Institution: Queen Mary University of London		
Unit of Assessment: 5		
Title of case study. Informing 'Glastir', a New Sustainable Land Management Scheme delivering Benefits to Public Spending, Welsh Farmers and the Environment		
Period when the underpinning research was undertaken: 2009 - present		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
1) J Iwan Jones	1) Head of the River Communities Group	1) 05/2009 - present
2) John F Murphy	2) Research Officer	2) 05/2009 - present
3) Amanda Arnold	3) Research Officer	3) 01/2011 - present
4) John H Blackburn	4) Research Officer	4) 05/2009 - 09/2012
5) Charles P Duerdoth	5) Research Assistant	5) 05/2009 - 08/2017
6) Adrianna Hawczak	6) Research Assistant	6) 05/2009 - 09/2013
7) James L Pretty	7) Laboratory Manager	7) 05/2009 - present
Period when the claimed impact occurred: 2014 - present		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact (indicative maximum 100 words)

Research by Queen Mary's River Communities Group, headed by Dr. Jones, underpins a new land management scheme in Wales designed to reduce pollution of waterways from agriculture. Known as Glastir, the scheme was funded by the Welsh Government from 2014-20, and determined how >GBP125,000,000 was allocated to Welsh farmers to support environmentally friendly farming practices. The funding support targets specific locations, enabling local diffuse pollution to be dealt with efficiently, and thus delivers greater environmental benefits than the previous schemes Tir Cynnal, Tir Gofal and the Organic Farming Scheme, which would diffusely fund activities in areas that were not appropriate. In 2020 alone, Glastir Advanced, the largest branch of Glastir, funded 2,393 holdings, committed a total value of GBP17,624,138 and covered 325,861 hectares of farmland. By modelling the appropriate targets for funding, Glastir is a highly cost effective scheme, benefiting both the biodiversity and wider economy of Wales, and has influenced the development of the Agri-Environment Climate and Environmental Stewardship schemes in Scotland and England.

2. Underpinning research (indicative maximum 500 words)

Balancing food growth and security with sustainable use of water for food production is critical for governments around the world. One approach is to encourage best practice in farming through agri-environment schemes, which pay farmers to farm in environmentally friendly ways. Between 2013-2017, the EU spent EUR23,000,000,000 on such schemes. However, for these schemes to work, it is vital that policymakers accurately assess their effectiveness to reduce pollution from farming practices and therefore their impact on water quality and resources.

Queen Mary's Dr. Jones has long-term expertise in applied aquatic ecological research, including studies on atmospheric [3.1], industrial [3.2], and nutrient pollutions [3.3] on rivers and lakes. Jones leads Queen Mary's River Communities Group, based at the River Laboratory in Dorset, which works on understanding freshwater ecosystems to ensure better management and protection of these environments. This is of particular importance as the Group has shown that it is difficult to demonstrate responses to targeted pollutant mitigation in river catchments using standard approaches [3.4].

Drawing on this expertise, in 2009, the River Communities Group and Jones were commissioned by the Welsh Government to investigate the characteristics, sources and consequences of pollution in relation to agricultural activity and the contribution of Welsh agri-environment schemes to improved water quality [3.5, EQR.1]. The underlying research (2009-2012) was conducted in collaboration with the environmental consultancy ADAS, the University of Bangor and the Centre for Ecology and Hydrology. Specifically, the River Communities Group collected biological data (plants and invertebrates) from field stations established across Wales (80 rivers, 80 ponds and 120 grassland sites). Uniquely, they examined this biological data in

combination with integrated farm practice surveys from across Wales to develop novel spatially-explicit ecological models that explain the distribution and extent of diffuse pollutant emissions from agricultural land. They used these mathematical models to assess the environmental benefits of the Welsh agri-environment schemes and results showed the schemes were not delivering benefits evenly across Wales.

With their new models, the River Communities Group linked the specific sources of pollutants in rivers with the source of farming activities and their ecological impacts on aquatic invertebrate and plant assemblages. In this way, they demonstrated the effectiveness of different management scenarios on water quality [3.5] and showed that the existing methods were failing to improve it. They concluded that a much more targeted approach, aimed at specific areas, would be needed to reduce pollutant emissions from farms [3.6].

