



An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
Food and the Marine

15S736 - Valuing Agricultural Catchments' Ecosystem Services

Final Report

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Food and the Marine Competitive Funding Programme.

SUMMARY

Agricultural catchment ecosystems provide a number of services that add greatly to society well-being. The most obvious service provided are the many forms of farm produce that are purchased and consumed. These 'provisioning services' are traded in established markets and their price gives a good indication of their value to society. Agro-ecosystems also generate ecosystem services and disservices which are not valued by any established market. Some of these non-market ecosystem services from agricultural landscapes include carbon sequestration, regulation of soil fertility and landscape and cultural services such as recreational opportunities on farmland. Ecosystem disservices on the other hand include nutrient runoff and greenhouse gas emissions. This project estimated values of the ecosystem services and disservices. Using hydrological catchment units to provide the spatial boundaries for case studies at different spatial scales, an ecosystem service framework known as the Common International Classification of Ecosystem Services (CICES) was used to identify the relevant ecosystem services and disservices. Then a variety of indicators or proxy indicators were used to measure the level of ecosystem service or disservice generated. Once the ecosystem services/disservices were identified and quantified, the costs and benefits of each were estimated using non-market valuation techniques based on results from other primary studies and value transfer techniques.

Including all the values of various ecosystem services and disservices within agro-catchment ecosystems helps to develop policies that insure the continued delivery of agro-ecosystem service benefits. The generation of such values can be used to bolster policies at national and EU level. For example, they can contribute towards achieving one of the targets of EU Biodiversity 2020 which is to map and assess the value of ecosystem services by 2020. Additionally, for future CAP policy, the focus may be more on results based payments as regards resource efficiency, environmental care and climate action.

KEYWORDS

Agricultural catchments, ecosystem services, valuation

ACRONYM

VACES

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Section 1 - Research Approach & Results

Start Date

01 March 2017

End Date

30 September 2018

Research Programme

Research Stimulus Fund

TRL Scale

TRL 1: Basic Principles Observed

NRPE Priority area

Sustainable Food Production and Processing

Total DAFM Award

€107,196.13

Total Project Expenditure

€85,176.50

Rationale for undertaking the Research

Agriculture has a significant environmental footprint in Irish society particularly in terms of its climate emissions. In 2014, 32% of Irish Greenhouse Gas (GHG) emissions were from the agriculture sector, having decreased to 6.8% below 1990 levels in 2014 (EPA, 2016). However, the same report notes that in the period 2014-2020, agriculture emissions are projected to increase by 6–7%. Water quality is also an area that was highlighted as facing pressure from the agricultural sector with 53% of suspected causes of pollution in rivers from agriculture sources (EPA, 2016).

One suggested concept for taking account of the impacts of agriculture on the environment is through the use of an ecosystem services approach which differs somewhat from an ecosystem approach as it more focused on the benefits and costs to society compared to the ecosystem approach which is more ecosystem conservation focused.

Without values for these non-market goods and services farmers lack the incentives for provision that come with prices. Failure to incorporate these non-market goods (both non-market ecosystem services and disservices) into the decision making process means the benefits and costs are ignored or underestimated and changes within the agricultural landscape may incur a net loss to society (Bateman et al, 2010). Therefore identifying, quantifying and valuing these agroecosystem services and disservices is one step towards integrating these non-market values back into the decision making process.

Methodology

The main aim of agroecosystem service valuation is to provide information to policy makers that can assist in deciding on the best options to pursue using an ecosystem based management approach. Valuing the benefits and costs of agroecosystem services and disservices can help to promote sustainable development by providing policymakers with information about the value of market and non-market agroecosystem services and they can also be used for demonstrating and communicating the importance of agroecosystems to the wider public.

In this project, no primary valuation exercises were undertaken with the main valuation methodologies based on market prices and value transfer. Where market prices were used, valuation was defined as quantity multiplied by price. Quantity produced is based on output from the farm. Note that this does not match output from the land as some output may be used internally on the farm enterprise such as forage. Where value transfer was used, values for either costs or benefits reported in the literature were transferred to the Irish case. The broad approach used in this report was to identify the relevant agroecosystem services or disservice based on CICES, try to identify a suitable indicator for the service or a proxy indicator and quantify the level of the agroecosystem service or disservice. If there was sufficient data the ecosystem service or disservice was then valued or mapped or both. The chosen scale and unit used as boundaries were 40 hydrological catchments as defined by the Environmental Protection Agency (EPA) in Ireland for EU Water Framework Directive monitoring purposes.

An expert survey approach was also adopted where 18 experts chose a catchment with which they were familiar and answered questions related to the agroecosystem in each catchment and the level of ecosystem service/ disservice delivery.

Project Results

The provisioning ecosystem services of cultivated crops and reared animals and their outputs are the main reason for agroecosystems in the first place. In 2010 the estimated value of cultivated crops and reared animals and their outputs was €4.3 billion. Organic fertiliser amounts were estimated based on animal numbers and nitrogen (N) and phosphorous (P) excretion rates per animal. Estimated available amounts of organic N and P were 168,973 and 63,344 tonnes respectively. Multiplying these figures by the estimated prices for N and P gives values of €138 million and €142 million respectively; combining for a total €280 million.

