review of all submissions received by an independently chaired expert group and discussions with the European Commission, the revisions to the Action Programme were given effect through the European Communities (Good Agricultural

Practice for the Protection of Waters) Regulations 2010, S.I. No. 610 of 2010.

The revisions did not fundamentally change the main provisions of Ireland's Action Programme but did introduce specific changes, including:

- A site-specific, risk-based approach for setback distances from drinking water abstraction points;
- A prohibition on the application of chemical fertiliser within 2 metres of a watercourse; previously this was 1.5 metres;
- New controls on storage of baled silage;
- Amendments to the maximum nitrogen and phosphorus fertilisation rates for cereal crops including a measure to address the issue of low protein levels in malting barley;
- Time-limited extension for transitional arrangements covering the use of pig and poultry manure and spent mushroom compost;
- Revision of certain dates where the establishment of green cover is required.

Under the Nitrates Directive, herd owners are legally required to limit the amount of nitrogen from livestock manure that is applied (including that which is deposited directly by the animals themselves) on individual farms to no more than 170 kgs Nitrogen/hectare/year.

In 2007, the EU Commission approved a derogation for Ireland which allows individual farms (upon application to DAFM) to operate above this statutory livestock manure limit, up to a maximum limit of 250 kgs Nitrogen/hectare/year, subject to strict conditions. In November 2010, the Commission approved the renewal of this derogation. The derogation will now run to the end of 2013, coinciding with the next

review of Ireland's Nitrates Action Programme.

The European Communities (Good Agricultural Practice for Protection of Waters) (Amendment) Regulations 2011 (SI 125 of 2011) amend Article 17 of the European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (SI 610 of 2010). Part 4 of the 2010 Regulations relates primarily to the prevention of pollution from fertilisers. Section 17 relates to the distance from water bodies required when applying fertilisers. This amendment allows a local authority to apply a land-spreading restriction to the upstream catchment area, and to the close proximity downstream of an abstraction point in the case of any surface waters.

The effectiveness of the measures under the Nitrates Action Programme is being assessed through a research programme - the Agricultural Catchments Programme. The results of this research programme will help to inform future Nitrates Action Programmes and will provide a basis for any modifications of the measures that might be required in order to achieve the objectives of the Nitrates Directive and the Water Framework Directive. For details of the preliminary results of the Agricultural Catchments Programme refer to Section 11 (Mitigation) of this report.

[4.1.2.2.5 Environmental Liability Directive 2004/35/EC and European Communities \(Environmental Liability\) Regulations 2008](#)

The Environmental Liability Directive 2004/35/EC (European Parliament and of the Council of 21st April 2004) sets out the principles with regard to the prevention and remedying of environmental damage. The Directive defines Environmental damage as:

- direct or indirect damage to the aquatic environment covered by

Community water management legislation;

- direct or indirect damage to species and natural habitats protected at Community level by the 1979 "Birds" Directive or by the 1992 "Habitats" Directive;
- direct or indirect contamination of the land which creates a significant risk to human health.

The principle of liability applies to environmental damage and imminent threat of damage resulting from occupational activities, where it is possible to establish a causal link between the damage and the activity in question.

The Directive therefore distinguishes between two complementary situations, each one governed by a different liability scheme: occupational activities specifically mentioned in the Directive and other occupational activities.

The first liability scheme applies to the dangerous or potentially dangerous occupational activities listed in Annex III to the Directive. These are mainly agricultural or industrial activities requiring a licence under the Directive on integrated pollution prevention and control, activities which discharge heavy metals into water or the air, installations producing dangerous chemical substances, waste management activities (including landfills and incinerators) and activities concerning genetically modified organisms and micro-organisms.

Under this first scheme, the operator may be held responsible even if he is not at fault.

The second liability scheme applies to all occupational activities other than those listed in Annex III to the Directive, but only where there is damage, or imminent threat of damage, to species or natural habitats protected by Community legislation. In this case, the operator will be held liable only if he is at fault or negligent.

The Directive is transposed into Irish law by the European Communities (Environmental Liability) Regulations 2008 (S.I.547 of 2008). The purpose of the Regulations is to establish a framework of environmental liability based on the 'polluter-pays' principle, to prevent and remedy environmental damage. The Regulations apply to occupational activities listed in Schedule 3, including:

- Operation of installations subject to Integrated Pollution Prevention Control (IPPC) licenses, which includes intensive farming;
- Waste management operations, including transport of dangerous goods by road and trans-boundary shipment of waste;
- Licensed discharges into inland surface water and groundwater;
- Industrial plant.

4.1.2.2.6 Integrated Pollution Prevention Control (IPPC) Licensing

The EPA has been licensing certain large-scale industrial and agriculture activities since 1994. Originally the licensing system was known as Integrated Pollution Control (IPC) licensing, governed by the Environmental Protection Agency Act, 1992. The Act was amended in 2003 by the Protection of the Environment Act, 2003 (SI No. 27 of 2003) which gave effect to the Integrated Pollution Prevention Control (IPPC) Directive 96/61/EC.

Detailed procedures concerning the IPPC licensing process are set out in the EPA Acts 1992 to 2011 and the associated licensing regulations.

Section 18 of the Protection of the Environment Act 2003 amended the Environmental Protection Agency Act 1992 by inserting a new First Schedule. This schedule lists activities to which Part IV applies, i.e. Integrated Pollution Prevention

Control. The list of licensable activities in Schedule 1 of the Act includes the following:

No. 6. *Intensive Agriculture*. The thresholds in this subsection are as follows:

- “6.1 - *The rearing of poultry in installations, whether within the same complex or within 100 metres of the same complex, where the capacity exceeds 40,000 places;*
- 6.2 - *The rearing of pigs in an installation, whether within the same complex or within 100 metres of the same complex, where the capacity exceeds—*
 - *750 places for sows in a breeding unit, or*
 - *285 places for sows in an integrated unit, or*
 - *2,000 places for production pigs.*

In this paragraph—

- *‘breeding unit’ means a piggery in which pigs are bred and reared up to 30kg in weight;*
- *‘integrated unit’ means a piggery in which pigs are bred and reared to slaughter;*
- *‘production pig’ means any pig over 30kg in weight which is being fattened for slaughter; ‘sow’ means a female pig after its first farrowing.”*

The Industrial Emissions Directive (Directive 2010/75/EU) replaces a number of directives, including the IPPC Directive.

4.1.3 Current Status

4.1.3.1 Surface Water

The baseline period with respect to Food Harvest 2020 is 2007-2009. This is in parallel to the EPA’s most recent three year average compendium of water quality that was undertaken between 2007 and 2009 (EPA, 2010)⁹⁴. This report also contains both nutrient maps (see Figure 4-1 and Figure 4-2) and summary Water Framework Directive classifications for each river basin districts in Ireland. Additionally the draft *Freshwater Pearl Mussel River Basin Management Plans* present the location of Freshwater Pearl Mussel populations and water quality data within each Freshwater Pearl Mussel catchment, which nest within defined River Basin Districts. These reports were used to assess (regional) risks within Freshwater Pearl Mussel catchments where higher water quality standards (i.e. ‘High Status’) are required based on the ecological requirements of the species.

As groundwater and surface water are inherently linked through water flow pathways it can be considered that where there are particularly high risks to groundwater there may be parallel high risks to surface water (e.g. karstic areas); though subject to different time lags in which contamination would be apparent. Therefore in highly sensitive groundwater areas where intensification of land use may result in a greater magnitude of impact, the risk to surface waters can also be expected to be higher. Therefore the calculation of risk to surface water will take cognisance of groundwater risk in the impact assessment.

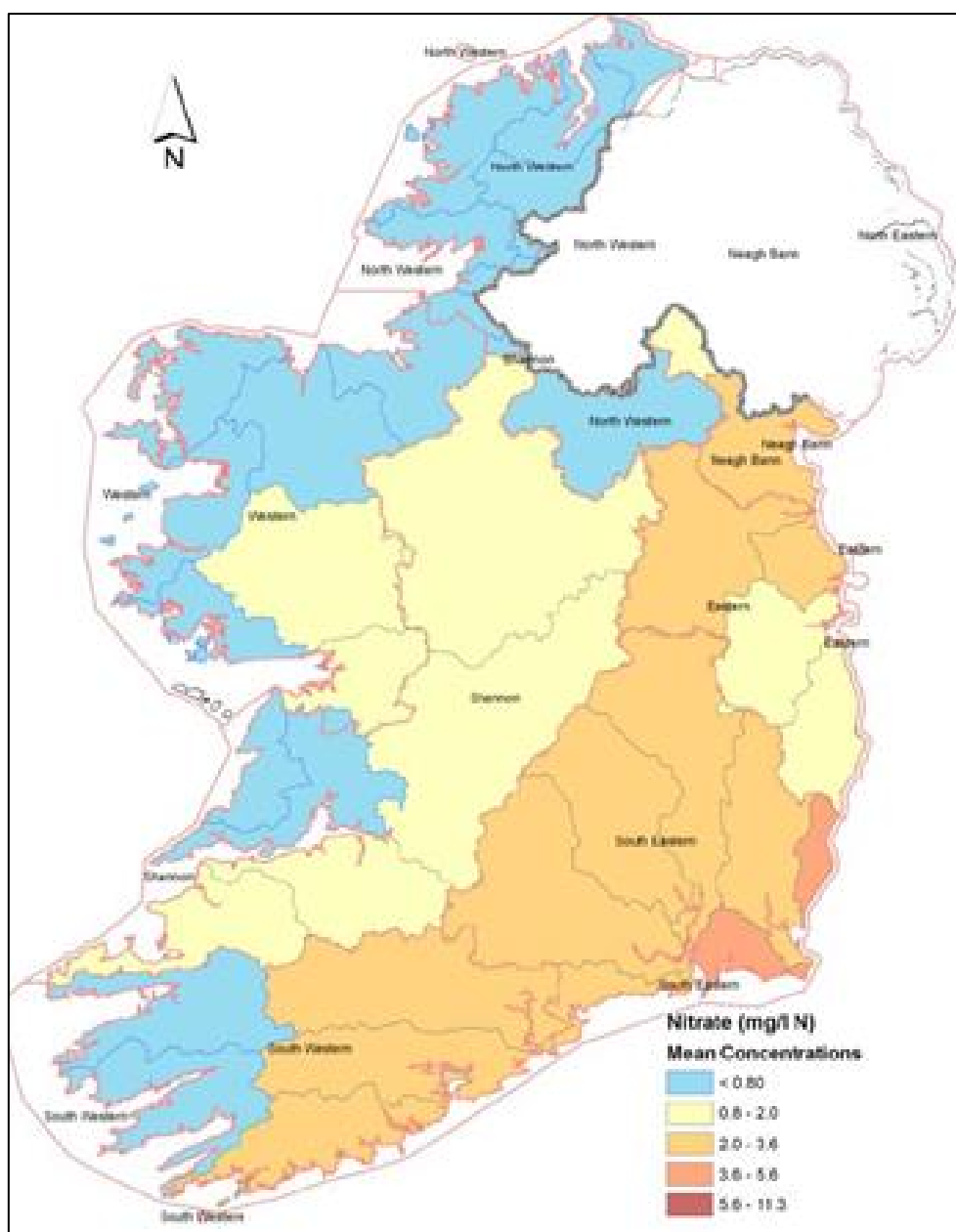


Figure 4-1: Average river [nitrate] in Irish RBDs (EPA 2010).

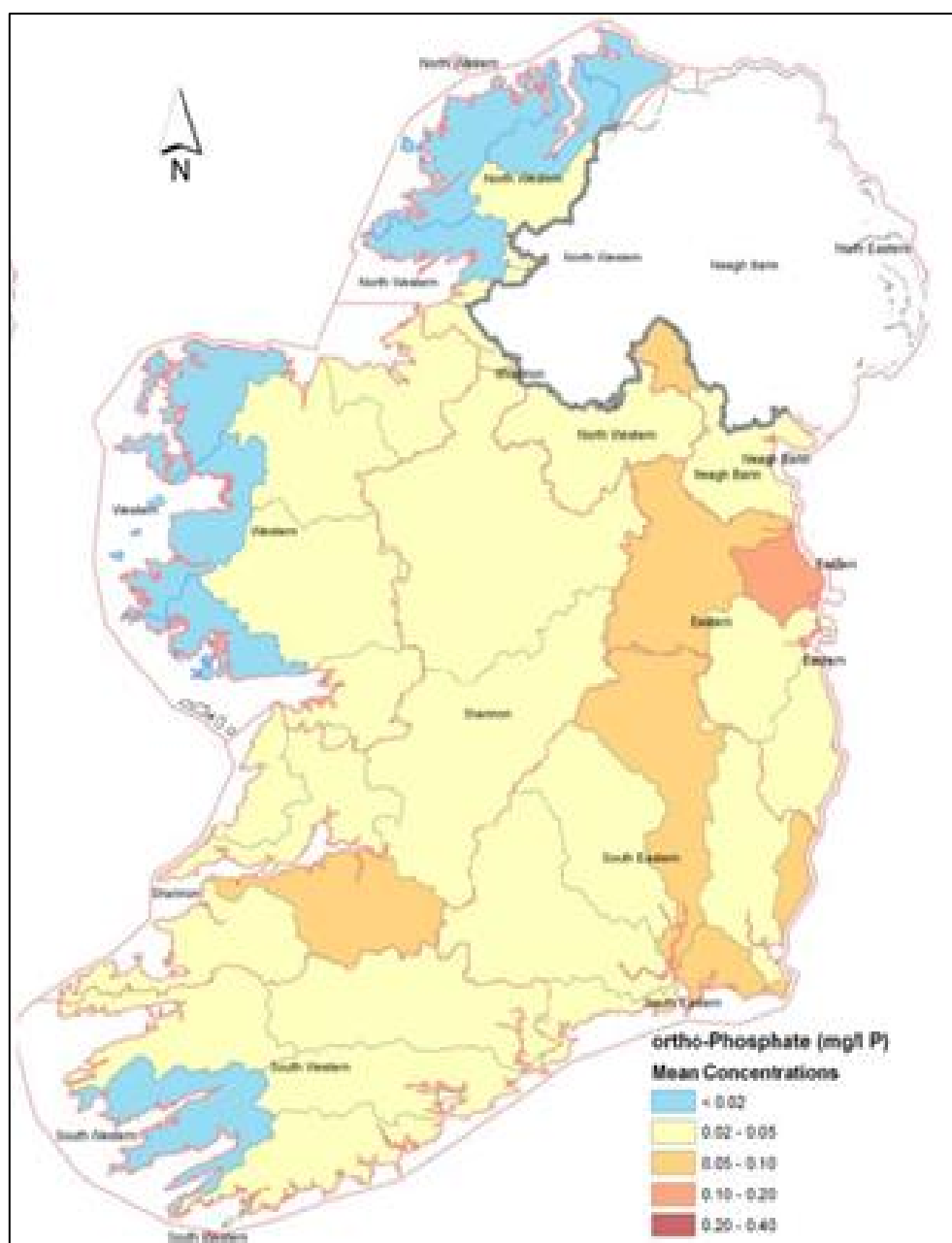


Figure 4-2: Average river [ortho-phosphate] in Irish RBDs (EPA 2010).

The Water Framework Directive Classification Scheme for surface water quality comprises five discrete classes that summarise water quality within Ireland's River Basin Districts. The location and extent of Ireland's River Basin Districts (RBD's) is shown in Figure 4-3.

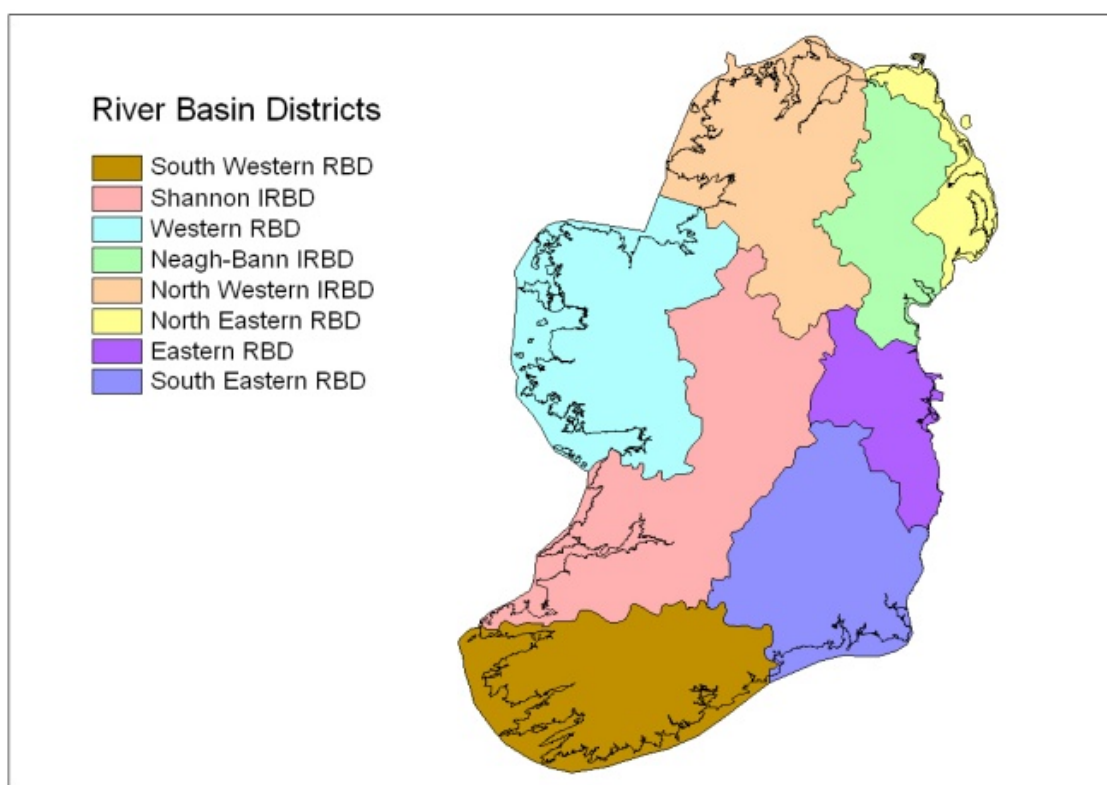


Figure 4-3: Location and extent of RBDs in Ireland.

These classes describe water quality on a scale ranging from high status to bad status (i.e. High, Good, Moderate, Poor, Bad). 'High status' can be defined as the biological, chemical and morphological conditions associated with low levels of human influence in a particular catchment and is required for SAC's designated for species such as Freshwater Pearl Mussel. High status is considered a 'reference condition' and thus represents the highest benchmark value.

Good status represents a deviation from the benchmark 'high status' and thus represents a deterioration in water quality. However 'good status' is prescribed as the pass criteria for rivers to achieve what is considered 'good water quality status' by 2015 under the remit of the Water Framework Directive.

As 'good status' water quality is monitored via both physiochemical and biological elements, throughout Irish River Basin Districts, biodiversity in aquatic habitats is monitored and afforded protection under the Water Framework Directive. Specifically WFD targets are achieved through monitoring of a variety of elements including

physical, biological and chemical, through a co-operative approach between numerous state bodies, for example Inland Fisheries Ireland, Marine Institute, Local Authorities, NPWS, BWI, NBDC, National Botanical Gardens, Third Level Institutions and the DECLG (EPA, 2010; EPA, 2012).

Monitoring carried out includes:

- River Monitoring (Physiochemical, Diatoms, Macrophytes, Macro-invertebrates and Hydromorphological assessment);
- Lake Monitoring (Physiochemical, Macrophytes, Macro-invertebrates and Plankton);
- Estuarine and Coastal Waters (Physiochemical, Macro-algae, Macrophytes and Phytoplankton).

Baseline water quality and associated biodiversity targets for Food Harvest 2020 can be assessed using the 2007-2009 water quality recorded by the EPA for rivers, lakes and transitional water-bodies (estuaries). The Water Framework Directive

summary data is available for these years for each of our national River Basin Districts. The EPA Water Quality in Ireland 2007-2009 programme surveyed 13,188km of river and stream channel (EPA, 2010). The EPA recorded a decrease in the length of slightly polluted channel (30% decrease in the number of polluted sites), while the length of moderately polluted channel remains unchanged. There had been a 2.5% decrease in the length of unpolluted channel since the last monitoring period in 2004-2006.

According to the EPA (2010) the water quality recorded in Irish rivers using the WFD categories and 'traditional monitoring approach' was as follows - 20.1% achieving High Status, 48.8% achieving Good Status, 20.7% achieving Moderate Status, 10% achieving 'Poor Status' and 0.4% achieving 'Bad' Status. Therefore 69.5% of the national river water bodies monitored nationally, achieved the target 'good status' or higher, required under the Water Framework Directive (EPA, 2010). However when using the one-out all-out approach and the 5 categories under the WFD Ecological Status approach only 52% of rivers were achieving the 'good status' or higher required under the remit of the WFD under the 2015 target year (EPA, 2010). This methodology is more stringent in that the water quality is determined by the lowest status of the recorded elements at the site and by the lowest status of the monitored sites within a water body (EPA, 2010).

Furthermore, it should be noted that approximately €2.5 billion has been spent in the

modification of farmyards to help achieve the goals of the Water Framework Directive (IFA, 2012). Ireland is currently ranked midway amongst ten European countries in achieving the targets of the Water Framework Directive (EPA, 2010).

4.1.3.1.1 Water Quality by River Basin District

The EPA Water Quality in Ireland Report (2007-2009) breaks down the percentage of channel lengths in each River Basin District (RBD) complying with the Water Framework Directive (i.e. those channels achieving 'good status' or higher). The western RBD's (i.e. SWRBD, WRBD and NWIRBD) have the highest proportion of unpolluted channel in Ireland, while the eastern RBD's had lower proportions of channel achieving 'good status' (i.e. SERBD, SERBD). The SWRBD achieved the best water quality of the national RBD's surveyed by the EPA and also illustrated a trend of further improvement in water quality since the previous two sampling periods between 2004-2006 and 2001-2003.

Teagasc (2009), highlight that one of the great difficulties with regard meeting water quality objectives is the significant lag time between the diffusion of nitrate and phosphorous through the vadose zone (sometimes incorrectly called the unsaturated zone) and saturated zone to surface waters, meaning that improvements in surface water quality from nutrient reduction may not be observed for many years.

Table 4-1: National Status of Rivers using the one-out-all-out; Numbers within RBD's in each of the five ecological status categories based on the combination of water quality elements (extracted EPA, 2010).

RBD/IRBD	High	Good	Moderate	Poor	Bad	Totals
East	16	26	54	41	1	138
Neagh/Bann	0	10	7	16	0	33
North West	23	72	45	55	4	199
South East	17	99	95	65	1	277
Shannon	27	142	121	83	8	381
South West	64	128	63	11	1	267
West	57	135	50	24	3	269
National	204	612	435	295	18	1564
% Per Status Category	13%	39%	28%	19%	1%	100%

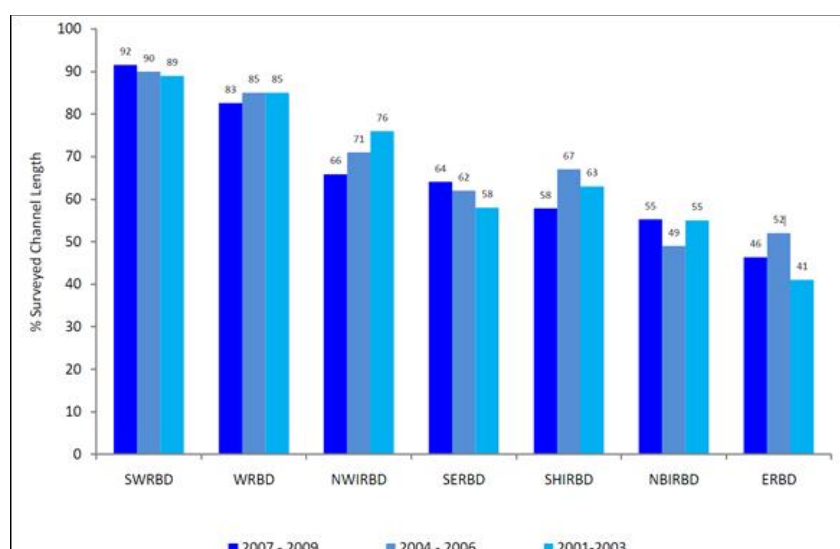


Figure 4-4: Trends in the percentage of unpolluted Class A (High and Good status) channel length in each River Basin District in the state for the survey periods 2007-2009, 2004-2006 and 2001-2003 (extracted from EPA 2010).

4.1.3.1.2 Lake Water Quality

According to the EPA, 81.1% of the lakes surveyed from a total of 222 lakes surveyed were of 'satisfactory status', during the 2007-2009 EPA monitoring period (EPA, 2010). This represented a 4% decline in the satisfactory category from the previous 2004-2006 period. Approximately 18% of the lakes surveyed between in the 2007-2009 period, were moderately to strongly eutrophic while only 1% of the lakes were in the most enriched category (EPA, 2010). Using the Water Framework Directive ecological status approach,

47.3% of the lakes achieved high or good status, 41.4% were of moderate status, 8.6% of poor status and 2.7% of bad status.

4.1.3.1.3 Estuarine Water Quality

According to the EPA (2010) 89 estuaries were sampled in Ireland to establish baseline water quality for the sampling period 2007-2009. The results found that 10.1% were eutrophic, 5.6% were potentially eutrophic, 34.8% were intermediate and 44% were unpolluted.

Using the WFD methodology approximately 121 transitional and coastal water bodies were assessed between 2007-2009 using both physiochemical and biological water quality indicators (EPA, 2010). Approximately 46% achieved high or good status while the remaining 54% achieved moderate status or lower. Estuaries are particularly sensitive to nitrate with 31 water bodies breaching the winter Dissolved Inorganic Nitrogen (DIN) assessment criterion (EPA, 2010).

4.1.3.2 Ground Water

4.1.3.2.1 Aquifer Classification

The Geological Survey of Ireland (GSI) has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size and productivity of the groundwater resource. The three main classifications are Regionally Important Aquifers (RI), Locally Important Aquifers (LI) and Poor Aquifers (P).

The GSI have developed a web-mapping site⁹⁵ which contains aquifer classification mapping and datasets for the Country. The aquifer classification map for the entire Country is shown in Figure 4-5.

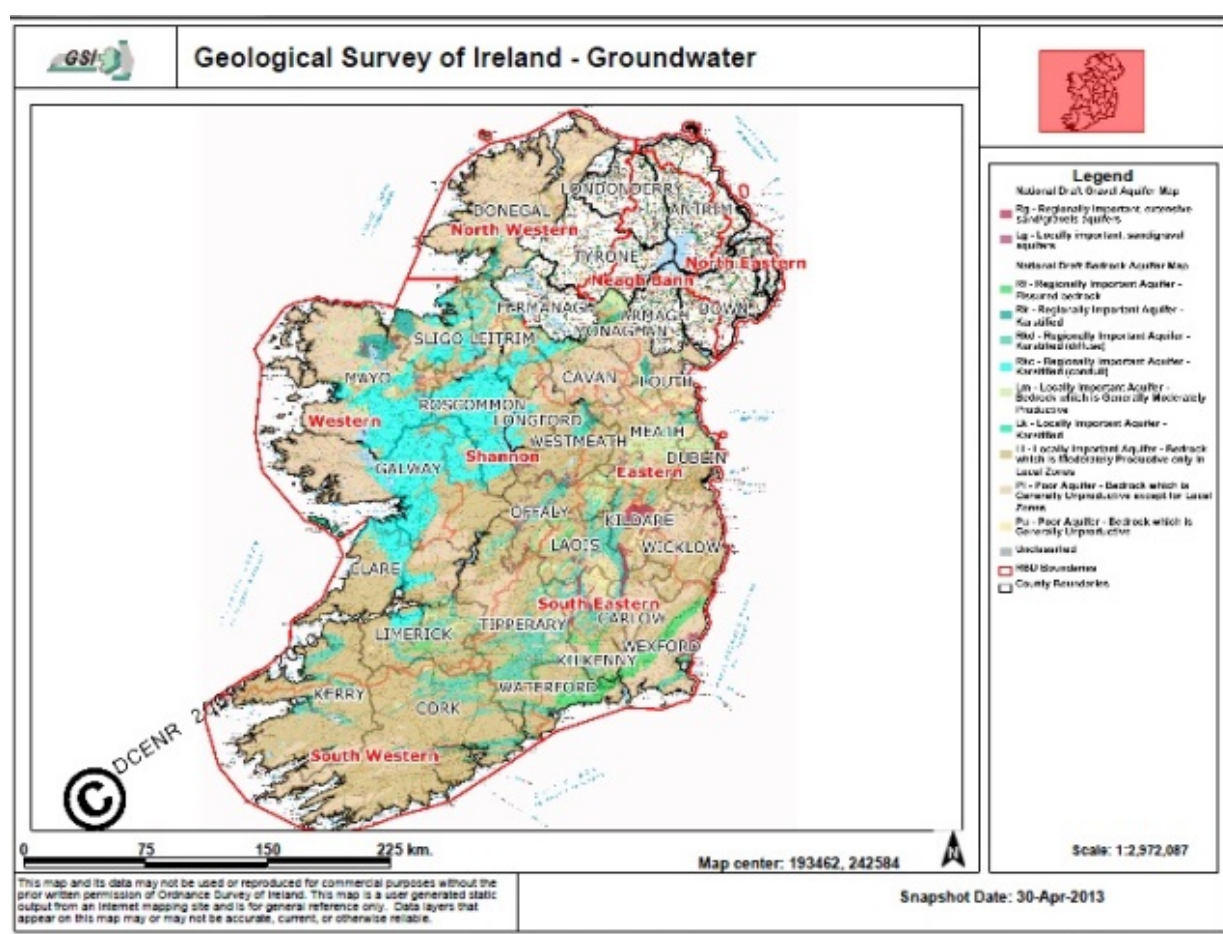


Figure 4-5: GSI Aquifer Classification Map of Ireland.

4.1.3.2.2 Groundwater Vulnerability

The vulnerability of a groundwater body is the term used to describe the ease with which the groundwater in the area can be contaminated by human activities. The vulnerability is determined

by many factors including the travel time, the quantity of contaminants and the capacity of the deposits overlying the bedrock to attenuate contaminants. These factors in turn are based on the thickness and permeability of the subsoil deposits, e.g. groundwater in bedrock which has a thick cover of low permeability clay is less

vulnerable than the groundwater in bedrock which is exposed at the surface. The criteria for determining groundwater vulnerability, as developed by the GSI⁹⁶, are shown in Table 4-2. The GSI have developed an on-line mapping site

containing vulnerability mapping for the entire Country. An example of a groundwater vulnerability map is shown in Figure 4-6.

Table 4-2: GSI Groundwater vulnerability mapping guidelines (DoELG 1999).

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type) & Thickness			Unsaturated Zone	Karst Features
	High Permeability (sand/gravel)	Moderate permeability (e.g. sandy subsoil)	Low permeability (e.g. clayey subsoil, clay, peat)	(sand/gravel aquifers only)	(<30m radius)
Extreme (E)	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 – 3.0m	-
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

Notes: (1) N/A = not applicable
 (2) Precise permeability values cannot be given at present
 (3) Release point of contaminants is assumed to be 1-2m below ground surface

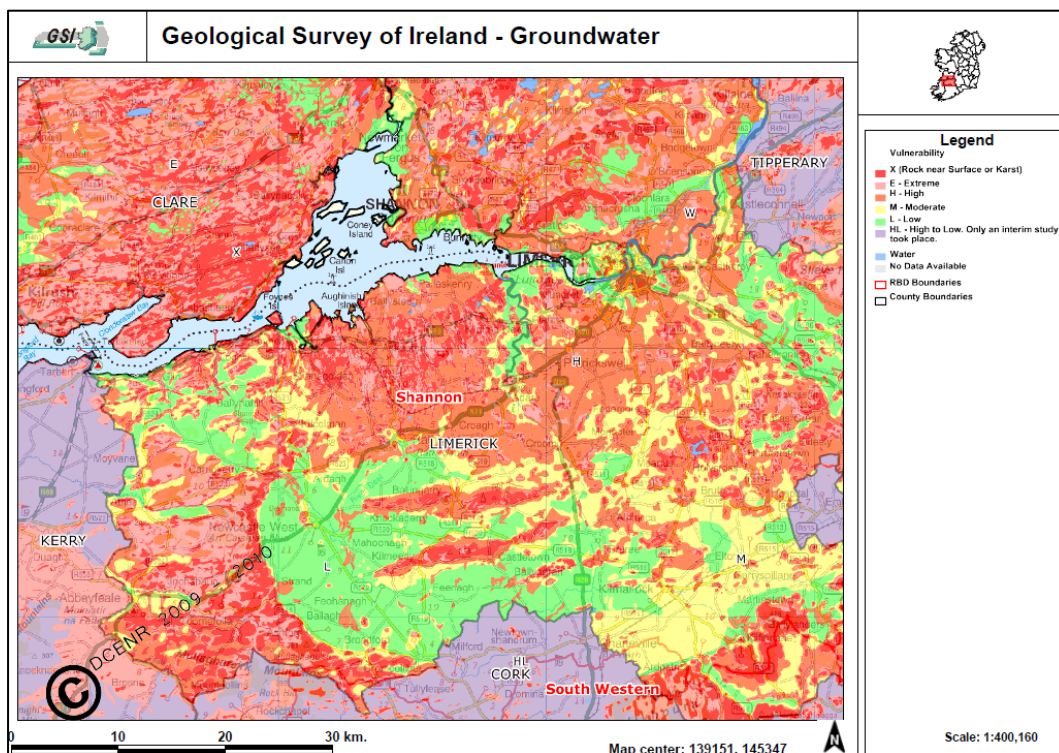


Figure 4-6: GSI Example of Groundwater Vulnerability Map.

4.1.3.2.3 Groundwater Protection Schemes

Groundwater Protection Schemes are county-based projects that are undertaken jointly between the GSI and the respective Local Authority. The overall aim of the Groundwater Protection Scheme is to preserve the quality of groundwater, particularly for drinking water purposes, for the benefit of present and future generations. The scheme is not intended to have any statutory authority, but provides a framework for decision-making and guidelines for the Local Authorities in carrying out their functions.

The Groundwater Protection Scheme comprises two components:

- i) A land surface zoning map (or maps) called the groundwater protection zone map;
- ii) Groundwater protection responses for existing and new potentially polluting activities.

The risk to groundwater is defined through assessments of groundwater vulnerability, aquifer potential and Source Protection Areas. The vulnerability and aquifer datasets cover the entire land surface of a given area, while the source protection area datasets are specific to the catchments of selected groundwater supply sources. The three datasets are merged to produce Groundwater Protection Zones. Each zone is represented by a code (e.g. Rf/H), which enables an assessment of the risk to groundwater, independent of any particular hazard or contaminant type. This assessment should be regarded as a guide in evaluating the likely suitability of an area for a proposed activity. Once the groundwater protection zone is defined for an area, the hazards posed by selected human activities can be evaluated to assess the appropriate risk management measures, or Groundwater Protection Responses for these activities. The Groundwater Protection Responses, which are shown by a code (e.g. R2¹), indicate the likely degree of acceptability of each activity in that Groundwater Protection Zone. There is a response code covering the land spreading of organic wastes, which includes agricultural slurries.

The GSI have developed an on-line mapping site containing Source Protection Area mapping for the entire Country.

4.1.3.2.4 GSI Well Records

GSI mapping shows the locations of all wells recorded by the GSI. However, as it is not a requirement for wells to be registered with the GSI, the GSI list of wells is not necessarily complete.

4.1.3.2.5 Ireland's Environment 2012- An Assessment (EPA 2012)

According to the recently published report by the EPA, groundwater is important as a source of drinking water in Ireland – providing approximately 25% of drinking water nationally. Groundwater also has significance in driving the ecology of many rivers, lakes and estuaries, especially during low-flow periods when groundwater forms a significant part of surface water flows. The report states that 85.6% of the area of groundwater aquifers in Ireland is at good status.

The EPA report states that the majority of the “*of poor-status groundwater bodies, particularly in the Western and Shannon River Basin Districts, are in areas where groundwater is contributing significant loads of phosphate to surface water bodies that are failing to meet their Water Framework Directive objectives due to eutrophication from diffuse sources.*”

Importantly, the EPA report states that Water Framework Directive criteria do not include microbiological elements in determining the assessment of ecological status. In 2010, 40% of all samples taken from the 285 wells and springs in the EPA national groundwater monitoring network were polluted by microbial pathogens, which can pose a threat to private water supplies in particular.

The EPA report states that overall, there is a continued need for improved protection of groundwater, especially in the context of achieving the WFD objective of good status for all waters by 2015. It also states that in some instances, it will not be feasible to meet this objective by this deadline, as it may take a number of years for the

measures to bring about a reduction in concentrations of nutrients. This is because the nitrate and phosphate will require time to flush through the groundwater system.

4.1.4 Drinking Water

The thirty four Water Services Authorities (WSA) (city and county councils) are responsible for the production, distribution and monitoring of drinking water from over 900 public water supplies serving 80.0% of the population. The rest is supplied by group water schemes (7.0%), small private supplies (0.7%) and private wells (12.3%) that are exempt under the Drinking Water Regulations. Responsibility for the water quality rests with the manager/operator of the supply.

4.1.4.1 Relevant Legislation

The European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. 278 of 2007) fully transpose and implement the EU Council Directive 98/83/EC on the quality of water for human consumption. These regulations came into effect on 12 June 2007. These regulations provide the EPA with supervisory powers for public water supplies. The EPA can direct a WSA to improve the management or quality of a public water supply. The WSAs have a similar supervisory role in relation to group water schemes and private supplies.

4.1.4.2 Drinking Water Supply in Ireland

In Ireland the majority of drinking water originates from surface water (81.9%) and the remainder originates from groundwater (10.5%) and springs (7.6%). Public Water Supplies (PWS) are particularly reliant on surface water sources.

4.1.4.3 Drinking Water Quality Issues

The availability of high quality drinking water and human health issues are closely related. Untreated private water supplies are particularly vulnerable to local quality variations. According to the EPA publication, *The Provision and Quality of Drinking Water in Ireland A Report for the Year 2011*, overall drinking water quality in Irish public water supplies serving 80% of the population continued to improve in 2011. In 2011, the EPA

found that, *E. coli* was detected in 12 (1.3%) public water supplies.

The microbiological quality of private group water schemes remains inferior to public water supplies. The number of private group water schemes where *E. coli* was detected in 2011 was 46 (10.2%), down from 56 (11.6%) in 2010.

Small private supplies showed a small increase in level of supplies with *E. coli* exceedances, from 7.4% of supplies in 2010 to 7.7% of supplies in 2011. The level of *E. coli* non-compliance in private supplies is higher than that of public supplies.

The most important health indicators of drinking water quality in Ireland are the microbiological pathogens and, in particular, *E. coli*. *E. coli* are present in very high numbers in human or animal faeces and are rarely found in the absence of faecal pollution in surface waters or groundwaters. As such, the presence of *E. coli* in drinking water indicates that the treatment process at the water treatment plant is not operating adequately or that contamination has entered the water distribution system after treatment.

Similar to *E. coli*, Enterococci bacteria are present in large numbers in sewage and water environments polluted by sewage or wastes from humans and animals. They are generally present in numbers lower than *E. coli* but they survive longer than *E. coli* and thus can indicate pollution that has occurred in the past.

4.1.4.4 Nitrates

Exceedance of the nitrate parametric value were reported in 17 supplies in 2011 (down from 19 in 2010). There was a reduction in the number of public water supplies with elevated levels of nitrates.

The population affected by nitrate exceedances also decreased, 23,153 in 2010 to 7,673 in 2011.

Elevated levels of nitrate were recorded in five public water supplies in 2011. The five supplies in 2011 were located in Carlow (one supply), Kilkenny (one supply) and Waterford (three supplies). The exceedances were attributed to abnormal contamination of the raw water source (one

supply) and diffuse pollution (four supplies). Of the six supplies reporting elevated levels of nitrate in 2010, one has been resolved by installation of a nitrate removal system, one has been resolved by blending, and one has been brought back into compliance by enforcement of Good Agricultural Practice (GAP) Regulations with a further three being addressed by a combination of GAP Regulations enforcement and source replacement.

Audits conducted by the EPA on public water supplies during 2011 found that problems arose from:

- Inadequate protection of the source (e.g. land spreading too close to source, inadequate borehole protection etc.) was noted in 33 audits compared to 46 in 2010.
- Ingress of surface water into boreholes was observed in four of the 96 groundwater supplies examined.

The main issues identified included:

- Inadequate or poor borehole construction;
- Evidence of ingress of surface water into boreholes (e.g. unsealed boreholes);
- Animal access to surface waters in the vicinity of abstraction points;
- Inadequate security.

4.1.4.5 Maintaining Drinking Water Quality

Source protection is the first barrier for the production of safe drinking water. By improving source protection, the quality of the source water may also be improved. This in turn, can lead to a reduction in the production of treatment by-products and minimise operational costs.

As a minimum, all drinking water supplies should be disinfected to ensure the safety of the final water for drinking.

Chlorination is the most common disinfection technology used in the treatment of drinking water in Ireland though UV is increasingly being used as a primary disinfectant in many supplies (usually with chlorination as a secondary disinfectant).

4.2 Environmental Assessment

4.2.1 Introduction

In this section, the potential impacts of the implementation of the Food Harvest 2020 scenario (Scenario A) on water quality are assessed for each of the farm sector groups, applying the methodology described in Section 2. This section deals with issues concerning the quality of surface and groundwater. Issues concerning water-dependant habitats and species are largely discussed in Section 3 on Biodiversity and Flora and Fauna and should be read in conjunction with this section. In order to assess impacts arising from Food Harvest 2020, which are undertaken from a national context, it is necessary to assess impacts regionally in order to establish national trends. The Census of the Agriculture 2010 data (CSO, 2010) examines agricultural sectors by geographic region (e.g. West, South West, South East etc.). In parallel, contemporary water quality data are summarised by River Basin Districts (Western River Basin District, South Western River Basin District etc.), which broadly overlap with the Census of Agriculture data. In the instance that the Census of Agriculture Regions do not overlap broadly with the River Basin Districts (e.g. the Border region), data from multiple RBD's overlapping that region are used to interpolate trends.

4.2.2 Identification of Key Agricultural Pressures

4.2.2.1 Surface Waters

Understanding the mechanism of pollutant transport to surface waters is a critical step in addition to source control in achieving 'good status' for receiving water bodies as required under the Water Framework Directive. Reducing nutrients at source and understanding the capacity of soil in storing nutrients and balancing nutrient cycling with production requirements is necessary in order to prevent nutrient enrichment of surface water and groundwater. DAFM (2008) identified a number of key pathways for the transport of water bound pollutants to sensitive surface waters. Key pollutant pathways in agricultural catchments are discussed. An example of phosphorous pathways from land to groundwater and surface waters is indicated in Figure 4-7. Key pathways include:

- Over surface: Surface run-off tends to occur more frequently on impermeable soils such as peat or heavy clays or on very thin soils over bedrock or iron pans. It is most evident during heavy rainfall;
- Through the soil/subsoil - this pathway is associated with highly permeable soils, e.g. brown earths and brown podsoles where water travels through the Vadose zone;
- Through drains/channels flowing directly from the site to the aquatic zone: This

pathway also includes temporary drains (in which water may not be permanently present) that may only operate during and immediately after rainfall;

- Through groundwater - water that permeates through the vadose zone and into the saturated zone (groundwater) where a sink of nutrients can be stored and liberated to surface waters that are recharged via springs.

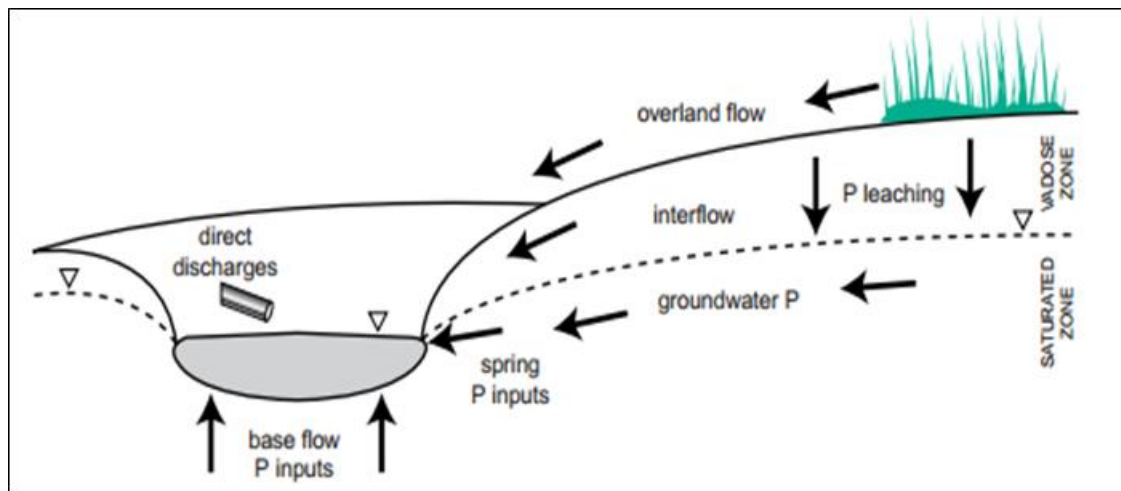


Figure 4-7: An example of phosphorous pathways from land to groundwater and surface waters (extracted from EPA, 2001).

The key pollutants associated with anthropogenic changes in land use patterns in agriculture that impact surface water quality include physical alteration (with associated release of fines), organic and chemical pollutants entering watercourses. Of these generic categories the following target pollutant sources are considered to present the most significant pressures in achieving the goals of the Water Framework Directive in the context of the agricultural sectors reviewed as part of Food Harvest 2020:

- Nutrient enrichment (Nitrate and Phosphate Pollutants);
- Siltation (suspended solid escapement);
- Acidification (Acidic deposition and resultant pH changes);
- Other Chemical Pollutants (Herbicides, Fungicides and Insecticides).

4.2.2.1.1 Nutrient Enrichment (N & P in surface Waters)

According to the EPA (2010), agricultural pollution was responsible for 39% of the 'moderate pollution' recorded by the EPA between 2007 and 2009. Pollution in the EPA 'moderate' category was attributed predominantly to diffuse sources including losses from farmyards, siltation from cattle poaching and bank erosion, phosphorus loss from riparian areas and nitrogen loss from tillage land.

The traditional application of animal wastes beyond the storage capacity of the soil propagates soil leaching of nutrients into rivers and lakes. Thus water quality deterioration is inevitable in the absence of nutrient management and the control of non-point sources of pollution in agricultural settings remains a complex task because of the difficulty in separating diffuse sources in scientific

and legal contexts (Berka *et al.* 2001)⁹⁷. Schulte *et al.* 2012⁹⁸, state that a key concern of nitrate application is the risk to groundwater on well drained soils where de-nitrification rates may not accommodate nitrate levels below 50mg/l that are required under the EU Nitrates Directive (91/676/EEC).

Apart from nitrogen, phosphorous is another critical nutrient in fertilisation practices and is a key driver of eutrophication in rivers (European Commission, 2010). Agriculture associated with intensive animal farming is also the largest contributor of phosphorus loading to the aquatic environment (Huttenen *et al.* 2011)⁹⁹ and in a number of countries in the EU, it has been responsible for up to 50% of the phosphorus loading (EEA, 2005)¹⁰⁰.

There have traditionally been strong links between animal and crop production on dairy farms, and as such management practices on individual elements can influence nutrient flows elsewhere (Huttenen *et al.* 2011). The production of feed grain and fertiliser outside the farm gate (Hart *et al.* 1997)¹⁰¹ has facilitated large livestock units on small land holdings. The author states that each farm should match plant nutrient requirements with target production while also reducing nutrient importation in animal feeds as a

mechanism of P reduction. In an Irish context, there has been an observed reduction in the national fertilizer sales of nitrogen, phosphorus and potassium with decreases of 20%, 40% and 37%, respectively, between 2003 and 2008 (Lalor, 2010)¹⁰². Figure 4-8 below illustrates P cycling on a hypothetical dairy farm.

Additionally there may be strong regional variation in the capacity of soils to denitrify groundwater nitrates, assimilate P and recycle nutrients. Nousiainen *et al.*, 2011¹⁰³ concluded from a model of P efficiency that P leaching to watercourses can be reduced by curbing mineral P application and regulating nutrient efficiency by matching it with nutrient uptake crop production. Therefore regional variation in fertilizer application rates, soil type and stocking rate, need to be balanced against water quality objectives and associated biodiversity gains (see Figure 4-8).

An evidence based understanding of the dynamic of nutrient cycling in relation to production intensity needs to be applied on a catchment by catchment basis following the dissemination of best practice methodologies from schemes such as Teagasc's, 'Agricultural Mini-Catchment Programme'. The consequences of intensification and the accumulation of non-point sources are discussed below in relation to aquatic biota.

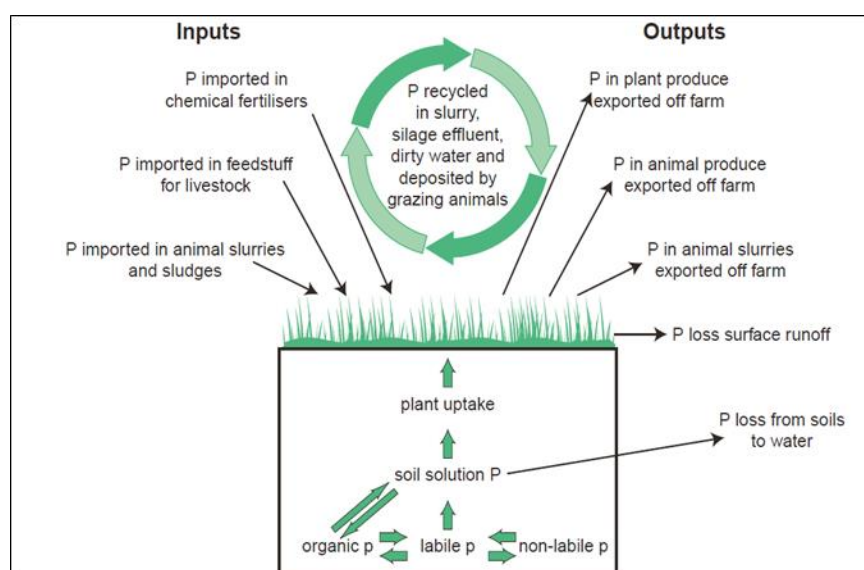


Figure 4-8: Inputs and outputs of P for a hypothetical farm (EPA 2001)¹⁰⁴.

The challenge of reconciling food production on a macro scale with water quality remains difficult primarily because of harmonisation between the deliverable of competitive food export prices and

the preservation of pollution sensitive aquatic systems. Some indicators of environmental water quality are given in Figure 4-9.

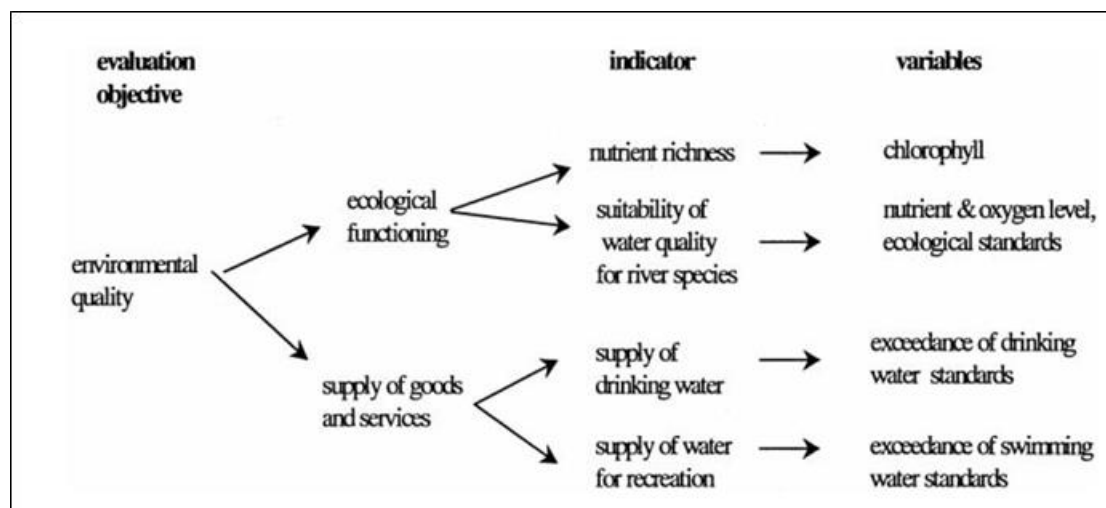


Figure 4-9: Indicators of environmental water quality (van der Vereen and Lorenz 2002).

4.2.2.1.2 Siltation

Siltation which arises from the release of suspended solids or peat to a watercourse can result in the clogging of the interstitial spaces in the gravels found in the bottom of river beds. These interstitial spaces facilitate the exchange of air and closing of them results in a significant reduction in available oxygen levels (sediment anoxia), thus impacting indicator species of water quality such as macro-invertebrates (including Freshwater Pearl Mussel), Fish and macrophytes that are indicator species for water quality objectives under the Water Framework Directive.

Physical alteration includes activities such as land drainage improvement that involves channel straightening, drainage ditch construction, clearance of riparian areas and other flood alleviation works that result in the liberation of fines to watercourses and thus reduce the surface water quality of surface waters. Cattle and sheep poaching of pastures or overgrazing can increase suspended solid losses to surface water.

4.2.2.1.3 Acidification

Acidification is the reduction of pH in surface waters and in agricultural catchments would be directly associated with coniferous afforestation.

The effect of acidification will depend on the buffering capacity of a particular catchment. Forests located on poorly buffered soils such as peat without underlying mineral soils can cause the acidification of the forest floor. This occurs because of chemical processes at the root zone and because of the deposition of pine needles (DECLG 2010) or enhanced transfer of atmospheric pollutants from the tree canopy and uptake of base cations that are lost during harvesting (Johnson *et al.*, 2010)¹⁰⁵. The reduction of pH in receiving water bodies can impact species used as indicators of water quality under the Water Framework Directive including invertebrates, fish populations, macrophytes and algae.

Reductions in pH can cause a slow breakdown of the calcareous mantle of pearl mussel while gonadal failure may also result and through problems with the regulation of acid-base mantle fluid homeostasis (Vinogradov *et al.* 1987)¹⁰⁶. Reductions in pH can also cause toxic mixing zones whereby metals become more labile and toxic to fish where acidic and base rich waters meet (Atland and Barlaup 1995)¹⁰⁷, or cause a reduction in the spawning capacity of salmonids (Kitamura & Ikuta 2000)¹⁰⁸.

4.2.2.1.4 Other Chemical Pollutants

There are numerous varieties of chemical pollutants applied to crops as a primary defence against pathogens, insects and fungi and noxious weeds including pesticides, herbicides and fungicides. These chemicals can impact surface water quality and damage non target organisms in the aquatic environment as they bio-accumulate in the watersheds of agricultural catchments.

According to (DAFM, 2007)¹⁰⁹, there was 1,520 tonnes of pesticides, 663 tonnes of herbicide, 619 tonnes of fungicide, 29 tonnes of insecticide applied to Irish arable crops. The most commonly detected pesticides in water quality are atrazine, simazine and bentazone which are considered broad spectrum weed-killers used domestically, by industries and also in agriculture that can make separation of source difficult (Isenbeck-Scroter *et al.* 1997)¹¹⁰ as with other non-point/diffuse source pollutants.

However, the EPA found from a pesticide monitoring programme during 2007-2009 that pesticide pollution of groundwater from diffuse sources was uncommon and the Drinking Water Maximum Admissible Concentration (MAC) of 0.1 µg/l for individual pesticides was exceeded in only 16 of 18,722 samples (<0.1%) indicating a very low level of contamination (EPA, 2010). There is no equivalent programme for surface waters.

4.2.2.2 Ground Water

4.2.2.2.1 Nitrate and Phosphate in Groundwater

According to the EPA's *Ireland's Environment 2012* report, in the period 2008–2009 there was a general reduction in nitrate concentrations compared with the previous period, which has been attributed to increased rainfall, reductions in inorganic fertiliser usage, improvements in organic fertiliser storage and the implementation of land-spreading restrictions. However, the report also states that elevated nitrate concentration in groundwater remains an issue, particularly in the southeast and south of the Country. The intensive agricultural practices in the south-east suggest that diffuse, agricultural sources are the cause of the elevated nitrate concentrations and the

vulnerable nature of the karst limestone aquifers in the west may explain the elevated phosphate concentrations in groundwater, and groundwater may be contributing to eutrophication in rivers and lakes in these areas.

In relation to diffuse pollution, the report states that agricultural activities associated with water pollution include land spreading of artificial fertilisers and animal manures in unsuitable climatic and ground conditions, silage effluent discharges, farmyard runoff, and poorly managed ring feeders. The EPA report states that there is a range of actions available to control groundwater pollution under existing legislation. This includes the implementation and enforcement of the Nitrates Action Plan under the EU Nitrates Directive. This is the most important measure to address diffuse agricultural pollution of freshwaters. This includes a code of Good Agricultural Practice (GAP) which is mandatory for all farms.

The Department of Agriculture, Food and Marine and the EPA licensing and enforcement activities have important roles in the regulation of land-spreading of slurry generated through intensive agricultural activities.

4.2.2.2.2 Microbiological Contamination

The EPA *Water Quality in Ireland Report 2007 – 2009* report states that the main sources of microbial pathogens are on-site wastewater treatment systems (e.g. septic tank systems), farmyard run-off, grazing animals and the land-spreading of manure or slurry. The report states that the natural environment, particularly soils and subsoils, can be effective in removing bacteria and viruses by filtration and absorption, but that not all areas are naturally well protected. Extremely vulnerable areas, including karst aquifers, fractured aquifers and areas with exposed outcrop or shallow soils, allow the rapid movement of contaminants into groundwater with minimal attenuation.

The report states that while the presence of glacial till subsoils and peat will, in many instances, retard the vertical migration of microbes, preferential secondary flow paths such as cracks in clay

materials can allow the filtering effect of the subsoils to be reduced or bypassed. The report states that the majority of private water supplies do not undergo any treatment prior to use, and that the delineation of source protection areas around water supplies provides an area in which protective measures can be applied. According to the report, the source protection area is based on the premise that 99.9 per cent of bacteria will die off within 100 days in groundwater.

Therefore proper management of activities within this 100 day “*time of travel*” area should reduce the risk of bacteriological contamination of the water supply. Refer to Figure 4-10 for a map detailing faecal coliform detections in groundwater 2007 – 2009.

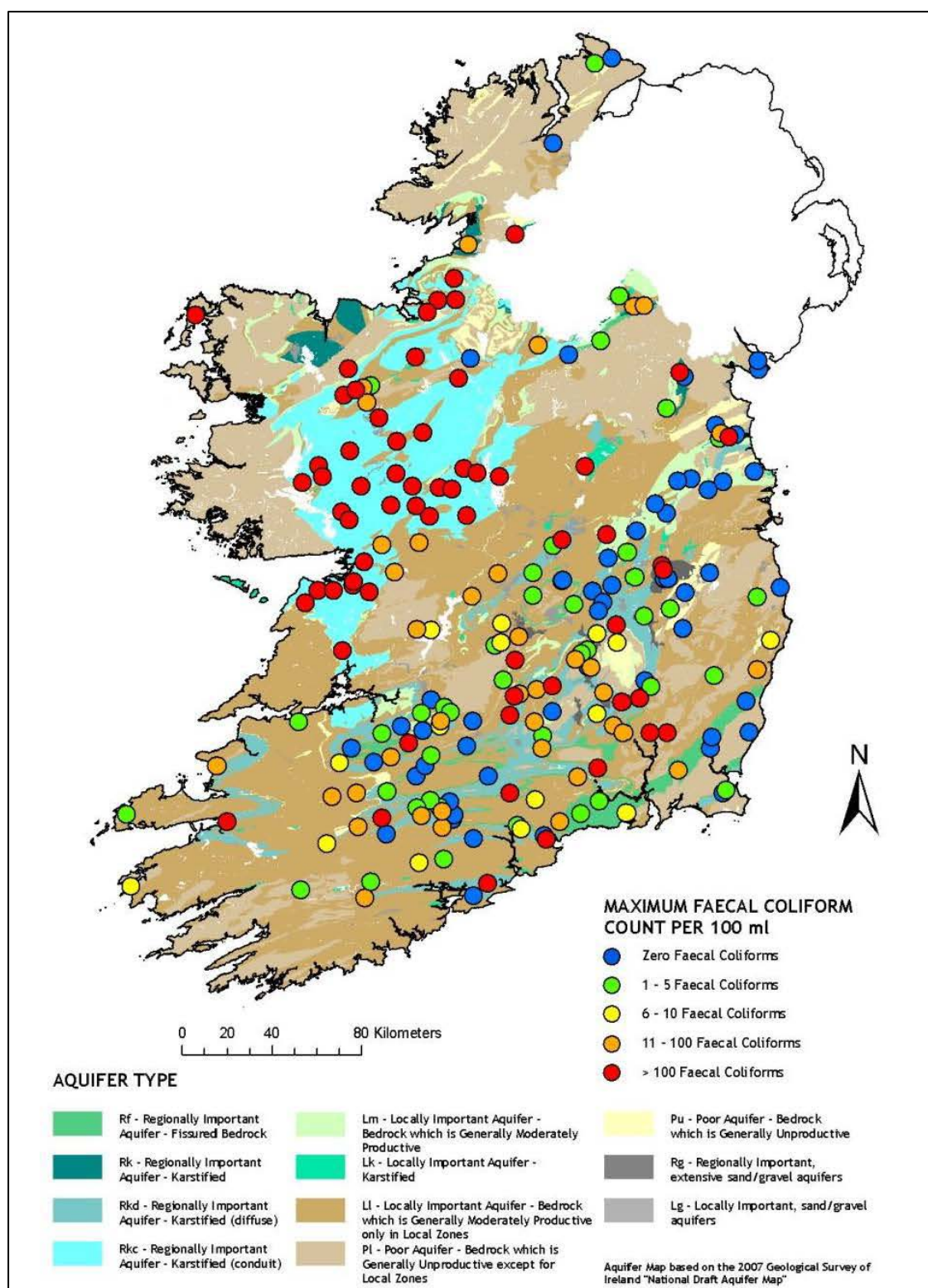


Figure 4-10: Faecal coliform detections in groundwater 2007 – 2009.

4.2.3 Assessment

In order to assess impacts arising from Food Harvest 2020, which are undertaken from a national context, it is necessary to assess impacts regionally in order to establish national trends. The *Census of the Agriculture 2010* data (CSO, 2010) examines agricultural sectors by geographic region (e.g. West, South West, South East etc.). In parallel, contemporary water quality data are summarised by River Basin Districts (Western River Basin District, South Western River Basin District etc.), which broadly overlap with the Census of Agriculture data. In the instance that the Census of Agriculture Regions do not overlap broadly with the River Basin Districts (e.g. the Border region), data from multiple RBD's overlapping that region are used to interpolate trends.

4.2.3.1 Water Status in the South west region

4.2.3.1.1 Surface water status

Water Framework Directive Classification

The South Western Region as defined by the Census of Agriculture 2010 (CSO, 2010) includes Counties Cork and Kerry. The South Western River Basin District Management Plan (2009-2015) contains very large areas of Counties Cork and Kerry and smaller parts of Limerick, South Tipperary and Waterford. The South Western River Basin District (SWRBD) provides a good baseline to compare regional trends in the CSO South West region because of the overlap between the SWRBD and the CSO south western region.

According to the South Western River Basin Management Plan (2009-2015), the SWRBD covers an area of approximately 11,000km² (with 4000km² of associated marine waters). The status of the water bodies in the SWRBD are discussed below.

The SWRBD also contains nine catchments that are designated as SAC's for the protection of Freshwater Pearl Mussel, a species that requires pristine water quality. The Freshwater Pearl Mussel catchments in the SWRBD include the Owenreagh, Caragh, Kerry Blackwater, Cummeragh, Cappal, Owenagappul, Bandon &

Caha, Munster Blackwater and the Licky that is shared with the SERBD.

WFD Status of Surface & Transitional Waterbodies

According to the South Western River Basin Management Plan (2009-2015), 32% of rivers and canals have High Status, 35% (Good Status), 26% (Moderate Status), 7% (Poor Status) and 0.1% (Bad Status).

A total of 57% of Lakes and Reservoirs have High Status, 25% (Good Status), 18% (Moderate Status) while no lakes or reservoirs fell into the lower Poor Status or Bad Status categories.

With regard estuarine habitats, 7% achieved High Status, 2% (Good Status) and 58% (Poor and Bad Status categories). However, water quality has yet to be determined for 33% of transitional water bodies.

Chemical Status

Nitrate and Phosphorous are key pollutants in agricultural landscapes. Nutrient maps for the SWRBD are illustrated below on Figure 4-1 (EPA, 2010). The EPA maps illustrate that mean nitrate concentrations are 2.0-3.5mg/l N and mean Phosphorous concentrations are 0.02-0.05mg/l P in Cork from the 2007-2009 sampling period. Nutrient levels were markedly lower in County Kerry with Nitrate levels recorded at <0.80mg/l N and Ortho-Phosphorous levels recorded at <0.02mg/l P respectively.

4.2.3.1.2 Groundwater Status

Water Framework Directive Classification

The South Western River Basin District includes Counties Cork and Kerry. Groundwater status is described in the South Western River Basin Management Plan (2009-2015)¹¹¹ as 97% (km²) 'Good Status', and 3% (km²) 'Poor Status'. The EPA's Water Framework Directive Risk Scores for Counties Cork and Kerry indicate that a large area of County Cork is currently classed as 'At risk of not achieving Good Status' by 2015 with the remainder of County Cork being classed 'Probably at risk of not achieving Good Status'. The majority of County Kerry is classed as 'Expected to achieve Good Status' by 2015, with some localised areas

classed as 'At risk of not achieving Good Status' by 2015 and 'Probably at risk of not achieving Good Status' by 2015¹¹².

Groundwater Productivity in the South West Region

Throughout the South Western River Basin District (which includes Counties Cork and Kerry) sandstone, siltstone and mudstone are the predominant bedrock. These rock types range from poorly productive to moderately productive aquifers (water-bearing rocks) but are generally not capable of producing groundwater supply for large population centres. Limestone and gravels are less prevalent but are important drinking water sources where they occur in north and east Cork. Groundwater, primarily in the limestone aquifers, also makes an important contribution to river flows.

According to the *Southwest River Basin District Management Plan 2009-2015*, areas underlain by poorly productive rocks comprise 88% of the district, areas underlain by karstic rock comprise 11% of the district and areas underlain by productive bedrock and sand/gravel aquifers comprise 1% of the district.

Source Protection Areas in the South West Region

There are some EPA and GSI 'Source Protection Areas' located in eastern and northern areas of County Cork as indicated on GSI online groundwater mapping¹¹³.

4.2.3.2 Water Status in the South East Region

4.2.3.2.1 Surface Water

Water Framework Directive Classification

The South Eastern Region as defined by the Census of Agriculture 2010 includes Counties Carlow, Kilkenny, South Tipperary, Waterford and Wexford. The South Eastern River Basin District (SERBD) contains all of Counties Carlow, Wexford and Kilkenny, the majority of Waterford, Tipperary, with smaller areas Kildare, Offaly and Wicklow. Very localised areas of south east Limerick and of east Cork are also within the

SERBD. The SERBD therefore provides a good baseline to compare regional trends in the CSO South East region because of the overlap between the SERBD and the Census of Agriculture 2010 South East region.

According to the South Eastern River Basin Management Plan (2009-2015), the South Eastern River Basin District (SERBD) covers an area of approximately 13,000km² and 1,000km² of marine waters making it one of Ireland's largest. In the SERBD, monitoring is carried out on 359 out of 672 river water bodies, 5 out of 12 lake water bodies, 103 out of 151 groundwater bodies and 14 out of 30 coastal and transitional waters. The water quality status of water bodies in the SERBD are discussed below.

The SERBD contains seven catchments that are designated as SAC's for the protection of Freshwater Pearl Mussel, a species that requires pristine water quality. The Freshwater Pearl Mussel catchments in the SERBD include the Nore, Dereen, Mountain-Aughnabriskey, Ballymurphy, Aughavaud and Clodiagh, while the Licky is shared with the SWRBD.

WFD Status of Surface & Transitional Waterbodies

According to the South Eastern River Basin Management Plan (2009-2015), 8% of rivers and canals have High Status, 39% (Good Status), 34% (Moderate Status), 18% (Poor Status) and 1% (Bad Status).

Lakes and reservoirs over the threshold size of 50ha that are required be measured for water quality under the Water Framework Directive (2000/60/EC) are regionally rare in the SERBD, with a total of 12 water bodies being measured. A total of 54% of Lakes and Reservoirs have Good Status, 38% (Moderate Status) while no lakes or reservoirs fell into the lower Poor Status and Bad Status categories or the High Status category. The water quality of 8% of the Lakes and Reservoirs in the SERBD, have yet to be determined.

With regard estuarine habitats 5% achieved Good Status and 16% fell into the Moderate Status category. No estuarine habitats were categorised into the High Status category.

Of the coastal habitats, 11% achieved Good Status, 33% achieved Moderate Status and the water quality of 56% of coastal water quality in the SERBD has yet to be determined.

Nutrient Status

The EPA nutrient maps illustrate that rivers in South Wexford, Carlow and Kildare had mean Ortho-P levels of between 0.05-0.10 mg/l P (EPA, 2010). The remainder of the SERBD (Waterford, Kilkenny, Tipperary, north Wexford, Carlow and South Wicklow) had lower mean Ortho-P levels of between 0.02-0.05mg/l P (see Figure 4-1 below).

The nitrate maps show that with the exception of Wexford the remainder of the SERBD had mean Nitrate concentrations of between 2.0-3.5mg/l N. Where Wexford borders the coastline on its eastern and southern seaboard Nitrate was elevated between 5.6-11.3mg/l N that represented the highest mean concentration of Nitrate nationally.

4.2.3.2.2 Groundwater Status

Water Framework Directive Classification

The South Eastern River Basin District (SERBD) includes Counties Carlow, Kilkenny, South Tipperary, Wexford and Waterford. According to the *South Eastern River Basin Management Plan 2009-2015*¹⁴, the groundwater status of the region is 98% 'Good Status' and 2% 'Poor Status'. The EPA's Water Framework Directive Risk Scores for the South-East Region indicate that a substantial area of South Tipperary is currently classed as 'At risk of not achieving Good Status' by 2015. Parts of County Wexford are also currently classed as 'At risk of not achieving Good Status' by 2015. Other areas of the South-East are classed 'Probably at risk of not achieving Good Status' and 'Expected to achieve Good Status' by 2015 (www.epa.ie).

The *South West River Basin Management Plan 2009-2015 (2010)* states that the National Monitoring Programme (which is undertaken by the EPA) has indicated a number of patterns of concern in relation to elevated nitrate concentrations in the east and southeast of the State in both groundwater and surface waters

(EPA, 2008 and 2009). The Plan also states that *"the same presence of intensive agricultural practices on free draining soils in the southeast suggests that diffuse agricultural sources are the cause of the elevated nitrate concentrations"*.

Groundwater Productivity in the South East Region

There are several important aquifers (water bearing rocks) in the southeast, including volcanic rocks in Waterford and Wexford and limestones underlying the lowland areas.

Groundwater is an important source of drinking water but also makes an important contribution to river flows. It is estimated that groundwater contributes about 40% of all the water flowing in the River Nore. In the South Eastern River Basin Management Plan, there were four groundwater body types identified, based on flow regime of the aquifer. These are poorly productive bedrock, productive fissured bedrock aquifers, karstic and gravel. The Plan also states that areas underlain by productive bedrock and sand/gravel aquifers comprise 37% of the SERBD, and poorly productive rocks underlie 63% of the District.

4.2.3.3 Water Status in the Western Region

4.2.3.3.1 Surface Water

Water Framework Directive Classification

The Western Region as defined by the Census of Agriculture 2010 includes Counties Galway, Mayo and Roscommon. There is broad overlap between the Census of Agriculture Western Region and the Western River Basin District that contains the majority of Counties Galway and Mayo, with the exception of County Roscommon that is located in the Shannon River Basin District.

The WRBD contains the majority of Counties Galway, Mayo and Sligo, parts of Leitrim and small areas of Clare and Roscommon. According to the Western River Basin Management Plan (2009-2015), the Western River Basin District (WRBD) covers an area of approximately 12,193km² and 2,700km of coastline.

The WRBD has a particularly high density of surface waters including 89 river catchments (covering 14,200km) and numerous large lake

catchments including Corrib (165km²), Conn (107km²), Mask (82km²) and Carra (15km²) to name a proportion of them.

The WRBD also contains four catchments that are designated as SAC's for the protection of Freshwater Pearl Mussel, a species that requires pristine water quality. The Freshwater Pearl Mussel catchments in the WRFB include the Newport, Bundorragha, Dawros and Owenriff.

WFD Status of Surface & Transitional Waterbodies

According to the **Western River Basin Management Plan (2009-2015)**, 19.2% of rivers and canals have High Status, 47.2% (Good Status), 15.8% (Moderate Status), 16.8% (Poor Status) and 1% (Bad Status).

Lakes and reservoirs over the threshold size of 50ha that are required be measured for water quality under the Water Framework Directive (2000/60/EC) are abundant in the WRBD, with a total of 321 water bodies being measured according to Western River Basin Management Plan (2009-2015). A total of 58.4% of Lakes and Reservoirs had High Status, 23.9% (Good Status), 16.8% (Moderate Status) and 0.6% (Poor Status).

With regard estuarine habitats 10.3% have High Status, 16.2% (Good Status) and 11.8% (Moderate Status). Of the coastal habitats, 43.3% achieved High Status, 20% achieved Good Status, while none fell into the Moderate Status category. The water quality of 36.7% of coastal water quality in the SERBD has yet to be determined.

Nutrient Status

According to the EPA nutrient maps (EPA, 2010), rivers in the western parts of County Galway and the majority of Mayo, and Sligo have low mean Nitrate concentrations <0.80mg/l N, representing some of the lowest recorded levels nationally as with many of the western counties of Ireland (EPA, 2010). Large areas of Galway in the limestone regions have more elevated Nitrate concentrations of between 0.8-2.0mg/l N. Ortho-Phosphorous concentrations are lowest along the western seaboard of Galway and Mayo with mean levels recorded at <0.02mg/l P. Ortho-Phosphorous levels

are more elevated in Counties Sligo, Mayo and Galway with levels recorded at between 0.02-0.05mg/l P.

4.2.3.3.2 Groundwater Status Water Framework Directive Classification

The Western River Basin District includes Counties Mayo, Roscommon and Galway. Groundwater status is described in the *Western River Basin Management Plan (2009-2015)*¹¹⁵ as 68% (km²) 'Good Status', and 32% (km²) 'Poor Status'. Large areas of Counties Mayo and Galway, in particular, are classed as having poor groundwater status, including the karst limestone areas with shallow soils in Galway, where ground-waters are most vulnerable to seepage of pollutants from agriculture. In these areas, groundwater is contributing significant loads of phosphate to surface water bodies that are failing to meet their Water Framework Directive objectives because of eutrophication from diffuse sources. The EPA's Water Framework Directive Risk Scores indicate that large parts of south-east Mayo, Roscommon and north Galway are currently classed as 'At risk of not achieving Good Status' by 2015 including the karst limestone areas with shallow soils in Galway, where ground-waters are most vulnerable to seepage of pollutants from agriculture. In these areas, groundwater is contributing significant loads of phosphate to surface water bodies that are failing to meet their Water Framework Directive objectives because of eutrophication from diffuse sources. Large areas of west Mayo and west Galway are classed as 'Expected to achieve Good Status' by 2015¹¹⁶.

Groundwater Productivity in the West Region

The ground-water body type in south Mayo and large parts of Galway, mainly in the area east of Loughs Corrib, Mask and Carra, is classed regionally important aquifer – karstified. The permeable rocks and soils in these areas allow ground-water to be stored in underground aquifers and these provide significant drinking water supply. The majority of northwest Mayo and the western area of County Galway are underlain by poorly productive aquifers. The area in the

vicinity of Loughrea in County Galway is underlain by locally important aquifers.

A large part of the ground-water body of County Roscommon is classified as Regionally Important Aquifer – Karstified (conduit) (Rkc).

Source Protection Areas in the West Region

There are some EPA and GSI 'Source Protection Areas' in County Roscommon, one near Clonbern in north-east Galway and one in north-east Mayo, near Foxford, as indicated on GSI online groundwater mapping.

4.2.3.4 Water Status in the Border Region

4.2.3.4.1 Surface Water

The Border Region¹¹⁷ counties as defined by the Census of Agriculture 2010 fall into a number of distinct river basin districts whose summary water quality data is described below in terms of each river basin district with exception of the WRBD that has been summarised previously. The border region includes Counties Cavan and Donegal that are both located in the North Western International River Basin District and Monaghan and Louth that are both located in the Neagh-Bann River Basin District. Finally Sligo is located within the Western River Basin District and Leitrim within the Shannon River Basin District.

4.2.3.4.1.1 North Western River Basin

Water Framework Directive Classification

According to the North Western River Basin Management Plan (2009-2015), the North Western International River Basin District (NWIRBD) covers an area of approximately 7400km² in the Republic of Ireland, with 4900km² in the north of Ireland. The NWIRBD region includes all of County Donegal. It also includes large areas of Fermanagh, Cavan, Derry, Leitrim and Longford with a small area of Sligo.

The NWIRBD has a particularly high density of surface water, particularly lake, water-bodies. There are 705 rivers and canals with 226 lakes including large lakes such as Lough Melvin (22 km²), Lough Oughter (13 km²) and Lough Gowna (13 km²). There are 2,500 km² of marine waters,

with the majority bordering County Donegal with smaller sections of the Leitrim and Sligo coastlines. In the NWIRBD the monitoring programme assesses 230 out of 703 river water bodies, 63 out of 233 lake water bodies and 13 out of 45 coastal and transitional water bodies.

The NWIRBD contains six catchments that are designated as SAC's for the protection of Freshwater Pearl Mussel, a species that requires pristine water quality. The Freshwater Pearl Mussel catchments in the NWIRBD include the Eske, Owenea, Clady, Owencarrow, Glaskeelan and Leannan.

WFD Status of Surface & Transitional Waterbodies

According to the **North Western River Basin Management Plan (2009-2015)**, 14% of rivers and canals have High Status, 40% (Good Status), 23% (Moderate Status), 22% (Poor Status) and 1% (Bad Status).

Lakes and reservoirs over the threshold size of 50ha that are required be measured for water quality under the Water Framework Directive (2000/60/EC) are very abundant in the NWIRBD, with a total of 63 out of 233 lake water bodies being measured. A total of 26% of Lakes and Reservoirs have High Status, 25% (Good Status), 44% (Moderate Status), 3% (Poor Status) and 2% (Bad Status).

With regard estuarine habitats 23% achieved High Status, 5% Good Status and 36% Moderate Status. The water quality of 36% of estuaries has yet to be determined.

Of the coastal habitats, 26% achieved High Status, 0% achieved Good Status, 30% achieved Moderate Status and the water quality of 44% of coastal water quality in the NWIRBD has yet to be determined.

Nutrient Status

The EPA nutrient maps illustrate that the river catchments in the NWIRBD have some of the lowest Nitrate levels in Ireland. Mean Nitrate concentrations are <0.80mg/l N apart from County Leitrim (EPA, 2010). The Ortho-phosphorous levels in the NWIRBD are very low in all of County

Donegal (<0.02mg/l P) apart from the south east of the county with mean levels recorded at 0.02-0.05mg/l P. Leitrim, Fermanagh, Sligo, Cavan and Longford have higher levels of Ortho-P with mean levels recorded at between 0.02-0.05mg/l P.

4.2.3.4.1.2 [Shannon River Basin](#)

Water Framework Directive Classification

The Shannon River Basin Management Plan (2009-2015) indicates that the Shannon River Basin District (ShIRBD) is the largest in Ireland, covering an area of approximately 18,000km². According to the management plan, the ShIRBD has an abundance of small lake habitats with 1,600 lakes present but less than 50 are over 1km². The largest lakes in the RBD are located on the Shannon itself and include Lough Derg (120km²), Lough Ree (100km²) and Lough Allen (30km²). The Shannon estuary is Ireland's largest covering an area of 1,500km².

The ShIRBD includes large areas of Counties Limerick, Clare, Tipperary, Offaly, Westmeath and Roscommon. The River Basin District also includes significant areas of Counties Kerry, Galway, Leitrim and Cavan. Very small areas of Sligo, Mayo, Cork, Laois, Meath and Fermanagh are also located within the ShIRBD. The water quality status of water bodies in the ShIRBD are discussed below.

The ShIRBD contains two small catchments that are designated as SAC's for the protection of Freshwater Pearl Mussel, a species that requires pristine water quality. The Freshwater Pearl Mussel catchments in the ShIRBD are the Owenmore and Cloon that are located in the south west.

WFD Status of Surface & Transitional Waterbodies

According to the Shannon River Basin Management Plan (2009-2015), 5% of rivers and canals have High Status, 38% (Good Status), 29% (Moderate Status), 26% (Poor Status) and 1% (Bad Status).

Of the lake catchments monitored under the Water Framework Directive, 14% are of High Status, 29% (Good Status), 51% (Moderate Status), 3% (Poor Status) and 1% (Bad Status). The water

quality of 2% of the Lakes and Reservoirs in the ShIRBD, has yet to be determined.

With regard estuarine habitats none achieved High Status, 35% achieved Good Status and 35% fell into the Moderate Status category. The water quality of 30% of the estuaries within the ShIRBD has yet to be determined.

Of the coastal habitats, 9% achieved High Status and 18% achieved Good Status while none fell into the moderate status category. The quality of 73% of coastal habitats has yet to be determined.

Nutrient Status

The EPA nutrient maps illustrate that the ShIRBD has a homogenous regional nutrient pattern with regard mean Nitrate levels (EPA, 2010). With the exception of County Clare that had very low mean Nitrate levels (<0.80mg/l N), elsewhere in the ShIRBD levels were recorded between 0.8 and 2.0mg/l N (see Figure 4.1).

The mean Ortho-Phosphorous levels in the ShIRBD also illustrate a homogenous pattern with the exception of County Limerick that had elevated levels, recorded between 0.05-0.10mg/l P. The remainder of the ShIRBD had moderate Ortho-Phosphorous levels that were recorded between 0.02-0.05mg/l P.

4.2.3.4.1.3 [Neagh-Bann River Basin](#)

Water Framework Directive Classification

The Neagh-Bann River Basin Management Plan (2009-2015) indicates that the Neagh Bann International River Basin District (NBIRBD) covers an area of approximately 2000km² in the republic of Ireland and 6000km² within Northern Ireland. According to the management plan, the Neagh Bann IRBD contains the River Bann which is the major river system in the RBD. It also contains Lough Neagh that is the largest lake in Britain and Ireland at 400km². The NBIRBD includes all of County Monaghan, large parts of Louth and Meath and small parts of Cavan in the Republic of Ireland.

WFD Status of Surface & Transitional Waterbodies

According to the Neagh Bann River Basin Management Plan (2009-2015), 20% of rivers and

canals have Good Status, 48% (Moderate Status), 30% (Poor Status), and 1% (Bad Status).

Lakes and reservoirs over the threshold size of 50ha that are required be measured for water quality under the Water Framework Directive (2000/60/EC) are limited in the NBIRBD, with a total of 16 water bodies being measured according to the River Basin Management Plan. A total of 13% of Lakes and Reservoirs have Good Status, 75% (Moderate Status), 6% (Poor Status) and 6% (Bad Status). No lakes or reservoirs in the NBIRBD achieved High Status.

With regard estuarine habitats 100% of those sampled fell into the Poor Status category.

Of the coastal habitats, 40% achieved Good Status, while 40% achieved Moderate Status and the water quality of 20% of coastal water quality in the NB RBD has yet to be determined. No coastal habitats fell into the High Status category.

Nutrient Status

The EPA nutrient maps within the river catchments in the republic of Ireland within the NBIRBD illustrated that mean Nitrate concentrations were variable in the NBIRBD. Parts of Counties Louth and parts of Monaghan within the NBIRBD had low mean nitrate levels with levels recorded at less than 0.8mg/l N.

The mean Ortho-Phosphorous levels in Louth and Monaghan were recorded between 0.02 and 0.05mg/l P, with the exception of north Monaghan that had mean Ortho-Phosphorous levels of between 0.05 and 0.10mg/l P.

4.2.3.4.2 Groundwater Status

Water Framework Directive Classification

According to the EPA's Water Framework Directive groundwater status maps, the majority of the Border Region is classed as 'Good Status'. There are localised areas of Counties Sligo and Leitrim which are classed as 'Poor Status'. The EPA's Water Framework Directive Risk Scores indicate that the majority of the Border Region is classed as 'Expected to achieve Good Status' by 2015. Some parts of Counties Sligo and Leitrim are currently

classed as 'At risk of not achieving Good Status' by 2015.

Groundwater Productivity in the Border Region

The groundwater body type in Donegal mainly consists of poorly productive bedrock aquifer, except for a localised area in the vicinity of Donegal and Ballyshannon towns which consist of some locally important and regionally important aquifers. Some parts of Counties Sligo and Leitrim are classed as regionally important aquifers. Counties Cavan, Monaghan and Louth are mainly classed as poor aquifers, except for some localised areas of north-west Cavan and in the vicinity of Clones, Monaghan town and Carrickmacross in County Monaghan which are classed as regionally important aquifers.

Source Protection Areas in the Border Region

The only EPA and GSI 'Source Protection Areas' in the Border Region are in the northern part of County Monaghan, as indicated on GSI online groundwater mapping.

4.2.3.5 Water Status in the Mid-East and Dublin Region

4.2.3.5.1 Surface Water

Water Framework Directive Classification

The Mid-East Region as defined by the Census of Agriculture 2010 includes Counties Dublin, Kildare, Wicklow and Meath. There is broad overlap between the Census of Agriculture Mid-East Region and the Eastern River Basin District (ERBD) that contains all of County Dublin, the majority of Counties Wicklow and Meath, large parts of Kildare. The ERBD also contains small parts of Counties Westmeath, Offaly and Cavan.

According to the Eastern River Basin Management Plan (2009-2015), the Eastern River Basin District (ERBD) covers an area of approximately 6300km² and 350km² of marine waters.

In the ERBD the main river catchments monitored under the Water Framework Directive are the Nanny/ Delvin, Liffey and the Avoca/Varty with 365 rivers in total being monitored. A total of 28 natural lakes and reservoirs over 50ha are being

monitored, while 130km of coastal and transitional waters are monitored.

Ecological Status of Surface & Transitional Waterbodies

According to the Eastern River Basin Management Plan (2009-2015), 4% of rivers and canals have High Status, 39% (Good Status), 31% (Moderate Status), 21% (Poor Status) and 5% (Bad Status).

A full programme of monitoring has been undertaken with regard the water quality of lakes and reservoirs in the ERBD with all of the lakes and reservoirs over the threshold 50ha size being monitored. A total of 4% of Lakes and Reservoirs have High Status, 12% (Good Status), 64% (Moderate Status), 3% (Poor Status) and 17% (Bad Status).

With regard estuarine habitats 100% fell into the Moderate Status category. With regard coastal habitats 58% fell into the High Status category and 26% achieved Moderate Status. The water quality of 16% of coastal waters has yet to be determined.

Nutrient Status

The EPA nutrient maps illustrate that within the ERBD river catchments in Wicklow, Kildare and south Dublin had mean Ortho-Phosphorus levels of between 0.02-0.05mg/l P while Meath, Westmeath, south Louth and south west Cavan had higher elevations of Nitrate, with levels recorded between 0.05-0.10 mg/l P. The greater Dublin city area had the highest nutrient levels in the Country with levels nationally with levels recorded between 0.20-0.40 mg/l P.

