CoFoRD

Final Report

'Valuing the Ecosystem Services of Forests in Ireland - ECOVALUE'

DAFM Project Reference No: 11/C/204

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End Date: 28/2/15

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Please place one "x" below in the appropriate area on the research continuum where you feel this project fits

<table>
<thead>
<tr>
<th>Basic/Fundamental</th>
<th>Applied/Pre Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
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</table>

Please specify priority area(s) of research this project relates to from the National Prioritisation Research Exercise* (NRPE) report:

<table>
<thead>
<tr>
<th>Priority Area(s)</th>
<th>I</th>
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Key words: (max 4)
Ecosystem services; valuation; benefit transfer; desktop study
1. **Rationale for Undertaking the Research**

The diversity of benefits that flow from forests and other ecosystems has long been recognised by society but the dramatic decline in many of these in recent decades led to the formation of the Millennium Ecosystem Assessment (MEA) in 2000 (MA, 2005). One of the primary observations of the MEA was that ecosystems and the services they provide are being degraded rapidly and that the consequences of this for society, and for future generations in particular, will be drastic. The outputs of the MEA were primarily observational rather than prescriptive but it placed renewed emphasis on the reliance of people on ecosystems (Powledge, 2006). More detailed assessment of the economic consequences of changes in the delivery of ecosystem goods and services has since been undertaken by the UN-sponsored ‘The Economics of Ecosystems and Biodiversity’ (TEEB) initiative, which has provided guidance and recommendations for policy-makers and businesses (TEEB, 2010). Central to discussions of ecosystems and society is the concept of ecosystem services (ES). The definition of ES is challenging given the complexity of ecosystems, their role in delivering outputs and the nature of their interaction with human beings. The MEA define ES as ‘the benefits people obtain from ecosystems’ and the TEEB employs ‘the direct and indirect contributions of ecosystems to human well-being’. Both definitions are broad in nature and have been supported with classifications of ES and examples to facilitate further comprehension.

These global initiatives have had a significant impact on national and international policies, particularly those that relate to land use. EU forestry, agriculture, biodiversity and water policies are increasingly adopting an ecosystem approach to the management of natural resources and the sustainable supply of ES (Maes et al., 2013). Reflecting the significance now being attached to ecosystem services, the Oslo meeting of the Ministerial Conferences on the Protection of Forests called for the estimation of “the full value of forest ecosystem services across Europe” by 2020 (www.foresteurope.org). To address this call, this desktop study was undertaken to:

a. Identify the ecosystem services associated with Irish forests.

b. Quantify the benefits from these services in relation to climate change mitigation, biodiversity conservation, forest recreation and human health/well-being, and water quality/quantity.

c. Model the value of the ecosystem services provided by the current forest estate and an afforestation programme.

2. **Research Approach**

This is a desktop study; hence no new surveys were conducted from which data could be drawn to model the value of ecosystem services. Instead, the valuation work relied on data from previous national/international studies where available. An outline of the methods used to value the various forest ecosystems services now follows.

**Biodiversity:** Benefit transfer was used to model the value of forest biodiversity. In simple terms, this method draws on previously conducted valuation studies and uses the values derived in these studies to estimate the value of a comparable good or service. The value can be transferred directly with adjustments for the character of the good or of the relevant population in Ireland. Alternatively, where available, the function derived to calculate value can be transferred directly and employed.
A comprehensive review of forest biodiversity valuation studies conducted in Ireland, the UK and the rest of Europe was conducted and a database built. Only studies that examined willingness to pay (WTP) for biodiversity of existing forests were included in the database. A meta-analysis, a quantitative statistical analysis of several separate but similar studies, of the data collected in these studies was then conducted. This helped identify the study and forest characteristics that influence WTP for biodiversity. A model was then developed which predicted WTP based on these key study and forest characteristics. By including values relevant to Ireland for these characteristics, an estimate of the WTP for biodiversity in Irish forests was derived.