In this way, the River Communities Group provided an accurate picture of agricultural pollution and its sources in Wales. Indeed, the research showed that across much of Wales, farmers were encouraged, for environmental reasons, to undertake activities that actually produced no environmental benefit. The project culminated in the publication of a Government report assessing the effectiveness of Welsh agri-environment schemes in maintaining and improving soil, water quality and the mitigation of climate change [3.5] and the conclusion by the Welsh Government was that an operational change was needed.

3. References to the research (indicative maximum of six references)

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[3.5] Anthony, S., Jones, J. I., Naden, P., Newell-Price, P., Jones, D., Taylor, R., Gooday, R., Hughes, G., Zhang, Y., Fawcett, L., Simpson, D., Turner, A., Fawcett, C., Turner, D., Murphy, J., Arnold, A., Blackburn, J., Duerdoth, C., Hawczak, A., Pretty, J., Scarlett, P., Laize, C., Douthwright, T., Lathwood, T., Jones, M., Peers, D., Kingston, H., Chauhan, M., Williams, D., Rollett, A., Roberts, J., Old, G., Roberts, C., Newman, J., Ingram, W., Harman, M., Wetherall, J. & Edwards-Jones, G. (2012). *Contribution of the Welsh agri-environment schemes to the maintenance and improvement of soil and water quality, and to the mitigation of climate change: Agri-Environment Monitoring and Technical Services Contract. Lot 3: Soil, Water and Climate Change (Ecosystems).* (Report No. 183/2007/08). Welsh Government. https://www.researchgate.net/publication/303338505_Contribution_of_the_Welsh_agri-environment_schemes_to_the_maintenance_and_improvement_of_soil_and_water_quality_and_to_the_mitigation_of_climate_change

[3.6] Jones, J. I., Murphy, J. F., Anthony, S. G., Arnold, A., Blackburn, J. H., Duerdoth, C. P., Hawczak, A., Hughes, G. O., Pretty, J. L., Scarlett, P. D., Gooday, R. D., Zhang, Y. S., Fawcett, L. E., Simpson, D., Turner, A. W. B., Naden, P. S. & Skates, J. (2017). Do agri-environment schemes result in improved water quality? *Journal of Applied Ecology*, *54* (2), 537-546. https://doi.org/10.1111/1365-2664.12780

Evidence of quality of the research:

[EQR.1] Anthony, S. (ADAS) [PI]. Jones, J. I. [Co-PI]. (2009-2011). Agri-Environment Monitoring and Technical Services Contract Lot 3: Soil, Water and Climate Change (Ecosystems) [No. 183/2007/08]. *Welsh Government*. Total GBP700,000, Jones, J. I. percentage GBP230,000.

4. Details of the impact (indicative maximum 750 words)

Governments around the world aim to deliver agricultural management schemes that minimise pollution, while ensuring food security. Between 2013-2017, the EU spent EUR23,000,000,000 on agri-environment schemes that encourage best practice in farming to reduce the impact of agriculture on the natural environment. Typically, the success of these schemes has been based on input measures, such as the number of farms participating, the land area under the scheme and the money spent, without assessing whether the scheme has actually reduced pollution.

Revealing that existing Welsh agri-environment schemes were not working

Research by the River Communities Group, headed by Dr. Jones, revealed that the existing agri-environment schemes in Wales – Tir Cynnal (Land Maintenance), Tir Gofal (Land Care) and the Organic Farming Scheme – were failing to deliver substantial reductions in diffuse pollution over much of the country [3.4]. The weakness of these schemes stemmed from the bluntness of their approach. Farmers across Wales were financially incentivised to undertake activities that were not tailored to the specific environmental problems in their location. As a result, diffuse pollution levels from agricultural practices, such as the use of slurry, fertilizer or pesticides, remained too high, and the schemes were not cost-effective. After evaluating Jones' research on these pre-existing schemes, the Welsh Government concluded: "the reports suggest that significant investment in potentially beneficial interventions was made in areas which were inappropriate for the activity selected," and that "none of the indicators for soil or water quality showed any significant difference between farms in and out of an AES [agri-environment schemes]" [5.1].