Mean Nitrate levels followed a similar pattern to Ortho-Phosphorous with more elevated levels of Nitrate recorded in Meath, Westmeath, south Louth and south west Cavan (2.0-3.6mg/l N), while lower levels of Nitrate were recorded in Wicklow and Kildare (0.8-2.0mg/l N). County Dublin had nitrate levels between (0.8-2.0mg/l).

4.2.3.5.2 Groundwater Status

Water Framework Directive Classification

According to the EPA's Water Framework Directive groundwater status maps, the majority of the mid-east and Dublin Region is classed as 'Good Status'.

4.2.3.5.2.1 Groundwater Status in Wicklow

Water Framework Directive Classification

According to the EPA's Water Framework Directive groundwater status maps, the majority of County Wicklow is classed as 'Good Status'. An area in the vicinity of the Avoca Mines in County Wicklow is classed as 'Poor Status'. (www.epa.ie). The Water Framework Directive Risk Scores indicates that the area in the vicinity of the Avoca Mines in County Wicklow is classed as 'At risk of not achieving Good Status' by 2015. The remainder of the County is classed as 'Probably at risk of not achieving Good Status' and 'Expected to achieve Good Status' by 2015.

Aquifer Productivity in County Wicklow

The groundwater body type in the County of Wicklow consists mainly of poorly productive bedrock aquifers.

Source Protection Areas in the County Wicklow

There are no EPA and GSI 'Source Protection Areas' in County Wicklow, as indicated on GSI online groundwater mapping.

Groundwater Productivity in Mid-East and Dublin Region

The area in the vicinity of Kildare and Newbridge towns is classed as regionally important, extensive sand/gravels aquifers (Rg). Parts of north Kildare, large areas of Meath and north Dublin is classed as locally important aquifer (Lm). The rest of Counties Meath, Kildare and Dublin are mainly classed as locally important (LI).

4.2.3.5.2.2 Source Protection Areas in the East Region

There are a number of EPA and GSI 'Source Protection Areas' in County Kildare, one in north County Dublin (Bog of the Ring) and one near Slane in County Meath.

4.2.3.6 *Water Status in Donegal, Galway and Mayo*

4.2.3.6.1 *Surface Water*

Counties Galway and Mayo are located within the Western River Basin District that contains a very high proportion of rivers and lakes in the High Status category. The whole of County Donegal is located within the NWIRBD that also has a high proportion of its rivers and lakes in the High Status category (see respective sections above for summary data on water quality status).

This is also reflected in the EPA nutrient maps whereby Ireland's western counties have lower mean nutrient levels within their respective river basins. The NWIRBD and the WRBD also contain numerous SAC's designated for Freshwater Pearl Mussel, that reflect the high water quality present in the catchments located within Counties Donegal, Galway and Mayo. Therefore these three western counties may be considered particularly sensitive to pollution.

4.2.3.6.2 *Groundwater Status*

4.2.3.6.2.1 *Sligo, Galway and Mayo*

According to the EPA report, Integrated Water Quality Report 2011 – Galway, Mayo and Sligo, nitrate concentrations in groundwaters in Counties Galway, Mayo and Sligo are relatively low. Large areas of Counties Galway, Mayo and Sligo are at poor status due to contribution of phosphate from groundwater to surface water bodies. There has been a general decrease in phosphate concentrations over the period 2001-2011. However, the slight increase in nitrate and phosphate concentration since 2009 highlights the importance of continuing with programmes of measures to ensure that overall nutrient loss to groundwater of nitrates and phosphates is minimised.

4.2.3.6.2.2 *Donegal*

Water Framework Directive Classification

According to the EPA's Water Framework Directive groundwater status maps, the majority of the groundwater body in County Donegal is classed as 'Good Status'.

Groundwater Productivity in Donegal

The groundwater body type in Donegal mainly consists of poorly productive bedrock aquifers, except for localised areas in the vicinity of Donegal and Ballyshannon towns which consist of some locally important and regionally important aquifers.

4.2.4 *Sectoral Analysis of Scenario A*

4.2.4.1 *Introduction*

The *Census of Agriculture 2010 - Final Results* (CSO 2012) indicates the Regions in the State in which the varying percentages of agricultural activities are undertaken. While all farming activities are represented in all counties, the census figures give useful information in relation to where each farming activity is predominately practiced. The Region which has the greatest percentage of dairying is the South-West Region; i.e. Kerry and Cork (35.5%). Dairying occurs to a lesser degree in the South-East; i.e. Carlow, Kilkenny, South Tipperary, Wexford and Waterford (20.15%). The Mid-West; i.e. Clare, North Tipperary and Limerick account for 16.64% of the dairying sector in the Country. The CSO Census of Agriculture shows that most of the beef farming activity in the State occurs in the West and Border Regions, with 17.72% of beef cows recorded in the Border Region, and 21.6% in the West, in 2010

According to the Central Statistics Office - *Final Results* (CSO 2012) the counties with the largest number of sheep were Donegal, Galway and Mayo, accounting for 33.64% of all sheep. The 2010 Census shows that the parts of the Mid-east Region (Kildare and Wicklow) and Waterford had the largest number of sheep per farm.

According to the Central Statistics Office (CSO) data for Agriculture for 2010, the majority of tillage, field and bio-energy crops are grown in the south-east (Carlow, Kilkenny, South Tipperary, Wexford and Waterford; 33.4% of land area), mid-east (Kildare, Meath and Wicklow) and Dublin (27.27% of land area). The tillage crops mainly consist of wheat, oats and barley. The field crops include potatoes, sugar beet, fodder beet, turnips and maize and the bioenergy crops consists mainly of *Miscanthus* and willow, as well as oilseed rape.

The CSO Census of Agriculture 2010 records that most of the pig and poultry farming activity in the State occurs in the Border Region. Approximately 20.6% of the pig farming and 66.25% of the poultry farming in the State is carried out in this Region. In June 2010, the counties with the largest number of pigs were Cavan and Cork accounting for 39.04% of all pigs. The counties with the largest average number of birds in 2010 were Cavan and Monaghan with 11,201.8 birds per farm.

For the purpose of this assessment, the impacts of the dairy, beef and sheep sectors on surface water are assessed for the Regions in which the greatest percentage of each activity occurs; i.e. the Southwest, South-East and Mid-West Regions that are located within South West River Basin District, South Eastern River Basin District and Shannon River Basin District. The CSO Census of Agriculture data per region can be used to determine trends within each of the River Basin Districts most loosely overlapping them, in order to establish an overall national magnitude of impact resulting from the Food Harvest 2020 projections for each sector. As the dynamic of change (i.e. an increase) in one sector may be accommodated by a decrease in a parallel sector with regard ruminants, Dairy, Beef and Sheep are assessed together. Where micro changes may occur that are subsumed by larger national patterns, caveats are discussed specific to the likely consequences of such changes.

Scenario A predicts a 24% increase in dairy cows and a 43% increase in dairy heifers which is partly offset by decreases in 0 to over 2 year old cattle (-14%), in other cows (-13%) and in other heifers (-15%). Therefore it is assumed that any potential impacts arising from the predicted decreases in beef numbers will be offset by the increase in dairying activity. The additional beef calves from the dairy herd produced as a result of the increase in dairy cows numbers is likely to achieve part of the targeted increase in output in the beef sector. It is also assumed that the projected decrease in the other cattle numbers and projected decreases in within the beef group will occur in the Regions where dairy farming is prevalent (i.e. south east and mid-west).

The potential impacts on surface waters from dairy, beef and cattle combined (ruminants) is likely to be slight negative overall in the absence of mitigation measures. Whilst a fall in sheep numbers is predicted, this will be primarily offset by uptake of released land for female beef cattle >2 years. Other land released from beef and sheep is likely to be used to partly meet the small net land required as a consequence of increase in dairy numbers. Where small scale tillage is no longer viable, this may be converted to dairying.

The main identified changes to agricultural practices in the dairy, beef and sheep sectors, due to the implementation of the Food Harvest 2020 through Scenario A, which have the potential to impact on surface waters are as follows:

- **A small increase in grazing pasture** - Scenario A predicts a national increase in pasture demand by 2020 for the dairy sector. For the dairy sector a predicted increase of 211,774ha (30% increase on the 2007/2009 baseline of 695,774ha). This is largely offset by the predicted reduction in land required for beef pasture, a reduction of 200,629ha from the baseline of 2,428,765ha. This leaves an imperceptible net increase in grazing land required of 11,145ha (or 0.36% of the combined baseline totals for beef and dairy);
- **A small overall increase in organic fertiliser application** - A national increase of 26,739 tonnes or 26% of organic nitrogen (dairy cows plus dairy heifers) from the baseline figure of 101,034 tonnes, and a national increase of approximately 4,029 tonnes or 26% of organic phosphate (dairy cows plus dairy heifers) from the baseline figure of 15,312 tonnes is predicted. This is offset to a large degree by predicted decreases in the organic fertilisers for beef cattle – reduction of 8% for organic nitrogen (minus 22,333 tonnes from a baseline of 269,179 tonnes) and 8% for organic phosphorus (minus 3,159 tonnes from a baseline of 38,784 tonnes). The remaining overall national increase in organic

nitrogen fertiliser is 4,406 tonnes (or 1.19% of the combined baselines for beef and dairy). The overall national increase in organic phosphorous is 870 tonnes (1.6% of the combined baselines for beef and dairy);

- **An overall increase in inorganic fertiliser application** - Scenario A predicts a national increase in the application of inorganic fertiliser (nitrogen) by 2020. An increase in nitrogen of 40,660 tonnes (approximately 39%) from the baseline figure of 102,975 tonnes is predicted for the dairy sector. An increase of 5,809 tonnes from a baseline of 172,442 tonnes is predicted for the beef sector. The net national increase in inorganic fertiliser is 43,738 tonnes or 14% of the combined baselines for dairy and beef;
- **An increase in inorganic phosphorus and inorganic nitrogen** - In combination across all sectors it is anticipated that there will be an increase of 4,222 tonnes of inorganic phosphorus and 47,347 tonnes of inorganic nitrogen due to the implementation of Food Harvest 2020 through Scenario A across the entire agricultural area and across all sectors.
- **An increase in concentrates** - Scenario A predicts an increase in concentrates for dairy sector of 27% (356,673 tonnes) from the baseline. A slight decrease for concentrates for beef sector is predicted of 8% (162,619). This leaves a net increase in concentrates of 194,054 tonnes, or 5.9% of the total combined for dairy and beef.

Assessment of Potential Impacts - Surface Water

An assessment of the likely impacts of Scenario A based on the impact sources listed above for the dairy and beef sectors on surface water attributes has been undertaken. As previously stated the projected decreases in sheep will absorb some of

the increases required for the dairy sector, particularly in lowland areas.

For the assessment of surface water impacts, those attributes determined relevant in addition to their assigned importance, are based on the Ecological classification of surface waters as described in the River Basin Management Plans, 2009-2015. This provides an indicator of overall water quality status in addition to nutrient status as derived broadly from EPA nutrient maps.

The likely impacts expected to occur by implementing Food Harvest 2020 through Scenario A are identified by examining key generic impact types associated with the sector. The magnitude of the impact is then assigned based on a consideration of both the importance of the attributes and the predicted scale of the likely impacts.

Impacts - Beef & Dairy

The resulting impact assessment for the dairy and beef sector groups on surface water are presented in, Table 4-3 Table 4-4 and Table 4-5.

The impact assessments outlined in this section are pre-mitigation impacts and mitigation measures. The predicted magnitude of impact of the Scenario A for the dairy sector group on surface water pre-mitigation is predicted to be Probable¹¹⁸ **Slight Negative impact**.

Impacts - Sheep

The reduction of 14,424 upland sheep (5% of the national projected reduction) is likely to result in a **Slight Positive Impact** in Upland regions where projected increases in Dairy will not overshadow reductions in sheep. Those reductions in lowland areas as previously stated will likely accommodate increases required for female beef cattle (>2 years) and dairy numbers.

Table 4-3: Dairy, Beef and Sheep impact type – leaching of nitrate and phosphorous to surface waters.

Region	River Basin District	Predicted impact
South West	SWRBD ¹¹⁹	Slight-Moderate Negative
South East	SERBD ¹²⁰	Slight Negative
East	ERBD	Slight Negative
Mid-west	ShIRBD	Slight Negative
West	WRBD ¹²¹	Slight Negative
North West	NWIRBD ¹²²	Slight Negative
Border Region	NWIRBD ¹²² , ShIRBD ¹²³ , NBIRBD	Slight Negative

Table 4-4: Dairy, Beef and Sheep impact type – increases in soil erosion near water courses and sediment escape.

Region	River Basin District	Predicted impact
South West	SWRBD	Slight-Moderate Negative
South East	SERBD	Slight Negative
East	ERBD	Slight Negative
Mid-west	ShIRBD	Slight Negative
West	WRBD	Slight Negative
North West	NWIRBD	Slight Negative
Border Region	NWIRBD, ShIRBD, NBIRBD	Slight Negative

Table 4-5: Dairy, Beef and Sheep impact type – hydrological changes arising from drainage improvement.

Region	River Basin District	Predicted impact
South West	SWRBD	Uncertain ¹²⁴
South East	SERBD	Uncertain ¹²⁴
East	ERBD	Uncertain ¹²⁴
Mid-west	ShIRBD	Uncertain ¹²⁴
West	WRBD	Uncertain ¹²⁴
North West	NWIRBD	Uncertain ¹²⁴
Border Region	NWIRBD, ShIRBD, NBIRBD	Uncertain ¹²⁴

4.2.4.2 Impacts – Tillage and field crops on surface waters

Introduction

Scenario A projection for wheat to 2020 is 8.97% increase in land area on the 2007/2009 baseline. There is a decrease in the 2020 land area projections for barley and oats of 16.89% and 16.06% respectively. There is a decrease in the 2020 land area projection for potatoes also, down

29.25%. In contrast, there is a 21.62% increase in the 2020 projection for land area for turnips. The 2020 land area projections for bioenergy crops are an increase of 750 ha per year to 2020. This assessment concentrates on the south east and mid-east and Dublin Region in terms of the potential impacts of the implementation of the Scenario A.

Assessment of Potential Impacts

The resulting impact assessment for the tillage, field and bio-energy sector group on surface water is presented in Table 4-6 and Table 4-7. The impact assessment outlined in this section is pre-

mitigation impacts and mitigation measures. The predicted magnitude of impact of the Scenario A for the tillage and bioenergy crop sector group on groundwater pre-mitigation is predicted to be **Probable Slight Negative**.

Table 4-6: Tillage, field and bioenergy impact type – nutrient enrichment to surface water.

CSO County	River Basin District	Predicted impact
Carlow and Kilkenny	SERBD	Neutral/Imperceptible
South Tipperary	SERDB	Neutral/Imperceptible
Wexford and Waterford	ERBD	Neutral/Imperceptible ¹²⁵
Kildare and Meath	ERDB	Slight Negative
Wicklow	ERDB	Neutral/Imperceptible
Dublin	ERDB	Neutral/Imperceptible

Table 4-7: Tillage, field and bioenergy impact type – chemical impacts to surface waters.

CSO County	River Basin District	Predicted impact
Carlow and Kilkenny	SERBD	Uncertain
South Tipperary	SERDB	Uncertain
Wexford and Waterford	ERBD	Uncertain
Kildare and Meath	ERDB	Uncertain
Wicklow	ERDB	Uncertain
Dublin	ERDB	Uncertain

4.2.4.3 Impacts of Pigs & Poultry on surface waters

Introduction

Scenario A projection for pigs to 2020 is 39.12% increase in pig numbers and the 2020 projection for poultry numbers is 19.58% increase. Whilst layer and broiler numbers are projected to increase, turkey numbers are projected to decrease by 37.42% to 2020.

This assessment concentrates on the Border Region and South West in terms of the potential impacts of the implementation of Scenario A because of the highest concentrations of pigs in these areas.

Identified Changes in Farming Practices associated with Implementation of the Food Harvest 2020 Scenario

The main changes to practices due to the implementation of the Food Harvest 2020 scenario for the pigs and poultry sector group are an increase in organic nitrogen fertiliser production of 208 tonnes and an increase in organic phosphorous fertiliser production of 41 tonnes.

Assessment of Potential Impacts

The resulting impact assessment for the pigs and poultry sector group on surface water is presented in Table 4-8 and Table 4-9. The impact assessment outlined in this section is pre-mitigation impacts and mitigation measures.

The predicted magnitude of impact of Scenario A for the pigs and poultry sector group on surface

water pre-mitigation is predicted to be a **Certain**¹²⁶ **Slight Negative** impact.

Table 4-8: Pigs and poultry impact type – nutrient enrichment of surface water.

CSO Region	Counties	RDB	Impact Magnitude
Border Region ¹²⁷	Cavan ¹²⁸	NWIRBD	Moderate Negative – Significant Negative
	Donegal	NWIRBD	Imperceptible - Slight Negative
	Monaghan	NWIRBD	Slight Negative
	Sligo	WRBD	Imperceptible-Slight Negative
	Letrim	ShIRBD	Slight Negative
	Louth	NB-RBD	Imperceptible-Slight Negative
South West	Cork	SWRDB	Slight Negative

Table 4-9: Pigs and poultry impact type – other water quality impacts; BOD, Ammonal Nitrogen and Suspended solids.

CSO Region	Counties	RDB	Impact Magnitude
Border Region 61	Cavan ¹²⁸	NWIRBD	Moderate Negative – Significant Negative
	Donegal	NWIRBD	Imperceptible - Slight Negative
	Monaghan	NWIRBD	Slight Negative
	Sligo	WRBD	Imperceptible-Slight Negative
	Letrim	ShIRBD	Slight Negative
	Louth	NB-RBD	Imperceptible-Slight Negative
South West	Cork	SWRDB	Slight Negative

4.2.4.4 Conclusion

The overall predicted impact of Food Harvest 2020 scenario on surface water is predicted to be¹²⁹ **Slight Negative** with a high degree of confidence based upon available data. The magnitude of

impact has been calculated by taking into account the average magnitude of impact per sector. The impact has been calculated in the absence of any mitigation being implemented. A summary of impacts relative to each agricultural sector are presented in Table 4-10.

Table 4-10: Summary of impacts of the implementation of Food Harvest 2020 on surface waters on a sectoral group basis.

Farm Group Sector	Magnitude of Impact
Dairy	Slight Negative
Beef	Slight Negative
Sheep	Slight Positive
Tillage & Bioenergy Crops	Slight Negative
Pigs & Poultry	Slight Negative

4.2.4.5 Identification of Potential Impacts-Groundwater

The main potential impacts identified are:

- Potential increased risk of diffuse pollution of groundwater as a result of the application of manure/slurry, artificial fertilisers and pesticides / herbicides on agricultural land;
- Potential increased risk of point source pollution of groundwater as a result of runoff of silage effluent due to inadequate storage of silage, inadequate slurry storage or washings from dairy parlours and farmyards;

- Increased demand for groundwater abstractions causing potential impact on groundwater yield;
- Decrease in stocking rates will reduce the risk of overgrazing and soil erosion which may reduce aquifer vulnerability.

In accordance with Scenario A projections, Table 4-11 identifies the agricultural activities which may cause the potential impact to occur. Potential positive impacts which have been identified have been listed also.

Table 4-11: Agricultural sectors that may cause potential groundwater impacts.

Potential Impact	Positive (+) or Negative (-) impact					
		Dairy	Beef	Sheep	Pigs & Poultry	Tillage
Potential increased risk of diffuse pollution of groundwater as a result of the application of manure/slurry, artificial fertilisers and pesticides / herbicides on agricultural land	-	-				-
Potential increased risk of point source pollution of groundwater as a result of runoff of silage effluent due to inadequate storage of silage, inadequate slurry storage or washings from dairy parlours and farmyards	-	-			-	
Increased demand for groundwater abstractions causing potential impact on groundwater yield	-	-			-	-
Decrease in stocking rates will reduce the risk of overgrazing and soil erosion which may reduce aquifer vulnerability	+		+	+		

4.2.4.6 Conclusions

The NRA guidance document 'Environmental Impact Assessment of National Road Schemes – Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (NRA, 2009) has been considered in the identification of the relevant groundwater attributes which have been assessed in this section of the report. The groundwater attributes which have been identified are:

- Regionally Important Aquifer
- Locally Important Aquifer
- Poor Bedrock Aquifer

As shown in Table 4-11, the changes in practices associated with Scenario A projections for dairy, pigs and poultry and tillage have the potential to cause an increased risk of diffuse pollution of groundwater.

Diffuse pollution arising from agricultural activity is mainly caused by the application of artificial fertilisers, organic fertilisers and chemicals used as pesticides and herbicides. This report assumes that the implementation of Scenario A will be carried out in accordance with the requirements of the Nitrates Directive and relevant codes of good practice for agriculture. The relevant legislation and codes set limits and restrictions on the frequency and methods of fertiliser and chemical

application and requires nutrient management plans to be implemented at farm level.

The assessment has taken into consideration the groundwater status and risk classification of the regions of Ireland in which the different agricultural activities are significant, as well as more sensitive regions such as the karst limestone areas of Mayo, Galway and Roscommon. The scale of the projected increases in fertiliser and chemicals application has also been considered i.e. a national increase of 4,727 tonnes of organic fertiliser production from the baseline figure of 414,052 tonnes and a national increase of 43,738 tonnes of inorganic fertiliser application from the baseline figure of 299,084 tonnes.

Whilst there is the potential for diffuse groundwater pollution arising from the implementation of Scenario A, in particular in areas where the groundwater status is currently poor and/or is at risk of not achieving good status by 2015, it is expected that the magnitude of this impact at a national scale will range from moderate negative to imperceptible, depending on whether the attributes under consideration are regionally important, locally important or poor bedrock aquifers. (Refer to

Table 4-12). Recommendations on potential mitigation measures which should be implemented to reduce this potential impact are outlined in Section 11.

Table 4-11, the changes in practices associated with Scenario A projections for dairy and pigs and poultry may have the potential to cause an increased risk of point pollution of groundwater. The main agricultural practices which may lead to point source contamination of groundwater are uncontrolled runoff from farmyards, piggeries, poultry houses and silage pits. Compliance with codes of good farming practice is a requirement under the Nitrates Directive and certain Government payment schemes. It is assumed that the implementation of Scenario A will be undertaken in accordance with the requirements of the legislation, codes and guidelines. It is

therefore expected that the magnitude of this impact on a national scale will range from moderate negative to imperceptible, as presented in Table 4-12. Recommendations on potential mitigation measures which should be implemented to reduce this potential impact are outlined Section 11.

Table 4-11 above shows that the Scenario A projections for dairy, pigs and poultry and tillage has the potential to result in the increased demand for groundwater abstractions causing potential impact on groundwater yield. It is expected that any increase in demand will be slight. Given that approximately 65 per cent of the bedrock aquifers in Ireland are generally unable to yield significant quantities of groundwater for abstraction, it is expected that at a national level, the magnitude of the impact will range from moderate negative to imperceptible, depending on whether the attributes under consideration are regionally important, locally important or poor bedrock aquifers.

Table 4-11 shows that Scenario A projections for beef and sheep have the potential to reduce the occurrence of overgrazing and soil erosion and thus reduce the risk of aquifer vulnerability. In the past, overgrazing and soil erosion was associated with upland sheep grazing. Through the implementation of legislation and management and protection plans, the occurrence of overgrazing and soil erosion caused by agriculture have greatly reduced in the last twenty years.

It is expected that the magnitude of this impact on a national scale will range from moderate positive to imperceptible, as presented in Table 4-12.

Table 4-12: Impact assessment of Food Harvest 2020 on groundwater.

Criteria for Impact assessment	Attribute	Importance	Magnitude of Impact
Potential increased risk of diffuse pollution of groundwater as a result of the application of manure/slurry, artificial fertilisers and pesticides / herbicides on agricultural land	Regionally Important Aquifer	High	Moderate negative
	Locally Important Aquifer	Medium	Slight negative
	Poor Bedrock Aquifer	Low	Imperceptible
Potential increased risk of point source pollution of groundwater as a result of runoff of silage effluent due to inadequate storage of silage, inadequate slurry storage or washings from dairy parlours and farmyards	Regionally Important Aquifer	High	Moderate negative
	Locally Important Aquifer	Medium	Slight negative
	Poor Bedrock Aquifer	Low	Imperceptible
Increased demand for groundwater abstractions causing potential impact on groundwater yield	Regionally Important Aquifer	High	Moderate negative
	Locally Important Aquifer	Medium	Slight negative
	Poor Bedrock Aquifer	Low	Imperceptible
Decrease in stocking rates will reduce the risk of overgrazing and soil erosion which may reduce aquifer vulnerability	Regionally Important Aquifer	High	Moderate positive
	Locally Important Aquifer	Medium	Slight positive
	Poor Bedrock Aquifer	Low	Imperceptible
Overall Magnitude of Impact			Slight negative

At a national level, the overall magnitude of the impact of Scenario A on groundwater is predicted to be slight negative. Recommended mitigation measures to reduce the impacts are outlined below in Section 11.

The Water Framework Directive quantitative and chemical classification information on groundwater bodies in Ireland is of significant value in understanding what measures need to be developed in order to ensure the protection of this valuable resource. Whilst the status of groundwater in Ireland is generally good, there are some areas of the Country which are of concern in terms of maintaining and/or reaching good status by 2015, notably the south of the Country and the mid-west of the Country.

It is predicted that the implementation of Scenario A will have a slight negative impact on groundwater, without any specific mitigation.

4.3 Notes and References

- 93 Within the framework of the Water Framework Directive a technical Working Group on Groundwater was established. The aim of the group is to exchange information and experiences on groundwater issues as they related to the Water Framework Directive (e.g. characterisation, risk assessment, monitoring, chemical status and trends, programmes of measures, etc.).
- 94 <http://www.epa.ie/pubs/reports/water/waterqua/WaterQuality0709.pdf>
- 95 Online groundwater mapping www.gsi.ie
- 96 GSI Groundwater Vulnerability Mapping Guidelines (DoELG 1999)
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- 108 Kitamura, S. & Ikuta, K. (2000). Acid rain severely suppresses spawning of hime salmon (land-locked sockeye salmon, *Oncorhynchus nerka*). *Aquatic Toxicology* 51, 107-113.
- 109 DAFF (Department of Agriculture, Fisheries and Food). (2007). Pesticide Usage Survey Report Number 2 (Arable Crops). Stationary Office, Dublin. pp. 12.
- 110 Isenbeck-Scröter, M., Bedbur, E., Kofod, M., König, B., Schramm, T. and Mattheß (1997). Occurrence of pesticide residues in water: assessment of the current situation in selected EU countries. *Berichte aus dem Fachbereich Geowissenschaften der Universität Bremen*, No 91. (Nur in englischer Sprache).
- 111 South Western River Basin Management Plan (2009-2015) (www.swrbd.ie)
- 112 www.epa.ie
- 113 www.gsi.ie
- 114 South Eastern River Basin Management Plan 2009-2015 (www.serbd.ie)
- 115 Western River Basin Management Plan (2009-2015)(www.wrbd.ie)
- 116 www.epa.ie
- 117 The Border Region includes Counties Cavan, Donegal, Monaghan, Louth, Sligo & Leitrim.
- 118 Probable: probability estimated at above 50%, but lower than 95%
- 119 Region contains the highest proportion of rivers & lakes in the High Status category nationally (32% & 57% respectively) with 7% estuaries in the High Status Category. 34% of national dairying is undertaken in Cork & Kerry. Nine Freshwater Pearl Mussel catchments are present. Additionally as the South Western region has the highest proportion of dairying nationally and highest quality water it is probable that impacts may be expected to be higher in this region than elsewhere nationally.
- 120 Rivers and Lake systems have (8% & 0% respectively) in the High Status category nationally. No estuaries in the High Status category. 23% of national dairying in Carlow, Kilkenny, South Tipperary, Wexford and Waterford.
- 121 19.2% of rivers & canals in the High Status category, while 58.4% of lakes and 10.3% of estuaries achieved High Status. The WRBD has four river catchments designated as SAC's for freshwater pearl mussel.
- 122 has 14% of rivers & canals in the High Status category, while 26% of lakes and 23% of estuaries achieved High Status. The NWIRBD has six river catchments designated as SAC's for freshwater pearl mussel
- 123 Rivers and Lake systems have (5% & 14% respectively) in the High Status category nationally. No estuaries are in the High Status category. 15.6% of national dairying in Clare, North Tipperary and Limerick
- 124 The impact of elevations in Pesticides and Herbicide application in surface waters remains unknown because detailed monitoring is unavailable for surface waters, but is available for groundwater.

Further research is required on mini catchments to ascertain magnitude of impact with high level of certainty.

- 125 Large areas of river catchments bordering the Wexford Coastline and smaller areas of river catchments bordering the Waterford coastline are suffering from N & P enrichment (see EPA nutrient maps). These areas are thus considered particularly sensitive to further elevations in nutrient applications. However, the projected levels of change with regard to tillage are considered small and thus impacts are considered Neutral / Imperceptible.
- 126 Certain; Probability estimated at 95% chance or higher.
- 127 The Border region has very high densities of rivers and lakes and thus is a very important region nationally for the protection of surface water quality
- 128 Cavan has some of the highest pig and bird numbers. Over half of the lakes that failed the Total Phosphorous EQS value for the Good Moderate Boundary were located in Cavan (EPA, 2010).
- 129 Certain/ Near certain: Probability of 95% chance or higher

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Soils

Section 5:

Soils

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5 Soils

5.1 Baseline

5.1.1 Introduction

In this section of the report, the potential impacts on soil of the implementation of Scenario A are assessed. For the purposes of Scenario A assessment, the potential impacts on soil in the regions of Ireland, in which the majority of the projected agricultural changes are expected to take place, will be identified and assessed. Additionally, any existing sensitive regions in Ireland in terms of soil will be considered and assessed in relation to the potential impacts arising from the projected changes in agriculture.

The Central Statistics Office (CSO) Census of Agriculture provides data on the current regional distribution of farm sector groups in Ireland. For example, the 2010 Final Results data shows that the majority of dairy cows are located in the south-west of the Country. For the purposes of Scenario A assessment, it is assumed that the projected changes in agriculture will follow the current regional distribution patterns, as shown in the CSO data. For example, it is assumed that the majority of any projected increases in dairy cow numbers will occur where the current majority of dairy cows exist.

5.1.2 Regulatory and Legislative Framework

5.1.2.1 Proposed Soil Framework Directive

There is relatively little legislation relating directly to soil and soil protection. Hence, the EU has identified that there is a need for a coherent and effective legislative framework, providing for common principles and objectives aiming at protection and sustainable use of soil in the community.

The proposal for a Soil Framework Directive (COM (2006)232) sets out common principles for protecting soils across the EU. The current proposal aims at filling the legislative gap and has the objective of establishing a common strategy for the protection and sustainable use of soil, based on the principles of integration of soil concerns into other policies, preservation of soil

functions within the context of sustainable use, prevention of threats to soil and mitigation of their effects, as well as restoration of degraded soils to a level of functionality consistent at least with the current and approved future use.

Relevant elements of the proposed Soil Framework Directive include:

- The establishment of a common framework to protect soil on the basis of the principles of preservation of soil functions, prevention of soil degradation, mitigation of its effects, restoration of degraded soils and integration in other sectoral policies.
- The requirement to identify, describe and assess the impact of some sectoral policies on soil degradation processes with a view to protect soil functions.
- The requirement for land users to take precautionary measures when their use of the soil can be expected to significantly hamper soil functions.
- Identification of areas at risk of erosion, organic matter decline, salinisation, compaction and landslides, and establishment of national programmes of measures.
- The extent of the areas at risk of these threats needs to be identified. To ensure a coherent and comparable approach, the identification of risk must be carried out on the basis of common elements. These elements include parameters which are known to be driving forces for the different threats.
- Risk reduction targets and programmes of measures to reach those targets will have to be adopted. Programmes can build on standards and measures already identified and implemented in national and Community contexts.
- Measures to limit the introduction of dangerous substances into the soil, to avoid accumulation in soil that would hamper soil functions and create a risk to human health and the environment.

To date, the Soil Framework Directive has not been ratified and is still being debated in the European Council and the European Parliament. If ratified, Member States will be required to identify areas where soil degradation processes have occurred or are likely to occur in the future. Once risk areas have been identified, Member States will be required to draw up programmes of measures, including a timetable for implementation. Ratification of the Directive will result in the unification of soil measures in one Directive and provide a common approach and level playing field for Member States with regard to soil protection (Creamer *et al.* 2010)¹³⁰.

5.1.2.2 Environmental Impact Assessment Regulations for On-Farm Development 2011 (S.I. No. 456 of 2011)

The *Environmental Impact Assessment Regulations for On-Farm Development 2011* (S.I. No. 456 of 2011) support soil protection in Ireland through the requirements for environmental impact assessments for on-farm activity such as commencing to use uncultivated land or semi-natural land for intensive agriculture.

5.1.2.3 Statutory Management Requirements (SMRs) – Single Payment Scheme

All agricultural soils are subject to the Statutory Management Requirements (SMRs) and the Good Agricultural and Environmental Condition (GAEC)

requirements of the Single Payment Scheme and where relevant to the provisions of Commonage Framework Plans and voluntary environmental schemes such as REPS. GAEC ensures that soils under continuous tillage will be identified, tested for soil organic matter and, where necessary, mitigation strategies put in place to prevent levels dropping. This is known as Cross Compliance.

5.1.3 Current Status

Information on soils falls into three broad categories:

- soil maps,
- soil inventories and
- soil monitoring systems (Van-Camp *et al* 2004)¹³¹.

Some soil maps and an inventory of soil geochemical properties have been published for Ireland. There is no national soil monitoring system. The *Digital Soil Information System for Ireland – Scoping Study* report concluded that soil data coverage of Ireland is incomplete in both detail and extent (Daly and Fealy, 2007)¹³². Great groups are amalgamations of soils that have broad similarities in their degree of development and properties, although each Great Soil Group contains soil ‘types’ that differ in detail from each other (Gardiner and Radford, 1980)¹³³. There are 10 great soil groups in Ireland, as shown in Table 5-1 and illustrated in Figure 5-1. The area covered by each soil group is also given.

Table 5-1: Soil Classification Scheme used in Ireland (Source: www.teagasc.ie/johnstowncastle/soilsofireland; Gardiner and Radford, 1980)

No.	Great Soil Group	Occurrence (%)	General Properties
1	Podzols	7.11	Formed by leaching of nutrients (podzolisation process), acidic and poorly drained
2	Brown Podzolics	11.71	Less depleted of nutrients than podzols, good physical characteristics
3	Grey Brown Podzolics	19.70	Usually formed from calcareous parent material which counteracts the effects of leaching, can be light to heavy textured
4	Brown Earths	13.60	Most occur on lime-deficient parent materials, therefore acidic in nature, relatively mature and well-drained
5	Gleys	25.03	Developed under the influence of permanent or intermittent waterlogging, impervious with poor physical structure, unsuitable for cultivation or intensive grazing
6	Rendzinas (Shallow Brown Earths)	4.08	Shallow soils, usually no more than 50cm depth, usually derived from limestone parent material, use limited by shallow depth
7	Lithosols	3.01	Skeletal stony soils, usually overlying solid or shattered bedrock, use limited to rough

No.	Great Soil Group	Occurrence (%)	General Properties
			grazing and forestry
8	Regosols	0.03	Alluvial soils found in low-lying flat areas along river courses and estuaries, texture can vary between sands and clays, can be acid or alkaline, depending on the material from which they are derived, wide range of uses.
9	Basin Peats	5.03	High organic matter content (> 30% down to at least 30cm depth)
10	Blanket Peats	10.70	High organic matter content (>30% down to at least 30cm depth), formed under conditions of high rainfall and humidity

5.1.3.1 The General Soil Map of Ireland

The map presented in Figure 5-1, derived from the General Soil Map of Ireland (Scale 1:575,000), based on work by An Foras Talúntais during the 1960s and 1970s, has been simplified to show great soil groups only.

Teagasc, together with Cranfield University, UK, and University College Dublin co-funded by the EPA is currently undertaking a project to develop a soil map at 1:250,000 scale and associated Soil Information System. This project involves the application of modern digital soil mapping techniques deployed in tandem with traditional field survey techniques for sampling and validation. A representative profile description database will be created for the 56% of Ireland that remains un-surveyed beyond general reconnaissance level. The completion of this work is recommended.

5.1.3.2 National Soil Database (2007)

The National Soil Database¹³⁴, published by the EPA, consists of data-point and spatial distribution maps for 45 elements, including major nutrients such as phosphorus, potassium and magnesium, essential trace elements such as cobalt, copper and selenium, and other elements of interest (due to their potential toxicity) such as cadmium, arsenic, lead, nickel and mercury.

This provides Ireland with a robust and structured baseline of soil geochemical properties relevant to environmental, agricultural and public health related pressures, which can be used to assess trends in measured parameters over time and to quantify the soil's response to environmental pressures. As part of the compilation of the National Soil Database, the EPA also performed large-scale microbiological analysis of soils and investigated microbial community structure in a range of soil types (Fay *et al.*, 2007a, 2007b)¹³⁵.

The National Soil Database demonstrates that there is generally a strong, but varying, relationship between the geochemical results and soil type and the underlying geology. Other influences include oceanic deposition, proximity to urban areas, and mining and agriculture activities.

5.1.3.3 Ireland's Environment 2012 - An Assessment (EPA 2012)

According to the recent EPA publication, "*Ireland's Environment 2012 - An Assessment*"¹³⁶, agriculture remains the largest use of land in Ireland, with over two-thirds of land devoted to it. According to the publication, most of this land is under grass for

pasture, silage or rough grazing. The publication states that almost one-fifth of land in Ireland is categorised as peat land. This includes raised bogs, blanket bogs and fens.

According to the publication, forestry accounts for 11% of land cover, which is low compared with a European average of 35%.

The publication states that the potential for adverse disturbance of vegetation, soils and landscape during afforestation and forest harvesting is large, and that there is the potential for afforestation processes to impact on water quality through acidification and nutrient mobilisation. Also of concern, according to the publication are the location and scale of forestry activities. In recent years, there has been a trend towards plantation on more appropriate land and soil types.

According to the publication, the general consensus is that soil quality in Ireland is good. The long growing season, absence of extreme temperatures, and frequent rainfall afforded by the temperate climate are beneficial to soil. The large percentage of permanent pastureland has protected Ireland's soils from serious degradation, with the notable exception of peatlands.

5.1.3.4 Regional Soil Information relevant to the Assessment

The soil types in Ireland vary significantly throughout the Country, with some areas of Ireland having well drained, highly fertile and highly productive soils while other areas of the Country have less productive soils with up-to 20% of the Country being covered by blanket peat which is of little use for agriculture. Many soils have poor drainage characteristics and have limited potential for agriculture. A soil classification system has been developed by Teagasc in order to classify soil types into groups which have the same kind, arrangement and degree of expression of horizons in the soil profile. Teagasc produced a general soil map for Ireland which shows the distribution of the ten main soil groups occurring in Ireland. The Teagasc soil map is presented in Figure 5-1.

For the purposes of the assessment, this section describes the main soil groups found in the regions of Ireland in which the different agricultural activities occur, as outlined earlier in this report.

5.1.3.4.1 Baseline Information on Soils in the South-West region

For the South-West, which includes Counties Cork and Kerry, the soil associations with the greatest coverage are:

- Brown Podzolics, from Sandstone and Lower Avonian shale glacial till parent material (mainly covering areas of south Cork and extending to Clonakilty and Skibbereen). Best agricultural use is in pasture.
- Peaty Podzols, from mostly granite – sandstone parent material (covers parts of west Cork and west Kerry). Not suitable for tillage or intensive grassland, confined mainly to upland sheep grazing and forestry.
- Gleys, dominantly influenced by surface-water impedence, from Upper Carboniferous shale glacial till parent material (covers parts of north-west Cork and north Kerry). Most gleys have poor physical conditions which make them unsuitable for cultivation or for intensive grassland farming.
- Brown Podzolics, from mostly sandstone parent material (covers some parts of north and east Cork).
- Acid Brown Earths, from mixed sandstone, limestone glacial till parent material (covers areas around Cork city and east Cork and some areas of north Cork). These soils are amongst the most extensively cultivated soils.

Other soil associations with smaller coverage include blanket peat (high level), principally in north Kerry, and lithosols and outcropping rock in south Kerry. Percentages of Soil Organic Carbon (SOC) ranges from greater than 35% in west Kerry to greater than or equal to 2% in east and north Cork. High levels of SOC are associated with wet, peaty acid soils, which can restrict their use from an agricultural point of view. A depleted SOC

content of less than 2% can result in low soil fertility and poor soil physical quality.

5.1.3.4.2 Baseline Information on Soils in the South-East region

For the South-East, which includes Counties Carlow, Kilkenny, South Tipperary, Waterford and Wexford, the soil associations with the greatest coverage are:

- Acid Brown Earths, with Ordovician – Silurian – Cambrian shale glacial till parent material (covers an area from west of Waterford City, extending across Wexford). These soils are amongst the most extensively cultivated soils in Ireland.
- Acid Brown Earths, with Upper Carboniferous shale and sandstone glacial till parent material (covers an area of South Tipperary and Kilkenny). These soils are amongst the most extensively cultivated soils in Ireland.
- Acid Brown Earths, with mostly granite or rhyolite glacial till parent material (covers area around Tramore in County Waterford and parts of Counties Kilkenny and Wexford). These soils are amongst the most extensively cultivated soils in Ireland.
- Gleys, with Upper Carboniferous shale glacial till parent material (covers parts of Counties Kilkenny and Carlow). Most gleys have poor physical conditions which make them unsuitable for cultivation or for intensive grassland farming.

Other soil associations with smaller coverage include Gleys with till of Irish Sea origin, with limestone and shale parent material, and Acid Brown Earths with morainic sands and gravels and blown sands parent material, along the Wexford coast.

Percentages of SOC in the South East Region are generally low – predominantly in the range 6.1 to 10%, with lower levels (2.1 to 6%) in east Wexford and the western fringes of Counties Waterford and Kilkenny. A depleted SOC content of <2% can result in low soil fertility and poor soil physical

quality, but only two samples in the Region recorded SOC contents at that level.

5.1.3.4.3 Baseline Information on Soils in the Mid-West region

For the Mid-West Region, which includes Counties Clare, North Tipperary and Limerick, the soil associations with the greatest coverage are:

- Gleys, with mostly Upper Carboniferous limestone and shale – sandstone glacial till parent material (covers an area of west Clare). Most gleys have poor physical conditions which make them unsuitable for cultivation or for intensive grassland farming.
- Gleys, with Upper Carboniferous shale glacial till parent material (covers parts of north-west Limerick and south-west Clare).
- Minimal Grey Brown Podzolics, limestone glacial till (covers large area of County Limerick, a large area of North Tipperary in vicinity of Borrisokane and Cloughjordan and an area in the vicinity of Nenagh, County Tipperary). These soils are good all-purpose soils.
- Gleys, basalt glacial till (covers an area from Ennis east to Lough Derg).
- Brown Podzolics, with Orovician-Silurian-Cambrian shales and mica schist parent material (covers an area of North Tipperary in vicinity of Templemore). Best agricultural use is in pasture.
- Acid Brown Earths, with Upper Carboniferous shale and sandstone glacial till parent material (covers parts of County Clare).
- Redzinas with Outcropping Rock (areas of north-west County Clare around the Burren). The agricultural uses of this soil are limited by the shallow depth.

5.1.3.4.4 Baseline Soil Information for the West Region

In the West Region, which includes Counties Galway, Mayo and Roscommon, the soil associations with the greatest coverage are:

- Blanket Peat (low level and high level) – parts of north-west Mayo and west Galway. Peats are characterised by a high content of organic matter. Due to poor drainage and adverse physical conditions, the range of uses of blanket peat in agriculture is limited. Upland sheep grazing would be the main agricultural use.
- Degraded Grey Brown Podzolics, with mostly limestone glacial till parent material – parts of north Mayo, south-east Mayo and east Galway.
- Shallow Brown Earths and Rendzinas, with limestone till parent material – extending from south Mayo to Gort, County Galway. These soils are suited mostly to extensive grazing.
- Lithosols and Outcropping Rock, with mostly sandstone, granite, quartzite or mica schist parent material – parts of Connemara, County Galway. Their use range is usually limited to rough grazing.
- Grey Brown Podzolics, with mostly limestone glacial till parent material – area around Castlebar, County Mayo and parts of County Roscommon. They are suited mainly to pasture production.

Other soil associations with smaller coverage include podzols and gleys, dominantly influenced by groundwater, seepage or springs.

Percentages of Soil Organic Carbon (SOC) in the West Region are generally the highest in the State. They range from greater than 35% in south west Galway to lower values (down to less than or equal to 2%) in the north Galway – south Mayo area. High levels of SOC are associated with wet, peaty acid soils, which can restrict their use from an agricultural point of view. A depleted SOC content of less than 2% can result in low soil fertility and poor soil physical quality.

5.1.3.4.5 Baseline Soil Information for the Border Region

For the Border Region, which includes Counties Cavan, Donegal, Leitrim, Louth, Monaghan and Sligo, the soil associations with the greatest coverage are:

- Gleys, with mostly Upper Carboniferous limestone and shale - sandstone glacial till parent material (covers large parts of County Leitrim and some areas in County Donegal)
- Gleys, with mostly Ordovician – Silurian shale - sandstone glacial till parent material (large areas of Cavan and Monaghan).
- Acid Brown Earths, with mostly Ordovician – Silurian shale – glacial till parent material (parts of County Louth).
- Blanket Peat (low level and high level) (covers parts of west Donegal, Leitrim and Sligo). Upland sheep grazing would be the main agricultural use.
- Grey Brown Podzolics, with mostly limestone glacial till parent material (parts of County Sligo, Monaghan and Cavan). They are suited mainly to pasture production.

Other soil associations with smaller coverage include other Acid Brown Earths, Peaty Gleys and Peaty Podzols with mostly granite – sandstone parent material.

There is a wide range of percentages of Soil Organic Carbon (SOC) in the Border Region soils. Parts of west County Donegal have very high levels (>35%), and values range down to 2.1% in south County Louth. High levels of SOC are associated with wet, peaty acid soils, which can restrict their use from an agricultural point of view. A depleted SOC content of <2% can result in low soil fertility and poor soil physical quality.

5.1.3.4.6 Soils in the Mid-East, Dublin and Louth

In the mid-east (Kildare, Meath and Wicklow) and Dublin Regions, the soil associations with the greatest coverage are:

- Gleys, with till of Irish Sea origin with limestone and shale parent material (parts of Kildare, Meath, north County Dublin and County Louth)
- Grey Brown Podzolics, with till of Irish Sea origin with limestone and shale parent material (large parts of County Dublin,

some parts of County Meath and County Louth)

- Grey Brown Podzolics, with limestone and shale glacial till parent material (large parts of County Meath).
- Brown Podzolics, with Ordovician – Silurian – Cambrian shales and mica schist parent material (large area of County Wicklow).
- Peaty Podzols, with mostly granite – sandstone parent material (upland areas of County Wicklow). Peaty Podzols contain 10 to 30% organic carbon. They usually occur in hill and mountain areas where the mechanical means of reclamation and cultivation are not feasible.

Other soil associations with smaller coverage include Acid Brown Earths, Brown Podzolics, and Lithosols and Outcropping Rock in the Wicklow Mountains.

Percentages of Soil Organic Carbon (SOC) in the Mid-East and Dublin Region are generally low, with most of Meath and Dublin in the range 2.1 to 6%. The mountainous areas of Wicklow have generally higher levels, of up to 15% SOC. A depleted SOC content of <2% can result in low soil fertility and poor soil physical quality, but only three samples in the Region recorded SOC contents at that level.

The Soil Geochemical Atlas of Ireland¹³⁷ shows high levels of available phosphorous in County Louth, east Dublin and southeast Wexford which are attributed to a combination of light-textured soils and vegetable and tillage farming in these areas.

5.2 Drainage Characteristics

5.2.1 Introduction

The drainage characteristics of soil are a large determinant of soil use and value from an agricultural perspective. Soil fertility and drainage characteristics are not to be confused. Soils of varying fertility are normally described as being well drained, moderately drained, or poorly drained.

The Great Soil Groups represent various combinations of fertility and drainage. Thus, Podzols are well drained with low fertility; Brown Podzolics are well drained with medium fertility; Grey Brown Podzolics are moderately drained with highest fertility; Brown Earths are well drained with high fertility; Gleys are poorly drained with high fertility; and Peats are poorly drained with poor fertility.

In a typical year approximately 450mm of water is removed from the soil through evapotranspiration (absorbed by plants and evaporation to water vapour). Rainfall amounts vary across the Country but in most cases exceed 900mm. The surplus water must be removed through drainage. In well drained soils this excess water can easily percolate through the top soil layers and into a permeable sub-soil thus preventing water logging in the root zone, providing ideal growing conditions and increasing stock carrying capacity without damage to either forage or soil structure. Poorly drained soils (particularly gleys and peats) display a poor ability for water percolation and in some instances they overlie impermeable sub-soil layers which will not allow downward movement of the excess rainfall. The excess rainfall has to move over the soil, on the surface, to open drains. This causes water logging of the root area, hampering growing conditions, and makes both forage and soil structure subject to damage from poaching by livestock.

5.2.2 Drainage Systems

Throughout the ages attempts to improve the drainage characteristics of farmlands have been made. Thus much of the Country has a network of subterranean drainage systems. In the seventies and eighties incentivised by European funds large

scale on farm drainage schemes were undertaken where necessary.

Large areas of the Country are subject to periodic flooding due to seasonal rainfall peaks and in many areas major state funded arterial drainage works have been undertaken to alleviate such flooding.

Wet soil conditions have been identified as the most important factor limiting the utilisation of grazing grass on Irish farms (Creighton et al. 2011)¹³⁸. In this context given the wide distribution of soils with moderate to poor drainage qualities there is likely to be an increased emphasis on farm drainage schemes in order to increase stock carrying capacities.

In its submission to the Second Review of Ireland's Nitrates Action Programme 2013¹³⁹, Teagasc highlights the probability of further on-farm drainage and draws attention to the wide ranging effects this could generate: both positive and negative; and short and long term.

5.2.3 Parent Material

Where the drainage problems are derived from parent material, in general little remediation is possible through drainage work.

Large areas of the Country, particularly along the western seaboard and border counties have soils with a high peaty content or are predominantly poorly drained gleys. Mechanical drainage solutions in these areas are not feasible as the drainage problems are not caused by topography or lack of outfall. Many of these soils are located in upland regions. Generally these soils are unsuitable for cultivation and are subject to degradation if intensively used for livestock. Because of the distribution of soil types throughout the Country many individual farms will have areas which display various drainage characteristics because of their origins. Thus on individual farms it is not uncommon to have some low lying areas displaying poor drainage characteristics. On such farms additional drainage works may be contemplated to facilitate an increase in stock carrying capacity.

5.3 Environmental Assessment

5.3.1 Introduction

The assessment will take into account the soil conditions in the regions of the Country where the expected changes are assumed to occur, as per the CSO data. In relation to soils, the Teagasc soil map is the primary information resource which will be consulted as part of this assessment. Where relevant, Geological Survey of Ireland data and the EPA's Irish National Soils Database of regional soil types will be consulted. A significance rating describing the degree of the potential impact will then be assigned, using a matrix as based on the EPA publication, *'Guidelines on the Information to be Contained in Environmental Impact Statements'* (2002). The range of criteria for assessing the

importance of soil and the range of criteria for quantifying the magnitude of impacts are adopted from the NRA guidance document *'Environmental Impact Assessment of National Road Schemes – Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'* (NRA, 2009)¹⁴⁰.

The significance rating of potential impacts on soil is based on the matrix presented in the NRA guidance, as shown in Table 5-2. This takes account of both the importance and the magnitude of the potential impacts on an attribute.

Table 5-2: Criteria for rating impact significance of environmental impacts.

Impact Level	Attribute Importance		
	High	Medium	Low
Significant	Permanent impact on significant proportion of attribute		
Moderate	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute	
Slight	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute
Imperceptible	Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute
Note: Based on NRA guidance document <i>'Environmental Impact Assessment of National Road Schemes – Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes'</i> (NRA, 2009)			

Finally, a separate table for soil will be presented which shows the overall significance rating for the potential impacts likely to result from the Food Harvest 2020 Scenario A. The significance rating assigned will be based on a consideration of the cumulative impacts and main interactions between the farm sector groups.

5.3.1.1 Significance Criteria

The ratings criteria used to describe the significance of the impacts on soil applied in the assessments are based on the EPA *Advice Notes on Current Practice (in the Preparation of*

Environmental Impact Statements). The significance ratings matrix is shown in Section 2.

5.3.1.2 Food Harvest 2020 – Scenario A Projections

Scenario A predictions which are of relevance to this assessment are as follows.

With respect to the dairy sector, Scenario A predicts a national increase of 258,000 dairy cows (24%) on the 2007/2009 average baseline figure of 1,057,576, by 2020, and a national increase of

84,000 dairy heifers (43%) on the 2007/2009 average baseline of 195,441, by 2020.

Scenario A predicts that cattle numbers within the beef sector will decrease by approximately 9% from the baseline figure of 5,565,235 total beef animals. From a soil perspective it is assumed therefore that beef cattle will be replaced by dairy cattle with an immaterial change in the stocking rate. Scenario A predicts a gradual reduction in sheep numbers from an average of 5,162,654 total sheep in 2007/2009 to 4,876,643 in 2020. This is a total reduction over the assessment period of 286,011 sheep, or a percentage reduction of 5.54%. Scenario A projection for wheat to 2020 is an 8.97% increase in land area on the 2007/2009 baseline. There is a decrease in the Scenario A land area projections for both barley and oats, -16.89% and -16.06% respectively. There is a predicted change in land use from potatoes to other root crops with the land area devoted to this sector remaining approximately the same. The 2020 land area projections for bioenergy crops are an increase of 750 ha per year to 2020.

Scenario A projection for pigs to 2020 is 39.12% increase in pig numbers and the 2020 projection for poultry numbers is 19.58% increase. The pig and poultry sector are mainly concentrated in the border region and the potential impacts in that region are assessed. With respect to the forestry sector, Scenario A projects an increase of 89,667 ha or 12.41% on the 2007/2009 baseline of 722,333 ha.

5.3.2 Key Agricultural Pressures Affecting Soil Functions

The main pressures which can lead to the deterioration or loss of soil functions are outlined below.

5.3.2.1 Decline in Soil Organic Matter (SOM)

Soil type is important when determining the erosion risk from land. The texture of a soil strongly influences soil organic matter (SOM) storage (Fullen *et al.* 2006)¹⁴¹. Soil organic matter breaks down faster in sandy soils than in fine-textured soils due to:

- i. A lack of clay for physic-chemical binding with SOM (Fullen *et al.* 2006); and

- ii. Greater oxygen availability for decomposition by microorganisms in the clay.

Disturbance of topsoil by tillage operations further aerates the soil which, in turn, increases soil SOM decomposition. Sandy soils are particularly vulnerable to erosion due to low SOM content and poor structural stability.

In a review of critical levels of SOM in tillage land in Ireland, Spink *et al.* (2010)¹⁴² concluded that soil function is unlikely to be adversely affected when SOM is above a threshold of 3.4%. Soils with less SOM than this threshold should be further assessed to see whether they are in good environmental and agronomic condition. These further measures could include observation of erosion, gullies in the field, compaction and capping (Spink *et al.* 2010). Peat extraction and land-use changes such as ploughing of rough or permanent grassland for tillage and energy crops will lead to increased SOM loss from soils.

5.3.2.2 Soil Erosion by Wind and Water

Soil erosion occurs as a result of poor soil management practices on vulnerable soils including inappropriate cropping regimes, overgrazing, and direct access to watercourses. Forestry activities can also cause significant soil erosion. Currently, serious incidents of soil erosion are localised but it is likely that climate change will cause increased rates of soil erosion due to higher rainfall intensity and possible loss of organic matter, which will result in reduced structural stability.

Forty-eight per cent of crop production is concentrated in the south of the Country (Schulte *et al.* 2010a)¹⁴³, where the soils are highly suitable for tillage, having a light-to-medium texture and free drainage (Gardiner and Radford 1980).

5.3.2.3 Compaction

Soil compaction occurs where a heavy load is applied to the soil surface from machinery and livestock trafficking, particularly during unfavourable weather and soil conditions (Hamza and Anderson 2005)¹⁴⁴. Soil low in organic matter is more vulnerable to soil compaction. No

comprehensive data are available on the severity or extent of soil compaction in Ireland.

5.3.2.4 Soil Contamination

Land-spreading of agricultural wastes can give rise to problems where the soil's assimilative and/or buffering capacity is exceeded and where the wastes contain potentially toxic contaminants. Over 60 million tonnes of agricultural organic wastes (animal slurries and manures, dirty water and silage effluent) are land-spread annually (EPA, 2005, 2008)¹⁴⁵. With proper management, these wastes recycle valuable nutrients to assist in crop productivity. However, with poor management, the application of these wastes in excess of crop requirements, or where the wastes contain toxic elements not required for plant growth, may result in soil degradation and water pollution.

Potassium and phosphorous are recorded in the Soil Geochemical Atlas of Ireland¹⁴⁶ in both the 'total' and 'available' forms. In the context of the role of these elements as essential nutrients for plant growth, the 'available' forms are of most interest. In each case, the influence of fertilizer application on soil chemical content means that there is no spatial coherence at a regional level. On a national scale, available phosphorous detected in soils at levels above expected background levels are generally associated with areas where intensive agriculture is practiced, and for tillage soils. While tillage land (cereal and root crops) accounts for a relatively small area – 9.6% of agricultural area utilised in Ireland (CSO 2010) – it accounts for the majority of the high phosphorous status soils in Ireland due to higher fertilisation rates on tillage land. Mean P fertiliser use in Ireland for cereals and root crops (<10% of tillage area) in 2008 was 20kg ha⁻¹ and 46kg ha⁻¹, respectively, while phosphorous fertiliser use for grassland was only 5kg ha⁻¹ (Lalor *et al.* 2010)¹⁴⁷.

High levels of available phosphorous in County Louth, East Dublin and South-East Wexford have been attributed to a combination of light-textured soils, and vegetable and tillage farming in these areas.

Similarly, in northwest Kerry, tillage farming on light-textured soils results in elevated Phosphorus

levels. Furthermore, high Phosphorus levels in east and central Cork were attributed to a combination of intensive dairying and tillage on highly fertile soils, while high levels in north Carlow and south Kildare may be due to intensive tillage on limestone-derived soils¹⁴⁸. Reducing these soil Phosphorus levels may not be possible in the short term, as Schulte *et al.* (2010a) showed that elevated soil Phosphorus concentrations resulting from agricultural land use may take many years to be reduced to agronomically and environmentally optimum levels.

5.3.2.5 Landslides

Landslides and floods are closely allied because both are related to heavy rainfall, slope runoff and the saturation of the soil by water. Landslides are generally a local phenomenon and Ireland is not considered a high-risk area. However the potential impact of climate change – increased intensity of rainfall and reduced soil structure stability – also needs to be considered and addressed.

5.3.3 Identified Changes in Agricultural Practices associated with implementation of the Food Harvest 2020 Scenario A

The main predicted changes to agricultural practices necessary to implement Scenario A, which have the potential to impact soils are:

- Increased pasture requirement - Scenario A predicts a national increase in pasture demand by 2020, i.e. an increase of 82,600 hectares (4.07% increase on the 2007/2009 baseline of 2,029,133 hectares). However, this increase is largely offset by a decreased hay, silage and rough grazing requirement of 39,300 ha on the 2007/2009 baseline of 1,717,367ha.
- An increase in organic nitrogen fertiliser production:- Scenario A predicts a national increase in organic nitrogen fertiliser production by 2020 i.e. a national increase of 4,727 tonnes from the baseline figure of 414,052 tonnes
- A national increase of approximately 930 tonnes of organic phosphate fertiliser

production from the baseline figure of 61,337 tonnes.

- A national increase in inorganic nitrogen fertiliser use of 43,738 tonnes from the baseline figure of 299,084 tonnes.
- A national increase in inorganic phosphorous fertiliser use of 4,222 tonnes from the baseline figure of 26,332 tonnes.

5.3.4 National Trends in Agricultural Activity relevant to the Assessment

The land area of Ireland is 6.9 million hectares, of which about 4.9 million hectares is used for agriculture or about 71% of total land area and 722,300 hectares for forestry or about 10.8% of total land.

Approximately 78% (3.74 million ha) of agricultural area is devoted to grass (silage, hay and pasture), 11% (0.45 million ha) is in rough grazing and the remainder circa 7% (0.35 million ha) is allocated to crop production.

The CSO Census of Agriculture 2010 results published showed there were 139,860 farms in 2010 compared to 141,527 farms in June 2000. The utilised agricultural area increased by 2.8% over the ten year period, from 4,443,071 hectares in June 2000 to 4,568,938 hectares in June 2010. The average size of agricultural holding increased from 31.4 hectares to 32.7 hectares.

In terms of regional trends in the distribution of agricultural activity, the *Census of Agriculture 2010 - Final Results* (CSO, 2012)¹⁴⁹ indicates the Regions in the State in which the varying percentages of agricultural activities are undertaken.

With respect to the dairy sector, dairying occurs throughout the Country and is represented in every county. The Region which has the greatest percentage of dairying is the South-West Region – Kerry and Cork (34%). Dairying occurs to a lesser degree in the South-East – Carlow, Kilkenny, South Tipperary, Wexford and Waterford (20.15%) and Mid-West – Clare, North Tipperary and Limerick (16.64%) regions.

The CSO Census of Agriculture shows that while beef farming is represented in all counties it is

predominately practised in the West (Counties Mayo, Roscommon and Galway) and Border (Counties Cavan, Donegal, Leitrim, Louth, Monaghan and Sligo) Regions, with 17.72% of beef cows recorded in the Border Region, and 21.6% in the West, in 2010.

It is assumed that the projected decrease in the other cattle numbers within the beef group will occur predominately in the Regions where dairy farming is prevalent, and thus will offset the impacts of the projected increases in the dairy sector.

According to the Central Statistics Office (CSO) data for 2010, the counties with the largest number of sheep were Donegal, Galway and Mayo, accounting for 33.64% of all sheep. The 2010 Census shows that the parts of the mid-east Region (Kildare and Wicklow) and Waterford had the largest number of sheep per farm. The resulting impact assessment of the sheep sector group on soil is presented below in Table 5. The impact assessment outlined in this section is pre-mitigation impacts and mitigation measures.

According to the Central Statistics Office (CSO) data for 2010, the majority of tillage, field and bioenergy crops are grown in the south-east (Carlow, Kilkenny, South Tipperary, Wexford and Waterford) (33.4% of land area), mid-east (Kildare, Meath and Wicklow) and Dublin (27.27% of land area) Regions of the Country. The tillage crops mainly consist of wheat, oats and barley. The field crops include potatoes, fodder beet, turnips and maize and the bioenergy crops consists mainly of *Miscanthus* and willow, as well as oilseed rape.

The CSO Census of Agriculture 2010 records that most of the pig and poultry farming activity in the State occurs in the Border Region. Twenty-four per cent of the pig farming and 66.25% of the poultry farming in the State is carried out in this Region. In June 2010, the counties with the largest number of pigs were Cavan and Cork accounting for 39.03% of all pigs. The counties with the largest average number of birds in 2010 were Cavan and Monaghan with 11,201.8 birds per farm.

5.3.5 Predicted Overall Magnitude of Impact of Scenario A on Soils

5.3.5.1 Identification of Potential Impacts

The potential impacts on soils which could result from the implementation of Scenario A are described in Section 5.2.2 *Pressures affecting Soil Function*. The main potential impacts identified are:

- Changes to grazing patterns, poaching and use of heavy machinery may lead to increased compaction and soil erosion and loss of Soil Organic Matter (SOM) issues
- Potential improved soil condition as a result of the application of animal manures.
- Potential soil contamination by potential pollutants through local point source

(spillages) from e.g. farm chemicals, machinery fuels, or as a result of pesticide use.

- Improved grazing patterns, reductions in poaching and soil erosion may lead to improvements in Soil Organic Matter (SOM) content, both in upland and lowland areas.
- Soil acidification – caused by increased biological activity during ground preparations, filtering of air pollutants by tree canopy and effects of conifer needles.

Based on Scenario A projections, Table 5-3 identifies the agricultural sectors which may cause potential impacts to occur. Potential positive impacts which have been identified have been included also.

Table 5-3: Agricultural sectors that may cause potential soil impacts

Potential Impact	Type of Impact (+/-)	Agricultural Sector of Relevance				
		Dairy	Beef	Sheep	Pigs & Poultry	Tillage
Changes to grazing practice, poaching and use of heavy machinery may lead to increased compaction and soil erosion and loss of Soil Organic Matter (SOM) issues	-	-				-
Potential improved soil condition as a result of the application of animal manures.	+	+			+	
Potential soil contamination by potential pollutants through local point source (spillages) from e.g. farm chemicals, machinery fuels, or as a result of pesticide use.	-	-			-	-
Changes to grazing patterns, reduction in overgrazing, poaching and soil erosion may lead to improvements in SOM content, both in upland and lowland areas.	+		+	+		
<i>Note:</i> + Positive Impact - Negative Impact						

5.3.5.2 *Impact Assessment of Food Harvest 2020 Scenario A*

The NRA guidance document 'Environmental Impact Assessment of National Road Schemes – Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (NRA, 2009) has been considered in the identification of the relevant soil attributes which have been assessed in this section of the report. The soil attributes which have been identified are:

- Well drained and/or highly fertile soils
- Moderately drained and/or high or moderate fertility soils
- High Soil Organic Matter (SOM) content

As shown in Table 5-3, Scenario A projections for dairy and tillage has the potential to result in increased compaction and soil erosion issues for well drained and/or highly fertile soils and moderately drained and/or high or moderate fertility soils. Food Harvest 2020 is not projected to impact upon poorly drained low fertility soils.

Intensive dairying and tillage activity are undertaken predominantly on well-drained, fertile soils in Ireland; for example, the acid brown earths of Cork and the South-East Region.

Notwithstanding this significant agricultural production occurs on high and medium fertility soils which are moderately or poorly drained. A significant proportion of milk production is supported on such soils. Given the unseasonably high rainfall patterns of recent years in both spring and autumn there has been a significant increase in interest by individual farmers in drainage techniques to increase the stock carrying capacity of their farms. This report assumes there will be no requirement for an increase in stock carrying capacity generally. As referred to in Section 2 of this report, the overall national changes will be composed of a myriad of changes at individual farm level. This report assesses potential changes at national level level and therefore changes as a result of drainage works at individual farm level are not considered.

In order to achieve the optimum output from dairy and tillage farming, it is essential to employ good

farming practices in terms of soil protection and management. Soil compaction and soil erosion are not beneficial to the maintenance of good drainage and fertile soil conditions. Table 5-4 presents the predicted magnitude of impacts for Scenario A. At a national level, it is not expected that the projections of Food Harvest 2020 as envisaged in Scenario A will lead to significant overgrazing, poaching and use of heavy machinery. An imperceptible impact has been predicted in the case of well drained and/or highly fertile soils and a slight negative impact has been predicted in the case of poorly/moderately drained moderate/high fertile soils.

Table 5-3 above shows that the Scenario A projections for dairy and tillage has the potential to result in the employment of farming practices which could lead to deterioration in SOM content. It is in the farmers' best interest that good fertility and soil condition is maintained in order to maximise the productivity potential of soils. The majority of farmers in Ireland are members of some type of Government payment scheme, such as the Single Payment Scheme (SPS) and REPS 4. Farmers partaking in such schemes are obliged to comply with the provisions of Good Agricultural and Environmental Conditions, one of which is the maintenance of organic matter levels in the soil. The practice of continuous tillage i.e. tillage for six years or more, tends to reduce the organic matter content of the soil unless appropriate management practices are implemented to reverse this trend. The decline is a gradual process. The process of replenishing soil organic matter is equally slow, but can be achieved through the adoption of appropriate management practices and the addition of organic materials to the soil.

Whilst there is the potential impact for deterioration of Soil Organic Matter (SOM), it is expected that the magnitude of this impact at a national level will be imperceptible, provided standard good practices are employed. Refer to Table 5-4.

Table 5-3 shows that Scenario A projections for dairy, pigs and poultry sectors has the potential to result in farming practice which could improve soil

condition as a result of the application of animal manures.

As shown in Table 5-4, it is expected that this will have a slight positive impact on Soil Organic Matter (SOM) at a national level. It will be important that the application of organic manures is undertaken in accordance with appropriate nutrient management planning at farm level in order to protect surface waters and groundwaters. Farmers applying for the Single Payment Scheme (SPS), the disadvantaged areas scheme (DAS) and REPS 4 are obliged to comply with the provisions of Good Agricultural and Environmental Conditions, one of which is the maintenance of organic matter levels in the soil.

Additionally, the projected decrease in sheep numbers has the potential to reduce the risk of overgrazing, poaching and soil erosion which may lead to improvements in Soil Organic Matter (SOM) content, both in upland and lowland areas. However, given the scale of the projected decrease in sheep numbers, it is predicted that the magnitude of the associated impact is imperceptible.

As shown in Table 5-3, Scenario A projections for dairy, pigs, poultry and tillage has the potential to lead to soil contamination through an increase in activity in these farming sectors. As mentioned earlier, it is of high importance to farmers to protect soil function and quality in order to gain maximum agricultural output. Additionally, farmers are obliged under various Government schemes e.g. the Single Payment Scheme (SPS) and REPS 4 to comply with the provisions of Good Agricultural and Environmental Conditions in relation to the prevention of potential pollution through local point source (spillages) from e.g. farm chemicals, machinery fuels, or as a result of pesticide use.

Certain intensive farming sectors are regulated by the Environmental Protection Agency through Integrated Pollution Prevention and Control (IPPC) licences. These licences oblige the farmers to comply with certain conditions ensuring the protection of the environment.

It is not expected that the projections of Scenario A will lead to issues associated with soil contamination at a national level.

Table 5-4: Impact assessment of Scenario A (Integrated Scenario) for soil.

Criteria for Impact assessment	Attribute	Importance	Magnitude of Impact
Overgrazing, poaching and use of heavy machinery may lead to increased compaction and soil erosion issues	Well drained &/or highly fertile soils e.g. Brown Earths	High	Imperceptible
Overgrazing, poaching and use of heavy machinery may lead to increased compaction and soil erosion issues	Poorly/Moderately drained moderate/high fertility soils e.g. Brown Podzolics	Medium	Slight negative
Overgrazing, poaching and soil erosion as a result of land-use changes may lead to deterioration of SOM content	High Soil Organic Matter (SOM) content	Medium	Imperceptible
Potential improved soil condition as a result of the application of animal manures.	Well drained &/or highly fertile soils	High	Slight Positive
Potential improved soil condition as a result of the application of animal manures.	Moderately drained &/or moderate fertility soils	Medium	Imperceptible
Potential improved soil condition as a result of the application of animal manures.	High Soil Organic Matter (SOM) content	Medium	Imperceptible
Potential soil contamination by potential pollutants through local point source (spillages) from e.g. farm chemicals, machinery fuels, or as a result of pesticide use.	Well drained &/or highly fertile soils	High	Imperceptible

Criteria for Impact assessment	Attribute	Importance	Magnitude of Impact
Potential soil contamination by potential pollutants through local point source (spillages) from e.g. farm chemicals, machinery fuels, or as a result of pesticide use.	Poorly/Moderately drained moderate/high fertile soils	Medium	Imperceptible
Potential soil contamination by potential pollutants through local point source (spillages) from e.g. farm chemicals, machinery fuels, or as a result of pesticide use.	High Soil Organic Matter (SOM) content	Medium	Imperceptible
Reduction in overgrazing, poaching and soil erosion may lead to improvements in SOM content, both in upland and lowland areas.	High Soil Organic Matter (SOM) content	Medium	Imperceptible
Soil acidification – caused by increased biological activity during ground preparations, filtering of air pollutants by tree canopy and effects of conifer needles	Well drained &/or highly fertile soils	High	Slight negative
Soil acidification – caused by increased biological activity during ground preparations, filtering of air pollutants by tree canopy and effects of conifer needles	Poorly/Moderately drained moderate/high fertile soils	Medium	Imperceptible
Overall Magnitude of Impact			Imperceptible

5.3.6 Conclusions

Irish soils in general are currently found to be in good quality. However, there is evidence of soil erosion in some upland areas in Counties Mayo and Galway in particular caused by sheep overgrazing. Overgrazing is no longer a phenomenon since the decoupling of payments from direct production levels.

Creamer *et al.* (2010) identify the principal threats to soil as being erosion (water, wind and tillage); decline in soil organic matter (SOC); compaction; and contamination. The EPA State of the Environment 2012 concludes that the general consensus is that soil quality is good. The absence of heavy industry generally has been a help in avoiding soil contamination. The predominance of pasture land; the length of the growing season; and the temperate climate have all combined to preserve the quality of Irish soils. While erosion, due to overgrazing, was a problem in the past timely action by government agencies addressed the problems and Agri-Environmental Schemes were designed to address both the problems of over grazing and under grazing.

The conclusions of this report are at national level and it should be noted that changes at individual farm level could have significant local impacts on soils. In the case of poorly or moderately drained lands drainage works to increase stock carrying capacity could have significant consequences not only for soils but also for: biodiversity; flora and fauna; and water quality. The agricultural catchments programme detailed at Section 11.3 of this report may establish linkages between nutrient applications and water quality (surface and groundwaters) which can be impacted by drainage works. Further research into the environmental impacts of land drainage works on all environmental characteristics is required.

At a national level, it is predicted that the impact of Scenario A on soils is imperceptible.

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Air quality

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6 Air quality

6.1 Baseline

6.1.1 Introduction

The implementation of Food Harvest 2020 has the potential to impact on air quality through the production of pollutants harmful to the atmospheric environment. Impacts on air quality can arise due to emissions from agricultural activities. The pollutants of concern are as follows:

- Ammonia (NH₃);
- Nitric oxide (NO);
- Particulate Matter (PM) (PM₁₀ (particulate matter <10 µm diameter) and PM_{2.5} (particulate matter <2.5 µm diameter));
- Non-methane Volatile Organic Compounds (NMVOC).

The main sources of NMVOC emissions in Ireland are solvent use and transport. These sources produce 85 per cent of the annual total with the agricultural/forestry/fisheries sector producing approximately 1% of the total. According to the EPA Informative inventory report 2012¹⁵⁰: Air pollutant emissions in Ireland 1990–2010, agricultural emissions of PM₁₀ amounted approximately 0.4% of total PM₁₀ with emissions of PM_{2.5} contributing approximately 0.1% of total PM_{2.5}. On the basis that agriculture contributes such insignificant amounts to overall concentrations; NMVOC, PM₁₀ and PM_{2.5} are not considered further in this assessment on air quality.

The EPA is responsible for the implementation of all Irish and EU ambient air quality legislation. It manages the ambient air quality monitoring network and is responsible for all reporting to results to the general public and the EU.

The impact of the Food Harvest 2020 scenarios on air quality are assessed using the methodology outlined in the *European Monitoring and Evaluation Programme (EMEP) and European*

*Environment Agency (EEA) Air Pollutant Emission Inventory Guidebook — 2009*¹⁵¹.

6.1.2 Regulatory and Legislative Framework

The Environmental Protection Agency (EPA) is responsible for monitoring ambient air, setting emission limits for licensed activities and reporting to the EU on air quality levels.

In order to protect our health, vegetation and ecosystems, EU directives set down air quality standards in Ireland and the other member states for a wide variety of pollutants. The objectives include avoiding, preventing and reducing the impact of harmful air emissions on human health and the environment.

6.1.2.1 Air Quality Standards

In order to reduce the risk of poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values are set for the protection of human health and ecosystems.

On April 12th 2011 the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011)¹⁵² came into force and transposed EU Directive 2008/50/EC into Irish law. The 2011 Regulations revoke the Air Quality Standards Regulations of 2002 (S.I. No. 271 of 2002), The Environmental Protection Agency Act, 1992 (Ambient Air Quality Assessment and Management) Regulations, 1999 (S.I. No. 33 of 1999) and the Ozone in Ambient Air Regulations, 2004 (S.I. No. 53 of 2004).

The purpose of the 2011 Regulations is to establish limit values and alert thresholds for concentrations of certain pollutants, to provide for the assessment of certain pollutants using methods and criteria common to other European Member States, to ensure that adequate information on certain pollutant concentrations is obtained and made publically available and to provide for the maintenance and improvement of ambient air quality where necessary.

The relevant limit values established under these Regulations are included in Table 6-1.

Table 6-1: Air quality standards (AQS) from AQS Regulation 2011 (S.I. No. 180 of 2011).

Pollutant	Limit value for the protection of:	Averaging period	Limit value (µg/m ³)	Basis of application of limit value	Limit value attainment date
NO ₂	Human Health	1-hour	200	≤18 exceedances p.a.	1 January 2010
		Calendar year	40	Annual mean	1 January 2010
NO _x	Vegetation	Calendar year	30	Annual mean	1 January 2010

6.1.2.2 National Emissions Ceiling (NEC) Directive

The pollutants and ammonia (NH₃) and nitrogen oxides (NO_x) are responsible for air pollution such as acidification, eutrophication and ground-level ozone pollution.

The Gothenburg Protocol is a multi-pollutant protocol which sets targets for NO_x, NMVOC and NH₃. The implementation of targets at European level is met by the EU National Emissions Ceiling (NEC) Directive (2001/81/EC). Ireland's limits specified in the directive are as follows:

- NH₃ - 116 kilotonnes
- NO_x - 65 kilotonnes

The Gothenburg Protocol sets Ireland's target for ammonia emissions at 0.5% reduction on 2005 levels by 2020 which equates to a value of 108.6 kilotonnes (kt) of ammonia in 2020. Ireland will be bound by these 2020 targets. In addition, a revised NEC Directive for emissions of PM will be developed during 2013 which will establish these targets in EU legislation.

This report assesses the impact of the Food Harvest 2020 scenarios against the NEC Directive 2010 targets.

6.1.3 Current Status

6.1.3.1 Introduction

The baseline years for this assessment are 2007, 2008 and 2009. The impact of the Scenario A Food Harvest 2020 is assessed against these baseline years. Every year the EPA publishes a report summarising air quality monitoring results from throughout the Country. This section considers the average concentrations recorded during those baseline years.

In 2010, there were 29 air quality monitoring stations operating in Ireland. Of these, 26 were fixed continuous-monitoring stations with air quality assessed by mobile monitoring units at three sites.

EU legislation on air quality requires that member states divide their territory into zones for the assessment and management of air quality. The zones adopted in Ireland are shown in Figure 6-1.

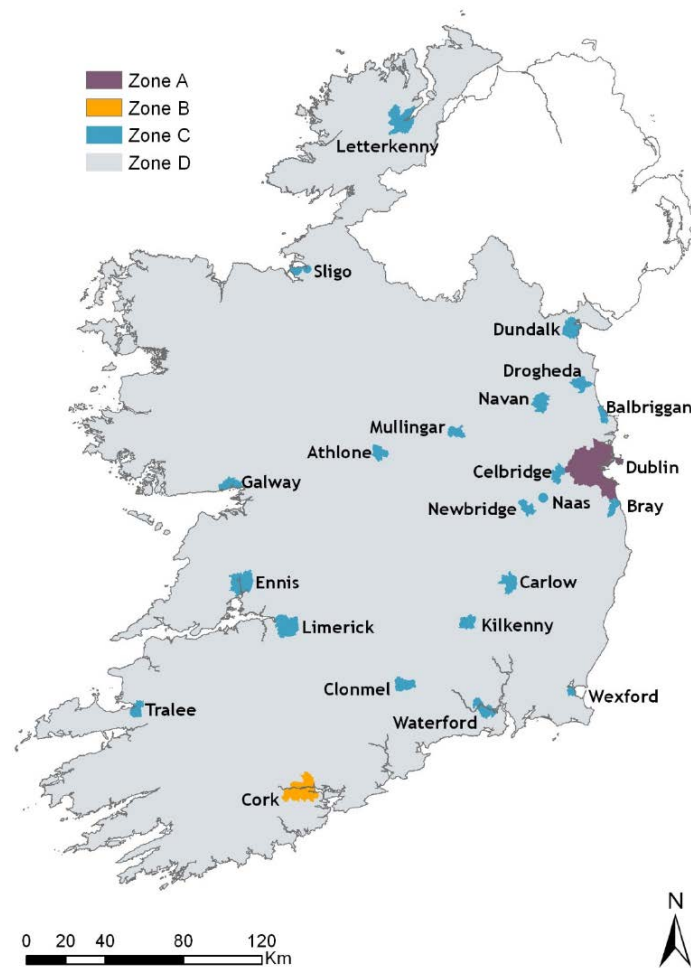


Figure 6-1: EU "Air Quality" zones.

Zone A is the Dublin conurbation, Zone B is the Cork conurbation with Zone C comprising 21 large towns in Ireland with a population >15,000. Zone D is the remaining area of Ireland. For the purposes of this assessment, monitoring values from Zone D are presented in this section as other zones are not expected to be significantly impacted by Food Harvest 2020 and the other scenarios. This assessment considers the national impact of the all scenarios.

Overall, air quality in Ireland continues to be of good quality and remains the best in Europe, due largely to the prevailing westerly airflow from the Atlantic and the relative absence of large cities and heavy industry.

Between 2007 and 2009, measured values of nitrogen oxides (NO_x) were all below limit and target values.

The EPA provides updates to the EU on the annual levels of emissions for Ireland for comparison with NEC limits. These values are provided in the sections below.

6.1.3.1.1 Ammonia

Ireland's national emission ceiling for NH₃ under the NEC Directive is 116 kilotonnes (kt), to be achieved by 2010. This is equivalent to an 8.8 per cent permitted increase in emissions from the 106.6 kt 1990 baseline figure. Data for 2011 show Ireland to be 7.3 kt below the 2010 limit.

The agricultural sector accounts for 98% of ammonia emissions in Ireland.

According to the EPA in 2013, NH₃ emissions from agricultural sources remain relatively unchanged between 1990 and 2011. Data for 2011 show Ireland to be 7.3 ktonnes below the 2010 limit. It states, however, given the strong performance of the agriculture sector in line with the ambitious targets of Food Harvest 2020, limiting NH₃ emissions to below the 2010 ceiling in the future could become an issue. Continued research on low emission landspreading techniques and other manure management strategies is required.

6.1.3.1.2 Nitrogen Oxides

Nitrogen oxides are produced during combustion at high temperatures, mainly in vehicles and power stations. Short-term exposure to NO₂ is linked to adverse respiratory effects including airway inflammation in healthy people and increased respiratory symptoms in asthmatics. Long-term exposure is associated with increased risk of respiratory infection in children.

NO₂ levels have remained relatively static in rural Ireland since 2002. NO₂ levels are low in rural areas with a maximum annual concentration of 10µg/m³ recorded in 2009, compared to an annual limit of 40µg/m³.

Ireland's national emission ceiling for NO_x under the NEC Directive is 65 kilotonnes (kt), to be achieved by 2010. This is equivalent to a 48.4 per cent reduction from the 1990 baseline level of 125.9 kt NO_x.

NO_x emissions in Ireland decreased by 47 per cent between 1990 and 2011. Despite this reduction, Ireland is currently exceeding its 2010 NO_x ceiling of 65 kilotonnes by 10.4 kilotonnes in 2010 and 2.6 kilotonnes in 2011. The latest estimates are 72.6 kt in 2010.

Between 2007 and 2009¹⁵³, the average NO_x emissions are reported by the EPA as 107kt.

The transport sector, which mainly consists of road transport, is the principal source of NO_x emissions, contributing approximately 55 per cent of the total in 2011. The power generation sector is the other

main source of NO_x emissions, accounting for 15 per cent of emissions in 2010. The remainder of NO_x emissions emanate from the industrial, agricultural/forestry/fisheries (approximately 10%) and residential/commercial sectors, which together produced over 33 per cent of the total in 2010.

Progress toward the ceiling of 65 kt for NO_x in 2010 has improved largely as a result of declining road transport emissions in the last three years.

6.1.4 EPA State of Environment 2012

The EPA State of Environment 2012¹⁵⁴ report concludes that overall *the air quality in Ireland continues to be good and is among the best in Europe. This is due largely to the prevailing clean westerly air-flow from the Atlantic and the relative absence of large cities and heavy industry. However, Ireland faces a number of challenges in the near future when trying to meet obligations under EU legislation.*

In terms of the impact of agricultural emissions and air quality, the report states that *“expected growth in the agricultural sector as outlined in the Food Harvest 2020 strategy (DAFM, 2010)”¹⁵⁵, along with the planned removal of milk production quotas within the European Union (CEU, 2009) will increase pressure on future emissions to air from this sector.”*

6.2 Environmental Assessment

6.2.1 Introduction

This section describes the approach taken to assess the impact of the various Food Harvest 2020 scenarios on air quality.

6.2.2 Key Pressures and Issues

6.2.2.1 Sources of emissions

According to the EMEP/EEA Air Pollutant Emission Inventory Guidebook 2009, *there is the potential for air emissions from animal husbandry, manure management, crop production and agricultural soils.*

There are four main sources of emissions from animal husbandry and manure management:

- livestock housing and holding areas (NH₃)
- manure storage (NH₃, NO)
- field-applied manure (NH₃, NO)
- manure deposited during grazing (NH₃)

There are three main sources of emissions from crop production and agricultural soils:

- fertiliser application (NH₃)
- soil microbial processes (NO)
- crop processes (NH₃)

The pollutants generated from these activities are described in the sections below.

6.2.2.1.1 *Ammonia*

Ammonia volatilisation occurs when NH₃ in solution is exposed to the atmosphere. The source of NH₃ emission from manure management is the nitrogen excreted by livestock. Ammonia is emitted wherever manure is exposed to the atmosphere; in livestock housing, manure storage, after manure application to fields and from excreta deposited by grazing animals

6.2.2.1.2 *Nitric Oxide*

Nitric oxide (NO) is formed through nitrification in the surface layers of stored manure or during the process of aerating manure. Nitric oxide emission from soils is generally considered to be a product of nitrification. Increased nitrification is likely to occur following application of manures and deposition of excreta during grazing.

Nitric oxide is rapidly oxidised in air to nitrogen dioxide. Therefore levels of nitrogen oxides are considered in the assessment of nitric oxide.

6.2.2.2 *Derivation of Emission Factors*

The EMEP/EEA air pollutant emission inventory follows the Guidelines for Reporting Emission Data under the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution and the EU National Emission Ceilings Directive. It provides guidance on how to compile an atmospheric emissions inventory. Emission factors for all pollutants except NH₃ are derived for each sector based on the Tier 1 approach. The Tier 1 emission factors are chosen in a way that they represent 'typical' or 'averaged' process. This approach is used in the

absence of more accurate values. Tier 1 default emissions factors have been used in Ireland for the calculation of various emissions in agriculture by Teagasc and the EPA. However, a high degree of uncertainty is associated with them. Teagasc currently proposes to carry out research to generate more accurate emission rates and future projections for the agricultural industry.

Tier 2 emissions for ammonia were provided by the EPA (B. Hyde, pers comm.)¹⁵⁶. These were derived for 2020 from a number of sources.

The guidelines provide emission factors from animal husbandry and manure management, including emissions following application of manures to land. Factors are provided for the following pollutants:

- Ammonia (NH₃)
- Nitric oxide (NO)

The impact of each scenario has been assessed for these pollutants under each agricultural sector.

6.2.2.3 *Assumptions*

A number of assumptions were made in the calculation of emissions to air:

- Each Ha of wheat receives approximately 200kg of N.
- On average each Ha of barley receives approximately 140kg of N
- As stated in the EPA inventory (Table 4 Ds1) to convert N₂O-n to N₂O use a factor of 1.5714 or 44/28
- Slurry emission factors were used for pigs and cattle; solid emission factor was used for sheep. Refer to EMEP/EEA air pollutant emission inventory "section 4.B animal husbandry and manure management subsection 3.2.2 page 14-17".