**Recreation:** To determine the value of forest recreation estimates of the value of a single forest visit and the total number of visits made to forests were required. The former was derived from data collected in a previous Irish household study (Ni Dhubhain et al., 2011). This household study collected data on distance between respondents’ homes and the closest recreation forest. Converting this information into travel costs, and modelling the resulting values against a range of socio-demographic factors, a WTP value for a single visit to a forest was derived.

To produce an estimate of the total annual visitation rates a recreation demand model was developed using the following 4 step process:

- A map of existing forest recreation sites was produced by combining existing forest cover data with volunteered geographic information regarding recreational trails in Ireland from OpenStreetMap;
- A simulated data set of every individual in Ireland was obtained from the Irish SMILE model and data on the location of households in Ireland;
- A negative binomial model of annual forest recreation based on household survey data from 2010 was developed that accounts for the characteristics of individuals and their proximity to the closest recreational forest;
- This model was used to derive total annual visitation from the simulated population including forest proximity.

**Carbon sequestration:** A recent Department of Environment, Community and Local Government report (2015) estimates that 31,533.45 kt CO₂ have been sequestered due to afforestation since 1990 (when emissions arising from deforestation have been accounted for). It also indicates that in 2013 the amount of carbon sequestered by Irish forests (including those planted prior to 1990) was 3,946.9 kt CO₂. There are various approaches that can be used for valuing carbon sequestration. In this study the market price approach was employed using prices published in a recent Department of Finance report (2015).

**Hydrological services:** For the valuation of flood mitigation services, it would be necessary to quantify the contribution of forests to reducing the frequency and intensity of flooding events at a spatial scale. Quantitative data on the flood mitigation services of Irish forests are lacking, making it impossible to assign a value to this service. To estimate the value of the water quality services of forests in Ireland, data collected by Howley et al. (2014) on Q-values (where Q-values are measures on a 1-5 scale of water quality employed by the EPA since 1971 and are based primarily on macroinvertebrate communities) and independent variables including spatially referenced septic tank distribution data from the small area Census of Population, levels of agricultural activity from the Census of Agriculture, forest land cover data from the Forest Service, data from the indicative soil map of Ireland and climactic data were collated. Regression analysis of these
data was used to determine the relationship between forest cover and Q-values. Once this relationship was quantified the aim had been to use benefit transfer to assign a value to it.

3. Research Achievements/Results

Biodiversity: Using the benefit transfer approach an annual willingness to pay value (WTP) per person for forest biodiversity was estimated to be €19.78. This was then expanded across the adult population of Ireland of 3,439,565 suggesting that the annual value of forest biodiversity is €68 million.

Recreation and human health benefits: Using data collated in a previous Irish study a WTP value for a single visit to a forest was estimated to be €6.16. The total annual visitation to Irish forests was estimated to be 29,105,759 visits per annum. Combining this with the WTP estimate gives an annual value of €179 million for forest recreation. The benefits from recreating in forests can be both physical and mental. To address the latter, a review of a pilot programme which involved people suffering from depression spending time in Irish forests was undertaken. It showed that organised ‘forest walks’ were considered by medical professionals as effective adjunctive interventions for those suffering from depression. This could provide significant economic benefits for the Health Service, arising from reduced medical drug dosage, reduced clinical appointments and reduced residential care in hospitals. Additionally a survey of visitors to two forests was conducted. This provided information on perceptions of the mental health benefits of forests by forest users and their mood change before and after their visit to the forest, and the contribution of forest recreation to overall physical activity.

Carbon sequestration: Using a market price of €5.80 per tonne, the total value of carbon sequestered due to afforestation since 1990 is €180 million. The value of the carbon sequestered by Irish forests (including those planted prior to 1990) in 2013 was 3,946.9 kt CO$_2$ yielding an annual value of €22.9 million.

Hydrological services: As highlighted above quantitative data on the flood mitigation services of Irish forests is lacking, making it impossible to assign a value to this service.