Informing the design of a new, location-specific scheme for Wales

This research informed the Welsh Government, providing compelling evidence that a change was needed to deliver meaningful and cost-effective environmental benefits, particularly in relation to water quality. In their written synopsis and response to Jones' research [5.1], the Welsh Government state: "From the reports, it is evident that to achieve the desired improvements in habitat quality, species populations, water, soil and climate change, there is a need to **target** the location of prescriptions more effectively." They acknowledged that this is especially true for interventions designed to improve water quality and protect aquatic life. The Welsh Government go on to state in their response to Jones' research: "Glastir has consequently been designed to address these priorities" [5.1].

Glastir is the new comprehensive Welsh agri-environment scheme replacing the pre-existing schemes and designed to address their shortcomings. It is divided into sections covering areas such as woodlands, grazing land, and organic farms. Glastir Advanced [5.2] delivers the targeted approaches developed by Jones to enable the sustainable land management of whole farms and, introduced in 2014, it is the largest of all the schemes within Glastir. Any agricultural landowner or farmer can join the advanced scheme if they commit to a five-year management plan, which allows members to apply for and receive funding for specific land management options provided by Glastir, options that fall under the scheme's environmental objectives. Glastir Advanced specifically targets failing water catchments from agricultural activity, instead of spreading financial support to improve water quality equally across Wales. This targeted approach is designed to achieve improvements in habitat quality, species populations, water and soil quality. It is also designed to address the impacts of climate change more effectively by drawing up agreements with farmers to fund alternative agricultural activities that produce less methane and nitrous oxide emissions.

An expert review panel concluded in 2015 that Glastir Advanced promised to provide a significant improvement compared with previous schemes in Wales [5.3]. The Glastir scheme was funded by the Welsh Rural Development Programme 2014-20 and adopted by the European Commission in May 2015, with the EU committing GBP126,300,000 to the scheme and the Welsh government providing a further GBP96,400,000 [5.4]. Glastir is the most ambitious agri-environment scheme ever implemented in Wales in terms of uptake, with Glastir Advanced the most popular component. In 2020 alone, a total of 2,393 holdings took part in the advanced scheme, with a coverage of 325,861 hectares of farmland and GBP17,624,138 in

committed funds [5.5], public money paid to farmers. This level of investment has been sustained consistently throughout the advanced scheme's lifespan, with the scheme supporting 1,473 holdings and 253,589 hectares of land in 2015 [5.6] and having a budget of ~GBP18,000,000 in 2018 [5.7].

Glastir Advanced is fundamental to the long-term future of water policy in Wales. In their Water Strategy for Wales [5.8], which sets out a strategic direction for water policy to 2035 and beyond, the Welsh Government state: "The Glastir Advanced Scheme will remain the main mechanism for targeting activity to meet the Water Framework Directive requirements that will help to improve water quality and management". In addition to a cost-effective use of limited budgets [5.9], Glastir Advanced delivers measurable outcomes, at both a local and landscape level.

Environmental and economic benefits of the Glastir schemes

The Welsh Government established the Glastir Monitoring and Evaluation Programme (GMEP) to monitor the programme's success. GMEP has shown that the scheme has delivered the expected improvements, including an increase in action from farmers. A survey of 600 farms found [5.10]:

- A 17% increase in the number of farms in Glastir schemes, compared to non-scheme farms, reporting they were undertaking actions to combat climate change, including flood, drought, soil erosion, biodiversity, pests and disease. There was also a reported 15% increase in investment by Glastir farms in on-farm renewable energy production and a small but significant reduction in pollutant loads from agriculture (>2% of total loads across all sectors in Wales).
- A 4% increase in the number of farms reporting they were undertaking actions for farm diversification, adding new money-making activities that produce less pollutants but are still profitable. There was a 17% increase in business diversification in Glastir Advanced participants alone.
- 77% of respondents stated viability had increased as a result of receiving the Glastir Efficiency Grant, with their farm becoming more economically viable and efficient in the long-term. There was a 9.5% and 18% decrease in the average carbon footprints expressed per kg of lamb live weight and milk from farms on these grants, indicating improved production efficiency.