6.2.2.4 *Significance Criteria*

The significance of impacts on air quality is determined based on the EPA *Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements)*¹⁵⁷ and are adapted to include potential positive impacts. The criteria are related to changes in pollution due to

the various scenarios. The impact rating is determined based on the change in pollution relative to the baseline (2007 to 2009). The percentage changes are based on an approach provided in the National Roads Authority (NRA) document, Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes, 2007¹⁵⁸, refer to Table

6-2. It should be noted that the significance criteria apply to the change in emissions between the baseline years and the projected 2020 levels. It is not appropriate to apply a target value to the significance criteria as the timeframes for each set of results are not comparable, with different applicable targets.

Table 6-2: Significance criteria for assessing air quality impacts.

Rating	Changes in Pollution against baseline 2007-2009
Significant Positive Impact	Decrease in pollution of greater than 20%
Moderate Positive Impact	Decrease in pollution of between 10 and 20%
Slight Positive Impact	Decrease in pollution of between 5 and 10%
Neutral	Change of less than 5%
Slight Negative Impact	Increase in pollution of between 5 and 10%
Moderate Negative Impact	Increase in pollution of between 10 and 20%
Significant Negative Impact	Increase in pollution of greater than 20%

6.2.3 Analysis of Scenario A (Integrated Scenario)

Scenario A is assessed for each grouped sector and cumulatively against the baseline greenhouse gas emissions based on baseline agricultural data from 2007 to 2009.

6.2.3.1 Livestock (Cattle and Sheep)

In this section the air quality impact of the implementation of Food Harvest 2020 as envisaged in Scenario A is assessed. The baseline emission levels for livestock (calculated from baseline data) is compared to the scenario where the Food Harvest 2020 is implemented (refer to Table 6-3).

Table 6-3: Air Quality Impact of Scenario A (Integrated Scenario) for Livestock Compared to Baseline

Pollutant	Baseline Emissions (tonnes/year)	Change in emissions due to Scenario A (Integrated Scenario) (tonnes/year)	Change in Emissions (%)	Impact Rating (refer to Table 6.2)
Ammonia	86,730	2,709	+3	Neutral
Nitric Oxide	28	0.9	+3	Neutral

It is predicted that Food Harvest 2020 as envisaged in Scenario A for livestock would be considered to have a neutral impact on air quality emissions.

The NEC Directive¹⁵⁹ limits Ireland to 65kt of NO_x and 116kt of NH₃ in 2010 (a likely limit of 108.6 kilotonnes (kt) of NH₃ in 2020). In isolation, an increase of under 3kt of NH₃ from livestock would have a negative impact on Ireland's ability to

comply with that commitment. In isolation, an increase of 0.0009kt of NO from livestock is not likely to have a significant impact on Ireland's ability to comply with the NO_x commitment.

6.2.3.2 Pigs

In this section the air quality impact of the implementation of the Scenario A is assessed. The baseline emission levels for pigs (calculated from baseline numbers) are compared to the scenario where the Food Harvest 2020 is implemented through Scenario A (refer to Table 6-4).

Table 6-4: Air quality impact of Scenario A (Integrated Scenario) for pigs compared to baseline.

Pollutant	Baseline Emissions (tonnes/year)	Change in emissions due to Scenario A (Integrated Scenario) (tonnes/year)	Change in Emissions (%)	Impact Rating (refer to Table 6.2)
Ammonia	7,758	2,620	+33	Significant negative
Nitric Oxide	8.8	2.94	+33	Significant negative

It is predicted that Food Harvest 2020 as envisaged for Scenario A for pigs would be considered to have a significant negative impact on air quality emissions.

The NEC Directive limits Ireland to 65kt of NO_x and 116kt of NH₃ in 2010 (a likely limit of 108.6 kilotonnes (kt) of NH₃ in 2020). In isolation, an increase of over 2.5kt of NH₃ from pigs would have a negative impact on Ireland's ability to comply with that commitment. In isolation, an increase of almost 0.003kt NO from pigs would have no

significant impact on Ireland's ability to comply with the NO_x commitment

6.2.3.3 Poultry

In this section the air quality impact of the implementation of Food Harvest 2020 as envisaged in Scenario A is assessed. The baseline emission levels for poultry (calculated from baseline numbers) is compared to the scenario where the Food Harvest 2020 is implemented (Table 6-5).

Table 6-5: Air quality impact of Scenario A (Integrated Scenario) for poultry compared to baseline.

Pollutant	Baseline Emissions (tonnes/year)	Change in emissions due to Scenario A (Integrated Scenario) (tonnes/year)	Change in Emissions (%)	Impact Rating (refer to Table 6.2)
Ammonia	2,213	775	35	Significant negative
Nitric Oxide	0.057	0.02	35	Significant negative

It is predicted that the Food Harvest 2020 scenario for poultry would be considered to have a significant negative impact on air quality emissions.

The NEC directive limits Ireland to 65kt of NO_x and 116kt of NH₃ in 2010 (a likely limit of 108.6 kilotonnes (kt) of NH₃ in 2020). In isolation, an

increase of 0.7kt of NH₃ from poultry would have a negative impact on Ireland's ability to comply with that commitment. In isolation, an increase of 0.00002kt of NO from poultry would have no significant impact on Ireland's ability to comply with the NO_x commitment.

6.2.3.4 Other Livestock

In this section the air quality impact of the implementation of Food Harvest 2020 as envisaged in Scenario A is assessed. The baseline

emission levels for other livestock (calculated from baseline numbers) is compared to the scenario where the Food Harvest 2020 is implemented through Scenario A (refer to Table 6-6).

Table 6-6: Air quality impacts of Scenario A (Integrated Scenario) for other livestock compared to baseline.

Pollutant	Baseline Emissions (tonnes/year)	Change in emissions due to Scenario A (Integrated Scenario) (tonnes/year)	Change in Emissions (%)	Impact Rating (refer to Table 6.2)
Ammonia	1,811	44	2.4	Neutral
Nitric Oxide	314	7.5	2.4	Neutral

It is predicted that the Food Harvest 2020 scenario for other livestock would be considered to have a neutral impact on air quality emissions.

The NEC directive limits Ireland to 65kt of NO_x and 116kt of NH₃ in 2010 (a likely limit of 108.6 kilotonnes (kt) of NH₃ in 2020). In isolation, an increase of 0.04kt of NH₃ from other livestock would have a no significant impact on Ireland's ability to comply with that commitment. In isolation, an increase of 0.0075kt of NO from other livestock would have no significant impact on

Ireland's ability to comply with the NO_x commitment.

6.2.3.5 Fertiliser Application

In this section the air quality impact of the implementation of Food Harvest 2020 as envisaged in Scenario A is assessed. The baseline emission levels for fertiliser application (calculated from baseline numbers) is compared to the scenario where the Food Harvest 2020 is implemented through Scenario A (refer to Table 6-7).

Table 6-7: Air quality impact of Scenario A (Integrated Scenario) for fertiliser application compared to baseline.

Pollutant	Baseline Emissions (tonnes/year)	Change in emissions due to Scenario A (Integrated Scenario) (tonnes/year)	Change in Emissions (%)	Impact Rating (refer to Table 6.2)
Ammonia	11,087	+1,680	15	Moderate negative
Nitric Oxide	8,123	+1,231	15	Moderate negative

Therefore, it is predicted that Scenario A for fertiliser would be considered to have a moderate to significant negative impact on air quality emissions.

The NEC directive limits Ireland to 65kt of NO_x and 116kt of NH₃ in 2010 (a likely limit of 108.6 kilotonnes (kt) of NH₃ in 2020). In isolation, an increase of 0.17kt of NH₃ from fertiliser would have a negative impact on Ireland's ability to comply with that commitment. In isolation, an increase of over 1.2kt of NO from fertiliser would

negatively impact on Ireland's ability to comply with the NO_x commitment

6.2.4 Conclusions

To conclude, the predicted overall magnitude of impact of Scenario A on air quality is examined. The air quality impact of the full implementation of Food Harvest 2020 as envisaged in Scenario A is assessed with the main sectors contributing to air quality considered. The baseline emission levels for all sectors are summed and compared to the

scenario where the Food Harvest 2020 is implemented through Scenario A (refer to Table 6-8). In order to determine the overall impact of the implementation of Food Harvest 2020, the change in emissions is considered in the context of the contribution of Agriculture, Forestry and Fisheries to Ireland's total emissions.

As described earlier, Agriculture, Forestry and Fisheries produce approximately 98% of total ammonia emissions. Scenario A is predicted to result in a 7% increase in this level, which

corresponds to an increase of almost 8kt of ammonia.

Agriculture/forestry/fisheries contribute approximately 10% of Ireland's total NO_x emissions. These are mainly expected to be generated by off-site effects. As nitric oxide is rapidly oxidised in air to nitrogen dioxide, increases in NO has the potential to impact on Ireland's commitments under a revised NEC Directive.

Table 6-8: Air quality impacts of Scenario A (Integrated Scenario) compared to baseline.

Pollutant	Baseline Emissions (tonnes/year)	Change in emissions due to Scenario A (Integrated Scenario) (tonnes/year)	Change in Emissions (%)	Impact Rating (refer to Table 6.2)
Ammonia	109,598	7,828	7	Slight negative
Nitric Oxide	8,474	1,242	15	Moderate negative

In summary, the main impact of the implementation of Food Harvest 2020 through Scenario A, therefore, arises from ammonia emissions as agriculture is the main contributor. On this basis, the implementation of Food Harvest 2020 is likely to have a slight negative impact on air quality. It should be noted that because the air quality limits outlined in the NEC Directive apply nationally, no regional assessment of air quality has been considered.

According to the EPA in 2013, given the strong performance of the agriculture sector in line with the ambitious targets of Food Harvest 2020, limiting NH₃ emissions to below the 2010 ceiling in the future could become an issue. Continued research on low emission landspreading techniques and other manure management strategies is required.

6.3 Notes and References

- 150 EPA Informative Inventory Report 2012
- 151 <http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009>
- 152 Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011)
- 153 EPA Air Quality Monitoring Reports (2007-2009)
- 154 https://www.epa.ie/pubs/reports/indicators/00061_EPA_SoE_2012.pdf
- 155 Department of Agriculture, Fisheries and Food, Food Harvest 2020 A Vision for Irish Agri-food and Fisheries
- 156 EPA (B. Hyde, pers comm)
- 157 EPA Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements (2002)
- 158 National Roads Authority (NRA) Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes, 2007.
- 159 EU National Emissions Ceiling (NEC) Directive (2001/81/EC)



Landscape

Section 7:

Landscape

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7 Landscape

7.1 Baseline

7.1.1 Introduction

Agricultural landscape has clear dependencies and interactions with other environmental parameters, (e.g. soil, water, climate, biodiversity *etc.*); with economic factors (e.g. income, investment, market demand, financial supports, *etc.*), and with social and cultural considerations. However, many of these parameters are beyond the scope of this section of the report or are considered elsewhere in the report.

As such, in this section focus is given to the agricultural landscapes that are the visible outcomes of the interaction between man (in the form of agricultural processes and uses), natural resources and the environment. Such considerations encompass aspects such as character, amenity, cultural influences and societal values.

The Irish landscape is very much an agricultural landscape, fashioned by geological and climatic factors and tempered by man's activities over thousands of years. Each in its own way plays a significant role in shaping the landscape as we continue to experience it today. Physically, Ireland is somewhat saucer-shaped, with flat lowlands through the centre and mountainous uplands around the coastal edge.

Coupled with soils and climate, this topography gave Ireland with a series of distinctive regions, both physically and in terms of its agricultural land capability, (See Figure 7-1). Over the centuries man and agriculture adapted to this environment, so much so that different regions have developed different types of traditional agricultural practice, (See Figure 7-2). This combination of geology, climate, soil and man has given us the characteristic productive dairying region of the Golden Vale, the mixed grazing areas of the west, the intensive grazing of the eastern midlands, and the stone walled field of the small farms of the western seaboard, *etc.*

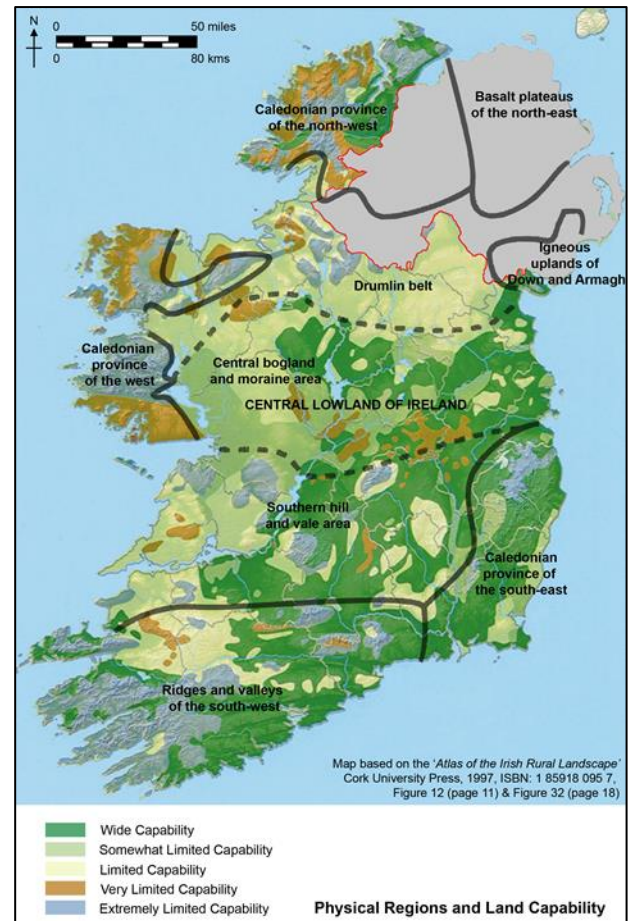


Figure 7-1: Landscape- physical regions and land capability¹⁶⁰

Therefore, agriculture is a particularly significant feature of the Irish landscape and through the centuries no part of the island has avoided its influence. Viewed from a historical context changes to the landscape from agricultural needs / practices have often been dramatic. Before the introduction of extensive agriculture, much of the island was covered in woodland; however by 1900, opening up of land for arable and grassland use had reduced the area of tree cover to 1%, and most of this was in the form of 19th century estate plantations. Formal enclosure of the landscape with hedgerows (or banks, ditches, walls *etc.*) was introduced in the 16th century and became established practice from the 17th century onwards.



Figure 7-2: Landscape - agricultural regions and land capability.

The combination of woodland clearance, the introduction of agricultural uses and the formal enclosure of land have given the landscape of Ireland the structure and character it retains to this day. As it is found in many areas of western seaboard of Europe, this pattern of enclosed small-scale pastoral landscape or 'bocage' is not uniquely Irish. However, it is best expressed as a national landscape characteristic in Ireland (for example see Figure 7-3)



Figure 7-3: Enclosed Irish agricultural rural landscape

Mechanisation brought major changes to agricultural practices through the first half of the 20th century, which in combination with improved education, breeding and farming systems, delivered the modern production practices of the second half of the 20th century. The combined impact led to an enlargement of farm sizes, enlargement of field sizes - particularly for arable production, larger buildings etc. and a significant reduction in hay production in favour of silage (influenced by climate also) and a general intensification of agricultural production. The changes have been noticeable throughout the Country; however, particularly on the more favourable lands of the east and south of the Country, which have shown a greater move towards increased specialisation and corresponding landscape homogeneity.

In addition to farming the landscape as an economic resource, farmers and agriculture are in effect the custodians of the landscape, managing the resource, its character, structure, quality and visual presentation.

Consideration of the relationship between agriculture and landscape is a complex and poorly understood area. This is all the more important in

Ireland, where over 80% of the landscape is directly influenced by agricultural activity.

The agricultural landscape is a place to live, to work, a resource, a source of food, a visual amenity, a place of recreation, a mosaic of habitats, a social, cultural and historical resource, and a major part of the natural ecosystem. Yet there is no single way in which it can be defined, classified or valued. To a large extent it is dependent on the relationship between the viewer to the landscape – the farmer, the local who views it every day, the ecologist, the urban visitor, the tourist, *etc.* – each will have a subjective perception based on their experiences and individual relationship with the landscape.

Agricultural landscapes are composed of three complex inter-related key elements¹⁶¹ (see also Figure 7-4):

- **structure or appearance**, including physical and environmental features (*e.g.* topography, drainage, habitats, *etc.*), land use patterns and distributions (*e.g.* arable, grazing, silage, systems of cultivation *etc.*), and man-made objects or cultural features (*e.g.* buildings, hedgerows, field gates, ringforts, *etc.*);
- **function**, for farmers and rural communities as a place to live and work, for society as a place to visit and space for the enjoyment of various recreational activities, and also the function of landscape in providing various environmental services, such as the provision of biodiversity;
- **value**, concerning the value society places on agricultural landscape, (*e.g.*

recreational, cultural and other amenity values associated with landscape) and the costs of maintaining and enhancing landscape provision by agriculture.

Changes or effects to any one or more of these principal elements will impact on character of the landscape. Depending on the sensitivity of the impacted feature(s), these effects will vary in terms of their nature, significance and duration.

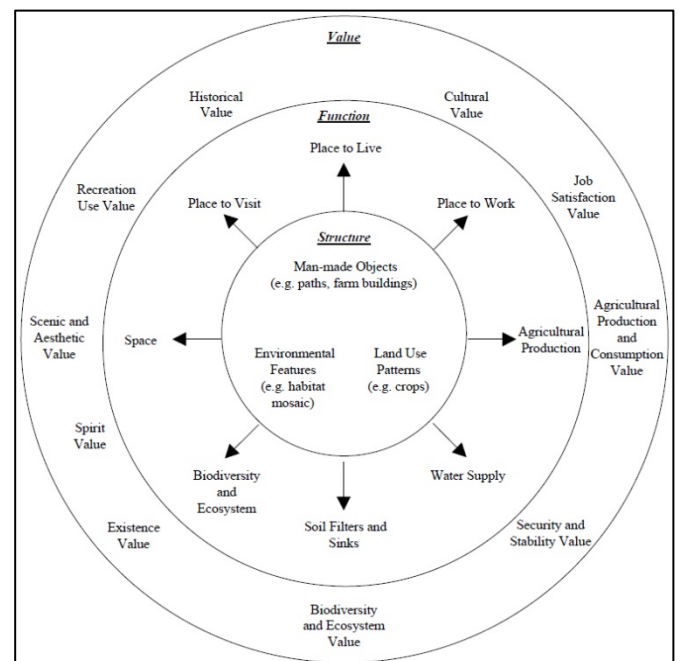


Figure 7-4: Landscape: structure, function and value Source: Parris 2002 (adapted from Bergstrom (1998))

7.1.2 Significance Criteria

The significance criteria used in the assessment of potential impacts of *Food Harvest 2020* are set out and defined in Table 7-1. The criteria have been selected following a review of relevant literature, and on the basis of the objective criteria.

Table 7-1: Significance criteria.

Nature of Impact	Description	Significance	Definition of Significance
Positive	A change which improves the quality of the environment	Significant +ve	High probability of Major effect on Magnitude & Intensity; on Integrity; and of Medium-term to Permanent duration The change / effect would have the potential to: <ul style="list-style-type: none"> enhance, maintain, restore, promote sensitive landscape characteristics integrate successfully with the scale, landform and pattern of the landscape
		Moderate +ve	Medium to High probability of Major effect of Short to Medium-term duration <u>or</u> Minor Permanent effect <u>or</u> Medium effect of Long-term to Permanent duration On Magnitude & Intensity and Integrity The change / effect would have the potential to: <ul style="list-style-type: none"> enhance, maintain, restore, promote characteristic features of the landscape fit in well with the scale, landform and pattern of the local landscape
		Slight +ve	Low to Medium probability of Minor or Medium effect on Magnitude & Intensity; on Integrity; and of Short to Medium duration The change / effect would have the potential to: <ul style="list-style-type: none"> enhance, maintain, restore or promote existing landscape quality and character fit with the scale, landform and pattern of the landscape
Neutral / Imperceptible	A change / effect without noticeable consequences on the characteristics, scale, landform and pattern of the landscape		
Negative Impact	A change which reduces the quality of the environment	Slight -ve	Low to Medium probability of Minor or Medium effect on Magnitude & Intensity; on Integrity; and of Short to Medium duration The change / effect would have the potential to: <ul style="list-style-type: none"> adversely affect the general nature of existing landscape quality and character be noticeable as not quite fitting with the scale, landform and pattern of the landscape
		Moderate -ve	Medium to high probability of Major effect of Short to Medium-term duration <u>or</u> Minor Permanent effect <u>or</u> Medium effect of Long-term to Permanent duration On Magnitude & Intensity and Integrity The change / effect would have the potential to: <ul style="list-style-type: none"> have an adverse impact on characteristic features of the landscape be out of scale with the landscape and/or at odds with the local pattern of the landscape
		Significant -ve	High probability of Major effect on Magnitude & Intensity; on Integrity; and of Medium-term to Permanent duration The change / effect would have the potential to: <ul style="list-style-type: none"> degrade the integrity of a range of sensitive landscape characteristics be at considerable variance with the scale, landform and pattern of the landscape

The EPA (Guidelines, 2002)¹⁶² states **significance of an impact** to mean either *‘the importance of the environment that is affected (its sensitivity to change) or the importance of the outcome of the impact (the consequences of the change)’*. Four objective criteria that have been selected to determine whether an impact is of significance (as adapted for this project) are:-

- **Magnitude & Intensity** - Any aspect of the plan which can cause effects over a wide area, to a large number of receptors, or effects which are of an intensity which is significantly in excess of those normally experienced.
- **Integrity** - The degree to which the character or attributes of the baseline environmental topic is continued, enhanced or reduced.
- **Duration** - Any development which can cause impacts for a long period of time (more than one generation) or which will cause permanent changes to any aspect of the environment.
- **Probability** – The level of certainty that can be applied to the magnitude, intensity, duration or consequences of any change.

The criteria incorporate magnitude & intensity, integrity and duration whilst acknowledging that effects may be **positive, neutral or negative** and that they may vary in their significance. Consideration is also given to whether an impact is reversible or not. Duration of impact (adapted from EPA, 2002) vary from:

- **Short to medium term** (lasting up to 15 years)
- **Medium to long term** (lasting 15 to 60 years)
- **Permanent** (lasting more than 60 years)

The assessment must take account of the probability of the effect occurring. The following levels of probability are incorporated in the criteria:-

- **High probability:** certain or high confidence
- **Medium probability:** reasonable confidence
- **Low probability:** uncertain or low confidence

7.1.3 Legislative and Regulatory Framework

The following discussion of legalisation and regulation focuses on aspects relating directly to landscape. Aspects of legislation and regulation relating to habitats, fauna, soil, water etc. are considered as appropriate under separate headings elsewhere in this report.

Landscape, in the broadest sense of being a social, cultural, environmental, economic and visual resource is generally not covered by legislation or regulation. In recent years some initial attempts have been made considering landscape as an integrated resource, firstly in the introduction into the Planning and Development Acts 2000-2011 of requirements for the preservation of the character of the landscape, including statutory provision for areas of special amenity and landscape conservation areas. In 2000, the then Department of the Environment, Heritage and Local Government (DoEHLG) issued **Draft Landscape and Landscape Assessment Guidelines**, with the aims of heightening awareness of landscape issues, guiding planners, and indicating specific requirements for development planning and control. While landscape character assessments have been completed on a county by county basis, with no overall National Landscape Character Structure, they are often inconsistent and generally there is a lack of clarity of the role of landscape character assessment in statutory planning and legislation.

Ireland signed and ratified the **European Landscape Convention** (done at Florence on 20 October 2000) in March 2002. The Convention came into effect in March 2004. In September 2011, the Department of Arts, Heritage and the Gaeltacht (DAHG), issued a Strategy Issues Paper for Consultation on **A National Landscape Strategy for Ireland**, a strategy Ireland committed to deliver in signing the Convention. The Issues Paper has

been circulated for public consultation and the National Landscape Strategy has no statutory role at present.

Therefore, with no clear landscape legalisation or regulation, development as it may effect or impact on landscape is generally controlled through the normal planning and development process as provided for in the primary legislation of the Planning and Development Acts (2000-2011) and / or through the Environmental Impact Assessment Directive (Council Directive 85/337/EEC as amended by Directive 97/11/EC, 2003/35/EC and 2009/31/EC).

7.1.3.1 Planning and Development Act 2000-2011

The Planning and Development Act (2000-2011) is the primary legalisation regulating physical planning and development in Ireland. The Act is supported by secondary legislation in the form of the Planning and Development Regulations (2001-2012).

Planning controls are generally enforced by the Local Authority with control and guidance provided through the policies and objectives of the Development Plan. From time to time the DECLG may also issue guidelines (e.g. Regional Planning Guidelines) to direct planning and development and to ensure consistency in the application of planning and land use policies.

‘Landscape’ under the Planning and Development Act 2011 (Section 2.—(1)) has the same meaning as it has in Article 1 of the European Landscape Convention (2000), that being:

Landscape is...

An area as perceived by people, whose character is the result of the action and interaction of natural and/or human factors

European Landscape Convention, 2000

‘Agriculture’ under the Act (Section 2.—(1)) is considered as including *horticulture, fruit growing, seed growing, dairy farming, the breeding and keeping of livestock (including any creature kept for the production of food, wool, skins or fur, or for*

the purpose of its use in the farming of land), the training of horses and the rearing of bloodstock, the use of land as grazing land, meadow land, osier land, market gardens and nursery grounds.

Section 3.—(1) of the Act states that ‘development’ means *the carrying out of any works on, in, over or under land or the making of any material change in the use of any structures or other land.*

The Act also considers that some aspects of agricultural activity are ‘exempt development’ *i.e.* development for which planning permission is not required. Most notably, Sections 4.—(1)(a) and 4.—(1)(i) of the Act states that development consisting of the use of land for the purpose of agriculture and the use of any building occupied together with such land, as well as development consisting of the thinning, felling or replanting of trees, forests or woodlands, but not including the replacement of broadleaf high forest by conifer species, shall be considered as exempt development.

7.1.3.2 Environmental Impact Assessment Directive (Directive 2011/92/EU (being a codified directive of Council Directive 85/337/EEC, as amended by Directive 97/11/EC, 2003/35/EC and 2009/31/EC))

The European EIA Directive is one of the most significant parts of legislation regulating environmental protection in Ireland. The Directive requires a process of assessment of the environmental impacts for certain projects, which are likely to have significant effects on the environment – including landscape – by virtue, inter alia, of their nature, size or location. Such projects are set out under two separate annexes – ANNEX I Projects which will automatically require Environmental Impact Assessment and ANNEX II Projects which will only require EIA if certain thresholds are met.

The EIA Directive is enacted in Ireland through PART X of the Planning and Development Acts 2000-2011 and the Planning and Development Regulations 2001 – 2012 with ANNEX I and ANNEX II projects listed in Part 1 and 2 of Schedule 5 of the Regulations. In addition, other sub-threshold

projects may also be subject to EIA on a discretionary basis as set out in Schedule 7 of the Regulations.

ANNEX I (of the Directive) and Schedule 5 Part 1 (of the Regulations) sets out project types for which EIA shall be mandatory. Project Type 17 refers to installations for the intensive rearing of poultry or pigs with more than:

- (a) 85,000 places for broilers, 60,000 places for hens;
- (b) 3,000 places for production pigs (over 30 kg); or
- (c) 900 places for sows.

ANNEX II (of the Directive) provides a list of project types for which Member States shall determine if the project is to be subject to an assessment or not. Project Type 1, **Agriculture, Silviculture and Aquaculture**, lists the following projects:

- (a) Projects for the restructuring of rural land holdings;
- (b) Projects for the use of uncultivated land or semi-natural areas for intensive agricultural purposes;
- (c) Water management projects for agriculture, including irrigation and land drainage projects;
- (d) Initial afforestation and deforestation for the purposes of conversion to another type of land use;
- (e) Intensive livestock installations (projects not included in Annex I);
- (f) Intensive fish farming;
- (g) Reclamation of land from the sea.

As previously noted, in Ireland ANNEX II projects are set out in detail in Part 2 of Schedule 5 of the Planning and Development Regulations, which provides for the following thresholds for (1.) Agriculture, Silviculture and Aquaculture projects:

- (c) Development consisting of the carrying out of drainage and/or reclamation of wetlands where more than 2 hectares of wetlands would be affected.
- (d) (ii) Replacement of broadleaf high forest by conifer species,

where the area involved would be greater than 10 hectares.

- (iii) Deforestation for the purpose of conversion to another type of land use, where the area to be deforested would be greater than 10 hectares of natural woodlands or 70 hectares of conifer forest.
- (e) (i) Installations for intensive rearing of poultry not included in Part 1 of this Schedule which would have more than 40,000 places for poultry.
- (ii) Installations for intensive rearing of pigs not included in Part 1 of this Schedule which would have more than 2,000 places for production pigs (over 30 kilograms) in a finishing unit, more than 400 places for sows in a breeding unit or more than 200 places for sows in an integrated unit.
- (f) Seawater fish breeding installations with an output which would exceed 100 tonnes per annum; all fish breeding installations consisting of cage rearing in lakes; all fish breeding installations upstream of drinking water intakes; other freshwater fish breeding installations which would exceed 1 million smolts and with less than 1 cubic metre per second per 1 million smolts low flow diluting water.
- (g) Reclamation of land from the sea, where the area of reclaimed land would be greater than 10 hectares.

7.1.3.3 European Communities (Environmental Impact Assessment) (Agriculture)) Regulations 2011

The most recent environmental legislation, the EIA (Agriculture) Regulations, 2011, brings tighter control to 3 specific types of on-farm activities:

- **Restructuring of rural land holdings;** including removal of over 500m lengths of field boundaries/hedgerows (excluding port and wire or electric fencing); re-structuring over 5ha of land by removal of field boundaries; and / or re-contouring over 2ha of land.
- **commencing to use over 5ha of uncultivated land or semi-natural areas for intensive agriculture;** including mechanical cultivation, adding or significantly increasing fertiliser used, sowing seed or clearing vegetation (except invasive briars)
- **land drainage works on over 15ha of lands used for agriculture (excluding drainage or reclamation of wetlands),** including installing open drains, installing enclosed field drains and or opening a watercourse.

7.1.4 Current Status of Landscape.

Despite the challenges of modern agriculture, the utilised agricultural area (*i.e.* the area under cereals, hay, silage, pasture and utilised rough grazing, including commonage) still accounts for over 72% of the Country – as compared to circa 45% across Europe as a whole. In contrast to much of Europe, well over 60% of the Irish landscape is under grass (*i.e.* hay, pasture, rough grazing, silage), with dairying and mixed livestock farming being the dominant land uses. Less than 6% of the utilised agricultural land area is under cereals. A further 11% of the Country is under forestry – a figure that is again in marked contrast to a European average of 43%.

The EPA, in Ireland's Environment – An Assessment, 2012, finds *'that Ireland's environment is in a generally good condition overall'*, stating that despite the rapid development of the past two decades *'the overall area of artificial surfaces remains low in*

comparison with other EU countries, and that 'Ireland's landscape is predominantly rural and agricultural'.

The report acknowledges that *'a healthy, protected and well managed environment underpins the development of our key economic sectors, such as tourism and agri-food industry which thrive on the clean and green image of Ireland'.*

The Report notes that the Irish landscape has experienced continual land cover changes for centuries and as a rate that is relatively high by European standards. The report goes on to state that the *"main changes have been an increase in the amount of forested lands and artificial areas and a decrease in the total amount of agricultural land and peatland. The area under forestry has increased from 7% to 11% of national land cover during this period, primarily due to the planting of peatland and pasture lands with coniferous plantations. The area under artificial surfaces increased by approximately 15% since 2000 to 2% of national land cover (EPA, 2011). This mainly occurred on former agricultural lands on the periphery of existing urban areas, including the suburbanisation of villages close to larger towns and cities".*

In discussing Forestry, the report notes that much of the resource is young with nearly 40% having being planted since 1990 and 75% of the national resource is of commercial coniferous timber species. The report notes the potentially significant landscape impact of both afforestation and forest harvesting.

The report draws attention to Food Harvest 2020, which it claims projects significant changes in production and notes that *"integration of environmental considerations with the agricultural objectives must be carefully managed".*

The report highlights the need for a National Landscape Strategy as the basis for an integrated approach to dealing with sustainable management of land use and related aspects noting that the *"European Landscape Convention, adopted in 2000, emphasises the need to seek the right balance between management planning and*

protection of a landscape. The National Landscape Strategy Steering Group was established by the DAHG in 2011 to develop a National Landscape Strategy with the aim of sustainable management of change affecting landscape”.

The report goes on to identify “four key environmental challenges for Ireland: Valuing and protecting our natural environment; Building a resource-efficient, low-carbon economy; Implementing environmental legislation; and Putting the environment at the centre of our decision-making”.

7.1.4.1 Historic, current and projected sectoral dynamics

7.1.4.1.1 Cattle

The review of cattle includes all cattle and dairy cows, heifers etc. A review of the historic data – even against the baseline information for activity (i.e. average of 2007, 2008 and 2009) shows some interesting results for the agricultural landscape. The principal findings are illustrated in Figure 7-5 and Figure 7-6.

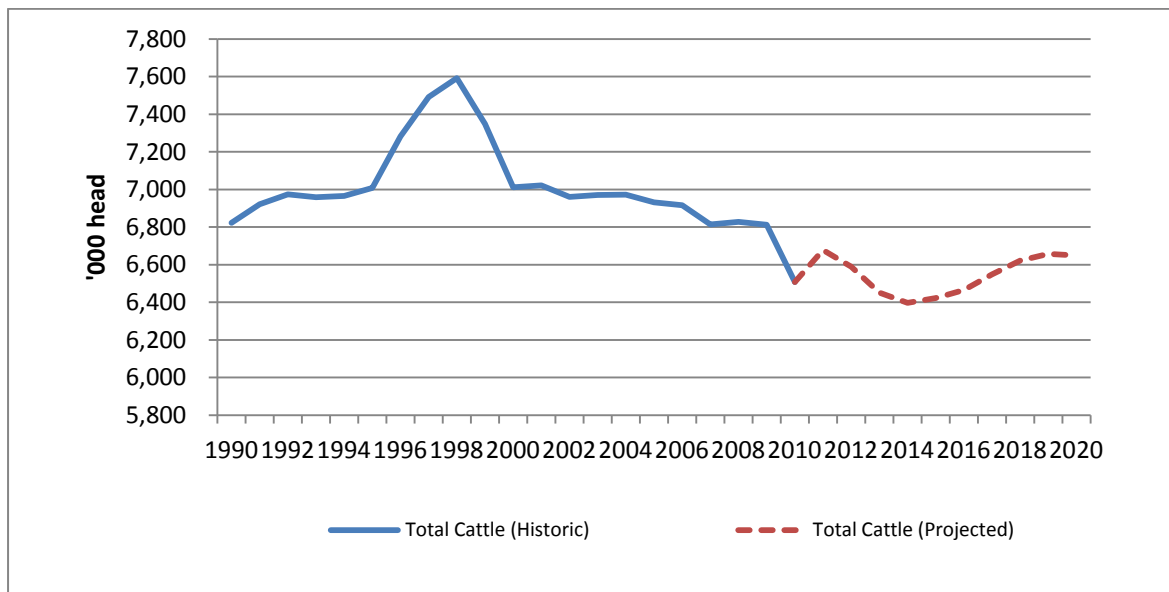


Figure 7-5: Total Cattle Numbers 1990 - 2020 (000 head) (FAPRI-Ireland).

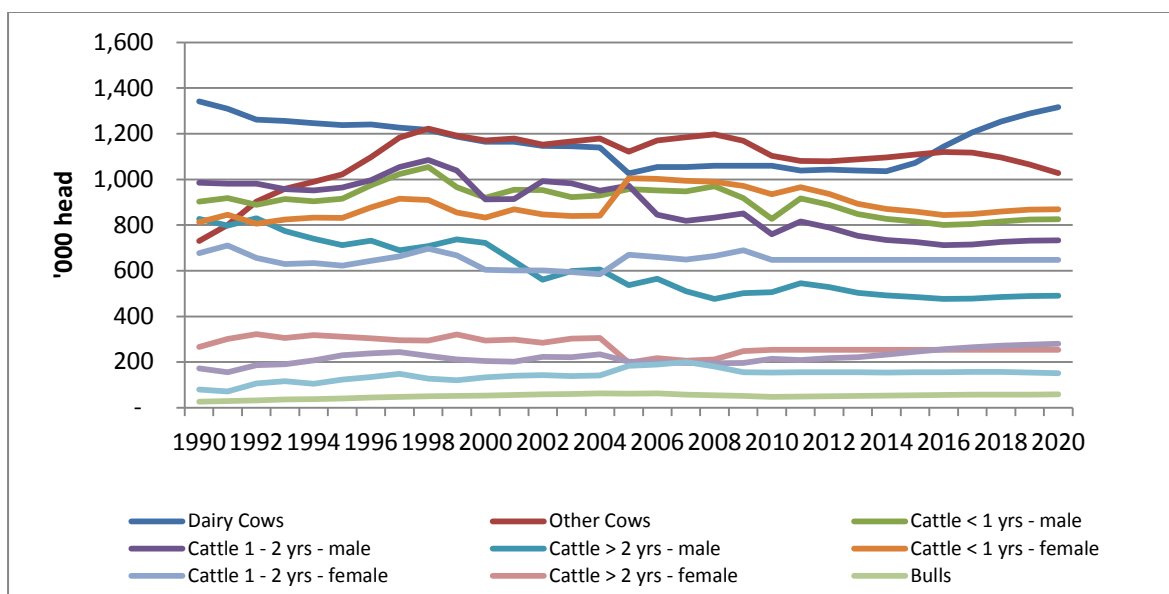


Figure 7-6: All Cattle Numbers 1990 - 2020 (000 head) (FAPRI-Ireland).

These figures indicate that:

1. The overall total head of all Cattle remained virtually unchanged (-0.05% reduction) between 1990 and the baseline (circa 18 years), though the numbers did increase gradually up to 1998 (+11% increase) before falling again.
2. Projected numbers to 2020 under Scenario A shows overall cattle numbers falling only slightly from the baseline (-2.5% reduction).
3. The actual number of dairy cows fell by -21% from 1990 to the baseline. Food Harvest Scenario A is projecting an approximate +24.5% increase in dairy cows by 2020 – effectively bringing numbers back to what they were in 1990.
4. Numbers show appreciable reductions and increases within 0 to over 2 year old cattle, with some categories falling by up to -40%, while others rise by up to +21% between 1990 and the baseline. Changes up to 2020 are less notable, with reductions and increases up to -12% and +14.5% in different categories. However, when considered as a group the changes in 0 to over 2 year old cattle are less significant, falling by circa -7% between 1990 and the baseline and by a further -7% up to 2020.
5. Between 1990 and the baseline, significant increases show up in Other Cows (+62%) and in Bulls and Other Heifers (over 100% in each case). Between the baseline and 2020, the

numbers of Other Cows and Other Heifers both fall by more than -13% each, while Dairy Heifers rise appreciably by over +43%. The overall increase in Bulls is not considered to be significant as it is from a very low 1990 level (represents only 0.4% of the total cattle numbers in 1990). The increase in Bulls from the baseline to 2020 is +6.5% or only 0.9% of the total cattle numbers projected in 2020.

6. When compared with 1990, the projected totals of 2020 show only minor variation in the principal/larger sectors (e.g. total Cattle -2.5%; Dairy Cows -2% and Cattle 0 to over 2 years -14%).

Between 1990 and the baseline there was a noticeable movement away from dairying towards livestock and Other Cows and Heifers. It is projected that this trend will be partly reversed by 2020, where a +24.5% increase in Dairy Cows and a +43% increase in Dairy Heifers is partly offset by decreases in 0 to over 2 year Old Cattle (-14%) in Other Cows (-13%) and in Other Heifers (-15%).

This is a complex area with a high degree of variation between categories. While the change in overall numbers is minimal, it is considered most likely that the projections will have potential for some degree of impact on the agricultural landscape.

7.1.4.1.2 Sheep and Goats

The review of sheep includes all sheep; lowland and upland ewes and rams; other lowland and upland sheep; and lowland and upland lambs. The principal findings all illustrated in Figure 7-7 and Figure 7-8.

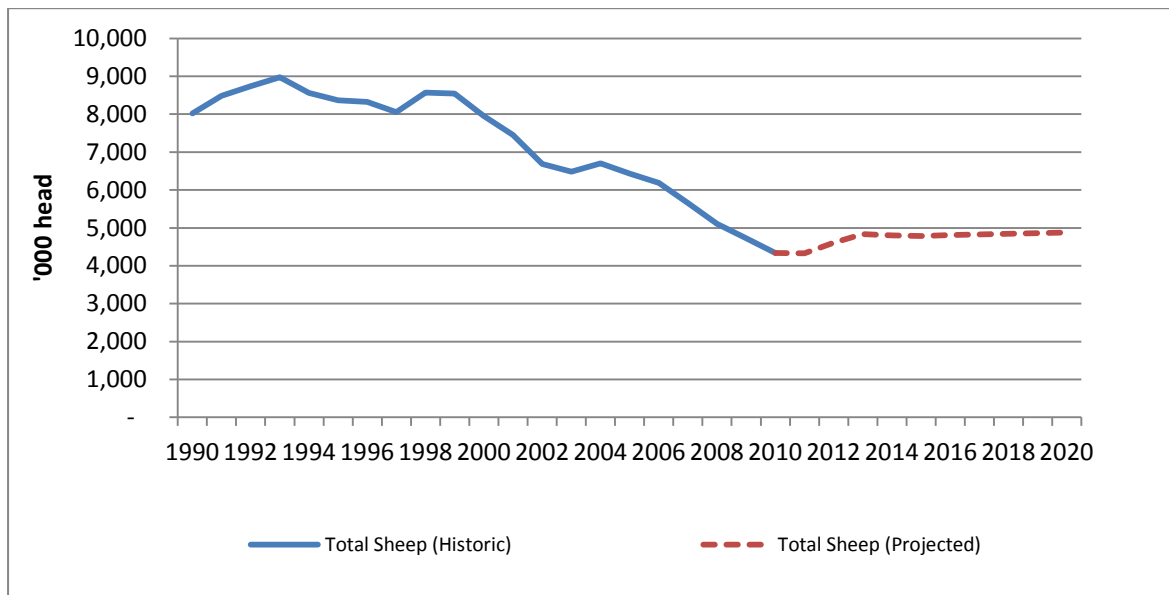


Figure 7-7: Total Sheep Numbers 1990 - 2020 (000 head) (FAPRI-Ireland).

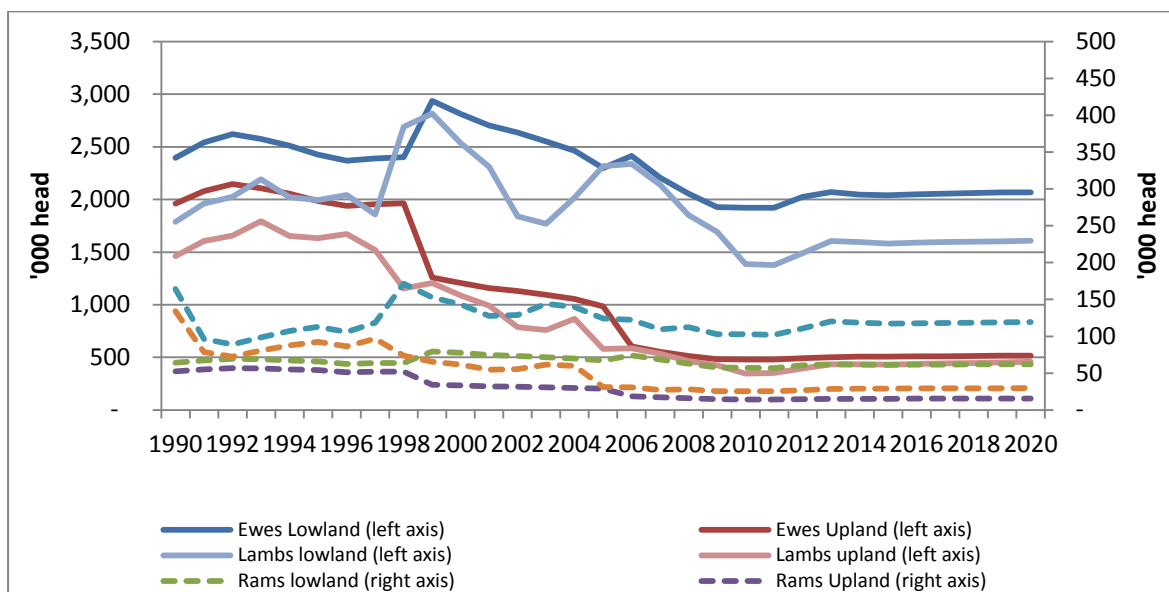


Figure 7-8: All Sheep Numbers 1990 - 2020 (000 head) (FAPRI-Ireland).

These figures indicate that:

1. The overall total head of all Sheep fell by over -35% between 1990 and the baseline. Food Harvest Scenario A projects that overall numbers will continue to fall, but by a much reduced level, of -5.5% by 2020.
2. In 1990 the overall sheep herd comprised significant numbers of Lowland Ewes and Lambs (54%) and Upland Ewes and Lambs

(45%). In the baseline the contribution of upland sheep had fallen off noticeably to less than 20% of overall sheep numbers. The contribution of upland sheep to overall sheep numbers is projected to remain relatively static at less than 21% by 2020.

3. The fall in Upland Sheep between 1990 and the baseline was pronounced at over 71% for all categories (Sheep, Ewes,

Rams, Lambs). Only a minor fall (less than -1.5%) is projected for all upland sheep categories through to 2020.

4. The fall in Other Lowland Sheep between 1990 and the baseline was also noticeable at -34%. However, Food Harvest projects a 10% increase in Other Lowland Sheep through to 2020.
5. While Lowland Ewes and Lambs showed slight increases (+14% and +6%) between 1990 and the baseline, Food Harvest is projecting a -15% fall in Lowland Lamb through to 2020.

Between 1990 and the baseline, there was a noticeable movement away from upland sheep. However, with only a slight increase in lowland sheep, there was a significant fall in (and move away from) sheep farming in general – especially in upland areas. Food Harvest projects a stabilisation in upland sheep numbers with less than a -1.5% fall. Food Harvest is projecting a 10%

rise in Other Sheep both Upland and Lowland – however, it is projected that overall numbers will continue to fall by over -5.5%. While the change in overall numbers is low it is considered that projections have potential for some degree of impact on the agricultural landscape.

Goat numbers in Ireland are very low (8,770 head) for the baseline. The numbers have fallen off noticeably (-50%) since 1990 and are projected to rise slightly (+15%) by 2020. However, the overall number as projected remains small (10,100 head by 2020) and it is considered most likely that projections will not have potential for significant impact on the agricultural landscape.

7.1.4.1.3 Pigs

The review of pigs includes all pigs; gilts, sows, boars, and pigs <20Kg and pigs >20Kg. The principal findings are illustrated in Figure 7-9 and Figure 7-10.

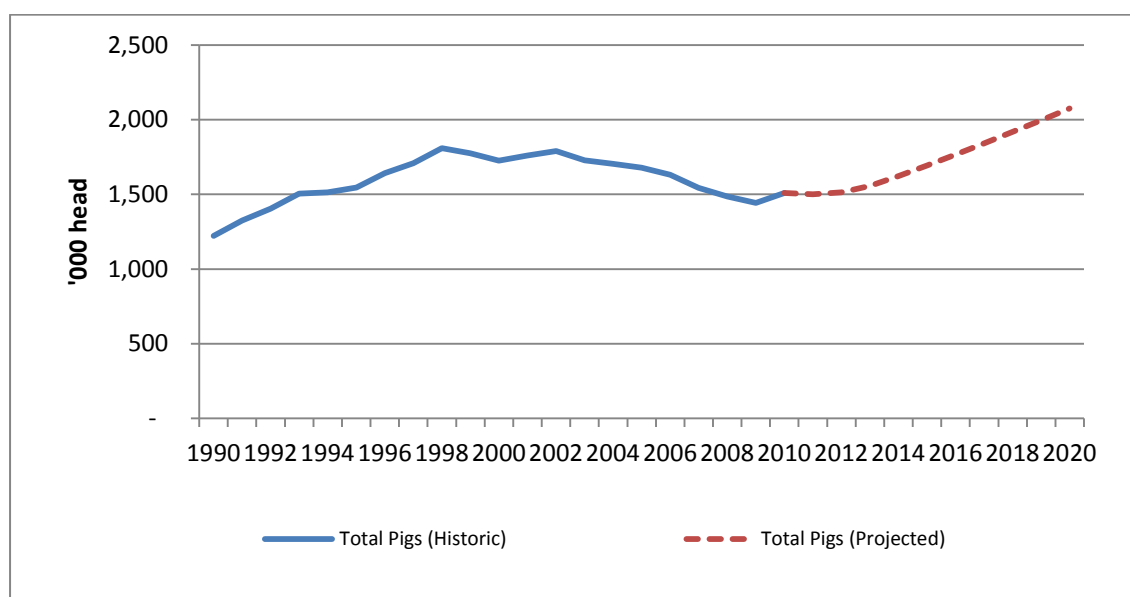


Figure 7-9: Total Pig Numbers 1990 - 2020 (000 head) (FAPRI-Ireland).

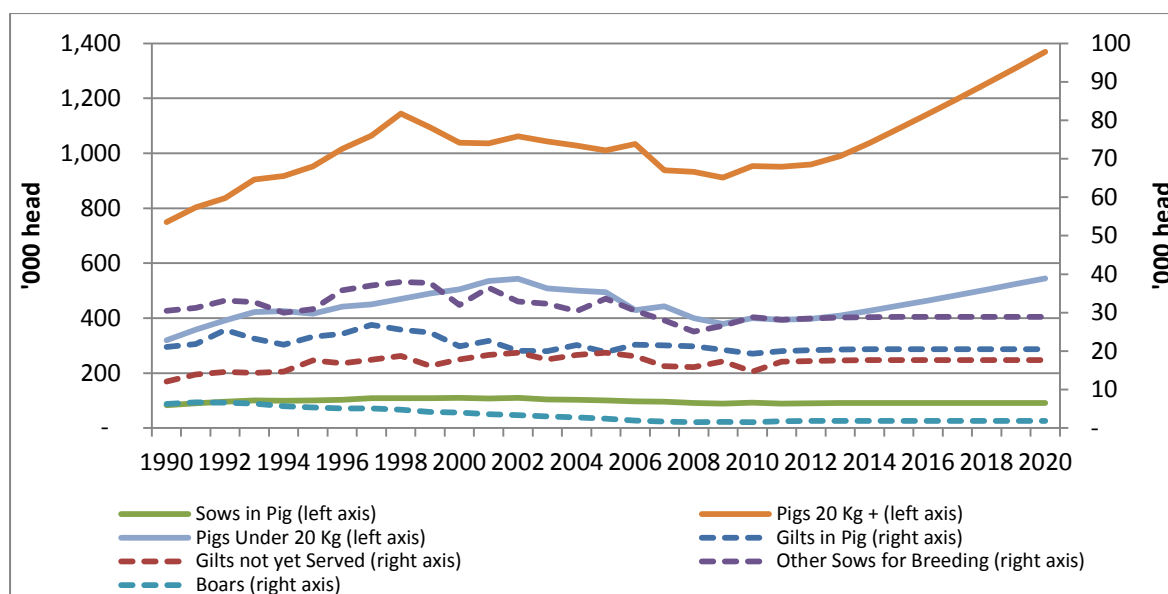


Figure 7-10: All Pig Numbers 1990 - 2020 (000 head) (FAPRI-Ireland).

These figures indicate that:

1. In the baseline, the vast majority of pig numbers comprises Pigs <20Kg (+61%) and Pigs >20Kg (+26%) – a total of 87% of all pig numbers. By 2020 it is projected that these two most significant pig categories will comprise 92% of total pig numbers.
2. The overall total head of all Pigs rose by 22% between 1990 and the baseline, with the greatest increase being in Pigs <20Kg (+27.5%), Pigs >20Kg (+23.5%) and in Gilts not yet served (+35.5%).
3. Food Harvest Scenario A projects that overall numbers will continue to rise further from the baseline to +39% by 2020. The most noticeable increases will again be in Pigs <20Kg (34%) and Pigs >20Kg (+47.5%).
4. Boar numbers fell by -74.5% from 1990 to the baseline, but are projected to rise by +15.5% from the baseline to 2020. However, this is not considered significant as the baseline Boars only represented

0.1% of the total pig numbers. Boars will only represent 0.09% of the total pig numbers as projected in 2020.

Between 1990 and the baseline, there was a +22% increase in overall pigs numbers comprised mainly of younger pigs (*i.e.* Pigs <20Kg, Pigs >20Kg (+23.5%) and Gilts not yet served). Food Harvest projects a further noticeable increase (+39%) in the overall pig numbers – again comprised of increases in younger pigs (*i.e.* Pigs <20Kg (+34%), Pigs >20Kg (+47.5%) and from a low level, Boars (+15.5%)).

With the main exception of waste disposal, pig farming is almost entirely an internal activity using specialised and often large buildings and one that is notably localised within the North Leinster region of the Country. It is considered most likely that projections will have potential for impact on the agricultural landscape.

7.1.4.1.4 Poultry

The review of poultry includes all poultry; layers, broilers and turkeys. The principal findings are illustrated in Figure 7-11 and Figure 7-12.

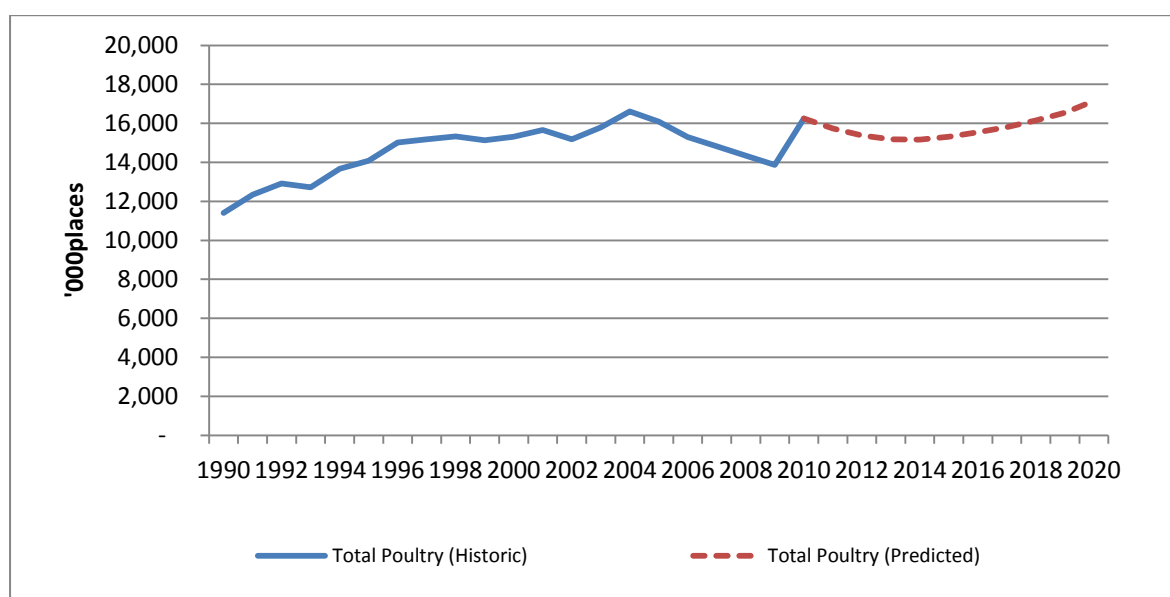


Figure 7-11: Total Poultry Numbers 1990 – 2020 (FAPRI-Ireland).

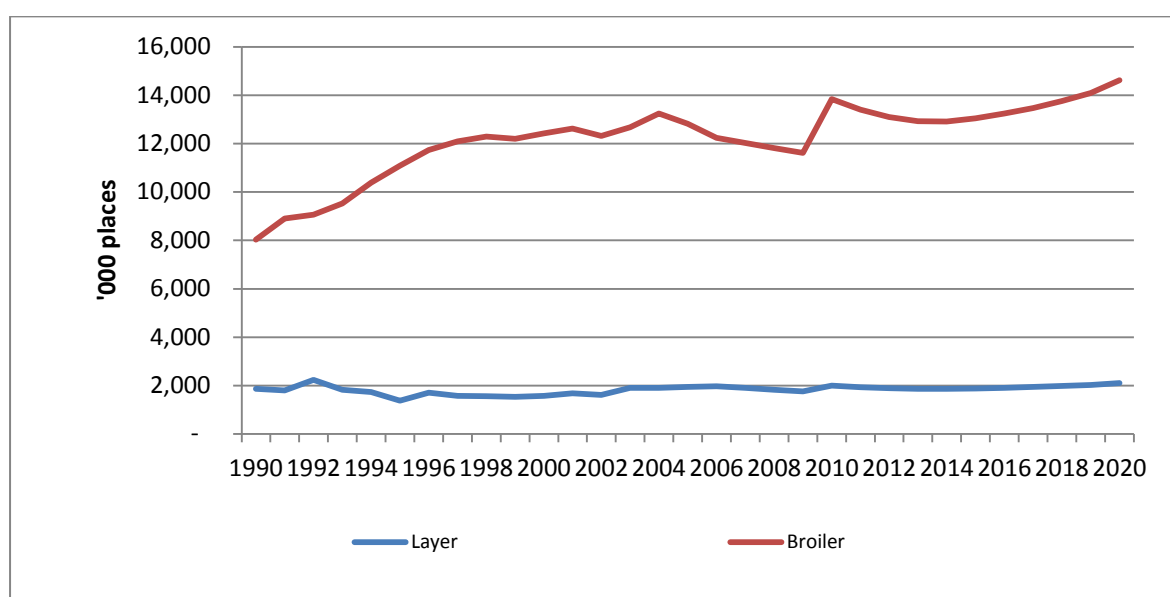


Figure 7-12: All Poultry Numbers 1990 – 2020.

These figures indicate that:

1. In the baseline, the vast majority of poultry places are made up of Broilers (82%). By 2020 it is projected that this most significant poultry category will comprise 85% of total poultry places.
2. The overall total places of all Poultry rose by +25.5% between 1990 and the baseline, with a +47% increase in Broilers

being somewhat offset by a -53.8% fall in turkey places.

3. Food Harvest projects that by 2020, there will be a further +23.5% increase in Broiler places, again partly offset by a further -37.5% fall in Turkey places.

Like pig farming, and with the main exception of waste disposal, poultry farming is almost entirely an internal activity using specialised and often large buildings and one that is notably localised

within the North Leinster area of the Country. It is considered most likely that projections will have potential for impact on the agricultural landscape.

7.1.4.1.5 Horses and Mules

Horse numbers in Ireland are a low 95,330 head at the baseline. The numbers have increased appreciably (+54.5%) since 1990 and are projected to rise only slightly (less than +3%) to 98,100 head by 2020. The level of projected increase is very low it is considered most likely that projections will not have potential for significant impact on the agricultural landscape.

Mule numbers in Ireland are a very low 8,270 head at the baseline. The numbers have changed little since 1990 and are only projected to rise slightly (+6.5%) by 2020. However, the overall number as

projected remains small (8,800 head by 2020) and it is considered most likely that projections will not have potential for significant impact on the agricultural landscape.

7.1.4.1.6 Fertiliser (Nitrogen)

The use of Nitrogen fertiliser fell actually by -17.5% between 1990 and the baseline. Food Harvest projects that level will rise by +15% between the baseline and 2020 – or by circa 5% over the 1990 level. It is considered most likely that projections will not have potential for significant impact on the agricultural landscape.

7.1.4.1.7 Pasture, Hay, Silage and Rough Grazing

The principal findings of the review of grass-based activities are illustrated in Figure 7-13.

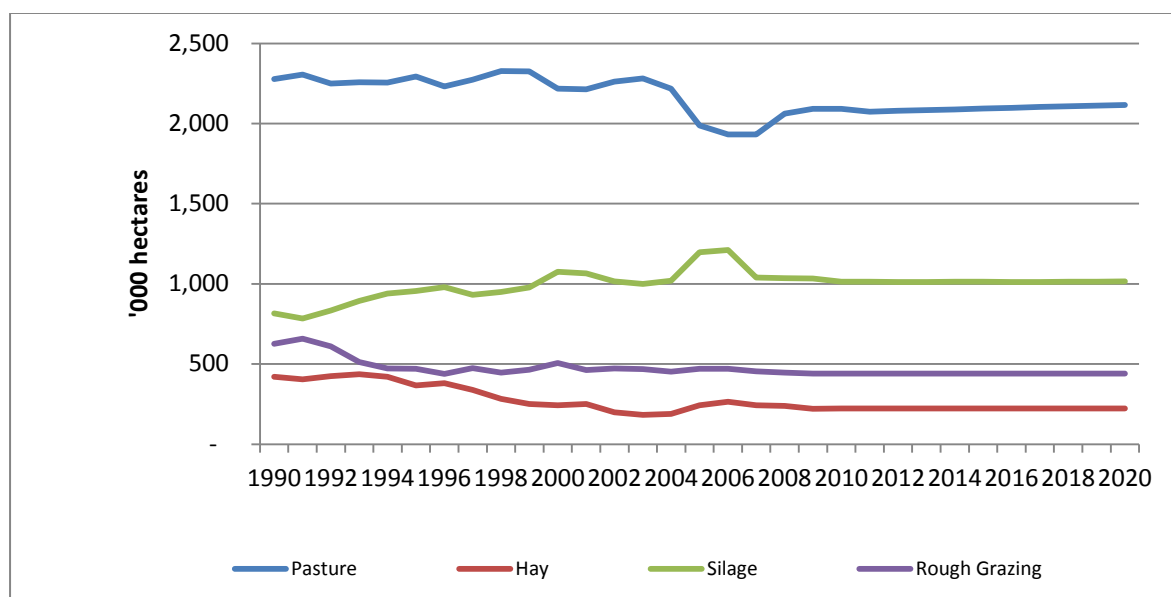


Figure 7-13: All Grass-based Areas 1990 - 2020 (hectares) (FAPRI-Ireland).

This figure indicates that:

- Between 1990 and the baseline almost 10% (-9.5%) of area moved away from these categories of use. The major fall off was in Hay (-44%), Rough Grazing (-28.5%) and Pasture (-11%). It is considered most likely that the area moved away from grass-based activity was partly to forestry and partly out of agriculture. The area under silage actually increased by +27%.
- By 2020 Food Harvest projects that the overall situation will have stabilised with a slight increase (+1.3%) – possibly through recovery of some lands lost over the previous 18 years.
- Food Harvest also indicates only slight movement between the grass-based categories, with Hay down a further -4.5%, Silage falling by -2% and Rough Grazing down by -1.3%. The area under

Pasture is expected to increase by just over +4%.

Grass-based activities, including pasture, hay, silage and rough grazing account for over 60% of the Irish agricultural landscape and as such is amongst the most important factor in determining and maintaining the characteristic appearance of the landscape as a whole. However, the projected change between the baseline and 2020 in these grass-based activities is very low and considered to

be within the likely natural variation in such activity. Therefore, it is considered most likely that projections will not have potential for significant impact on the agricultural landscape.

7.1.4.1.8 Cereals

The review of cereals includes all cereals; wheat (total, spring and winter); barley (total, spring and winter), oats (total, spring and winter) and maize. The principal findings are illustrated in Figure 7-14.

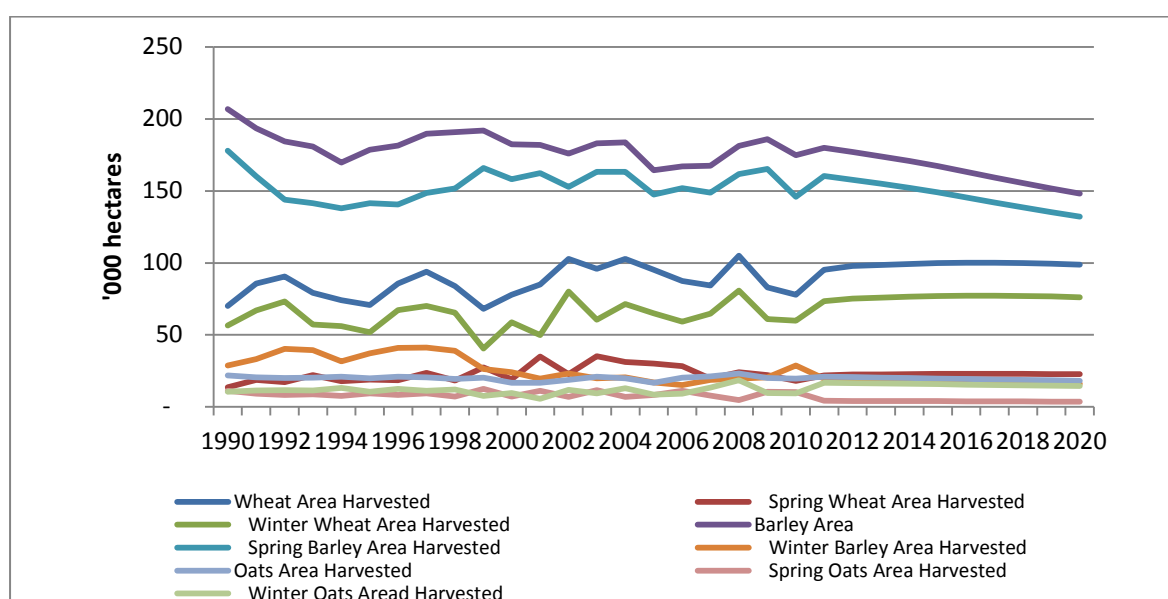


Figure 7-14: All Cereal Areas 1990 - 2020 (000 hectares) (FAPRI-Ireland)

This figure indicates that:

1. The overall area of Cereal grown in Ireland has remained relatively stable, showing only a minor -2.5% fall between 1990 and the baseline (excluding maize, for which there are no 1990 figures). However, this included a -14% fall in Total Barley (with -10% in spring barley and -31.5% in winter barley) and a +29.5% increase in Total Wheat (+61% in Spring Wheat and +22% in Winter Wheat).
2. While there was little change (-1%) in overall oats between 1990 and the baseline, there was a noticeable switch from spring oats (-31.5%) to winter oats (+31%).
3. Food Harvest Scenario A projects that there will be a further -8.5% decrease in the area under cereals by 2020. This comprises a -17% fall off in Total Barley (with -16.5% in spring barley and -18% in winter barley) and a -16% fall off in Total oats (with -52.5% in spring oats and -4% in winter oats). Food Harvest projects that the area of maize is to remain relatively unchanged at just under 21,000 hectares.
4. Food Harvest Scenario A projects that there will be a +9% increase in the area Total Wheat (with +3.5% in Spring Wheat and +10.5% in Winter Wheat).

Food Harvest Scenario A projects that trends that have been evident over the last 20 years will

continue through to 2020. These include a noticeable decline in the area under Barley and oats and a slight increase in the area under Wheat.

The area of cereal production in Ireland is low (circa 6%) and the projected change between the baseline and 2020 in cereals is also low (-9%) and are considered to be within the likely natural variation in such activity over this period. Therefore, it is considered most likely that projections will not have potential for significant impact on the agricultural landscape.

7.1.4.1.9 Root Crops

The review of root crops includes all root crops; potatoes, sugar beet, fodder beet (though not solely a root crop) and turnips. There is no data for sugar beet or fodder beet for either the baseline or 2020. Otherwise, the principal findings are illustrated in Figure 7-15.

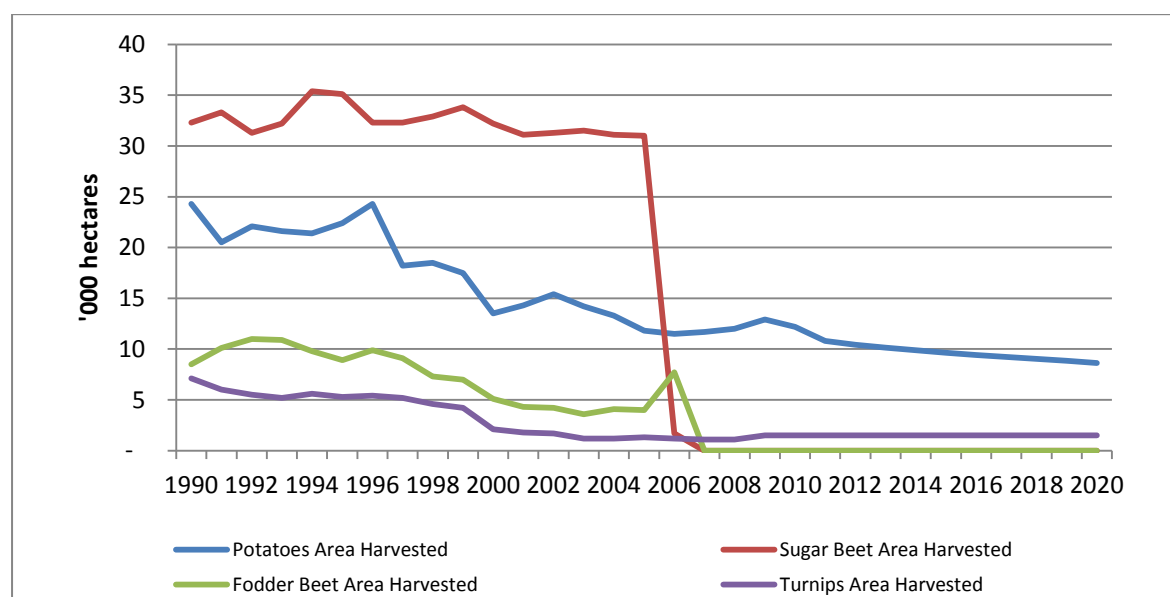


Figure 7-15: All Root Crops Areas 1990 – 2020 (FAPRI-Ireland).

This figure indicates that:

1. The area of potatoes grown in Ireland has fallen by -50% between 1990 and the baseline. This figure is projected to fall by a further -29% by 2020 to just over 8,600 hectares.
2. The area of turnips grown in Ireland has fallen by -82% between 1990 and the baseline. This figure is projected to remain increase by 2020 to circa 1,500 hectares.

The level of root crop production in Ireland is extremely limited and the projections contained in Food Harvest are also of very low significance. It is considered most likely that projections will not

have potential for significant impact on the agricultural landscape.

7.1.4.1.10 Forestry

The level of forestry in Ireland increased by +52.5% between 1990 and the baseline. Food Harvest 2020 Scenario A projects that forestry will increase by a further 12.5% (or 90,000 hectares) between the baseline and 2020 (Figure 7-16). This number is well below previous targets for Irish forestry and it is considered likely that projections will not have potential for significant impact on the agricultural landscape.

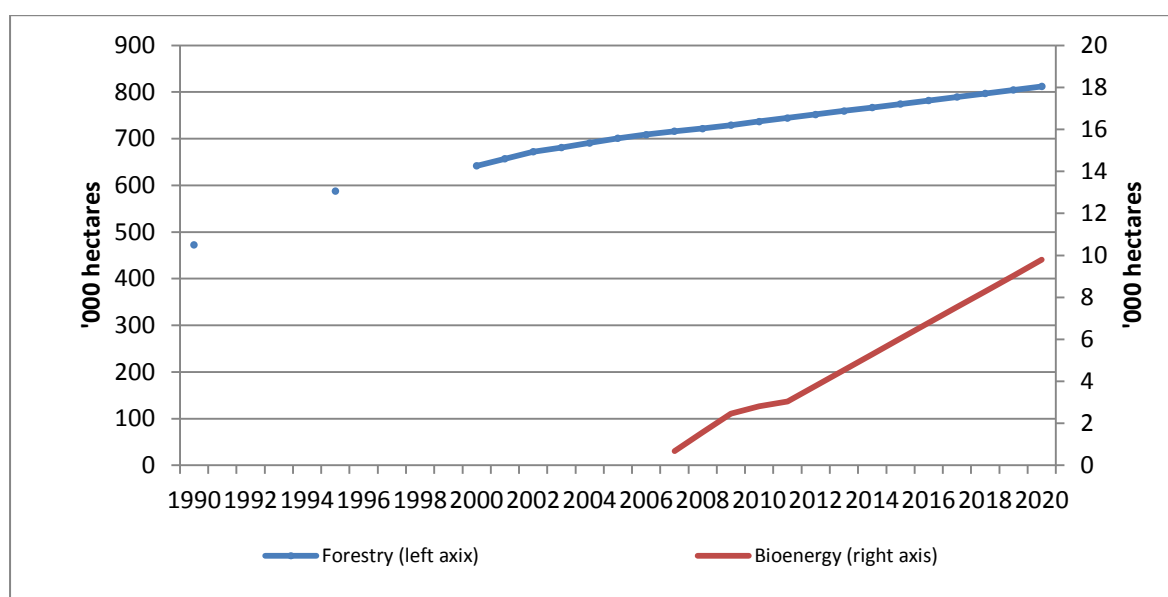


Figure 7-16: Total forestry and bioenergy areas 1990 - 2020 (000 hectares) (FAPRI-Ireland).

7.1.4.1.11 Bioenergy

Bioenergy is a very minor contributor to the agricultural landscape, with the baseline being measured at only 3000 hectares. Food Harvest projects that Bioenergy will increase to an area of 11,000 hectares by 2020 – a 367% increase over the minimal baseline level (See Figure 7-16). While the increase is significant in percentage terms the overall area – which is expected to displace existing arable or pasture land – remains very low and it is considered likely that projections will not have potential for significant impact on the agricultural landscape.

7.2 Environmental Assessment

7.2.1 Introduction

Year by year background data (1990 to 2011) and projected data as per Scenario A (2012 to 2020 (i.e. Food Harvest target year)) has been analysed for each agricultural sector. Figure 7-5: Total Cattle Numbers 1990 - 2020 (000 head) (FAPRI-Ireland). Figure 7-6 to Figure 7-16 illustrate, in chart format, the changes that have taken place / are projected to occur between 1990 and 2020.

A review of the historic data highlights the already dynamic nature of agriculture in Ireland, with

significant variation in most sectors. A review of projected data indicates where future pressures, changes and potential landscape impacts may arise.

7.2.2 Key Pressures and Issues

There is, and always has been, on-going pressure for agriculture to be as economically competitive and productive as possible. These requirements are all the more important given that agriculture operates within the influence of a worldwide market where many countries have significantly greater competitive advantage in terms of climate and commercial agricultural production.

In terms of potential impact on landscape, the general pressures are evident in:

- Enlargement of field sizes – resulting in reduced diversity of visual appearance; in loss of field boundaries, tree-lines and hedgerows and in potential loss of cultural features, e.g. townland boundaries, traditional field gates, stiles etc.
- Improvement of agriculturally marginalised land – resulting in potential impact / loss on wetlands, rocky ground,

semi-natural agricultural areas, and on local character.

- Re-contouring and improvement of land – levelling, etc.
- Intensification and specialisation – resulting in increased homogeneity and loss of local character and visual landscape diversity.
- Larger buildings and new structures arising from an increased scale, increased specialisation and from greater intensification.
- Loss of economic viability – resulting in potential abandonment of land, spread of invasive gorse, loss of access on lower uplands, etc.
- In particularly areas, the incorporation of other development, e.g. urban expansion, road infrastructure etc.

The EPA, in Ireland's Environment – An Assessment, 2012, notes that '*land is subject to many competing demands. Current land use is the result of a sequence of past human interventions on the natural landscape. Policies related to forestry, renewable energy, agriculture, peatlands and the built environment have associated impacts on land use change and land resource management*'.

7.2.3 Assessment

7.2.3.1 Assessment of National and Regional Impacts

The potential impacts of Food Harvest 2020 as envisaged in Scenario A and its various scenarios are assessed at both a national and a regional scale. In each instance the impacts of the entire plan is considered first, followed by an assessment of likely effects of projections for each sector (e.g. dairying, sheep, cereals, etc.)

Regional assessment is based on a consideration of the landscape as sub-divided through the physical regions, land capability and agricultural regions (Aalan *et al.*, 1997) as illustrated on Figure 7-1 and Figure 7-2

7.2.3.2 Macro Level Scenario and Analysis

For the purposes of the assessment the projections of Food Harvest 2020 have been

transposed into a National Macro Level Scenario' which provides baseline information (average of 2007 – 2008 – 2009) and target 2020 (Food Harvest) levels for:

- Head of Cattle, Sheep, Pigs, Poultry, Horses, Mules, Goats;
- Places of Poultry;
- Tonnes of Nitrogen Fertiliser use;
- Tonnes of Pulses, Potatoes, Sugar Beet, Barley, Oats and Wheat;
- Hectares of Pasture, Hay, Silage, Rough Grazing;
- Hectares of Wheat, Barley, Oats, Potatoes, Sugar Beet, Fodder Beet, Turnips, and Maize;
- Hectares of Forestry and Bioenergy;

7.2.3.3 Assessment of Likely Impact on the Landscape

An analysis of the data (see 7.1.4) indicates that some degree of measureable impact on landscape may arise as a result of particular changes in the Macro Level sectors. The areas assessed as having the most likely potential for some degree of impact on the landscape are Cattle, Sheep, Pigs, Poultry, Cereals and Root Crops.

It is considered likely that no discernible landscape impact will arise as a result of the Food Harvest 2020 projections for Goats, Horses, Mules, Nitrogen Fertiliser, Grass-based activity (*i.e.* Pasture, Hay, Silage, Rough-grazing), Forestry and Bioenergy.

7.2.4 Conclusions

7.2.4.1 Findings of Assessment of Scenario A impact on Landscape

The assessment of likely impact of Scenario A on the landscape is set out in detail in Table 7-2 .

The principal findings of the Scenario A are as follows:

1. The overall impact of the Scenario A projections on the landscape is considered to be imperceptible to slight and neutral in nature.

2. The assessment shows that there is likely to be an imperceptible change to land use area of the key grass-based activities (Pasture, Hay, Silage and Rough grazing) that define the Irish farming landscape.
3. The assessment shows that projecting growth in dairying will have a slight positive impact on the landscape, underpinning existing agricultural activity and management practices. The additional demand for land supporting an increased dairying sector is likely to come in part from:
 - a reversal of the move away from dairying lands experienced between 1990 and the baseline year(s);
 - a take-up of projected fall-off in cereal and root crop production areas; and
 - by a fall-off in other cattle-based activities.
4. Projections show a stabilisation in Upland Sheep numbers, which have fallen off significantly since 1990. However, lowland sheep numbers are expected to fall towards 2020 – with a potential slight negative impact on the existing landscape structure and pattern as existing lowland grazing may move towards forestry, bioenergy or out of agriculture.
5. The Projection for a significant increase in pig numbers has potential for a slight negative impact as a result of the increased demand for large buildings/structures in the landscape.
6. Food Harvest projections for growth in forestry are low and well within other previous projections / targets for the land use.
7. The projections for Goats, Horses, Mules, use of Nitrogen Fertiliser will have little or no impact on the landscape.

Table 7-2: Analysis of landscape impact of “Macro Scenario”.

Sector	Description of Issues	Landscape Considerations	Magnitude and Intensity	Integrity	Duration	Probability	Overall Impact
Cattle	<p>This is a major agricultural activity. Projections are complex with a high degree of movement between different categories. Projected minor fall in overall cattle numbers of 2.5% by 2020. There is a strong (24%) move back towards dairying – in part reversing the movement away that occurred between 1990 and the baseline. In balancing the overall numbers, projections also show a strong move away from Other Cows, Other Heifers and from 0 to over 2 year old Cattle.</p>	<p>Cattle and dairy farming, which is strongly linked with grass-based farming, is critical to maintaining the distinctive character of Ireland’s landscape. A noticeable move back towards dairying will reverse some previous landscape change from dairying to other activity. It is also likely to intensify existing dairying activity in areas of historic dairying importance and competitive dairying advantage (e.g. Golden Vale) Increased demand for dairy lands will be provided, at least in part, by a reduced projection in arable crops on existing productive lands</p>	Likely Low to Moderate Effect	Likely Low Effect	Medium term Reversible	Medium to High	Slight Positive
Sheep	<p>Projected fall in numbers of 5.5% by 2020 – mainly in lowland lambs. 35.5% fall in numbers from 1990 to baseline – mainly in upland sheep & lambs.</p>	<p>Sheep grazing is important in maintaining the perceived open character of upland areas. Projected changes are minimal - with a stabilisation in upland numbers. Some existing lowland sheep grazing may move to alternative activity (e.g. Bioenergy or Forestry) or fall out of agricultural production.</p>	Overall No Effect to Low Effect	Overall No Likely Effect	Medium term Reversible	High	Imperceptible to Slight Negative

Sector	Description of Issues	Landscape Considerations	Magnitude and Intensity	Integrity	Duration	Probability	Overall Impact
Goats	Very low overall herd (8,770 head). Projected 15% rise in numbers to 2020 (represents only 1,330 additional head). 50% fall in numbers from 1990 to baseline.	No issue arising.	No Likely Effect	No Likely Effect	Not applicable	High	Imperceptible
Pigs	Primarily internal activity requiring large buildings. Projected 39% increase in numbers by 2020. 22% increase in numbers from 1990 to baseline.	Generally localised agricultural activity, primarily served by relatively low number of specialised facilities. Large buildings can have localised significant landscape and visual impact.	Overall No Effect to Low Effect	Overall No Likely Effect	Medium term Reversible for most part	High	Slight Negative
Poultry	Primarily internal activity requiring large buildings. Projected 23.5% increase in places by 2020. 25.5% increase in places from 1990 to baseline.	Highly localised agricultural activity served by very low number of specialised facilities. Large buildings can have localised significant landscape and visual impact.	Overall No Effect to Low Effect	Overall No Likely Effect	Medium term Reversible for most part	High	Imperceptible
Horses	Low overall herd (95,330 head). Projected increase in numbers of only 3% by 2020 (only 2,770 additional head). 54.5% increase in numbers from 1990 to baseline.	Relatively small but locally important agricultural activity. Projected changes are minimal. No issue arising.	No Likely Effect	No Likely Effect	Not applicable	High	Imperceptible
Mules	Very low overall herd (8,270 head). Projected 6.5% rise in numbers to 2020 (represents only 530 additional head). Numbers only fallen by 30 head since 1990.	No issue arising.	No Likely Effect	No Likely Effect	Not applicable	High	Imperceptible

Sector	Description of Issues	Landscape Considerations	Magnitude and Intensity	Integrity	Duration	Probability	Overall Impact
Fertiliser (Nitrogen)	Projected 15% rise in usage to 2020 (represents 48,688 additional tonnes). 17.5% fall in usage from 1990 to baseline.	No issue arising.	No Likely Effect	No Likely Effect	Not applicable	Medium	Imperceptible
Pasture Hay Silage Rough Grazing	Most significant agricultural land use. Projected only 1.5% area increase by 2020. Only slight variation between categories. 9.5% fall in area from 1990 to baseline.	Grass-based land use is the most significant agricultural activity defining the characteristics of the Irish landscape. Projected changes are minimal. No issue arising.	No Likely Effect	No Likely Effect	Not applicable	High	Imperceptible
Cereals and Pulses	Low overall area compared to European average. spring barley is principal crop. Minor 2.5% fall in area from 1990 to baseline, with noticeable switch from Barley to Wheat. Projected 8.5% further fall by 2020 with continued move away from Barley (and oats – which is a minor crop).	Relatively small but locally important agricultural activity. Generally comprises most productive land – so likely to remain in some agricultural activity. Some fall off area may move dairying or towards Bioenergy.	Low Effect	No Likely Effect	Short to Medium term Consistent with existing pattern Reversible	High	Imperceptible to Slight Neutral
Root Crops	Very low overall area (14,400 hectares, of which 90% is in Potatoes). Projected 24.5% fall in overall area to 2020 (represents only 4,270 less hectares). 30% fall in area under potatoes.	No issue arising.	No Likely Effect	No Likely Effect	Not applicable	High	Imperceptible to Slight Neutral

Sector	Description of Issues	Landscape Considerations	Magnitude and Intensity	Integrity	Duration	Probability	Overall Impact
Forestry	Low overall area compared to European average. 52.5% increase in area from 1990 to baseline. Area is well below previous projections / targets. Projected 12.5% increase by 2020. Remains well below other projections / targets.	Mainly private sector growth. New forestry increasingly likely to displace other agricultural activity, e.g. pasture or rough grazing. Significant land use in some upland areas Long-term rotation crop. Major landscape change with initial planting, emerging landscape structure and during harvesting.	Low Effect due to low growth levels	Low level of planting Will likely fit well within landscape pattern – especially in existing lowland agricultural areas	Long term Consistent with existing pattern Reversible for most part on existing agricultural land	High	Slight Neutral
Bioenergy	Very low overall area (only 3,000 hectares). Projected increase to 47,000 hectares by 2020 – still low overall area.	Emerging mixed (variable) land use area – minimal detail available. Likely to displace areas of existing arable production (falling anyway), pasture or rough grazing. Small scale activity akin to longer-rotation arable production. Some landscape change in regular harvesting (willows etc.).	No Likely Effect to Low Effect	Will likely fit well within landscape pattern – especially in existing arable areas	Not applicable to Short term Reversible for most part on existing agricultural land	Medium to High	Imperceptible

7.2.4.2 Regional Issues

It is considered likely that the projections as outlined in Food Harvest 2020 will have varying degree of effect in different regions of the Country. For example, it is considered most likely that increases in dairying will likely be most noticeable in the agriculturally advantaged areas of the south and east. Likewise, pig and poultry production, which requires large buildings and structures, is concentrated in north Leinster. It is also unlikely that growth in dairying will reverse the trend away from such traditional activity the more disadvantaged areas of the northwest and west. Within these areas, forestry – even on lowland – and loss of land to agriculture are likely to be an increasingly evident aspect of the landscape.

Arable production is localised in Ireland and already tends to focus on better lands. With a fall-off projected in Food Harvest, it is likely that such lands will move towards projected growth areas, including dairying, beef, bioenergy (effectively a form of arable activity); and possibly limited forestry.

As stated at the outset of this section of the report, agriculture is a dynamic activity, one that responds to a wide range of economic and market, cultural and climatic stimuli. All of the trends noted here are already present to a greater or lesser degree with the Irish agricultural sector and as such, within this context it is difficult to assess the significance or otherwise of the Food Harvest 2020 on the agriculture landscape.

7.3 Notes and References

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Climatic factors including
impacts on greenhouse gas
emission levels

Section 8:

Climatic factors including impacts on greenhouse gas emission levels

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8 Climatic factors including impacts on greenhouse gas emission levels

8.1 Baseline

8.1.1 Introduction

Emissions of greenhouse gases from Ireland's agriculture sector arise mainly as a result of natural processes. The main gases are:

- Methane from ruminants from the breakdown of plant material, by diverse rumen flora, during the digestion process. This is a symbiotic relationship which has developed over several millions of years and enables the animals to convert inedible plant material, like grass, to nutritious human food;
- Methane from stored manure. This is again a natural process resulting from the anaerobic digestion of animal excreta;
- Nitrous oxide from soils. Arising from the natural processes of the nitrogen cycle which occur when animal manures and artificial nitrogen are placed on the soil as crop fertilisers.

Methane (CH₄) and nitrous oxide (N₂O) make up the vast bulk of agricultural greenhouse gas emissions, due to the dominance of cattle and sheep livestock production in Irish agricultural output.

8.1.2 Regulatory and Legislative Framework

The EPA compiles Ireland's annual greenhouse gas emission inventories and projections. This allows the Government to assess progress in terms of meeting key targets, such as the Kyoto Protocol limitation target, and to inform policy development in terms of developing appropriate mitigation measures.