The influence of forest cover on biological measures of water quality (i.e. Q-values) was modelled. The model showed that forest cover had a negligible (although statistically significant) impact on changes to water quality as assessed using the Q-values. Given this negligible effect the value of the effect was also considered negligible.

Predicting future values for ecosystems services is challenging. What this study showed is that an expanding forest estate arising from continued afforestation is likely to lead to an increase in biodiversity value. It also highlighted that such an expansion is essential to avoid the forest estate becoming a net source of carbon by 2025. Future afforestation in Ireland will be carried out by the private sector and currently public access to private forests is not available. Hence the recreational value of these new forests will be negligible unless this situation changed. Further data will be required to estimate how the other ecosystem services would change over time.

4. Impact of the Research
The study is the first to address the value of ecosystem services delivered by the forest estate in Ireland. Previous research on this topic focused on the afforestation programme and or the public forest estate only. The results are relevant and have positive impacts for the following end-users:

From the regulatory authority’s perspective, the results are the first step in delivering on the Irish Government’s commitment made at the Oslo Ministerial Conference to estimate “the full value of forest ecosystem services across Europe” by 2020. They provide the baseline figures and foundation for future assessments in this regard. They can also be used to inform policy as they show how forest management practices can influence the extent of the ecosystem service delivered.

For the scientific community and regulatory authorities’ perspective they identify where the data gaps are and where research should be focused in order to have the scientific data that are required (e.g. interaction between forests and water quality and quantity) in order to make valuation of the service possible.

For society, knowledge of the range of ecosystem services that forests provide and the value of these services is important for the continued support for afforestation programme.

4(a) Summary of Research Outcomes

(i) Collaborative and Industry links developed during this research

Research and knowledge transfer link on Payments for Ecosystem Services (PES) developed with World Forestry Centre, Oregon through a Fellowship undertaken by ECOVALUE contract researcher. This provided the background for a journal article on PES drawing on the US perspective.

(ii) Outcomes where new products, technologies and processes were developed and/or adopted

Not relevant.

(iii) Outcomes with economic potential

Not relevant.

(iv) Outcomes with national/policy/social/environmental potential

The study generated the first set of values for a range of forest ecosystem services in Ireland delivered by the current forest estate. The generation of these values will go some way to addressing the commitment made at the Oslo meeting of the Ministerial Conferences on the Protection of Forests called for the estimation of “the full value of forest ecosystem services across Europe” by 2020. The study outcomes can also be used to inform policy as they show how forest management practices can influence the extent of the ecosystem service delivered.
4 (b) Summary of Research Outputs

(i) Peer-reviewed publications, International Journal/Book chapters.

- Upton, V., Ní Dhubbáin, Á., and Bullock, C. 2012. Are forest attitudes shaped by the extent and characteristics of forests in the local landscape? Society and Natural Resources. DOI: 10.1080/08941920.2014.933925.
- Upton, V. 2015. Payments and markets for forest ecosystem services in the USA. Irish Forestry, 72(1&2), 101-119.

(ii) Popular non-scientific publications and abstracts including those presented at conferences

- O’Callaghan, C. Ecosystem Services of Planted Forests Through Provision of Habitat. IUFRO 2015 World Congress, Salt Lake City, Utah, USA 5-11 October 2014.

(iii) National Report


(iv) Workshops/seminars at which results were presented

Commented (T1): Where is this available?
Commented (A2): Tom, it is this report I am referring to -- should I remove this to avoid confusion

(v) Intellectual Property applications/licences/patents

None.

(vi) Other

5. Scientists trained by Project

Total Number of PhD theses: 0

Please include authors, institutions and titles of theses and submission dates. If not submitted please give the anticipated submission date

Total Number of Masters theses: 2

Please include authors, institutions and titles of theses and submission dates. If not submitted please give the anticipated submission date

• Iwata, Y. University College Dublin. The Impact of Spending Time in Forests on Human Health and Well-being in Ireland. MScAgr awarded December 2014.