As well as farmers, the scheme also benefits other land managers, including wildlife charities. The Wildlife Trust of South and West Wales (WTSWW) entered Glastir Advanced in 2019 with their large landholding of 105 managed nature reserves [5.11]. Their five-year contract with the scheme provides GBP15,000 for capital works in the first year, and a further GBP48,000 per year for habitat management options. These funds are being used to underpin core activities that support the charity's aims of biodiversity maintenance and enhancement. This includes land management activities, infrastructure works, and supporting staff posts. According to Dr. Lizzie Wilberforce, the Conservation Manager at WTSWW: "[without Glastir] critical biodiversity features would deteriorate and be lost…we could not keep the sites secure for grazing animals, and the grassland habitats would deteriorate relatively rapidly into poor condition." She goes on to say that "without the income from Glastir this year we would almost certainly have been considering job losses," and that four of the five Wildlife Trusts in Wales have been in Glastir for varying periods of time as well, not just WTSWW, indicating similar effects across Wales.

Overall, Glastir Advanced is a highly successful agri-environment scheme, delivering benefits to the biodiversity and economy of Wales. The targeted scheme is cost-effective, delivers better water quality and improves biodiversity, for less money. It therefore benefits both the Welsh environment and the taxpayer. In incorporating the spatially targeted approaches developed by Jones into the scheme, Wales was the first country in Europe to target government subsidies by location to help the environment. The design of the scheme has been praised by the European Commission for being pioneering and innovative in how it seeks to target interventions most effectively [5.12]. This approach is leading the way for other countries. The Agri-Environment Climate and Environmental Stewardship schemes subsequently introduced in England and

Scotland are also spatially targeted, and spatial targeting is now advocated across Europe [5.13, 5.14].

5. Sources to corroborate the impact (indicative maximum of 10 references)

[5.1] Welsh Government. (October 2013). *Tir Cynnal and Tir Gofal monitoring and evaluation programme: Synopsis report*. (pp. 3 para 3, 10 paras 3&5, 12 para 4, 14 para 5).
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[5.3] Welsh Government. (2015). *Glastir Advanced Evaluation Panel: Synopsis and the Welsh Government's Response*.
[5.4] Welsh Government. (2017, 28 March). *Quarter of a billion pound boost for Wales' rural communities* [Press release]. https://gov.wales/quarter-billion-pound-boost-wales-rural-communities
[5.5] S. Neil. Agriculture and Rural Affairs Statistician. *Glastir Schemes: Uptake and Coverage*. Welsh Government. [Corroborator 1]
[5.6] Slade, A. Director of Agriculture, Food and Marine, Natural Resources Department. *Welsh Government.* Letter to Millar, D., AM. Chair of the Public Accounts Committee. *National Assembly for Wales*. (31 July, 2015).
[5.7] Welsh Government. (2017, 10 May). *Glastir Advanced*. [Press release].
[5.8] Welsh Government. (2015). *Water Strategy for Wales: Supporting the sustainable management of our natural resources*. https://gov.wales/sites/default/files/publications/2019-06/water-strategy.pdf
[5.9] Welsh Government. (2014). *Proposals for the Glastir scheme, part of the rural development plan for Wales 2014-2020: Analysis*. (pp. 14).
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[5.11] L. Wilberforce. Conservation Manager. *The Wildlife Trust of South and West Wales*. (testimonial letter, 01 August, 2019). [Corroborator 2]
[5.12] Evans, R. Deputy Minister for Farming and Food. (2015, 5 June). Written Statement - Glastir Advanced Evaluation Panel. *Welsh Government*. https://gov.wales/written-statement-glastir-advanced-evaluation-panel
[5.13] Reed, M. S., Moxey, A., Prager, K., Hanley, N., Skates, J., Bonn, A., Evans, C. D., Glenk, K. & Thomson, K. (2014). Improving the link between payments and the provision of ecosystem services in agri-environment schemes *Ecosystem Services*, *9*, 44-53. https://doi.org/10.1016/j.ecoser.2014.06.008
[5.14] European Commission & Alliance Environment. (2019). *Evaluation of the impact of the CAP on habitats, landscapes, biodiversity: Executive Summary*. https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cmef/sustainability/impact-cap-habitats-landscapes-biodiversity_en