Ireland is currently faced with meeting two limits with respect to greenhouse gas emissions:

- The Kyoto Protocol, arising from the United Nations Framework Convention on Climate Change (UNFCCC), sets legally binding targets and timetables for cutting

the greenhouse gas emissions of industrialised countries. Ireland ratified the Kyoto Protocol in 2002 and agreed to a target of limiting its greenhouse gas emissions to 13 % above 1990 levels by the commitment period, 2008–2012. Domestic policy to achieve that target is outlined in the National Climate Change Strategy 2007–2012. Primary measures in place in Ireland to limit emissions include renewable energy targets, revised building regulations, the EU emissions trading system, and climate change awareness campaigns;

- In December 2008, the EU Climate Change and Renewable Energy Package set out a number of commitments. This commits to reduce the EU's greenhouse gas emissions from non- Emission Trading Scheme (ETS) sectors (such as transport, agriculture, residential and waste) by 20% on 2005 levels by 2020 or by a more ambitious 30% in the event of a comprehensive global agreement. As part of the effort-sharing proposal of this package, Ireland is one of the countries facing the highest target of a 20% reduction on 2005 levels for non-ETS sectors. There is also a commitment to achieve a mandatory EU target of 20% renewable energy by 2020, including a 10% bio fuel target.

In February 2013, the Irish Government published the draft Climate Change Bill accompanied by the Final Report of the National Economic and Social Council (NESC) Secretariat, entitled Ireland and the Climate Change Challenge: Connecting “How Much” with “How To”. The Government is expected to adopt a national policy position on transition to a low carbon future by the end of 2013.

This document outlines the basis for achieving Ireland's binding mitigation targets and obligations, which place obligations on the Government with respect to Ireland's path to a low carbon economy through the creation of various plans or roadmaps. The draft bill provides

for both national and sectoral roadmaps. National roadmaps will specify the mechanisms to achieve the management of net greenhouse gas emissions in line with existing EU mandated targets, or targets agreed at an international level. These roadmaps are aimed at achieving a transition to a low carbon, climate resilient and environmentally sustainable economy in a cost effective way before 2050.

In relation to agriculture the report cites Food Harvest 2020 strategy for developing the agriculture and food sector which implies an increase in emissions in the period to 2020. However, it points to research by Teagasc which identifies profitable opportunities to reduce emissions.

8.1.3 Current status and Key Agricultural Pressures affecting Climatic Factors

The latest inventory data from the EPA (October 2012) indicates that emissions of greenhouse gases in Ireland in 2011 were 57.5 Mt CO₂eq. This represents a reduction of 6.5% (4. Mt CO₂eq) on emissions in 2010. Agriculture remains the single largest contributor to the overall emissions at 32% of the total and 44% of non-ETS emissions. The contribution of agriculture to Irish greenhouse gas emissions is high compared to the EU average of 9%. This is due to the following:

- The importance of agriculture to the Irish economy;
- The absence of heavy industry in Ireland and associated emissions;

- The livestock-based nature of Irish agriculture and the small proportion of tillage.

Emissions from agriculture decreased by 0.4 million tonnes (2.1%) in 2011. Reductions in emissions are due to a 4.7% decrease in nitrogenous fertiliser use and a 5.9% decrease in gasoil use on farms.

A review of long-term data shows that emissions from agriculture reached a peak in 1998 and have decreased to below their 1990 level since 2004, reflecting long-term decline in livestock populations and in fertiliser use. Emissions from the sector in 2010 were 8.3% lower than the 1990 reference levels.

Methane emissions sourced from livestock enteric fermentation is the primary source of greenhouse gases, accounting for 45% of total agricultural emissions in 2010, whilst N₂O emissions arising as a result of chemical/organic fertiliser application and animal deposition comprise a further 37% (EPA, 2012). The other major source is methane and nitrous oxide emissions associated with manure management, accounting for 13% of agricultural emissions.

Enteric and nitrogen-sourced emissions have continued on a downward trajectory since 1998. Details of emissions in million tonnes CO₂eq are provided in Table 8-1 below for agriculture between 2007 and 2009. (Values based on ruminant digestion, agricultural soils, manures, gasoil used on farms).

Table 8-1: Carbon equivalent emissions for the agricultural sector during baseline (2007–2009) years (Mt of CO₂eq)

Year	Mtonnes CO ₂ eq
2007	19.16
2008	19.11
2009	18.73
Average	18.995

The target for Ireland's non-emissions trading sectors (NETS) is to reduce emissions by 20% in 2020 relative to 2005 levels. This limit is provisionally calculated by the EPA as 37.5 Mtonnes of CO₂eq. It is estimated that Ireland will exceed its 2020 limit by 5 – 8 Mtonnes of CO₂eq (including the implementation of Scenario A (Food Harvest 2020)). This is 3% – 10% below 2005 levels compared with a limit of 20% below 2005 levels. There is projected to be a cumulative distance to target of 7 – 24 Mtonnes for the period 2013-2020 with Ireland breaching its annual limits in 2015-2016.

The necessary reductions in carbon emissions must be found from within the non-emissions trading sectors (ETS) of energy, agriculture or transport.

The contribution of each sector of the economy to meeting the non-ETS target for the post Kyoto period, has yet been to be decided. It is unclear at this stage how these reduction targets will be translated into targets for individual sectors within the non-ETS sector. For the purposes of this assessment, a 20% decrease in emissions in the agricultural sector is assumed, equating to a required reduction of 3.96 Mt CO₂eq (or 3,960Gg) relative to the 2005 reference year.

For the purposes of the assessment of the various scenarios, the baseline values of pollutants are calculated from the baseline agricultural data for the relevant sector.

8.1.4 EPA State of Environment 2012

The EPA State of Environment 2012 report concludes that emissions from agriculture reached a peak in 1998 and have decreased to below their 1990 level in recent years. This reflects a long-term decline in cattle population and in fertiliser use, due largely to the EU CAP. 2010 saw a substantial increase in nitrous oxide emissions due to increased fertiliser sales (up 18% on 2009). The increase in nitrous oxide emissions was offset by the continuing decline in total cattle and sheep numbers in 2010, while swine numbers have increased relative to 2009 levels. Ireland's position within the EU as the Country with the highest national proportion of agriculture emissions will

present major challenges in limiting emissions and meeting future targets.

The report also highlights that it is of particular importance that the implementation of Food Harvest 2020 takes place in a sustainable manner, to ensure that any increase in greenhouse gas emissions from the agriculture sector is addressed and does not overburden other key sectors.

8.2 Environmental Assessment

8.2.1 Methodology and Significance Criteria

8.2.1.1 Derivation of Emission Factors

The methodology for calculating the impact of the various Food Harvest 2020 scenarios on greenhouse gas emissions was derived from the EPA's National Inventory Report 2011. This report describes annual inventories adopted from guidance from the United Nations Framework Convention on Climate Change (UNFCCC) on the reporting of greenhouse gas inventories.

The inventory lists source categories in agriculture, where CH₄ and N₂O are the key greenhouse gases. The agricultural sources of particular importance in Ireland are those under Enteric Fermentation, Manure Management and Agricultural Soils only, some of which are identified as being among the largest greenhouse gas emission sources in the Country.

These emission factors are applied to the baseline and predicted animal numbers, crop areas and fertiliser usage for the various scenarios and the associated greenhouse gas emissions calculated. The changes in the greenhouse gas emissions are assessed against the baseline (2007-2009 average) greenhouse gas value for that sector. The level of change is rated using the significance criteria outlined in Section 8.2.2.

Values for the CO₂eq impacts associated with the implementation of Food Harvest 2020 Scenario were derived from the Teagasc published report *A Marginal Abatement Cost Curve for Irish Agriculture* (Teagasc 2012). In this report, Teagasc compares the predicted 2020 greenhouse gas emissions following the implementation of Food

Harvest 2020 to the 2010 baseline value. The assessment below compares the predicted greenhouse gas emissions to the baseline calculated for 2007-2009.

The climate impact assessment also considers the impact of greenhouse gas against the Ireland's 2020 climate commitments for agriculture.

The emission factors for the sectoral analysis are derived from Teagasc Sectoral Road maps for the various sectors apart from tillage where EPA emission factors are used.

8.2.2 Significance Criteria

The significance of impacts on climate is determined based on *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements* (EPA 2003) and are adapted to

include potential positive impacts. The criteria are related to changes in CO₂eq emissions due to the various scenarios. The impact rating is determined based on the change in CO₂eq emissions relative to the baseline levels (2007-2009). The percentage changes are based on an approach provided in the National Roads Authority (NRA) document, *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes, 2007*, refer to Table 8-2.

It should be noted that the significance criteria apply to the change in CO₂eq emissions between the baseline years and the projected 2020 levels. It is not appropriate to apply a target value to the significance criteria as the timeframes for each set of levels are not comparable, with different applicable targets.

Table 8-2: Significance criteria for changes in CO₂eq.

Rating	Changes in CO ₂ eq against 2007-2009 baseline
Significant Positive Impact	Decrease in CO ₂ eq emissions of greater than 20%
Moderate Positive Impact	Decrease in CO ₂ eq emissions of between 10 and 20%
Slight Positive Impact	Decrease in CO ₂ eq emissions of between 5 and 10%
Neutral	Change of less than 5%
Slight Negative Impact	Increase in CO ₂ eq emissions of between 5 and 10%
Moderate Negative Impact	Increase in CO ₂ eq emissions of between 10 and 20%
Significant Negative Impact	Increase in CO ₂ eq emissions of greater than 20%

8.2.2.1 Assumptions

A number of assumptions were made in the calculation of climate emissions:

- Conversion of N₂O to CO₂eq apply a factor of 310;
- Conversion of CH₄ to CO₂eq apply a factor of 25;
- Each Ha of wheat receives approximately 200kg of N;
- On average each Ha of barley receives approximately 140kg of N;
- As stated in the EPA inventory (table 4 D s1) to convert N₂O-n to N₂O use a factor of 1.5714 or (44/28).

8.2.3 Analysis of Scenario A (Integrated Scenario)

In 2013, the EPA projected greenhouse gas emissions for the various sectors in 2020. The report predicted an increase from 18.8 MtCO₂eq in 2010 to 20.6 MtCO₂eq by 2020, a relative increase of 1.2 MtCO₂eq or approximately 9.6%. This increase is mainly the result of the higher number of ruminants projected under a FH202 scenario with the associated increased methane emissions, as well as a concurrent projected increase in N fertiliser use, leading to increased N₂O emissions. Table 8-3 assesses the impact of the implementation of the Food Harvest 2020 scenario

relative to baseline values (2007-2009) used in this assessment.

Table 8-3: Climate impact of Scenario A (Integrated Scenario) relative to baseline data.

Baseline CO ₂ eq (Mtonnes/year)	CO ₂ eq due to Scenario A (Integrated Scenario) (Mtonnes/year)	Change in CO ₂ eq (Mtonnes/year)	Change in CO ₂ eq (%)	Impact Rating (refer to Table 2.1)
18.995	20.6	1.6	+8.5	Slight negative impact

The impact of the implementation of the Food Harvest 2020 targets as envisaged in Scenario A would be considered to have a slight negative impact on greenhouse gas emissions, based on the significance criteria outlined in Table 8-2. It should be noted that the Scenario A levels can be compared to the 15Mt limit for the agricultural sector, however, the baseline value applies to the years 2007-2009 so the limit is not applicable to these years.

It should be noted that as outlined previously, Ireland is committed to reducing CO₂eq emissions from the non-ETS sectors by 20% relative to the 2005 reference year in 2020. In this regard it can be argued that the agricultural sector should not be subject to a pro-rata reduction. In isolation, an increase of over 1Mt of CO₂eq due to Food Harvest 2020 Scenario A could have a negative impact on Ireland's ability to comply with that commitment.

In the assessment, no additional or novel abatement technologies are assumed to be deployed. Therefore, it is expected that the use of abatement technologies would lead to lower levels of emissions than projected here. Possible abatement or mitigation measures are outlined in Section 11.

8.2.4 Regional Issues

As the climate limits prescribed by the Kyoto Protocol and the EU Climate Change and Renewable Energy Package apply nationally, no regional assessment of climate has been considered.

8.2.5 Conclusions

In 2012, the EPA estimated that achieving the Scenario A Food Harvest 2020 targets will increase

projected agricultural greenhouse gas emissions from 18.8 Mt CO₂eq in 2010 to 20.6 Mt CO₂eq per annum by 2020, a relative increase of 1.8 Mt CO₂eq, or 9.6% approximately. This increase is mainly the result of the higher number of ruminants projected under a Food Harvest 2020 Scenario A with associated increased methane emissions, as well as a concurrent projected increase in nitrogen fertiliser use, leading to increased N₂O emissions. Compared to the baseline of 2007-2009 used in this assessment, an increase in greenhouse gas of 8.5% is predicted to occur. It is concluded that the impact of the implementation of the Food Harvest 2020 targets as envisaged in Scenario A would have a slight negative impact on greenhouse gas emissions.

In 2012, the EPA reported that Ireland is on track to meet its Kyoto commitment. However, the Country faces considerable challenges in meeting EU 2020 targets. Ireland is committed to reducing CO₂eq emissions from non-ETS sectors by 20% or 3.73 Mt CO₂eq (for agriculture) relative to the 2005 reference year in 2020. In isolation, this increase of over 1Mt of CO₂eq due to Food Harvest 2020 would have a negative impact on Ireland's ability to comply with that commitment.

This assessment has specifically excluded any mitigation that might be achieved through the adoption of abatement measures described in Section 11. The effectiveness of such mitigation measures are currently the subject of on-going research programmes. These measures, if deemed effective, will require provision of incentives in order to realise their environmental potential, mainly through knowledge transfer facilitated by large-scale advisory programmes. As a first step in

this process, Teagasc and Bord Bia are currently developing the Carbon Navigator to advise farmers on the most cost-effective approach to implementing these measures on individual farms.

As part of the Marginal Abatement Cost Curve of Irish Agriculture analysis completed by Teagasc, a number of cost-effective mitigation measures were proposed with the potential to deliver 1.1 MtCO₂eq. If implemented by 2020, these measures could offset any increase in greenhouse gas relative to 2010 levels.

The Climate Change Bill, 2013 requires the Minister for the Environment, Community and Local Government to make, and submit to Government, a National Low Carbon Roadmap, incorporating sectoral roadmaps prepared by the relevant Ministers and approved by Government. This Roadmap will specify policy measures required to ensure compliance with climate related obligations.

8.3 Notes and References

- Department of Agriculture, Fisheries and Food, Food Harvest 2020 A Vision for Irish Agri-food and Fisheries
- EPA's National Inventory Report 2011
- United Nations Framework Convention on Climate Change (UNFCCC) on the reporting of greenhouse gas emission inventories
- Teagasc published the report Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets 2011
- EPA Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements
- National Roads Authority (NRA) Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes, 2007.
- EPA CO₂ projections (March 2012)
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- Teagasc Sectoral Road maps for the various sectors



Inter relationships between
environmental aspects

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9 Inter relationships between environmental aspects

9.1 Significant Interrelationships

9.1.1 Introduction

The potential significant interrelationships between the various environmental characteristics studied in this report are detailed in this Section. The significance of the interrelationships is all the more important because of the influence of other factors on the environment generally. The influence of agriculture on the environment is clearly important but agriculture fits as part only of the factors which may influence the environment positively or negatively. In addition to agriculture, the environment is subject to the influences of the human population, industry, services and transport. Environmental characteristics such as water quality, so important for human health and biodiversity, are influenced by agricultural activity and all other human and industrial activities including municipal waste water treatment plants and domestic septic tanks.

As noted in Ireland's Environment An Assessment 2012, published by the EPA, *"in broad terms approximately half of the polluted sites are due to*

what may be termed large point sources such as municipal waste water treatment plants and the other half are polluted as the result of diffuse sources particularly agricultural activities as well as a range of other activities such as forest and peat harvesting."

It is clear that all life depends on the interaction between environmental media. Plant growth is dependent on water, soil, air and climate. Animal life clearly depends on water, air, and climate and indirectly on soil for food production. In this study it is noted that almost all environmental aspects are interrelated to some degree. The intensity of the interrelationship varies. The key interrelationships and key links between the environmental aspects have been assessed at a strategic level for Food Harvest 2020.

The significant interactions between environmental characteristics have been considered in Sections 3 to 8 of this Report. The significant effects that changes on an individual environmental characteristic would have on other environmental characteristics has also been considered.

A matrix detailing where the main potential interactions occur is presented in Table 9-1.

Table 9-1: Matrix of the main potential interactions.

CAUSE	EFFECT					
	Biodiversity and Flora & Fauna	Water quality including drinking water	Soil	Air Quality	Landscape including buildings	Climate change including GHG emissions
Biodiversity and Flora & Fauna		•	•	•	•	•
Water quality including drinking water	•		•	•		•
Soil	•	•		•	•	•
Air Quality	•	•	•		•	•
Landscape including buildings	•		•	•		•
Climate change including GHG emissions	•	•	•	•	•	

9.1.2 Biodiversity and Flora and Fauna

Biodiversity and flora and fauna have the potential for linkages at varying degrees of intensity with water, soils, air quality, landscape and climate change. Biodiversity and flora and fauna in Ireland have a high degree of affinity with water and many water dependent species and habitats are protected, rare or considered to be vulnerable.

9.1.3 Water Quality

Water is fundamental to all life and has the potential to interact with all environmental media, particularly biodiversity, soils and climate change. The interdependence between water quality and biodiversity is clear and soils play a key role in drainage, filtration and flood protection.

9.1.4 Soil

Soil has the potential to interact with biodiversity, water and landscape. Soil quality and stability affect land use patterns and habitat stability while landslides or soil erosion can materially influence the landscape and water quality.

9.1.5 Air Quality

Air quality interacts with all other environmental media. Air quality standards have been developed for the protection of vegetation which would have impact on flora and fauna and biodiversity. Deteriorating air quality could have serious effects on landscape character.

9.1.6 Landscape

Landscape interacts with and is influenced by all the environmental media. Climate change could lead to significant changes in land use patterns which would drive changes in landscape.

9.1.7 Climate Change

Climate change has the potential to have interactions with air quality, soils, water, biodiversity and flora and fauna. Changes in climate change could result in a variation in rain fall which would impact on all other environmental aspects.

9.2 Relationship with other relevant plans and programmes

9.2.1 Introduction

The achievement of the targets set within Food Harvest 2020 is clearly dependent on a range of other plans, policies and programmes at national, European and world level. Agriculture as a major sector within the Irish economy operating as it does throughout the Country cannot progress in isolation from the broader economy. Therefore all plans and programmes which contribute to the broader economic recovery are relevant to Food Harvest 2020. With projected capacity to produce food for 50 million people set against an Irish population of circa 4.6 million, the need for capacity to export is clear. In this context the outcome of World Trade Organisation negotiations is of crucial importance.

Economic recovery at European and world level will dictate the ability of the market place to purchase Irish exports at a price which will drive the production targets set in Food Harvest 2020. Therefore, plans and programmes which contribute to European and world economic recovery are of relevance to Food Harvest 2020.

9.2.2 European Legislation and Directives

As detailed throughout the study, Irish agriculture and therefore its potential to achieve the targets set in Food Harvest 2020, operate within and subject to a broad suite of European legislation and directives. Of particular note are:

- Habitats Directive
- Water Framework Directive
- Birds Directive
- Nitrates Directive
- Environmental Assessment Directive
- National Emissions Ceiling Directive

9.2.2.1 Common Agricultural Policy

Reform proposals and discussions regarding budget allocations and spending proposals are important to Food Harvest 2020. Under CAP the Rural Development Programme 2014-2020 is currently being developed. This will provide an opportunity for the development of measures to

enhance environmental sustainability within the context of Food Harvest 2020.

9.2.3 National Plans and Policies

As already referred to in this report the parallel plans for forestry (*Growing for the Future*)¹⁶³ and aquaculture (*Harnessing our Ocean Wealth*)¹⁶⁴ and the Sea Food Operational Programme) are important.

Operating as it does across the length and breadth of Ireland agriculture is influenced by all national plans and policies and indeed is heavily influenced by local plans and policies. Of particular relevance to the achievement of targets in Food Harvest 2020 are:

- Individual River Basin Management Plans
- Individual regional and local authority plans
- National development plans
- National Climate Change Policy 2011
- Climate Action and Low Carbon Dependency Bill 2013
- National Energy Efficiency Action Plan 1
- National Energy Efficiency Action Plan 2
- Our Sustainable Future

9.3 Notes and References

- 163 <http://www.agriculture.gov.ie/forests-service/publications/growing-for-the-future/>
- 164 <http://www.ouroceanwealth.ie/SiteCollectionDocuments/Harnessing%20Our%20Ocean%20Wealth%20Report.pdf>



Sectoral Scenario and Analysis

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10 Sectoral Scenario and Analysis

10.1 Introduction

Agriculture makes up a significant portion of the Bio Economy in Ireland. With fertile soils, a temperate climate and abundant rain water, Ireland has natural advantages for farming the land to produce food, fibre and fuel. Aided by the moderating influence of the Gulf Stream, Ireland's climate is particularly suited for the growth of ryegrass, an excellent and inexpensive feed for livestock. This simple comparative advantage is the basis for much of Ireland's farming sector. Beef and milk production are the two most important farming sectors in Ireland¹⁶⁵, accounting for around 70% of agricultural output. The scale of our farming output relative to our domestic population of 4.6 million people means that Ireland exports some 90% of its net beef output, making Ireland the largest beef exporter in Europe and one of the largest in the world. Similarly, 85% of dairy output¹ is exported. The value of exports of Irish food and drink was almost €9 billion in 2011. This equates to the Republic of Ireland's farmers producing enough food for an estimated 36 million people. Food Harvest 2020 sets out ambitious plans, which if achieved, would increase that production level to the equivalent of an estimated 50 million people with food exports amounting to over €12 bn.

Irish agriculture is entering a new growth era, with the removal of milk quota, the reform of the CAP and the global increase in demand for food, particularly livestock produce. Food Harvest 2020¹⁶⁶ outlines the industry's ambition for the various sectors of the Agri-Food sector. A key target is to increase the value of primary output for the agriculture, fisheries and forestry sectors by €1.5 billion. Various volume and financial targets are set for the various sectors of the Agri-Food sector. The overall vision is to also: act smart, think green and achieve growth. This strategy gives a profoundly new role to the concept of environmental sustainability in Irish agriculture: it no longer considers this merely in the context of constraining agricultural production; instead, it puts sustainability at the heart of the strategy to

deliver growth and added value to Irish produce (Food Harvest 2020).

The overall analysis of the Agri-Food sector in relation to its impact on the environment is outlined in some detail in Sections 3 to 8 of this report. In addition, DAFM requested that *"The analysis should consider a number of alternative approaches and formulate an optimum approach to achieving the growth targets, presenting a number of scenarios for meeting the volume and value targets, including higher production efficiency, intensification and expansion/land use change within an environmental context"*.

10.2 Analysis of Scenarios/Scenarios

The consideration of scenarios in relation to how the targets set in Food Harvest 2020 can be met is very complex as it involves a consideration of changes in a number of important variables. Some of these include:

- Overall market environment;
- Government policy and how it might evolve to influence Food Harvest 2020 ambitions;
- Evolving EU policy issues;
- Production systems at farm level and how they might evolve to meet Food Harvest 2020 ambitions as well as the prevailing market and regulatory environment;
- Interaction of various enterprises in relation to land use etc.

A recent analysis carried out by Donnelly and Hanrahan (2012)¹⁶⁷, has captured many of these issues in the evaluation of the impact of Food Harvest 2020.

10.2.1 Scenarios to achieving projection Targets

The analysis carried out in Sections 3 to 8 of this report assumes that the targets for the various sectors of the Agri-Food sector will be met. For example in the case of dairying the targets will be met by a combination of increased cow numbers and improved productivity per cow. A 'micro' level analysis of a number of scenarios will provide information on alternative approaches to achieving the volume and value targets set in Food Harvest 2020. The most likely scenarios as

suggested by DAFM include: higher production efficiency, intensification and expansion/land use change within an environmental context. It is proposed to consider the three most likely scenarios for the pathway level analysis. These include:

- Scenario B Low Intensity – In the case of livestock, by the use of a less intensive system and associated with lower stocking rate. This scenario has a requirement for more land per Livestock Unit.
- Scenario C Increased Intensification – In the case of livestock, by increasing stocking rates (with associated higher inputs) and increased concentrate input with associated increase in animal performance.
- Scenario D High Technology- Producing more food without increasing inputs through for example improved genetics. It includes a very high level of productivity per unit of land area and a high level of management skills. It captures high technology systems coming from research. Higher stocking rates (up to maximum of 2.8LU /Ha) are needed to utilise extra grass produced in the case of livestock production.

The scenarios described above were modelled on a framework suggested by Schulte *et al* (2012)¹⁶⁸. This framework was modified to meet the requirements of this analysis by incorporating information in the Teagasc Roadmaps¹⁶⁹ for the various enterprises.

10.2.2 Comparison of Scenarios

These scenarios will be compared to a ‘reference’ system for each of the enterprises considered in this analysis. The reference system is the best estimate of the parameters (technical and environmental) associated with the relevant enterprise in the years just prior to the year 2020. This time period was also chosen because it allows this analysis to be anchored to a very comprehensive analysis of enterprises carried out by Teagasc in relation to the development of roadmaps for each enterprise of the Agri-Food sector. It is therefore a proxy to the Food Harvest 2020 system used in the analysis in Section 3 to 8 of this report. The technical and environmental

aspects of these ‘scenarios’ are considered by reference to published literature and by the use of Bio-economic modelling. Much of the technical data used in this analysis have recently been published in Teagasc Roadmaps and other Teagasc publications for the various sectors. (www.teagasc.ie). The comparison of scenarios cannot give the full interaction of all the scenarios at National level. The methodology for such an analysis is outside the scope of this study. The FAPRI Ireland analysis has captured changes at National level and these are outlined in Section 2. The analysis does however give an indication of the changing trends expected by the adoption of one type of technology versus another. This provides valuable insights when considering mitigation strategies.

10.3 Analysis of Scenarios for the Ruminant Livestock Sector

The ruminant livestock sector (dairy, beef and sheep) makes a very significant contribution to Agriculture and the National Economy with an output valued at €3,794.5 million (72.4% of Goods Output) in 2011. The contribution to Goods Output (excluding forage) for milk is €1,820.4 million (34.7%), cattle is €1,787.5million (34.1%) and sheep is €186.6million (3.6%). Systems of production for livestock farming are mainly based on grassland with most of the feed resource coming from grazed grass and silage. Almost 89% of agricultural land is devoted to pasture, hay and grass silage (3.34 million hectares), 11% to rough grazing (0.45 million hectares). An evaluation of ruminant livestock farming in Ireland will involve crop (grass) livestock interaction and in particular the land area allocated to livestock farming. This sector includes dairying, beef and sheep. In the case of these enterprises, three scenarios are compared to the reference system. The reference system should be considered as a ‘proxy’ to the various systems modelled in Section 3 to 8 of this report (i.e. achieving the targets set in Food Harvest 2020). The achievement of the targets set in Food Harvest 2020 will be by a combination of: higher production efficiency, intensification and expansion/land use change within an environmental context. A consideration of Scenario B (Low Intensity); Scenario C (Increased

Intensification) and Scenario D (High Technology) allows some insight into the independent effects of these pathways to achieving the targets set in Food Harvest 2020.

10.3.1 Dairying

The dairy industry in Ireland has been constrained by the milk Quota system which was introduced in 1984. Quota constraint, rather than a land constraint was the main determinant on the size of the dairy enterprise on farms. Many dairy farmers have a beef enterprise on their farms as a result of

milk quota constraints. The expected growth on many dairy farms post milk quota in 2015 will come from a decline in their beef enterprise. This will be replaced by growth in dairy cow numbers.

10.3.1.1 Assumptions used – Dairy Sector

Much of the technical data used in this analysis have recently been published in the Teagasc Roadmap for dairying. The main assumptions for the dairy scenarios are given in Table 10-1.

Table 10-1: Main assumptions used for pathway analysis (dairying).

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Milk Solids /Cow Kg	378	360	422	448
Calving Interval (days)	380	380	380	365
Mean Calving date (MCD)	Mar-10	Mar-10	Mar-10	Feb-20
Cows /Labour Unit	67	55	67	100
Stocking Rate (LU/Ha)	2.1	1.9	2.5	2.8
Herbage Utilised (Kg DM /Ha)	8.7	6.5	8.0	13
GHG (Kg CO ₂ e /Kg MS)	13.53	16.06	15.50	11.50
Replacement Rate (%)	22	25	22	18
Concentrates /Cow (Kgs)	750	1,000	1,500	400
Concentrates /Replac. Heif. (Kgs)	600	600	700	500
Inorganic Nitrogen (Kg /Ha)	192	155	225	250
Organic Nitrogen (Kg /cow)	85	85	85	85
Organic Nitrogen (Kg /Replac. Unit)	81	81	81	81
Phosphorus Kg /cow	13	13	13	13
Phosphorus Kg /Replacement Unit	11	11	11	11
Source: Teagasc				

10.3.1.2 Dairy production and environmental indicators for various scenarios

The scenarios are compared by reference to a given supply of milk (100,000 Kg milk solids). The data in Table 10-2 gives a breakdown of the

number of cows required together with the total level of concentrate use and land area required in the production of 100,000 Kg of milk solids. The change in the total quantity (Kg) of nitrogen (inorganic and organic) and phosphorus as well as greenhouse gas is also given.

Table 10-2: Dairy production and environmental indicators for the various scenarios in the production of 100,000 Kg of milk solids

Scaled up parameters	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Milk Supply (kg Milk Solids)	100,000	100,000	100,000	100,000
Number of Cows	265	277	237	223
Number of Replacements	58	69	52	40
Total Livestock Units	323	346	289	263
Total Land Required (Ha)	154	182	116	94
Total Concentrates Fed (kg)	233,333	318,560	391,943	109,375
Inorganic Nitrogen (Total Kg)	29,509	28,248	26,019	23,517
Organic Nitrogen (Total Kg)	27,201	29,155	24,365	22,228
Phosphorus (Total Kg)	4,079	4,363	3,654	3,344
Green House Gas (Kg CO2 Equiv.)*	1,353,000	1,606,000	1,550,000	1,150,000
*Note: Number of cows derived from milk solids produced per cow as indicated in assumptions in Table 10-1				
**Includes component for Replacement Heifers				

10.3.1.3 Impact of scenarios on Dairy production and environmental indicators

The relative change (%) for all these parameters relative the reference system is given in

Table 10-3. The data indicates that 7.3% increase in livestock units is required for the Low Intensity scenario to produce a given quantity of milk relative to a reduction of 10.4% and 18.4%, respectively, for Scenario C and Scenario D. There is a large variation in the amount of land required depending on the scenario of production. The 18.6% increase in land required for Scenario B (Low Intensity scenario) is driven by the additional amount of land required per livestock unit as well as the lower level of per cow performance (more cows to produce a given level of milk). There is a large reduction in the land area required for Scenario C (24.8%) and Scenario D (38.8%) relative to the Scenario A reference. There is a large increase in the level of concentrate required for Scenario B (36.5%) and Scenario C (68%). This is driven mainly by the lower productivity per cow for Scenario B (more cows for given volume of milk) and the relatively high level of concentrate

feeding in the case of Scenario B and C. The level of concentrates required for Scenario D is reduced by (53.1%) relative to the reference system. This is driven by the relatively low level of concentrate feeding per cow coupled with the good level of cow productivity (milk solids) for this Pathway.

Table 10-3: Comparison of alternative productions scenarios relative to Reference System

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Change in Milk Supply (Kg Milk Solids)	0.0	0.0	0.0	0.0
Change in Livestock Units	0.0	7.3	(10.4)	(18.4)
Change in Land Area Required	0.0	18.6	(24.8)	(38.8)
Change in Level of Concentrate Usage	0.0	36.5	68.0	(53.1)
Change in Inorganic Nitrogen	0.0	(4.3)	(11.8)	(20.3)
Change in Organic Nitrogen Use	0.0	7.2	(10.4)	(18.3)
Change in Phosphorus Excretion	0.0	6.9	(10.4)	(18.0)
Change in Green House Gas	0.0	18.7	14.6	(15.0)

There is a reduction in the level of inorganic nitrogen required for Scenario B (-4%) and C (12%) relative to the Scenario A. There is a higher reduction of 20.3% for inorganic nitrogen for Scenario D. This is due to the fact that the high productivity from cows in this Scenario results in fewer cows required for a given volume of milk output. There is an increase in the level of organic nitrogen (7.2%) for Scenario B while there is a reduction of 10.4% and 18.3% for organic nitrogen for Scenario C and D, respectively. The changes in the level of organic nitrogen are driven by the change in livestock numbers as the organic nitrogen per Livestock unit is fixed. There is an increase in the level of phosphorus excretion for Scenario B (6.9%) and a reduction for Scenario C (10.4%) and for Scenario D (18%) relative to Scenario A reference. The level of Green House Gas emissions are increased for Scenario B (18.7%) and Scenario C (14.6%) while it is reduced by 15% for Scenario D relative to the Scenario A reference.

10.3.1.4 Qualitative environmental impact for various scenarios

A qualitative environmental assessment of the various scenarios in relation to the Scenario A

(reference system) is given in Table 10-4. Scenario D has the greatest positive impact on groundwater due to the decrease in livestock units, decrease in land area required and decrease in organic and inorganic fertiliser use. Scenario D has the greatest positive impact on soils due to the decrease in livestock units and decrease in land area required. Scenario D has the greatest positive impact on air quality emissions due to the decrease in livestock units. In relation to landscape, Scenario D is the most preferable, underpinning growth and most likely to maintain the existing predominantly grassed-based nature of the Irish agricultural countryside. Scenario C is likely to result the most noticeable change to landscape use and pattern. Scenario D will have a positive impact on reducing greenhouse gas emissions due to the decrease in livestock units and due to nutrient use efficiency. Ireland is committed to reducing CO₂eq emissions by 20% or 3.73 Mt relative to the 2005 reference year from agriculture in 2020. In isolation, this decrease in greenhouse gas emissions would have a positive impact on Ireland's ability to comply with that commitment.

Table 10-4: Qualitative effect of Scenarios in relation to some environmental factors.

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Biodiversity				✓
Flora/Fauna				✓
Water Quality (including drinking water)				✓
Soil				✓
Air Quality				✓
Landscape & Buildings				✓
Climatic Factors				✓

10.3.2 Beef

No physical performance targets are given in Food Harvest 2020 for the beef sector. A monetary value increase of 20% is given instead for this sector. Unlike dairying, the beef sector is made up of many different beef production systems. The beef industry has however, evolved into two main sub-sectors over the last three decades. Specialised beef based on suckler cows grew rapidly since the introduction of the milk quota. There is also a significant beef industry based on steer calves coming from dairy herds. Continental type beef breeds now make up a large proportion of beef progeny. Like dairying, beef systems are mainly based on beef from grassland.

Two beef systems are used to assess the impact of scenarios for beef production. These include:

1. Suckler cow system; and
2. Steer beef mainly originating from the dairy herd.

10.3.2.1 Assumptions used – Beef Sector based on Suckler Cows

The technical and environmental aspects of these ‘scenarios’ are considered by reference to published literature. Much of the technical data used in this analysis have recently been published in Teagasc Roadmaps. The main assumptions for the beef (single suckler cow) scenarios are given in Table 10-5.

Table 10-5: Main assumptions used for pathway analysis (Beef Single Suckling)

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Calving Interval (days)	390	400	390	367
Calving Feb. - Mar. (%)	52	42	52	70
Cows /heifers calving in 3 Mts (%)	69	61	69	100
Heifers calving at 23 to 26 months (%)	25	13	25	100
Replacement Rate (%)	17	15	20	20
Calves /Cow /Year	0.87	0.81	0.87	0.95
Average SBV (€)	100	62	100	120
Grass (% in Total Diet)	51	49	51	61
Silage (% in Total Diet)	38	38	38	31
Concentrates (% of total DM in Diet)	11	13	11	8
Herbage Utilised (Kg DM /Ha)	5,997	4,760	6,000	10,048
Concentrates /LU (Kg DM)	438	505	906	325
Steer (bull) carcase Wt (Kg)	361	355	360	395
Steer (bull) age at finishing (mts)	26	28	26	24
Heifer carcass weight (kg)	326	321	326	315
Heifer age at finishing (mts)	24	26	24	20
Mean Carcase Grade	R=3=	R=3=	R=3=	R+3=
GHG emissions (kg CO ₂ e /Kg carcass)	20.0	21.2	21.0	18.0
Organic Nitrogen (Kg /Ha)	130	110	150	210
Inorganic Nitrogen (Kg /Ha)	80	71	130	195
Liveweight Output (Kg /Ha)	580	457	623	1065
Carcass Output (Kg /Ha)	317	250	355	586
Costs per Kg Live weight (€/Kg)	1.52	1.77	1.93	1.29
Stocking Rate (LU /Ha)	1.67	1.43	2.00	2.66
Phosphorus /Ha	16.7	14.3	20.0	26.6
Gross Output (€ /Ha)*	887	699	993	1514
Gross Margin (€ /Ha)	377	262	207	761
Net Margin (€ /Ha)	5	(110)	(165)	340
*Note Gross output (€/Ha) will be used to derive livestock numbers for given level of € output				

10.3.2.2 Beef production and environmental indicators for various scenarios

The scenarios are compared in Table 10-6 by reference to a given value (€) of beef output (€1 million) in addition to a breakdown of the number

of beef cow units required, together with the total level of concentrate use and land area required in the production of €1 million of beef value. The change in the total quantity (Kg) of nitrogen (inorganic and organic) and phosphorus as well as greenhouse gas is also provided.

Table 10-6: Beef production and environmental indicators for the various scenarios in the production of €1M of beef.

Scaled Up Parameters	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Reference Farm Sales (€)	1,000,000	1,000,000	1,000,000	1,000,000
Number of Hectares Required (Ha)*	1,127.4	1,430.6	1,007.0	660.5
Number of Livestock Units (LU)	1,879	2,044	2,014	1,756
Live weight Output (Kg)	653,890	653,791	627,392	703,435
Carcass Output (Kg)	357,384	357,654	357,503	387,054
Concentrate Use (Kg)	822,999	1,032,087	1,824,773	570,624
Organic Nitrogen	146,561	157,368	151,057	138,705
Inorganic Nitrogen	90,192	101,574	130,916	128,798
Phosphorus	18,828	20,458	20,141	17,569
Green House Gas (Kg CO2 Equiv.)	7,147,689	7,582,260	7,507,553	6,966,975
*Note Gross output (€/Ha) was used to derive total Ha required for a given level of € output				

10.3.2.3 Impact of production scenarios on production and environmental indicators

The relative change (%) for all these parameters relative the reference system is given in Table 10-7. The data indicates a significant increase (26.9%) in land area is required for the Scenario B - Low Intensity as compared with a reduction of 10.7% and 41.4% of land area required for Scenario C and Scenario D, respectively. There is also an increase in livestock units 7-9% for

Scenarios B and C whereas there is a reduction of 7% in the number of livestock units required for Scenario D relative to the reference system. There is no change in carcass output for Scenarios B and C while there is an increase of 8% in carcase output for Scenario D. There is a very large increase in the level of concentrate feeding required for Scenario B (25.4%) and Scenario C (121.7%) relative to Scenario A Reference while there is a reduction of 31% in the level of concentrate required for Scenario D.

Table 10-7: Impact of production scenarios on production and environmental indicators.

Impact	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Change in Land area Required (%)	0.0	26.9	(10.7)	(41.4)
Change in LU's (%)	0.0	8.8	7.2	(6.6)
Change in Live weight output (%)	0.0	0.0	(4.1)	7.6
Change in Carcass output (%)	0.0	0.1	0.0	8.3
Change in Concentrate Use (%)	0.0	25.4	121.7	(30.7)
Change in Organic Nitrogen (%)	0.0	7.4	3.1	(5.4)
Change in Inorganic Nitrogen (%)	0.0	12.6	45.2	42.8
Change in Phosphorus (%)	0.0	8.7	7.0	(6.7)
Change in Green House Gas	0.0	6.1	5.0	(2.5)

The organic nitrogen output is increased by 7.4% and 3.1% for Scenarios B and C, respectively, while it is reduced by 5% for Scenario D. The level of inorganic nitrogen is increased for all Scenarios relative to reference system with an increase of 12.6%, 45.2% and 42.8% for Scenario B, C and D respectively. There is an increase in the level of phosphorus output (7-9%) for Scenario B and C while the level is reduced by 7% for Scenario D. Greenhouse gas production is increased by 5-6% for Scenario B and C while it is reduced by 3% for Scenario D.

10.3.2.4 Qualitative environmental impact for various scenarios

The data in Table 10-8 gives a qualitative environmental assessment of the various scenarios in relation to the Scenario A Reference. Scenario D has the greatest positive impact on groundwater due to the decrease in livestock units, decrease in land area required and decrease in organic and inorganic fertiliser use. Scenario D has the greatest positive impact on soils due to the decrease in livestock units and decrease in land area required. Scenario D has the greatest positive impact on air quality emissions due to the decrease in livestock units. In relation to landscape, Scenario D is the most preferable, underpinning growth and most likely to maintain the existing predominantly grass-based nature of the Irish agricultural countryside (less pressure for additional land). Scenario D will have a positive impact on reducing greenhouse gas emissions due to the decrease in livestock units and due to nutrient use efficiency.

Table 10-8: Qualitative effect of scenarios in relation to some environmental factors.

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Biodiversity				✓
Flora/Fauna				✓
Water Quality (including drinking water)				✓
Soil				✓
Air Quality				✓
Landscape & Buildings				✓
Climatic Factors				✓

10.3.2.5 Assumptions used – Beef Sector (Steers)

The main assumptions for the beef (steers) scenarios are given in Table 10-9 below.

Table 10-9: Main assumptions used for Pathway Analysis (Steers).

Beef Steers	Scenario A Reference (FH2020)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Grass (% in Total Diet)	55	57	57	58
Silage (% in Total Diet)	25	28	28	20
Concentrates (% of total DM in Diet)	20	15	15	22
Herbage Utilised (Kg DM /Ha)	6,800	5,650	5,650	8,090
Concentrates /LU (Kg DM)	900	555	900	898
Steer (bull) carcass Wt (Kg)	355	370	370	323
Steer (bull) age at finishing (mts)	26	30	28	24
GHG emissions (kg CO ₂ e /Kg carcass)	15	16.5	17	13.6
Organic Nitrogen (Kg /Ha)	170	136	170	210
Inorganic Nitrogen (Kg /Ha)	130	106	120	142
Live weight Output (Kg /Ha)	1,197	825	934	1,479
Carcass Output (Kg /Ha)	623	431	495	806
Gross Output (€ /Ha)	1,712	1,155	1,327	2,217
Gross Margin (€ /Ha)	622	367	442	848
Net Margin (€ /Ha)	47	-208	(132)	198
Stocking Rate (LU /Ha)	2.20	1.80	2.20	2.60
Phosphorus /LU	11.9	13.7	12.8	11.0

10.3.3 Beef production and environmental indicators for various scenarios

The scenarios are compared in Table 10-10 by reference to a given value (€) of beef output (€1 million). The data gives a breakdown of the number of beef Livestock Units (LU's) required together with the total level of concentrate use and land area required in the production of €1 million of beef value. The change in the total quantity (Kg) of nitrogen (inorganic and organic) and phosphorus as well as 'green house' gas is also given.

Table 10-10: Beef production and environmental indicators for the various scenarios in the production of €1M of beef.

Scaled Up Parameters	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Reference Farm Sales (€)	1,000,000	1,000,000	1,000,000	1,000,000
Number of Hectares Required (Ha)	584.1	865.8	753.6	451.1
Number of Livestock Units (LU)	1,285	1,558	1,658	1,173
Live weight Output (Kg)	699,182	714,286	703,843	667,118
Carcass Output (Kg)	363,902	373,160	373,022	363,554
Concentrate Use (Kg)	1,156,542	864,935	1,492,087	1,053,135
Organic Nitrogen	99,299	117,749	128,109	94,723
Inorganic Nitrogen	75,935	91,775	90,430	64,051
Phosphorus	15,292	21,351	21,221	12,900
Green House Gas (Kg CO2 Equiv.)	5,458,528	6,157,143	6,341,372	4,944,339

10.3.3.1 Impact of production scenarios on production and environmental indicators

The relative change (%) for all these parameters relative the reference system is given in Table 10-11. The data in Table 10-11 shows that a very significant increase (48.2%) in land area is required for the Scenario B and Scenario C (29%) as compared with a large reduction of 23% in the land area required for Scenario D. There is also an increase in livestock units for Scenario B (21.3%) and for Scenario C (29%) whereas there is a reduction of 9 % in the number of livestock units required for Scenario D relative to the Scenario A Reference. There is a small positive increase in live-weight (1-2%) and carcass output (2.5%) for Scenarios B and C, respectively, as compared with a small reduction in live-weight (5%) and no change in carcass output for Scenario D relative to the Scenario A Reference. There is a large reduction (25%) in the level of concentrate feeding for Scenario B and a reduction of 9% in level of concentrate use for Scenario D. In contrast however, there is a large increase (29%) in the level of concentrate use for Scenario C.

Table 10-11: Impact of production scenarios on production and environmental indicators

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Change in Land area Required (%)	0.0	48.2	29.0	(22.8)
Change in LU's (%)	0.0	21.3	29.0	(8.7)
Change in Live weight output (%)	0.0	2.2	0.7	(4.6)
Change in Carcass output (%)	0.0	2.5	2.5	(0.1)
Change in Concentrate Use (%)	0.0	(25.2)	29.0	(8.9)
Change in Organic Nitrogen (%)	0.0	18.6	29.0	(4.6)
Change in Inorganic Nitrogen (%)	0.0	20.9	19.1	(15.7)
Change in Phosphorus (%)	0.0	39.6	38.8	(15.6)
Change in Green House Gas	0.0	12.8	16.2	(9.4)

The organic nitrogen output is increased by 18.6% and 29% for Scenarios B and C, respectively, while it is reduced by 5% for Scenario D. The level of inorganic nitrogen is increased for Scenarios B (20.9%) and C (19.1%) as against a reduction of 15.7% for Scenario D. There is a large increase in the level of phosphorus output (39%) for Scenario B and C while the level of phosphorus is reduced by 16% for Scenario D. Greenhouse gas production is increased by 13-16% for Scenarios B and C while it is reduced by 9% for Scenario D.

10.3.3.2 Qualitative environmental impact for various scenarios

The data in Table 10-12 gives a qualitative environmental assessment of the various scenarios in relation to the Reference System. Scenario D has the greatest positive impact on groundwater due to the decrease in livestock units, decrease in land area required and decrease in organic and inorganic fertiliser use. Scenario D has the greatest positive impact on soils due to the decrease in livestock units and decrease in land area required. Scenario D has the greatest positive impact on air quality emissions due to the decrease in livestock units. In relation to landscape, Scenario D is the

most preferable, underpinning growth and most likely to maintain the existing predominantly grassed-based nature of the Irish agricultural countryside. Scenario C is likely to result the most noticeable change to landscape use and pattern. Scenario D will have a positive impact on reducing greenhouse gas emissions due to the decrease in livestock units and due to nutrient use efficiency. Ireland is committed to reducing CO₂eq emissions by 20% or 3.73 Mt relative to the 2005 reference year from agriculture in 2020. In isolation, this decrease in greenhouse gas emissions would have a positive impact on Ireland's ability to comply with that commitment.

Table 10-12: Qualitative effect of Scenarios in relation to some environmental factors.

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Biodiversity				✓
Flora/Fauna				✓
Water Quality (including drinking water)				✓
Soil				✓
Air Quality				✓
Landscape & Buildings				✓
Climatic Factors				✓

10.3.3.3 40% increase in value of beef output

Food Harvest 2020 sets a 20% increase in the monetary value of beef output by 2020. The model presented at Table 2-2 envisages that this increase will be achieved mainly through improvements in breeding, farm management and prices with a corresponding decrease in the actual numbers of suckler cows and beef animals. This report envisages that this reduction in suckler cow numbers will occur predominately on farms that are presently devoted to dairying and beef and the land released by the reduction in suckler cow numbers will be taken up by an increase in dairy cow numbers. Subsequent to the publication of Food Harvest 2020 The Beef Activation Group called for an increase in the value of beef output of 40% which envisaged an increase in suckler cow numbers. The findings of this report are based on the national herd numbers as presented in Table 2-2. The environmental impact of any increase beyond these national herd numbers has not been studied in this report. However, should an increase in suckler cow numbers occur on lands traditionally devoted to beef farming it is unlikely that a small increase nationally would have any significant effect on biodiversity; flora and fauna; water quality; soils or landscape. The effect and air quality and greenhouse gas emissions would be directly proportionate to the increase in numbers.

10.3.4 Sheep

Sheep production in Ireland is a significant contributor to the agricultural and National economy with an output valued at €187 million (3.6% of Goods Output) in 2011. This is despite the national sheep number declining from a 7.55M in 2000 to 5.08M in 2010. There are currently 32,200 sheep farmers with a breeding ewe flock of 2.5 million ewes. Ireland is 377% self-sufficient in sheep meat resulting in over 70% of the total

production been exported. In the National Farm Survey, the average gross margin is €675 per hectare (mid-season lamb in 2011) with the top one third of farms generating a gross margin of €1,098/ha. The lowland sheep flock is the major source of lamb output, accounting for 85% of carcass output.

10.3.4.1 Assumptions used – Sheep

Since the lowland flock is the major source of lamb output (85% carcass output), it was decided to use this sector of the sheep sector in order to compare scenarios to achieving Food Harvest 2020 targets. Three scenarios will be compared to a reference system in relation to the production of a given value (€) of sheep meat output (Table 10-13). Value of output was chosen because a value target (20% increase in value of sheep output) was set for the Sheep sector in Food Harvest 2020. These scenarios are compared to a reference system which is the best estimate of a typical Sheep enterprise in the period up to 2020. Like the other enterprises, it is a proxy to the Food Harvest 2020 system used in the analysis in Section 3 to 8 of this report. The reference system was derived by reference to the best estimate of the components of this system as outlined the Teagasc Roadmap for Sheep and from recent publications from Teagasc.

Table 10-13: Main assumptions used for Pathway analysis (Sheep).

Sheep Mid-Season Flocks	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Litter Size	1.61	1.37	1.37	2.1
Ewes lambled (%)	94	93	93	96
Lambs weaned per ewe joined	1.4	1.27	1.27	1.8
Lamb mortality (%)	7.8	7.1	7.1	11.8
Stocking Rate (ewes /Ha)	9	8	10	13
Concentrate input (Kg /Ewe)	50	78.6	80	35
Average carcass weight /lamb (Kg)	20	20	20	20
Carcass output (Kg /Ha)	252	203	254	468
Nitrogen (Kg /ha)	68	73.5	95	159
Gross Output (€ /Ha)	824	747	934	1,576
Direct Costs (€ /Ha)	372	382	478	528
Gross Margin (€/Ha)	452	365	456	1,048
Fixed Costs (€ /Ha)	262	262	327	400
Net Margin (€/Ha)	190	103	129	648
Organic Nitrogen/ewe & lambs	13	13	13	13
Phosphorus /ewe & lambs	2	2	2	2
GHG emissions (kg CO ₂ e /Kg carcass)	19	20.5	21	17.6

10.3.4.2 Sheep production and environmental indicators for various scenarios

The scenarios are compared by reference to a given level of sheep meat value. A breakdown of the number of ewes required, the total level of concentrates required together with the total level of sheep meat produced in the production of €1million of sheep meat is given in Table 10-14. Changes in the total quantity (Kgs) of organic nitrogen, inorganic nitrogen, phosphorus and the change in greenhouse gas emissions are presented also.

Table 10-14: Sheep production and environmental indicators for the various scenarios in the production of €1M value of Sheep-meat

Scaled Up Parameters	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Reference Farm Sales (€)	1,000,000	1,000,000	1,000,000	1,000,000
Number of Hectares Required (Ha)	1,213.6	1,338.7	1,070.7	634.5
Number of Ewe Units	10,922	10,710	10,707	8,249
Carcass Output (Kg)	305,825	271,754	271,949	296,954
Concentrate Use (Kg)	546,116.50	841,767.07	856,531.05	288,705.58
Organic Nitrogen	141,990	139,224	139,186	107,234
Inorganic Nitrogen	82,524	98,394	101,713	100,888
Phosphorus	21,845	21,419	21,413	16,497
Green House Gas (Kg CO ₂ Equiv.)	5,810,680	5,570,950	5,710,921	5,226,396

10.3.4.3 Impact of production scenarios on production and environmental indicators

The relative change (%) for all these parameters relative the reference system is given in

Table 10-15. The data indicate that 10.3% more land is required for the less intensive Scenario B as compared with a reduction 12% and 48% for Scenario C and Scenario D, respectively, to produce given value of sheep meat. The carcass output is reduced for all Scenarios relative to Scenario A reference with a drop in carcass output of 11% recorded for Scenario B and Scenario C. There is a very significant increase in the level of concentrates required for Scenarios B and C (54-57%) while the concentrate requirement for Scenario D is 47% less than the Scenario A reference. There is a small negative reduction in organic nitrogen for Scenario B and C but there is a very large reduction in organic nitrogen for Scenario D relative to Scenario A Reference. There is an increase in the order of 19-23% in the level of Inorganic nitrogen for Scenarios B, C and D respectively. The change in phosphorus excretion is reduced by 2% for Scenario B and C and it is reduced by 24 % for D. Greenhouse gas emission is reduced for Scenario B (4.1%) and for Scenario C (2%) and is reduced by 10% for Scenario D.

Table 10-15: Impact of Scenarios of production and environmental indicators.

Impact	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Change in Land area Required (%)	0.0	10.3	(11.8)	(47.7)
Change in LU's (%)	0.0	(1.9)	(2.0)	(24.5)
Change in Carcass output (%)	0.0	(11.1)	(11.1)	(2.9)
Change in Concentrate Use (%)	0.0	54.1	56.8	(47.1)
Change in Organic Nitrogen (%)	0.0	(1.9)	(2.0)	(24.5)
Change in Inorganic Nitrogen (%)	0.0	19.2	23.3	22.3
Change in Phosphorus (%)	0.0	(1.9)	(2.0)	(24.5)
Change in Green House Gas	0.0	(4.1)	(1.7)	(10.1)

10.3.4.4 Qualitative environmental impact for various scenarios

The data in Table 10-16 gives a qualitative environmental assessment of the various scenarios in relation to the Reference System. Scenario D has the greatest positive impact on groundwater due to the decrease in livestock units, decrease in land area required and decrease in organic and inorganic fertiliser use. Scenario D has the greatest positive impact on soils due to the decrease in livestock units and decrease in land area required. Scenario D has the greatest positive impact on air quality emissions due to the decrease in livestock

units. In relation to landscape, Scenario D is the most preferable, underpinning growth and most likely to maintain the existing predominantly grassed-based nature of the Irish agricultural countryside. For Sheep, which is projected to fall in overall in Food Harvest, the Low Intensity Scenario (B) is considered most preferably, being most likely to underpin the existing land use patterns – and possibly recover some element of lost landscape tradition. Scenario D will have a positive impact on reducing greenhouse gas emissions due to the decrease in livestock units and due to nutrient use efficiency.

Table 10-16: Qualitative effect of Scenarios in relation to some environmental factors

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Biodiversity				✓
Flora/Fauna				✓
Water Quality (including drinking water)				✓
Soil				✓
Air Quality				✓
Landscape & Buildings		✓		
Climatic Factors				✓

10.3.5 Sustainable Farming – Scenarios to Food Harvest 2020 for the Ruminant Livestock Sector

Protection of Ireland's natural environment has been a central element of the European Union CAP and Irish Government Policy for over 20 years. Payments to farmers under the CAP are dependent on the achievement and maintenance of baseline standards on environmental and public health, animal and plant health, and animal welfare – otherwise known as “cross compliance”. This would include tagging all calves at birth and recording all sales and purchases; maintaining a record of all veterinary medicines used; preventing soil erosion and maintaining wildlife habitats (<http://ec.europa.eu/agriculture>). The Rural Environment Protection Scheme (REPS) was introduced in Ireland in 1994 and has proved to be one of Europe's best environmental stewardship schemes. Farmers are required to comply with a five year environmental plan in order to qualify for an annual payment co-funded by the EU and the Irish Exchequer. Soil testing, fencing off of watercourses and planting of hedgerows are just some of the measures central to the scheme. Quality assurance plays a fundamental role in promoting food and horticulture and provides the platform for consumer promotion of product quality. The Irish food promotion body, An Bord Bia, provides quality assurance schemes for beef, lamb, pig-meat, poultry, eggs and horticulture. Products produced through the scheme carry the Bord Bia Quality Assurance logo (www.bordbia.ie). Since January 2011, the Beef Quality Assurance Scheme (BQAS) includes an objective assessment of the farm's carbon footprint under the auspices of the Carbon Trust in the UK. This will ensure that the environmental credentials of the 32,000 BQAS participants can be proven to the world. Also important is the Suckler Cow Welfare Scheme, which was established in 2008 to improve the

quality of the beef cow herd and to promote the highest standards of animal welfare. The Environmental Protection Agency (www.epa.ie) is the statutory body charged with monitoring and protecting Ireland's environment. They produce regular reports on the quality of Ireland's water air and natural environment.

10.3.5.1 Discussion of scenarios for Ruminant livestock in Context of Food Harvest 2020

Ruminant livestock, which includes Dairy, beef and sheep are considered together because systems of production in Ireland are mainly based on grassland farming with most of the feed resource coming from grazed grass and grass silage. Ruminant livestock systems in Ireland are unique in that most of the feed resource is produced on the farm with the result that there is a strong link between ruminant livestock and land use. There are also a high proportion of farms with a combination of enterprises (e.g. dairying and dry-stock, dry-stock and sheep, dry stock and some tillage).

10.3.5.2 Livestock Numbers changes and Food Harvest 2020

The change in livestock numbers over time is given in Figure 10-1. Over the period considered by Food Harvest 2020, dairy cow numbers are expected to increase by 24%. However, suckler cow numbers are expected to reduce by 13%. Overall, the total cattle count is expected to be 6.82M by 2020. This represents a reduction in total cattle numbers of 2% as compared with the average cattle count over the period 2007-2009. Over a longer term horizon, the overall cattle count has fallen by 12% from a peak in 1998 (Figure 10-1). Over the period of Food Harvest 2020, sheep numbers are expected to decline by 5.5%. However, by 2020, total sheep numbers will have fallen by 46% from peak in 1993.

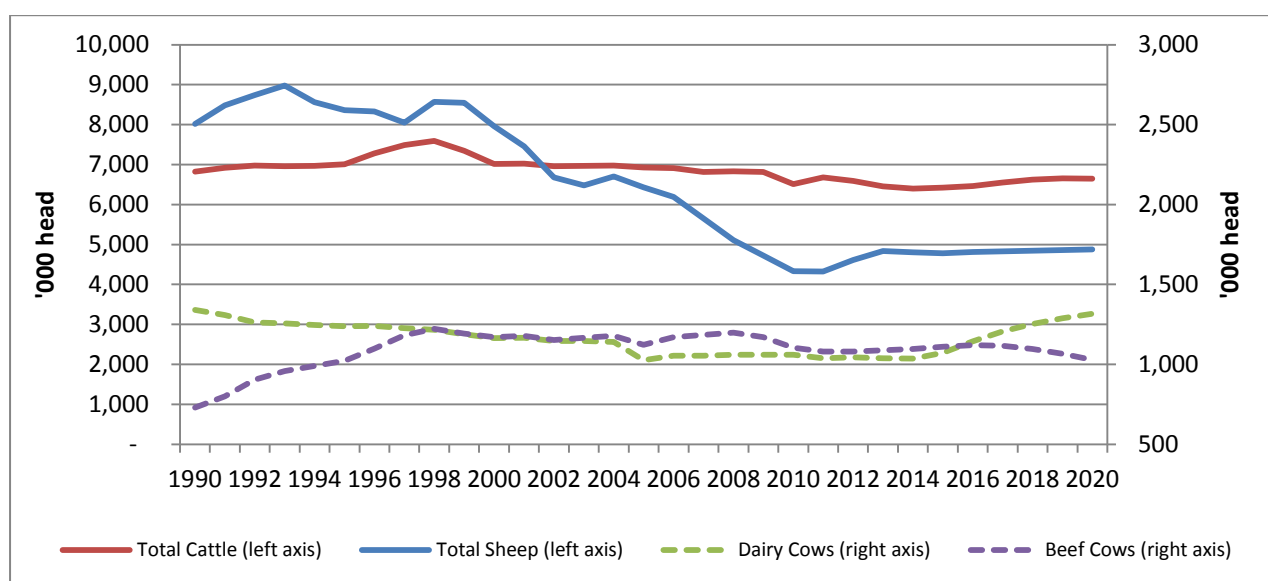


Figure 10-1: Change in Livestock Number over time (All cattle and Sheep left axis, dairy cows and Suckler cows on right axis). Source: FAPRI Ireland/Teagasc

At the macro level, there will be little change in total livestock numbers while there will be some substitution of beef cows for dairy cows.

The effect of Pathway to Food Harvest 2020 on livestock numbers across four livestock types is given in Table 10-17.

Table 10-17: Comparison of 3 scenarios – Livestock number changes relative to reference system.

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensity	Scenario C - Increased Intensification	Scenario D - High Technology
Dairying	0.0	7.3	(10.4)	(18.4)
Beef – Single Suckling	0.0	8.8	7.2	(6.6)
Beef – Steer System	0.0	21.3	29	(8.7)
Sheep	0.0	(1.9)	(2.0)	(24.5)

Additional livestock numbers will be needed for all cattle enterprises if system of farming is based on an extensive system. There is no change in the case of sheep. In the case of a system based on increased intensity, fewer animals are required in the case of dairying and sheep, while additional livestock are required for beef and especially for the steer system. The improved production efficiency scenario requires less livestock for all ruminant livestock enterprises.

10.3.6 Land Area Requirement

Due to the strong association of ruminant livestock with land (most feed grown on farm), livestock numbers need to be considered with land area requirements. The land area requirement for the four ruminant livestock classes is given in Table 10-19 for three scenarios of production. The land requirement for Scenario A (Integrated Scenario) is high relative to Food Harvest 2020. This is due in part to extra livestock (Table 10-17) and also the extra allocation of land per livestock unit. The

increased production efficiency has a much reduced requirement for land relative to Food Harvest 2020 with the exception for Beef Steer system. There is a very significant reduction in land requirement for Scenario D resulting from reduced animals and also reduced land requirement per animal.

The impact of the various Scenarios relative to Food Harvest 2020, need to be considered where all these livestock classes interact in farming systems across Ireland. The data in Table 10-19

gives expected change in the areas of forage crops from the reference period (2007-2009) to 2020. The change in the areas of forage is minimal due to the interaction of changes in livestock numbers over time. This is mainly because of the decline in suckler cows and beef sector (substitution of enterprises). The 50% expansion in dairying proposed when considered with changes in the scale of other enterprises will not have any significant effect on the current forage area in the Country.

Table 10-18: Land Area Required Relative to the Reference System (%)

	Scenario A Reference (Integrated Scenario)	Scenario B- Low Intensification	Scenario C - Increased Intensification	Scenario D – High Technology
Dairying	0.0	18.6	(24.8)	(38.8)
Beef – Single Suckling	0.0	26.9	(10.7)	(41.4)
Beef – Steer System	0.0	48.2	29.	(22.8)
Sheep	0.0	10.3	(11.8)	(47.7)

Table 10-19: Forage Crop Area ('000 Ha)

Forage Crop	(2007-2009)	2020	Change	% Change
Pasture	2,029.1	2,115.7	86.5	4.3
Hay	233.9	222.7	(11.1)	(4.8)
Silage	1,036.2	1,014.8	(21.4)	(2.1)
Rough Grazing	447.3	441.2	(6.1)	(1.4)

The scenario chosen to deliver on the milk volume predicted for 2020 has a very significant effect on the land area required for the dairy enterprise. The use of a Low Intensification system of production (Scenario B) would result in the requirement of additional land (18.6%) relative to the reference system (Scenario A) whereas there is a very significant reduction in the land area required for the increased intensification system (24.8%) and high technology (38.8%). These results clearly show that there is no need to reclaim additional land not currently used for livestock because of enterprise substitution and the very large impact that a moderate level of intensification has on land requirement for dairying.

10.3.6.1 Concentrate Use

The feed budget for ruminant livestock is mainly forage-based (grazed grass and silage). Generally, the forage component of the diet is produced on farm whereas the concentrate proportion of the diet is imported from outside the farm (produced on tillage farms in Ireland and imported from abroad). In general, the results show that the extensive system of production is associated with a high level of concentrate feeding. In situations with less than optimal management, concentrates substitute for forage on the farm. Beef from steer system of production is associated with low concentrate feeding for the extensive system of production. The increased intensification system is

associated with a high level of concentrate feeding relative to Food Harvest 2020. Intensive systems are frequently associated with high output systems. For all livestock classes, the increased production efficiency pathway is associated with reduced concentrate feeding. High tech systems of production are associated with much improved grassland/forage management with the result high grass utilisation reduces the requirement for concentrates. Lower levels of concentrate feeding are associated with more economic systems of production.

The absolute level of concentrate feed used and the ratio of concentrate to forage in the diet are important from an environmental perspective because nutrients are imported onto the farm. This is particularly important in the case of phosphorus. The high technology system is optimum in the case of Concentrate use.

10.3.6.2 Nitrogen Use

On grassland dairy farms an increase in Nitrogen use allows the potential to increase the stock carrying capacity of land. The optimum level of Nitrogen use is dictated by the biological response to additional increments of N, the ratio and cost of nitrogen relative to value of milk and environmental consideration. There is a considerable volume of information on nitrogen use for grassland in Ireland (Teagasc). Nitrogen use is now governed by legislation (Nitrate Directive). There is a reduction in total level of inorganic nitrogen for Scenarios B, C and D (Dairying) with a reduction of 20% for Scenario D. The organic nitrogen level is reduced significantly for Scenarios C and D.

In the case of beef and sheep, the above relationship does not hold because the numbers of animals required for a given € value of output is governed by the gross output € value for the particular enterprise. Direct comparisons cannot be made with dairying. The use of inorganic nitrogen is relatively high for all of the Scenarios for dry-stock with the exception of increased production pathway for steer production.

The extensive and increased intensification Pathway for the beef enterprises is associated with

high organic nitrogen. There is little change in organic nitrogen across all scenarios for sheep with the exception of Scenario D (24% reduction).

There is however, an increased risk of nitrogen loss for the more intensive systems (on a per Ha basis). While the level of Nitrogen use per hectare is within legislative guidelines, it is important that excellent management is applied in relation to the use of Nitrogen. The organic levels for all scenarios compared were within the limits set by legislation.

10.3.6.3 Phosphorus

Phosphorus use on farms comes from mineral phosphorus in the fertiliser use on grassland as well as phosphorus imported with feed purchased onto the farm (mainly concentrates). In this analysis the extensive system has an increased level of phosphorus relative to reference system for dairy systems. The increased production efficiency system results in reduced phosphorus output relative to Food Harvest 2020. The risk of phosphorus to the environment mainly results from phosphorus runoff to water (rivers and streams). The phosphorus index of the soil, soil type, topography, rainfall, etc. are important variables. The risk of phosphorus loss can be significantly reduced by improved nutrient management on farm. The increased production efficiency system adds additional improvements in relation to phosphorus output when compared to the reference system (Food Harvest 2020).

10.3.6.4 Greenhouse Gas

The extensive and increased intensification system of production resulted in a 15-19% increase in Green House Production in the case of dairying. Similarly, these systems of production resulted in higher levels of greenhouse gas for beef and especially for steer beef. These scenarios had no significant effect on greenhouse gas for sheep systems. The increased production efficiency system resulted in reduced levels of greenhouse gas emissions for all classes of ruminant livestock.

In general, the high technology system proved to be the most desirable Scenario in relation to its positive impact on biodiversity, flora/fauna, surface water, soil, air quality, landscape and climate factors.

Conclusion

The data in Figure 10-1 indicates that overall livestock numbers are not expected to increase over reference year's values. There is also a marked reduction in livestock from historic values. In addition, there is little change in grassland area. Overall, Food harvest will have no or at most only a minor negative effect on the environment. The move towards increased production efficiency systems for ruminant livestock will further enhance the environment while achieving the targets set in Food Harvest 2020.

10.3.7 Pigs

Pig production ranks third in importance behind beef and dairy in terms of economic value at the farm gate in Ireland. The 2010 Census of Agriculture found that there were 1,200 farms in Ireland with some pigs. However, the reality is that pig farming has moved from being a common feature of thousands of farmyards to a highly specialised intensive operation. In fact, a January 2011 Teagasc survey found that the vast majority of pig-meat produced in Ireland comes from just 290 commercial sow herds. They had a total of 150,700 sows or an average of 520 sows per farm. Furthermore, over 70% of commercial sows are in herds with more than 500 sows. Having survived the peaks and troughs of the pig price cycle without any subsidy or protection from market forces, those that remain in pigs in Ireland tend to be highly efficient and technically excellent. The best producers achieve output of 23.1 pigs per sow per year, a figure that compares very well internationally. Output grew by 9% in 2011, due to higher numbers but mainly better genetics and feeding. Feed represents 70% of the costs of pig production. Virtually all the protein feed

ingredients, and a significant proportion of the cereals used in pig feeds, must be imported. It is estimated that 1,300 labour units are employed on Irish pig farms, with a further 7,000 employed in the associated service sectors.

In 2011, Ireland exported 170,000 tonnes of pig-meat worth approximately €395 million. The UK was the most important market, accounting for almost half of all exports. Continental EU markets accounted for 38,000 tonnes of product with an estimated value of €65 million. Based on Food and Agriculture Organisation (FAO) data from 2006-2008, Ireland was the 13th largest pig-meat exporter in the world. Cork, Tipperary, Cavan and Monaghan are the most significant counties in terms of commercial pig farm numbers.

10.3.7.1 Scenarios to achieving targets set in Food Harvest 2020

In the case of Pigs, two scenarios are compared to a reference system in relation to the production of a given value(€) of pig output. Value of output was chosen because a value target (50% increase in value of pig output) was set for the Pig sector in Food Harvest 2020. These scenarios are compared to a reference system which is the best estimate of a typical pig enterprise in the period up to 2020. Like the other enterprises, it is a proxy to the Food Harvest 2020 system used in the analysis in Section 3 to 8 of this report. The reference system was derived by reference to the best estimate of the components of this system as outlined the Teagasc Roadmap for Pigs and from recent publications from Teagasc.

10.3.7.2 Assumptions used – Pig Sector

The main assumptions for the Pig scenarios are given in Table 10-20.

Table 10-20: Main assumptions used for Scenario analysis – Pigs.

Pigs	Scenario A Reference (Integrated Scenario)	Scenario B Less Intensive	Scenario C Increased Intensification
Pigs Produced per Sow per Year	24	21	27
Carcase Weight of pig sold	80	79	80
Total pig-meat per sow per year	1,920	1,659	2,160
Price per kg of pig-meat (€)	1.46	1.46	1.46
Value of Sales of pig-meat per Sow (€)	2,883	2,501	3,234
Total Feed Cost per Sow	1,688	1,540	1,843
Total Concentrates fed /Sow (tonne)	6.8	6.3	7.4
Margin over Feed per sow	1,195	962	1,390
Variable Production Costs per Sow	390	341	438
Gross Margin per Sow	805	621	952
Fixed Costs per sow (i.e. Labour, Building Dep. Interest)	480	420	540
Margin (€ /Sow)	325	201	412
GHG emissions (kg CO ₂ eq /Kg carcass)	5.0	5.0	5.0
Organic Nitrogen (Kg /sow)	87	87	87
Phosphorus Kg /sow	17	17	17
Output of pig manure per sow per year m ³	20.23	20.23	20.23
Energy KW per Sow	648	567	729

10.3.7.3 Impact of production scenarios on production and environmental indicators

The scenarios are compared by reference to a given level of pig-meat value. In Table 10-21, the analysis is carried out for €1 million value of pig-meat. A breakdown of the number of sows

required, the total level of concentrates required, together with the total level of pig-meat produced in the production of €1 million of pig-meat is shown. The change in the total quantity (Kgs) of organic nitrogen, phosphorus and pig-manure is given, in addition to the change in greenhouse gas emissions and energy requirements.

Table 10-21: Pig production and environmental indicators for the various scenarios in the production of €1M value of pig-meat.

Scaled up parameters	Scenario A Reference (Integrated Scenario)	Scenario B - Less Intensive	Scenario C - Increased Intensification
Value of Pig Meat Output (€)	1,000,000	1,000,000	1,000,000
Number of Sows	347	400	309
Total Kg of pig-meat Produced (Kg)	665,973	663,335	667,904
Total Concentrates fed (tonne)	2,359	2,519	2,288
GHG emissions (kg CO ₂ eq) Kgs	3,329,865	3,316,673	3,339,518
Organic Nitrogen (Kgs)	30,177	34,786	26,902
Phosphorus (Kgs)	5,897	6,797	5,257
Pig Manure Output (m3)	7,017	8,089	6,255
Energy Consumption (KW)	224,766	226,709	225,417

10.3.7.4 Impact of production scenarios on production and environmental indicators

The relative change (%) for all these parameters, relative to the reference system is presented in Table 10-22. This data indicates that a 15.3% increase in sow numbers is required for the less intensive system of production to produce given value of pig-meat relative to a reduction of 10.9% for the more intensive system of production (Scenario C). The carcase weight for both scenarios is similar to Scenario A reference. An additional increase of 6.8% in the level of concentrate

required compared to a small reduction of 3% in concentrate use for Scenario C when compared to the Scenario A Reference. There is no difference in the level of greenhouse gas emission for Scenario B and Scenario C relative to the Scenario A Reference. There is an increase of 15.3% in the level of organic nitrogen, phosphorus and pig manure output for Scenario B relative to the Scenario A Reference system. This contrasts with a reduction of 10.9% for these environmental indicators for Scenario C. There is a relatively insignificant difference in the energy requirement for Scenario B and Scenario C relative to the Scenario A Reference.

Table 10-22: Impact of Scenarios of production and environmental indicators.

Impact	Scenario A Reference (Integrated Scenario)	Scenario B - Less Intensive	Scenario C - Increased Intensification
Change in Number of Sows (%)	0.0	15.3	(10.9)
Change in Carcass Weight (%)	0.0	(0.4)	0.3
Change in Concentrates fed (%)	0.0	6.8	(3.0)
Change in GHG Emissions (Kg CO ₂ e) (%)	0.0	(0.4)	0.3
Change in Organic Nitrogen (%)	0.0	15.3	(10.9)
Change in Phosphorus Excretion (%)	0.0	15.3	(10.9)
Change in Pig Manure Output (%)	0.0	15.3	(10.9)
Change in Energy Consumption (%)	0.0	0.9	0.3

10.3.7.5 Qualitative environmental impact for various scenarios

The data in Table 10-23 gives a qualitative environmental assessment of the various scenarios in relation to the Reference System. Increasing Intensification (Scenario B and C) has a positive impact on groundwater due to the reduction in livestock numbers and organic fertiliser production. The reduction in sow numbers

associated with Scenario B and C has a positive impact on soils. Increasing Intensification has a positive impact on air emissions due to the reduction in livestock numbers. Scenario C is considered to be most preferable for pigs. Pig production is largely an internal activity, requiring large buildings and structures. Intensification is most likely to reduce pressure on and for such new structures and buildings – thereby reducing potential visual impact on landscapes.

Table 10-23: Qualitative effect of Scenarios in relation to some environmental factors.

	Scenario A Reference (Integrated Scenario)	Scenario B- Less Intensive	Scenario C- Increased Intensification
Biodiversity		✓	✓
Flora/Fauna			✓
Water Quality (including drinking water)			✓
Soil		✓	✓
Air Quality			✓
Landscape & Buildings			✓
Climatic Factors			✓

10.3.7.6 Environmental Implications

The density of pig production in Ireland is not a constraint on the expansion of production within the existing environmental regulations. The environmental impact of the projected increase can be substantially offset by improvements in feed formulation. The location of the increased production in areas with low density of production and in tillage areas would reduce the cost of transporting pig manure to be used as a valuable grassland and crop fertiliser. Pig producers will be required to invest in dry sow housing before the end of 2012 in order to comply with EU legislation and national regulations (SI 311 of 2010).

10.3.8 Tillage

The Tillage sector in Ireland makes an important contribution to the agricultural and National economy with the cereal sector having an output valued at €296 million (5.6% of Goods Output) in 2011. Ireland is a net importer of cereal grains, but there is a very specialised and efficient group of growers producing grain in Ireland for the home market. Spring barley is the most popular cereal crop grown by farmers and is used for the malting, seed and feed industries in the Country. Winter wheat, winter barley and winter and spring oats are the other important grain crops produced for the agri-food industry.

10.3.8.1 Assumptions used – Tillage Sector

The technical, economic and environmental aspects of these 'scenarios' are considered by reference to published literature and by the use of Bio-economic modelling. The main assumptions for the tillage scenarios are shown in Table 10-24.

Table 10-24: Main assumptions used for Pathway analysis (Tillage Winter Wheat).

Tillage Wheat	Scenario A Reference (Integrated Scenario)	Scenario B- Current system	Scenario C–Top 10% of producers
Yield /Ha (tonnes)*	9.5	8.5	11.0
Seed (Kg /Ha)	140	140	140
Nitrogen Application (Kg /Ha)	210	210	210
Phosphorus Application (Kg /Ha)	36	36	40
Potassium Application (Kg /Ha)	93	93	108
Herbicides (€/Ha)	56	56	56
Fungicides (€ /Ha)	165	165	165
Insecticides (€ /Ha)	38	38	38
Growth Regulators (€ /Ha)	15	15	15
Machinery Hire-Ploughing (€ /Ha)	70	70	70
Machinery till, sow & roll (€ /Ha)	90	90	90
Machinery Hire-Spraying (€ /Ha)	95	95	95
Machinery Hire-Fertiliser Spreading (€ /Ha)	59	59	59
Machinery Hire-Harvesting (€ /Ha)	131	131	131
Transport of Grain (€/tonne)	6	6	6
Energy* MJ/Ha	7,000	7,000	7,000
Greenhouse Gas CO ₂ e /Ha	3,693	3,693	3,693
Gross Output (including straw) /Ha	1,784	1,604	2,054
Total Variable Costs /Ha*	1,307	1,307	1,307
Gross Margin € /Ha	477	297	747
*The difference in Productivity between Scenarios is assumed to be due principally to level of management rather than to variation in level of inputs on a /Ha basis. The variable costs /ha are therefore similar			

10.3.8.2 Wheat production and environmental indicators for various scenarios

The scenarios are compared in Table 10-25 by reference to a given weight of wheat (1,000 tonne). A breakdown is given of the land area required, fertiliser use and cost of chemicals, in addition to energy use and greenhouse gas emissions. The gross margin for the various scenarios is also given.

Table 10-25: Wheat production and environmental indicators for the various scenarios in the production of 1,000 tonne wheat.

Scaled Up Parameters	Scenario A Reference (Integrated Scenario)	Scenario B- Current system	Scenario C– Top 10% of producers
Reference Farm Grain Produced	1,000	1,000	1,000
Number of Hectares Required (Ha)	105.3	117.6	90.9
Nitrogen Application (Kg /Ha)	22,105	24,706	19,091
Phosphorus Application (Kg /Ha)	3,789	4,235	3,636
Potassium Application (Kg /Ha)	9,789	10,941	9,818
Herbicides (€/Ha)	5,895	6,588	5,091
Fungicides (€/Ha)	17,368	19,412	15,000
Insecticides (€/Ha)	4,000	4,471	3,455
Growth Regulators (€/Ha)	1,579	1,765	1,364
Transport of Grain (€/tonne)	6,000	6,000	6,000
Energy* MJ	736,842	823,529	636,364
Greenhouse Gas CO ₂ e	388,737	434,471	335,727
Gross Margin (€)	50,210.5	34,941.2	67,909.1

10.3.9 Impact of production scenarios on wheat production and environmental indicators

The relative change (%) for all these parameters relative the reference system is given in Table 10-26. The data indicate that 12% more land is required for Scenario B as compared with 14% reduction in the amount of land required for Scenario C. The level of Nitrogen, Phosphorus and potassium applied for Scenario B is increased by 12% when compared with the Scenario A Reference system. In the case of Scenario C, the level of Nitrogen is reduced by 14%, the level of phosphorus is reduced by 4% and there is no change in the level of potassium relative to the Scenario A Reference. The cost of chemical used is used as a proxy to the use level of chemicals across Scenarios. The cost of chemical use is increased by 12% for Scenario B while it is reduced by 14 % for Scenario C. Energy requirement and greenhouse gas emissions are increased by 12% for Scenario B while they are reduced by 14% for Scenario C.

Table 10-26: Comparison of 3 scenarios relative to Reference System

Impact	Scenario A Reference (Integrated Scenario)	Scenario B- Current system	Scenario C–Top 10% of producers
Change in Land area Required (%)	0.0	11.8	(13.6)
Change in Nitrogen Application (%)	0.0	11.8	(13.6)
Change in P Application (%)	0.0	11.8	(4.0)
Change in K Application (%)	0.0	11.8	0.3
Change in Herbicides Costs (%)	0.0	11.8	(13.6)
Change in Fungicide Costs (%)	0.0	11.8	(13.6)
Change in Insecticide Cost (%)	0.0	11.8	(13.6)
Change in Growth Regulators Cost (%)	0.0	11.8	(13.6)
Change in Energy Requirement (MJ)	0.0	11.8	(13.6)
Change in Greenhouse Emissions (CO ₂ e)	0.0	11.8	(13.6)
Change in Gross Margin (%)	0.0	-30.4	35.2

10.3.10 Qualitative environmental impact for various scenarios

The data in Table 10-27 gives a qualitative environmental assessment of the various scenarios in relation to the Reference System. In Scenario C – Top 10% of producers has a positive impact on groundwater due to the reduction in fertiliser and pesticides and herbicides use. Likewise the positive

impact on soils due to the reduction in land area required (Scenario C) has a positive impact on soil. Scenario C is also the preferred option in relation to air emissions. Scenario B is considered most preferable in maintaining the existing nature of arable production in the Irish countryside. In relation to greenhouse gas, Scenario C is the preferred option.

Table 10-27: Qualitative effect of Scenarios in relation to some environmental factors.

	Scenario A Reference (Integrated Scenario)	Scenario B- Current system	Scenario C–Top 10% of producers
Biodiversity			✓
Flora/Fauna			✓
Water Quality (including drinking water)			✓
Soil			✓
Air Quality			✓
Landscape & Buildings		✓	
Climatic Factors			✓

10.4 Notes and References:

165. Fact Sheet on Irish Agriculture – April 2012.
166. Food Harvest 2020: A vision for Irish Agri-Food and Fisheries
167. Donnelly, T and Hanrahan, K. (2012). Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets.
168. Schulte *et al* (2012). Food Harvest 2020: a brighter shade of green? TResearch, Volume 7: Number 1, spring 2012. PP 28-29.
169. Sectoral Roadmaps : Dairying, Beef, Sheep, Pigs and Tillage www.teagasc.ie



Mitigation and Monitoring

Section 11:

Mitigation
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11 Mitigation and Monitoring

11.1 Introduction

11.1.1 Definition of Mitigation

Mitigation as an integral part of environmental assessment aims at the avoidance and reduction of impacts that may be connected with policies, plans, programmes or projects. The EU defines mitigation in Directive 85/337/EC as *‘measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects’* (European Union, 1985)¹⁷⁰. Treweek (1999)¹⁷¹ defined mitigation as *‘any deliberate action that is taken to alleviate adverse effects, whether by controlling the sources of impacts or the exposure of receptors to them’*. Rundcrantz and Skärbäck (2003)¹⁷² defined mitigation as something that ‘limits or reduces the degree, extent, magnitude or duration of adverse impacts’.

The European Commission’s guidance note on Article 6 of the Habitats Directive (European Commission, 2000), defining mitigation as ‘measures at minimizing or even negating the negative impact of a plan or project, during or after its completion’.

11.1.2 The Importance of Mitigation

Ireland in common with most countries around the world seeks to promote economic growth, while at the same time, Ireland is committed to reducing environmental impacts and to reversing global environmental deterioration.

These two goals are not in conflict. However, it is important from the outset when planning national strategies to integrate environmental sustainability with the desired economic and output growth targets. In this context environmental assessment has emerged as an important support tool which alerts policy makers to potential environmental consequences of proposed actions. In practical terms an environmental assessment will suggest methods to reduce and mitigate negative environmental impacts.

Agriculture and in particular the dairy industry will play an important part in national economic

recovery and future economic growth. This analysis has established - all other factors remaining constant – that the changes envisaged under Food Harvest 2020 would lead, before mitigation, to a slight negative impact in the environmental characteristics under the headings: biodiversity flora and fauna; water quality; air quality and climatic factors and to a neutral/imperceptible impact on soils and landscape.

In the case of biodiversity, flora and fauna and water quality the slight negative finding nationally is based principally on risks associated with projected increases in inputs of organic and inorganic nitrogen and phosphorous fertilisers. Meeting requirements of the Nitrates Directive, Phosphorus Regulations and the Surface Water Regulations will be vital in reducing the slight negative finding. While certain assumptions can be made about the broad pattern of agricultural changes that will occur to deliver Food Harvest 2020 it is more difficult to be certain as to how these changes will actually occur on a farm by farm (and hence regional) basis and therefore to provide specific mitigation which may address these issues. This introduces a degree of uncertainty which must be considered and allowed for as Food Harvest 2020 is implemented and its implementation is monitored and reported on.

Assuming full compliance with environmental legislation and codes of good farming practice and with careful implementation of appropriate and iterative mitigation and monitoring at an individual farm basis, greater regional/localised impacts can potentially be avoided.

Where expansion or land use change may impact on particularly sensitive biodiversity, mainly water dependent habitats and species, and specifically Freshwater Pearl Mussel catchments, higher levels of mitigation, monitoring and adherence to good farm practices will be required. More detailed measures may be required for Natura 2000 sites, and these should be prioritised in areas where the dairy and pig/poultry sectors are predicted to expand or intensify.

In the case of air quality the finding is of a slight negative impact.. Mitigation measures are

available to reduce ammonia emissions. Mitigation measures are required to reduce ammonia emissions in order for Ireland to meet its EU level commitments

In the case of climate change the finding is of a slight negative impact. Mitigation measures are available to reduce emissions of CO₂eq.

In the context of the above findings it is important that a suite of suitable mitigation measures are adopted which in all cases can ensure that the impact of Food Harvest 2020 is at worst neutral/imperceptible with respect to the environmental characteristics studied and at best environmental gains can be achieved.

11.2 Mitigation and Food Harvest 2020

A wide range of mitigation measures are available in relation to biodiversity, flora and fauna and water quality. Teagasc is currently undertaking research in relation to mitigation measures for greenhouse gases and air quality. Many of the issues raised in relation to mitigation for greenhouse gases are also relevant to other environmental characteristics. In general mitigation measures tend to be cross-cutting with many mitigation measures suggested for greenhouse gases will also have beneficial impacts on biodiversity, flora and fauna and water quality. The following discussion highlights the issues identified by Teagasc, particularly with respect to their work on greenhouse gas mitigation measures. However, the issues raised are relevant to all environmental characteristics.

11.2.1 A Marginal Abatement Cost Curve for Irish Agriculture

A Marginal Abatement Cost Curve for Irish Agriculture was a submission made to the public consultation on National Climate Policy Development by Teagasc. They used this opportunity to collate the outcomes of their research and knowledge transfer programmes on greenhouse gas emissions, into *A Marginal Abatement Cost Curve (MACC) for Irish Agriculture*. (Schulte *et al* 2012)¹⁷³. Some key outputs of this analysis are outlined in the sections below.

While there is no one approach fits all in relation to the challenges to the environment and the development of appropriate mitigation strategies, it is suggested that this approach might be used to consider abatement/mitigation strategies for all environmental indicators.

11.2.2 Technical Feasibility

In the case of greenhouse gases, there is an extensive list of technically feasible measures for mitigating damage to the environment (Schulte *et al* 2012).