The production of biomass for energy production is relatively a small element of Ireland’s agricultural sector and hence the area of agroecosystem dedicated to it is also small. Three main energy crop species, oilseed rape (OSR), miscanthus and short rotation coppice (SRC), are grown in Ireland. The OSR production area is concentrated in the east of Ireland, with 6 catchments containing 65% of total area. In terms of value, 41,700 tonnes were produced in 2017 which at a price of €380 per tonne gave a producer value of €15.8 million in 2017. A very visible regulating ecosystem service for agroecosystems is that of pollination. Worldwide, of the 100 crops that provide 90% of the world’s food supply, 71 are pollinated by bees (NBDC, 2015) and the pollination ecosystem service is estimated to underpin between 3 to 8% of global crop production (in tonnage) worth US\$361 billion worldwide (Hanley et al., 2015). NBDC (2015) estimated that the value of crops pollinated by bees in Ireland was €53 million in 2014.

Agroecosystems both emit and sequester greenhouse gases (GHGs) that in turn affect the climate through their build-up in the earth’s atmosphere. On balance in Ireland, the agroecosystems are net emitters of GHGs. Using the €20 figure for the Irish value of carbon, the agroecosystems in Ireland represent a net cost of €483 million in 2010.

One of the most visible cultural ecosystem services in agricultural catchments is recreational services. Four main outdoor activities were identified that are most associated with agroecosystems in Ireland. These are walking/hiking, cycling, horseriding and gamesports. Finally the project estimated the percentage of land per catchment covered by biodiversity hotspots.

An assessment of the level of agroecosystem services and disservices within the catchments was also undertaken using the expert opinion survey method. Eighteen experts with long experience in both the agricultural sector and the ACP responded to the survey. The experts tended to consider that agriculture had positive contributions to biodiversity indicators within the catchments except for in the case of rare breeds. Agriculture was considered by the experts across the catchments, to contribute positively to the regulating ecosystem services of pollination, shelter from weather and pests and disease. No significant differences between experts were noticed in the level of recreational activities and across the catchments similar trends emerged, with walking, horse riding and cycling the most likely to associated with higher level of activities.

Section 2 - Research Outputs

Summary of Benefits / Improvements of Project Findings

The project provided an outline of the agro-ecosystem services and disservices generated by agricultural landscapes in Irish catchments. The provisioning ecosystem services were the most significant valued at €6.4bn with greenhouse gas emissions the largest disservice value at €480 million. Other important agro-ecosystem services include recreation with significant numbers of both Irish public and tourists taking place in recreational activities within agro-ecosystems. The project also undertook an expert opinion survey of the level of ecosystem services provided by the catchments in the Agricultural Catchments Programme (ACP), demonstrating that there is potential for using the ACP catchments for assessing the change of agro-ecosystem services and disservices in Ireland.

While this report demonstrates the value of ecosystem services and also the cost of some agro-ecosystem disservices based on the flow of ecosystem services/disservices, it ignores whether these flows are sustainable or are in fact depleting the natural base underlying them. Additionally, this listing/accounting approach does not account for the fact that agricultural catchment is in itself and within the wider environment, part of many integrated systems (ecological, hydrological, social, etc.) that include various feedbacks, thresholds and stability issues. More research is needed in this regard. The project and its results were presented at three conferences including the Agricultural Economics Society conference and the National Biodiversity Conference and researchers also took part in four workshops presenting the work on project. A peer reviewed paper presenting the project outputs is also forthcoming in 'Biology and Environment' journal. An Excel spreadsheet of ecosystem service/disservice indicators and data sources used in this project has been generated and is available on the project website.

Summary of Staff Outputs

Research Output	Male	Female	Total Number
Post Doctorates	1	0	1

Summary of Academic Outputs

Research Outputs	Total Number	Details
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Peer Reviewed Conference Papers 3

Daniel Norton, Stephen Hynes, Mary Ryan, Edel Doherty Valuing agricultural catchment ecosystem services (VACES) Agricultural Economics Society, University of Warwick, UK, 17th April 2018

Daniel Norton, Stephen Hynes, Cathal Buckley, Mary Ryan, Edel Doherty Valuing agricultural catchment ecosystem services (VACES) 166th EAAE Seminar on Sustainability in the Agri-Food Sector at NUI Galway, 30th/31st August 2018

Daniel Norton, Stephen Hynes, Cathal Buckley, Mary Ryan, Edel Doherty Valuing agricultural catchment ecosystem services (VACES) The National Biodiversity Conference, 20th/21st February 2019

Publications in Peer Reviewed Scientific Journals

Daniel Norton, Stephen Hynes, Cathal Buckley, Mary Ryan, Edel Doherty (2020). An assessment of the value of Ireland's agro-ecosystem services by water catchment. *Biology and Environment* (forthcoming).