6. Permanent Researchers
<table>
<thead>
<tr>
<th>Institution Name</th>
<th>Number of Permanent staff contributing to project</th>
<th>Total Time contribution (person years)</th>
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</thead>
<tbody>
<tr>
<td>UCD</td>
<td>1</td>
<td>0.20</td>
</tr>
<tr>
<td>Teagasc</td>
<td>2</td>
<td>0.40</td>
</tr>
<tr>
<td>UCC</td>
<td>2</td>
<td>0.26</td>
</tr>
<tr>
<td>UL</td>
<td>1</td>
<td>0.16</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6</strong></td>
<td><strong>1.02</strong></td>
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### 7. Researchers Funded by DAFM

<table>
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<tr>
<th>Type of Researcher</th>
<th>Number</th>
<th>Total Time contribution (person years)</th>
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<tbody>
<tr>
<td>Post Doctorates/Contract Researchers</td>
<td>2</td>
<td>1.85</td>
</tr>
<tr>
<td>PhD students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masters students</td>
<td>3</td>
<td>3.20</td>
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<tr>
<td>Temporary researchers</td>
<td>1</td>
<td>0.083</td>
</tr>
<tr>
<td>Other</td>
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<td></td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>6</strong></td>
<td><strong>5.133</strong></td>
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### 8. Involvement in Agri Food Graduate Development Programme

<table>
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<tr>
<th>Name of Postgraduate / contract researcher</th>
<th>Names and Dates of modules attended</th>
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<tbody>
<tr>
<td>None</td>
<td></td>
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**Commented (T3):** John Enright listed with UCC in period 1 of the project. Please explain

**Commented (A4):** I have changed the number of masters students to 3; as per ecovlaueppr2 response to queries the student initially hired in UCC to the project, John Enright resigned and was replaced with Cormac O’Callaghan, hence Cork at 2 at a total of 18 months
9. **Project Expenditure**

Total expenditure of the project:

Total Award by DAFM: €201,755

Other sources of funding including benefit in kind and/or cash contribution: €0

**Breakdown of Total Expenditure**

<table>
<thead>
<tr>
<th>Category</th>
<th>UCD</th>
<th>Teagasc</th>
<th>UL</th>
<th>UCC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract staff</td>
<td>9248.0</td>
<td>6890.08</td>
<td></td>
<td></td>
<td>78157.08</td>
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<tr>
<td>Temporary staff</td>
<td>1993.50</td>
<td></td>
<td></td>
<td></td>
<td>1993.50</td>
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<tr>
<td>Post doctorates</td>
<td>31160.06</td>
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<td>59815.02</td>
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<tr>
<td>Post graduates</td>
<td>672.28</td>
<td>40.18</td>
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<td></td>
<td>926.54</td>
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<tr>
<td>Consumables</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Travel and subsistence</td>
<td>1352.92</td>
<td>7468.23</td>
<td>300.52</td>
<td>810.63</td>
<td>9932.50</td>
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<tr>
<td>Sub total</td>
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<td>76417.49</td>
<td>300.52</td>
<td>29679.67</td>
<td>150824.44</td>
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<tr>
<td>Durable equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1792.09</td>
<td></td>
<td></td>
<td></td>
<td>1792.09</td>
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<tr>
<td>Overheads</td>
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<td>19104.37</td>
<td>75.13</td>
<td>7419.92</td>
<td>37706.11</td>
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<td><strong>Total</strong></td>
<td>57325.54</td>
<td>95521.86</td>
<td>375.65</td>
<td>37099.59</td>
<td>190322.64</td>
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</tbody>
</table>

10. **Leveraging**

Summarise any additional resources/funding leveraged by this award from other sources i.e. Additional Staff, National/EU funding secured, EI Commercialisation Fund

None to date.

11. **Future Strategies**

*Outline development plans for the results of the research.*