Many of these mitigation measures will be effective in mitigating impacts under other environmental characteristics. For biodiversity and flora and fauna a less intensive farming system that favours the development of diverse habitats is a recommended mitigation. For water quality loss of nutrients to watercourses and groundwater is identified as the cause of potential impacts and therefore reduced nutrient inputs or matching inputs more precisely to crop use are seen as mitigation. Changes in grazing patterns and housing periods for livestock are seen as mitigation for air quality. Afforestation, while sometimes perceived as a threat to biodiversity, flora and fauna and water quality serves as mitigation for climatic factors, air quality, soils and landscape. Improvements in the application techniques for organic fertilisers are deemed a mitigation measure for all characteristics.

Schulte *et al* noted that mitigation measures cannot simply be copied from other countries but must be designed with Irish socio-economic and physical environments in mind. They noted that in many cases incentivisation would be necessary to promote the adoption of realistic mitigation measures. Below is a synopsis of Schulte *et al* discussion on incentivisation.

11.2.3 Incentivisation of cost-beneficial measures

Most of the cost-beneficial measures relate to increased resources use efficiency ("*green measures*"); their implementation should result in monetary savings in the long term. However, most of the green measures require intensive farm management (including nutrient management,

grassland management and animal husbandry), and therefore require a concerted programme of knowledge transfer and advisory services. Teagasc and Bord Bia have developed the Carbon Navigator to aid individual farmers in customising and implementing these “green measures”. In addition, there are a number of food processor-led initiatives aimed at implementing these measures. The Teagasc and Bord Bia Carbon Navigator is a carbon calculator for beef production, which can be used to record and account for on-going reductions in greenhouse gas emissions from individual farms.

11.2.4 Incentivisation of cost-neutral measures

Most of the cost-neutral measures are those that involve land use change, and specifically the planting of biofuel/bioenergy crops (“yellow measures”). Whilst these measures would not be associated with net costs to farmers, their implementation would not result in monetary savings in the long term, either. A major obstacle to incentivisation of these measures is that the greenhouse gas emissions associated with biofuel/bioenergy crops (through displacement of fossil fuel inputs) are currently attributed to the transport and power generation sectors. In previous reports and submissions, Teagasc discussed how a Domestic Offsetting scheme could provide a mechanism to overcome this obstacle, by attributing (part of) the associated reductions in greenhouse gas emissions to the agricultural sector and providing further financial incentivisation for the uptake of these measures.

11.2.5 Incentivisation of cost-effective measures

Only one of the measures included in the MACC curve, i.e. the cultivation of sugar beet for ethanol production, carried an associated cost close to the price of carbon, namely €24.39 per t CO₂eq (IPCC methodology) or €38.39 per t CO₂eq (LCA methodology). In practice, this means that implementation of this measure would be associated with a cost to farmers; therefore it is unlikely that its abatement potential will be realised through market-forces alone. At the same time, as the cost of this measure is below the price of carbon credits, financial incentivisation of this

measure could theoretically constitute a marginal cost saving to society as a whole – compared to the costs of the hypothetical purchase of carbon credits. This is complicated by the fact that the abatement potential of this measure – similar to that of other biofuel and bioenergy crops will largely be attributed to the transport and power generation sectors.

11.2.6 Incentivisation of cost-prohibitive measures

Most of the cost-prohibitive measures are those associated with the introduction of technological solutions, such as the introduction of nitrogen inhibitors. Incentivisation of these measures is likely to require a reduction of the associated costs to farmers, for example a reduction in the capital investment costs. It is important to note that this reduction in costs to farmers does not equate to a reduction in the cost to society – since measures such as grants would have to be funded from taxation.

In a targeted research project Teagasc have studied the technical, financial and environmental effectiveness of the following proposed mitigation strategies:

- i. Accelerated gains in the genetic merit of cows (as measured by the Economic Breeding Index);
- ii. Higher daily weight gain in beef cattle;
- iii. Extended grazing season;
- iv. Manure management;
- v. Other gains in nitrogen efficiency (incl. use of clover);
- vi. Use of nitrification inhibitors;
- vii. Minimum tillage techniques;
- viii. Use of cover crops;
- ix. Bio-fuel/bioenergy crops;
- x. Anaerobic digestion of pig slurry.

11.2.7 Mitigation Uptake

The uptake or not of mitigation measures at farm level is highly dependent on improved knowledge transfer. This report advocates the adoption of best available technology as the principal mitigation measure. Uptake of effective mitigation will depend upon an understanding at farm level of the following:

- What impact is preventable?
- What is the nature of the impact if not prevented?
- What actions are required?
- How is this different from previous practice?
- What is the cost?
- What is the benefit?
- What are the consequences of not doing it?

In practical terms, each farm will require a carefully designed suite of mitigation measures if negative impacts to the environment are to be prevented. In the majority of cases the principal mitigation measure will be:

- i. A continuation or improvement in good farm management practices.
- ii. The adoption of best technology which has the potential to: greatly reduce input for given quantity of output; further reduce inputs through an improved animal disease status and improved nutrient delivery systems.

Other relevant factors will be: the farming enterprise; the management system employed; the grazing pattern employed; the soil type; the permeability of the sub-soil and ground rock; the topography and drainage system; the presence of water courses and wells; and other factors individual to each farm. Regional factors such as rainfall, length of growing season and average mean temperature are also relevant. Table 11-1 below details a range of mitigation measures with an estimation of their potential to increase or decrease risks under each environmental characteristic.

While certain assumptions can be made about the broad pattern of agricultural changes that will occur to deliver Food Harvest 2020 it is more difficult to be certain as to how these changes will actually occur on a farm by farm (and hence regional) basis and therefore to provide specific mitigation which may address these issues. This introduces a degree of uncertainty which must be considered and allowed for as Food Harvest 2020 is implemented and its implementation is

monitored and reported on. As an example; many small mixed farm enterprises farm both livestock and grow tillage crops. If such farms shift towards a more exclusively livestock based (or dairy) system, there could be a resultant simplification / homogenisation of the agricultural landscape in these areas; a pattern which has already occurred in many parts of the Country. This in turn has already resulted in negative impacts on species groups such as lowland birds; e.g. the progressive eastern retraction in the range of yellowhammer to tillage areas in the south and east of Ireland is an example.

This clarifies the importance of an iterative and integrated Food Harvest 2020 monitoring and mitigation programme which includes both high level and specific measures acting as indicators of type, level and degree of impacts occurring under the plan, and from which more specific mitigation measures may arise.

Legislative

Implementation of Food Harvest 2020 will be undertaken in compliance with wider legislative and legal procedures (e.g. planning permission, EIA, Appropriate Assessment, IPPC licensing etc.). For example, Appropriate Assessment would be required for potentially significant impacts on Natura 2000 sites from agriculture; EIA would be necessary for any projects meeting the development thresholds in the EIA (Agriculture) Regulations. The application of legislative controls, particularly for water quality under the Water Framework Directive and Natura 2000 sites, mean that many potentially significant impacts can be mitigated at an early stage and alternatives and site based mitigation measures developed. At the farm level, it is recommended that regular monitoring of farm practices by the relevant statutory body be undertaken to ensure compliance with legal requirements and adopted codes and plans.

Monitoring to Inform an Iterative Mitigation Process

Monitoring of the environmental impacts from the implementation of Food Harvest 2020 will need guidance and steering of a cross body group. The

composition of this group may need to be widened to reflect relevant stakeholders from areas not specifically addressed in this Report (for example cultural heritage, population and human health) which would be tasked with the review of data collated under the chosen monitoring programmes and projects undertaken under the guidance and review of an expanded Agri-Research Expert Advisory Group (AREA). Where impacts are considered to be negative, or greater than those anticipated by this high-level assessment, the Group should recommend appropriate remedial action(s). Data is to be primarily collated from existing environmental monitoring programmes and projects, with emphasis on presenting results on an appropriate spatial scale. The Group may also advise on primary research required to address impacts from Food Harvest 2020.

Retention and Strengthening of Green Infrastructure Linkages

Extensive HNV farmland along the western seaboard and in the uplands serves as a reservoir of both biodiversity, flora and fauna and traditional management systems. This farming landscape integrates with extensive non-HNV farmland which although more intensified still may retain semi-natural features, through to areas of intensified agricultural land where semi-natural features are minimal. Food Harvest 2020 targets are likely to be met within the extensive non-HNV areas and intensive agricultural areas, and the retention and strengthening of green corridor linkages between HNV farmland and these areas, and within the areas themselves will be essential (James Moran, Sligo IT, pers comm).

Agri-environment Schemes

Regional variations exist in biodiversity, soils, and susceptibility to climate change. Dunford (2010)¹⁷⁴ indicates that agri-environment schemes to date are not flexible at the regional and local level, thereby returning less environmental benefits than anticipated, particularly for Natura 2000 sites. It is recommended that Food Harvest 2020 specific agri-environment options are developed in conjunction with anticipated CAP reforms of Pillar II, where there is an opportunity to target funding towards ecosystem services through the auspices

of the forthcoming Rural Development Programme 2014-2020.

The framework for CAP post 2013 recognises that High Nature Value farmland is imperative to the achievement of maintenance of biodiversity within the farm setting. Current AES do not provide specific targeted financial incentives for High Nature Value farmland, although this may be incorporated, to some extent, when CAP negotiations and funding format is finalised. Nor do current AES specifically integrate multi-functional models of agriculture, i.e. farming that produces environmental goods such as clean water, habitat for protected species as well as traditional goods such as livestock and grains. Tailoring of AES to recognise HNV farmland and incentivise its retention and management within a Food Harvest 2020 system is indicated (this may need to recognise the need for greater intensification of parts of farm landholdings). Readjustment of AES options for HNV farmland, and also for Natura 2000 network, could be based on the Burren system where management is “*not generalist and prescriptive, but rather is tailored to defined conservation outcomes and which has the flexibility to set management prescriptions*” on a farm by farm and preferably field by field basis (see Dunford, 2010, McGurn *et al.*, 2012¹⁷⁵). This system emphasises the role that farmers and other stakeholders should have in developing a whole-farm scheme that provides appropriate and readily implementable management practices, work schedules and conservation outcomes at the individual farm level, or at least at bio-geographical region level.

Upland Habitats

The potential release of small upland areas from grazing pressure has unquantifiable impacts on biodiversity as most studies to date have focused on overgrazing. The Commonage Framework Plan reviews also offer opportunities for revisiting stocking numbers and carrying capacity on uplands, and preliminary steps are being taken to examine these issues (James Moran, Sligo IT, pers comm). Primary research on upland areas which may be destocked under Food Harvest 2020 may be required, followed by preparation of an uplands

management plan specifically focused on these areas to maintain traditions of some grazing. Furthermore an impact assessment matrix may need to be established where the benefits of grazing in certain areas may be offset by potential impacts to other habitats (for example siltation and nutrient enrichment of 'High Status' waterbodies).

More detailed mitigation measures for uplands could focus on opportunities for funding targeted biodiversity measures under CAP II and the RDP 2014-2020.

Water Quality

Continued implementation of the Water Framework Directive will be the key mitigation factor for maintenance and improvement of water quality.

According to the EPA (2010) agricultural pollution was responsible for 39% of the 'moderate pollution' recorded by the EPA between 2007 and 2009. Pollution in the EPA 'moderate' category was attributed predominantly to diffuse sources including losses from farmyards, siltation from cattle poaching and bank erosion, Phosphorus loss from riparian areas and nitrogen loss from tillage land.

Recent Teagasc research (Buckley and Carney, 2013)¹⁷⁶ has indicated that increased efficiencies in use of Nitrogen and Phosphorus can be achieved at the farm gate for specialist dairy and tillage farms which can reduce the risk of diffuse nutrient losses from agricultural land.

Assessments must be supported by farm inspections and cross-compliance arrangements as per the EPA's recommendations in accordance with their environmental analysis of Food Harvest 2020. The monitoring should gather information on non-point sources of pollution through primary research in regions where a higher risk of impacts may be anticipated. For example by targeting areas such as the south west, where the highest proportion of 'High Status' rivers exist (i.e. a declining category in Irish Rivers) and where dairying is concentrated and where new pig / poultry enterprises may be located.

Catchment monitoring of non-point sources using customised monitoring techniques can inform catchment management policy by regulating agricultural activity in sensitive river basins following screening and the later implementation of monitoring protocols. The EPA have highlighted a number of current studies including important primary research being implemented by Kilkenny County Council; 'A Study of the Interaction between the on Farm Dairy Sector, Food Harvest 2020 Dairy Targets and Water Quality Objectives in County Kilkenny'. Two additional and more broadly based studies include, 'The Agricultural Catchments Programme' (refer to Section 11.3.2 of this Report for further details) and the EPA-funded 'Pathways Project', which were implemented to evaluate farm pressures and to inform later farm management practices.

Current Prioritised Research Programmes

The recent establishment of the Agri-Research Expert Advisory Group (AREA) in February 2011 came about in response to a recommendation in Food Harvest 2020 which stated that DAFF "*should establish structures to facilitate greater input and resources from the agriculture industry into the design and structure of primary research programmes*". The AREA Group's remit was to develop a Strategic Research Agenda for the Food Sector, establishing the design of research programmes which in turn reflects the key priorities contained within Food Harvest 2020. Subsequently, the Stimulating Sustainable Agricultural Production through Research and Innovation (SSAPRI)¹⁷⁷ was published with the aim of providing technical and scientific knowledge to underpin key growths under Food Harvest 2020. Under the Sustainability theme, SSAPRI encompasses bio-energy, water/soil, climate change and transboundary gas emissions and biodiversity.

In November 2012 DAFM announced a €32 million research package for the agri-food and forest industries. Research priorities in this package cover sustainable food production, bioscience research and development, with a focus on meat related research, part of an on-going investment in research.

There is considerable scope for the interaction of the Food Harvest 2020 monitoring and mitigation outcomes with the SSAPRI programme, and specifically under the Sustainability theme and also through the recent call for research projects under the 'Future Agri-food' theme for SFI Investigators Programme 2013. As the iterative Food Harvest 2020 monitoring processes identifies gaps in knowledge and understanding on the environmental impacts of Food Harvest 2020, it should be possible to bringing forward 'ranking research' projects under SSAPRI to address knowledge deficiencies.

Knowledge Transfer

The continued support of the role of Advisors (both Teagasc and private sector) in providing the industry with the knowledge and skills to deliver predicted sectoral changes in the context of adherence to appropriate environmental regulations is recognised by this report. This will include a strong system of feedback to farmers at the individual farm level on when and where (to allow for regional patterns of variation) measures are found to be successful or more particularly where measures fall short of adherence to required regulatory requirements, sectoral guidance, best practice etc.

Provision of best practice guidance will be essential to ensure farmers and others are in a position to implement Food Harvest 2020 targets effectively whilst also meeting their obligations under statutory regulations, agri-environmental schemes and cross compliance.

In this assessment the potential for negative impacts on water quality is strongly influenced by an assumption of strict adherence to obligations under statutory regulations, agri-environmental schemes and cross compliance. It is therefore clear that poor adherence to same could result in an increase in predicted level of impacts and a potential for a reversal in the water quality gains of recent years. The need for a clear programme of monitoring and feedback to farmers is strongly indicated.

Best Practice Guidance

Provision of best practice guidance will be essential to ensure farmers and others are in a position to implement Food Harvest 2020 targets effectively whilst also meeting their obligations under statutory regulations, agri-environmental schemes and cross compliance. It is recommended that the following best practice documents be delivered as part of Food Harvest 2020 environmental considerations:

- Measures to meet the Water Framework Directive under Food Harvest 2020 targets;
- Expanding agriculture under Food Harvest 2020 in ecologically sensitive areas;
- Expanding dairy farming under Food Harvest 2020;
- Farming High Nature Value farmland under Food Harvest 2020 targets;
- Farming uplands under Food Harvest 2020 targets;
- Monitoring the environmental aspects of achieving Food Harvest 2020 targets;
- Identifying mechanisms for monitoring non designated habitats and species of biodiversity importance (i.e. initially quantifying risk rather than directly maintaining status).

To this end it is also critical that areas of High Nature Value farmland in Ireland continue to be identified and mapped.

Furthermore, the forthcoming publication of the *Bird Atlas 2007-2013* offers a timely opportunity to re-assess the distribution and abundance of farmland birds in Ireland with respect to agricultural practices.

Table 11-1 Indicative potential impact of a number of abatement measures on environmental variables

	Biodiversity & Flora and Fauna	Water Quality (including drinking water)	Soil	Air Quality	Landscape & Buildings	Climate Change (including greenhouse gases)
EBI - improved genetics focusing on fertility and productivity	✓	✓	✓	✓	✓	✓
Liveweight Gain – to shorten time to finishing in beef cattle	✓	✓	✓	✓	✓	✓
Extended Grazing	✗	✗	✗	✓	✗	✓
Manure Management - improved techniques and equipment	✓	✓	✓	✓	✓	✓
Nitrification Inhibitors	✓	✓	✓	✓	✓	✓
Nitrogen Efficiency – use of clover, improved techniques	✓	✓	✓	✓	✓	✓
Minimum Tillage	✓	✓	✓	✓	✓	✓
Cover Crops	✓	✓	✓	✓	✓	✓
BioEnergy Crops	✗	✓	✓	✓	✗	✓
BioFuel Crops	✗	✓	✓	✓	✗	✓
Anaerobic Digestion of slurry	✗	✓	✓	✓	✓	✓
Regular monitoring of farm practices	✓	✓	✓	✓	✓	✓
Extend and refine agri-environmental schemes	✓	✓	✓	✓	✓	✓
Fund targeted biodiversity schemes	✓	✓	✓	✓	✓	✓
Continued implementation of Water Framework Directive	✓	✓	✓			
Area Wide Nutrient Management Plans for poor water quality areas	✓	✓	✓			
On-going monitoring of groundwater bodies	✓	✓	✓			
Use of low emission slurry application techniques	✓	✓	✓	✓	✓	
Use of out-wintering wood chip pads	✓	✗	✗	✓		✓
Use of nitrification inhibitors	✓	✓	✓	✓		✓
Carbon sequestration through forestry	✗	✗	✗	✓	✓	✓
Optimising forest productivity	✓	✓	✓	✓	✓	✓
Continued compliance with environmental legislation, national plans and policies	✓	✓				✓
Note: ✓ indicates reduced environmental risk; ✗ indicates potential for increased risk						

11.3 Monitoring

Monitoring of outcomes is crucial to the success of any plan or programme and this is particularly important in the case of many environmental characteristics. The EPA is responsible for monitoring and report annually on environmental characteristics. There is a perception however that greater monitoring would result in better outcomes particularly in relation to biodiversity, flora and fauna and water quality. This is so because these environmental characteristics may be impacted by pollutants from variant sources over variant time periods which may interact with each other and cause cumulative effects.

11.3.1 Water Quality

11.3.1.1 Agricultural Catchments Programme

Of particular relevance to the monitoring of water quality as it may be impacted by agricultural sources are the Agricultural Catchment Programmes being undertaken by Teagasc. Details of these programmes are outlined below.

The Agricultural Catchments Programme was initiated to provide a comprehensive scientific and socio-economic evaluation of the Good Agriculture Practice (GAP) regulations in Ireland. A catchment is an area of land that defines the

water supply influence on a river, lake or estuary and is the scale at which all EU member states must manage water bodies. Small catchments have, therefore, been selected based on criteria that include farming intensity, soil type, and minimal influences from rural populations and forestry. Catchments have also been chosen to include representations of tillage agriculture in Ireland and medium to high stocking densities on grassland enterprises.

As the use of Nitrogen and Phosphorus is a farm management and economic concern as well as a concern in the aquatic environment, four component programme tasks are being undertaken with original data collection and assessments. These are:

- **Socio Economic Factors:** An assessment of how management trends, habits and attitudes are affected by the GAP regulations and what the perceived implications are for farm incomes.
- **Source Factors:** An investigating how nutrients at the soil and farm scale are influenced in terms of supply/availability and potential mobilisation to water.
- **Pathway Factors:** Defining the main pathways for mobilised nutrients in each farming catchment.
- **Delivery Factors:** Identifying the load and concentration patterns of nutrients from the catchments, in each river.
- **Impact Factors:** Establishing the current ecological status of each catchment river network and the implications for water bodies downstream of the catchments.

11.3.1.2 Objectives of Programme

The objectives of the programme are to:

- Provide a scientific evaluation of the effectiveness of the National Action Programme measures.
- Underpin the basis for any modifications of the measures that might be required to achieve Nitrates Directive water quality objectives.
- Consider the scaling up of the results to larger catchments scales by model development or

adaptation and validation in conjunction with national and international expert groups.

- Provide information on attitudes and awareness of farmers to water pollution issues and the economic impact of changed agricultural practices arising from compliance with Nitrates Directive measures.
- Provide national focal points for technology transfer and education.
- Provide advisory support for participating farmers to underpin the profitability of their enterprises and facilitate the implementation of the National Action Programme measures.

11.3.1.3 Selection and Location of Agricultural Catchments

The selection of catchments was influenced by EU guidelines which suggest that monitoring efforts should be concentrated in “*areas of intensive crop and livestock production ...with elevated nitrate concentrations... adjacent to existing or projected eutrophication areas...with similar land use, soil type or agricultural practice*”. Using these guidelines a new Geographic Information System (GIS) based selection methodology was developed for the programme. National catchment data was used to generate a list of 1,300 catchments to select from. A range of data covering land use, livestock density, housing density, geology, soils, and nutrient loss risk was used in a Multi-Criteria Decision Analysis (MCDA) approach. Selection criteria were given weightings which reflected how they affected the suitability of the catchments for inclusion in the Programme.

11.3.1.4 Ranking the Catchments

The catchments were divided into two broad categories - grassland and tillage. For the criteria shown below the lower the score the higher the ranking for both types of catchment:

- Housing density
- Forestry area
- Area of peat
- Area of non-agricultural land use

For grassland dominated catchments the higher the stocking rate and percentage forage area the

higher the ranking while for tillage-dominated catchments a higher ranking was given for higher percentage of tillage area and lower stocking rates.

11.3.1.5 Risk of nutrient loss to water

Catchments were also ranked by risk of loss of nitrogen or phosphorus to water, based mainly on the drainage characteristics of the soil. Generally more poorly drained soils have a greater risk of phosphorus loss through overland flow or run-off which the more freely drained soils have a greater risk of nitrogen loss through leaching down through the soil.

11.3.1.6 Selected Catchments

Six catchments were selected using this methodology.

Two of these are catchments with a high proportion of tillage:

- A catchment with free-draining soils where the greatest risk is of nitrogen loss through leaching
- A catchment on heavier soils where phosphorus loss through surface run-off is more likely.

There are four grassland-dominated catchments

- One with a high nitrogen loss risk
- Three predominantly at risk of phosphorus loss with varying levels of nitrogen loss risk.

A site on pure limestone geology and dominated by groundwater pathways remains to be selected. The GIS methodology described above was designed for surface water dominated catchments and so doesn't suit limestone areas. Wide consultation with experts in the field and existing survey data is being used to help identify suitable sites. This selected site is likely to be west of the Shannon in the extensive karst area of Galway/Mayo and will require substantial on-site investigation to delineate its zone of groundwater contribution.

The catchments selected:

- Castledockerell, County Wexford
- Ballycanew, County Wexford

- Dunleer, County Louth
- Timoleague, County Cork

The locations of the Catchments are indicated at Figure 11-1.

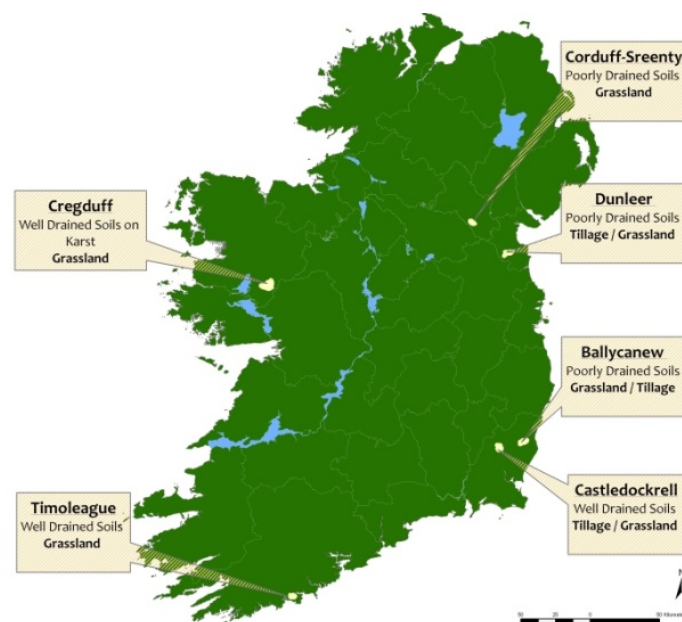


Figure 11-1 Agricultural Catchment Location Map (Teagasc)

11.3.1.7 Results of Catchment Programme

The first four year phase of the Agricultural Catchments Programme (ACP) was completed at the end of 2011. The principle objective of the programme was to evaluate the effectiveness of the package of measures implemented in Ireland's National Action Programme (NAP) under the Nitrates Directive. In particular the ACP was expected to provide an objective basis for derogation under the Nitrates Directive which permits farmers to exceed the 170kg per hectare limit for organic nitrogen from livestock manure and farm up to 250kg per hectare of organic nitrogen,

The results from phase one have been published in a series of peer reviewed scientific papers. The Agriculture Catchments Programme Phase 1 Report (Teagasc, June 2013)¹⁷⁸ contains a synopsis of these reports along with the findings of additional studies which have not yet been peer

reviewed. According to the report the first phase of the ACP has provided significant evidence to support the hypothesis that the package of measures introduced to implement Ireland's Action Programme under the Nitrates Directive is effective.

11.3.2 Biodiversity

As part of its commitments under various legislative instruments, Ireland already is in the process of generating and collating monitoring data on a number of ecological and environmental attributes. The programmes include monitoring under the WFD, status of EU protected habitats and species under Article 17 of the EU Habitats Directive and collation of information on uptake of agri-environment options. Additionally, voluntary, often medium-term, ecological data is being collated by organisations including BirdWatch Ireland, Irish Wildlife Trust and others on relevant attributes such as birds, amphibians and terrestrial invertebrates, some of which can assist Food Harvest 2020 monitoring objectives. Of primary potential use from the non-governmental sector is the Countryside Bird Survey run by BirdWatch Ireland since 1998 which monitors population trends of widespread and common birds. Other data is more limited in its coverage and applicability, but could be reviewed periodically to give general indications of micro ecological trends.

The key ecological factors which may be impacted by Food Harvest 2020 implementation are:

- Water dependent habitats and species;
- Natura 2000 habitats and species;
- HNV farmland;
- Farmland birds;
- Farmland invertebrates;
- Upland habitats and species;
- Other flora & fauna.

Therefore, chosen monitoring indicators should be related to the potential for establishing changes in the above factors. These are further summarised in Table 11-2.

The interaction between the indicators will provide valuable sources of information on the interaction between the often complex and hard

to discern and quantify ecosystem level. Habitat data such as that potentially gathered for HNV farmland can provide 'macro' level indicators of change in the farm environment (Heath and Rayment 2001)¹⁷⁹. It will be essential that indicators chosen are indicative of the state of ecosystem services and are easily used on a pan European basis. The challenge will be to design a monitoring system which will pick up negative changes at an early stage and allow them to be addressed / reversed.

Strategically, choosing indicators with cross compliance appeal will be a useful and valuable approach. For example, population of birds in farmland can measure the effectiveness of a range of REPS/AEOS measures which are aimed at enhancing and protecting biodiversity and generally also benefit bird populations through preserving habitats and food supplies: e.g. measures dealing with hedgerows, habitats, field margins, and biodiversity options such as nature corridors, species rich grassland, tree planting and environmental management of set-aside.

In order to progress the monitoring programme for Food Harvest 2020, it is suggested that a comprehensive and integrated Food Harvest 2020 Monitoring Scheme Programme be established with timescales, targets, and feedback indicators and review process clearly set out. The key organisations responsible for delivery of the monitoring programme should also be identified.

Such monitoring programmes may already exist and information may be readily available for key biodiversity indicators, for example under The Water Framework Directive. While the WFD provides an existing platform for the management of water quality that includes bio-diversity targets, gaps in its ability to identify biodiversity related impacts in agricultural catchment's should be highlighted, with a reformatted approach where feasible to provide higher resolution at chosen indicator sites.

By monitoring such changes in more intensive agricultural catchments where risks may be considered higher or where High Status species such as Freshwater Pearl Mussel exist, under the Food Harvest 2020 scenarios, information

pertinent to catchment level changes can be extracted and utilised to inform policy. As indicated by the EPA document, Ireland's Environment an Assessment (2012)¹⁸⁰ the number of high status catchments in Ireland has declined and *“targeted interventions are needed in catchments with high status sites to prevent further loss”*.

In conclusion, a Food Harvest 2020 Annual Implementation Report, drawing together the results of the chosen monitoring programmes for key biodiversity indicators in terrestrial and aquatic ecosystems, with specific recommendations should be compiled and reviewed. These recommendations should then be fed into the iterative monitoring process based on a staged review from data compiled over defined monitoring periods.

Table 11-2 Potential Food Harvest 2020 monitoring indicators for Biodiversity, Flora & Fauna, Surface Water, Groundwater and Climate Change

Indicator	Measurement	Source & level of baseline information	Indicator attributes	Links with other plans, targets & monitoring programmes	Significant gaps or deficiencies	Possible adjustments for FH2020 monitoring
Area under organic farming	Area (km ²) which is registered as organically farmed with DAFM	Data held by DAFM	<ul style="list-style-type: none"> Organic farming can be correlated with biodiversity gains¹ 	European Environment Agency (EEA) measure area under organic farming (CSI 026) as a biodiversity indicator	None	Spatial distribution within areas of where agriculture has or will intensify under FH2020
Area under agri-environment support	Area (km ²) which is designated as receiving agri-environment option monetary support under REPS and AEOS	Data held by DAFM	<ul style="list-style-type: none"> Can be taken as a measure of uptake of environmental options and as an indicator of some net positive gains for biodiversity in general 	EAA measure area under agri-environment schemes as a biodiversity indicator (SEBI 020)	<p>Data is generally comprehensive as required for financial reporting to EU</p> <p>More substantive data is needed on success or otherwise of existing agri-environment options</p>	Spatial links to proposed areas of farming intensification under FH2020 required; cross-reference with ecologically sensitive areas and HNV farmland to determine uptake of mitigating and spatially relevant agri-environment options
Natura 2000	Status of EU Annex habitats and species	<p>Status available from NPWS (2008). Update due in 2014</p> <p>Generally comprehensive monitoring and assessment, backed up by specialist surveys</p>	<ul style="list-style-type: none"> Favourable conservation status of Annex habitats and species Many of the species exist within farmland settings 	<p>EEA measure species of European interest (SEBI/CSI 007) as a biodiversity indicator based on good/bad/unfavourable status commonly used</p> <p>Required under Article 17 of the EU Habitats Directive</p>	Generally comprehensive monitoring is undertaken but over a long time period, which may not be suitable for FH2020 timeframe, i.e. for annual monitoring, but can give indication of trends	Summary of relevant monitoring results, trends and species/habitat specific research to be compiled annually to allow for assessment of impacts within areas where agricultural intensification is spatially proximal to ecologically sensitive habitats/species
Water quality	Q-index	Good range of baseline information from EPA	<ul style="list-style-type: none"> National coverage Indicator of aquatic invertebrate diversity 	WFD; RBMP's	Comprehensive but smaller watercourses not assessed	Spatial link of Q monitoring data to areas where intensification under FH2020 is anticipated; targeted Q survey in these areas;

¹ <http://www.eea.europa.eu/data-and-maps/indicators/area-under-organic-farming-1>

Indicator	Measurement	Source & level of baseline information	Indicator attributes	Links with other plans, targets & monitoring programmes	Significant gaps or deficiencies	Possible adjustments for FH2020 monitoring
						possibly expand scheme to include smaller farm-based watercourses not currently assessed within ecologically sensitive areas
Water quality	Study of the Interaction between the on Farm Dairy Sector, Food Harvest 2020 Dairy Targets and Water Quality Objectives in County Kilkenny'; Agricultural Catchments Programme & Pathways project	Macro studies on farm catchments	Scope of project to be confirmed when project report is available	WFD, RBMP, FH2020	Scope of project to be confirmed when project report is available	Scope of project and any extensions and adjustments to be confirmed when project report is available
Water quality	Measurement of N and P within selected catchments	Agricultural Catchments Programme – Teagasc – currently captures data in 6 catchments.	<ul style="list-style-type: none"> Provides direct data on N and P release from representative farm systems Records other farm setting data such as fertiliser use, feed, livestock import and export and farm products exported 	WFD, Nitrates Directive; RBMP	Currently 6 catchment areas analysed, four in the east, one in the south and one in the west; currently a 4 – year programme	Potentially requires new catchments to be included in monitoring within areas where N and P risk to water quality may increase under FH2020; timeframe of ACP would need to be expanded to cover FH2020 timeline
Farmland birds	Measure trends in species populations	<p>Baseline from BirdWatch Ireland Countryside Bird Survey, and Lowland Farmland Bird Survey; information available through NBDC</p> <p>Trends in farmland birds (23 chosen species) are specifically recorded as are woodland,</p>	<ul style="list-style-type: none"> High level indicators of habitat changes Can be used as an indicator of invertebrate diversity Occupy a broad range of ecosystems Results are easily converted to public knowledge Can be used as an indicator of 	<p>Lowland Farmland Bird Action Plan</p> <p>Other action plans for birds of specific habitats²</p> <p>2nd National Biodiversity Action Plan</p>	<p>Countryside Bird Survey relies primarily on volunteer recording; monitoring is not targeted specifically to agricultural land, but accounts for a high proportion of records</p> <p>Ten years of data needed</p>	Baseline data from Countryside Bird Survey Data can be used to analyse general trends in farmland bird populations; may need to be augmented by targeted surveys in areas where agricultural intensification under FH2020 occurs

² BirdWatch Ireland have produced a series of action plans for birds in different habitats, including Upland Birds, Woodland and Scrub Birds, Dune and Machair Birds, amongst others, which may be relevant to agriculture

Indicator	Measurement	Source & level of baseline information	Indicator attributes	Links with other plans, targets & monitoring programmes	Significant gaps or deficiencies	Possible adjustments for FH2020 monitoring
		park and garden birds	pollution	Possible measure of CAP II success European Environment Agency has adopted birds (part of CSI 009) as one of the indicators for biodiversity in the SEBI 2010.	to establish long term trends NBDC intend to publish first overview trend report in 2018	Standard transect method used in at least 19 countries across Europe and therefore can be easily expanded and remain comparable to European surveys
Farmland birds	Impact of climate change	Baseline from BirdWatch Ireland Countryside Bird Survey, and Lowland Farmland Bird Survey	<ul style="list-style-type: none"> High level indicators of climate change Results are easily converted to public knowledge 	EEA measure impact of climate change on bird populations (SEBI 011) based on 122 common and widespread bird species	As above	As above
Wetland birds	Measure trends in species populations of wintering waterbirds	Baseline from BirdWatch Ireland I-WeBs database	<ul style="list-style-type: none"> High-level indicators of water quality Proxy status indicator of wetland habitats Results are easily converted to public knowledge 	2nd National Biodiversity Action Plan European Environment Agency has adopted birds (part of CSI 009) as one of the indicators for biodiversity in the SEBI 2010.	I-WeBs relies on volunteer survey effort, is long running (2012 was the 19 th season for data collection)	Baseline data could be extracted for potentially sensitive catchments where agricultural intensification may occur, although other influences on water and habitats quality would be a factor
Upland habitats	Stocking rates and carrying capacity Grazing condition of habitats	Information contained within 4,500 CFPs covering approximately 440,000 ha, replaced in late 2012 by the review process - DAFM	<ul style="list-style-type: none"> Monitoring sensitive habitat Covers a large land area, but is regionally distinctive 	Reporting under Article 17 EU Habitats Directive 2 nd National Biodiversity Action Plan	Plans have been reviewed after a 10 year period and stocking rates have been revised. However, a proposed Implementation Plan has not yet been finalised (as of March 2013)	To be reviewed when Implementation Plan has been finalised by DAFM
Upland birds	Monitor populations	Baseline from BirdWatch Ireland Countryside Bird Survey, and from specialist research undertaken by NPWS, e.g. Hen Harrier, Merlin and Red Grouse etc.	<ul style="list-style-type: none"> Good indicator of condition of upland habitats Results are easily converted to public knowledge Results can be used as an indicator of agri-environment options Can be used as an indicator of invertebrate diversity 	Action Plan for Upland Birds in Ireland 2011-2020 BirdWatch Ireland Action Plan for Raised Bog Birds in Ireland Commonage Framework Plans WFD	Some but not all data is collected voluntarily and is not targeted for upland bird species nor for agricultural areas	Agreement on species to be monitored and monitoring implementation and frequency Spatial database needed from existing surveys-identification of regional 'hotspots' which can be

Indicator	Measurement	Source & level of baseline information	Indicator attributes	Links with other plans, targets & monitoring programmes	Significant gaps or deficiencies	Possible adjustments for FH2020 monitoring
				European Environment Agency has adopted birds (part of CSI 009) as one of the indicators for biodiversity in the SEBI 2010. EEA measure impact of climate change on bird populations (SEBI 011) based on 122 common and widespread bird species		targeted for protection and identification of areas where restoration may be possible; Monitoring required for a sub-sample of sites on a yearly basis Link to commonage framework plan monitoring and review process for correlation of stocking rates and densities on bird populations
High Nature Value farmland	Monitoring of extent and quality of HNV farmland features	Basic information exists at regional level held by different organisations, principally Teagasc, IT Sligo, DAFM, EFNCP Comprehensive baseline to be established	<ul style="list-style-type: none"> Recognises important ecological features outside of Natura 2000 network Establishes information on habitats within wider countryside Regional variation 	National Biodiversity Plan Action Target 5 EU 2020 Biodiversity Strategy Possible measure of CAP II/RDP Axis 2 post 2013	High resolution identification of HNV at farm and regional level is required	Certain HNV features could be targeted for monitoring, e.g. area of hedgerows on farms. This information may feed into any monitoring of agri-environment schemes within the wider reformed CAP and RDP 2014-2020
Freshwater Pearl Mussel	Conservation status of FPM	Monitoring of 27 FPM populations in 19 SAC's – NPWS	<ul style="list-style-type: none"> Highly threatened water-dependent species Sensitive to changes in water quality and sediment load Occurs within regions where intensification may occur under FH2020 	FPM Catchment Plans WFD; RBMPs	Monitoring data is regarded as sensitive by NPWS due to potential for interference with populations and is therefore not publically available Some data is available for this species outside of the protected SAC catchments but may not be sufficient for baseline monitoring	Data collected by NPWS could be made available to the Working Group for consideration of FH2020 implications and a summary of trends could be included in Annual Implementation report
Non Target Species	List of indicator species/groups which	Data held by numerous institutions (i.e. published and	<ul style="list-style-type: none"> Important terrestrial & water dependant species 	EU 2020 Biodiversity Strategy	Data often unconsolidated and omitted from plans &	Spatial distribution within areas of where agriculture

Indicator	Measurement	Source & level of baseline information	Indicator attributes	Links with other plans, targets & monitoring programmes	Significant gaps or deficiencies	Possible adjustments for FH2020 monitoring
	can be useful for establishing health of ecosystem services , e.g. butterflies, pollinating insects	unpublished grey literature, statutory and non-statutory reports)	<ul style="list-style-type: none"> • Important bio-indicators of isolated, macro or fragmented habitats • May also occur in larger habitat complexes but may not be subject to habitat regulations 	2 nd National Biodiversity Action Plan	targets but nonetheless such data is a critical part of broader biodiversity in the landscape	has or will intensify under FH2020, particularly for key indicator species that are particularly sensitive to change.
Environment (general)	State of the environment	State of the Environment reporting is compiled and published annually by EPA drawing on EPA research and monitoring and with reference to thematic assessments	<ul style="list-style-type: none"> • Natura 2000 network • Water quality • Climate change • Air Quality • Waste • Biodiversity • Socio-economic context 	Crosscutting with many relevant legislation, plans and programmes	Comprehensive high level summary	None
Quality Assurance	<p>Compliance with standards of the voluntary Bord Bia Beef and Lamb Quality Assurance Scheme Producer Standard Revision 01, November 2010;</p> <p>Bord Bia Egg Quality Assurance Standard: Producer / Rearer Revision 03, June 2009;</p> <p>Bord Bia Pigmeat Quality Assurance Scheme: Producer Revision 02 / January 2006</p>	Bord Bia inspections	<p>Environmental protection measures as set out in the relevant standards, including</p> <ul style="list-style-type: none"> • Compliance with GAEC • Measures to prevent pollution from organics and effluents • Protection of watercourses by fencing 	WFD, Nitrates Directive, GAEC	None, data is collected on all standards for each producer within an 18 month period for beef and lamb QA scheme	None

11.4 Notes and references

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Findings and Recommendations

Section 12:

Findings
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12 Findings and Recommendations

12.1 Findings

12.1.1 Introduction

The purpose of the report is to provide information to policy makers in relation to the environmental consequences (positive and negative) of the implementation of the primary production proposals contained in Food Harvest 2020. The report also seeks to comment on alternative scenarios by which the production and output targets could be achieved. Additionally, the report seeks to comment on regional variations where they might occur. Having chosen the enterprise mix and production targets as set out by Teagasc in its submission to the National Climate Policy Development Consultation *A Marginal Abatement Cost Curve for Irish Agriculture* as the main scenario to be assessed, alternative sectoral scenarios were developed for the primary agricultural sectors: dairy; beef; sheep; pigs and tillage. The study concentrated on the environmental characteristics of: biodiversity; flora and fauna; water quality (including drinking water); soil quality; air quality, landscape (including buildings); and climatic factors including greenhouse gas emissions.

12.1.2 Assessment Process

A desktop study review of the published literature was carried out to establish the baseline status for each environmental characteristic. The legislative, regulatory and target framework applicable to each characteristic was reviewed and noted. The key pressures or pathways by which specific elements of the environment might be impacted were then noted. As detailed in Section 2 of this report, a standardised mechanism for assessing the significance of any impact (positive or negative) was adopted. A detailed environmental impact assessment was undertaken by suitable qualified expert consultants under each environmental characteristic. Mitigation measures were suggested where appropriate and recommendations made. Table 12-1 summarises the pre-mitigation findings.

Table 12-1 Summary of Pre-Mitigation Findings

Environmental Characteristic	Pre-Mitigation Impact
Biodiversity & Flora/Fauna	Slight Negative
Water Quality (including drinking water)	Slight Negative
Soils	Neutral/Imperceptible
Air Quality	Slight Negative
Landscape and Buildings	Neutral/Imperceptible
Climatic Factors	Slight Negative

12.1.3 Biodiversity and Flora & Fauna

Ireland's rich and diverse flora and fauna (habitats and species in the wider landscape) and biodiversity (protected species and habitats) are protected by a wide range of European and Irish law. Extensive parts of the Country are designated as Natura 2000 where human activities are restricted in order to afford greater protection to biodiversity and flora and fauna. Many areas of rich biodiversity and flora and fauna are already under threat from human activity including agriculture. Key pressures e.g. potential eutrophication of waters; loss of habitat through more intensive farming practices; and changes in traditional land management practices all pose threats. While noting the increased pressure which might be caused by increased inputs to the environment generally, consideration was also given to the existing legislative, regulatory and best practice framework within which each sector must operate. Furthermore the advisory role of consultants and Teagasc, and the knowledge transfer opportunity through on-going farm schemes such as REPS and AEOS were noted. Noting the need for continuing vigilance, mitigation measures were suggested and recommendations made.

The overall impact for the proposals under Food Harvest 2020 before mitigation for biodiversity and flora and fauna were found to be slight negative.

In the case of biodiversity and flora and fauna these findings nationally are based on risks

associated with projected increases in inputs of organic and inorganic nitrogen and phosphorous fertilisers, along with strict adherence to existing legislation and codes of good farm practice. With careful implementation of appropriate mitigation and monitoring at an individual farm basis greater regional/localised impacts can be avoided and nutrient thresholds as recommended by the Nitrates Directive, Phosphorus Regulations and the Surface Water Regulations can be met. By adopting an iterative approach to expansion, monitoring and application of best practice potential impacts can be reduced below slight negative both nationally and regionally/locally.

12.1.3.1 Natura 2000

The Natura 2000 network dating from 1971 is a Europe wide designation of sites which have been selected for protection as they support habitats and/or species which are deemed to be of European importance under the Birds Directive and the Habitats Directive. Natura 2000 sites are governed by the Habitats Directive, which is transposed into Irish law under The European Communities (Birds and Natural Habitats) Regulations, 2011. The National Parks and Wildlife Service (NPWS) is responsible for designating sites. The NPWS set individual conservation objectives for each Natura 2000 site with SACs being designated to protect habitats, and SPAs being designated to protect birds. Currently there are 423 Natura 2000 sites in Ireland. Many of the sites are in upland regions or consist of blanket bogs, raised bogs, dune vegetation and wetlands, where generally, if farming is practiced it is on a less intensive scale. However, some are located in important agricultural areas such as limestone grasslands, water bodies in the South West where dairying is prevalent and river catchments throughout the Country.

12.1.3.2 Appropriate Assessment

Article 6(3) of the EU Habitats Directive dictates that any plan or programme which could have a significant effect on a Natura 2000 site should be subject to an Appropriate Assessment. A full screening of Food Harvest 2020, in so far as its effects can be measured at a national level, was carried out. The potential pressures on Natura 2000 sites were found to be: changes in grazing

regime; impact on water quality; nutrient loading of terrestrial habitats; change in land management; off-site impacts; and interaction of impacts from all Food Harvest 2020 sectors and cross cutting of impacts from other disciplines. The screening was carried out across the main agricultural activities of: ruminants; pigs and poultry; and tillage and field crops. The outcome of the screening process was that direct loss of Natura 2000 habitat is not being considered as a likely outcome of Food Harvest 2020. However, screening indicates potential for some adverse impacts, primarily through alteration in nutrient status. Significant adverse impacts would be those which cause delays or impede progress in reaching conservation objectives of a site. It was concluded, on a national basis and at a strategic level of assessment that the implications of Food Harvest 2020 for the Natura 2000 network appears to indicate generally non-significant impacts.

However, where intensification or land use pattern may impact an individual Natura 2000 site then individual assessments may be necessary.

12.1.4 Water Quality including Drinking Water

Ireland's rich bodies of surface waters together with the highly productive groundwater (which provide drinking water for much of the population) are protected by European and national legislation. Much of this legislation overlaps with that which addresses the protection of biodiversity and flora and fauna. Much of the surface water is designated Special Areas of Conservation while important groundwater sources are subject to groundwater protection orders.

Pressures identified included nutrient enrichment of surface waters, increased sedimentation, and hydrological changes. In the case of groundwater, contamination by nutrients sourced from agriculture fertiliser and point source contamination caused by run-offs and spillages were identified as pressures. For both categories the increased level of inputs together with a potential intensification of farming practices were noted as threats. Consideration was given to the legislative and best practice framework within

which each sector must operate. The overall impact for the proposals under Food Harvest 2020 before mitigation for surface water and groundwater were found to be slight negative.

This finding nationally is based on risks associated with projected increases in inputs of organic and inorganic nitrogen and phosphorous fertilisers along with strict adherence to existing legislation and codes of good farm practice. With careful implementation of appropriate mitigation and monitoring at an individual farm basis greater regional/localised impacts can be avoided and nutrient thresholds as recommended by the Nitrates Directive, Phosphorus Regulations and the Surface Water Regulations can be met. By adopting an iterative approach to expansion, monitoring and application of best practice potential impacts can be reduced below slight negative both nationally and regionally/locally.

12.1.5 Air Quality and Climate Change

Ireland's air quality is deemed one of the highest in Europe. Ireland's climate change commitments are both subject to European and national legislation along with commitments under the Kyoto protocol. The key pressures under both air quality and climate change were identified as increased livestock numbers, even though the livestock numbers forecast under Food Harvest 2020 are not as great as the historic livestock numbers pertaining in the 1990's. Attention was drawn to targets to reduce greenhouse gas emissions under international agreements and to the necessity for annual reporting by the EPA at national and European level. A substantial range of mitigation measures were proposed which would contribute towards Ireland meeting its greenhouse gas targets. The need for knowledge transfer and further research and education was particularly highlighted. The overall impact of the proposals under Food Harvest 2020 before mitigation for air quality and climate change was found to be slight negative.

In the case of Air Quality the finding of a slight negative impact was based on a projected increase of 7% in emissions of ammonia.

In the case of Climate Change the finding of a slight negative impact on climate change was based on a projected increase of 5.3% in emissions of CO₂eq.

It should be noted that in the case of air quality and climate change additional mitigation measures will be necessary to enable Ireland to meet its targets in these areas.

12.1.6 Soils and Landscape & Buildings

Ireland's rich national resource of soil and its landscape (noted as an environment in which to work and enjoy) are unique in that neither is covered by any existing EU Directive. Regulation however does exist through the Planning Acts and EPA regulation. The baseline state of Ireland's soils was found to be generally good with a large proportion of the soils being suitable for productive agricultural purposes. Ireland's landscape pattern while rich and varied is described as ever evolving. The current landscape pattern is of relatively recent origin having evolved from changed farming practices over the past two hundred years. Pressures for soils were identified as contamination, compaction and erosion. The main threat to landscape character was deemed to be the inclusion of large scale agricultural buildings. Mitigation measures were proposed, the need for legislative protection was advanced, and in common with other environmental characteristics, key emphasis was placed on education and knowledge transfer. The overall impact of the proposals under Food Harvest 2020 before mitigation for air quality and climate change were found to be neutral/imperceptible.

12.1.7 Sectoral Analysis

Through the sectoral analysis it has been identified that opportunities exist to expand production whilst delivering benefits to the environment. The environmental analysis of the sectoral scenarios indicates a strong preference for the scenario which delivers growth through increased use of technology and increased productivity. Substantial environmental gains can be achieved by improving the output performance on individual farms. It is noted that the output targets envisaged under the preferred scenario have already been achieved by the top 10% of

farmers in each sector. It is also noted that these output targets can also be achieved within national and EU emission limits and within best practice codes.

12.2 Recommendations

12.2.1 Principal Recommendation

The attainment of the twin objectives of a sustainable environment and achievement of the targets set out in Food Harvest 2020 are all the more likely considering the following:

- The stature and status of the original committee members who generated the Food Harvest 2020 Report;
- The on-going support and monitoring of Food Harvest 2020 by the HLIC;
- The annual reporting of progress through the publication of *Milestones for Success*;
- The recent establishment of the Agri-Research Expert Advisory Group;
- The current preparation of the Rural Development Programme 2014 – 2020.

Agricultural practices as they effect environmental quality and conservation have been receiving increasing attention at Irish and EU level. This is particularly important in the areas of biodiversity, flora and fauna, water quality and climate change. There is a growing concern among the public for environmental values. This has been accompanied by a growing understanding of the negative and positive environmental impacts of agricultural practices.

The current CAP reforms seek to address these issues by introducing a new “green” payment in Pillar 1 conditional on farmers following measures to improve the environment. Additionally climate change and environmental improvement are in the six priorities for the development of the Rural Development Programme 2014 to 2020.

Food Harvest 2020 seeks to increase food production while at the same time enhancing the environment. Teagasc, in its Sectoral Roadmap for Agriculture and the Environment (2011) has set targets and outlined its programme in terms of research and knowledge transfer for nutrient

efficiency, water quality, gaseous emissions, soil and biodiversity.

Reaching national and international targets will require significant innovations and improved practices at farm level. This report has identified a knowledge deficit which exists both at the professional advisor level and at individual farmer level. This may create a “win-win” situation whereby the objectives of Food Harvest 2020 of increased food production and environmental sustainability can be met. This would suggest a high rate of return on investment in the areas of knowledge transfer and advice can be achieved.

Elsewhere in this report it has been noted that the top 10% of Irish farmers have achieved output levels, through the adoption of best available technology, which are superior to the output levels analysed in the main scenario. Many of these best technologies were developed and piloted by Teagasc. Despite the fact that up to two-thirds of the available pool of Approved Farm Advisors are in the private sector there are no direct linkages between these advisors and the Teagasc Research Service. In addition, Teagasc researchers are currently developing mitigation measures which will require to be rolled out on a farm-by-farm basis if Ireland is to achieve its targets in conservation, water quality, air quality and climate change.

The transmission of best technology and new mitigation measures can best be achieved if formal structures are put in place for the continuous up skilling of all advisors by the Teagasc Research Service. This would also deliver best value to the taxpayer who ultimately funds the research.

The Principal findings and recommendations of the report are:

- Environmental impact pre-mitigation will be slightly negative in some cases;
- Appropriate mitigation measures exist or are being developed which if implemented could reverse the negative impact in most cases to a neutral impact and lead to an environmental gains in other cases.

- Adoption of the best technology at farm production level will yield the best environmental results.
- There is a need and opportunity for increased uptake of best technology and targeted mitigation measured through

up skilling the environmental knowledge base of advisors and knowledge transfer to farmers.

Figure 12-1 below summarises the principal findings and recommendations of this report.

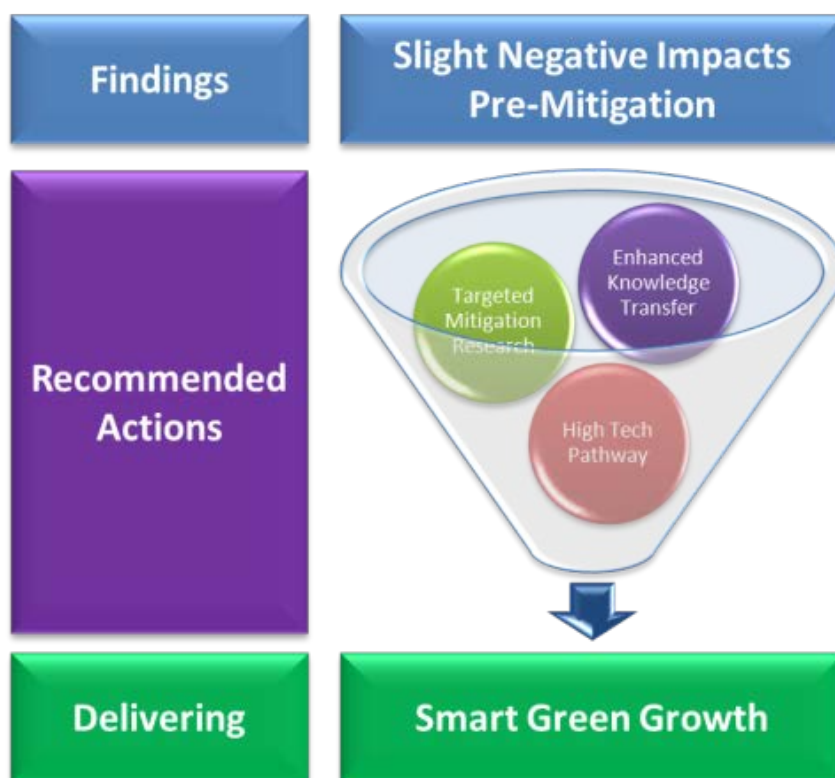


Figure 12-1 Summary of Report Findings

The following actions are recommended:

- Bespoke environmental knowledge Continuing Professional Development (CPD) courses to be developed and delivered by Teagasc/universities for professional agricultural advisors and consultants. There are approximately 570 Approved Farm Advisors whose advisory experience could now be channelled to achieving uptake of high technology production coupled with best environmental practice at farm level.
- To achieve best value for money and maximum on-farm uptake create a formal structure to ensure that the output of the Teagasc Research Service is made available on an equal basis to both private and public sector advisors.
- Future agri-environmental programmes should be designed to achieve the delivery of targeted environmental advice and best outcomes at individual farm level.
- Devise and implement a best environmental practice certification scheme which could be modelled and linked to the Origin Green Scheme. This scheme could act as a “one-stop-shop” for all on farm inspections and certification. It would include all environmental areas such as traceability, animal welfare, food miles, carbon footprint etc.
- Develop an integrated and iterative monitoring programme for key indicators impacting biodiversity and water quality.
- Recognise the role and responsibility of all players in the agri-food industry

including: farmers; processors; exporters; retailers and regulators.

Knowledge transfer and targeted advice to farmers has been identified across all environmental characteristics as the principal recommendation of this Report.

12.2.2 Funding

With agriculture, environment and climate change as priorities within the Rural Development Programme 2014 -2020 there is the potential for funding of knowledge transfer. In general, measures under the RDP may require co-funding by member states by 47%. For operations contributing to the objectives of the environment and climate change mitigation and adaptation the level of national co-financing is reduced to 25%. In addition, monies transferred from a member state's Pillar 1 allocation to Pillar 2 require no national co-financing.

12.2.3 Other recommendations

Other recommendations include:

- Promote improved environmental outcomes through a strict adherence and enforcement of the existing regulatory, legislative and best practice codes.
- Prioritise improvements in farm practice to be facilitated through knowledge and technology transfer by the Teagasc Advisory Service and private sector consultants.
- Implement improvements in monitoring and reporting under each environmental characteristic.
- Support EPA in on-going initiatives to develop a new management structure for waters under the Water Framework Directive. In particular examine an increased role for DAFM in relation to the Nitrates Directive and Phosphorus Regulations. Continue and extend on farm schemes such as farmer discussion groups, quality assurance, carbon monitoring and animal welfare.
- Prioritise further research and knowledge transfer in relation to workable on farm mitigation proposals in particular through

the Agri-Research Expert Advisory Group's Stimulating Sustainable Agricultural Production through Research and Innovation (SSAPRI) programme.

- Examine options for funding on farm mitigation measures through the Rural Development Programme 2014-2020.
- Encourage increases in farmer awareness on environmental issues through continuation of initiatives such as The Farmers Journal/Teagasc/ Bord Bia Sustainable Beef competition, The Carbon Navigator Initiative and greenhouse gas measurements.
- Establish Environmental Best Practice guidelines for farmers.

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Appendix I – Public Submissions Received

As part of the analysis the DAFM facilitated a stakeholder consultation process by seeking written submissions from interested parties. Advertisements were placed in national newspapers on 16th May 2012 and 35 submissions, as listed below, were received prior to the extended closing date of 6th July 2012.

An Taisce
Cavan County Council
Coast Watch
Cork Environmental Forum
Dr Elizabeth Cullen
Environmental Protection Agency
Environmental Research Institute
EOS Sustainable Systems
FEASTA
Friends of the Environment
IBEC - The Irish Dairy Industries Association/Meat Industry Ireland/Food and Drink Industry Ireland
Irish Cattle & Sheep Farmers' Association (ICSA)
Irish Climate Justice Group
Irish Creamery Milk Suppliers Association (ICMSA)
Irish Farmers Association
Irish Organic Farmers and Growers Association (IOFGA)
Mr Andrew Doyle TD
Mr David Mullins/Plandala
Mr Eric Conroy
Mr John Heney
Mr Richard Auler
Mr Stiofan Schmeitz
North West Group
Organic Trust Ltd
RPS (rx3)
Save Bantry Bay
SWAN (Sustainable Water Network)
The FIG
The Green Party
The Sustainability Institute
Tokn Grain
Veterinary Ireland
Environmental Pillar
Bird Watch Ireland
Mr Fergus Robson

DAFM facilitated a further stakeholder consultation on the draft final report by seeking written submissions from interested parties. Advertisements were placed in national newspapers on 16th September 2013 and 25 submissions, as listed below, were received prior to the extended closing date of 11th November 2013.

Agricultural Consultants Association (ACA)
An Taisce
BirdWatch Ireland
Coastwatch
Cork Environmental Forum
Cork Food Policy Council
Health Service Executive Consultant in Public Health Medicine Environment and Health Group
Health Service Executive Department of Public Health
Health Service Executive National Drinking Water Group
Inland Fisheries Ireland
Irish Cattle & Sheep Farmers' Association (ICSA)
Irish Creamery Milk Suppliers Association (ICMSA)
Irish Farm Association (IFA)
Irish Water
Irish Wildlife Trust
Limerick Institute of Technology
Midland Regional Authority
Mr John Heney
Mr Richard Auler
Piper Systems Limited
Sustainable Water Network (SWAN)
The Environmental Pillar
The FIG
The Heritage Council of Ireland
Westmeath County Council

Appendix II – FAPRI Ireland Data

Description	Units	1990	2000	2010	2015	2020
Housing (storage) Period						
Total Cattle	000 head	5,969.1	6,557.7	6,231.7	5,574.2	5,843.9
Dairy Cows	000 head	1,341.6	1,173.8	1,022.4	1,031.6	1,293.3
All Other Cattle	000 head	4,627.5	5,383.9	5,209.3	4,542.6	4,550.5
Other Cows	000 head	659.2	1,166.8	1,134.9	1,086.1	1,032.6
Dairy Heifers	000 head	172.3	210.4	195.2	233.5	271.2
Other Heifers	000 head	100.0	125.2	153.7	144.6	143.4
Cattle < 1 yrs	000 head	1,436.2	1,648.9	1,794.0	1,543.1	1,553.6
Cattle < 1 yrs – male	000 head	775.3	892.2	857.9	807.0	812.6
Cattle < 1 yrs –female	000 head	660.9	756.7	936.1	736.1	741.1
Cattle 1 - 2 yrs	000 head	1,311.7	1,446.4	1,447.8	1,149.8	1,157.6
Cattle 1 - 2 yrs – male	000 head	813.8	904.8	803.7	694.4	699.2
Cattle 1 - 2 yrs - female	000 head	497.9	541.6	644.1	455.4	458.5
Cattle > 2 yrs	000 head	922.6	738.7	434.9	338.4	340.7
Cattle > 2 yrs – male	000 head	638.7	491.1	275.3	216.0	217.5
Cattle > 2 yrs - female	000 head	283.9	247.6	159.6	122.4	123.2
Bulls	000 head	25.5	47.5	48.8	47.2	51.3
Total Sheep	000 head	8,021.0	7,957.3	4,127.3	5,104.8	5,076.7
Ewes Lowland	000 head	2,396.6	2,814.3	1,782.9	2,035.3	2,070.3
Ewes Upland	000 head	1,960.9	1,206.1	445.7	505.0	515.8
Rams	000 head	116.9	110.7	66.9	76.2	77.6
Other Sheep > 1 yr	000 head	298.4	204.7	98.4	122.5	129.7
Lambs	000 head	3,248.3	3,621.6	1,733.5	2,365.8	2,283.2
Total Pigs	000 head	1,212.1	1,718.7	1,500.4	1,730.5	2,114.5
Gilts in Pig	000 head	21.1	21.3	19.3	20.5	20.5
Gilts not yet Served	000 head	12.1	17.9	14.7	17.6	17.7
Sows in Pig	000 head	83.5	109.7	91.9	91.2	91.4
Other Sows for Breeding	000 head	21.0	23.9	28.8	28.9	28.9
Boars	000 head	6.3	4.0	1.6	1.8	1.9
Pigs 20 Kg +	000 head	749.2	1,037.9	953.4	1,062.6	1,340.2
Pigs Under 20 Kg	000 head	319.0	504.2	399.7	435.5	534.4
Total Poultry	000 head	11,412.8	15,320.5	16,248.2	15,322.3	17,158.1
Layer	000 head	1,868.3	1,572.0	1,995.0	1,881.2	2,106.7
Broiler	000 head	8,035.1	12,426.1	13,840.0	13,051.5	14,615.1
Turkey	000 head	1,509.5	1,322.4	413.2	389.6	436.3
Horses	000 head	61.6	69.9	98.1	98.1	98.1
Mules	000 head	8.3	5.0	8.8	8.8	8.8
Goats	000 head	17.4	8.1	10.1	10.1	10.1
Fertiliser	kg of N	379,311	407,598	362,395	345,104	359,786

Source: CSO and FAPRI Ireland Model (2012) (Reproduced from Appendix A to *A Marginal Abatement Cost Curve for Irish Agriculture*; Teagasc April 2012)

Description	Units	1990	2000	2010	2015	2020
Pasture Period						
Total Cattle	000 head	6,816.1	7,037.5	6,606.6	6,281.6	6,585.7
Dairy Cows	000 head	1,359.7	1,177.5	1,092.5	1,037.7	1,316.0
All Other Cattle	000 head	5,456.4	5,860.0	5,514.1	5,243.9	5,269.8
Other Cows	000 head	731.3	1,187.0	1,136.7	1,116.7	1,061.8
Dairy Heifers	000 head	158.6	206.5	233.7	245.8	285.5
Other Heifers	000 head	68.6	125.1	163.2	164.5	163.1
Cattle < 1 yrs	000 head	1,716.1	1,751.9	1,761.3	1,676.1	1,693.7
Cattle < 1 yrs - male	000 head	903.2	919.4	826.7	816.3	824.9
Cattle < 1 yrs -female	000 head	812.9	832.5	934.6	859.6	868.8
Cattle 1 - 2 yrs	000 head	1,663.1	1,517.1	1,407.5	1,302.4	1,316.0
Cattle 1 - 2 yrs - male	000 head	985.8	912.4	760.3	725.4	733.0
Cattle 1 - 2 yrs - female	000 head	677.3	604.7	647.2	576.9	583.0
Cattle > 2 yrs	000 head	1,092.6	1,016.3	759.8	678.1	685.2
Cattle > 2 yrs - male	000 head	826.4	721.6	506.2	485.1	490.1
Cattle > 2 yrs - female	000 head	266.2	294.7	253.6	193.0	195.0
Bulls	000 head	26.1	56.1	52.0	60.7	64.6
Total Sheep	000 head	8,021.0	7,957.4	4,694.62	5,104.8	5,076.7
Ewes Lowland	000 head	2,396.6	2,814.3	1,782.9	2,035.3	2,070.3
Ewes Upland	000 head	1,960.9	1,206.1	445.7	505.0	515.8
Rams	000 head	116.9	110.7	66.9	76.2	77.6
Other Sheep > 1 yr	000 head	298.4	204.7	98.4	122.5	129.7
Lambs	000 head	3,248.3	3,621.6	1,733.5	2,365.8	2,283.2
Total Pigs	000 head	1,212.1	1,718.7	1,500.4	1,730.5	2,114.53
Gilts in Pig	000 head	21.1	21.3	19.3	20.5	20.5
Gilts not yet Served	000 head	12.1	17.9	14.7	17.6	17.7
Sows in Pig	000 head	83.5	109.7	91.9	91.2	91.4
Other Sows for Breeding	000 head	21.0	23.9	28.8	28.9	28.9
Boars	000 head	6.3	4.0	1.6	1.8	1.9
Pigs 20 Kg +	000 head	749.2	1,037.9	953.4	1,062.6	1,340.2
Pigs Under 20 Kg	000 head	319.0	504.2	399.7	435.5	534.4
Total Poultry	000 head	11,412.8	15,320.5	16,248.2	15,322.4	17,158.1
Layer	000 head	1,868.3	1,572.0	1,995.0	1,881.3	2,106.7
Broiler	000 head	8,035.1	12,426.1	13,840.0	13,051.5	14,615.1
Turkey	000 head	1,509.5	1,322.4	413.2	389.6	436.3
Horses	000 head	61.6	69.9	98.1	98.1	98.1
Mules	000 head	8.3	5.0	8.8	8.8	8.8
Goats	000 head	14.4	8.1	10.1	10.1	10.1
Fertiliser	kg of N	379,311	407,598	362,395	345,104	359,786

Source: CSO and FAPRI Ireland Model (2012) (Reproduced from Appendix A to *A Marginal Abatement Cost Curve for Irish Agriculture*; Teagasc April 2012)

Description	Units	1990	2000	2010	2015	2020
Crops						
Pulses	tonnes	15,000	7,700	18,600	18,600	18,600
Potatoes	tonnes	605,000	454,800	420,000	334,651	313,829
Sugar beet	tonnes	1,480,000	1,829,000	-	-	-
Barley	tonnes	1,223,000	1,309,900	1,223,000	1,183,270	1,067,009
Oats	tonnes	144,000	126,600	148,000	161,404	153,697
Wheat	tonnes	598,000	737,400	669,000	824,051	840,433
Pasture	ha	2,277,809	2,218,100	2,092,400	2,093,145	2,115,679
Hay	ha	420,397	242,600	222,596	222,327	222,759
Silage	ha	815,724	1,074,700	1,014,049	1,012,823	1,014,791
Rough Grazing	ha	626,454	506,500	441,200	441,200	441,200

Source: CSO and FAPRI Ireland Model (2012) (Reproduced from Appendix A to *A Marginal Abatement Cost Curve for Irish Agriculture*; Teagasc April 2012)

Output, Input and Income in Agriculture in a non FH2020 Scenario

	2009 2007/09	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	vs.
	2020												
Livestock	2,254	2,277	2,653	2,609	2,652	2,708	2,728	2,721	2,731	2,756	2,781	2,801	17%
of which: <i>cattle</i>	1,468	1,498	1,795	1,745	1,767	1,820	1,837	1,835	1,843	1,861	1,877	1,890	22%
<i>pigs</i>	307	335	362	361	360	360	361	359	359	364	368	370	19%
<i>sheep and lambs</i>	158	164	210	223	242	246	249	247	246	247	249	251	47%
Livestock Products	1,142	1,583	1,849	1,694	1,797	1,769	1,830	1,901	1,963	2,013	2,046	2,075	38%
of which: <i>milk</i>	1,100	1,537	1,802	1,647	1,750	1,722	1,783	1,854	1,916	1,966	1,999	2,028	39%
Crops	1,372	1,449	1,588	1,486	1,504	1,524	1,531	1,544	1,558	1,570	1,584	1,596	3%
Total Cereals	107	194	229	197	203	200	190	188	188	187	186	184	1%
Root Crops	82	111	80	81	82	82	83	85	86	87	88	89	1%
Forage Plants-Output	852	824	958	886	896	916	931	942	952	962	972	982	6%
Goods output producer prices	4,768	5,309	6,091	5,789	5,953	6,001	6,089	6,166	6,251	6,339	6,411	6,473	19%
Contract Work	269	268	259	260	265	271	277	283	289	295	301	307	10%
Subsidies less taxes on products	15	16	19	19	3	-15	-15	-15	-15	-15	-15	-15	0.0%
Ag. Output basic prices	5,051	5,593	6,369	6,068	6,221	6,257	6,351	6,435	6,526	6,620	6,697	6,765	18%
Intermediate consumption	4,103	4,098	4,454	4,200	4,287	4,362	4,432	4,494	4,561	4,624	4,677	4,725	12%
Feeding stuffs	1,079	1,062	1,190	1,145	1,160	1,172	1,172	1,181	1,195	1,207	1,214	1,218	10%
Fertilisers	416	451	565	458	463	468	491	499	510	520	526	529	24%
Energy & Lubricants	303	345	391	393	424	440	449	454	459	464	469	473	47%
Forage Plants-Input	844	812	947	874	884	905	920	931	941	951	961	972	6%
Contract Work-Input	269	268	259	260	265	271	277	283	289	295	301	307	10%
Gross value added basic prices	952	1,495	1,915	1,868	1,934	1,895	1,920	1,940	1,964	1,996	2,020	2,041	37%
Fixed capital consumption	756	749	703	687	681	683	689	698	708	720	732	745	0%
Net value added basic prices	196	746	1,212	1,182	1,253	1,212	1,231	1,242	1,256	1,276	1,288	1,296	73%
Subsidies less taxes on production	1842	1684	1850	1717	1692	1692	1692	1692	1692	1692	1692	1692	
Factor income	2,038	2,430	3,062	2,899	2,945	2,904	2,923	2,934	2,948	2,968	2,980	2,988	14%
Compensation of employees	428	420	412	410	418	425	433	440	447	453	460	467	7%
Operating surplus	1,610	2,010	2,650	2,488	2,527	2,478	2,490	2,494	2,501	2,515	2,520	2,521	16%

Source: FAPRI-Ireland Model (2011).

Historical data, CSO Output, Input and Income in Agriculture.

Reproduced from *Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets* (Donnellan & Hanrahan) Teagasc 2012. Please refer to Section 6 of *Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets* (Donnellan & Hanrahan) for a discussion of the caveats related to the above projections.

Activity Levels for Irish Agriculture (Cattle and Sheep) in a non FH2020 Scenario

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Cattle	6677.32	6588.91	6452.35	6397.94	6423.41	6465.98	6547.85	6622.40	6657.58	6649.78
Dairy Cows	1038.35	1043.21	1038.62	1036.54	1071.67	1144.45	1205.70	1252.94	1288.90	1315.70
Other Cows	1080.53	1079.29	1087.32	1096.18	1109.42	1120.66	1116.92	1096.62	1065.31	1027.26
Cattle < 1 yrs - male	917.30	888.50	847.78	827.12	816.33	800.96	804.96	816.43	824.05	824.88
Cattle 1 - 2 yrs - male	815.15	789.55	753.37	735.01	725.42	711.76	715.32	725.52	732.28	733.02
Cattle > 2 yrs - male	545.05	527.94	503.74	491.47	485.06	475.92	478.30	485.12	489.64	490.14
Cattle < 1 yrs - female	966.11	935.78	892.89	871.13	859.77	843.58	847.79	859.88	867.90	868.78
Cattle 1 - 2 yrs - female	647.19	647.19	647.19	647.19	647.19	647.19	647.19	647.19	647.19	647.19
Cattle > 2 yrs - female	253.60	253.60	253.60	253.60	253.60	253.60	253.60	253.60	253.60	253.60
Bulls	49.46	50.75	52.02	53.27	54.46	55.57	56.59	57.38	57.86	58.00
Dairy Heifers	209.29	217.61	221.00	232.03	245.69	256.75	265.23	271.62	276.33	279.61
Other Heifers	155.29	155.49	154.84	154.41	154.81	155.55	156.27	156.11	154.51	151.59
Total Sheep	4326.24	4611.72	4835.93	4804.82	4782.05	4808.56	4829.01	4844.10	4862.68	4876.64
Ewes Lowland	1920.48	2023.61	2071.87	2046.21	2040.36	2049.27	2055.06	2059.87	2066.52	2067.91
Ewes Upland	480.12	491.87	499.97	505.69	506.49	509.18	511.25	513.00	514.87	515.82
Rams lowland	56.84	60.66	62.16	61.39	61.21	61.48	61.65	61.80	62.00	62.04
Rams Upland	14.21	14.74	15.00	15.17	15.19	15.28	15.34	15.39	15.45	15.47
Other Sheep>1 lowland	101.86	110.84	120.17	118.48	117.22	117.80	118.24	118.47	118.80	119.24
Other Sheep>1 upland	25.47	26.91	28.43	29.16	29.09	29.26	29.40	29.49	29.60	29.71
Lambs lowland	1375.71	1488.47	1605.62	1595.26	1580.81	1588.98	1595.25	1598.75	1603.42	1609.36
Lambs upland	351.55	394.62	432.72	433.45	431.68	437.32	442.82	447.33	452.04	457.11

Source: FAPRI-Ireland (2011)

Reproduced from *Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets* (Donnellan & Hanrahan) Teagasc 2012. Please refer to Section 6 of *Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets* (Donnellan & Hanrahan) for a discussion of the caveats related to the above projections.

Activity Levels for Irish Agriculture (Pigs, Poultry and Fertiliser) in a non FH2020 Scenario

		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Pigs	000 Head	1,501.33	1,514.43	1,557.13	1,622.87	1,694.29	1,767.51	1,842.15	1,918.18	1,995.78	2,074.76
Gilts in Pig	000 Head	19.98	20.23	20.37	20.45	20.49	20.51	20.52	20.53	20.53	20.52
Gilts not yet Served	000 Head	17.21	17.43	17.55	17.62	17.65	17.67	17.68	17.68	17.68	17.68
Sows in Pig	000 Head	88.97	90.09	90.72	91.05	91.24	91.33	91.38	91.40	91.40	91.38
Other Sows for Breeding	000 Head	28.15	28.50	28.70	28.81	28.87	28.90	28.91	28.92	28.92	28.91
Boars	000 Head	1.80	1.82	1.84	1.84	1.85	1.85	1.85	1.85	1.85	1.85
Pigs 20 Kg +	000 Head	950.94	958.63	989.01	1,036.90	1,089.23	1,143.06	1,198.02	1,254.04	1,311.26	1,369.53
Pigs Under 20 Kg	000 Head	394.29	397.73	408.94	426.21	444.96	464.19	483.80	503.76	524.14	544.88
Total Poultry	Places	15,742.24	15,374.19	15,176.80	15,164.41	15,322.43	15,541.03	15,813.49	16,148.51	16,539.43	17,158.09
Layer	Places	1,932.88	1,887.69	1,863.45	1,861.93	1,881.33	1,908.17	1,941.63	1,982.76	2,030.76	2,106.72
Broiler	Places	13,409.05	13,095.55	12,927.42	12,916.86	13,051.46	13,237.66	13,469.74	13,755.11	14,088.09	14,615.05
Turkey	Places	400.31	390.95	385.93	385.61	389.63	395.19	402.12	410.64	420.58	436.31
Horses	000 Head	98.10	98.10	98.10	98.10	98.10	98.10	98.10	98.10	98.10	98.10
Mules	000 Head	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80	8.80
Goats	000 Head	10.10	10.10	10.10	10.10	10.10	10.10	10.10	10.10	10.10	10.10
Fertiliser(kgs N)	000 kg	358,694.24	342,953.87	337,265.46	331,458.33	345,104.20	348,830.30	354,876.49	359,842.99	361,128.01	359,786.46

Source: FAPRI-Ireland (2011)

Reproduced from *Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets* (Donnellan & Hanrahan) Teagasc 2012. Please refer to Section 6 of *Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets* (Donnellan & Hanrahan) for a discussion of the caveats related to the above projections.

Activity Levels for Irish Agriculture (Crops) in a non FH2020 Scenario

		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Pulses Production	tonnes	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600	18,600
Potatoes Production	tonnes	373,978	360,835	350,285	339,866	334,576	330,550	326,772	322,790	318,411	313,621
Sugarbeet Production	tonnes	0	0	0	0	0	0	0	0	0	0
Barley Production	tonnes	1,256,958	1,245,130	1,223,431	1,208,372	1,188,809	1,163,535	1,143,889	1,125,619	1,107,463	1,091,066
Oats Production	tonnes	165,161	165,611	162,959	162,826	162,159	160,721	159,816	158,990	158,045	157,163
Wheat Production	tonnes	813,928	794,388	803,078	816,464	827,909	833,555	842,232	850,200	855,442	859,381
Pasture	hectares	2,073,751	2,080,030	2,084,252	2,087,156	2,091,262	2,096,030	2,099,990	2,103,261	2,106,379	2,109,530
Hay	hectares	222,609	222,109	222,187	222,366	222,277	222,170	222,176	222,255	222,333	222,360
Silage	hectares	1,014,109	1,011,832	1,012,186	1,013,002	1,012,597	1,012,110	1,012,134	1,012,495	1,012,851	1,012,974
Rough Grazing	hectares	441,200	441,200	441,200	441,200	441,200	441,200	441,200	441,200	441,200	441,200
Wheat Area	000 ha	95.28	97.79	98.57	99.53	100.47	100.93	101.24	101.42	101.35	101.10
Spring Wheat Area	000 ha	21.89	22.47	22.65	22.87	23.08	23.19	23.26	23.30	23.28	23.23
Winter Wheat Area	000 ha	73.39	75.32	75.92	76.66	77.38	77.74	77.98	78.12	78.07	77.88
Barley Area	000 ha	179.83	176.99	174.14	171.18	168.04	164.49	160.98	157.63	154.44	151.47
Spring Barley Area	000 ha	160.29	157.76	155.22	152.58	149.78	146.62	143.49	140.50	137.66	135.01
Winter Barley Area	000 ha	19.54	19.23	18.92	18.60	18.26	17.87	17.49	17.13	16.78	16.46
Oats Area	000 ha	20.99	20.68	20.34	20.08	19.83	19.55	19.28	19.02	18.76	18.51
Spring Oats Area	000 ha	4.23	4.17	4.10	4.05	4.00	3.94	3.89	3.84	3.78	3.73
Winter Oats Area	000 ha	16.76	16.51	16.24	16.03	15.83	15.61	15.39	15.18	14.97	14.78
Potatoes Area	000 ha	10.79	10.42	10.15	9.90	9.64	9.42	9.22	9.03	8.83	8.63
Sugar Beet Area	000 ha	0	0	0	0	0	0	0	0	0	0
Fodder Beet Area	000 ha	0	0	0	0	0	0	0	0	0	0
Turnips Area	000 ha	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Silage Area	000 ha	1014.11	1011.83	1012.19	1013.00	1012.60	1012.11	1012.13	1012.50	1012.85	1012.97
Hay Area	000 ha	222.61	222.11	222.19	222.37	222.28	222.17	222.18	222.26	222.33	222.36
Maize Area	000 ha	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9	20.9

Source: FAPRI-Ireland (2011)

Reproduced from *Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets* (Donnellan & Hanrahan) Teagasc 2012. Please refer to Section 6 of *Greenhouse Gas Emissions by Irish Agriculture: Consequences arising from the Food Harvest Targets* (Donnellan & Hanrahan) for a discussion of the caveats related to the above projections.