Intellectual Property

N/A

Summary of other Project Outputs

Project Outputs	Details	Total No.
New Products	An Excel spreadsheet of ecosystem service/disservice indicators and data used in the project	1 sources

Potential Impact related to Policy, Practice and Other Impacts

Impact	Details
Environmental Sustainability	Hynes, S. (2019). Valuing Ireland's Ecosystem Services. Invited talk at the Environment and Marine Session of the British-Irish Parliamentary Assembly - 58th Plenary Session, Druids Glen, Wicklow, 13th and 14th of May.

Dissemination Activities

Activity	Details
Workshops at which results were presented	Daniel Norton, Ecosystem Services panel at Sea Land & Spirit Conference in Dingle 25th May 2017
	Daniel Norton, Our Ocean Wealth Summit - Discussion panel on Ecosystem Services, 28/6/2018
	Stephen Hynes, Ecosystem service valuation, Presentation at Inland Fisheries Ireland, Dublin, 20/9/2018
	Daniel Norton Poster at the Whitaker Institute Research Day, 19/4/2018
	Hynes, S. (2019). Exploring Natural Capital Solutions: Valuing Ireland's Catchment Ecosystem Services. BIM's Exploring Natural Capital Solutions for our Shared Marine Environment, 13 November, Royal College of Surgeons, No.6 Kildare Street, Dublin.

Knowledge Transfer Activities

Identify knowledge outputs generated during this project.

The results of this project will be used by policymakers to address needs arising from the following specific policy issues;
 Output can contribute to DAFM submission for Action 2.1.3. of National Biodiversity Action Plan - Complete national terrestrial habitat, land cover, land use, and ecosystem service maps
 Output can contribute to DAFM submission for 2.1.5. of National Biodiversity Action Plan -Support research on economic and societal valuations and non-economic valuations of ecosystem services and benefits and how biodiversity underpins these values and support tools to maintain and enhance its biodiversity and ecosystem services.
 Output can contribute to design of Ireland's CAP Strategic Plans which will be required under the post 2020 CAP. Output may contribute specifically to the achievement of the objective of "Contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes" under Article 6 of the proposed regulation concerning the development of Ireland's CAP Strategic
 The outputs of this work can contribute to the aims of Foodwise 2025. They can advise on appropriate monitoring across sectors of the agri-food industry on the environmental impacts of 2025 strategy including impacts at regional level and DAFM efforts in relation to the Water Framework Directive.

Identify any knowledge transfer activities executed within the project. N/A

List any impacts resulting from the knowledge transferred during the project. N/A

Section 3 - Leveraging, Future Strategies & Reference

Leveraging Metrics

Type of Funding Resource	Funding €	Summary
EU R&I programmes	€179,239.00	<p>EU Atlantic Area INTERREG ALICE project, Total project budget €2.8 million. NUIG share €179 thousand.</p> <p>On the basis of the project, EU Atlantic Area funding was secured by NUI Galway. They are a partner on the EU ALICE project. ALICE builds on this project by developing an integrative, landscape management approach incorporating socioeconomic and climate change scenarios to ensure the delivery of benefits from investments in Blue and Green Infrastructures (BGI) to meet the 2020 EU biodiversity targets and sustainable development in the Atlantic Region. Carlingford Lough is one of the case study catchments in the ALICE project.</p>

Future Strategies

A worthwhile area for future research would be to work directly with policy makers to use the ecosystem service approach in order to generate policy solutions targeted at a local catchments level to help Ireland's agricultural sector undertake production in a environmental sustainable fashion. There has also been a lot of recent interest in the development of natural capital accounts. Natural capital accounting allows for the integration of natural assets within economic and political decision making. It can improve natural resource governance and permits the development of environmentally adjusted macroeconomic indicators to serve as complements to Gross Domestic Product. There have been many positive developments regarding natural capital accounting in Ireland but we still lag behind natural capital pioneers such as Norway, the Netherlands and the UK. Much work remains to be done in order for an adequate sustainability assessment of Irish economic development. One area where current attempts fall down is in the incorporation of non-market ecosystem service value flows into national income account type frameworks. Building on the research conducted in this project it would be interesting to develop an agricultural natural capital account for Ireland.

Project Publications

1. Daniel Norton, Stephen Hynes, Cathal Buckley, Mary Ryan, Edel Doherty (2020). An assessment of the value of Ireland's agro-ecosystem services by water catchment. Biology and Environment (forthcoming).
2. Hynes, S. (2019). Valuing Ireland's Ecosystem Services. Invited talk at the Environment and Marine Session of the British-Irish Parliamentary Assembly - 58th Plenary Session, Druids Glen, Wicklow, 13th and 14th of May.
3. Daniel Norton, Stephen Hynes, Mary Ryan, Edel Doherty Valuing agricultural catchment ecosystem services (VACES) Agricultural Economics Society, University of Warwick, UK, 17th April 2018
4. Daniel Norton, Stephen Hynes, Cathal Buckley, Mary Ryan, Edel Doherty Valuing agricultural catchment ecosystem services (VACES) 166th EAAE Seminar on Sustainability in the Agri-Food Sector at NUI Galway, 30th/31st August 2018

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