Appendix III - Summary of key plans or projects which could, along with agriculture, contribute to cumulative impacts on biodiversity

Theme	Policy/Plans in Place	Key Objectives	Potential of the Plan or Project to have significant adverse impacts on biodiversity	Potential for in-combination effects with FH2020
International				
Conventions and treaties	OSPAR Convention (1992) Convention for the Protection of the Marine Environment of the North-East Atlantic	OSPAR has six key strategy areas in relation to protection of the marine environment of the NE Atlantic - Protection and Conservation of Marine Biodiversity and Ecosystems; Eutrophication; Hazardous Substances; Offshore Oil and Gas Industry; Radioactive Substances, and Monitoring and Assessment	Positive impacts on biodiversity as the Convention focuses on protection of NE Atlantic marine waters	+ve
	UN Convention on Biological Diversity (1992) Including Nagoya Protocol on Access and Benefit Sharing, Cartagena Protocol on Biosafety	A legally binding agreement which sets out three main goals for the protection of biodiversity: a) conservation of biological diversity; b) sustainable use of biodiversity components; and c) fair and equitable sharing of benefits arising from genetic resources. Signatories are required to report towards progress in accordance with Article 26; and many positive actions for biodiversity have arisen from implementation of the Convention, including development of Biodiversity Action Plans; Global Strategy for Plant Conservation and in Ireland, setting up of the National Biodiversity Data Centre	Positive impacts through delivery of actions through the 2 nd National Biodiversity Action Plan; Strategy for Plant Conservation (Botanical Gardens) and through the EU Biodiversity Strategy to 2020	+ve
	The Ramsar Convention (1971) The Convention on Wetlands of	Under the terms of this commitment, signatories must maintain the ecological character of their wetlands of international importance and to	Positive impact on conservation of wetlands and wetland species due to commitments to improve water quality, raise awareness, integrate wetlands into policy and strategic	+ve

Theme	Policy/Plans in Place	Key Objectives	Potential of the Plan or Project to have significant adverse impacts on biodiversity	Potential for in-combination effects with FH2020
	International Importance (1971 and subsequent amendments)	plan for the "wise use", or sustainable use, of all of the wetlands in their territories	decisions and designate Ramsar sites	
	UN Koyto Protocol (1997) The United Nations Framework Convention on Climate Change Kyoto Protocol	An international treaty which sets legally binding targets to reduce greenhouse gas emissions over two commitment periods. The first commitment period applies to emissions between 2008-2012, and the second commitment period applies to emissions between 2013-2020 (recently amended but not yet in force)	Ireland is currently on track to meet its Kyoto Protocol commitment for the 2008–2012 Period (EPA 2012) but this has been mainly due to economic downturn.	Yes Potential increases in GHG from implementation of FH2020 may cause cumulative impacts if the second commitment targets are not met on sensitive habitats and species, particularly those which are vulnerable to changes in climatic factors, such as species sensitive to water temperature
European				
EU Directives	EU Water Framework Directive (2000/60/EC) Transposed into Irish law by European Communities (Water Policy) Regulations (S.I. No. 722 of 2003, as amended) European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009)	Maintain and enhance the quality of all surface waters in the EU by 2015. It also includes measures to enhance groundwater. Provides for the management of water quality on the basis of River Basin Districts	Positive impacts on biodiversity as the Directive is in place to improve water quality	+ve

Theme	Policy/Plans in Place	Key Objectives	Potential of the Plan or Project to have significant adverse impacts on biodiversity	Potential for in-combination effects with FH2020
	<p>EU Groundwater Directive (2006/118/EC)³</p> <p>Transposed into Irish law by the European Communities Environmental Objectives (Groundwater) Regulations (S.I. No. 9 of 2010)</p>	The Directive establishes groundwater quality standards and measures to prevent or limit pollution of groundwater	Likely positive impacts on biodiversity as the Directive is in place to improve groundwater quality	+ve
	<p>EU Floods Directive (2007/60/EC)</p> <p>Transposed into Irish law as European Communities (Assessment and Management of Flood Risk) regulations 2010 (S.I. No. 122 of 2010)</p>	Sets a framework undertaking preliminary flood risk assessment to identify areas of significant flood risk, preparation of flood hazard and risk maps and preparation of flood risk management plans (by 2015) setting out prioritised actions	Negative impacts could arise from necessity to provide flood defence structures through the national Catchment Flood Risk Assessment and Management (CFRAM). Positive impacts from tendency for 'soft defences' such as wetlands to provide biodiversity gain. The related DoEHLG Guidelines on Flood Risk Management and the Planning System (2009) seek to prevent development in areas prone to flood risk which would have positive impact on biodiversity	<p>Yes</p> <p>Potential in-combination effects could result where flood defence infrastructure is required in or adjacent to sensitive biodiversity receptors and where agricultural intensification and/or land management changes may occur under FH2020</p>
	<p>The Integrated Pollution Prevention Control Directive (96/61/EC)</p> <p>Transposed into Irish law by Protection of the Environment Act 2003, as amended (S.I. No. 27 of 2003)</p>	The objectives of the Directive are to prevent or reduce emissions to air, water and land, reduce waste and use energy and resources efficiently	Likely positive impacts on biodiversity as the Directive is in place to prevent and reduce pollution	+ve
	EU Nitrates Directive	The Directive aims to protect water	Likely positive impacts on biodiversity as the	+ve

³ This Directive, along with the Water Framework Directive replaces the Groundwater Directive (80/68/EEC), which is to be repealed by 2013

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	<p>(91/676/EEC)</p> <p>Transposed into Irish law by European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2009 (S.I. No. 101 of 2009)</p> <p>European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010 (S.I. No. 610 of 2010)</p> <p>European Communities (Good Agricultural Practice for Protection of Waters) (Amendment) Regulations 2011 (S.I. No. 125 of 2011)</p>	quality from pollution by nitrates from agricultural sources and required a Nitrates Action Programme to be put in place	Directive is in place to prevent and reduce pollution from nitrates	
	<p>EU Dangerous Substances Directive (76/464/EEC)</p> <p>Various statutes have been used to implement this Directive</p>	This Directive regulates potential impacts on water quality through restrictions on discharges	Likely positive impacts on biodiversity as the Directive is in place to prevent and reduce pollution from dangerous substances	+ve
	<p>Urban Waste Water Treatment Directive (91/271/EEC) as amended by Directive 98/15/EEC</p> <p>Transposed into Irish law as European Communities (Urban Waste Water Treatment)</p>	The Directive sets out requirements for sewage systems and waste water collection systems and set deadlines for provision of sewage treatment; requires monitoring of discharges from treatment systems	Likely positive impacts on biodiversity as the Directive is in place to prevent and reduce pollution from waste water	+ve

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	Regulations 2001 (S.I. No. 254 of 2001)			
	EU Shellfish Directive (79/923/EEC) Transposed into Irish law as European Communities (Quality of Shellfish Waters) (S.I. No. 268 of 2006) and European Communities (Quality of Shellfish Waters) (Amendment) (S.I. No. 55 of 2009)	Established regime to protect and manage designated shellfish waters	Likely positive impacts through requirement for good quality waters to support shellfish production	+ve
	Sewage Sludge Directive (86/278/EEC) European Communities Waste Management (Use of Sewage Sludge in Agriculture) Regulations 1998 (S.I. No.148 of 1998)	The Directive provides for protection of the environment, and in particular of soil, and sets controls on the use of sewage sludge in agriculture.	Likely positive impacts on biodiversity as the Directive is in place to prevent and reduce pollution from sewage sludge	+ve
	EU Landfill Directive (1999/31/EC) Transposed into Irish law by Waste Management (Licensing) (Amendment) (S.I. No. 336 of 2002) and European Communities (Amendment of Waste Management (Licensing) Regulations 2000) Regulations 2002 (S.I. No. 337 of 2002)	This Directive sets out detailed rules for waste landfills; requires an approved conditioning plan to reduce impacts from landfill on surface water, groundwater, soil and air	Likely positive impacts on biodiversity as the Directive is in place to prevent and reduce pollution from sewage sludge, however, potential impacts may arise where during siting, operation and remediation of landfill sites	Possible Potential cumulative impacts may arise from the location of landfill sites in proximity to ecologically sensitive areas where agricultural intensification may occur under FH2020, but implementation of the Directive should ameliorate significant cumulative impacts
	Environmental Liability Directive	Requires 'polluter' to pay for environmental damage, including	Likely positive impacts on biodiversity as the Directive is in place to ensure damage is	+ve

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	(2004/35/EC) Transposed into Irish law by European Communities (Environmental Liabilities) Regulations (S.I. No. 547 of 2008)	damage to Natura 200 sites, water and land	prevented or remediated	
	EU Habitats Directive (92/43/EEC; as amended) Transposed into Irish law by European Communities (Natural Habitats) Regulations 1997 (S.I. No. 94 of 1997) as amended by European Communities (Natural Habitats) (Amendment) Regulations 1998 (S.I. No. 233 of 1998) and European Communities (Natural Habitats) (Amendment) Regulations 2005 S.I. No. 378 of 2005; European Communities (Birds and Natural Habitats) (Control of Recreational Activities) Regulations 2010 (S.I. No. 293 of 2010); and consolidated by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011)	The Directive seeks to prevent and eliminate the causes of habitat loss and maintain and enhance current levels of biodiversity, particularly for Annex habitats and species through the designation of Special Areas of Conservation; Article 6(3) requires an Appropriate Assessment for plans or projects not directly connected with the management of a Natura 2000 site	Likely positive impacts on biodiversity as the Directive is in place to protect and enhance favourable conservation status; AA is underpinned by Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities 2009	+ve
	EU Birds Directive (79/409/EEC) Transposed into Irish law by European Communities (Natural Habitats) Regulations 1997 (S.I. No. 94 of 1997); European	The Directive seeks to prevent and eliminate the causes of bird species loss, maintain biodiversity, particularly for Annex species through the designation of Special Protection Areas	Likely positive impacts on birds as the Directive is in place to protect and enhance favourable conservation status	+ve

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	Communities (Birds and Natural Habitats) (Control of Recreational Activities) Regulations 2010 (S.I. No. 293 of 2010); and consolidated by the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011)			
	EU Freshwater Fish Directive (78/659/EEC) ⁴ Transposed into Irish law by European Communities Regulation (Quality of Salmonid Waters) (S.I. No. 293 of 1988)	Designed to protect surface waters identified as suitable for sustaining salmonid and cyprinid populations	Likely positive impacts on fish as the Directive is in place to protect and enhance favourable conservation status	+ve
	SEA Directive (2001/42/EC) Transposed into Irish law through a number of statutes: S.I. No. 435 of 2004 S.I. No. 436 of 2004 S.I. No. 200 of 2011 S.I. No. 201 of 2011	Strategic level environmental assessment of plans and programmes which are likely to have significant impacts on the environment	Likely positive impacts through the integration of environmental considerations into strategic level policies and plans	+ve
	EIA Directive (85/337/EEC) as amended by Directives 97/11/EC, 2003/35/EC and	Requires Environmental Impact Assessment of the potential environmental impacts of projects or	Positive impacts on biodiversity through the planning process which must take the potential for impacts on biodiversity into	+ve

⁴ Freshwater Fish Directive will be repealed in 2013 and replaced by the Water Framework Directive

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	<p>2009/31/EC</p> <p>Implemented in Ireland by the following key legislation:</p> <p>European Communities (Environmental Impact Assessment) (Amendment) Regulations 1999 (S.I. No. 93 of 1999)</p> <p>Planning and Development (Amendment) Act 2000 (S.I. No. 30 of 2000)</p> <p>Planning and Development Regulations 2001-2007</p> <p>European Communities (Environmental Impact Assessment) (Agriculture) Regulations 2011 (S.I. No.</p>	plans which may have significant environmental impacts	consideration as well as proposed mitigation and compensation	
	<p>Proposal for a Soils Framework Directive (COM(2006 232)</p>	This proposed Directive will set out a framework for the protection and sustainable use of soils	Positive impacts on soil biota and functioning and on biodiversity through implementation of soil protection and improvement measures	+ve
European strategies	EU Biodiversity Strategy to 2020	Targets and actions to enhance and conserve biodiversity at a European level; to safeguard important habitats and species in Europe; integrate biodiversity into the planning process; and reduce the impact of alien species	Likely positive impacts through the promotion of biodiversity considerations to be integrated into policies and plans; and positive impacts through achievement of targets and actions	+ve

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	European Climate Change Programme 2008	Commitment at European level to a comprehensive package of policy measures to reduce greenhouse gas emissions requiring each Member State to put in place their own domestic actions which build on or integrate the programme	Likely positive impacts on biodiversity through the reduction in greenhouse gas emissions	+ve
National				
National planning & policies	National Spatial Strategy 2002-2020 Decommissioned as of March 2013	The strategy aims to achieve a better balance of social, economic and physical development across Ireland, supported by more effective planning.	The strategy may result in impacts through infrastructure and development projects, but has now been shelved	+ve
	National Development Plan (2007-2013) and update due for 2014-2019	The existing NDP provides a basis for development and investment of a balanced socio-economic infrastructure in Ireland, and interlinks with policies in the National Spatial Strategy The proposed NDP 2014-2019 is likely to be based on a comprehensive review of Ireland's public investment priorities over the timeframe of the plan and major capital projects will be subject to a cost benefit analysis	Delivery of the projects and infrastructure may result in impacts on biodiversity The proposed NDP may impact result in impacts on biodiversity through the delivery of capital projects	Yes Potential in-combination effects from the delivery of major capital programmes, where infrastructure and development is required in or adjacent to sensitive biodiversity receptors and where agricultural intensification and/or land management changes may occur under FH2020
	Transport 21 2006-2015	This is a capital investment plan which supports the National Spatial Strategy through policy initiatives for development of the national transportation system	Potential impacts to biodiversity through provision of transport infrastructure and associated capital projects	Yes Potential in-combination impacts where new transport infrastructure is required in or adjacent to sensitive biodiversity receptors and

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				where agricultural intensification and/or land management changes may occur under FH2020
	Framework for Sustainable Development 2011-2020 – Our Sustainable Development	This framework aims at improving synergies and identifying and tackling policy gaps, policy conflicts and trade-offs as part of a coherent, joined-up approach to policy making on sustainable development.	In terms of biodiversity, the framework incorporates a 'Respect for ecological integrity and biodiversity' principle which states that <i>'the abundance of wildlife and extent of habitats should be maintained, improved and restored where necessary, through sustainable management.'</i>	+ve
	National Recovery Plan 2011-2014	The plan sets out a strategy for sustainable economic recovery which looks enterprise competitiveness, growth and employment and measures to reduce expenditure and a public capital investment	The plan has the potential to result in impacts on biodiversity through the delivery of measures contained, including capital projects	Yes Potential in-combination impacts from the delivery of capital programmes where infrastructure and development is required in or adjacent to sensitive biodiversity receptors and where agricultural intensification and/or land management changes may occur under FH2020
	Sharing our Future: Ireland 2025 Strategic Policy	This policy provides a long term assessment of what is required to develop a competitive sustainable enterprise sector. It outlines 11 global forces of change that may impact on Ireland including climate change, natural resources and conflict and energy supply and proposes key strategic policy areas for action	The plan has potential to impact on biodiversity through promotion of enterprises which may lead to requirement for infrastructure and other developments	Yes Potential in-combination impacts from the delivery of capital programmes where infrastructure and development is required in or adjacent to sensitive biodiversity receptors and where agricultural

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				intensification and/or land management changes may occur under FH2020
	Programme for Government 2011-2016	Sets out a programme which covers the main themes of economy, reform fairness and progress; sets out measures to stimulate the economy	Implementation of the plan requires the acceleration of capital works; increase growth including promotion of new enterprises which could require infrastructure; growth of the agri-food industry nationally and globally particularly with reference to CAP reforms	Yes Potential in-combination impacts from the delivery of projects and infrastructure, particularly agri-food projects outside of FH2020, to support the programme where these occur in or adjacent to sensitive biodiversity receptors and where agricultural intensification and/or land management changes may occur under FH2020
	National Climate Change Strategy 2007-2012 (update?)	Provides Ireland's pathway to meeting Kyoto commitments; with sectoral measures to reduce greenhouse emissions by stated targets	Likely positive impacts through reduction in greenhouse gas emissions	+ve
	National Heritage Plan 2002	The Plan sets out a range of actions to protect and enhance Ireland's natural and cultural heritage	Overall, the plan is likely to result in positive impacts on biodiversity through achievement of actions; some potential for impacts to occur where projects and works arising out of the actions are located within or adjacent to sensitive biodiversity	Yes Potential for in-combination impacts where projects or actions of the plan occur within or adjacent to sensitive biodiversity receptors and where agricultural intensification and/or land management changes may occur under FH2020here agricultural intensification

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				and land management change may occur under FH2020
	Actions for Biodiversity 2011-2016	The second NBAP, which sets out targets and actions for achieving stated biodiversity goals including education, environmental protection and	Likely positive effects through awareness raising, training and projects to protect biodiversity	+ve
	Format for a Prioritised Action Framework (PAF) for Natura 2000: For the EU Multiannual Financing Period 2014-2020 (Draft 1.1 January 2013)	Preliminary scoping document which sets out funding mechanisms for Natura 2000 sites	Likely positive impacts through financing of measures to reach conservation objectives for Natura 2000 sites	+ve
	Agenda 21 (1992) Action for Sustainable Development	Integration of the role of sustainable development into local and regional decision making process	Likely positive effects through awareness raising, integration of sustainability into policies	+ve
	Smarter Travel. A Sustainable Transport Future, A New Transport Policy for Ireland 2009-2020	Promotes sustainable travel measures and objectives and introduction of fiscal measures to promote sustainable travel	Implementation of the plan will require investment in infrastructure to provide alternative modes of transport	Yes Potential for in-combination impacts where projects or measures are set in or adjacent to sensitive biodiversity receptors and where agricultural intensification and/or land management changes may occur under FH2020
	Growing for the Future - A Strategic Plan for the Development of the Forestry Sector in Ireland	Strategic plan for the growth of the forestry sector in Ireland, with a four-fold target for increase in timber output by 2030	Potential for positive and negative interactions; Forest Service is implementing Sustainable Forest Management (SFM) with a view to ensuring that all timber produced in Ireland is derived from sustainably managed forests and afforestation is in line with Code of Best Forest Practice; potential adverse impacts where afforestation occurs within or	Yes Potential in-combination impacts where afforestation occurs in conjunction with or adjacent to sensitive biodiversity receptors and

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			adjacent to sensitive biodiversity areas	where agricultural intensification and/or land management changes may occur under FH2020
	National Countryside Recreation Strategy	Sets out priorities for achieving strategic objectives of improving countryside recreation, including; development of infrastructure for recreation; provision of countryside recreation opportunities; education and awareness raising and engagement	Potential impacts on biodiversity through the delivery of infrastructure projects under the strategy, in particular where access and infrastructure is located within or adjacent to sensitive biodiversity areas	Yes Potential in-combination effects could result where recreation infrastructure and facilities are required in or adjacent to sensitive biodiversity receptors and where agricultural intensification and/or land management changes may occur under FH2020
	Stimulating Sustainable Agricultural Production through Research & Innovation (SSAPRI)	SSAPRI was prepared in response to a recommendation in FH2020 to set out a strategic research agenda which provides underpinning scientific knowledge to achieve FH2020 targets. SSAPRI identifies ranking research required under four thematic research areas – Animals, Crops, Sustainability (includes water/soil, biodiversity, climate and bioenergy) and Socio-economic, Policy and Other Cross Sectoral Issues	Potential positive impacts as research initiated under SSAPRI may lead to efficiencies and innovative measures which could reduce environmental impacts of FH2020	+ve
National legislation	Wildlife Act 1976 (S.I. No 39 of 1976); Wildlife (Amendment) Act 2000 (S.I. No. 28 of 2000)	Gives protection to certain biodiversity elements; strengthen protection for NHA's; interact positively with FH2020 in terms of biodiversity protection; Planning and Development (Amendment) Act 2000	Likely positive impacts through protection of biodiversity through implementation of the legal requirements of these planning acts and order	+ve

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	Wildlife Amendment Act 1976 (S.I. No. 19 of 2010)	clarifies obligations of Local Authorities in relation to Habitats and Birds Directives; FPO extends protection to listed species		
	Flora Protection Order 1999 (S.I. No. 94 of 1999)			
	The Water Services Act 2007 and Amendment 2012 (Domestic Waste Water Treatment Systems) (S.I. No. 30 of 2007)	Provides standards and a duty of care for owners of premises to ensure their treatment system does not result in adverse impacts on human health, or the environment	Likely positive impacts through the regulation and reduction of pollution into surface and groundwater	+ve
	European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations (S.I. No. 296 of 2009).	Draft Management Plans for Freshwater Pearl Mussel are currently being prepared under the River Basin Management Plan programme of measures.	Likely positive impacts through the regulation and reduction of pollution and other pressures in FPM catchments	+ve
	Environmental Agency Protection Act 1992	The objectives of this act are to provide for better protection of the environment through licencing and monitoring	Likely positive impacts through regulation and monitoring of potential pollutants	+ve
Sectoral plans and strategies	OPW - Arterial Drainage Maintenance and High Risk Channel Designation Programme 2011 – 2015	<p>This document provides Strategic Environmental Strategies when employing channel maintenance</p> <p>This document also provides standard operating procedures for a number of protected species and habitats when undertaking arterial drainage maintenance.</p>	The programme aims to negate potential impacts to receptor habitats and species associated with arterial drainage schemes. Arterial drainage by its nature is likely to cause some level of negative impact to receptor habitats and species but in addition may also cause negligible to positive impacts in the short to medium term	<p>Yes</p> <p>In combination effects where arterial drainage coincides with agricultural intensification and/or land management changes under FH2020</p>
	Arterial Drainage Acts (S.I. No. 14 of 1995) (S.I. No 3 of 1945)	Arterial drainage is primarily the responsibility of OPW. It entails the maintenance of river channels to ensure they are free-flowing, thus	The OPW's Arterial Drainage Maintenance Annual Works Programme is screened for potential impacts on Natura 2000 Sites. Recent practice for any new localised flood	<p>Yes</p> <p>Potential in-combination</p>

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		reducing flood risk; maintenance of river and coastal embankments	alleviation projects is to carry out Screening for Appropriate Assessment, and full AA if required, or an ecological assessment if the works are not within a Natura 2000 Site.	impacts may occur where arterial drainage works coincides with areas of agricultural intensification under FH2020
	Bord Bia Strategic Plan 2012-2014	The overarching aim of the strategic plan is to drive long-term sustainable growth in the agri-food industry. The plan has been developed to fully support the implementation of <i>Pathways for Growth</i> and <i>Food Harvest 2020</i> .	Potential impacts from the plan on biodiversity may arise from implementation of actions to grow the specified agri-food sectors	Yes The plan is complementary to FH2020, and potential in-combination impacts may occur from the development of agri-food growth and projects not currently considered in the scenarios assessed as part of this review
	2030 Rail Network Strategy	This strategy sets out the future development requirements of Iarnród Éireann InterCity network and regional services and looks at the potential for freight rail.	Potential impacts on biodiversity through the enhancement of existing infrastructure and provision of new infrastructure and facilities	Yes Potential in-combination impacts where upgrading or development of new infrastructure is required in areas of agricultural intensification and land management change under FH2020
	Department of Defence Strategic Plan 2011-2014	Strategy to maintain and enhance Ireland's national and overseas defence capabilities; to provide support for emergency planning and other supports. Department of Defence and the Defence Forces are committed to employing best practice	Potential impacts may arise where there is a requirement for new infrastructure or facilities or in operation of existing facilities in line with the strategic plan	Yes Potential in-combination impacts may arise where new infrastructure or facilities occur within or adjacent to agricultural intensification or

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		to ensure the protection of Ireland's natural environment and heritage resources		land management change under FH2020
	Waterways Ireland Corporate Plan 2011-2013	The plan strategically shows how Waterways Ireland will continue to manage, maintain, restore and develop the waterways to maximise their potential to provide a high quality recreational infrastructure for a diverse range of users and leisure activities. This Plan seeks to promote sustainable growth, social inclusion and regional development	Key actions such as a maintenance and improvement programme for waterways; and infrastructure required have potential to impact on sensitive biodiversity	Yes Potential in-combination impacts may arise where maintenance and/or new infrastructure or facilities occur within or adjacent to agricultural intensification or land management change under FH2020
	Teagasc - Food Technology and Knowledge Transfer Strategy	This offers scientific solutions to the food industry using five gateways - technology and IP platforms, research updates to industry, pilot food plant facilities, product development and technological expertise and access to global scientific services		
Sectoral biodiversity plans	Bord na Mona Biodiversity Action Plan 2010-2015	<p>To comply with best practice and relevant legislation within all Bord na Mona bogs</p> <p>Identify and survey all potential biodiversity areas</p> <p>Promote and develop best practice in terms of rehabilitation for all Bord na Mona owned bogs</p> <p>Raise awareness and appreciation of the biodiversity and natural heritage</p>	Positive impacts resulting through implementation of best practice, further surveying and rehabilitation of cutaway and disturbed bogs owned by Bord na Mona	+ve

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		of Bord na Mona cutaway bogs Monitor the progress of the Bord na Mona Biodiversity Action Plan		
	EPA Biodiversity Action Plan 2011 - 2013	This plan sets out the EPA's action plan for the implementation of its role in the protection of biodiversity. The actions are grouped under a series of headings that include Monitoring, Research, Informatics, Assessment and Reporting, Environmental Change and Climate Change & Management and Communications.	Positive impacts through the implementation of the biodiversity plan which in turn will protect and enhance biodiversity as a part of its wider mission	+ve
	Coillte Biodiversity Action Plans (currently underway) – for species listed as rare or endangered on the EU Habitats Directive	Coillte is developing biodiversity action plans on habitats and species; i.e. Hen Harrier, Freshwater Pearl mussel, Lesser Horseshoe bat and Raised bog. These habitats are listed as rare or endangered and are potentially impacted by Coillte's activities	Positive impacts on those species concerned and potentially on associated (secondary) habitats and species. The biodiversity Action Plans for the species of conservation concern will focus on further data collation on species, further surveys of those species in addition to liaison and consultation with statutory and non-statutory bodies e.g. National Parks and Wildlife Service	+ve
	Commonage Framework Plans (and review)	Commonage Framework Plans provide an assessment of the vegetation condition of an area of commonage. They outline required changes (if any) in animal stocking levels. These plans are currently being reviewed by NPWS and it is expected that some increases in stocking rates may be allowed	Potential negative impacts through increased stocking density on sensitive biodiversity; however at present under grazing of land may be causing impacts and increased stocking rates may be necessary to bring habitats back into favourable conservation status	Yes Potential in-combination impacts may arise where the increases or decreases in stocking rates occur i
	Department of Defence Sectoral Biodiversity Action Plan (2010 –	Conserve and enhance biodiversity on those lands held by the Department of Defence. Minimise impacts	Positive impacts through the implementation of the biodiversity action plan which in turn will protect and enhance biodiversity within	+ve

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	2012)	potential adverse impacts to these lands whilst promoting the issue of biodiversity.	those lands held by the Department of Defence	
	National Parks and Wildlife Service – Actions for Biodiversity 2011 – 2016 Ireland's National Biodiversity Plan	To overriding objectives include the promotion of biodiversity in the decision making process across all sectors while increasing awareness and appreciation of biodiversity and ecosystems services. Conserve and restore biodiversity and ecosystem services in the wider countryside / marine environments and expand and improve on the management of protected	Positive impacts on biodiversity through liaison, restoration and conservation in addition to the promotion of biodiversity across all areas.	+ve
	Irish Seafood Operational Programme	Measures to provide a sustainable and competitive seafood industry, including aquaculture expansion, fleet restructuring, new technologies and competitiveness performance	Potential impacts on sensitive biodiversity through implementation of actions such as expansion of aquaculture	Yes Potential for in-combination impacts where measures of the plan are implemented in proximity to areas of agricultural intensification under FH2020
Waste water treatment	Water Services (Amendment) Act 2012 (S.I. No. 2 of 2012)	New requirements for septic tanks to protect and restore surface and ground water quality.	On-going improvements in estuarine water quality may reduce carrying capacity of estuaries for wintering waterfowl but otherwise likely positive impacts on biodiversity	+ve
Bioenergy	Bioenergy Action Plan 2007	A cohesive plan which sets out targets for growth of the national bioenergy sector including targets to promote bioenergy crops through financial incentives	Potential to impact on sensitive biodiversity through the planting, growing and harvesting phases of bioenergy crops	Yes Potential in-combination impacts where bioenergy plan measures are implemented in proximity to areas of

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				agricultural intensification or land management change under FH2020
Natural resources/renewable energy (general)	Energy Policy Framework 2007-2020	Sets out how Ireland will respond to international energy supply issues and Ireland will be legally required by 2020 to have at least 16% of all energy to be supplied by renewables. Wind, bioenergy, biofuels, green technologies are targeted.	Potential impacts may arise from the siting, construction and operation of renewable energy infrastructure	Yes Potential impacts from the requirement to provide renewable energy infrastructure and from production of biofuel crops
	Strategy for Renewable Energy 2012-2020	Strategy which sets out the development of the renewable energy sector in Ireland to 2020; including five strategic goals – increasing on and off shore wind, building a sustainable bioenergy sector, fostering research and development and growing sustainable transport	Potential impacts on biodiversity may arise from the construction and operation of renewable energy infrastructure	Yes Potential in-combination impacts from the requirements to meet the strategy where it occurs within or adjacent to areas of agricultural intensification or land management change under FH2020
	EIRGRID GRID25 Implementation Programme 2011-2016	This programme sets out EirGrid's strategy for implementation of the 2007 Government White Paper on Energy - "Delivering a Sustainable Energy Future for Ireland". The Implementation Programme (IP) is a practical overview of how the early stages of Grid25 are to be implemented.	Potential impacts on biodiversity through the implementation of the plan, primarily from infrastructure	Yes Potential in-combination effects through requirement for grid related infrastructure where it occurs within or adjacent to areas of agricultural intensification or land management change under FH2020
	Wind Energy Development Guidelines (2009)	Sets out a strategy for the location and development of wind farms and	Negative impacts on peat-based upland habitats / extensive proposals for wind	Yes

Theme	Policy/Plans in Place	Key Objectives	Potential of the Plan or Project to have significant adverse impacts on biodiversity	Potential for in-combination effects with FH2020
		the assessment of planning applications for wind farms	energy in midlands	Potential in-combination effects where wind energy projects are sited within or close to sensitive areas where FH2020 may also have impacts
	County based wind energy strategies	Strategies at the county level for the support and integration of wind energy into planning and	Potential for impacts on biodiversity through the siting, construction and operation of wind energy infrastructure	Yes Potential in-combination effects through requirement for wind energy related infrastructure where it occurs within or adjacent to areas of agricultural intensification or land management change under FH2020
	Eirgrid – Ecology Guidelines for Electricity Transmission Projects	Provides a standardised approach when undertaking Ecological Impact Assessment (EclA) for High Voltage Transmission Projects.	Potential alleviation of impacts through the adaptation of best practice and mitigation measures	Yes Potential in-combination effects where new transmission infrastructure is required in areas where FH2020 may also have impacts
Surface and ground water	River Basin Management Plans	RBMPs to be produced for identified river basins and establishment of management prescriptions to enhance water quality and to set up a programme of monitoring	Likely positive impacts as RBMPs promote improved water quality by setting specific objectives for each water body under consideration and provide a programme of measures to implement this measures	+ve
	Flood Risk Management Plans	FRMPs are in place to identify and map existing future flood risk areas; implement flood risk management on a catchment basis; provide strategic information base to manage flood risk	Potential impacts on biodiversity through the implementation of flood risk management projects which may include arterial drainage and flood defences	Yes Potential in-combination impacts may occur where flood maintenance works

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		and to identify measures to manage flood risk at local and catchment level		under FRMPs coincide with areas where FH2020 may have impacts
	The Local Government (Water Pollution) Act, 1977 (Water Quality Standards for Phosphorous) Regulations, 1998	Sets requirements for retention of good water quality in rivers and for improvement of quality in others	Likely positive impacts as the regulations support water quality protection and enhancement	+ve
	Proposal for Water Supply Project	Bord na Mona have completed an SEA on the need for a water supply infrastructure to supply water to the greater Dublin area and Mid-east regions and a preferred solution has emerged whereby an interim storage facility will be constructed at Garryhinch which will enable the abstraction from source to be regulated in proportion to river water flow rate	Potential impacts on biodiversity through alteration of groundwater regime, direct impacts on biodiversity during construction and operational phases	Yes Potential in-combination impacts if the plan proceeds if agricultural intensification and/or land management changes occurs within the region under FH2020
Regional plans	Urban Framework Plans Regional Development Strategies Regional Planning Guidelines Flood Risk Management Plans Regional Waste Management Strategies Retail Strategies	Present strategies and policies for development within defined regions; with emphasis on socio-economic development and policies for mitigating potential impacts	Development processes are regulated at regional and county level, most plans subject to SEA, some to AA, and take Natura 2000 network and other ecologically sensitive areas/species into consideration with specific targets or policies. Potential for negative and positive interactions with FH2020.	Yes Potential in-combination effects where new infrastructure and development is planned, particularly where development occurs in-combination with agricultural intensification

Theme	Policy/Plans in Place	Key Objectives	Potential of the Plan or Project to have significant adverse impacts on biodiversity	Potential for in-combination effects with FH2020
	Regional Transport Strategies			
County, City, Town and Local Plans	County, Town and City Development Plans Local Development Plans County Biodiversity Action Plans County Heritage Plans	Present strategies and policies for development within counties and defined local areas; with emphasis on socio-economic development and policies for mitigating potential impacts; the Biodiversity Action Plans and County Heritage Plans set out policies for protection of heritage resources	Development processes are regulated at regional and county level, most plans subject to SEA, some to AA, and take Natura 2000 network and other ecologically sensitive areas/species into consideration with specific targets or policies. Potential for negative and positive interactions with FH2020. The BAP and Heritage Plans have likely positive impacts through protection policies	Yes Potential in-combination effects where new infrastructure and development is planned, particularly where development occurs in-combination with agricultural intensification
Shale gas fracking	Various legislation applies; EPA commissioned report Fracking: Current Knowledge and Potential Environmental Impacts (Draft, May 2012)	Unknown	Possible negative impacts through exploration and operation phases	Yes Potential fracking areas in north-west and west, which may correspond with HNV farmland/ Natura 2000 sites
Afforestation	Irish National Forest Standards 2000	Aims to ensure the establishment of sustainable forestry	Sustainable forestry is positive for biodiversity, however afforestation could result in potential impacts on biodiversity through direct effects such as habitat loss and indirect effects such as water acidification	Yes Where afforestation occurs in combination with agricultural intensification there is potential for in-combination effects
	Native Woodland Scheme	This scheme supports the establishment of new native woodland on greenfield sites with the aim of expanding and protecting the native woodland resource in Ireland	Potential positive impacts on biodiversity through provision of new habitats and wildlife corridors Potential negative impacts where woodland is situated in Acid Sensitive Areas (ASA) which overlaps with Freshwater Pearl Mussel but applications must include mitigating	Yes Potential in-combination impacts where agricultural intensification occurs in conjunction with native woodland afforestation

Theme	Policy/Plans in Place	Key Objectives	Potential of the Plan or Project to have significant adverse impacts on biodiversity	Potential for in-combination effects with FH2020
			measures and potentially where afforestation occurs on or within Natura 2000 sites	
Other relevant drivers of biodiversity with reference to agriculture	EU Life Projects funded through INTERREG e.g. Control of Aquatic Invasive Species and Restoration of Natural Communities in Ireland BurrenLife	Measures to protect and enhance valued ecological components;	Likely positive impacts on biodiversity through restoration and protection	+ve
	Irish Peatland Conservation Council Plan 2020 – halting the loss of peatland biodiversity	To develop a national strategy for the conservation and management of all peatland types in Ireland	Positive impacts on biodiversity (in particular peatland habitats) through the implementation of the plan	+ve
	BirdWatch Ireland 2020: A Forward Strategy for BirdWatch Ireland 2010-2020 BirdWatch Ireland Species Action Plans	Various plans and work programmes designed to bring positive impacts on bird populations, including those associated with agriculture	Likely positive impacts on biodiversity through actions to protect, restore and enhance bird populations	+ve
	Other relevant NGO plans, policies and projects including Irish Wildlife Trust, SWAN,	Various plans, projects and policies in place which aim to conserve, protect and restore biodiversity	Likely positive impacts on biodiversity through actions to protect, restore and enhance the natural environment	+ve
	Cessation of Turf Cutting Compensation Scheme	Payments and other measures as compensation to turf cutters for cessation of turf cutting on designated peatlands.	Positive impacts through the protection of high quality peatland habitat.	+ve
	Tidy Towns	The concept driving Tidy Towns is to create interest from communities in maintaining and enhancing their local environs; marks are awarded under a number of categories including litter control, residential areas, landscaping	Likely positive impacts through the development of local based projects to enhance and improve biodiversity and local features.	+ve

Theme	Policy/Plans in Place	Key Objectives	Potential of the Plan or Project to have significant adverse impacts on biodiversity	Potential for in-combination effects with FH2020
		and wildlife and natural amenities.		
	Green Infrastructure for Ireland	The Comhar research report details the findings and recommendations for establishment of a national green infrastructure to conserve natural ecosystems and provide ecosystem services.	Likely positive impacts through the retention of green infrastructure within the wider landscape and provision of biodiversity stepping stones.	+ve
	Biodiversity Awareness Understanding and Impact of Its Loss. A Barometer Survey prepared for the Heritage Council (Fanning, 2010)	This study measured consumer awareness, understanding and interest in biodiversity.	Likely positive impacts through awareness raising of gaps in environmental education.	+ve
	Biodiversity's economic value (Bullock et al, 2008)	A report which attempted to place monetary calculations for the provision of a small number of public goods delivered through ecosystems services.	Likely positive impacts through awareness raising of ecosystem services.	+ve
	Teagasc programmes including BETTER Farms (beef, sheep, dairy) Technology Transfer Strategy Carbon Navigator tool development Teagasc and DAFM in process of developing livestock production system benchmarking system Genomic Selection scheme		Potential positive and negative impacts through the delivery of various programme aims and objectives	Yes

Theme	Policy/Plans in Place	Key Objectives	Potential of the Plan or Project to have significant adverse impacts on biodiversity	Potential for in-combination effects with FH2020
	Quality Assurance Schemes e.g. Bord Bia Lamb and Beef Quality Assurance Scheme BIM 'Origin Green'	These voluntary schemes are in place to enhance the life cycle and to work towards more sustainable credentials for member food producers and companies.	Likely positive impacts through voluntary adherence to identified sustainable practices; compliance is monitored independently to identify	+ve

Appendix IV - Impact Assessment for the Dairy and Beef Sectors on Biodiversity (outside of Natura 2000 network) and Flora & Fauna (Pre-mitigation)

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁵	Significance of impact
Water-dependent Annex 1 habitats	High International	<p>Slight risk of increased eutrophication as a result of increased inorganic/organic fertiliser, may be regionally concentrated in existing dairy areas</p> <p>Potential localised hydrological impacts from adjacent drainage as a result of intensification</p> <p>Potential for increase in sediment load, adverse effects on freshwater pearl mussel, salmon spawning etc. from</p>	Probable	Slight negative

⁵ Probability of occurrence:

- Certain / near-certain: probability estimated at 95% chance or higher;
- Probable: probability estimated at above 50%, but lower than 95%;
- Unlikely: probability estimated above 5%, but less than 50%; and
- Extremely Unlikely; probability estimated at less than 5%.
- Uncertain; probability cannot be determined

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁵	Significance of impact
Water-dependent Annex II, IV and V species	High International	increased stocking rates Overall, potential for slight adverse impacts on conservation status of Annex habitats and species		
Terrestrial Annex 1 habitats	High International	Potential changes in vegetation composition as a result of run-off from increase in organic/in-organic nutrients	Probable	Slight negative
Annex I bird species	High International	Potential loss of semi-natural habitat Intensification of existing dairy landscape may lead to reduced habitat heterogeneity and suitability Potential adverse impacts on species associated with eutrophication of wetlands	Probable	Slight negative
Natural Heritage Areas	High National	Potential drainage which could affect integrity of wetlands and associated species Potential eutrophication of wetlands and soils from increased organic/inorganic fertiliser use	Probable	Slight negative
Nationally protected flora	High national	Potential loss of semi-natural habitat associated with rare species, particularly those associated with tillage	Unlikely / Probable	Slight negative

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁵	Significance of impact
Nationally protected fauna	High national	Potential loss of semi-natural habitat leading to reduction in species Potential eutrophication of wetlands and watercourses	Unlikely / Probable	Slight negative
Red Data Book species	Medium national	Potential loss of semi-natural features which support these species Possibility of change in management which makes habitat unsuitable to support rare species	Unlikely / Probable	Slight negative
Birds (other than Annex 1)	Medium national	Possible small scale loss of semi-natural habitats on a landscape scale Beneficial impact to some species associated with dairy farming landscape Change of use from beef to dairy cattle may result in some changes to bird assemblages, but extent is unknown	Probable	Slight negative
HNV farmland features	Medium national	Dairy expansion and intensification may be predicted to occur outside majority of HNV farmland areas, but some impacts within HNV farmland may be possible Possible effects from small-scale conversion, drainage of semi-natural habitats to pasture Potential severing of green infrastructure connections between HNV farmland and more extensive and intensive agricultural areas Possible localised loss of HNV features Potential localised eutrophication of small wetlands from increased fertiliser use	Probable	Slight negative

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁵	Significance of impact
Other flora/fauna	Low, medium, uncertain	Uncertain impacts - soil biota may be negatively or positively impacted by increases in organic/inorganic fertiliser and by changes in land management. However, there is a lack of research and current status information to predict the significance of these impacts	Uncertain	Unknown
Overall national predicted impact				Slight negative

Appendix V - Impact Assessment for the Sheep Sector on Biodiversity (outside of Natura 2000 network) and Flora & Fauna (Pre-mitigation)

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁶	Significance of Impact
Water-dependent Annex 1 habitats	High International	Potential for slight adverse effects where sheep pasture is converted to cattle pasture, resulting in increased animal manure and application of organic/inorganic fertilisers, although this will only affect a small land area	Unlikely	Neutral / imperceptible
Water-dependent Annex II, IV and V species	High International	Potential for slight increase in soil stability leading to reduced erosion risk in uplands Unlikely to be perceptible changes to conservation status of Annex habitats/species unless replaced by intensive cattle enterprises		

6 Probability of occurrence:

- Certain / near-certain: probability estimated at 95% chance or higher;
- Probable: probability estimated at above 50%, but lower than 95%;
- Unlikely: probability estimated above 5%, but less than 50%; and
- Extremely Unlikely; probability estimated at less than 5%.
- Uncertain; probability cannot be determined

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁶	Significance of Impact
Terrestrial Annex 1 habitats	High International	Slight beneficial impacts for currently overgrazed uplands and lowland habitats Potential long-term changes in vegetation composition as a result of under grazing in uplands, although this is likely to be low, given the marginal decrease predicted for upland sheep numbers Marginal reduction in upland grazing pressure leading to localised increased habitat suitability for some species	Unlikely / Probable	Neutral / imperceptible
Terrestrial Annex II, IV and V species	High International	Unlikely to be perceptible changes to conservation status of Annex habitats/species unless replaced by intensive cattle enterprises		Neutral / imperceptible
Annex I bird species	High International	Slight reduction in grazing pressure leading to potential localised increase in ground-nesting opportunities Slight increase in food resources in currently overgrazed habitats Unlikely to be perceptible changes to conservation status of Annex bird species unless replaced by intensive cattle enterprises	Unlikely / Probable	Neutral / imperceptible
Natural Heritage Areas	High National	Slight reduction in overgrazing in uplands and lowlands, although lowland sheep may to be replaced by cattle Potential for under grazing leading to adverse impacts over the longer term Slight reduced risk of eutrophication in uplands, potential for increased risk if intensive cattle system replaces low intensity sheep system Overall, unlikely to be perceptible changes to condition of NHA's unless replaced by intensive cattle enterprises	Probable	Neutral / imperceptible
Nationally protected flora	High National	Slight reduction in upland overgrazing pressure, with potential for increase in associated species in the short to medium term, under grazing may be a slight negative factor over the longer term	Unlikely	Neutral / imperceptible

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁶	Significance of Impact
		<p>Change in land use from sheep to beef grazing may lead to localised impacts, but not likely to be significant as nationally protected flora are not strongly associated with lowland sheep pasture</p> <p>Overall, imperceptible change to conservation status of nationally protected flora</p>		
Nationally protected fauna	High national	<p>Slight reduction in overgrazing leading to increased habitat suitability for some fauna</p> <p>Potential for slight adverse effects where non-intensive sheep systems are replaced by more intensive cattle systems</p> <p>Slightly reduced risk of eutrophication of wetlands and watercourses in uplands, slight potential for increase in lowlands if cattle (particularly intensive) replace sheep systems</p> <p>Slight potential for enhanced habitat suitability in the lowlands if non-intensive cattle systems replace sheep</p> <p>Overall, imperceptible change to conservation status of nationally protected fauna</p>	Unlikely	Neutral / imperceptible
Red Data Book species	Medium national	<p>Slight reduction in upland overgrazing pressure which may increase habitat suitability for some RDB species</p> <p>Slightly reduced risk of eutrophication of upland wetlands and watercourses, slight potential for increase in lowlands if cattle replace sheep systems</p> <p>Slight potential for enhanced habitat suitability for Red Data Book species in the lowlands, although these species are not strongly associated with lowland sheep pasture</p> <p>Unlikely to have perceptible impacts on Red Data Book Species</p>	Unlikely / Probable	Neutral / imperceptible

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁶	Significance of Impact
Birds (other than Annex 1)	Medium national	<p>Slight increase in vegetation structure in uplands and lowlands which would favour ground nesting birds, although change to beef grazing may negate or alter level of change</p> <p>Possible changes to bird assemblages, mainly in lowlands, as sheep grazed pasture is converted to beef pasture</p> <p>Possible adverse impacts in the long-term as a result of under grazing, primarily in uplands, but likely to be minuscule</p>	Probable	Slight positive
HNV farmland features	Medium national	<p>Slight reduction in upland and lowland grazing pressure leading to increased habitat structure</p> <p>Change of land use from sheep to cattle may be beneficial or slightly negative for a range of features</p> <p>Reduction in traditional upland management practices</p>	Probable	Neutral / imperceptible
Other flora/fauna	Low, medium, uncertain	<p>Changes unknown for soil biota in uplands</p> <p>Other common flora/fauna may increase as a result of decreased stocking rates</p>	Uncertain	Unknown
Overall national level predicted impact				Neutral / imperceptible

Appendix VI - Impact Assessment for the Pig and Poultry Sector on Biodiversity (outside of Natura 2000 network) and Flora & Fauna (Pre-mitigation)

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁷	Significance of Impact
Water-dependent Annex 1 habitats	High International	Potential for slight increase in potential eutrophication as a result of increased organic fertiliser Possible implications for conservation status of water dependent Annex habitats and species proximal to pig / poultry systems and land where waste manure is spread	Probable	Slight negative
Water-dependent Annex II, IV and V species				
Terrestrial Annex 1 habitats	High International	Potential increase in potential eutrophication where sites are located in proximity to pig / poultry enterprises	Probable	Slight negative
Terrestrial Annex II, IV and V species				
Annex I bird species	High International	Potential impacts from eutrophication of wetland and terrestrial bird habitat located in proximity to pig / poultry enterprises	Probable	Neutral / imperceptible
Natural Heritage	High National	Potential slight increase in potential eutrophication where	Unlikely / Probable	Slight negative

⁷ Probability of occurrence:

- Certain / near-certain: probability estimated at 95% chance or higher;
- Probable: probability estimated at above 50%, but lower than 95%;
- Unlikely: probability estimated above 5%, but less than 50%; and
- Extremely Unlikely; probability estimated at less than 5%.
- Uncertain; probability cannot be determined

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁷	Significance of Impact
Areas		located in proximity to pig / poultry enterprises		
Nationally protected flora	High national	Potential slight increase in potential eutrophication which may reduce habitat suitability for protected plants but not likely to be located in areas where protected plants are present	Unlikely	Neutral / imperceptible
Nationally protected fauna	High national	Potential slight potential for adverse impacts from eutrophication but unlikely to be significantly affected	Unlikely	Neutral / imperceptible
Red Data Book species	Medium National	Slight potential for adverse impacts from eutrophication, but possibly impacts more pronounced on species which are water dependent	Unlikely / Probable	Slight negative
Birds (other than Annex 1)	Medium national	Slight adverse impacts from eutrophication of habitats and changes in land use in proximity to pig / poultry enterprises	Probable	Slight negative
HNV farmland	Medium national	Low potential as major pig and poultry areas are currently and likely to be located outside of recognised HNV farming areas, but localised eutrophic impacts on wetlands within HNV catchments in proximity to pig / poultry enterprises	Unlikely	Neutral / imperceptible
Other flora/fauna	Low, medium, uncertain	Changes for soil biota are uncertain Common flora/fauna may decline in habitats located adjacent to pig/poultry units as a result of eutrophication	Uncertain	Unknown
Overall national level predicted impact				Slight negative

Appendix VII - Impact Assessment for the Tillage and Field Crop Sector on Biodiversity (outside of Natura 2000 network) and Flora & Fauna (Pre-mitigation)

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁸	Significance of Impact
Water-dependent Annex 1 habitats	High International	Possible benefits to water quality through potential decreases in inorganic/organic fertiliser(not quantified) Possible slight increases in soil erosion from release of land from crops, may result in increased sediment load Possible reduction in pesticide/herbicide drift	Uncertain / unlikely ⁹	Neutral / imperceptible
Water-dependent Annex II, IV and V species				

⁸ Probability of occurrence:

- Certain / near-certain: probability estimated at 95% chance or higher;
- Probable: probability estimated at above 50%, but lower than 95%;
- Unlikely: probability estimated above 5%, but less than 50%; and
- Extremely Unlikely; probability estimated at less than 5%.
- Uncertain; probability cannot be determined

⁹ Consideration of probability of impacts for tillage and field crops is restrained by lack of quantitative information on pesticide/herbicide usage envisaged under FH2020

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁸	Significance of Impact
Terrestrial Annex 1 habitats	High International	Possible benefits to water quality through potential decreases in inorganic/organic fertiliser(not quantified) Possible slight increases in soil erosion from release of land from crops, may result in increased sediment load Possible reduction in pesticide/herbicide drift	Probable?	Neutral / imperceptible
Terrestrial Annex II, IV and V species				
Annex I bird species	High International	Slight reduction in semi-natural habitats used by birds associated with arable landscape Potentially, intensification of existing tillage landscape may increase or decrease certain populations Slight reduction in food resources from increased pesticide/herbicide use	Probable	Neutral / imperceptible
Natural Heritage Areas	High National	Possible benefits to water quality through potential decreases in inorganic/organic fertiliser(not quantified) Possible slight increases in soil erosion from release of land from crops, may result in increased sediment load Possible reduction in pesticide/herbicide drift	Probable	Neutral / imperceptible

Sensitive Ecological Receptor	Importance	Criteria for Impact Assessment	Probability ⁸	Significance of Impact
Nationally protected flora	High national	Possible benefits through potential decreases in inorganic/organic fertiliser(not quantified) Possible reduction in pesticide/herbicide drift Possible slight reduction in habitat suitable for rare arable weeds	Probable	Neutral / imperceptible
Nationally protected fauna	High national	Unlikely to be any significant impacts as nationally protected fauna is not strongly correlated with tillage and crop land	Probable	Neutral / imperceptible
Red Data Book species	Medium national	Possible slight reduction in habitat suitable for rare arable weeds, potential for some Red Data book species to benefit as a result of possible decreases in inorganic /inorganic fertilisers	Probable/unlikely	Neutral / imperceptible
Birds (other than Annex 1)	Medium national	Reduced landscape heterogeneity through loss of small-scale and larger areas of tillage may be an adverse impact	Probable	Neutral / imperceptible
HNV farmland	Medium national	Tillage and field crop areas mainly located outside of recognised HNV farmland and unlikely to lead to significant impacts	Probable	Neutral / imperceptible
Other flora/fauna	Uncertain	Soil biota may be negatively impacted by increased pesticide/herbicide use Some soil biota could be enhanced through increase in fertiliser application	Uncertain	Uncertain impact
Overall national level predicted impact				Neutral / imperceptible

Appendix VIII - Current conservation status of Annex I habitats protected under the Habitats Directive associated with or impacted by agriculture

Habitat	Influencing factors	Location	Status
<i>Terrestrial habitats associated with agriculture</i>			
Orchid rich/ calcareous grasslands (6210)	Abandonment of traditional management practices	Widespread but local in centre, west/north-west	Bad
Lowland hay meadows (6510)	Abandonment of traditional management practices	Localised along floodplains of large rivers, e.g. Shannon, Moy	Bad
Species rich <i>Nardus</i> grassland (6230)	Overgrazing, abandonment of traditional management practices	Widespread in upland areas	Bad
<i>Molinia</i> meadows (6410)	Drainage, intensification and abandonment of traditional land practices	Widespread, on fluctuating water tables/acid soils	Bad
<i>Calaminarian grassland</i> (6130)	Dumping, recreational pressures, lack of grazing, erosion	Associated with old mine sites, very localised and scattered mainly in south and east	Poor
Hydrophilous tall herb (6430)	At risk from agricultural improvements along the river edge	Rivers Fergus; Shannon, Blackwater; Nore-Barrow-Suir/Slaney	Poor
Mediterranean Salt Meadows (1410)	Over-grazing by sheep or cattle	Widespread along coastline	Poor
Halophilous scrub (1420)	Poaching by cattle	Five sites in the southeast	Bad
Atlantic salt meadows (1330)	Over-grazing by sheep or cattle	Widespread along coastline	Poor
Fixed dunes (grey dunes) (2130)	In appropriate grazing and recreation	Widespread along coastline	Bad
Decalcified dune heath (2150)	Over/under grazing, supplementary feeding	Coasts Donegal, Mayo, Wicklow	Bad
Decalcified Empetrum dunes (2140)	Agricultural improvement, over and under grazing, quarries and natural vegetation succession	Restricted to small number of sites along north-west coast	Bad
Humid dune slacks (2190)	Over/under grazing, water abstraction, inappropriate development	Widespread along coastline	Bad
Machair (21A0)	Division of open commonage, over/under grazing, recreation	Widespread along north-west coast	Bad
Dunes with creeping willow (2170)	Over/under grazing, agricultural improvements	Occasional along coastlines	Poor

Habitat	Influencing factors	Location	Status
Turloughs (3180)	Eutrophication and over/under grazing	West	Poor
<i>Chenopodium rubri</i> (3270)	Eutrophication, excessive poaching by livestock	Associated with riverine turloughs in the West, along the River Lee and the Gearagh and one location in Kilkenny	Poor
Wet heath (4010)	Overstocking, reclamation, afforestation	Widespread in uplands/west	Bad
Dry heath (4030)	Afforestation, over/under grazing, burning	Widespread in a range of areas	Poor
Limestone pavement (8240)	Quarrying, reclamation for agriculture, reduced grazing	Burren, localised outcrops in west/north-west	Poor
Juniper scrub (5130)	Overgrazing, agricultural expansion, fire	West	Poor
Blanket bog (7130,) active - priority habitat	Overgrazing, peat cutting, drainage	Mainly lowlands/uplands of Atlantic coast	Bad
Rhynchosporion depressions (7150)	Can exploit degraded bog and heath habitats, therefore in favourable condition	Widespread in all but the east and south-east	Good
Active raised bog (7110) - priority	Drainage, peat cutting, over/under grazing	Local, mainly in midlands	Bad
Degraded raised bog (7120)	Drainage, peat cutting, over/under grazing	Widespread, mainly in midlands	Poor
Bog woodland (91D0) - priority	Drainage, peat cutting, burning, development	Central and north midlands	Poor
Siliceous scree (8110)	Extent of damage from historical grazing pressures unclear	High uplands/mountains	Poor
Siliceous rocky slopes (8220)	Possibly recreational activities and grazing, but not yet determined	Small isolated patches along in upland areas	Poor
Calcareous scree (8120)	Extent of damage from historical grazing pressures unclear	Uplands of Sligo/Leitrim	Poor
Calcareous rocky slopes (8210)	Extent of damage from historical grazing pressures unclear	High uplands/mountains	Poor
Alpine and sub-alpine heath (4060)	Over-burning, over-grazing by sheep, afforestation	Generally summits and slopes >350m	Bad
Old oak woodlands (91A0)	Clearance in the past, now under grazing an issue	Acidic soils, mainly Cork, Kerry and Wicklow	Bad
Alluvial forests (91E0)	Fragmentation, alien species, sub-optimal grazing	Widespread along rivers subject to flooding	Bad
Yew woodland (91J0)	Invasive aliens, lack of suitable habitat to expand, overgrazing	Very localised in south and midlands	Bad

Habitat	Influencing factors	Location	Status
Coastal lagoons	Eutrophication from agricultural run-off, drainage	Concentrated in west, south and south-east	Bad
Hard water lakes (31401)	Eutrophication from agricultural run-off, particularly phosphorus	Concentrated in centre, east and west	Bad
Dystrophic lakes (3160)	Overgrazing, peat cutting, afforestation	Widespread in uplands, peaty soils	Bad
Upland oligotrophic lakes (3130)	Eutrophication from agricultural run-off, invasive species	Extensive in lowlands	Bad
Alkaline fens (7230)	Drainage, eutrophication from agricultural run-off, infilling	Widespread, but local from midlands northwards	Bad
Lowland oligotrophic lakes (3110)	Eutrophication from agricultural run-off, invasive species	Extensive in uplands	Bad
Alkaline fens (7230)	Drainage, eutrophication from agricultural run-off, infilling	Widespread, but local from midlands northwards	Bad
Calcareous fens with <i>Cladium mariscus</i> / <i>Carex davalliana</i> (7210) - priority	Drainage, land reclamation, peat cutting and forestry	Widespread but localised in a variety of habitats, most common in midlands, west and south-east	Bad
Floating river vegetation (3260)	Eutrophication, afforestation, alien species	Widespread in rivers	Bad
Transition mires and quaking bogs (7140)	Vulnerable to water abstraction and drainage	Widespread but rare in south and east	Bad
Natural eutrophic lakes (3150)	Nutrient enrichment	Concentrated in Clare, Galway and northwest.	Bad

Appendix IX - Current conservation status of Annex II, IV and V species associated with or impacted by agriculture, which are protected under the Habitats Directive

Species	Influencing factors	Location	Status
Higher plants, mosses and liverworts			
Marsh saxifrage (1528) Annex II, IV	Peat cutting, under grazing	Bogs in north-west Mayo	Good
Slender naiad (1833) Annex II, IV	Eutrophication from agricultural and domestic sources, manure spreading	Mainly in western lakes	Poor
Petalwort (1395) Annex II, IV	Development, agricultural improvement and overgrazing (+ve)	Lime rich sand along mainly western coastline	Good
<i>Leucobryum glaucum</i> (1400) Annex V	Quality of associated habitats, bogs, heath, woodland, are poor due to inappropriate grazing	Relatively widespread on acid substrate, mainly west and centre	Poor
<i>Hematocaulis vernicosus</i> Annex II	Possibly over grazing, wind farms, drainage	Bog flushes in west and centre	Good
<i>Lycopodium</i> group (1413) Annex V	Loss of associated heath, <i>Nardus</i> grassland and moorland through over grazing, improvement	Variety of habitats mainly in west and south-west	Poor
<i>Cladonia</i> species (5113) Annex V	Decline in associate habitats – mountain, sand dunes, bogs	Widespread	Poor
<i>Spaghnum</i> species (1409) Annex V	Loss of associated habitat, drainage, over grazing, afforestation etc.	While widespread the condition of many associated habitats is itself inadequate	Poor
Fauna			
Narrow-mouthed whorl snail (1014) Annex II	Loss of wetland habitat, drainage, sheep grazing	Mainly along western seaboard	Poor
Geyer's Whorl Snail (1013) Annex II	Loss of wetland habitat, drainage; lack of appropriate grazing	Mainly along western seaboard & midlands	Poor
Desmoulin's whorl snail (1016) Annex II	Loss of wetland habitat, drainage, excessive grazing (light grazing can be beneficial).	Mainly from Shannon basin & midlands east to Dublin	Bad
Kerry slug (1024) Annex II, IV	Intensification of land use, afforestation, invasive species	Woodland, blanket bog, heath in south-west and south-east	Good
Freshwater pearl mussel (1029)	Increased sediment load, eutrophication, acidification of	Widespread, nutrient poor waters	Bad

Species	Influencing factors	Location	Status
Annex II, V	waters		
Nore Freshwater pearl mussel (1990) Annex II, V	Eutrophication, siltation, acidification of waters	Restricted to 10km stretch of the River Nore	Bad
Marsh fritillary (1065) Annex II	Extensive habitat loss of damp meadows, dunes and wet heath, heavy summer grazing, fragmentation of habitat	Widespread, centre and west	Poor
River (1099) lamprey Annex II, V Brook (1096) lamprey Annex II	Eutrophication, arterial drainage, destruction of suitable spawning areas	Widespread but local in rivers and suitable lakes	Good
White-clawed crayfish (1092) Annex II, V	Eutrophication, pesticides, increased sediment load	Widespread by localised in limestone rich waters	Poor
Sea lamprey (1095) Annex II	Weirs, channel maintenance, possibly eutrophication	Spawn in lower reaches of rivers, mainly along the south-east, south-west and western coasts	Poor
Killarney shad (5046) Annex II, V	Eutrophication of Lough Leane	Lough Leane only	Good
Twaite shad (1103) Annex II, V	Eutrophication, presence of weirs	Spawning activity has only been recorded in five large rivers in the south-east: the Barrow, Munster Blackwater, Suir, Nore and Slaney.	Bad
Allis shad (1102) Annex II, V	Drift netting in the past, other adverse factors unclear	Lower reaches of estuaries along the south-east, west and south-west coasts	Unknown
Pollan (5076) Annex V	Eutrophication, introduced species	Loughs Derg, Ree and Allen	Bad
Natterjack toad (1202) Annex	Land drainage is the primary adverse factor	Dingle and Iveragh peninsulas in Kerry	Bad
Atlantic salmon (1106) Annex II, V	Reduced survival, eutrophication from a number of sources, over-fishing	Widespread in high quality waters	Bad
Common frog (1213) Annex V	Wetland drainage, reduction in microhabitats	Widespread	Poor
Lesser horseshoe bat (1303) Annex II, IV	Loss of linear commuting features such as hedgerows, agricultural intensification results in lower	Confined to western counties - Cork, Kerry, Limerick,	Good

Species	Influencing factors	Location	Status
	populations of prey items	Clare, Galway and Mayo.	
Other Bats (combined) Annex IV	Positive impacts with increasing woodland, farmland with hedges and other features for foraging	Widespread	Good
Irish hare (1334) Annex V	Reduction in habitat, loss of refuges such as hedgerows	Widespread	Poor
Otter (1355) Annex II, IV	Depends on good water quality, which has been increasing	Widespread	Poor
Pine marten (1357) Annex V	At risk from deforestation	Widespread, mainly centre, north and west in woodlands, scrub	Good

Notes: -

Annex II: Animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation.

Annex IV: Animal and plant species of community interest in need of strict protection.




Annex V: Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures.

Appendix X - Current conservation status (Status after Lynas *et al.*, (2007)) of Annex I bird species protected under the Birds Directive and associated with agriculture which regularly occur in Ireland

Bird Species	Influencing factors	Location	Status
Barnacle geese	Habitat loss of semi-improved grasslands, over and under grazing of grasslands leading to changes in ideal feeding conditions	Localised winter visitor to coasts and off-shore islands	Amber
Bar-tailed godwit	Possibly global warming, habitat loss	Winter Visitor to coastal estuaries; unlike Black-tailed Godwit not known to feed on agricultural fields.	Amber
Bewick's swan	Appears to be short stopping on the continent and in UK due to climate change	Now an increasingly rare winter visitor to wetlands in Ireland	Red
Chough	Long term declines, related to loss, fragmentation and deterioration in semi-natural grasslands and coastal heath, chemicals in cow pats lowering invertebrate production	Resident along rocky coasts in Munster, as well as parts of Connaught and Ulster	Amber
Corncrake	Changes in agricultural practices, heavy flooding in Shannon Callows	Hay meadows, Donegal, western Connaught, Shannon Callows	Red
Dunlin	Loss of breeding habitat along the western and northern coasts due to land use intensification/ developments	Summer and winter visitor along the coast	Amber
Golden eagle	Formerly bred in Ireland – extirpated in the 18th Century. Poisoning now the major threat	Currently re-introduced into Donegal, birds recorded in upland areas throughout Ireland	Red
Golden plover	Red listed as a breeding species – breeds in moorlands and acid grasslands where it is at risk from agricultural intensification, landuse change, drainage of wetlands and predation	Widespread but local as a wintering visitor along coasts, and inland; feeds away from the coast on open grassland often in large numbers	Red
Greenland white-fronted geese	As with other geese and swans has been shifting more to foraging on agricultural grassland / crops. Increasing dependence & hence risk from agriculture, landuse change etc Climate change has been raised as a major adverse factor, collision with man-made structures, agricultural intensification	Scarce winter visitor to wetlands; majority using a limited number of sites such as in Wexford Wildfowl Reserve	Amber

Bird Species	Influencing factors	Location	Status
Hen harrier	Habitat loss in uplands, overgrazing by sheep, persecution. Wintering birds often forage over coastal stubble fields – vulnerable to habitat loss through early removal of stubble through spraying or ploughing-in.	Uplands/bogs in summer, lowlands around coast in winter	Red
Kingfisher	Changes in water quality and associated fish stocks may influence kingfisher populations	Widespread, but local	Amber
Nightjar	Historic declines associated with woodland clearance for agriculture, degradation and fragmentation of heathland and block afforestation	Summer visitor to uplands in south-east	Red
Merlin	Agricultural intensification, in uplands and afforestation	Widespread but local	Amber
Peregrine	Historic reduction on breeding success as a result of exposure to chemicals from a variety of sources, including agriculture	Widespread but local	Green
Short-eared owl	Habitat loss of rough grassland, coastal marsh and sand dunes	A scarce winter visitor favouring coastal lowlands mainly in the south and east. A rare upland breeding species	Amber
Whooper swan	As with other geese and swans has been shifting more to foraging on agricultural grassland / crops. Increasing dependence & hence risk from agriculture, landuse change etc. Also vulnerable to climate change, collision with man-made structure, lead poisoning and water pollution	Winter visitor to wetlands in centre, north and west, also in south-east coast	Amber

Appendix XI – High level Screening Assessment of Annex I habitats listed on the Habitats Directive, associated with agricultural influences, from potential impacts under FH2020 (pre-mitigation)










Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹⁰
		+/- Grazing	Eutrophication	Drainage	Land management changes			
Upland (primarily) water dependant habitats	Upland oligotrophic lakes (3130) 		✓			Possible	Widespread in uplands, and also found in lowland areas. FH2020 indicates slight reduction in upland sheep numbers; under grazing and subsequent vegetation change may become an issue in west, north-west and south-west; vegetation changes may be brought about by switch from sheep to cattle; localised impacts may occur	Medium
	Dystrophic lakes (3160) 		✓			No	Upland sheep numbers under FH2020 to decline slightly, therefore no change in FSC expected as a result of FH2020;	High
	Wet heath (4010) 	✓			✓	No	Reduction in sheep numbers under FH2020 may result in localised under grazing or aid recovery of this habitat, but unlikely to be a significant impact on wet heath status	High
	Blanket bog (7130 active priority)	✓			✓	Possible	Reduction in sheep numbers may result in localised and	High











¹⁰ Reliability in the potential impact assessment is considered to be a three-stage:









High reliability indicates that there is sufficient and robust scientific data/knowledge available to be very confident in the impact assessment











Medium reliability indicates there is generally sufficient and somewhat robust data/knowledge available to inform the impact assessment








Low reliability indicates that there is little scientific data or knowledge available, or what data is available is not robust

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹⁰
	habitat) 						insignificant under grazing; possibility of livestock change from sheep to cattle in places which may impact on vegetation composition and impacts such as trampling; localised impacts possible	
	<i>Rhynchosporion</i> depressions (7150) 					No	An ephemeral habitat which is unlikely to be significantly impacted under FH2020	High
	Transition mires and quaking bogs (7140) 		✓		✓	Possible	Widespread but rare in south and east. Vulnerable to adjacent improvements to agricultural land such as drainage and water abstraction; may be vulnerable to changes in stocking density; localised impacts possible	Medium
	Natural eutrophic lakes (3150) 		✓			Possible	Range of habitat type needs to be clarified ; potential for some increase in nutrient level but this may not be significant	Low/medium
Other upland (primarily) habitats	Species rich <i>Nardus</i> grassland (6230) 	✓			✓	Possible	Widespread in upland areas. Increased or decreased stocking densities could result in vegetation change; intensification and changes of land management can impact on condition, e.g. supplementary feeding; however the distribution of this grassland type is likely to be outside of main potential areas for intensification, but localised impacts may occur	High
	Dry heath (4030) 	✓				No	Increased or decreased stocking densities and possibility of change of livestock type under FH2020 may result in vegetation changes but as the numbers are very small this is not likely to be significant	High
	Calcareous scree (8120) 	✓				No	FH2020 anticipates general decreases in sheep numbers which may have positive impact on scree habitat; under grazing unlikely to be a significant factor	High
	Calcareous rocky slopes (8210) 	✓				No	As for calcareous scree above	High
	Siliceous scree (8110) 	✓				No	As for calcareous scree above	High
	Alpine and sub-alpine heath	✓				No	Upland sheep numbers under FH2020 to decline slightly,	High

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹⁰
	(4060) 						therefore no change in FSC expected as a result of FH2020;	
	Siliceous rocky slopes (8220) 					No	No impacts predicted on this habitat as occurs in small, isolated patches	High
Freshwater & associated habitats	Petrifying springs with Tufa formation (7220) – priority 		✓	✓		Possible	Because of the wide range of situations in which this habitat occurs, including within fen, heathland grassland etc. there is low to medium potential for FH2020 to cause impacts	Medium
	Hard water lakes (31401) 		✓			Yes	Potential for increased eutrophication from agricultural intensification	Medium
	Turloughs (3180) – priority 		✓			Possible	Although outside of the potential key areas of dairy expansion, intensification of mainly cattle farming in vicinity may cause localised eutrophication; species associated with turloughs are very vulnerable to changes in nutrient status and grazing changes	High
	Hydrophilous tall herb (6430) 		✓		✓	Possible	Scattered and rare, although not surveyed in detail in Ireland; potentially there may be negative impacts from increased fertiliser use in sensitive river catchments in south-east	Medium
	Floating river vegetation (3260) 		✓			Possible	Potential for increases in eutrophication from increased fertiliser use in catchments under FH2020	High
	Lowland oligotrophic lakes (3110) 		✓			Possible	Potential for eutrophication as a result of agricultural intensification under FH2020	High
	<i>Chenopodium rubri</i> (3270) 	✓	✓			Possible	Isolated and associated with turloughs, requires nutrient input and grazing to remain open but can also be impacted by diffuse pollution and poaching by livestock; should dairying expand in areas where turloughs are present there is potential for impacts	High
Raised bogs, fens and mires	Active raised bog (7110) – priority 	✓				No	Reduction in sheep numbers under FH2020 may result in localised under grazing but is not likely to be a significant impact on this habitat;	High




Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹⁰
	Degraded raised bog (7120) 	✓			✓	Possible	Potential decrease in lowland sheep numbers; or change from sheep to cattle in midlands may have localised impacts	High
	Alkaline fens (7230) 		✓			Possible	Widespread except from south-west dependent on groundwater. Although this habitat appears to have high buffering capacity for N and P, potential increases in fertiliser and farming intensification in midlands may have localised impacts	Medium
	Calcareous fens with <i>Cladium mariscus</i> / <i>Carex davalliana</i> (7210) - priority 				✓	Possible	Because of the wide range of situations in which this habitat occurs, including within overgrown ditches, wet meadows, floodplains etc. there is low to medium potential for FH2020 to cause impacts	Medium
	Bog woodland (91D0) - priority 		✓			No	Associated with raised bogs; potentially impacted by agricultural intensification but these impacts unlikely to be significant under FH2020 as this habitat is of limited interest for agriculture	High
Lowland grassland	Orchid rich/ calcareous grasslands (6210) 	✓			✓	Yes	Widespread, but local, primarily in centre, west and north-west. Change in stocking density and livestock type may occur; changes in land management techniques possible; however largest areas outside of the potential primary areas of dairy expansion, but potential for impact on some sites supporting this habitat type	High
	Lowland hay meadows (6510) 	✓			✓	Unlikely	Primarily along the floodplains of large rivers such as the Shannon and Moy. Grazing restricted on these habitats till after hay cut if in Natura 2000 site; slight potential for increased grazing under FH2020 but unlikely to be significant but localised impacts could occur	High
	<i>Molinia</i> meadows (6410) 	✓		✓	✓	Yes	Widespread, on fluctuating water tables/acid soils. Change in stocking density and livestock type may occur; changes in land management techniques possible	High
	Limestone pavement (8240) 	✓			✓	Yes	Widespread, but local, primarily in centre, west and north-	High

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹⁰
							west. Intensification of grazing and changes in management practices may occur under FH2020, but extent and of changes are unknown	
	Calaminarian grassland (6130) 				✓	No	No impact predicted from FH2020 on this grassland with very restricted range associated with old mines	High
Coastal	Mediterranean salt meadows (1410) 	✓				No	Unlikely to be significant increases in livestock numbers on this habitat under FH2020	High
	Atlantic salt meadows (1330) 	✓				No	Unlikely to be significant increases in livestock numbers on this habitat under FH2020	High
	Halophilous scrub (1420) 					No	Very localised in occurrence, mainly at risk of coastal erosion and unlikely to be significant increases in livestock numbers on this habitat under FH2020	High
	Fixed dunes (grey dunes) (2130) 	✓				No	FH2020 unlikely to result in significant increases/decreases in stocking densities on this habitat	High
	Dunes with creeping willow (2170) 	✓				No	FH2020 unlikely to result in significant increases/decreases in stocking densities on this habitat	High
	Humid dune slack (2190) 		✓			No	FH2020 unlikely to result in significant increases/decreases in stocking densities on this habitat	High
	Decalcified <i>Empetrum</i> dunes (2140) 	✓				No	Very restricted in extent to a small number of sites along the north-west coast, FH2020 will not result in increases/decreases in stocking densities on this habitat	High
	Decalcified dune heath (2150) 	✓			✓	No	Generally restricted to coasts of Donegal, Mayo & Wicklow, FH2020 unlikely to result in significant increases/decreases in stocking densities on this habitat	High
	Machair (21A0) – priority 	✓			✓	Possible	Restricted to western coasts. Generally unlikely to be potential for expansion of intensive farming methods in areas of machair; however, sensitive to a hydrological changes and N and P inputs	High

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹⁰
	Estuaries (1130) 		✓			Possible	Widespread. Potential for regional impacts on water quality, mainly in SWRB district where highest proportion of dairy farming is located and may be subject to expansion	Medium
	Coastal lagoons (1150)- priority 		✓			Possible	Concentrated in west, south and south-east. Eutrophication from agricultural sources is one the main causes of current 'bad' status; FH2020 may result in slight increase in nutrient supply and could have potential impacts on this habitat	Medium
	Vegetated sea cliffs (1230) 	✓				No	FH2020 unlikely to result in significant increases/decreases in stocking densities on this habitat	High
Woodland and scrub	Old oak woodlands (91A0) 					No	No specific FH2020 target which impact on annex oak habitat	High
	Alluvial forests (91E0)- priority 		✓			Possible	Widespread along rivers subject to flooding. Potential for eutrophication from off-site agricultural intensification and drainage may cause impacts	High
	Juniper scrub (5130) 	✓				No	FH2020 may result in reduction in sheep grazing pressure which would be positive for this habitat; possible slight increase in grazing pressure from lowland sheep may impact on recruitment of juvenile plants; maintenance of current grazing is a significant negative impact	High
	Yew woodland (91J0) 					No	Impacts under FH2020 unlikely for this habitat which is very restricted to a small number of sites	High




Notes:

Conservation status of habitats is based on information in NPWS (2008)

	Bad conservation status
	Poor conservation status
	Good conservation status

The screening assessment above is based on available information and predictions/assumptions on the roll out of FH2020. The screening matrix should be revisited and revised as more detailed FH2020 proposals come forward, and particularly when the updated conservation status assessment is published by National Parks and Wildlife Service.

Appendix XII – High level Screening Assessment of Annex II, IV and V species listed on the Habitats Directive, associated with agricultural influences, from potential impacts under FH2020 (pre-mitigation)






Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹¹
		+/- Grazing	Water quality	Drainage	Land management changes			
Upland plant species	Marsh saxifrage (1528)  Annex II, IV	✓				No	Very restricted distribution to north Mayo. FH2020 indicates slight reduction in upland sheep numbers but unlikely to be significant impacts.	High
	Petalwort (1395)  Annex II, IV		✓			No	Found on lime rich sandy habitats along western coastline, which might experience some changes in grazing levels and stock types, but as this is restricted in distribution, unlikely to be significant impact.	High
	<i>Leucobryum glaucum</i> (1400)  Annex V	✓		✓	✓	Possible	Widespread but patchy, in west, centre and south-west. The wetland habitats with which it is associated are in general decline; slight reduction in upland sheep numbers unlikely to be a significant positive impact; elsewhere intensification of dairy farming, expansion of pig/poultry could have localised impacts in the southerly range of this species.	High







¹¹ Reliability in the potential impact assessment is considered to be a three-stage:







High reliability indicates that there is sufficient and robust scientific data/knowledge available to be very confident in the impact assessment








Medium reliability indicates there is generally sufficient and somewhat robust data/knowledge available to inform the impact assessment




Low reliability indicates that there is little scientific data or knowledge available, or what data is available is not robust


Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹¹
	<i>Hematocaulis vernicosus</i> (1393)  Annex II	✓		✓		No	Found in bog flushes in west and centre. The wetland habitats with which it is associated are in general decline, however, due to the very restricted range it is unlikely to be significantly impacted by FH2020.	High
	<i>Lycopodium</i> species group (1413)  Annex V	✓		✓	✓	Possible	Recent records indicate a more southerly range than previously thought, and this group may be under-recorded. The habitats which this group are associated are also in decline and their conditions are poor or bad. The species are vulnerable to adjacent improvements to agricultural land such as drainage; lowland populations may be vulnerable to intensification, would need to be assessed at local level.	Medium
	<i>Cladonia</i> species subgenus <i>Cladonia</i> (5113)  Annex V	✓			✓	Possible	A group which comprises common and rare species. The wetland and heathland habitats with which the <i>Cladonia</i> group are associated are in general decline and may be impacted further under FH2020. These species are vulnerable from improvements to agricultural land such as drainage; may be vulnerable to changes in stocking densities, but this would need to be assessed as FH2020 rolls forward as key areas of intensification unlikely to impact significantly on this moss group.	Medium
	<i>Sphagnum</i> genus (1409)  Annex V		✓			Possible	Widespread genus, primarily associated with wetland, bog and heath habitats which are themselves considered to have a poor to bad conservation status. Further deterioration in these habitats as a result of alterations in grazing regimes, management practices and improvements, would have negative impacts on this genus, but this would need to be assessed as FH2020 rolls forward as key areas of intensification unlikely to impact significantly on this moss group.	High
Other plant species	Killarney fern (1421) 					No	Very restricted distribution. Grazing has been described as an adverse issue in colonies accessible to grazers, and fertiliser	High

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹¹
	Annex II, V						use may impact on survivability. FH2020 appears to be unlikely to significantly affect the status of this species.	
Freshwater Species	Slender naiad (1833)  Annex II, IV		✓		✓	Possible	Mainly found in western and south-western lakes. Potential impacts could occur from eutrophication as a result of intensification, possibly in the south-west, but would be localised as main areas of intensification would not be within distribution range.	High
	White-clawed crayfish (1092)  Annex II, V		✓			Yes	This species is widespread in suitable lime rich watercourses and generally prefer unpolluted waters, although they can occur in slight to moderately polluted waters. Agricultural intensification along watercourse catchments has potential to increase nutrient loads and could cause negative impacts on crayfish in slight to moderate polluted waters.	High
	Freshwater pearl mussel (1029)  Annex II, V		✓		✓	Yes	Potential impacts may arise from increase in nutrients within sensitive catchments. The key issue is potential for increases in sediment loading of water bodies, as this species is particularly vulnerable to even temporary increases in sedimentation.	High
	Nore freshwater pearl mussel (1990)  Annex II, V		✓		✓	Yes	This species is very restricted in distribution to a 20km stretch of the River Nore and is considered to be on the verge of extinction. Potential impacts may arise from increase in nutrient loading along the River Nore catchment. The key issue is potential for increases in sediment loading of the Nore and its tributaries, as this species is particularly vulnerable to even temporary increases in sedimentation.	High
	Sea lamprey (1095)  Brook (1096) lamprey  Annex II		✓			Yes	Widespread in suitable river and lake catchments, but declining. Potential impacts may arise from increases in nutrient loads and fine sediment loads within sensitive river catchments; decreases in water quality may impact on lamprey, although the level of water quality which is optimal for lamprey is not yet quantified.	Medium

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹¹
	River (1099) lamprey 							
	Annex II,V							
	Killarney shad (5046) 		✓			No	Confined to Lough Leane, which has ‘moderate’ water quality at present (EPA) and water quality is gradually improving; potential increases in nutrient loads may cause negative impacts but as this species is so spatially restricted, impacts can be avoided from FH2020 through targeted measures.	High
	Twaite shad (1103)  Annex II, V		✓			Yes	Spawning activity has only been recorded in five large rivers in the south-east: the Barrow, Munster Blackwater, Suir, Nore and Slaney, within catchments where dairy expansion may occur. Potential impacts may arise from increase in nutrient loads within sensitive river catchments in south-east.	High
	Allis shad (1102)  Annex II, V					Unknown	Lower reaches of estuaries along the south-east, west and south-west coasts. Current threats to this species are unclear, potentially increases in nutrient loads in the south-east may impact on viability of this species, although there are no known spawning grounds for Allis shad in Ireland. Potential may need to be assessed on a site by site basis for this species during implementation of FH2020.	Low
	Atlantic salmon (1106)  Annex II, V		✓			Yes	Potential increase in diffuse pollution from agricultural intensification, particularly phosphorus, within sensitive catchments could lead to excessive plant growth and impact on salmon.	High
	Pollan (5076)  Annex V		✓			Unlikely	Restricted to Lough Derg, Ree and Allen. Populations are currently at critically low levels and thus very susceptible to threats. Potential increase in diffuse pollution from agricultural intensification, particularly phosphorus, within sensitive catchments could lead to excessive plant growth and impact on pollan.	Medium




Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹¹
	Otter (1355)  Annex II, IV		✓			Yes	Widespread. Direct impacts on otter are unlikely from FH2020; however potential impacts could occur where increases in nutrient loading result in adverse impacts on stocks of prey fish.	High
	Natterjack toad (1202)  Annex IV		✓			No	A rare species, found only in Dingle and Iveragh peninsula's and a translocated population in Co Wexford; land drainage has been the main impact on this species in the past at the Kerry sites, but locations of this species are well documented and additional drainage should not occur under FH2020; increased nutrient loads into breeding water bodies may impact on this species, but unlikely to be significant under FH2020.	High
	Common frog (1213)  Annex V		✓			No	Loss of microhabitats which are important for spawning may occur. However, this is a widespread species, and FH2020 appears to be unlikely to significantly affect the status of this species.	High
Invertebrates	Geyer's Whorl Snail (1013)  Annex II	✓		✓	✓	Unlikely	Restricted to west and small flushes in the centre. Potential impacts may occur from localised measures which impact on quality of wetland habitats but overall unlikely to be significant impacts under FH2020.	High
	Narrow-mouthed Whorl Snail (1014)  Annex II	✓		✓	✓	Unlikely	Restricted to the western seaboard and very localised in east. FH2020 unlikely to result in intensification of associated habitats along the coast.	High
	Desmoulin's Whorl Snail (1016)  Annex II	✓			✓	Possible	Mainly Shannon basin and eastwards through midlands to Dublin. Potential impacts may arise from intensification of agriculture in these areas but would need to be determined on a site by site basis.	High
	Marsh fritillary (1065)  Annex II	✓			✓	Yes	Widespread in the centre and west where devil's-bit scabious occurs. The exact habitat and life cycle requirements of this	Medium

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹¹
	Annex II						species are not thoroughly understood. However, where agricultural intensification occurs within suitable areas for marsh fritillary, it could result in fragmentation of breeding sites with resultant loss of integrity of metapopulation; changes in grazing density or stock types could alter habitat suitability and abundance of the foodplant, devil's-bit scabious.	
	Kerry slug (1024)  Annex II, IV	✓			✓	No	Found in woodland, blanket bog, heath in south-west (more recently Galway). Potential impacts could occur through changes in stocking density and intensification but as the habitats it is associated with are unlikely to be targeted for intensification, these impacts are unlikely to be significant.	High
Bats	Bats (combined)  Lesser horseshoe bat (1303) – Annex II, IV Common pipistrelle (1309) Soprano pipistrelle (5009) Nathusius' Pipistrelle (1317) Natterer's Bat (1322) Daubenton's Bat (1314) Whiskered Bat (1330) Brandt's Bat (1320) Brown Long-eared Bat (1326) Leisler's Bat (1331) All bats listed on Annex IV				✓	Yes	Direct impacts to bat are unlikely, but could occur at local level though loss of roosting opportunities. Indirect impacts may arise from the loss of linear commuting features such as hedgerows and from lowered prey populations where agricultural intensification occurs.	High
Other mammals	Irish hare (1334) 				✓	No	This is a widespread species, but local impacts may occur from loss of refuges such as hedgerows and from changes in habitat quality where under or over grazing occurs. FH2020 appears to	High

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹¹
	Annex V						be unlikely to significantly affect the status of this species.	
	Pine marten (1357) 				✓	No	The main impact on this species is deforestation which is not likely to occur on a significant basis under FH2020.	High
	Annex V							




Notes:

Conservation status of habitats is based on information in NPWS (2008)

	Bad conservation status
	Poor conservation status
	Good conservation status

The screening assessment above is based on available information and predictions/assumptions on the roll out of FH2020. The screening matrix should be revisited and revised as more detailed FH2020 proposals come forward, and particularly when the updated conservation status assessment is published by National Parks and Wildlife Service.

Appendix XIII - Screening Assessment of regularly occurring Annex I bird species listed on the Birds Directive and which are associated with agriculture from potential impacts under FH2020 (pre-mitigation)








Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹²
		+/- Grazing	Water quality	Drainage	Land management changes			
Upland bird species	Hen Harrier 	✓			✓	No	FH2020 indicates slight reduction in upland sheep numbers but possible conflict with CFP review process where increased stocking densities may occur; overgrazing is cited as a current issue, FH2020 targets may help reduce some of this pressure in upland areas, but in the long term under grazing may become a factor under FH2020; vegetation changes may be brought about by switch from sheep to cattle, this impact on hen harrier is not readily quantifiable.	Medium
	Golden eagle 				✓	No	The key threats to this species are persecution and poisoning (e.g. by rodenticides); FH2020 will not result in significant adverse impacts as Golden eagle is outside of key areas of expansion	Medium
	Nightjar 	✓			✓	No	Rare visitor/breeder in southern uplands; FH2020 does not appear to have potential to result in significant impacts on habitats associated with Nightjar in Ireland	Medium







¹² Reliability in the potential impact assessment is considered to be a three-stage:



High reliability indicates that there is sufficient and robust scientific data/knowledge available to be very confident in the impact assessment

Medium reliability indicates there is generally sufficient and somewhat robust data/knowledge available to inform the impact assessment

Low reliability indicates that there is little scientific data or knowledge available, or what data is available is not robust




Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹²
	Short-eared owl 				✓	No	A scarce visitor which uses uplands and coastal lowlands; potential impacts may occur from intensification of coastal lowland habitats under FH2020; potential positive impacts in uplands from reductions in sheep numbers	Low
Wetland and wading species	Bewick's swan 		✓	✓		No	Now a rare winter visitor to wetlands along the east coast and Ireland is at the westernmost extent of its European range; increased in tillage in south-east may favour forging Bewick's swan;	Medium
	Golden plover 		✓	✓	✓	Possible	Uses a wide range of habitats throughout Ireland; the small breeding population is primarily coastal whilst non-breeding birds can be found inland; FH2020 targets may result in slight negative impact on water quality which could have impacts on the small breeding population; elsewhere changes in land use and management practices could have impacts on foraging birds	High
	Barnacle goose 	✓			✓	Possible	Loss of semi-improved coastal grassland and over/under grazing of coastal grasslands which could result from FH2020 implementation could adversely impact on this species, but it is not clear if impacts on these grassland habitats would be significant under FH2020 targets	Medium
	Bar-tailed godwit 		✓			Possible	Occur principally along estuaries particularly sand ones; potential for regional impacts on water quality in estuaries, mainly in SWRB district where highest proportion of dairy farming is located;	Medium
	Dunlin 		✓			No	Small –scale loss of breeding habitat along the west and north coasts may occur but unlikely to be significant	Medium
	Greenland white-fronted goose 				✓	No	A scarce winter visitor to Wexford Wildfowl Reserve western Ireland; foraging could be potentially impacted through agricultural intensification under FH2020 but not likely to be significant	Medium

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹²
	Little egret 				✓	Possible	Has significantly increased its population in Ireland since 1997; potential impacts from FH2020 may arise from agricultural intensification resulting in loss of nesting habitat (trees, scrub); possible impact from predicted slight decrease in surface water quality but whether this would result in significant impacts is unclear	Medium
	Red-throated diver 		✓			Possible	Widespread overwintering bird, but only breeds in Donegal in small numbers; feeds on a variety of food items including sand eels, sprats, frogs, shrimps and molluscs; potential for impacts on food items from slight impact on surface water quality predicted under FH2020	Medium
	Whooper swan 		✓		✓	Possible	Widespread distribution and overwinters in Ireland; potentially sensitive to agricultural intensification and slight impact on surface water quality which may result under FH2020	Medium/ high
Lowland and other birds	Corncrake (1395) 				✓	No	Corncrake are restricted to a small number of hay meadows in the Shannon Callows, Donegal and occasionally elsewhere in western Connaught; AEOS and REPS offer current management options for the strongholds; and other known locations; FH2020 will be rolled out in tandem with existing corncrake measures and will not impact on this species.	High
	Chough 				✓	No	Resident along rocky coasts; the main impacts which could arise from implantation of FH2020 are further fragmentation and deterioration in semi-natural grasslands and coastal heath but unlikely to be significant	Medium
	Kingfisher 		✓			Possible	This species is dependent on freshwater habitats, and there is no indication that eutrophication has adversely impacted populations; slight negative impact predicted on surface water quality from FH2020 may potentially have impact on this species through reduction in prey, but this is	Low/ medium

Natura 2000 Qualifying Interest categories	Qualifying Interest and current status	Primary potential changes under FH2020				Potential for significant negative impacts on FCS of Qualifying Interest under FH2020	Rationale	Reliability ¹²
							not readily quantifiable at present	
	Merlin 				✓	Possible	The key threats to this species are agricultural intensification and poisoning (by e.g. rodenticides); FH2020 will may result in agricultural intensification and could potentially significant adverse impacts on this bird of prey species through reduction in habitat and availability of prey and indirectly through potential increased use of rodenticides	Low /medium
	Peregrine 				✓	Possible	Similarly to Merlin, FH2020 may result in impacts on Peregrine through agricultural intensification which may decrease habitat and prey availability, and indirectly through potential for increased use of rodenticides	Low/Medium

Notes:

Conservation status of habitats is based on information in Lynas *et al.*, (2007)

	Bad conservation status
	Poor conservation status
	Good conservation status

The screening assessment above is based on available information and predictions/assumptions on the roll out of FH2020. The screening matrix should be revisited and revised as more detailed FH2020 proposals come forward, and particularly when the updated conservation status assessment is published by National Parks and Wildlife Service.

Addendum: Summary of Biodiversity and Flora & Fauna characteristics of Regions

Baseline Information on Biodiversity in the South-West region

The south-west region covers the Counties of Cork and Kerry which is predominantly used for dairying activities in the lowlands and sheep in the uplands. Designated habitats and species of importance relate primarily to the upland and coastal areas, and are concentrated in County Kerry.

Water Dependent Annex 1 Habitats¹³ and associated Annex II, IV and V species in this region are primarily located along the coastline; e.g. Atlantic salt meadows, fixed dunes, or occur as part of the extensive Killarney National Park in Kerry. Upland blanket bog is scattered in extent, but wet heath, natural dystrophic lakes and oligotrophic to mesotrophic standing waters feature. Freshwater pearl mussel is present within a number of river catchments. The Gearagh, a site of international importance, is where the most extensive alluvial woodland in Western Europe is found. Otter is present, as are sea, river and brook lamprey and Killarney shad. A 20km area around Derrynane is one of the primary locations for the protected natterjack toad in Ireland.

Terrestrial Annex 1 Habitats¹⁴ and Annex II, IV and V species in this region are primarily located within the uplands and include *Molinia* meadows, old sessile oak woodlands (e.g. in Killarney and Glengarriff), European dry heaths and alpine and boreal heaths. Kerry slug, Killarney fern occur, with marsh fritillary known from some sites of *Molinia* grassland. Bats are common throughout.

Annex 1 birds listed under the Birds Directive in the Cork/Kerry area include those with coastal affinities such as chough and peregrine, merlin and populations of hen harrier in the uplands.

In addition to Natura 2000 sites, there are a small number of nationally protected Natural Heritage Areas which encompass a range of water dependent and terrestrial habitats and associated complement of rare and notable flora and fauna species.

Nationally protected flora includes those associated with species diverse semi-improved grassland; e.g. clustered clover and autumn crocus, with old hedgerows, e.g. bird cherry and with wetland areas, e.g. mudwort.

Nationally protected species such as smooth newt, brown hare, and viviparous lizard are widespread though local.

Other bird species associated with the region are primarily lowland farmland birds with less ornithological interest associated with features such as hedgerows, extensive cattle grazed pasture in the lowland, sheep grazed pasture in the uplands (mainly in co Kerry).

Red Data Book Species in this region include species scarce and rare annual weeds associated with now declining areas of tillage land, flora and fauna in upland habitats such as recurved sandwort (Caha Mountains), species of species diverse semi-improved grassland such as. A number of rare beetles, butterflies and other invertebrates have been recorded in suitable habitats. They are generally not associated with intensive dairy pasture, but with remaining semi-natural habitats and wetlands.

High Nature Value farmland habitats which within the region is likely to consist of semi-natural grassland, scrub, hedgerows, ponds and wetlands. These features will be spread throughout the region, but will be localised in occurrence. Much valuable semi-natural grassland exists outside of national and international designations and so is vulnerable to inappropriate grazing.

¹³ Protected under EU Habitats Directive, excludes marine water bodies

¹⁴ Protected under EU Habitats Directive

Other flora and fauna include soil biota such as earthworms, nematodes, springtails; common plants and invertebrates associated with existing pasture in the lowlands; and more specialised, but still common and relatively widespread, flora and fauna associated with upland habitats.

Baseline Information on Biodiversity in the South-East Region

The South-East includes Counties Carlow, Kilkenny, South Tipperary, Waterford and Wexford. These areas are primarily used for dairying activities and host the following key biodiversity elements:

Water Dependent Annex 1 Habitats and associated Annex II, IV and V species in this region are extensive and primarily located along the coastline and along the major river valleys; e.g. River Barrow and River Nore SAC, River Nore SPA. The area supports the only known population of the Nore freshwater pearl mussel, and large populations of freshwater pearl mussel, and high water quality is required in these catchments. They also attract large populations of winter wildfowl and rate as some of the most important bird areas in Ireland. Sea, river and brook lamprey.

Terrestrial Annex 1 Habitats and Annex II, IV and V species in this region are more scattered and include dry heath of the Blackstairs and Galtee Mountains, orchid rich calcareous grasslands of the Cullahill Mountains and species rich *Nardus* grassland in the Moanour Mountain.

Annex 1 birds listed under the Birds Directive in the south-east region include those with coastal and wetland affinities, particularly populations of Bewick's swan and Greenland white-fronted geese.

In addition to Natura 2000 sites, there are a small number of nationally protected Natural Heritage Areas which encompass a range of water dependent and terrestrial habitats and associated complement of rare and notable flora and fauna species.

Nationally protected flora include those associated with species diverse semi-improved grassland such as bird's-foot, species such as heath cudweed which are associated with heathland, and the nettle leaved bellflower is found only on the edges of the River Barrow and Nore.

Nationally protected species such as smooth newt, brown hare, viviparous lizard are widespread though local. There is a natterjack toad population which has been translocated to a reserve in Co Wexford.

Other bird species associated with the region are primarily lowland farmland birds associated with the extensive cattle grazed pastures, coastline and semi-natural habitat features.

Red Data Book Species in this region include species scarce and rare annual weeds associated with now declining areas of tillage land, species associated with semi-improved grassland, river valleys and with wetlands. A number of rare beetles, butterflies and other invertebrates have been recorded in suitable habitats. They are generally not associated with intensive dairy pasture, but with remaining semi-natural habitats and wetlands.

High Nature Value farmland habitats which within the region is likely to consist of semi-natural grassland, scrub, hedgerows, woodland strips, ponds and wetlands. These features will be spread throughout the region, but will be localised in occurrence. Much valuable semi-natural grassland exists outside of national and international designations and so is vulnerable to inappropriate grazing.

Other flora and fauna include soil biota such as earthworms, nematodes, springtails; common plants and invertebrates associated with existing pasture in the lowlands; and more specialised, but still common and relatively widespread, flora and fauna associated with upland habitats.

Baseline Information on Biodiversity in the Mid-West Region

For the Mid-West Region, which includes Counties Clare, North Tipperary and Limerick, the principal land use is for beef, with lesser amounts of dairying and tillage.

Water Dependent Annex 1 Habitats and associated Annex II, IV and V species in this region are located mainly along the coasts and as lakes and rivers, particularly the large complex of the Lower River Shannon. The Clare region is famous for its turloughs which are of international note as their main extent is in Ireland and the Shannon Callows are of importance for a host of species.

Terrestrial Annex 1 Habitats and Annex II, IV and V species in this region are characterised by the karstic limestone outcrop of the Burren region with its associated species rich limestone grassland, some traditionally managed hay meadows and other semi-improved habitats. This region is one of the strongholds for the lesser horseshoe bat.

Annex 1 birds listed under the Birds Directive are protected within a number of SPA's in the region, such as the Slieve Aughty Mountains SPA which is important for hen harrier and merlin, the corncrake of the Shannon Callows, and peregrine along in the high mountains.

In addition to Natura 2000 sites, there are a small number of nationally protected Natural Heritage Areas which encompass a range of water dependent and terrestrial habitats and associated complement of rare and notable flora and fauna species.

Nationally protected flora include those associated with species diverse limestone grasslands and karst areas of the Burren such as shrubby cinquefoil, specialist plants of upland mountains (e.g. bog-hair grass), rare wetland species in the Shannon Callows such as opposite-leaved pondweed, and those associated with turloughs such as mudwort.

Other bird species associated with the region are primarily lowland farmland birds associated with the semi-improved and improved pastures, coastline, wetland features and semi-natural habitat features.

Red Data Book Species in this region are numerous and include species associated with semi-improved grassland, river valleys and with wetlands. A number of rare beetles, butterflies and other invertebrates have been recorded in suitable habitats, particularly the Burren region.

High Nature Value farmland habitats which within the region is likely to consist of semi-natural grassland, scrub, hedgerows, woodland strips, ponds and permanent and ephemeral wetlands. These features will be spread throughout the region, but will be localised in occurrence. Much valuable semi-natural grassland exists outside of national and international designations and so is vulnerable to inappropriate grazing.

Other flora and fauna include soil biota such as earthworms, nematodes, springtails; common plants and invertebrates associated with existing pasture in the lowlands; and more specialised, but still common and relatively widespread, flora and fauna associated with upland mountain habitats. The turloughs and other wetland features provide good quality habitat for common species of semi-natural habitats.

Baseline Biodiversity Information for the West Region

In the West Region, which includes Counties Galway, Mayo and Roscommon the main land use is for beef production, with small areas of dairying and tillage in east Galway.

Water Dependent Annex 1 Habitats and associated Annex II, IV and V species in this region are important and frequent, located mainly along the coasts and lakes and rivers which dissect the region. They include the River Moy, Lough Derg and part of the Shannon Callows. Turloughs are also common within this region.

Terrestrial Annex 1 Habitats and Annex II, IV and V species in this region are characterised by grasslands over free-draining limestone soils and upland heath and acid grassland areas. The offshore islands, such as Aran Islands still have strong but declining traditional management which supports a range of protected habitats and species, including species rich limestone grassland, dry heaths. Of particular note are the remaining, traditionally managed hay meadows, particularly those along the River Moy. Machair is also a rare and notable habitat in this region. This region is one of the strongholds of the rare and protected lesser horseshoe bat.

Annex 1 birds listed under the Birds Directive are found throughout the semi-improved and improved habitats, such as chough along the coastal margins, peregrine falcons, quail and corncrake in the Shannon Callows and dunlin associated with turloughs and hedgerows. Whooper swans are relatively common winter visitors.

In addition to Natura 2000 sites, there are a small number of nationally protected Natural Heritage Areas which encompass a range of water dependent and terrestrial habitats and associated complement of rare and notable flora and fauna species.

Nationally protected flora include those associated with species diverse limestone grasslands and hay meadows such as dandelion, cornflower and meadow barley on dry alluvial grassland, The coastal habitats host to a number of protected plant species, including purple milk-vetch and hairy violet. Rare arable weeds occur within traditional areas of rye cultivation for thatching on the islands and occasionally on the mainland. The Callows are also important for plants, with protected species such as opposite-leaved pondweed found in drainage ditches.

Other bird species associated with the region are primarily lowland farmland birds associated with the semi-improved and improved pastures, coastline, wetland features and semi-natural habitat features.

Red Data Book Species in this region are numerous and include species associated with semi-improved grassland, river valleys and with wetlands. A number of rare beetles, butterflies and other invertebrates have been recorded in suitable habitats, particularly associated with wetland features and with the species diverse limestone grasslands and hay meadows.

High Nature Value farmland habitats which within the region is likely to consist of semi-natural grassland, scrub, hedgerows, woodland strips, ponds and permanent and ephemeral wetlands. These features will be spread throughout the region, but will be localised in occurrence. Much valuable semi-natural grassland exists outside of national and international designations and so is vulnerable to inappropriate grazing. One of the key features of this region is the continued, but declining, influence of traditional management techniques on the environment which has largely contributed to the unique and outstanding biodiversity of the region.

Other flora and fauna include soil biota such as earthworms, nematodes, springtails; common plants and invertebrates associated with existing pasture in the lowlands; and more specialised, but still common and relatively widespread, flora and fauna associated with upland mountain habitats. The turloughs and other wetland features provide good quality habitat for common species of semi-natural habitats

Baseline Biodiversity Information for the Border Region

For the Border, which includes Counties Cavan, Donegal, Leitrim, Louth, Monaghan and Sligo, the main existing agricultural use is for beef cattle, sheep grazing and for the intensive pig/poultry industry. There are approximately 130 Natura 2000 sites within the region.

Water Dependent Annex 1 Habitats and associated Annex II, IV and V species in this region are important and extensive, located mainly along the coasts and lakes and rivers which dissect the region. They also include the extensive upland areas of active blanket bog (a priority habitat), fens and flushes, degraded blanket bogs and occasional turloughs. Freshwater pearl mussel, salmon, brook, river and sea lamprey are present in addition to other Annex species.

Terrestrial Annex 1 Habitats and Annex II, IV and V species in this region are characterised by *Molinia* and *Nardus* grasslands, upland heath and occasional lowland hay meadow. The maintenance of traditional management practices across much of the region has helped shape the biodiversity value of this region.

Annex 1 birds listed under the Birds Directive are found throughout the semi-improved and improved habitats such as, red grouse in Boleynbrack Mountains, merlin, hen harrier and peregrine in the uplands. The recently re-introduced golden eagle in Donegal is of interest, as is one of the largest remaining populations of corncrake in the Sligo/Donegal region.

In addition to Natura 2000 sites, there are a small number of nationally protected Natural Heritage Areas which encompass a range of water dependent and terrestrial habitats and associated complement of rare and notable flora and fauna species.

Nationally protected flora include those associated with upland areas such as Ben Bulbin and Kings Mountains range (e.g. fringed sandwort), with upland blanket bog (e.g. heath cudweed), in calcareous grassland (e.g. small-white orchid) and in other semi-natural habitats

Other bird species associated with the region are primarily lowland farmland birds associated with the semi-improved and improved pastures, coastline, wetland features and semi-natural habitat features.

Red Data Book Species in this region are numerous and include species associated with semi-improved grassland, river valleys and with wetlands. A number of rare beetles, butterflies and other invertebrates have been recorded in suitable habitats, particularly associated with wetland features and with the species diverse limestone grasslands and hay meadows.

High Nature Value farmland habitats which within the region is likely to consist of semi-natural grassland, scrub, hedgerows, woodland strips, ponds and permanent and ephemeral wetlands. These features will be spread throughout the region and will be relatively common still as part of farm enterprises. Much valuable semi-natural grassland exists outside of national and international designations and so is vulnerable to inappropriate grazing. One of the key features of this region is the continued, but declining, influence of traditional management techniques on the environment which has largely contributed to the unique and outstanding biodiversity of the region.

Other flora and fauna include soil biota such as earthworms, nematodes, springtails; common plants and invertebrates associated with existing pasture in the lowlands; and more specialised, but still common and relatively widespread, flora and fauna associated with uplands. The less intensive, semi-natural and traditionally managed land will be of value to a range of biodiversity and flora/fauna species.

Baseline Biodiversity in the Mid-East, Dublin and Louth

In the mid-east (Kildare, Meath and Wicklow) and Dublin Regions, biodiversity is in existence with the highest density of people and with intensive agricultural and horticultural practices. Natura 2000 sites are infrequent in this region, primarily based outside of the Dublin regions.

Water Dependent Annex 1 Habitats¹⁵ and associated Annex II, IV and V species in this region are primarily located along the coastline and the raised blanket bogs in the centre, Pollardstown fen in County Kildare, with the largest water-dependent unit being the Poulaphouca Reservoir in Co Wicklow. Otter is abundant along with other water dependent Annex species such as whorl snails at Pollardstown Fen.

Terrestrial Annex 1 Habitats¹⁶ and Annex II, IV and V species in this region are primarily located within the uplands of the Wicklow Mountains, and the extensive grasslands of the Curragh in County Kildare.

Annex 1 birds listed under the Birds Directive include golden plover in the Curragh, peregrine and merlin in Wicklow Mountains, kingfisher along watercourses. There have been recent poisonings of red kites within the region. The Boyne and the Nanny estuaries in County Meath are important bird areas and support bar-tailed godwit and golden plover in addition to other non-annex species.

In addition to Natura 2000 sites, there are a small number of nationally protected Natural Heritage Areas which encompass a range of water dependent and terrestrial habitats and associated complement of rare and notable flora and fauna species.

Nationally protected flora include arable weeds associated with tillage areas, although now in sharp decline, with the Wicklow uplands such as parsley fern and bog orchid, and with the grasslands in the Curragh.

Nationally protected species such as smooth newt, badgers, brown hare, viviparous lizard are widespread though local.

Other bird species associated with the region are primarily lowland farmland birds with less ornithological interest associated with features such as hedgerows, extensive cattle grazed pasture in the lowland, sheep grazed pasture in the uplands (mainly County Wicklow)

Red Data Book Species in this region include species scarce and rare annual weeds associated with now declining areas of tillage land, flora and fauna in upland habitats in Wicklow species of species diverse semi-improved grassland. A number of rare beetles, butterflies and other invertebrates have been recorded in suitable habitats. They are generally not associated with intensive dairy pasture, but with remaining semi-natural habitats and wetlands.

High Nature Value farmland habitats which within the region is likely to consist of semi-natural grassland, scrub, hedgerows, ponds and wetlands. These features will be spread throughout the region, but will be localised in occurrence. Much valuable semi-natural grassland exists outside of national and international designations and so is vulnerable to inappropriate grazing.

Other flora and fauna include soil biota such as earthworms, nematodes, springtails; common plants and invertebrates associated with existing pasture in the lowlands; and more specialised, but still common and relatively widespread, flora and fauna associated with upland habitats

¹⁵ Protected under EU Habitats Directive, excludes marine waterbodies

¹⁶ Protected under EU Habitats Directive

Notes and References

Notes and References:

Notes and References

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- ² [CSO Annual Population, Migration Estimates September 2012]
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- ¹⁷ http://www.epa.ie/pubs/advice/ea/EPA_development_methodology_SEA_synthesis_report.pdf
- ¹⁸ Sensitivity or a sensitive aspect of the environment refers to the key indicators being considered; i.e. sites, habitats, species or targets / thresholds (e.g. water quality targets such as those specified for salmonids or freshwater pearl mussel).
- ¹⁹ <http://www.nra.ie/Environment/EnvironmentalPlanningGuidelines/EnvironmentalImpactAssessmentofNationalRoadSchemes-DraftGuidelines/>
- ²⁰ <http://www.epa.ie/pubs/reports/air/airemissions/>
- ²¹ <http://tnet.teagasc.ie/fapri/downloads/pubs2003/luxag/paper3141003a.pdf>
- ²² Based on EPA, 2012 & preliminary NPWS Article 17 reporting.
- ²³ http://ec.europa.eu/environment/nature/natura2000/financing/docs/ENV-12-018_LR_Final1.pdf
- ²⁴ In 2008 environmental condition is considered 'relatively good', in 2012 environmental condition is considered 'good'.
- ²⁵ According to the 2012 report, "a review of water governance is currently under way to deliver more effective integration of roles and policies between the key government departments, the EPA and the lead local authorities".
- ²⁶ National Parks and Wildlife Service (www.npws.ie); Environmental Protection Agency (www.epa.ie); Department of Arts, Heritage and the Gaeltacht, Bullock et al (2008).
- ²⁷ For list of STRIVE reports, see <http://www.epa.ie/downloads/pubs/research/>
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- ²⁹ <http://www2.ul.ie/pdf/932500843.pdf>
- ³⁰ Indecon International Economics Consultants (2010). Mid-Term Evaluation of the Rural Development Programme Ireland (2007-2013)
- ³¹ See Ecology Supporting Information & Literature Review, Annex Document
- ³² An International Convention is a formal statement of principles, which becomes formally binding when ratified. Once ratified, International Conventions have the same force as International Treaties.
- ³³ Our life insurance, our natural capital: an EU biodiversity strategy to 2020" (EU, June 2011)
- ³⁴ Ecosystem approach is defined as a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.
- ³⁵ Sectoral Road Map 2018: Agriculture and the Environment Teagasc (2011)
- ³⁶ The Wildlife Act 1976 sets out the basis for designation of NHAs, and further designated under the Wildlife (Amendment) Act 2000
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- ¹¹⁸ The Border Region includes Counties Cavan, Donegal, Monaghan, Louth, Sligo & Leitrim.
- ¹¹⁹ Probable: probability estimated at above 50%, but lower than 95%
- ¹²⁰ Region contains the highest proportion of rivers & lakes in the High Status category nationally (32% & 57% respectively) with 7% estuaries in the High Status Category. 34% of national dairying is undertaken in Cork & Kerry. Nine Freshwater Pearl Mussel catchments are present. Additionally as the South Western region has the highest proportion of dairying nationally and highest quality water it is probable that impacts may be expected to be higher in this region than elsewhere nationally.
- ¹²¹ Rivers and Lake systems have (8% & 0% respectively) in the High Status category nationally. No estuaries in the High Status category. 23% of national dairying in Carlow, Kilkenny, South Tipperary, Wexford and Waterford.
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- ¹²³ has 14% of rivers & canals in the High Status category, while 26% of lakes and 23% of estuaries achieved High Status. The NWIRBD has six river catchments designated as SAC's for freshwater pearl mussel

- ¹²³ Rivers and Lake systems have (5% & 14% respectively) in the High Status category nationally. No estuaries are in the High Status category. 15.6% of national dairying in Clare, North Tipperary and Limerick
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Food Harvest 2020

Environmental Analysis Report

Final Report – January 2014





Food Harvest 2020

Environmental Analysis Report

Ecology Supporting Information & Literature Review



Prepared on behalf of

Food Harvest 2020 Environmental Analysis Report

Ecology Supporting Information & Literature Review

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1.

Overview

- 1.1 The Irish landscape and culture is one that incorporates agriculture at its core, and it is not surprising that many elements of our biodiversity have developed in tandem. Since Ireland joined the European Union, then the European Economic Union, in 1973 the pace at which agricultural expansion and intensification has occurred and been encouraged by subsidies, has resulted in landscape and biodiversity changes which are still being quantified.
- 1.2 As the agricultural production has intensified internationally, all levels of biological diversity (genetic, species, and habitats) have declined in farming environments (Walls, 2006). It is argued that only conventional agriculture can produce enough food to feed the world population of 9-10 billion, but emerging evidence supports that alternative agricultural methods could also provide enough food on a global basis to sustain the world population (Chappell & Lavalle, 2011). As such it has highlighted by many studies and policies, nationally and at European level, the importance of harmonising production goals with the preservation of biodiversity in the farmed landscape.

Adverse Impacts	Positive impacts
<ul style="list-style-type: none"> •Reduction in semi-natural habitat size, extent and integrity •Loss of traditional management practices •Land abandonment •Increased fertiliser applications with intensification leading to reduction in plant diversity and eutrophication of watercourses from run-off •Reduction in populations of a range of flora and fauna, notably birds •Policies and funding for actions/targets with negative environmental impacts 	<ul style="list-style-type: none"> •Implementation of Natura 2000 network •Recent recognition of High Nature Value farmland •Maintenance of habitat and species diversity •Retention of appropriate management in some marginal areas •Agri-environment schemes •Integration of biodiversity to the core of national and EU policies •Recent acknowledgement of the ecosystem services provided by the environment, which is starting to be integrated into policies and actions •Requirement for cross-compliance to reduce negative impacts of policies/action on the environment •CAP II which appears may increase funding opportunities for biodiversity led actions

Figure 1.1 - Summary of key positive and adverse agricultural pressures acting on biodiversity since Ireland joined the EU (then the EEU) in 1973 (Sources NPWS, 2008; Geneletti, 2007; EPA, 2012; Newton, 2004, ADAS, 2007)

- 1.3 Increasingly there is recognition that agriculture is a multifunctional service that provides many roles in addition to its primary role of producing food and other commodities (Geneletti, 2007). The value of ecosystem services associated with agricultural environments is still poorly understood and is not always consistently rewarded within agri-environment schemes. A recent study of the value of ecosystem services in Ireland estimated that the value of a small number of ecosystem services within an agricultural framework, namely soil biota,

pollinators, pest control and public utility benefits, benefited the economy by at least €1.4 billion annually (Bullock *et al.*, 2008).

- 1.4 However, one of the major factors likely to impact on the agriculture/biodiversity interface within the coming years is proposed reforms to the Common Agricultural Policy (CAP). Proposals are still being debated, and are likely to emerge by June 2013. However, indications are that the EC is proposing to link up to 30% of the CAP budget to the second pillar of CAP, which could be used to support rural development and environmental objectives (Irish Times, January 2013). This movement of resources from direct income support paid to farmers to targeted support for the provision of environmental goods may characterise the CAP post 2013 (Bureau and Mahé, 2008) and therefore ‘convergence’ will see the agriculture industry asked to deliver environmental services as well as food products.
- 1.5 Reaching the targets of Food Harvest 2020 for development of more intensive, efficient and productive farming industries in Ireland can only be achieved within the legal parameters of relevant European and national legislation. Major policy and legislative drivers impacting on the interaction between biodiversity and agriculture are illustrated in Figure 1.2 below: -

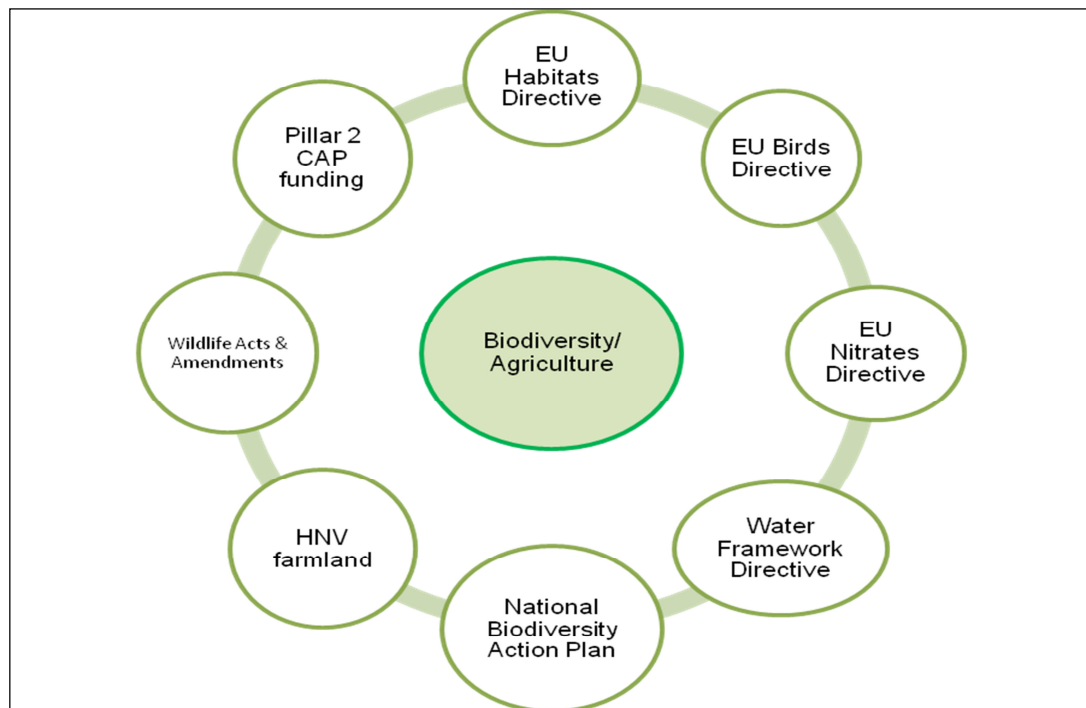


Figure 1.2 - Main legislative and policy drivers which influence the interaction between agriculture and biodiversity in Ireland at a national and European level.

- 1.6 In addition to the legal requirements, Ireland is a signatory to the Convention on Biological Diversity, as are most other European Nations. The EU has produced an Agricultural Action Plan on Biodiversity, as part of the activities needed to fulfil its commitments under the Convention on Biological Diversity (Hoffmann, 2000). The Plan aims at enhancing the potential role of rural areas for protecting biodiversity and nature conservation. Ireland has a National Biodiversity Action (recently supplemented by *Actions for Biodiversity 2011 – 2016. Ireland’s National Biodiversity Plan*) which sets out targets for the conservation and restoration of ecosystems in Ireland in order to halt the loss of biodiversity and the degradation of ecosystems (paraphrased from the *Ireland’s Vision for Biodiversity*, NBP, 2011).

Scope of the Project

- 1.7 The scope of this report is a review of the existing literature and policy framework regarding potential impacts on biodiversity and flora & fauna from agricultural productivity targets under Food Harvest 2020 under the following sectors: -
- Beef & Dairy (i.e. predominantly outdoor livestock)
 - Sheep
 - Pigs & poultry (i.e. predominantly housed livestock)
 - Tillage
 - Horticulture
- 1.8 The baseline of 2007-2009 for FH2020 is considered, in addition to historic impacts, both positive and negative on habitats and species, as well as outlooks for biodiversity and flora & fauna. Of particular importance is drawing together baseline information on possible impacts of FH2020 under the auspices of the sectors above on water quality; impacts from changes in land use and grazing regimes; and potential for impacts on the Natura 2000 network.
- 1.9 Separate environmental assessments are being undertaken for aquaculture and forestry. The scope of this document does not include other FH2020 sectors such as bioenergy and organic farming.

The Current Status of Biodiversity in Ireland

- 1.10 Within a global context Ireland supports a very small diversity of habitats and species, but they are of intrinsic value, with an estimated 10,000+ species (NBDC, 2010) and 117 habitats (Fossitt, 2000) identified to date. However, conspicuous groups with which most farmers and land managers are familiar – mammals, higher plants, birds and amphibians account for a very small proportion of known species. Numerous factors acting in tandem are responsible for the occurrence, extent and condition of the current habitats and species found in Ireland. Many of these habitats and species are influenced by, or owe their origin to, agricultural practices. Ireland, like much of Europe has rural landscapes and associated biodiversity which are currently threatened by the intensification of farming, as well as by the marginalisation and abandonment of traditional land uses due to underlying economic forces and changes in social expectations.
- 1.11 Ireland's first ever inventory of the country's biodiversity in a report entitled "*State of Knowledge, Ireland's Biodiversity 2010*" was published by the National Biodiversity Data Centre. The inventory set out to produce an overview of the state of knowledge on Ireland's biodiversity, to detail the current knowledge on what species and habitats occur in Ireland, their distribution, range and population. What is clear from the report is that the limited biodiversity Ireland supports has yet to be fully documented, with a small number of well-studied groups such as habitats, vascular plants, birds, mammals and some invertebrates (butterflies, beetles, molluscs), and others such as soil flora and fauna where there are evident gaps in knowledge.
- 1.12 When biodiversity is detailed, it is mainly applied at the macro-ecological level. There has been recognition in recent years that more research is required on other elements of Ireland's flora and fauna. Put in context, to the estimated 1000 native plant species, the latest estimate of invertebrate diversity in Ireland stands at nearly 10,000 species, and non-insect invertebrates at 8,000+ (NBDC, 2010). Information varies on groups, some have species lists and assessments of status, others have a provisional species list but little information on status whilst other groups, such as nematodes, are largely unknown
- 1.13 The EPA State of the Environment Report 2012 provides an update on environmental conditions since publication of the previous report in 2008. The report examines key themes which influence environmental

condition, including Nature and Biodiversity, Greenhouse Gases and Climate Change, Water and Land and Soil. As in 2008, the 2012 report finds that Ireland's environment is in general good condition¹ but challenges remain towards reaching true sustainability. These challenges can be summarised as:

- Building a resource efficient low-carbon economy
- Putting the environment at the centre of decision making
- Valuing and protecting the natural environment
- Implementing environmental legislation.

1.14 In a recent review of methods to create and enhance farmland habitats, Carlin *et al.*, (2010) postulated that when considering farmland biodiversity, it may be useful to differentiate among the following different types of species and habitats: -

- priority habitats and species designated as Natura 2000 sites;
- priority habitats and species that occur outside of Natura 2000 sites;
- rare and threatened species that are named in Red Data Books;
- other protected, rare and threatened species;
- species that are declining, but are not yet rare or threatened;
- common farmland habitats and species.

1.15 Taking the views of Carlin *et al.*, (2010) into account, a list has been drawn up of main groups of habitats/species for which there is sufficient information to list conservation status – European protected habitats, European protected species, nationally protected fauna (excluding birds); birds of conservation concern; and nationally protected flora. In Ireland, provisional lists exist for some groups of rare and threatened species, contained within published Red Data Books, although these are only available for a small number of groups. Within the context of agriculture, it is important, however, to extend consideration to habitats and species which may form part of High Nature Value farmland, and to give an indication of other, less recognised groups, which can inhabit agricultural land. A list of common farmland habitats is included with High Nature Value farmland, but to list common flora and fauna species associated with farmland would be exhaustive.

1.16 A number of sources were consulted to draw up the lists, and these are listed in Table 1.1 below. In addition, the most recent checklist of protected and rare species in Ireland (Kingston, 2012) was also consulted.

¹ In 2008 environmental condition is considered 'relatively good', in 2012 environmental condition is considered 'good'.

Table 1.1 - Sources of information, and confidence limits, for current status of notable habitats and species associated with agriculture.

Ecosystem Feature	Sources	Confidence in Status Assessment
Annex 1 Habitats	The status of EU protected habitats and species in Ireland (NPWS, 2008)	High confidence, but changes to listed status likely with next reporting round report due in 2013
European protected species	The status of EU protected habitats and species in Ireland (NPWS, 2008)	High confidence, but changes to status likely with next reporting round information
Birds	- Birds of Conservation Concern (BirdWatch Ireland), updated by Lynas <i>et al</i> (2007) - Wildlife Act 1976, Amendment 2000	Medium to high confidence with Bird Atlas data likely to update findings
Nationally protected fauna species	Wildlife Act 1976, Amendment 2000	Medium confidence, some baseline information available from Red Data Books, and recent targeted surveys, e.g. otter, common frog etc.
Nationally protected flora species	- Flora Protection Order 1999 - Irish Red Data Book: Vascular Plants - Threatened plant species in Ireland (Anon, 2008)	Low to medium confidence, FPO and RDB list urgently need updating
High Nature Value Farmland	- Semi-natural grassland survey of Ireland report (O'Neill <i>et al</i> , 2008, 2009, 2010) - County Hedgerow reports - Strive reports - Other published materials	Low to medium confidence, some baseline information exists but current status of some habitats is unknown or not clear. Especially habitats of protected sites
Other	- European Soil Biodiversity Atlas - Other Irish Red Data Books - NBDC data	Low to medium confidence, research limited, gaps in knowledge, but recent Red Data Books published by NPWS are bridging gaps

1.17 The main threats and pressures identified acting on both Annex habitats and species (NPWS, 2008) are:

- Direct damage, such as peat cutting, drainage and infilling, building and road making, reclamation of wetlands such as bogs and fens; removal of sand and gravel;
- Overgrazing and undergrazing;
- Pollution of waters by nutrients or silt;
- Unsustainable harvesting;
- Invasive alien species.

1.18 Under Article 17 of the Habitats Directive, each member state is obliged to report to the European Commission on the status of listed habitats and species every six years. In December 2007, Ireland submitted the first baseline assessments of conservation status for all 59 Annex I habitats and 100 Annex II species that occur in Ireland. The most recent report was submitted in 2007, with another report due to be submitted to Europe in 2013. The upcoming reporting round will be better informed by a number of baseline habitat surveys which

have been commissioned, including semi-natural grasslands, sea cliffs, woodlands and sand dunes and thus can better assess any changes to current conservation status that may have occurred.

- 1.19 Research is ongoing on other elements of Ireland’s biodiversity, for example soil biodiversity and invertebrates. Analysis of High Nature Value farmland, discussed below, will assist in identifying important features for conservation of biodiversity associated within the agricultural environment.

European Protected Habitats

- 1.20 Although a small country, Ireland supports a wide range of habitats important in a European context due to its relatively large coastline, underlying geology, mild climate and soil composition. In total, 59 habitats which occur in Ireland are listed as Annex I habitats under the EU Habitats Directive, and Ireland has designated 424² Special Areas of Conservation (SAC) which protect best examples of these habitats.
- 1.21 Table 1.2 includes relatively widespread habitats, or those with localised occurrences but which are of significant size, where an impact(s) directly related to agriculture is considered to be an influencing factor on its current status. We have also attempted to summarise the regional distribution of these habitats and presented their current conservation status.

Table 1.2 - Status of Annex I habitats in Ireland associated with agriculture.

Habitat	Influencing factors	Location	Status
Orchid rich/ calcareous grasslands (6210)	Abandonment of traditional management practices	Widespread but local in centre, west/north-west	Bad
Lowland hay meadows (6510)	Abandonment of traditional management practices	Localised along floodplains of large rivers, e.g. Shannon, Moy	Bad
Species rich <i>Nardus</i> grassland (6230)	Overgrazing, abandonment of traditional management practices	Widespread in upland areas	Bad
<i>Molinia</i> meadows (6410)	Drainage, intensification and abandonment of traditional land practices	Widespread, on fluctuating water tables/acid soils	Bad
Hydrophilous tall herb (64300)	At risk from agricultural improvement along the river edge	Fergus; Shannon; Blackwater and Nore-Barrow-Suir / Slaney	Poor
Atlantic salt meadows (1330)	Over-grazing by sheep or cattle	Widespread along coastline	Poor
Mediterranean Salt Meadows (1410)	Over-grazing by sheep or cattle	Widespread along coastline	Poor
Halophilous Scrub (1420)	Poaching by cattle	Five sites in the southeast	Bad
Fixed dunes (grey dunes) (2130)	In appropriate grazing and recreation	Widespread along coastline	Bad
Decalcified dune heath (2150)	Over/under grazing, supplementary feeding	Coasts Donegal, mayo, Wicklow	Bad
Dunes with creeping willow (2170)	Over/under grazing, agricultural improvements	Occasional along coastlines	Poor
Humid dune slacks (2190)	Over/under grazing, water abstraction, inappropriate development	Widespread along coastline	Bad
Machair (21A0)	Division of open commonage,	Widespread along north-west	Bad

² As of December 2012, the Minister for Arts, Heritage and Gaeltacht has proposed has proposed six new marine sites for designation as Special Areas of Conservation (SACs) to protect marine habitats and species listed on the 1992 EU Habitats Directive. These are not included in the current total of 424 SAC's.

	over/under grazing, recreation	coast	
Turloughs (3180) (inc. 3270)	Eutrophication and over/under grazing	West	Poor
Wet heath (4010)	Overstocking, reclamation, afforestation	Widespread in uplands/west	Bad
Dry heath (4030)	Afforestation, over/under grazing, burning	Widespread in a range of areas	Poor
Limestone pavement (8240)	Quarrying, reclamation for agriculture, reduced grazing	Burren, localised outcrops in west/north-west	Poor
Juniper scrub (5130)	Overgrazing, agricultural expansion, fire	West	Poor
Blanket bog (7130, active priority habitat)³	Overgrazing, peat cutting, drainage	Mainly lowlands/uplands of Atlantic coast	Bad
Active raised bog (7110, priority)/	Drainage, peat cutting, over/under grazing	Local, mainly in midlands	Bad
Degraded raised bog (7120)	Drainage, peat cutting, over/under grazing	Widespread, mainly in midlands	Poor
Alpine and sub-alpine heath (4060)	Over-burning, over-grazing by sheep, afforestation	Generally summits and slopes >350m	Bad
Siliceous scree (8110)	Extent of damage from historical grazing pressures unclear	High upland / mountains	Poor
Calcareous Scree (8120)	Extent of damage from historical grazing pressures unclear	Uplands of Sligo / Leitrim.	Poor
Calcareous Rocky Slopes (8210)	Extent of damage from historical grazing pressures unclear	High upland / mountains	Poor
Old oak woodlands (91A0)	Clearance in the past, now under grazing an issue	Acidic soils, mainly Cork, Kerry and Wicklow	Bad
Alluvial forests (91E0)	Fragmentation, alien species, sub-optimal grazing	Widespread along rivers subject to flooding	Bad
Water dependent habitats indirectly affected by agriculture			
Coastal lagoons (11500)	Eutrophication from agricultural run-off; drainage	Concentrated in west, south and south east.	Bad
Hard water lakes (31401)	Eutrophication from agricultural run-off, particularly phosphorus	Concentrated in centre, east and west	Bad
Dystrophic lakes (3160)	Overgrazing, peat cutting, afforestation	Widespread in uplands, peaty soils	Bad
Upland oligotrophic lakes (3130)	Eutrophication from agricultural run-off, invasive species	Extensive in lowlands	Bad
Lowland oligotrophic lakes (3110)	Eutrophication from agricultural run-off, invasive species	Extensive in uplands	Bad
Alkaline fens (7230)	Drainage, eutrophication from agricultural run-off, infilling	Widespread, but local from midlands northwards	Bad
Floating river vegetation (3260)	Eutrophication, afforestation, alien species	Widespread in rivers	Bad
Natural Eutrophic lakes	Nutrient enrichment	Concentrated in Clare, Galway	Bad

³ Also associated with *Rhynchosporion* depressions (7150).

(3150)		and northwest.	
Turloughs (3180) (inc. 3270)	Eutrophication and over/under grazing	West	Poor
Estuaries (1130)	Nutrient enrichment	Widespread along Irish coastline	Poor

- 1.22 Other, more localised and small scale Annex I habitats, such as halophilous scrub (1420), decalcified *Empetrum* dunes (2140), coastal lagoons (1150), hydrophilous tall herbs (6430) and natural eutrophic lakes (3150), for example, may be influenced to some extent by agriculture or farm practices and should be noted on a local level. Over grazing, primarily by sheep, may also have had impacts on specialised upland Annex I habitats which are rated as poor status – such as siliceous scree (8110), calcareous scree (8120), calcareous rocky slopes (8210) and siliceous rocky slopes (8220) – but this has not yet been fully assessed at a regional or national level.
- 1.23 Overall, of the total 59 habitats in the report, the majority were found to be primarily in unfavourable condition, with 47% deemed bad, 46% deemed inadequate and only 7% of the habitats examined in good conservation status. Of the 28 habitats listed in Table 1.2 above, 13 are in poor condition and 23 in bad condition. The report highlights the fact that many habitats associated with agriculture are in decline or are in bad condition – e.g. lowland hay meadow, important for birds such as corncrake and plants such as cornflower, bogs and coastal grasslands. Future prospects of these habitats are generally unfavourable as the key threats, intensification of agriculture and changes in traditional farming practices, are likely to remain a threat in the short and medium term.

European Protected Species (excluding birds)⁴

- 1.24 As with protected habitats, the status of those species listed in the EU Habitats Directive which occur in Ireland must be reported every six years. The latest reporting round for habitats and species was 2007 (NPWS, 2008), and updated status is due to be submitted in 2013/2014. These are addressed in Table 1.3.

Table 1.3 - Status of Annex II flora and fauna species in Ireland associated with agriculture.

Species	Influencing factors	Location	Status
Higher plants, mosses and liverworts			
Marsh saxifrage (1528) Annex II, IV	Peat cutting, under grazing	Bogs in north-west Mayo	Good
Slender naiad (1833) Annex II, IV	Eutrophication from agricultural and domestic sources, manure spreading	Mainly in western lakes	Poor
Petalwort (1395) Annex II, IV	Development, agricultural improvement and overgrazing (+ve)	Lime rich sand along mainly western coastline	Good
<i>Leucobryum glaucum</i> (1400) Annex V	Quality of associated habitats, bogs, heath, woodland, are poor due to inappropriate grazing	Relatively widespread on acid substrate, mainly west and centre	Poor
<i>Hematocaulis vernicosus</i> Annex II	Possibly over grazing, wind farms, drainage	Bog flushes in west and centre	Good
<i>Lycopodium</i> group (1413) Annex V	Loss of associated heath, <i>Nardus</i> grassland and moorland through over grazing, improvement	Variety of habitats mainly in west and south-west	Poor
<i>Sphagnum</i> species (1409)	Loss of associated habitat, drainage,	While widespread the	Poor

⁴ Discussed separately below

Annex V	over grazing, afforestation etc.	condition of many associated habitats is itself inadequate	
Cladonia species (5113) Annex V	Decline in associate habitats – mountain, sand dunes, bogs	Widespread	Poor
Fauna			
Geyer's whorl snail (1013) Annex II	Loss of wetland habitat, drainage; lack of appropriate grazing	Mainly along western seaboard & midlands	Poor
Narrow-mouthed whorl snail (1014) Annex II	Loss of wetland habitat, drainage, excessive grazing or sheep grazing.	Mainly along western seaboard	Poor
Desmoulin's whorl snail (1016) Annex II	Loss of wetland habitat, drainage, excessive grazing (light grazing can be beneficial).	Mainly from Shannon basin & midlands east to Dublin	Bad
Kerry slug (1024) Annex II, IV	Intensification of land use, agricultural reclamation, afforestation, invasive species	Woodland, blanket bog, heath in south-west (more recently in Galway)	Good
Freshwater pearl mussel (1029) Annex II, V	Increased sediment load, eutrophication	Widespread, nutrient poor waters	Bad
Nore Freshwater pearl mussel (1990) Annex II, V	Eutrophication, arterial drainage, destruction of suitable spawning areas		Bad
White-clawed crayfish (1092) Annex II, V	Eutrophication, pesticides, increased sediment load	Widespread but favors base rich waters	Poor
Marsh fritillary (1065) Annex II	Extensive habitat loss of damp meadows, dunes and wet heath, heavy summer grazing, fragmentation of habitat	Widespread, centre and west	Poor
River (1099) Annex II, V & Brook (1096) Annex II lampreys (combined)	Eutrophication, arterial drainage, destruction of suitable spawning areas	Widespread but local in rivers and suitable lakes	Good
Sea lamprey (1095) Annex II	Weirs, channel maintenance, possibly eutrophication	Spawn in lower reaches of rivers, mainly along the south-east, south-west and western coasts	Poor
Allis Shad (1102) Annex II, V	Drift netting in the past, other adverse factors unclear	Lower reaches of estuaries along the south-east, west and south-west coasts	Unknown
Killarney shad (5046) Annex II, V	Eutrophication of Lough Leane (primarily from domestic sources)	Lough Leane only	Good
Twaite Shad (1103) Annex II, V	Eutrophication, presence of weirs	Spawning activity has only been recorded in five large rivers in the south-east: the Barrow, Munster Blackwater, Suir, Nore and Slaney.	Bad
Pollan (5076) Annex V	Eutrophication & impacts from introduced species	Loughs Derg, Ree and Allen	Bad
Atlantic salmon (1106) Annex II, V	Reduced survival, eutrophication from a number of sources, over-fishing	Widespread in high quality waters	Bad
Natterjack Toad (1202)	Land drainage is the primary adverse factor	Dingle and Iveragh peninsulas in Kerry, one introduced population in	Bad

Annex IV		Wexford	
Common frog (1213) Annex V	Wetland drainage, reduction in microhabitats	Widespread	Poor
Lesser horseshoe Bat (1303) Annex II, IV	Loss of linear commuting features such as hedgerows, agricultural intensification results in lower populations of prey items	Confined to western counties i.e. Cork, Kerry, Limerick, Clare, Galway and Mayo.	Poor
Other Bats (combined) Annex IV	Positive impacts with increasing woodland, farmland with hedges and other features for foraging	Widespread	Good
Irish hare (1334) Annex V	Reduction in habitat, loss of refuges such as hedgerows	Widespread	Poor
Otter Annex II, IV	Depends on good water quality, which has been increasing	Widespread	Poor
Pine marten (1357) Annex V	At risk from deforestation	Widespread, mainly centre, north and west in woodlands, scrub	Good

Notes: -

Annex II: Animal and plant species of community interest whose conservation requires the designation of Special Areas of Conservation.

Annex IV: Animal and plant species of community interest in need of strict protection.

Annex V: Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures.

- 1.25 Fish species and other aquatic fauna will be at risk from deterioration in water quality, but where specific information on impacts of agriculture were not included within the status report, these species have not been included in the list above.
- 1.26 Approximately 39% of overall 100 species listed under the Habitats Directive are in a favourable state. However, of the ca. 17 species associated with agriculture, only five are in favourable condition. The majority, particularly those of wetland and freshwater environments, are in poor or bad conservation status.
- 1.27 Bats – Lundy *et al.*, (2011) found that brown long-eared bat, whiskered bat and natterer's bats all preferentially selected maternity roosts adjacent to scrub (Bat Conservation Trust, pers comm.). Removal of large areas of scrub during farm practice could therefore at times be in contravention of Ireland's commitments under Articles 12(1) and 12(2) of the Habitats Directive; i.e. "to take requisite measures to establish a strict protection for the species listed in Annex IV(a)" should removal of such areas of scrub also impact upon associated roosts. A single male of the greater horseshoe bat, a new bat species to Ireland, was found during a survey of a farm building as part of the REPS 4 Traditional Farm Buildings grant scheme administered by the Heritage Council, which emphasises the importance of farm habitats, both natural and built, for bats and other fauna.
- 1.28 Threat response plans have been prepared for four species / groups in part response to the judgement of the European Court of Justice case C-183-05. concerning *inter alia* Article 12 of the EU Habitats Directive 92/43/EEC and the requirement to establish a system of strict protection for the animal species listed in Annex IV(a) of the Directive. To date, plans have been prepared for Kerry slug, Vesper bats, otter and Irish cetaceans. These plans are implanted by NPWS.

Birds

- 1.29 According to current information (NBDC, 2010), there are 457 bird species which are resident or regular visitors to Ireland. BirdWatch Ireland, in conjunction with RSPB Northern Ireland published 'Birds of Conservation Concern 2008-2013', Lynas *et al.*, (2007) which assigned species to three categories - red list (i.e. of most conservation concern); the amber list (generally of unfavourable

conservation status); and green list (of least concern). During the most recent assessment of the population status of 199 species of the most commonly occurring bird species (Lynas *et al.*, 2007), 25 were placed on the Red list, 85 on Amber List and 89 on the Green list. The assessment of conservation status is not related to the legal protection afforded to individual species, but rather an assessment of current breeding and population status. Red and amber listed species associated with agriculture are presented in Table 1.4.

Table 1.4 - Red and Amber list bird species listed in Birds of Conservation Concern in Ireland 2008-2013 (BirdWatch Ireland, 2008) and updated by Lynas *et al.*, (2007) associated with agriculture and birds listed in Annex I of the EU Birds Directive which occur in Ireland

Bird Species	Influencing factors	Location	Status
Bird species listed in Annex I of Birds Directive			
Barnacle geese	Habitat loss of semi-improved grasslands, over and under grazing of grasslands leading to changes in ideal feeding conditions	Localised winter visitor to coasts and off shore Islands	Amber
Bar-tailed godwit	Possibly global warming, habitat loss	Winter visitor to coastal estuaries; unlike Black-tailed Godwit not known to feed on agricultural fields.	Amber
Bewick's swan	Appears to be short stopping on the continent and in UK due to climate change	Now an increaseling rare winter visitor to wetlands in Ireland	Red
Chough	Long term declines, related to loss, fragmentation and deterioration in semi-natural grasslands and coastal heath, chemicals in cow pats lowering invertebrate production	Resident along rocky coasts in Munster, as well as parts of Connaught and Ulster	Amber
Corncrake	Changes in agricultural practices, heavy flooding in Shannon callows	Hay meadows, Donegal, western Connaught, Shannon callows	Red
Dunlin	Loss of breeding habitat along the west and north coasts due to land use intensification/ developments	Summer and winter visitor along the coast	Amber
Golden eagle	Formerly bred in Ireland – extirpated in the 18th Century. Poisoning now the major threat	Currently re-introduced into Donegal, birds recorded in upland areas throughout Ireland	Red
Golden plover	Red listed as a breeding species – breeds in moorland & acid grasslands where it is at risk form agricultural intensification, landuse change, drainge and predation	Widespread but local as a wintering visitor along coasts and inland; feeds away from coast on open grassland often in large numbers	Red

Greenland white-fronted geese	As with other geese and swans has been shifting more to foraging on agricultural grassland / crops. Increasing dependence & hence risk from agriculture, landuse change etc. Climate change has been raised as a major adverse factor on breeding grounds	Scarce winter visitor to wetlands; majority using a limited number of sites such as Wexford Wildfowl Reserve	Amber
Hen harrier	Habitat loss in uplands, overgrazing by sheep, persecution	Uplands/bogs in summer, lowlands around coast in winter	Red
Kingfisher	Changes in water quality and associated fish stocks may influence kingfisher populations	Widespread, but local along suitable river corridors	Amber
Nightjar	Historic declines associated with woodland clearance for agriculture, degradation and fragmentation of heathland & block afforestation	Summer visitor to uplands in south-east	Red
Merlin	Agricultural intensification in uplands & afforestation	Widespread but local	Amber
Peregrine	Historic reduction on breeding success as a result of exposure to chemicals from a variety of sources, including agriculture	Widespread but local	Green
Red-necked phalarope	Historical decline, eutrophication of wetlands	Last recorded breeding in northwest Mayo	Red
Short-eared owl	Habitat loss of rough grassland, coastal marsh and sand dunes	A scarce winter visitor favouring coastal lowlands mainly in the south and east. A rare upland breeding species.	Amber
Whooper swan	As with other geese and swans has been shifting more to foraging on agricultural grassland / crops. Increasing dependence & hence risk from agriculture, landuse change etc. Also vulnerable to collision with man-made structures, lead poisoning and water pollution	Winter visitor to wetlands in centre, north and west, also in south-east coast	Amber
Other Birds of Conservation Concern			
Barn owl	Agricultural intensification, anti-coagulant rodenticides, severity of recent winters	Widespread, but local in lowlands areas	Red

Common scoter	Small numbers breed on a limited number of inland lakes where it is vulnerable to Eutrophication of water, mink predation.	As a wintering bird widespread in shallow offshore waters with suitable bivalve prey. Breeds on large inland lakes susceptible to water quality changes	Red
Curlew	At risk as a breeding species; vulnerable to changes in agricultural practices, drainage, etc.	Widespread but local on coasts, breeds in wet pasture, heather and meadows	Red
Grey partridge	Decline in cereal growing, herbicide and pesticide induced fall in prey items	Boora, Co. Offaly & at a new very successful reintroduction site in north Co. Dublin.	Red
Lapwing	Changes in agricultural practices, drainage etc.	Widespread on open farmland, wetlands, pasture in winter. Increasingly rare breeder	Red
Quail	Decline in tillage, improvement of rough ground etc.	Rare summer visitor in South-east	Red
Red grouse	Decline in upland habitat due to overgrazing (sheep), drainage, afforestation	Widespread but local, uplands especially in the north and west	Red
Redshank	Loss of breeding areas in wetlands to agricultural intensification, drainage	Widespread around coasts, breeds inland in west & north; increasingly rare breeder	Red
Shoveler	Loss of wetlands	Winter visitor to shallow lakes in centre and localised breeder; susceptible to water quality changes from agricultural runoff	Red
Twite	Loss of hay meadows and salt marshes	North and west coast; very localised breeder	Red
Yellowhammer	Decline in cereal growing	Population declining and contracting towards areas in south and east where cereals are still grown	Red
Black-tailed godwit	Loss and degradation of breeding habitat in n lowland wet grassland and marshes (Shannon Callows)	Winter population increasing at wetland sites around the coast; also feeds on agricultural grassland; increasingly rare breeder	Amber
Greylag goose	Possibly affected by reduction in arable grassland, particularly cereal stubble	Winter migrant, mainly north, east and south-east, resident feral population	Amber
Grasshopper warbler	Loss of rough grassland and other habitats	Widespread but local	Amber

House sparrow	Has declined, but appears currently stable. Lack of nest sites & decline in invertebrate abundance	Widespread, gardens, farmland	Amber
Kestrel	Agricultural intensification, anti-coagulant rodenticides	Widespread but the new Bird Atlas is indicating significant decline in numbers	Amber
Linnet	Loss of rough grassland, overgrazing by sheep in uplands	Widespread	Amber
Red kite	Went extinct in Ireland in 18 th century, now illegal poisoning is the major threat	Re-introduction programme in Wicklow, north Dublin and Northern Ireland, spreading slowly	Amber
Sedge warbler	Uncertain, likely to be loss of habitat, change in land use	Widespread in wetlands	Green
Skylark	Decline in cereal growing	Common in uplands throughout, also in cereal growing areas, especially in winter	Amber
Snipe	Changes in land use, drainage	Widespread in wetland and damp habitats	Amber
Spotted flycatcher	Reduced breeding opportunities with removal of hedgerows	Widespread	Amber
Starling	Possibly reduction in abundance of invertebrates but uncertain	Widespread in farmland, urban areas	Amber
Stockdove	Decline in cereal growing	Widespread mainly in south and east, associated with cereal growing	Amber
Swallow	Secure in Ireland, but declines in Europe	Widespread, feeds over pasture	Amber
Swift	Loss of nest sites in buildings,	Widespread, feeds over pastures	Amber
Tree sparrow	Decline in cereal growing	Local resident in east of Ireland, & along the south and west coasts; new Bird Atlas indicates this species is increasing in Ireland.	Amber
Wheatear (northern)	Intensification of farming, severity of winters	Breeds in rocky coasts, pasture, widespread along coast	Amber
Whinchat	Intensification of farming, loss of rough pasture	Insect rich meadows/bracken in eastern and southern coasts	Amber
Wigeon	Loss of coastal and wetland habitat	Winter visitor to wetlands throughout Ireland	Amber

1.30 Remaining species which occur in Ireland and are associated with agricultural habitats are considered to have secure populations and are placed on the green list. Bird species which are strongly associated with cereal crops are dealt with separately in the Cereals and Horticulture literature review presented below.

1.31 In addition to the above list, there are other valuable sources of information including the annual Countryside Birds Survey (Coombs *et al.*, 2009), wetland counts (I-WeBS) and ongoing research for specific species such as corncrake, breeding waders, etc. by National Parks and Wildlife Service. The forthcoming Bird Atlas also provides a timely opportunity to review the population trends and distribution of bird species in Ireland potentially influenced by changes in agriculture.

Nationally protected fauna species

1.32 A small number of other fauna species protected under the Wildlife Act 1976 (and as Amended, 2000), are largely dependent on agricultural land, or associated habitats (Table 1.5).

Table 1.5 - An indication of the status nationally protected fauna species under the Wildlife Act 1976 and Amendments in Ireland associated with agricultural land (excluding Annex II, V species).

Species	Influencing factors	Location	Status
Mammals*			
Hedgehog	Removal of hedgerows, road kills, predation, pesticides	Widespread	LC
Pygmy shrew	Climate, agricultural intensification, predation	Widespread in many habitats	LC
Brown hare	Persecution, agricultural intensification, road kills	Widespread in lowland open fields, mainly in south	NA
Badger	Persecution, road kills; DAFM culling strategy	Widespread in many habitats, near farmland	LC
Reptiles and Amphibians**			
Common lizard	Habitat loss, predation,	Widespread, mainly northern but local in many habitats	LC
Common frog	Habitat loss	Widespread in temporary and permanent wetlands	LC
Smooth newt	Eutrophication, drainage, agricultural intensification, development	Widespread in temporary and permanent wetlands	LC
Natterjack Toad	Drainage, agricultural intensification	Localised in the Dingle & Iveragh peninsula in West Kerry. Introduced to Wexford.	EN

* Status derived from Marnell *et al.*, (2010)

** Status derived from King *et al.*, (2011)

1.33 The majority of these species are considered to be of Least Concern, with stable populations and favourable conservation outlook with the exception of Natterjack Toad that has very localised populations on the Iveragh and Dingles peninsuls, Kerry.

Nationally protected flora species

1.34 There are approximately 1000 native plant species in Ireland. A total of 64 vascular plant species are listed on the Flora Protection Order 1999. This list was largely based on the now very out of date Irish Red Data Book: Vascular Plants (Curtis and McGough, 1988).

- 1.35 Whilst information on the status of the majority of these protected species is available, primary research on the causes of decline of many of the species is largely absent, and in some cases deficient. Species listed in Table 1.6 below are those which could be associated with habitats present on grazed land, including heath and moorland, sand dunes etc. (Table 1.6).
- 1.36 The so called arable weeds have in particular suffered from increased agricultural efficiency including modern methods of seed cleaning and the use of herbicides and a decline in the area under tillage, with for example corncockle, corn chamomile and sheperd's-needle all assumed extinct while other species such as darnel, cornflower, sharp-leaved fluellen etc. are all considered to be under threat.

Table 1.6 - The status of nationally protected plant species in Ireland associated with agriculture (excluding Annex II, IV species).

Species	Scientific Name	Influencing factors	Location	Status
Higher plants				
Autumn crocus	<i>Colchium autumnale</i>	Loss of habitat as a result of agricultural intensification	East coast	CR
Rough poppy	<i>Papaver hybridum</i>	Decline in arable crops on sandy ground	Howth	CR
Meadow saxifrage	<i>Saxifraga granulata</i>	Under/over grazing of pastures/sandhills	Very local, Dublin, Arklow	CR
Marsh saxifrage	<i>Saxifraga hirculus</i>	Drainage for agricultural intensification	Single site in Mayo	CR
Slender cottongrass	<i>Eriophorum gracile</i>	Bog drainage, intensification of agriculture and afforestation	Connemara, west Galway, recent isolated records from Cork/Kerry/Midlands	EN
Lesser centaury	<i>Centaureum pulchellum</i>	Possibly over/under grazing, developments	Sand dunes/hills east and south-east coasts	EN
Round-leaved wintergreen	<i>Pyrola rotundifolia ssp maritime</i>	Land reclamation and drainage	Wet bogs, fens in north-east midlands	EN
Betony	<i>Stachys officinalis</i>	Loss of hedgerow, grassland habitat	Localised in midlands, east and south-west,	EN
Bog orchid	<i>Hammarbya paludosa</i>	Drainage of bogs, over grazing by sheep	Very local in uplands in west	EN
Irish Lady's-tresses	<i>Spiranthes romanzoffiana</i>	Possibly drainage and over grazing, natural fluctuations	Very local in damp/flooded pastures, mainly in Cork, Kerry Galway	EN
Narrow-leaved Helleborine	<i>Cephalanthera longifolia</i>	Over-grazing in damp woods, disturbance from livestock	Damp woodlands in west	EN
Small-white Orchid	<i>Pseudorchis albida</i>	Over-grazing in upland pastures and heaths, reclamation, fertilisers	Very local in west	EN
Bog Hair-grass	<i>Deschampsia setacea</i>	Bog drainage, possibly grazing pressure	Wet bogs and lakes, west Galway	EN
Meadow Barley	<i>Hordeum secalinum</i>	Reclamation of meadows bordering estuaries and reduction in grazing	Meadows near estuaries in south-east, Shannon and Dublin	EN
Opposite-leaved	<i>Groenlandia densa</i>	Possibly eutrophication of	Along watercourses/muddy	EN

Pondweed		wetlands,	estuaries mainly in south	
Globeflower	<i>Trollius europaeus</i>	Drainage and eutrophication of wetland habitats	Wetland habitats in north-west	EN
Great burnet	<i>Sanguisorba officinalis</i>	Natural fluctuations, associated with wet pastures and lakes, abandonment of traditional land management	Hay meadows along River Moy, Mayo	EN
Hairy violet	<i>Viola hirta</i>	Quarrying and over-grazing of limestone grasslands	Limestone grassland, mainly west, local east	EN
Pale dog-violet	<i>Viola lacteal</i>	Heathland reclamation	Heath in Waterford and Galway	EN
Wild Chives	<i>Allium schoenoprasum</i>	Not known	Limestone soils, native to one site in east Galway	VU
Wild asparagus	<i>Asparagus officinalis</i> ssp. <i>prostrate</i>	Erosion, trampling, lack of grazing	Sea cliffs, dunes, south-east	VU
Fringed sandwort	<i>Arenaria ciliate</i>	Possibly undergrazing	Limestone cliffs, Ben Bulbin, Co Sligo	VU
Recurved sandwort	<i>Minuartia recurva</i>	Unknown	Acid grassland and heath in Caha Mts, Co Kerry	VU
Red hemp nettle	<i>Galeopsis angustifolia</i>	Decline in arable crops	Mainly on disturbed ground in eskers	VU
Wood Small-reed	<i>Calamagrostis epigejos</i>	Possibly under/over grazing of habitat	Damp rocky places Aran Islands, Slieve Aughty Mts	VU
Irish St. John's-wort	<i>Hypericum canadense</i>	Unknown	Lough Mask, Mayo and Glengarriff, Cork	VU
Hoary rock-rose	<i>Helianthemum canum</i>	Possibly undergrazing	Calcareous grasslands Clare, Aran Islands	VU
Mudwort	<i>Limosella aquatica</i>	Drainage of turloughs, over/under grazing	Turloughs, river, lakes in west, Macroom, Co Cork	VU
Lesser snapdragon	<i>Misopates orontium</i>	Decline in root crops, negative impact by autumn cultivation and sowing	Only two recent records for this species in Ireland. One in Cork and one in Wexford	VU
Common rock-rose	<i>Helianthemum nummularium</i>	Over/under grazing	Calcareous grassland, East Donegal	VU
Heath cudweed	<i>Gnaphalium sylvaticum</i>	Decrease in fallow ground	Upland pastures, damp sandy habitats, Donegal/Carlow, record from south-west	VU
Slender naiad	<i>Najas flexilis</i>	Eutrophication from agricultural and domestic	Mainly in western lakes	VU

		sources, manure spreading		
Purple milk-vetch	<i>Astragalus danicus</i>	Over/under grazing,	Calcareous grassland on Aran Islands	VU
Alpine saw-wort	<i>Saussurea alpina</i>		High mountains in west, south and north	VU
Hairy bird's-foot trefoil	<i>Lotus subbiflorus</i>	Unknown – possible undergrazing	Short coastal grassland, island off west Cork, record from south-east	VU
Orange foxtail	<i>Alopecurus aequalis</i>	Unknown, possibly drainage of wetlands	Very local in Clare and south-east	DD
Annual knawel	<i>Scleranthus annus</i>	Unknown	Recent records from Kerry and Wexford	DD
Alpine bistort	<i>Persicaria vivipara</i>	Unknown, possibly over grazing by sheep an issue	Upland mountain ranges in west	DD
Basil thyme	<i>Clinopodium acinos</i>	Modern methods weed control, gravel extraction	Calcareous soils on eskers, east midlands	DD
Mosses**, liverworts				
Baltic bryum	<i>Bryum maritimum</i>	None at present, possibly lack of grazing may be an issue	Uplands in west, including Achill Island, Donegal	EN
Moss	<i>Bryum calophyllum</i>	Possibly high grazing pressure on damp hollows and machair	Keel, Tramore	EN
Golf-club moss	<i>Catocarpium nigritum</i>	Drainage, eutrophication from agricultural sources, disturbance	Associated with Machair (21AO) & humid dune slack (2190)	NT
Moss	<i>Hematocaulis vernicosus</i>	Drainage, eutrophication from agricultural sources	Associated with alkaline fen (7230), mainly west and south-east	DD
Moss	<i>Paludella squarrosa</i>	Drainage, eutrophication from agricultural sources	Associated with alkaline fen (7230) in Mayo	DD
Moss	<i>Orthotrichum sprucei</i>	Possibly eutrophication of rivers, moss grows on riverine trees	To be confirmed.	DD
Moss	<i>Tortella inclinata</i>	Possibly overgrazing and disturbance of coastal dunes	Coastal dunes in West Mayo	DD
Moss	<i>Tortula wilsonii</i>	Unknown	Scattered site in east and south-east	DD
Moss	<i>Weissia longifolia</i>	Loss of damp, non-calcareous grassland or bare calcareous soils, depending on	Scattered in south-east and east	DD

		subspecies		
Moss	<i>Weissia rostellata</i>	Possibly drainage and eutrophication of wetlands	Damp habitat, edge of ponds in north-west	DD
Liverwort	<i>Leiocolea gillmanii</i>	Drainage, eutrophication from agricultural sources	Associated with Machair (21AO) & humid dune slack (2190), Donegal, Kerry	DD
Liverwort	<i>Leiocolea rutheana</i> var. <i>Rutheana</i>	Drainage, eutrophication from agricultural sources	Associated with alkaline fen (7230) in Mayo	DD

*Most up to date assessment of status is taken from 'Endangered species in Ireland' (Anon, 2008).

** Conservation status from Lockhart *et al.*, (2012)

Key to assessment criteria (in Curtis and McGough, 1988): -

EX: Extinct species

CR: Critically Endangered - taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included are taxa whose numbers have been reduced to a critical level or whose habitats are so drastically reduced that they are deemed to be in danger of extinction.

EN: Endangered - taxa believed to move into the Critically Endangered category in the near future if the causal factors continue operating. Included are taxa of which most or all the populations are decreasing, or with populations seriously depleted, or those with still abundant populations but under threat from several factors.

VU: Vulnerable - taxa with small populations that are not at present endangered or vulnerable, but are at risk

DD: Data Deficient - species which are Endangered, Vulnerable or Rare but there is not enough information to say which of these categories is appropriate.

- 1.37 Even though vascular plants are relatively well studied compared to other groups, sufficient information is not available for some species to allow conservation assessment. Additionally, threats to the conservation status of many plants are not clearly identified.
- 1.38 It is likely that any update of the Red Data Book for vascular plants will include a reassessment of existing species, and add new species. For instance, several new plant species have been recorded, such as a sand-dune grass (*Mibora minima*) at Cannawee dune system in West Cork in 2009 (Parnell and Curtis, 2012), the first record of this species in Ireland and others are likely to exist. Intensive bryological surveys invariably lead to the discovery of new species or reassessment of the status of known species.
- 1.39 What also needs to be recognised is that a substantial number of plant species with secure conservation status, at present, are supported by agricultural land, and the importance of farmland for a diverse range of plant species is an important feature and maintenance of this diversity at landscape and farm level is crucial to plant conservation efforts.

Red Lists

- 1.40 A number of Red Data Books⁵ have been published by the National Parks and Wildlife Service. The Red Lists do not provide a favourable conservation outlook for the species or groups assessed, but they do provide a summary of conservation declines over the individual recording intervals chosen for assessment. A small number of species are protected under the Habitats Directive and are

⁵ See <http://www.npws.ie/publications/redlists/> for list of currently published Red Data Books.

therefore subject to the FSC assessment compiled by NPWS on a six-year basis. Others are listed on the Flora Protection Order 1999 and Wildlife Act 1976 as amended by the Wildlife (Amendment) Act, 2000, which confers legal protection, but no legal requirement to assess conservation status. The presence of a species on the Red List has been assessed using the International Union for the Conservation of Nature (IUCN) criteria and the main threats are identified.

- 1.41 The red lists indicate that more than a third of Irish bee species and non-marine mollusc species are threatened. In addition, over 15% of Irish water beetle species, butterfly species and dragonflies and damselflies are threatened. Whilst reasons for the threatened status of the species listed in the published red lists are varied, and are likely to be the result of multiple drivers, the following identified threats are, or are likely to be, partially attributable to agriculture: -
 - Eutrophication of nutrient poor water/waterbodies – affecting dragonflies and damselflies, non-marine molluscs, water beetles;
 - Habitat loss due to agricultural intensification, drainage etc – all groups;
 - Abandonment of traditional farming practices, particularly on marginal land – butterflies, bees, non-marine molluscs.
- 1.42 *Bryophytes*: Lockhart *et al.*, (2012). Ireland's humid, oceanic climate has encouraged the development of an extensive and species diverse bryophyte flora, which represents *ca.* 48% of the European total. In compiling the Red Data List, IUCN threat categories were assessed for a total of 239 liverwort species and 596 moss species (Lockhart *et al.*, 2012). The majority of species, 59% are of Least Concern, 12% Near Threatened, 11% Vulnerable, 5% Endangered; 3% Critically Endangered and 1% Near Extinction. A further 4% were Data Deficient. Bryophytes can be temporary colonists and this may explain the threatened status of some of the rarer species in Ireland; other species are assessed as threatened due to loss of habitat and changes in management practices leading to changes in habitat condition. For instance, the loss of a moss species, *Dicranum undulatum* from midland raised bogs is attributed to industrialised peat cutting, whilst other threats identified include overstocking with sheep on the upland corries in the west (affecting the internationally important Northern Atlantic hepatic mat community); inappropriate grazing regimes generally (e.g. affecting coastal and upland species); canalisation, channel maintenance and local pollution (riverine species); development pressures; water abstraction and drainage; natural limitations due to restricted habitat suitability; and stochastic events which have yet to be researched sufficiently including climate change.
- 1.43 *Mayflies*: Kelly-Quinn and Rega, (2012). Ireland has a depauperate mayfly diversity compared to Europe as a result of our isolation from the European mainland, and at present consists of 33 identified species. Mayflies inhabit watercourses and as such as important as indicators of water quality and are used as one of the biotic for the EPA Q-value system. IUCN threat categories for the 33 mayfly species showed that 73% are Least Concern; 6% Near Threatened, 9% Vulnerable; 6% Endangered, 3% Critically Endangered and 3 % Data Deficient. The main threats identified in the Red List are the long-term history of eutrophication in Irish rivers; changes in water temperatures; increased sediment loads; and acidification of watercourses.
- 1.44 *Damselflies and Dragonflies*: Nelson *et al.*, (2011). Similarly to mayflies, Ireland supports a very small assemblage of dragonflies and damselflies, with 24 resident species assessed for Red Data List. Of these species, 80% are of Least Concern, 4% Near Threatened and 8% Vulnerable and Endangered, respectively. The precise threats to these species are not yet well researched, but the main threats identified in the Red List are the long-term history of eutrophication in Irish rivers; changes in water temperatures and other factors which may result from climate change; and habitat loss.

- 1.45 *Amphibians, Reptiles and Freshwater Fish*: King *et al.*, (2011). Of the 15 freshwater fish assessed, one, the European eel, was found to be Critically Endangered and five others (pollan, Arctic char, twaite shad, Killarney shad and Atlantic salmon) Vulnerable whilst the sea lamprey was classified as Near Threatened. Several of these fish are listed on Annex II of the Habitats Directive. The causes of declines in fish populations are both extensive and local in origin; decreased water quality is a consistent threat identified, mainly as a result of diffuse pollution; as are unsympathetic river management; water abstraction; barriers to migration; invasive species; overfishing and potentially climate change in the future. Ireland supports only three amphibian species and two terrestrial reptile species, and the rarest of these, the natterjack toad which is classified as Endangered, is confined to a small area of coastland in Kerry. Habitat loss is identified as the key threat to natterjack toads.
- 1.46 *Butterflies*: Kelly Quinn and Regan (2010). Butterflies can be used as an indicator of ecosystem functioning as they are sensitive to changes in their niches, which can be quantified quickly given the short life cycles of butterflies. In Ireland, 33 species are recorded as regularly occurring and of these, 64% are Least Concern; 15% are Near Threatened; 9 % are Vulnerable and Endangered respectively and one species, the mountain ringlet, is extinct. The threats affecting butterflies relate to long-term population declines primarily as a result of range reduction from habitat loss and decline in existing habitat quality, including Annex habitats which can be associated with threatened butterfly species such as marsh fritillary, an Annex II species. Climate change is likely to impact both negatively and positively on the Irish butterfly assemblage, causing some threatened species to decline further whilst creating opportunities for northwards migration of generally more southern based species.
- 1.47 *Terrestrial Mammals*: Marnell *et al.*, (2009). A total of 26 mammals are considered Irish natives. One species, the grey wolf has been extinct since 1850. The black rat is classified as Vulnerable, whilst three species are Near Threatened; Leisler's bat, otter and red squirrel. Overall, the populations are generally in favourable conservation status although bat species as a group remain at risk as a group due to habitat losses. Other threats to mammals include unsympathetic habitat management, poor water quality, road kill and persecution, whilst future key threats include climate change and alien invasive species.
- 1.48 *Non-marine Molluscs*: Byrne *et al.*, (2009). The 150 native Irish non-marine molluscs are of international importance, with ten species having a significant proportion of their global population in Ireland and six species are legally protected under the Habitats Directive. Of the total natives, 61% are Least Concern; 4% Near Threatened; 17% Vulnerable; 9% Endangered 3% Critically Endangered and 5% Data Deficient. Two species were evaluated as being Regionally Extinct. Poor water quality, loss of habitat and changes in habitat management are the three key threats to non-marine molluscs, and these threats act on threatened species which may be already at the edge of their climatic ranges. Climate change is an unquantified threat, and there are increasing threats arising from alien invasive species.
- 1.49 *Water Beetles*: Foster *et al.*, (2009). Water beetles require a range of good quality water habitats such as fens, rivers, bogs, etc, which have been in historic decline but the Red List recognises that some threat assessments for this group may reflect '*intensity of recording activity as a whole*'. Of 244 taxa assessed, 61% are of Least Concern, 10% are Near Threatened; 9% Vulnerable; 5% Endangered; and 3% Critically Endangered and Regionally Extinct respectively. The Threatened and Regionally Extinct species are generally associated with fen and peat and running water habitats, reflecting habitat loss and water quality issues, and species declines may be exacerbated by climate change in future.
- 1.50 *Irish Bees*: Fitzpatrick *et al.*, (2006). The number of native bees in Ireland stands at 102, and of this number only 36% are of Least Concern whilst 16% are Data Deficient; 12% are Near Threatened;

14% Vulnerable; 10% Endangered; 6% Critically Endangered; 3% Regionally Extinct and 3% Near Extinction. Overall threats are not identified in the report, but species specific threats include trampling of ground nesting bees, loss and decline of habitat, changes in habitat management and intrinsic factors such as small population bases and ranges. For some species no single identifiable factor can be held accountable for recorded declines.

- 1.51 *Vascular Plants*: The Red List for vascular plants is outdated (1988), but more recent surveys and assessments give an indication of the status and prospects of vascular plants nationally protected plants above. Key threats to vascular plants include habitat loss; land management change; eutrophication of wetland and terrestrial habitats and unknown factors. The European Red List of Vascular Plants indicates that population trends for plants assessed at European level shows that 38.4% have declining populations, 21.8% have stable trends, 36.7% have an unknown trend and small percentage (3.1%) have increasing populations. Population trends for aquatic plants and crop wild relative⁶ plants at a European level are for the most part unknown or difficult to quantify due to complexities of reproduction and lack of quantitative data on populations.

Other Flora and Fauna

- 1.52 NPWS provides a checklist of protected and rare species in Ireland (Kingston, 2009), many of which have not as yet been addressed by a Red List or other comprehensive survey or monitoring projects. Primary groups outside of the Natura 2000 network and Red List groups which can be considered are lichens, fungi, algae, endemic species and soil biodiversity.
- 1.53 *Lichens and lichenicolous fungi*: The recent Lichen Ireland project⁷ has increased records of lichens and in the near future a Red List for lichens based on the project is likely. As of current estimates, Ireland supports 1,050 lichen taxa, 30% of the European total, which makes the lichen assemblage of international importance, and of that number 34 species are considered to be threatened in Europe (www.lichens.ie). One lichen taxa, *Cladonia* subgenus *cladina* is listed in Annex V and is currently assessed as 'poor' condition. Air pollution in Ireland is low compared to Europe and this combined suitable climate and habitats such as woodland, parkland, pasture, calcareous grasslands, peatlands, rivers and streams, sand dunes, machair, limestone pavement and splash zones above the high tide mark on coasts (www.lichens.ie).
- 1.54 *Fungi*: No species of fungi of the 3,500 approximate species present in Ireland currently receive legal protection and fungi are generally under-recorded in Ireland. O'Hanlon and Harrington (2011) believe that from preliminary evidence important habitats for mushroom forming fungi (Agaricomycetes) in Ireland include native woodland such as oak woodlands and birch woodland on raised bog margins, sand dunes, unimproved grassland and the Burren area. The majority of studies undertaken have tended to focus on grassland fungi, particularly waxcaps, as these are used as bio-indicators of habitat condition. Waxcaps populations and grassland fungi in general are thought to be in decline as a result of loss of semi-natural and unimproved grassland habitat and from nutrient changes through addition of fertilisers (McHugh *et al.*, 2001). Loss of woodland habitat and air pollution may also be threats to general fungi conservation (Anon, 2010).
- 1.55 *Algae*: The majority of Irish algae are coastal and marine and numbers of species can only be roughly estimated in the region of 524 species of marine macro-algae, 181 species of marine phytoplankton and 700 species plus of desmids (Anon, 2010). Causes of decline and threats have not been clearly identified but include excessive UV radiation resulting from atmospheric ozone depletion and water pollution. Stoneworts are a group of submerged, aquatic algae which are found mainly in calcareous fresh water and in brackish lagoons and which prefer nutrient poor waters. Of the 25 Irish species

⁶ 53 crop wild relative plants and 181 aquatic plants assessed for Ireland

⁷ www.lichens.ie

listed in the Checklist of Protected and Rare Species in Ireland (Kingston, 2009), 2 are Extinct; 3 are Rare; 5 are Vulnerable; 2 are Indeterminate. Threats to stoneworts are loss of habitat and eutrophication.

- 1.56 *Endemic Species:* Ireland has a very low level of endemism within its native flora and fauna and the status of supposed endemics is still being debated. According to McGarrigle and Champ (1999) *‘the western Irish lakes represent a super-sensitive ecological category requiring particularly strict catchment controls in order to protect the diversity of native flora and fauna including unusual glacial relict species and the unique genetic strains of fish which are present’*. To date, morphological analysis appears to support the ‘unique’ forms of Coomasaharan char in Co. Kerry, (Cullen *et al.*, 2006) and other forms of char may also be distinctive particularly those in Lough Melvin, Co. Leitrim as may the Killarney shad which is restricted to Lough Leane, Co. Kerry. Deteriorating water quality, introduction of non-native fish and habitat degradation are the main factors affecting these fish, and some populations of char have become locally extinct as a result of these threats, eg those in Lough Corrib. The Nore freshwater pearl mussel a hard-water form of the freshwater pearl mussel and is restricted to lime rich waters of the River Nore, where current threats are poor water quality and siltation. A small number of other invertebrates may be endemic⁸, but this remains to be firmly established. Ireland does not appear to support true endemic vascular plant species, but two endemic subspecies are generally recognised, fringed rockcress and hart’s saxifrage (Curtis and McGeogh, 1988), as are microspecies of the dandelion and hawkweed families. Threats to these plants arise from habitat loss and changes in land management. Three bird species are considered endemic; the dipper, coal tit (though it is not recognised by all authorities) and Eurasian jay.
- 1.57 *Soils:* The European Soil Biodiversity Atlas (Jeffrey *et al.*, 2010) and the results of the CreBeo project (Schmidt *et al.*, 2005; Schmidt 2005) give a preliminary indication of the status of soil biota in Ireland. Current information indicates the number of species present it is relatively poor by European standards, which fits with our general spread of biodiversity, as a result of geographic location and climate. The status of known elements of soil biota is poorly understood, but potentially areas of Limerick, Kerry, Cavan and Leitrim show a higher risk to loss of soil biodiversity than other parts of the Republic, whilst soils along the Western seaboard are judged at least risk (Jeffrey *et al.*, 2010).
- 1.58 The European Soil Biodiversity Atlas (Jeffrey *et al.*, 2010) and the results of the CreBeo project (Schmidt *et al.*, 2005; Schmidt, 2005) help to illuminate the often unknown diversity associated with Irish soils. This is vital information as over 90% of agricultural land in Ireland is based on a grass producing system and therefore so grassland soils sustain agriculture, dominate landscapes and imprint environmental quality (Brogan, 2008). Soil biodiversity is consequently of both inherent interest, and of value for the other ecosystem services it maintains and produces. Current information indicates it is relatively poor by European standards, which fits with our general spread of biodiversity, as a result of geographic location and climate (Schmidt *et al.*, 2005). Multiple threats include to soil biodiversity include: land use change, habitat disruption, intensive human exploitation, invasive species, soil compaction, erosion and pollution. Areas of Limerick, Kerry, Cavan and Leitrim show a higher risk to loss of soil biodiversity than other parts of the Republic, whilst soils along the Western seaboard are judged at least risk (Jeffrey *et al.*, 2010).
- 1.59 The impacts of climate change and alien invasive species are also likely to have significant adverse effect on the above groups.

⁸ <http://Intreasures.com/ireland.html>. Accessed 14 March 2013.

HNV farmland habitats and other semi-natural habitats

- 1.60 The Habitats Directive recognises habitats and species of conservation importance within a European context, but it has long been recognised that habitats and species of value occur on non-Annex quality habitat.
- 1.61 The concept of High Nature Value (HNV) farmland has emerged from a recognition that certain patterns of farmland are inherently of high biological richness, especially when existing at a landscape scale. Landscapes that contain a significant proportion of land in a semi-natural condition, such as permanent pastures and meadows with associated hedgerows, grazed woodlands and traditional orchards are considered to be good examples of HNV farmland (Beaufoy, 2011).

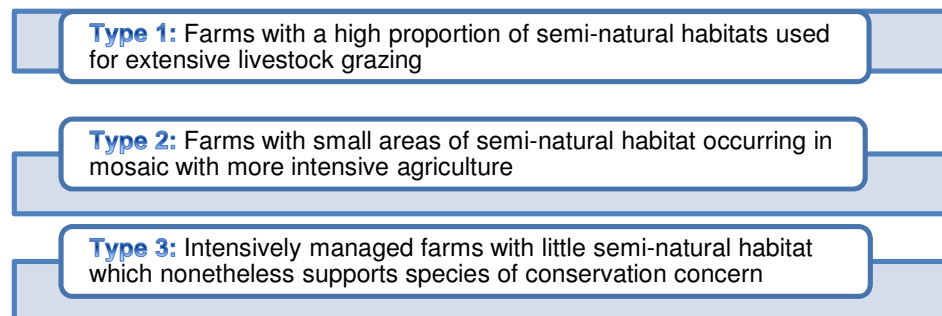


Figure 1.3 - Three types of HNV farmland (from Smith *et al.*, 2011).

- 1.62 Although HNV farmland can include Annex I habitats, much HNV farmland in Ireland exists outside of designated areas (Sullivan *et al.*, 2010). Baseline information on HNV in Ireland is at a rudimentary stage. A correlation can be assumed between Less Favoured Areas which account for 75 per cent of our agricultural land, it is possible that a similar proportion of high nature value areas are situated within them. The maintenance of farming in these areas is therefore vital in terms of maintaining a strong biodiversity base.
- 1.63 Studies in France have estimated that for a farming landscape to support high levels of biodiversity, it should include a minimum of 20% semi-natural land cover (Le Roux *et al.*, 2008). Through intensification over the previous decades, semi-natural features which result in HNV farmland have been lost, which coupled with a decline in traditional land management techniques, land abandonment and marginal profitability result in a less diverse landscape (Smith *et al.*, 2011). Agri-environment schemes such as REPS, and more laterally AEOS, have attempted to incentivise maintenance and expansion of these HNV features and practices, but economic pressures may have a contradictory impact on the success of these measures. The outstanding Burren Farming for Conservation programme, a LIFE funded project (initially termed BurrenLIFE), is an example of how targeted agri-environment schemes can be used to achieve conservation goals in a distinctive HNV farmland setting.
- 1.64 To date, there has been no national scale assessment of HNV farmland, nor any assessment of the status of potential HNV elements. Carlin *et al.*, (2010) contains a summary of management options associated with many of the habitats listed below and the effectiveness of agri-environment schemes. However, there are very few ways of attributing current status to these habitats. A general indication of the status of non-Annex grasslands and native woodlands can be attempted using O'Neill *et al.*, (2008, 2009, 2010)¹ and Perrin *et al.*, (2008)² respectively. Where little or no conservation status information is available, these groups have been listed as data deficient (DD).

Table 1.7 - Semi-natural habitats and features of High Nature Value farmland.

HNV Feature	Associated Biodiversity	Influencing factors	Location	Status
Semi-natural grassland	Plant diversity, invertebrates, birds	REPS option 'species-rich grassland	Widespread, but localised	Bad? ²
Traditional hay meadows (not Annex I quality)	Plant diversity, invertebrates, birds	REPS option 'species-rich grassland	Widespread, but localised	Bad? ²
Woodland, woodland glades	Flora and fauna diversity,	REPS options for native woodland planting	Widespread but localised	Poor? ³
Grassland field margins	Plant and invertebrate diversity, wildlife corridors	Field margins options in REPS not thought to be effective ¹	Widespread	DD
Hedgerows	Tree/shrub/ground flora diversity, wildlife corridors	REPS 4 encouraged laying, coppicing and creation of new hedgerows ¹ , many lost through intensification	Widespread, mainly lowlands	DD
Veteran trees ⁹	Moth, moss, and lichen habitat,	Removal of trees, agricultural improvement	Widespread but local	DD
Ponds ¹⁰	Aquatic flora and fauna, amphibians	Drainage, infilling, eutrophication, grazing intensity	Widespread	DD
Orchards	Invertebrates, fungi, lichens, old fruit varieties	REPS 4 option for recreating traditional Irish orchard, however mainly declines	Localised	DD
Traditional stone walls, earthen banks	Habitat for mosses, lichens, spiders, snails, lizards etc, wildlife corridor	REPS options for creation and maintenance ¹ , BurrenLife project positive impacts, abandonment in traditional management techniques, land abandonment negative impacts	West of Ireland mainly, widespread but local elsewhere	DD
Watercourse margins/riparian margins	Reservoir for plants, small mammals, invertebrates	REPS options cross compliant with National Biodiversity Action Plan but, value decreased by conflicting management advice ¹	Widespread	DD
Boundary ditches	Wetland plants, aquatic invertebrates, amphibians,	Eutrophication, dredging, infilling,	Widespread	DD
Heterogeneity of habitats, management practices and connectivity at landscape scale	Wildlife corridors, positive influence on species and populations	Agricultural intensification has led to some loss of these features throughout Ireland, more particularly in intensive areas of south, south-east and east	Widespread but declining throughout	DD

1.65 The farming systems used to create and maintain HNV farming systems are vital. They cannot be distanced from the socio-economic aspects which are also part of the farming system, for example part-time farming in marginal areas may be having a negative impact on the ability to maintain HNV features due to less time available for farm management (Smith *et al.*, 2011).

⁹ Tree Register of Ireland – www.botanicgardens.ie

¹⁰ Gioria, M. (2011). Strive Report No. 80

Agri-environment Schemes

- 1.66 The four various rounds of the Rural Environment Protection Scheme (REPS), which have been in existence since 1994, and most recently AEOS and Natura 2000 schemes, have attempted to provide incentives for appropriate and pro-active management of valued ecological features which occur within farmland through a series of compulsory and optional measures. The common feature of these measures is that there is a requirement to halt or remove intensive farming practices. A criticism of these schemes has been that uptake of ecological measures has been greatest amongst extensive farming systems, and researchers have questioned the ultimate value of the schemes to environmental improvement (Hynes *et al.*, 2008b). The single farm payment scheme applies to all farmers and, through mandatory cross-compliance, requires farmers to maintain their land in 'good agricultural and environmental condition' and to comply with 19 Statutory Management Requirements (EPA, 2012).
- 1.67 While some biodiversity gains from agri-environmental schemes have been reported, the mid-term review of the National Rural Development Plan 2002-2013 (Indecon, 2010) states that '*relatively little evidence can be attributed to this scheme in relation to an increase in biodiversity in rural areas and other initiatives are required to ensure success in this area*'. Research has indicated that certain habitats, namely wetlands and reclaimed peatlands, are relatively well protected by the REPS scheme (Murphy *et al.*, 2011), and measures which are relatively simple to achieve, e.g. hedgerow planting and stone wall building have been subject to high uptake. Positive gains for species such as Corncrake or Grey Partridge have been recorded from species specific schemes; as has recently been the case in Northern Ireland for Yellowhammer (Colhoun *et al.*, 2013). In contrast based upon a study across sixty farms over four years Feehan *et al.* (2005) failed to find any evidence of benefits to either plants to carabid ground beetles.
- 1.68 Concerns with the REPS amongst farmers relate to the perception of an emphasis on quantity rather than quality – for example, the focus on numbers of trees or hedgerows planted rather than on the most sustainable species (Indecon, 2010). The generality of options and lack of regionally applicable targets and outputs is also viewed as a shortcoming - for example in the Burren area, where traditional reverse transhumanence which was of vital importance for the development of species rich limestone grasslands was abandoned because pollution control through animal housing became central to compliance with REPS (BurrenLIFE, 2010a).
- 1.69 A major gap in knowledge is quantification of the success of these agri-environment schemes. Whilst REPS has been subject to several once-off, non-repeated, small-scale surveys examining aspects of its ecological impact, there is no co-ordinated system of ongoing monitoring in place. Feehan *et al.* (2005) has found some measures in REPS were not optimal for biodiversity, such as fencing watercourse margins, and that non-REPs field margins were more diverse than margins within REPS farms. She attributed this to the fact that the recommended 1.5m buffer was too narrow to be of ecological value. It is vital that targeted feedback on options be developed, and that examinations of the AES schemes go beyond examining narrow measures of success (e.g. length of hedgerow planted) to concentrate instead on looking at real measures of conservation and biodiversity gain.

2. Outdoor Bovine Livestock

Scope & Background

- 2.1 This section looks at the three primary types of outdoor livestock in Ireland, beef (drystock), suckler beef and dairy cattle.
- 2.2 Approximately 93,000 farms have a cattle enterprise on their farm, making cattle production by far the most prevalent agricultural enterprise on Irish farms (Teagasc, 2011). Ireland is the fourth highest exporter of beef cattle internationally (Teagasc, 2011). The success of Irish cattle and dairy enterprises is founded on the favourable climatic and soil conditions which favour long grass growing season with generally low costs of housing and winter-feeding (Lafferty *et al.*, 1999). The value of beef and cattle output in 2010 was €1.7bn representing 38% of total agricultural output and was the largest single agricultural sector (Teagasc, 2011).
- 2.3 For the purposes of this report, the potential impacts of beef and dairy sectors on biodiversity will be amalgamated, as research has focused mainly on the impacts of grazing, and not generally on the type of farm system. It is important to note that regional variation in geology and geomorphology influences the distribution of dairy and beef herds. The mountainous, wetter grasslands of the western seaboard and the south-west have traditionally supported suckler and beef enterprises, whereas the flatter, drier more productive grasslands in the midlands and south are primarily utilised for dairying and beef finishing. A recent, limited scale review of a small number of farms showed correlation between drystock, semi-natural habitats and inclusion in REPS (Sligo region) and conversely between dairy, non-participation in REPS and increasing stocking rates (Cork region) (Sheridan, 2011). It is clear that regional variation exists in terms of farm size, management techniques and practices, density and type of cattle enterprise.
- 2.4 Suckler beef is the most widespread of the Irish cattle enterprises, and expanded in Ireland from the 1980's onwards as milk quotas for dairy herds were introduced (Teagasc, 2011). Suckler farms have a wider geographic distribution in contrast to dairy farming, which is primarily based in Munster (CSO, 2007). Suckler beef in Ireland is approximately 9% of the European total, and is indicated as an area where increases in productivity can be achieved on a European wide basis (Hocquette and Chatellier, 2011). However, farming models indicate that the Irish suckler cow herd is projected to decline by 25% between 2005 and 2020 (Howley *et al.*, 2010), and is an enterprise with a very low profit margin (Crosson and McGee, 2009). The majority of suckler herds in Ireland are at very low stocking rates and herds are on average comprised of 17 cows. Therefore, part time farming is a feature of suckler beef production across the country and this influences the intensity of farm management.
- 2.5 The EU dairy herd has been steadily declining across all EU member states (23.4 million of dairy cows in the EU-27 in 2010). In Ireland, the dairy herd is projected to decline by 13% between 2005 and 2020 due to an increase in milk yields/cow (Howley *et al.*, 2010). The abolition of milk quotas in 2015 and the introduction of decoupling of direct payments could encourage the development of milk production in the most competitive geographical areas at the expense of other less profitable agricultural production. In Ireland, milk production, and therefore dairying, is likely to grow at the expense of suckler cows. Dairy farms are largely based in the Munster region, but smaller scale dairying enterprises are found in every county. The average dairy farm size is 56ha (NFS, 2012).
- 2.6 How increases in productivity in the beef/dairy sectors meet the challenges of the CAP reform, particularly the move towards compulsory modulation (second pillar) where payments will be linked a more multifunctional agricultural output of goods and environmental services, remains to be seen. Furthermore, through cross-compliance obligations, even eligibility for the main direct payments is now conditional on achieving environmental and welfare goals (Howley *et al.*, 2010).

Current Status of the Dairy/Beef Sectors

Protected habitats and species

- 2.7 Irish grasslands have co-developed with the rise of pasture based agriculture, and to a greater or lesser extent, are dependent on grazing to maintain their structure and species diversity. Permanent grassland covers approximately 60% of the Irish landscape (EPA, 2012). Additionally, grazing by cattle, mainly by sucklers, is a feature of habitats other than grassland, including dunes, salt meadows and heaths, and some level of grazing is required to maintain these systems.
- 2.8 Two Annex 1 habitats, both priority habitats, may be associated with low-lying beef and dairy pastures. Estimated area of the habitat occurring in Ireland and the proportion of which occurs in designated areas (SACs, SPAs and (p)NHAs) were sourced from National Parks and Wildlife Service (2008).
 - Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia* (priority) Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) (priority) – 6210
 - Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) (priority) - 6510.
- 2.9 Two further Annex I grassland habitats are found in upland areas which are mainly used for beef cattle and sheep: -
 - *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) – 6410
 - Species-rich *Nardus* grasslands on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe) - 6230
- 2.10 Important Annex I aquatic habitats may also be affected by beef and dairy farming. These included Lowland oligotrophic lakes (3110) and hardwater lakes (3140) that have a very widespread distribution in the Irish lowlands and adjoin low lying beef and dairy pastures. Similarly estuarine habitats (1130) are connected to upstream catchments via Ireland's dense network of river channels. The condition and future prospects of the majority of these Annex I habitats is assessed as being poor or bad.
- 2.11 As primary beef and dairy production is concentrated in the lowlands, upland habitats and species will be addressed within the sheep sector.
- 2.12 Perrin *et al.* (2010) note that the Annex I grassland habitats are in serious decline as a result of intensification of agriculture, land abandonment and unsuitable grazing regimes. Lower yields from Annex I meadows and High Nature Value grassland have resulted in improvement of many, although Perrin *et al.* (2010) reports anecdotal evidence that species-rich hay cut from these grassland types fetches a higher price, which may off-set some losses in yield.
- 2.13 A large number of other Annex 1 habitats are subject to low/medium intensity grazing and may be at risk from intensification of production, including: -
 - Mediterranean Salt Meadows (1410)
 - Atlantic salt meadows (1330)
 - Fixed dunes (grey dunes) (2130)
 - Decalcified *Empetrum* dunes (2140)
 - Decalcified dune heath (2150)
 - Dunes with creeping willow (2170)
 - Humid dune slacks (2190)

- Machair (21A0)
 - Turloughs (3180)
 - Cladium Fens (7210)
 - Alkaline Fens (7230)
 - Wet heath (4010)
 - Dry heath (4030)
 - Limestone pavement (8240).
- 2.14 The condition and future prospects of the majority of these Annex I habitats is assessed as being poor.
- 2.15 Other, habitats may occur within a High Nature Value farmland setting, which of themselves not of Annex concern, but contribute in a wider sense to local and national biodiversity. These habitats include: -
- Species diverse hedgerows, particularly as part of a wider hedgerow network
 - Veteran trees
 - Semi-natural woodland and scrub
 - Ponds, streams and drainage channels.
- 2.16 Woodland systems may also be affected by cattle grazing, and may be locally significant, but these are not of prime importance for beef/dairy herd production and so will not be addressed in this section.
- 2.17 Approximately twenty two species of vascular plant species, ten moss species and three liverwort listed on the Flora Protection Order 1999 are strongly associated with pastoral grassland. Two Annex II species are considered to be associated with cattle pasture. Slender naiad, occurs in western lakes, is considered to be at risk from eutrophication from agricultural fertilisers and manure spreading. Petalwort, a liverwort occurs in machair grassland in Mayo and Galway and thrives on over-grazed areas of this grassland type.

Table 2.1 - Protected plant species associated with mainly lowland cattle pasture.

Common Name	Scientific Name	Protection
Vascular plants		
Slender naiad	<i>Najas flexilis</i>	Annex II
Betony	<i>Stachys officinalis</i>	FPO
Meadow saxifrage	<i>Saxifraga granulata</i>	FPO
Lesser centaury	<i>Centaureum pulchellum</i>	FPO
Irish Lady's-tresses	<i>Spiranthes romanzoffiana</i>	FPO
Narrow-leaved helleborine	<i>Cephalanthera longifolia</i>	FPO
Basil thyme	<i>Clinopodium acinos</i>	FPO
Autumn crocus	<i>Colchium autumnale</i>	FPO
Meadow Barley	<i>Hordeum secalinum</i>	FPO
Opposite-leaved Pondweed	<i>Groenlandia densa</i>	FPO
Globeflower	<i>Trollius europaeus</i>	FPO
Great burnet	<i>Sanguisorba officinalis</i>	FPO

Hairy violet	<i>Viola hirta</i>	FPO
Wild Chives	<i>Allium schoenoprasum</i>	FPO
Wild asparagus	<i>Asparagus officinalis ssp. prostrata</i>	FPO
Irish St. John's-wort	<i>Hypericum canadense</i>	FPO
Hoary rock-rose	<i>Helianthemum canum</i>	FPO
Mudwort	<i>Limosella aquatica</i>	FPO
Common rock-rose	<i>Helianthemum nummularium</i>	FPO
Purple milk-vetch	<i>Astragalus danicus</i>	FPO
Orange foxtail	<i>Alopecurus aequalis</i>	FPO
Annual knawel	<i>Scleranthus annus</i>	FPO
Mosses, liverwort and lichens		
Petalwort	<i>Petalophyllum ralfsii</i>	Annex II
Moss	<i>Bryum calophyllum</i>	FPO
Golf-club moss	<i>Catoscopium nigrum</i>	FPO
Moss	<i>Hematocaulis vernicosus</i>	FPO
Moss	<i>Paludella squarrosa</i>	FPO
Moss	<i>Bryum calophyllum</i>	FPO
Moss	<i>Orthotrichum sprucei</i>	FPO
Moss	<i>Tortella inclinata</i>	FPO
Moss	<i>Tortula wilsonii</i>	FPO
Moss	<i>Weissia longifolia</i>	FPO
Moss	<i>Weissia rostellata</i>	FPO
Liverwort	<i>Leiocolea gillmanii</i>	FPO
Liverwort	<i>Leiocolea rutheana var. rutheana</i>	FPO

- 2.18 A study by Finn and Jebb (2011) indicates of the distribution of Flora Protection Order species indicates that a considerable occurrence of these species is currently outside of designated areas. The Red Data Book for vascular plants urgently needs to be updated, and updates are also outstanding on lower plant species. The National Botanic Gardens lists an updated conservation status of 188 plant species which have been used to list conservation status in Table 2.2 above (Anon, 2008). Many of the vascular plants listed the Red Data Book which are not subject to legal protection, are likely to be found on agricultural land and / or adjoining habitats.
- 2.19 Fauna species strongly associated with agricultural grasslands, hedgerows and other farmland features are listed in Table 2.3 below. All bird species receive some level of protection under the Wildlife Act 1976 and Amendment (1980). Farmland birds are too numerous to mention, therefore focus has concentrated on Red Listed species (Lynas *et al.*, 2007). BirdWatch Ireland have produced an Action Plan for Lowland Farmland Birds in Ireland 2011-2020.

Table 2.3 - Protected fauna species associated with cattle pasture.

Common Name	Scientific Name	Protection
Invertebrates		
Marsh fritillary	<i>Euphydryas aurinia</i>	Annex II
Mammals		
Irish hare	<i>Lepus timidus hibernicus</i>	Annex V
Badger	<i>Meles meles</i>	WA
Hedgehog	<i>Erinaceus europaeus</i>	WA
Bats (all species)	-	Annex II, IV
Amphibians and reptiles		
Common frog	<i>Rana rana</i>	Annex V
Viviparous / common lizard	<i>Lacerta vivipara</i>	WA
Birds		
Barn owl	<i>Tyto alba</i>	Red list
Common scoter	<i>Melanitta nigra</i>	Red list
Corncrake	<i>Crex crex</i>	Red list
Curlew	<i>Numenius arquata</i>	Red list
Lapwing	<i>Vanellus vanellus</i>	Red list
Quail	<i>Coturnix coturnix</i>	Red list
Redshank	<i>Tringa totanus</i>	Red list
Shoveler	<i>Anas clypeata</i>	Red list
Twite	<i>Carduelis flavirostris</i>	Red list

- 2.20 Protected flora and fauna of semi-natural habitats that could be sensitive to conversion to more intensive pastoral agriculture are too numerous to mention and depend on the habitats present in the land to be converted. Protected species in lakes, rivers and other watercourses where diffuse pollution, including from agricultural sources, is a factor are at risk of eutrophication.

Current baseline knowledge

- 2.21 Due to the large cover of grasslands in Ireland, the impacts of grazing by cattle have been the subject of much research, although this has tended to concentrate on macro-ecological groups such as birds, beetles and higher plant diversity. Baseline information is largely absent for many taxa, notably lower plants, herpetofauna, small mammals, soil fauna and invertebrates. What is also largely absent, is comprehensive research into the complex interactions between farmland habitats, species, farmland practices and ecosystem processes which influence biodiversity on a species and spatial level. It is clear that the separation of pastoral and arable farming systems has led to declines in bird populations, and grassland management in arable landscapes would improve habitat diversity within farmland. What research does exist shows that agricultural intensification has many components, such as loss of landscape elements, enlarged farm and field sizes and larger inputs of fertilizer and pesticides, which result in primarily negative impacts on species and habitats of importance.
- 2.22 The Status of EU Protected Habitats and Species in Ireland (NPWS, 2008) suggests that over and under-grazing was the most important pressure acting on habitats listed on the Habitats Directive, and a minor factor

- affecting Annex species. Sensitive habitats of high conservation value, e.g. orchid rich grasslands of the Burren are susceptible to scrub encroachment in the wake of reduced or eliminated grazing effects (Byrne, 2001). Similarly the *Chenopodium rubri vegetation* (3270) community of riverine truloughs occurs in areas where animal treading and dunging adds to partial disturbance and enrichment of the soil (NPWS, 2008).
- 2.23 Allied to the impacts from grazing, other pressures which can be attributed to greater intensity agriculture, including restructuring agricultural land holdings (e.g. removal of hedgerows), fertilisation, abandonment of land, trampling and stock feeding influenced the condition of Annex habitats. Therefore, the impact of cattle grazing on Irish habitats is one of the most important factors in the maintenance and condition of habitat and species biodiversity.
- 2.24 Ireland has undergone a period of beef/dairy expansion since the 1980's, and it is estimated that arable and permanent pastures increased by over 30% since 1990 (EPA, 2006), although this now appears to be in decline (Howley *et al*, 2010). It is obvious that in the past this expansion has been at the expense of semi-natural habitats, primarily grassland, and through drainage and reclamation of heathland and wetlands. Conversion of semi-natural habitats to more intensive pastoral regimes undoubtedly results in biodiversity losses, the magnitude of which depends on the quality and extent of habitat being replaced.
- 2.25 One of the anticipated results of the CAP reform was that the number of mixed farming units could be expected to decline (Oglethorpe, 2005). There are distinct biodiversity benefits from having a more diverse land use system, and the impact of expansion and intensification of beef/dairy needs to take account of regional variation. In the UK, research has identified that regional variation also exists in location of different beef enterprises, and identified a wide range of systems to be particularly vulnerable to changes in profitability in the beef sector, including: coastal grazing marsh, wet acidic grassland/marshland, upland moor and heath, calcareous grassland and neutral grassland. NPWS (2008) noted in their review of the status of Annex 1 habitats that many of the coastal salt meadows, dunes and in addition to limestone pavements were being adversely affected by over or under-grazing.
- 2.26 Although pressures for more productive beef/dairy systems may lead to expansion into the wider countryside and intensification of existing farms, it may also result in abandonment of marginal land with low profit margins. Whilst this is likely to affect a small land area, potential impacts on biodiversity are mixed; negative impacts include loss of structural diversity, changes in plant communities and scrub encroachment; whilst positive impacts such include less disturbance by poaching and reduced sources of pollution (Oglethrope, 2005). Orchids, seen as positive indicators of good quality habitats, are thought to be in decline in Ireland due to agricultural intensification and lack of appropriate management such as grazing (Duffy *et al.*, 2007).
- 2.27 Despite intensification over the past decades, Ireland still supports a range of species diverse grassland types which are dependant to a greater or lesser extent on the presence and level of grazing. Additionally, the botanical diversity of grassland swards depends on a number of concomitant factors, including underlying geology and hydrology, levels of soil fertility and management techniques. Where soil fertility has increased, for example through increased organic fertiliser application or increased manuring as a result of greater stocking density, there is a resultant decrease in botanical diversity. Neutral grasslands, which form the bulk of pasture in the east and centre of the country, where dairy in particular is dominant, have seen reductions in plant diversity as a result of fertiliser applications and changes in land management (Heritage Council and Teagasc, 2010). Only pockets of semi-natural grasslands remain in these areas (Perrin, 2010). In the west and north, limestone, acid and wet grasslands have fared better, but only marginally so.
- 2.28 Sowing of competitive mono-species grasses facilitates out-competition of semi-natural flora and provides for changes in management such as increased frequency of cutting for silage (Mortimer, 2010). Livestock production is generally lower on semi-natural grasslands, as the dry matter yield and digestibility is lower per hectare than from improved land. Where the focus is on increased livestock production, reseeding of these less productive swards has been recommended by Teagasc. Research in the UK has looked that the potential for forb species of high wildlife value which may persist in moderately fertile grassland systems. Yarrow (*Achillea*

millefolium), knapweed (*Centaurea nigra*), ox-eye daisy (*Leucanthemum vulgare*) and ribwort plantain (*Plantago lanceolata*) were found to be retained but these may disappear under intensive management (Mortimer *et al.*, 2006). These species have also been found to be indicators of semi-improved grasslands under low to moderate intensity management in Ireland (O’Sullivan, 2010). What is unclear is whether the presence of these species can also support greater diversity of invertebrate and avian taxa with the farm system and perhaps act as indicators for monitoring.

- 2.29 Silage has higher moisture content than hay and so mowing for silage can begin as early as mid-March and can be repeated every few weeks until the autumn. This allows little time for both grass and forb species to flower and set seed and little opportunity for seed to enter the seed bank. In contrast, hay is usually cut in mid to late summer, allowing many plants species to set seed. Species rich hay meadows (6510) are Annex 1 habitats, and have declined substantially in Ireland (Perrin *et al.*, 2010). Silage cutting, with fast cutting machines, occurs at a time of year when leverets (young hares) are using the grass fields for feeding and cover, resulting in potentially high mortality levels (Boatman *et al.*, 2008) and is also a risk for ground nesting birds.
- 2.30 Drainage of wetlands has resulted in the loss of habitats and associated species. Wet grasslands that remain support distinctive plant communities, and offer opportunities for a number of rare species (Perrin *et al.*, 2010). Drainage channels themselves can act as refuges for species lost in the wider area through land drainage, such as amphibians, aquatic invertebrates and wetland plants. Farmland ponds have been found to act as reservoirs for aquatic flora and fauna, and a recent study of 54 farmland ponds found a total of 76 beetle species, 4 species are red list species (Gioria, 2011). A large proportion of farmland ponds were lost in the past 50 years due to arterial and field drainage schemes incentivised by entry to the EU and Farm Improvement Schemes (Burdon, 1986).
- 2.31 As with arable fields, the biodiversity value of grassland field margins tends to be greater at the margins of fields rather than in the centre (Fritch *et al.*, 2011), although rank grass growth and high soil fertility will reduce the potential value of this habitat, and the size of buffer is also important. Whilst not the subject of detailed research, what evidence exists indicates that these areas, with the implementation of interventionist management, including the exclusion of livestock from field margins using fencing, and the sowing of species-rich seed mixtures may provide reservoirs for plants, invertebrates and birds in particular (Sheridan *et al.*, 2008a).
- 2.32 The most commonly studied faunal groups in the Irish agricultural system are birds, beetle communities and to a lesser extent, butterflies. The majority of these studies show declines in diversity and abundance of these taxa as agricultural intensity increases.
- 2.33 Where landscapes are dominated by intensively managed grassland, declines in farmland bird species, particularly seed-eating species, have been recorded (Donald *et al.*, 2001; Sotherton, 1998). Invertebrate-eating birds are also negatively affected by agricultural intensification (Tucker, 1992), however, some benefit from shorter swards, for example swallows and starlings (Møller, 2001) and improved grassland left to seed can provide winter food resources for buntings and finches (Buckingham and Peach, 2006). Land drainage results in decreases of waders (Smith, 1983). In Ireland, positive indicators of bird diversity on farms were found to include geographical location, smaller field size, presence of hedgerows and type of farm enterprise (Copland and O’Halloran, 2010b). The stimulation of rapid grass growth by fertiliser in grasslands can render the sward unsuitable for ground-nesting birds and stimulated grass growth allows early and more frequent cutting, so that birds do not have time to complete breeding before cutting destroys nests (Donald *et al.*, 2002).
- 2.34 Vegetation structure is also linked to invertebrate diversity and density, and where structural heterogeneity is reduced, this will inevitably lead to reduced invertebrate diversity. Removal of hedgerows contributes to landscape simplification and eliminates habitats used by a wide range of species (Russ and Montgomery, 2002; O’Brien *et al.*, 2008; BirdWatch Ireland, 2011). Whilst the impacts of intensification on pasture land may be similar for beef/dairy farms, breeding bird populations within field boundaries are significantly greater on dairy farms compared with non-dairy farms (McMahon *et al.*, 2008), which if extrapolated may indicate potential for

- higher loss of bird diversity upon expansion of dairy farms. Loss of hedgerows has been cited as a cause in the decline of butterflies (Dover *et al.*, 1997), bees (Goulson *et al.*, 2008) as well as small mammals and bird species.
- 2.35 The invertebrate diversity of agricultural grasslands is driven by botanical composition and vegetation structure and their combined effects on food resource abundance and microclimate. Most work has focused on a small number of invertebrate taxa and on the use of insecticides, fungicides and veterinary pharmaceuticals which are seen to limit invertebrate abundance and diversity, most notable dung beetle communities (Dadour *et al.*, 1999; Wardhaugh *et al.*, 2001). Veterinary chemicals in cattle slurry can reach the environment directly through the excretion of outdoor grazing stock, and indirectly through the spreading of manure as fertiliser (Hamscher *et al.*, 2002 in Kümmerer, 2009). Whilst these may have negative impacts on algae, bacteria and water fleas (Kümmerer *et al.*, 2000; Boxall *et al.*, 2003a) the wider risks in on terrestrial and aquatic systems are not clearly quantified. On pasture grasslands, pesticides are used less intensively, though herbicides may be used to control some broad-leaved weeds in order to maximise grass quality for livestock grazing.
- 2.36 Dung beetles are essential in the nutrient cycling process, and have been used as indicators of biodiversity potential of grazing systems. Research on dung beetle looking at diversity and biomass on three different farm types found greater diversity of species/abundance on organic farms, followed by rough grazing and least on intensively managed farms (Hutton and Gittings, 2003). Loss of internal features such as hedgerows is also thought to impact negatively on dung beetle populations as it increases rate of dung drying, reducing timescales for dung beetle colonisation.
- 2.37 It is not only terrestrial invertebrates that are impacted upon by agricultural practices. The critically endangered freshwater pearl mussel has been found to be adversely affected by eutrophic waters and increases in silt, whilst liming of land has direct toxic effects, and leads to shortened life expectancy through increased growth rates and, thus, loss of reproductive years (Bauer *et al.* 1991, Skinner *et al.* 2003). Pearl mussels continued to thrive until recent years in catchments with very extensive agricultural practices. The intensification of agriculture, particularly with slurry and artificial fertilisers has led to cumulative effects that have had very severe, adverse consequences for pearl mussel reproductive success and hence for the conservation status of the species (NPWS, 2010). Increases in sediment loads have also been associated with lower survival rates of salmon fry (Greig *et al.*, 2005).
- 2.38 To bridge some of the gaps in knowledge of agricultural impacts on Irish farm systems, an integrated five-year EPA STRIVE project, informally known as the ‘Ag-Biota’ Project, was set up in 2000 (Purvis *et al.*, 2009). Ag-biota has published a range of outputs which summarise research outcomes on biodiversity. In summary, the abundance and diversity of bees, birds and other species of insects and plants have suffered serious losses as a result of changing farming practices in Ireland (Purvis *et al.*, 2009b).
- 2.39 Information on how agricultural intensity and management practices impact on other fauna taxa is patchy. Loss of refuge areas like hedgerows/rushy fields is considered to be a contributing factor to the decline in Irish hare population (NPWS, 2008). Low intensity agriculture may result in higher numbers of rabbits and foxes, with consequential over-grazing by rabbits in areas of conservation concern and negative impacts on ground-nesting birds by foxes (Reid *et al.*, 2007).
- 2.40 Cattle are known to cause compacting of soil structure and poaching of soil in well used areas, particularly around drinking water troughs, entrances to fields and other parts of the land where the animals congregate. Vegetation regeneration in these areas may take some time and be different to the original community. Compacted soil becomes strong making it difficult for new shoots to penetrate the soil and emerge; structureless soil is unlikely to drain well and will pond after moderate rainfall. Soil particles from these zones will be susceptible to erosion carrying particles, organic matter and phosphorus to surface waters (Warren *et al.*, 1986) where they can result in impacts on species susceptible to increases in suspended solids such as freshwater pearl mussel and spawning salmonids.

- 2.41 Terrestrial primary production from riparian areas is a critical part of the energy subsidy (Vannote *et al.* 1980; Nakano *et al.*, 1999) required by birds, bats and fish along river corridors and lake margins. As such the removal of vegetation to facilitate access by cattle to rivers and lakes for drinking or to open out marginal habitats. The integral part of riparian zones to riverine systems is exemplified when their loss results in the disappearance of fish and invertebrates that only return after the recovery of the habitat lost (Penczak, 1997).
- 2.42 The potential impacts of intensive management on soil biodiversity have received patchy coverage in literature. Curry *et al.*, (2008) found that populations of earthworms in Irish soils were not negatively affected by intensive management. This is backed up by Purvis *et al.* (2009) who found that the pasture ecosystem is critically dependant on earthworm populations to ameliorate the impact of high stocking rates on soil structure. Intensification of animal farming systems induced an increase in nitrogen spillage in the soil-crop-animal interaction. The addition of artificial fertilizer to natural habitats can harm soil mycorrhizae, which in turn can reduce recruitment and growth of some orchid species (Silvertown *et al.*, 1994).
- 2.43 Cattle slurry contains nitrogen, phosphorous and potassium and as well as being left in situ, can also be collected and spread over grasslands in place of urea. The amount of urine delivered to grassland soils by a grazing cow has been estimated to deliver approximately instantaneous application of 400-1200 kg N ha⁻¹ (Addiscott *et al.*, 1991). Such an amount burns vegetation and is often toxic to plant roots which cannot immediately recover to take up the N (full recovery can take up to 12 months and the problem is obviously worst in areas where animals congregate). Urea in soil is quickly hydrolysed and given that grass can take up perhaps 400 kg N ha⁻¹ annually without loss, pollution of groundwater or the atmosphere is almost inevitable whenever urine is applied directly to soil. Both calcium and magnesium are also lost in substantial amounts from urine patches on pasture soils (Early *et al.*, 1998).
- 2.44 The nutrient content of slurry is variabl. Excess N has been shown to accumulate in groundwater and surface waters, but generally does not in grassland soil. In contrast, P is immobile and tends to accumulate in soils at point of application. In Ireland, the southern and eastern parts of the country have been found to be at risk of higher nitrate levels in rivers and estuaries, due to the concentration of intensive agriculture and other factors such as meteorology and soils (Schulte *et al.*, 2006), resulting in reduced biological water quality. In contrast, the P pathways for pollution of watercourses are more susceptible in the north-west, but reduced stocking densities mean that higher P levels are also found in southern and south-eastern areas.
- 2.45 The EPA Strive Report 91 on Water Quality & Aquatic Environment (Taylor, 2012) determined relationships between environmental conditions and P concentrations. Data collected for the period 1995–2008 for Lough Sheelin where the study was focused indicated the extent of poorly drained soils, cattle-stocking densities and runoff having the strongest positive influence on P concentrations.
- 2.46 Ultimately eutrophication causes algal blooms, turbidity and reductions in oxygen that reduce the diversity of plants and animals present in brackish and freshwater environments (HELCOM, 2009). For example once the rate of nutrient application exceeds the natural balance of the soil resulting in loss to waterways, it sets the way for noxious plants and blue green algae to colonise (Tilman, 1999) as they exploit the free nurtients, which can cause cascading ecosystem impacts as they outcompete competitors with narrow bands of environmental tolerance and change the architecture of the habitat causing wide ranging biodiversity impacts.
- 2.47 Hypoxia as a result of eutrophication can alter the composition of a community by killing sensitive or poorly mobile organisms, reducing suitable habitat for others, and changing interactions between predators and prey (Horwarth *et al.*, 2000). It is known that sedimentation impacts sensitive benthic invertebrates such as empheroptera, plecopteran and trichopteran taxa as it smothers their integuments and gills and fills interstitial habitats that they occupy (Chutter, 1968; Allan, 2004). Curtis *et al.*, (2009), review a plethora of water dependant species and habitats designated under the EU Habitats Directive and list eutrophication as a key threat to their biodiversity value given that they host a wide range of fish, plant and invertebrate species.
- 2.48 Research has shown that the efficiency of P use in cattle can be improved by using the enzyme phytase in animal concentrates and the use of low phytate grains in concentrate mixes will help reduce surplus P in the animals diet

(Bourke *et al.*, 2008). By reducing nutrients in the diet P losses can be reduced at the field interface and to waterbodies.

- 2.49 Changes in livestock types may have a neutral, negative or positive impact on biodiversity, depending on change and geographical location (Isselstein *et al.*, 2007). For instance in the Burren, negative impacts on Annex grasslands occurred in the changeover from hardy old breeds to heavy Continental breeds, due to e.g.increasing trampling.
- 2.50 One option for increasing production may be the extension of grazing periods, coupled with an earlier calving date. The inappropriate application of extended grazing may increase risk of soil compaction, with associated risks to water quality, and also increase impacts such as poaching and nutrient enrichment. This may be of importance in systems which have evolved with specific grazing periods, e.g. winterage in the Burren.
- 2.51 It is possible that increases in productivity will require enhanced application of organic and inorganic fertilisers within the farm gate. Fertilizers can lead to the eutrophication of water bodies by providing nutrients to algae which then reduce oxygen levels to the point which reduce aquatic biodiversity. Other invertebrates too were found to have declined in agricultural systems as a result of increased fertiliser application and reduced plant species diversity, including leafhoppers, springtails and butterflies (Ponge *et al.*, 2003).
- 2.52 Future developments in animal genetics and genomics have potential to be neutral or slightly positive impacts on biodiversity, and work on this in Ireland has been targeted through a number of schemes, such as the Suckler Welfare Scheme. Where phenotypes can be manipulated up to include sustainability traits such as efficiency of nutrient use, emissions (nitrogen, phosphorus, and greenhouse gas) as well as robustness and productivity, these may reduce impacts on farming systems from the drive to increase productivity (Hocquette and Chatellier, 2011). Indeed, the increase in milk yield per cow, which is closely linked to genetic progress, has led to a decline in the number of dairy cows in all EU member states (European Commission, 2011).
- 2.53 Louwagie *et al* (2011) have established a baseline for an Agri-environment Footprint Index (AFI) to assess farmscale changes in the environmental impacts of drystock and dairy farming and to assist the assessment of European agri-environment schemes in Ireland. This is an interesting premise which focuses on three farm management areas used as indicators - organic nutrient application and storage and grass husbandry. The AFI has potential to be expanded to a national level, and where it may be combined with key bio-indicator groups for assessment of the impacts of agriculture on wider biodiversity (Purvis *et al.*, 2009b), amongst other indicators.

Increasing Productivity

a) Intensification

- 2.54 One of the key factors which may drive intensification of dairy production is the removal of milk quotas in 2015 (Hennessy *et al.*, 2011). Both beef and dairy stocks will have increased focus on genetic selection of animals based on the Economic Breeding Index (EBI), which is a biodiversity neutral tool. It is likely that dairy herd reproductive performance will be one of the key methods used to increase productivity, attempting to better co-ordinate calving times with grass growth. Läpple and Hennessy (2012) found that when milk quota is limiting, farm profit is maximised by minimising production costs. When the quota is no longer limiting, most farms will find that land is the most limiting resource. The results suggest that when milk quota is no longer binding, dairy farmers will maximise profit by increasing the stocking rate on the grazing platform. The current optimal stocking rate around the existing grazing platform is 1.8 cows per hectare. The analysis showed that this optimal rate would increase to 2.8 cows per hectare if there was no quota constraint on production.
- 2.55 The key ways in which increases in dairy and beef herd productivity may impact on the biodiversity of terrestrial and aquatic habitats are: -
 - Converting low profit margin drystock farms into dairying farms

- Increasing stocking rate per hectare
- Earlier mean calving date (15 Feb as opposed to 15 March) to maximise grass-based forage
- Extended grazing season
- Converting non-agricultural land to pasture
- Converting non-intensive management systems to intensive systems
- Increasing fertiliser and slurry applications
- Sowing of competitive grasses and clovers in semi-improved pasture
- Removal of hedgerows and associated drainage features
- Increased arterial drainage
- Change in livestock types
- Increases in discharge of animal waste;
- Financial incentives to change traditional management techniques
- Change from suckler enterprises to sheep farming in upland areas?
- Provide add-on value through farm-based businesses, eg cheese making, yogurt production.

b) Expansion

2.56 The potential for expanding dairy and beef farming within the landscape are generally limited as much of lowland grassland systems are already exploited for these enterprises. Expansion may be achieved through replacing beef on a dairy farm with increased dairy stock, and possible small-scale conversion of other habitats to pasture. Expansion of beef/dairy farming may be incentivised by a number of measures, such as grant-aid, tax incentives, changes to regulations, improving access to markets and better provision of technical advice. In and of themselves, these measures are biodiversity-neutral.

2.57 Implementation may result in different types of expansion:

- At a field scale:
 - Replacement of existing low intensity pasture with high intensity pasture use
 - Replacement of existing semi-improved grassland
 - Replacement of other existing semi-natural habitats, eg bracken, scrub, wetlands
 - Removal of internal landscape features such as hedgerows, ponds and drainage.
- At a landscape scale:
 - Expansion mainly in intensive agricultural landscapes where dairy/beef enterprises are already frequent (e.g. south and east)
 - Expansion mainly in moderately improved agricultural landscapes with smaller fields and more semi-natural habitat pockets where beef/suckler cattle enterprises are the dominant form of agriculture (e.g. midlands and border region)
 - Expansion mainly in extensive agricultural landscapes where semi-natural habitats are abundant and where suckler cattle enterprises are dominant (e.g. west and uplands)
 - Abandonment of land with production limitations
 - Expansion of existing or new pasture within proximity to watercourses.

Possible Impacts on Biodiversity and Flora & Fauna

- 2.58 Possible impacts can be summarised from information in above review, but clarity on potential for adverse, neutral and positive impacts will become more apparent when detailed regional scenarios are available. The potential impacts of the interaction between the existing ecological conditions at the field and landscape scales are summarised in matrix form in Table 2.4.
- 2.59 Although there is a large volume of research on the biodiversity of Irish grasslands, a full inventory of species is not yet complete. For example, previously unrecorded species in Ireland of hymenoptera were found during surveys of intensively managed dairy farms (Anderson *et al.*, 2006). However, many of the key issues have been elucidated or identified and therefore confidence in these predictions is moderate to high.

Table 2.4 - Possible impacts on habitats and species from measures to increase productivity in the dairy and beef sectors.

Measure	Impact	Comments
Increase stocking rates		Negative impacts through potential for over-grazing semi-improved grassland
Conversion of non-intensive pasture to intensive grazing regime		Likely negative impacts as possible loss of species diversity
Conversion of low profit drystock land to dairy land		Possibly negative impacts as stocking rates will increase and loss of semi-natural features
Increase fertiliser/slurry applications		Likely negative impacts on terrestrial and aquatic biodiversity
Convert non-agricultural land to pasture		Loss of semi-natural habitats which are of value in areas of intensive agriculture
Hedgerow removal		Loss of habitat for flora and fauna, reduced landscape structure
Change in mean calving time		Earlier intensive grazing, but impacts likely to be neutral
Expansion near watercourses		Increased poaching, nutrient run-off and impacts on aquatic biodiversity
Genetic breeding		Most likely neutral impact, potential for positive impact if grazing efficiency is enhanced
Change in livestock type		Probably neutral in current intensive areas, may have impacts in less intensive land
Increased arterial drainage		Negative impacts on marginal land, but potential for increases in aquatic diversity/range
Sowing of competitive species		Reduces sward diversity, reduces value of HNV farmland
Providing add-on value		Potential increases in waste and on-farm sources of pollution
Change from suckler enterprises in upland areas to sheep		Possible structural and biodiversity losses in habitats requiring cattle grazing, possibly of benefit
Reduction in existing area of agricultural land		Potentially beneficial if land is converted to semi-natural habitats

3. Sheep

Scope and Background

- 3.1 Sheep farms in Ireland are divided into two main types. ‘Hill farms’ are located within the Irish uplands, on marginal land which is generally deemed unsuitable for the more intensive beef and dairy sectors. Lowland sheep farms occur on low lying marginal land and are the more productive in terms of meat output, accounting for 85% of production¹¹. Lowland sheep may be pastured on commonage uplands for part of the year.
- 3.2 FH2020 envisages an increase in output value of 20%, targeted through efficiencies and improvements at farm level and during processing. It is likely that potential for increases in productivity will be based mainly in the lowland areas, as this has the highest percentage of the national sheep flock. This literature review looks primarily at the impacts of sheep on lowlands, but also includes an assessment of potential for impacts on the more sensitive upland environment.
- 3.3 Recent data indicate that between 2005 and 2008 the Irish ewe flock has contracted by almost 22% and there are projected overall declines of up to 42% by 2020 (Howley *et al.*, 2010). The number of ewes has been declining since the introduction of cross compliance obligations in 1998 designed to reduce the number of ewes in environmentally sensitive areas.

Current Status of the Sheep Sector in Ireland

Protected habitats and species

- 3.4 Irish upland areas are primarily underlain by peat and support a number of habitats and species which are of national and international significance. Almost 19% of Ireland can be considered to support upland habitats (Perrin *et al.*, 2009). Over 40% of the peat-covered uplands, and western Ireland in particular, has been proposed and/or designated as Natural Heritage Area (NHA) and/or Special Area of Conservation (SAC) and Special Protection Areas (Perrin *et al.*, 2010).
- 3.5 The following habitats associated with upland areas are included within the Annex 1 of the Habitats Directive.

Table 3.1 - Principal protected upland habitats associated with sheep farming.

Habitat Type	Habitat Code
North Atlantic wet heaths	4010
European dry heaths	4030
Species-rich <i>Nardus</i> grasslands, on siliceous substrates in mountain areas (priority)	6230
Blanket bog (priority, active bogs only)	7130
Raised bog (priority active bogs only)	7110
<i>Molinia</i> meadows on calcareous, peaty or clayey-silt laden soils (<i>Molinia caerulea</i>)	6410
Upland Oligotrophic Lakes	3130

¹¹ http://www.teagasc.ie/publications/2010/8/8_todaysfarmMayJun2010.pdf

Dystrophic Lakes ¹²	3160
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3.6 Other upland habitats which have elements of sheep grazing include: -

- Alpine and sub-alpine heath (4060)
- Juniper scrub (5130)
- Siliceous scree (8110)
- Calcareous scree (8120)
- Calcareous rocky slopes (8210).

3.7 Sheep farming is not restricted to upland areas. Where it occurs in the lowlands, it is generally on marginal, less productive land and in coastal grassland, dunes and saltmarsh, areas which have retained some semi-natural plant communities. Species diverse, semi-natural dry, calcareous grasslands and scrubland facies on calcareous substrates (Annex code 6210) may be grazed by sheep.

3.8 Irish upland habitats exist in a complex mosaic, which increases their value to flora and fauna, providing habitat suitable for various life cycle stages. At least fifteen vascular plant species protected under the Flora Protection Order 1999 are strongly associated with upland habitats, three Annex V moss/liverwort species, one Annex II moss species, *Hematocaulis vernicosus*, and another moss, *Bryum marratii*, which is listed on the Flora Protection Order.

Table 3.2 - Protected plant species associated with mainly lowland cattle pasture.

Common Name	Scientific Name	Protection
Vascular plants		
Marsh saxifrage	<i>Saxifraga hirculus</i>	FPO
Slender cottongrass	<i>Eriophorum gracile</i>	FPO
Round-leaved wintergreen	<i>Centaurium pulchellum</i>	FPO
Bog orchid	<i>Hammarbya paludosa</i>	FPO
Small-white Orchid	<i>Pseudorchis albida</i>	FPO
Bog Hair-grass	<i>Deschampsia setacea</i>	FPO
Pale dog-violet	<i>Viola lactea</i>	FPO
Fringed sandwort	<i>Arenaria ciliata</i>	FPO
Recurved sandwort	<i>Minuartia recurva</i>	FPO
Wood Small-reed	<i>Calamagrostis epigejos</i>	FPO
Irish St. John's-wort	<i>Hypericum canadense</i>	FPO
Heath cudweed	<i>Gnaphalium sylvaticum</i>	FPO
Alpine saw-wort	<i>Saussurea alpina</i>	FPO
Hairy bird's-foot trefoil	<i>Lotus subbiflorus</i>	FPO
Alpine bistort	<i>Persicaria viviparia</i>	FPO
Mosses, liverworts, lichens		
Moss	<i>Leucobryum glaucum</i>	Annex V

¹² Dystrophic Lakes and Ponds may occur in bogs and heaths in uplands and lowlands

Moss	<i>Hematocaulis vernicosus</i>	Annex II
Baltic bryum	<i>Bryum marratii</i>	FPO
Reindeer moss	<i>Cladonia species</i>	Annex V
Clubmoss	<i>Lycopodium group</i>	Annex V

- 3.9 A number of protected fauna species occur with upland habitats. These habitats are of prime importance for bird species which are too numerous to detail here, which has instead concentrated on Red List species (Lynas, 2007). Birds of prey such as merlin (Amber) and peregrine falcon (Red) are likely to occur in addition to kestrels and sparrowhawks. Upland breeding waders such as golden plover, curlew and lapwing will use grasslands and other upland habitats. Nightjar is a rare visitor to uplands in the south.

Table 3.3 - Protected fauna species strongly associated with upland habitats and sheep grazing.

Common Name	Scientific Name	Protection
Invertebrates		
Narrow-mouthed whorl snail	<i>Vertigo angustior</i>	Annex II
Marsh Fritillary	<i>Euphydryas aurinia</i>	Annex II
Mammals		
Irish hare	<i>Lepus timidus hibernicus</i>	Annex II
Pygmy shrew	<i>Sorex minutus</i>	WA
Amphibians and reptiles		
Smooth newt	<i>Lissotriton vulgaris</i>	WA
Common frog	<i>Rana rana</i>	Annex V
Viviparous lizard	<i>Lactera vivipara</i>	WA
Birds		
Hen harrier	<i>Circus cyaneus</i>	Annex I / Red List
Golden eagle	<i>Aquila chrysaetos</i>	Annex I / Red List
Golden plover	<i>Pluvialis apricaria</i>	Annex I / Red List
Nightjar	<i>Caprimulgus europaeus</i>	Annex I / Red List
Red grouse	<i>Lagopus lagopus scotica</i>	Red list
Curlew	<i>Numenius arquata</i>	Red List
Lapwing	<i>Vanellus vanellus</i>	Red List

- 3.10 Bog pools are an important habitat for invertebrates and Red Book list dragonflies and damselflies are associated with these habitats. Otters may use bog pools and whilst a more inhospitable foraging and roosting terrain than the lowlands, some bat species may use upland areas.

Current baseline knowledge

- 3.11 Sheep, like cattle, through the direct impact of grazing are responsible for the maintenance of different grassland communities in Ireland. Stocking rates have varied over the past decades, with increases as subsidies became favourable for sheep farming, followed by reduction in numbers in uplands as a result of mandatory destocking under decoupling and lower returns.
- 3.12 According to Teagasc research, many lowland sheep farms have low stocking rates compared to the national average of 8.7 ewes/ha, and in terms of increasing production, extended grazing season is recommended (Keady, 2012). The impact of this on semi-natural grasslands has not been tested, but is likely to result in lowering of ability for plants in semi-natural habitats to set seed with knock on effects for plant diversity.
- 3.13 One of the major historic impacts of sheep farming has been the conversion of semi-natural habitats like heathland, moorland and mountain grasslands into grasslands, but such losses have plateaued over the last decade. There is evidence of long-term reductions in species and structural diversity, increased erosion of peats and soils, and the expansion of coarse grasses at the expense of heather and moss dominated communities (Walsh, 2008). Upland habitats are still relatively intact at a landscape scale which increases their intrinsic value to biodiversity compared to more fragmented lowland habitats, but could offer opportunities for extensive upland habitat restoration.
- 3.14 The manner in which sheep graze influences their impact on vegetation. Sheep tend to bite off vegetation close to the ground and so produce very short swards. Sheep are also selective feeders, avoiding tall plants and tussocky areas and often selecting flowers over grass stems. The type of sheep will influence what type of vegetation is selected. Wethers (castrated rams) are less selective grazers and have a lower mineral requirement than lambs or ewes and so will often feed on coarser and less palatable vegetation (Boatman *et al.*, 2008).
- 3.15 Overgrazing in upland areas, primarily by sheep, has resulted in many documented negative impacts, including soil erosion (Walsh *et al.*, 2001). Blanket bogs in Mayo/Galway have been severely degraded by increases in sheep numbers as a result of the EU Headage Scheme (McGowan, 1993). NPWS (2007) state that Alpine and Sub-alpine Heath (4060) is increasingly under threat from sheep grazing. Over-grazing by sheep is one of the causes of loss of narrow-mouthed whorl snail (NPWS, 2007; Byrne *et al.*, 2009).
- 3.16 Overgrazing by sheep can also result in the loss of heather and the spread of rank grasses and there is evidence that the sheep themselves compete directly with the hares for food and cause disturbance to feeding hares (Hudson and Newborn, 1995). When heather has been overgrazed, increases in bracken and grasses (particularly purple moor grass and mat grass) and bog cotton occur (Hetherington & Gardner 2002a,b). High intensity sheep grazing can reduce tree regeneration in upland woodlands (Hester *et al.*, 1999). Plot studies on the Teagasc Hill Sheep Farm, Leenaun, indicate that semi-natural vegetation is especially sensitive to intensive winter grazing (Walsh *et al.*, 2000).
- 3.17 Whilst the variation in grazing pressure may maintain diversity of micro-habitats, it also leads to high stocking pressure in preferential grazing areas, which impacts negatively on the environment and ecology through erosion, nutrient enrichment and inadvertent botanical responses. The heterogeneous distribution of the sheep activity leads to the local concentration of urine and dung, in particular at the resting areas. The associated concentration of nutrients (P and N) may not only induce inadvertent botanical responses, but also increase the risk of nutrients to water.
- 3.18 Increased sheep stocking densities have been linked to reductions in pastoral bird populations through reductions in seed and invertebrate availability as a result of lower sward height and plant diversity (Newton, 2004). Populations of the scarce hen harrier in the UK and Ireland are thought to be negatively affected by

increasing sheep numbers in uplands as a result of lowering potential for small mammal prey by decreasing areas of rough grassland (Amar *et al.*, 2010). However, as sheep numbers continue to fall, these impacts may be halted or reversed.

- 3.19 According to the Salmon Research Agency, overgrazed peat lands can lose up to 250t km⁻¹ of peat, which is five fold greater than quantities lost from sites that are not subject to intensive grazing (Whelan, 1995). Destocking of hillsides was undertaken under the Commonage Framework Plans that resulted in a decrease in sheep numbers to 7.2 million by 2002, a number that was still more than double the 1980 population (EPA, 2004). Overgrazing can impact Annex I aquatic habitats such as upland oligotrophic lakes and dystrophic lakes that occur in the uplands and are vulnerable to nutrient enrichment from overgrazing given that sediment bound nutrient transfer can elevate the trophic status of these lakes habitats and cause long term biodiversity losses.
- 3.20 Intensification of the sheep industry in Ireland by 2020 may be achieved through increased efficiencies and therefore may see an overall reduction in the number of sheep, reducing or possibly eliminating sheep grazing pressure in some affected areas. As the emphasis in the past has been on productivity, research has tended to investigate the impacts of over-grazing and not under-grazing. A reduction in grazing pressure may be viewed as a positive, resulting in increases in vegetation height and of the richness of mesophytes and leafy plants, and red-list species in some grassland systems (Vasseliev *et al.*, 2011, Marriott *et al.*, 2009). However, undergrazing or abandonment of grazing may result in adverse changes in the longer terms, and if it occurs extensively at a landscape scale, this could be viewed as being unfavourable towards biodiversity as overgrazing. Research indicates that where grazing effect is abruptly halted, in conjunction with stopping of fertiliser application, the potential of the land to act as a carbon sink is adversely affected. Undergrazing of habitats may lead to rapid changes in plant communities, changes in sward height and structure and possibly the elimination of some desirable species (Holland *et al.*, 2008). Whilst sheep numbers may drop other herbivore numbers may increase, eg deer (as the case in the Wicklow Mountains), may increase which could negate any beneficial impacts (Hope *et al.*, 1996).
- 3.21 In upland areas, large-scale burning of heather is a management practice used to reduce woody growth of heather, stimulating seed germination and shoot regeneration, bringing beneficial impacts, particularly for red grouse (Tharme *et al.*, 2001). Where supplementary feeding is employed in uplands during winter months, this can reduce viability of heather stands via trampling and increased nutrients from dung (Shrubb, 2003).
- 3.22 Toxic products have also resulted in the deaths of adult and juvenile freshwater pearl mussel losses and, in one extreme case, the loss of an entire freshwater pearl mussel population (Moorkens, 1999, 2006). Pesticides such as sheep dip products are probably the most severe. Organophosphates are banned because of their toxic effects, and sheep dips are now largely formulated from synthetic pyrethroids (pyrethrin). However, even in low doses, run-off of these compounds from dipping tanks or soils used for disposal can be toxic to aquatic fauna, including fish for distances up to 10km from source (Moore and Waring, 2001). Like many other aquatic crustaceans and insects, the white-clawed crayfish species is highly susceptible to permethrin-type sheep-dips (Peay, 2000).
- 3.23 Ticks and tick-borne diseases are a major contributing factor to underperforming sheep herds, and increases in treatments may occur to facilitate enhanced productivity. The ticks and tick-borne pathogens can directly affect birds such as red grouse (Hudson *et al.*, 1997). A more widespread implication for biodiversity is a potential increase in the frequency of use anti-parasite dips and pour-ons are toxic to a range of invertebrates (Porter *et al.*, 2010). According to research undertaken by CEFAS in the UK (Moore, 2003), levels of sheep dip as low as low as 1 nanogram L⁻¹ can damage the ability of fish to spawn, their embryo survival and fish survival at sea and levels of sheep dip have exceeded Environmental Quality Standards by up to 34,900 nanograms L⁻¹. Given the sensitivity of upland catchments for salmonids and invertebrates such as pearl mussel and salmonids the use of dips will continue to pose a threat to aquatic biodiversity as well as in the terrestrial sphere.
- 3.24 The impact of sheep faeces and urine deposition on the receiving environment is not as well studied as for cattle and pigs. Limited research indicated that upland soil bacterial communities may be increased by high

volumes of sheep urine (Rooney *et al*, 2006), sheep urine may also cause localised soil eutrophication which could place low-nutrient tolerant plants at a disadvantage.

- 3.25 Sheep in general do not cause the same level of adverse impacts on soil structure as cattle. At equivalent (i.e. metabolic weight) stocking densities on wet soils, short-term treading by sheep was found to be less damaging than treading by cattle (Betteridge *et al.*, 1999).

Increasing Productivity

a) Intensification and efficiency

- 3.26 Sheep numbers have continued to fall in Ireland over the past decade, with numbers falling from a peak of 4.8 million breeding ewe in 1992 (www.sheep.ie) to 2.52 million in 2011 (CSO, 2011). Measures which may aid increases in productivity such as increasing beneficial genetic traits are seen as biodiversity neutral.
- 3.27 The possible impacts described below for sheep grazing relate mainly to the upland environment, as literature on effects on lowland habitats in Ireland appear to be largely absent.
- 3.28 Continued falls in sheep numbers present an interesting possibility for biodiversity gains through the release of large areas of land from what can be an intensive, over-grazed system in both upland and lowlands. On the other hand, levels of grazing are required to maintain many of the potentially impacted communities. Possible impacts which may result are: -
- Decrease of grazing in lowland and upland areas
 - Decrease in associated impacts such as trampling, manuring and nutrient cycling
 - Decreases in nitrogen application
 - Reduced vegetation structure and plant species diversity from lack of grazing on abandoned/under-grazed habitats
 - Reduced frequency/abandonment of heather burning in uplands
 - Reduction in upland supplementary winter feeding
 - Increased intensity of grazing in retained sheep farms / commonage areas
 - Year round grazing replacing seasonal grazing in retained sheep farms / commonage areas
 - Increased efforts to control ticks and through frequent use of anti-parasite dips or pour-ons with potential for impacts on invertebrates in retained sheep farms.

b) Reduction of Sheep Grazing on a Landscape Level

- 3.29 FH2020 indicates an increase in output in sheep, resulting in potential for release of land from sheep grazing,
- At a field scale: -
 - Replacement of existing low intensity of upland or lowland sheep pasture with high intensity pasture use in some areas
 - Potential for intensifying improved/semi-improved grasslands
 - Potential for expansion of semi-natural grasslands
 - Potential for expansion of other existing semi-natural habitats, eg bracken, scrub, wetlands

- None or little increase in removal of internal features such as hedgerows, ponds etc.
- At a landscape scale: -
 - Limited reduction of sheep grazing in high intensity agricultural landscape, where few sheep farms are located (i.e. south and south-east)
 - Reduction of scale of grazing in a moderate intensity landscape, with potential for increase in semi-natural habitats
 - Reduction in scale of sheep grazing in moderately improved agricultural landscapes with smaller fields and more semi-natural habitat pockets where beef/suckler cattle enterprises are the dominant form of agriculture (e.g. midlands and border region)
 - Reduction in sheep grazing within extensive agricultural landscapes where semi-natural habitats are abundant and where suckler cattle enterprises are dominant (e.g. west and uplands)
 - Abandonment of land with production limitations.

Possible Impacts on Biodiversity and Flora & Fauna

- 3.30 The range and extent of possible impacts is highly dependent on how FH2020 is rolled out at farm level, spatial location of destocking and conversion to other agricultural uses.

Table 3.5 - Possible impacts on biodiversity and flora & fauna from measures to increase productivity in the sheep sector.

Measure	Impact	Comments
Decrease stocking rates		Potentially positive impacts through elimination of over-grazing in sensitive upland areas
Decrease in upland area used for sheep farming		Likely positive impacts in short-term, but in long term may be adverse
Reduction in nitrogen use		Possibly negative impacts as stocking rates will increase and loss of semi-natural features
More frequent disease control applications to remaining flocks		Likely negative impacts on terrestrial and aquatic biodiversity
Reduction in supplementary feeding		Beneficial to heather communities in particular
Reduced burns in uplands		Beneficial impacts in the short-term, long-term will lead to biodiversity losses
Convert low profit suckler farms to sheep farming		Loss of semi-natural habitats which are of value in areas of intensive agriculture
Year round grazing replacing seasonal grazing		Increased poaching, nutrient run-off and impacts on sensitive habitats within retained farms
Abandonment of land		Beneficial impacts in short-term, adverse impacts in long term if no grazing regime implemented
Genetic breeding		Most likely neutral impact, potential for positive impact if grazing efficiency is enhanced

4. Indoor Livestock

Scope and Background

- 4.1 High intensity pig and poultry production form the main indoor livestock farms in Ireland. There are approximately 310 commercial piggeries in Ireland, concentrated in the border counties of Cavan and Monaghan and in counties Cork and Tipperary, accounting for over 95% of pig production within Ireland (CSO, 2011). Typically pigs in these commercial piggeries are kept indoors and are not 'free-ranging'. Processing plants tend to be located near the main supply sources. The pig industry is the third most important agricultural section in Ireland after beef and dairy. Since the 1990's however, the Irish breeding sow herd numbers have declined, largely as a result of high feed costs and costs of compliance with environmental regulations (Howley *et al.*, 2010); although latest figures indicate small rises in overall pig numbers (CSO, 2011).
- 4.2 Small holding pigs and poultry, kept on a part-time or low-level commercial basis are scattered throughout Ireland but they will not be the prime target of FH2020 expansion targets.

Current Status of the Indoor Livestock Sector in Ireland

Impact of Husbandry and Nitrates Directive Derogation Changes

- 4.3 Both pig and poultry farming are in line for significant changes as a result of implementation of EU laws in the coming years.
- 4.4 A significant factor in determining how the rise in pig numbers will be integrated into existing farms is the requirement for the average Irish pig farmer with a 550-sow herd to convert individual sow crates to loose housing before January 1, 2013 (Irish Independent, 19 June 2012). However, the conversion process will also mean that farmers will have to reduce the number of sows in their herds, or to maintain numbers, farmers will be required to convert existing sheds and erect new buildings, with implications for landtake.
- 4.5 A ban on conventional battery cages for poultry came into effect in 2012.
- 4.6 As part of the EU Nitrates Directive, the maximum amount of livestock manure that may be spread on land, together with manure deposited by the livestock, cannot exceed 170 kg of nitrogen (N) and 49 kg of phosphorous (P) per ha per year. This limit is dependent on grassland stocking rate and the P index of the soil. Presently, these limits may only be exceeded when spreading spent mushroom compost, poultry manure, or pig manure (Anon, 2010; www.teagasc.ie); and if the size of a holding has not increased since 1 August 2006 and the N application limit is not exceeded. The amount by which these limits can be exceeded will be reduced gradually to zero by 1 January, 2017.

Protected habitats and species

- 4.7 There is no evidence of any protected flora or fauna species which are strongly associated with intensive pig/poultry farms in Ireland, nor with free-ranging pigs or poultry.

Current baseline knowledge

- 4.8 As the major pig and poultry producing farms house the livestock inside year round, there are limited impacts from grazing, trampling and habitat use, which are associated with the cattle and sheep sectors. Therefore, the commercial pig/poultry sectors have minimal role to play in creating and maintaining habitats.
- 4.9 It should be noted however, that free-ranging pig and poultry can have a limited role in habitat management where they occur. Free-ranging pigs have some specific requirements. They are not able to self-regulate their temperature and so need access to shade (woodland), cool water and mud wallows. Where pigs are free roaming, damage to trees, habitats and soils from rooting and excavation activities can occur, as can stripping of

tree/shrub barks and leaves. Soil erosion has been noted as a problem (www.sepa.org), particularly on steeper slopes. If wallows are located close to watercourses, they may result in increased sediment and nutrient loads into the adjacent catchment (ADAS, 2008). Localised soil erosion may occur in proximity to outdoor hen houses, which could lead to small-scale erosion hotspots (ADAS, 2008).

- 4.10 Wild pigs and to a lesser degree, poultry, were once a feature of the woodlands of Europe, including Ireland and influenced the plant communities now present (McLean *et al.*, undated.). Low intensity pig grazing was found to maintain certain flora and fauna communities of conservation concern in Germany, with bird and ground beetle diversity being favoured by rooting behaviour (Hill *et al.*, 2004). In the UK, pigs have been used on a small scale basis for nature conservation, including control of bracken (Randall, www.islayinfo.com), for woodland conservation (Forestry Commission, www.forestry.gov.uk) and for clearing brash and scrub. Severe poaching has been reported from free-range pigs, and this may reduce plant diversity and soil structure (DEFRA, 2005). However, there is a general paucity of information on the impacts of free-ranging poultry/pig livestock on biota.
- 4.11 The primary impact on biodiversity from pig/poultry farming is the use of waste manure as fertiliser, generally off-site the production farm. Spreading of pig/poultry manure to improve nitrogen and phosphorus levels collected from commercial piggeries on grassland and cereal crops is well established. However, implementation of the EU Nitrates Directive has resulted in severe limits on use of the manure, and many of these farms are no longer suitable as the organic N loading from grazing livestock is already at or approaching the 170 kg/ha limit. Effort has been made to minimise nutrient excretion through feed formulation and efficiency of production and efforts to improve these issues are ongoing (Dourmad and Jondreville, 2007).
- 4.12 Nonetheless, adverse impacts on biodiversity, and most frequently water quality, have been reported as a result of manure spreading. The unregulated release of pig manure as implicated in a serious pollution incidents at Lough Sheelin in 1963 and 1974 (Keating and Dodd, 1975), which occurred before implementation of the EU Nitrates Directive. Brown trout stocks were severely affected at Lough Sheelin by eutrophication. Excess nitrates in standing waters causes increased aquatic plant growth, eventually resulting in anoxic conditions as the decomposing bacteria consume the dissolved oxygen in the water. Where anoxic conditions occur, there are consequential impacts for ecosystems, including loss of flora and faunal diversity and fish kills. Poultry manure has high nitrogen availability and is readily leachable from grassland with consequent negative implications for water quality and biodiversity.
- 4.13 As other technologies for treating pig and poultry manure remain cost ineffective, eg anaerobic digestion, solid-liquid separation, manure spreading is likely to continue in the short to medium term (Nolan *et al.*, 2011 & 2012), although Teagasc are investing in a demonstration anaerobic digester. Post 2017, it is estimated that a further 45-50% land-spread area will be required when soil test phosphorus will fully limit the use of pig and poultry manure (O'Flynn, 2012). Finding farm systems with appropriate stocking rates, nutrient load and soil structure for increased quantities of pig slurry may be difficult. In Canada, pig slurry is being used to fertilise willow plantations (Cavanagh *et al.*, 2011), which may also be an attractive option in Ireland as short-rotation crop willow becomes better established.
- 4.14 To minimise illness and disease spread in pigs and poultry, antibiotics are widely administered. The potential impacts of antibiotics in pig slurry on biodiversity has been addressed by a small number of studies, which invariably shows reduced levels of biodiversity or concerns for long-term impacts. Research from Germany indicates that the presence of antibiotics in pig manure has long-term, negative impacts on soil microbial communities (Hammesfahr, 2007). One study indicated that red-billed choughs in Spain had a high bacterial resistance to multiple antibiotics, resembling the resistance profile found in locally applied pig slurry (Blanco *et al.*, 2008). Primary research on the wider environmental impacts of pig/poultry manure spreading in Ireland appears to be absent.
- 4.15 Gaseous ammonia emissions from indoor, intensive pig and poultry units can be significant at the point of emission, although the amount released and range of deposition depends on farm management practices, wind

and other factors. The revision of the National Emission Ceilings Directive 2001/81/EC (NECD) is currently being amended to set 2020 targets for four listed substances, including ammonia emissions. However, the European Environment Agency has stated that ammonia emissions have been reduced by 22% between 1990 and 2007 and 22 of the 27 EU member states, including Ireland achieved their ammonia ceiling targets. Nonetheless, under scenarios to increase productivity in piggyeries, ammonia levels can be expected to increase. According to the EPA (2012), Ireland is predicted to be 6.1 ktonnes of ammonia over the revised Gothenburg Protocol target for 2020 assuming full implementation of Food Harvest 2020. An increase in ammonia could potentially impact watercourses through eutrophication and acidification, impacts that are particularly damaging to salmonids.

- 4.16 Deposition of ammonia can be directly toxic to vegetation adjacent to intensive pig/poultry farms (Pitcairn, 1998). Recognised impacts of ammonia on biodiversity include potential for eutrophication (DEFRA, 2002), promoting rank species over less competitive species as a result of fertiliser effect and acidification (Van Breemen *et al.*, 1982). It has been postulated that high concentrations of ammonia can result in damage to lichen, moss and heather (Wolseley *et al.*, 2006, Cape *et al.*, 2009), and adverse impacts on sensitive woodland, heathland, bog and semi-natural grassland habitats (Krupa, 2003).
- 4.17 Research concerning the influence of free-ranging pigs/poultry manure on the environment is deficient. Free-ranging pigs/poultry will also produce manure, which by the nature of the animals will be spread throughout the farm. Where rotational grazing/landuse is in place to ensure even distribution of manure, however, the negative effects of manure on the environment as outlined above, albeit on a reduced level, will still occur. Modern pig breeds are not able to supply their nutritional needs with roughage available on a free-range farm and so will also require supplementary feeding, which increases the nitrogen content of manure and has consequential impacts on soil nutrient levels and potential for run-off to catchments (Hill *et al.*, 2004).

Increasing Productivity

a) Intensification and efficiency

- 4.18 It is likely that output value will be increased through the channels of improvements in animal health, genetics and farm improvements, although increases in number of pigs will also be required to hit the Food Harvest 2020 target of 50% increase in output value.
- 4.19 Increasing productivity of the pig and poultry industries has potential to impact on biodiversity and flora & fauna in the following ways: -
 - Increased pig/poultry numbers
 - Increasing use of disease control chemicals
 - Increase in potential for point source pollution
 - Increased volume of waste manure
 - Increased land area for manure spreading in line with limits set by Nitrates Directive
 - Possible requirement for anaerobic digesters or other manure treatment processes
 - Increase in pig/poultry meal consumption
 - Increased soil erosion and poaching.
- 4.20 Other measures such as achieving productivity through genetic selection and efficiencies in production measures are likely to be biodiversity neutral.

b) Expansion

4.21 Under two of the scenarios, extensive and intensive pathways, increases in sow herd have been postulated. Some of this expansion may be absorbed within existing pig farms, whilst new piggeries may need to be established, particularly under the extensive pathway and to comply with loose housing requirements for breeding sows.

- At a field scale:
 - Conversion of existing improved grassland to piggeries/poultry sheds
 - Conversion of semi-improved grassland, or other semi-natural habitat, to piggeries/poultry sheds
 - Conversion of individual sow crates to loose housing, resulting in erection of new buildings on mainly improved land to maintain current herd numbers.
- At a landscape scale:
 - Potential for expansion in existing intensive pig and poultry rearing landscapes which are currently clustered in the north, north-west and midlands
 - Potential for expansion outside of the current core indoor pig/poultry locations
 - Construction of waste disposal units, including anaerobic digesters
 - Requirement for additional land for spreading manure
 - Expansion near watercourses.

Possible Impacts on Biodiversity and Flora & Fauna

4.22 Based on the information on the flora & fauna and biodiversity of pig/poultry sectors outlined in the previous sections, impacts from measures to increase indoor livestock productivity were predicted (Table 4.2). Confidence in these predictions is weak to moderate as primary research in Ireland is limited. However, the major impacts will relate to the use of waste manure from increased livestock numbers following the intensive and extensive pathways, and the potential biodiversity impacts of this are generally well documented.

Table 4.2 – Possible impacts on biodiversity and flora & fauna from measures to increase productivity in the pig / poultry sector.

Measure	Impact	Comments
Increase in stocking rates of intensive piggeries/poultry farms		Likely to require new landtake, possibly in already intensive areas
Increase in manure output		High correlation with negative impacts on habitats, water quality and ammonia emissions
Requirement for additional land for manure spreading		Potential for change in vegetation communities,
More frequent disease control applications		Likely negative impacts on terrestrial and aquatic invertebrate biodiversity
Provision of waste disposal units		Could reduce ammonia emissions which would benefit biodiversity, possible emission issues
Expansion near watercourses		Increased risk of eutrophication, adverse impacts on water quality and aquatic biodiversity
Increased disease control		Potential negative impacts on soil biodiversity, birds and other fauna
Increase in meal consumption		Limited impacts on Ireland, but down the chain, negative impacts on source ingredient providers
No increase in pig numbers (extensive pathway)		Impacts still remain from existing levels of manure, ammonia and other emissions
Increase in soil erosion, poaching, plant grubbing from free ranging stock		Adverse impacts where effects are concentrated in the landscape, greater impacts if effects within semi-natural habitats

5. Tillage & Horticulture

Scope and Background

- 5.1 Given the similarities in biodiversity in tillage crops in general and the paucity of Irish research on biodiversity in tillage (discussed below), this review considers cereals and horticulture together. Where appropriate, differences in biodiversity and potential impacts between the two systems are identified.
- 5.2 Tillage is currently undertaken on approximately 9% of the UAA, covering some 350,000ha (Doyle, 2013). No specific targets for tillage were included in FH2020 and in response a Tillage Sector Development Plan 2012 was drawn up by Teagasc.
- 5.3 According to the Central Statistics Office (CSO) data for Agriculture for 2010, the majority of tillage and field are grown in the south-east (Carlow, Kilkenny, South Tipperary, Wexford and Waterford) (34% of land area), mid-east (Kildare, Meath and Wicklow) and Dublin (27% of land area) Regions of the country. The tillage crops mainly consist of wheat, oats and barley. The field crops include potatoes, sugar beet, fodder beet, turnips and maize.
- 5.4 As part of ‘greening’ of CAP, Ecological Focus Areas (EFA) could be introduced under Pillar 1. These are areas which would be set aside for biodiversity. At present, negotiations on CAP are ongoing, and the final form of EFA’s and set aside area required is not known precisely, although it is likely to be in the region of 3-7%. EFA’s at present will apply on arable land above a 15ha minimum threshold, with the rate of set aside to be agreed. EFA’s may be facilitated not just at farm gate, but regionally or collectively.

Current Status of Tillage and Horticulture

Protected habitats and species

- 5.5 Protected flora and fauna, including habitats, were reviewed to identify species and habitats that are potentially sensitive to changes in the tillage sector.
- 5.6 There are no Habitats Directive habitat types strongly associated with tillage. Increases in the area of tillage have limited potential to impact negatively on the Habitats Directive Annex I habitats lowland hay meadows (6510), calcareous grasslands (6210) and perhaps others if the semi-natural habitats are replaced by tillage.
- 5.7 Four vascular plant species listed on the Flora (Protection) Order, 1999 occur in arable fields. No plant species listed on Annex II of the Habitats Directive and no bryophytes protected under Irish or EU law are likely to occur in tillage fields.

Table 5.1 - Protected plant species listed on the Flora Protection Order associated with arable crops.

Common Name	Scientific Name	Group
Red hemp-nettle	<i>Galeopsis angustifolia</i>	vascular plant
Lesser snapdragon	<i>Misopates orontium</i>	vascular plant
Rough poppy	<i>Papaver hybridum</i>	vascular plant
Annual knawel	<i>Scleranthus annuus</i>	vascular plant

- 5.8 Red hemp-nettle was formerly a widespread arable weed, but at present it is an endangered species that tends to occur mainly on disturbed ground on eskers (Preston *et al.*, 2002; Kingston, 2005; Parnell and Curtis, 2012). Lesser snapdragon is an endangered species mainly associated with root crops; it is negatively impacted by autumn cultivation and sowing (Curtis and McGough, 1988; Preston *et al.*, 2002; Kingston, 2005). Rough poppy is a critically endangered species of arable fields on sandy soils (Kingston, 2005; Parnell and Curtis, 2012).

Annual knawel is a rare plant of sandy waste ground, roadsides and arable fields (Preston *et al.*, 2002; Kingston, 2005; Parnell and Curtis, 2012).

- 5.9 No animal species specifically protected under the Wildlife Acts or the Habitats Directive appear to be strongly associated with tillage crops in Ireland. It is likely that these crops or field margins are used at least on occasion for foraging by protected species. No birds listed on the Birds Directive are strongly associated with tillage crops, although some, such as Bewick's swan and whooper swan, may make occasional use of tillage or field crop land (BirdWatch Ireland, 2011). Virtually all bird species are offered some protection under the Wildlife Act, and many birds of conservation concern are associated with cereal crops. Quail and grey partridge, both now very rare and red Listed (Lynas, 2007), have affinity for tillage fields. Other farmland birds have declined with the decline of small-scale tillage, particularly in the west of Ireland.
- 5.10 Protected flora and fauna of semi-natural habitats that could be sensitive to conversion to tillage are too numerous to mention and depend on the habitats present in the land to be converted. As most expansion in the cereal and horticulture sectors would be expected to take place on good quality land, most likely occupied by improved grassland, nationally few protected species would be at risk, but there is uncertainty in this assumption when transferred to the local level.

Current baseline knowledge

- 5.11 There has been little research carried out in Ireland on the biodiversity of tillage farming, particularly when compared with the larger body of research on grassland systems, e.g. AgBiota (Purvis *et al.*, 2009). In a comprehensive review of the literature to date, O'Brien *et al.* (2008) found only 21 published, peer-reviewed papers on the impacts of tillage on biodiversity in Ireland, but note that the frequency of published research has been increasing in recent years. The lack of research attention for tillage agriculture may be due to dominance of grass-based farming: in 2007, only 8.9% of farmed land was under tillage, including fruit crops (Department of Agriculture and Food, 2008). More recent, complete statistics are not readily available; however, the Census of Agriculture found that the area under cereals has remained more or less steady, declining by 1.8% over the 10 years since 2000 (Central Statistics Office, 2012). O'Brien *et al.* (2008) also point out that it is risky to rely on British or continental research, given the smaller species pool and different ecological history in Ireland.
- 5.12 Despite the lack of detailed research, it is inarguable that past intensification of agriculture from the first half of the 20th century has resulted in a significant amount of biodiversity loss in Ireland. Important factors contributing to this loss include (Curtis and McGough, 1988; Robinson and Sutherland, 2002; O'Brien *et al.*, 2008; BirdWatch Ireland, 2011): -
- A trend away from mixed farming with small-scale rotational cropping to single-enterprise farming, resulting in –
 - Decreases in the area of tillage
 - Reduced crop species diversity
 - Reduced landscape heterogeneity
 - Decreased use of crop rotation
 - Shifts from spring-sown to winter-sown cereals
 - Removal of hedgerows and other marginal habitats
 - Drainage and reclamation
 - Increased inputs of fertilisers
 - Increased inputs of pesticides

- Improvements in seed cleaning technologies
 - Increased harvesting efficiency
- 5.13 A number of factors have resulted in a significant movement away from traditional mixed farming of livestock, cereals and other tillage crops to larger farm enterprises focusing on one or two enterprises. This has led to a reduction in the total area of tillage in Ireland, as the Irish climate and soils are more suited to grassland farming systems, which is predicted to expand slightly under FH2020. With mechanisation, mixed systems to grow fodder (e.g. fodder beet, oats) for the farm horse are no longer required, contributing to lower numbers of different crops that are cultivated. These factors have combined to result in a simplified landscape, composed of relatively large, monocultural blocks. Landscape simplification has been found to reduce diversity in farmland birds in Ireland (McMahon *et al.*, 2008). Loss of mixed farms and reduction in tillage area has also been implicated in the extinction of corn bunting in Ireland (Taylor and O'Halloran, 2002; O'Brien *et al.*, 2008; BirdWatch Ireland, 2011). Simplification and intensification have also been implicated in declines in bumblebee diversity (Santorum and Breen, 2005 in O'Brien *et al.*, 2008).
- 5.14 With the advent of modern pesticides and fertilisers, crop rotation is no longer standard practice. This reduces the number of fields left fallow or under stubble over the winter. Similarly, the shift from spring-sown to winter-sown crops, which allows a longer growing season, eliminates winter stubble. Permitting fields to lie fallow or allowing stubble to persist until spring allows many arable weed species to set seed and germinate. Increased abundance of plants favours invertebrate populations, and both provide better bird habitat (Robinson and Sutherland, 2002). Birds also benefit from the over-winter cover provided by stubble fields, and the lighter vegetation structure of spring-sown cereals is more favourable for ground-nesting birds (Taylor and O'Halloran, 2002; O'Brien *et al.*, 2008; BirdWatch Ireland, 2011).
- 5.15 There is limited knowledge on the extent of erosion and P loss from tillage land as research has concentrated on the quantification of losses from grasslands (Regan *et al.* 2010). Phosphorous loss from soils on tilled land accounts for disproportionate loss of P from agricultural land and biodiversity losses associated with nutrient enrichment of watercourses are likely in areas where high concentrations of tillage are located in sensitive catchments with soil types prone to nutrient loss. Given that in the southeast, cereals account for 17% of farmed land in County Carlow and 23% in County Wexford (Hooker *et al.*, 2008) significant pressures on surface water quality from tillage may exist given the observed declines in water quality based on EPA records for the south east. It was reported that nearly 50% of the rivers sampled in the South Eastern River Basin District (SERBD) would not achieve good status based on P inputs to rivers (Lucey *et al.*, 2009). Typically invertebrate diversity is lowered in enriched streams with mayflies and stoneflies being extirpated first followed by changes in fish community structure all of which have consequences for biodiversity.
- 5.16 Removal of hedgerows contributes to landscape simplification and eliminates habitats used by a wide range of species (Russ and Montgomery, 2002; O'Brien *et al.*, 2008; BirdWatch Ireland, 2011). Drainage and reclamation of semi-natural habitats has produced the same results (O'Brien *et al.*, 2008).
- 5.17 The biodiversity effects of chemical applications in tillage are frequently difficult to elucidate (Robinson and Sutherland, 2002; O'Brien *et al.*, 2008). Effects of pesticides are highly dependent on the timing of the application and the stage of the life-cycle of the non-target species (Robinson and Sutherland, 2002). Spring sprayed herbicides tend to have the greatest impact on plant populations, with follow-on impacts on invertebrates (Purvis and Curry, 1984; Robinson and Sutherland, 2002). Some non-target invertebrates recover quickly from pesticide applications, whereas others may experience long-term population reductions. For example, Purvis and Bannon (1992) (in O'Brien *et al.*, 2008) in Ireland found significant long-term decreases in carabid beetle populations following repeated applications of anti-molluscan pesticides, and Aebischer (1990) in Britain found long-term decreases in sawfly abundances following application of aphicides. Artificial fertilisers do not appear to have significant biodiversity impacts on terrestrial habitats, although invertebrate assemblages may be affected. Robinson and Sutherland (2002) suggest that fertiliser-sensitive tillage weeds may have long

since been extirpated from arable fields. However, application of farmyard manure has been found to benefit early-breeding carabids (Purvis and Curry, 1984).

- 5.18 Improvements in seed-cleaning techniques when preparing tillage crop seed for sowing has significantly reduced the amount of weed seed sown alongside the crop. This has resulted in drastic declines in a number of formerly widespread arable weed species (Curtis and McGough, 1988). Similarly, increased efficiencies in mechanised harvesting have significantly reduced amount of cereals spilled, reducing autumn and winter food supplies for farmland birds (Robinson and Sutherland, 2002) and small mammals.
- 5.19 As a result of these changes, there are a large number of bird and vascular plant species associated with arable agriculture that were once common but that are now rare or extinct in Ireland. It is likely that the same pattern is replicated among other species groups, but these groups have been much better recorded in the past. In addition, declines in populations in other, non-specialist species have occurred, and part of their declines are likely to be as a result of changes in tillage farming practices. For example, in Britain, approximately half of all bird species occurring in farms (i.e. not just cereal crop specialists) have declined since 1968 (Siriwardena *et al.*, 1998); it is likely that similar trends have taken place in Ireland, as in the rest of northern and western Europe (Robinson and Sutherland, 2002). Thus, the rare and threatened species outlined in Tables 6.2 do not provide a comprehensive picture of biodiversity in tillage farms, but they can serve to some extent as examples and as indicators of potential impacts that may arise from changes to the tillage sector.

Table 5.2 - Rare and threatened bird species strongly associated with tillage crops.

Common Name	Scientific Name	Status ¹³
Grey partridge	<i>Perdix perdix</i>	R
Quail	<i>Coturnix coturnix</i>	R
Turtle dove	<i>Streptopelia turtur</i>	A
Tree sparrow	<i>Passer montanus</i>	A
House Sparrow	<i>Passer domesticus</i>	A
Linnet	<i>Carduelis cannabina</i>	A
Skylark	<i>Alauda arvensis</i>	A
Stock Dove	<i>Columba oenas</i>	A
Yellowhammer	<i>Emberiza citronella</i>	R
Corn bunting	<i>Emberiza calandra</i>	EX
Chough	<i>Pyrrhocorax pyrrhocorax</i>	A

- 5.20 The method of soil cultivation has the potential for significant effects on biodiversity. Several Irish studies have found that minimum tillage, which is an AEOS scheme option, benefits soil invertebrates in comparison with conventional ground preparation methods (O'Brien *et al.*, 2008). Minimum tillage would also be expected to result in less soil erosion, thus protecting water quality and aquatic ecology.

¹³ According to Lynas *et al.* (2007): EX = extinct as a breeding species, R = red listed, A = amber listed.

Table 5.3 - Rare and threatened vascular plant species strongly associated with tillage crops¹⁴

Common Name	Scientific Name	Status ¹⁵
Corn cockle	<i>Agrostemma githago</i>	EX
Corn chamomile	<i>Anthemis arvensis</i>	EX
Stinking chamomile	<i>Anthemis cotula</i>	P
Bristle oat	<i>Avena strigosa</i>	P
Cornflower	<i>Centaurea cyanus</i>	P
Common cudweed	<i>Filago vulgaris</i>	P
Small-flowered crane's bill	<i>Geranium pusillum</i>	P
Henbane	<i>Hyoscyamus niger</i>	V
Sharp-leaved fluellen	<i>Kickxia elatine</i>	EN
Field pepperwort	<i>Lepidium campestre</i>	P
Darnel	<i>Lolium temulentum</i>	EN
Fine-leaved sandwort	<i>Minuartia hybrida</i>	P
Prickly poppy	<i>Papaver argemone</i>	P
shepherd's needle	<i>Scandix pecten-veneris</i>	CR
small-flowered catchfly	<i>Silene gallica</i>	P
Night-flowering catchfly	<i>Silene noctiflora</i>	P
Broad-fruited cornsalad	<i>Valerianella rimosa</i>	P

- 5.21 Other recent practices in cereal cultivation and horticulture have received very little research attention. The use of plastic mulch to suppress weeds increases runoff from arable fields due to the increase in permeable surfaces. In North America, increased runoff from tomato crops has been found to lead to increased export of sediments and pesticides when compared with organic mulch (Rice *et al.*, 2001). Use of plastic mulch in apple orchards in northwest Spain has also been found to reduce abundance of carabids and alter assemblage composition (Miñarro and Dapena, 2003). Plastic mulch could have similar biodiversity impacts to herbicide use; however, this apparently has not been studied.
- 5.22 Potential impacts of large-scale use of polytunnels for horticulture have also been poorly studied. Polytunnels may result in similar increases in runoff and potentially siltation of watercourses (Entec UK, 2006). Covering large areas with polytunnels effectively removes the land as a resource for many species, such as bats and birds; the extent to which this is significant depends on how valuable the land was previously for biodiversity. Soil sterilisation is a common practice when growing soft fruits in polytunnels, and the long-term impacts of this on biodiversity and soil structure are unknown (Entec UK, 2006).

¹⁴ Including species formerly associated with tillage in the past, but now occurring mainly in other habitats.

¹⁵ Current status according to draft revised Red Data Book (Kingston, 2005): EX = extinct, CR = critically endangered, EN = endangered, V = vulnerable, P = proposed for listing. Note that some species listed were once considered extinct, but have been re-found.

Increasing Productivity

a) Intensification and efficiency

5.23 Increases in intensification and efficiency in the tillage sector may be implemented by a number of measures that are potentially of relevance for flora & fauna:-

- Planting more productive varieties
- Increasing use of chemical inputs, i.e. fertilisers and herbicides
- Increasing proportion of winter-sown cereals relative to spring-sown
- Specialising in a smaller number of crop species
- Diversifying into a larger number of crop species
- Increasing / clustering density of arable crops within a landscape which may be linked to expansion of pig and poultry industry
- Removal of hedgerows and other marginal habitats to increase field size
- Increasing use of polytunnels in horticulture.

b) Expansion

5.24 Expanding tillage and field crops may be incentivised by a number of measures, such as grant-aid, tax incentives, changes to regulations, improving access to markets and better provision of technical advice. In and of themselves, these measures are biodiversity-neutral. However, their implementation may result in different types of expansion:

- At a field scale:
 - Replacement of existing improved grassland
 - Replacement of existing semi-improved grassland, bracken or young scrub
 - Replacement of existing semi-natural habitats
 - Improvement of drainage networks.
- At a landscape scale:
 - Expansion mainly in intensive agricultural landscapes where tillage is already frequent and grassland systems are dominated by beef finishing and dairying (e.g. south and east)
 - Expansion mainly in moderately improved agricultural landscapes with smaller fields and more semi-natural habitat pockets where beef / suckler cattle enterprises are the dominant form of agriculture (e.g. midlands and border region)
 - Expansion mainly in extensive agricultural landscapes where tillage is very rare or absent, semi-natural habitats are abundant and where sheep and suckler cattle enterprises are dominant (e.g. west and uplands)
- In proximity to watercourses:
 - Expansion along the boundaries of rivers meaning greater length of river channel exposed to pollutants.

Possible Impacts on Flora & Fauna and Biodiversity

- 5.25 A generalised assessment of possible impacts is presented below based on the information on the flora & fauna and biodiversity of tillage crops outlined in the previous sections. Several of the impacts are contingent on other factors, as outlined in the baseline knowledge. In particular, measures to encourage expansion may have positive or negative impacts, depending on the biodiversity of the habitats to be converted and the habitats and dominant agriculture in the surrounding landscape. Area under tillage is expected to decline and the impact of replacing tillage with other agricultural activities would be dependent on type, scale and level of intensity. The possible impacts of the interaction between the existing ecological conditions at the field and landscape scales are summarised in matrix form below, and this also provides some indication of regional variation in impacts.
- 5.26 Confidence in these predictions is weak to moderate as primary research in Ireland is limited. However, the historical impacts on biodiversity of intensification and reduction of the tillage sector have been well documented. This is especially the case in British research, and when differences in species pools, environment and land-use history is taken into account, those results should be broadly applicable to Ireland. New technologies and management methods arise frequently in the tillage sector, and the impacts of these may be difficult or impossible to predict, but increases in efficiencies and productivity as a result may be beneficial to biodiversity and flora & fauna.
- 5.27 The Tillage Sector Development Plan (Teagasc, 2012) predicts that under the targets for expansion of tillage in that plan, there is potential for the following impacts:
- There is a potential in some scenarios for nutrient applied (particularly N) to crops to leach into ground and surface water at a higher rate than on permanent grassland.
 - There is potentially a greater challenge to maintain biodiversity where tillage is the predominant land use in an area. However, this risk is much lower when compared with more intensive crop producing region in other countries.
 - Tillage may result in higher soil losses than grassland farming, especially on heavier soils and with winter cropping of combinable crops, root-crops and potatoes

Table 5.4 - Possible impacts on flora & fauna and biodiversity from measures to increase productivity in the tillage sector.

Measure	Impact	Comments
Productive varieties		Probably neutral, depending on variety traits
Increasing chemical inputs		Negative effects on local biodiversity and increased risk of negative impacts to aquatic ecology
Decreasing chemical inputs		Positive or neutral effects, the degree of which is dependent on level of reduction
Increasing winter-sown cereals		Further reductions in crop diversity, feeding and breeding habitat
Increased specialisation		Reductions in landscape diversity
Increased diversification		Increases in landscape diversity, assuming new crops of same or more positive impact
Increasing density		Reductions in landscape diversity
Removing marginal habitats		Only remaining semi-natural habitat in many intensively farmed areas
Increasing polytunnels		Impacts on aquatic ecology from large-scale tunnel horticulture
Expansion near watercourses		Siltation, fertiliser and pesticide impacts on aquatic ecology

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