Design of Agri-Environmental Schemes – evidence from the monitoring and evaluation GLAS in Ireland

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Design of Agri-Environmental Schemes – evidence from the monitoring and evaluation GLAS in Ireland[1]

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ABSTRACT

The Green Low-Carbon Agri-Environment Scheme (GLAS) is the main agri-environment scheme (AES) in Ireland, funded under the CAP rural development programme (RDP) 2014-2020. GLAS was designed to support and encourage more sustainable production practices at farm level and underpins a range of over-arching environmental objectives as set down in EU Directives and National and International Strategies. AES have been widely used as a policy instrument to deliver environmental protection and enhancement on commercial farms, above and beyond the regulatory baseline. To be effective, this requires a number of individual land managers within a given landscape or catchment to voluntarily participate in schemes and select and implement an appropriate mix of actions over time. There is a wealth of literature on the design of agri-environmental schemes based on theories of behaviour change (scheme uptake and attitudinal change) and how to affect environmental change (effectiveness of actions at site and landscape scale). This paper considers both.

In 2015, ADAS and Scott Cawley were contracted to undertake the monitoring and evaluation of GLAS to evaluate scheme structure, composition and effectiveness. The approach started with a detailed literature review of the existing research on agri-environment measures in Ireland and the development of a sampling plan and protocols for a longitudinal (5 year) field-based assessment of GLAS actions targeting biodiversity. Actions for water and climate change are being assessed through a modelling approach, using FARMSCOPER, a decision support tool to assess diffuse agricultural pollutant loads to water and air. The work also includes an attitudinal survey of the GLAS sample farmers as well as a counterfactual group (non-participants) to understand farmer motivations to participate in the scheme, secure feedback on their experience and identify influences of participation on environmental behaviour. Critically, all elements measure change over time (3 field surveys and 2 attitudinal surveys) and include a baseline assessment, while the evaluation of motivations and influence on attitudes is an important element for a voluntary scheme. A desk-based evaluation of GLAS will provide evidence of scheme impact for the 2019 enhanced RDP reporting and make recommendations for future agri-environment schemes.

The baseline field survey has been completed on a sample of 313 farms, using 'Measures of Success' for 26 actions to assess site condition and action implementation. Bird actions and simple habitat actions were generally well implemented and most measures of success were met but this was less so for more complex habitat actions. The attitudinal survey found that half of scheme participants were part-time farmers, mainly cattle rearing (37%) and mixed livestock farms (31%)

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and key reasons for participation in GLAS were financial. For water and climate change, the model development provides a spatially explicit baseline assessment of pollutants. Catchment scale impact is based on action uptake by farm type for each WFD waterbody at Ireland level. Nationally 32% of agricultural land is in the GLAS scheme but only 13% of farms are specialist dairying and this is expected to limit the contribution to mitigating the impacts of agriculture on water quality and climate change.

Key-words: Agri-environment scheme, participation, attitudinal, policy design.

INTRODUCTION

This paper examines the role of agri-environment scheme (AES) design in meeting policy objectives for sustainable agriculture, using the current monitoring and evaluation of the Green Low-Carbon Agri-Environment Scheme (GLAS) in Ireland as a case study.

Agriculture production systems in Europe are expected to meet the twin objectives of increasing food production to meet the demand from a growing global population whilst at the same time achieving environmental sustainability. The EU Common Agricultural Policy (CAP) seeks to address these aims through a combination of three policy instruments; direct payments to farmers and market support measures under Pillar I, and multi-annual rural development programmes (RDPs) under Pillar II. Direct payments require a baseline level of sustainable practice through Cross Compliance and most recently 'Greening' measures while Pillar II productivity grants support investment in input efficiency. The main instrument for delivery of environmental objectives is through agri-environment schemes (AES) in Pillar 2. AES were initially conceived as a mechanism to compensate farmers for loss of income associated with less intensive management of environmentally sensitive areas and in 1992 AES became compulsory for all EU Member States (EU Regulation 2078/92). In the 2014-2020 RDP programme, some 30% of EU funding is required to be linked to combating climate change including measures for agri-environment and climate practices, organic farming and payments for areas facing natural constraints.

The literature on design and evaluation of AES highlights both positive outcomes and limitations. For example, a review of the role of agri-environment schemes in conservation and environmental management (Batáry *et al.,* 2015) concluded that AES can be effective for conserving wildlife on farmland, but they are expensive and need to be carefully designed and targeted. Key factors for effectiveness include the extent of uptake of actions (farmer participation and option selection), the spatial distribution of actions (coherence and scale effects), quality of implementation (farmer capacity and ownership of outcomes) and persistence of impact. More generally, there is a trade-off between simple, easy-to-access AES with widespread participation and more complex, highly targeted schemes which seek to improve additionality for limited public budgets. In a review of deadweight in Environmental Stewardship in England, Rayment et al. (2012) highlight the case for tolerating some degree of deadweight as it rewards existing provision of public goods and can help to foster positive attitudes to the environment, which may enhance long term additionality.

More recently, Cullen et al. (2018a) report that AES are sub-optimal at achieving sustainability goals because they are predominantly top-down and action-based, relying on voluntary participation in exchange for payments. The authors draw attention to design issues such as geographical dispersion, adverse selection and complexity (of implementation and administration), and make a case for participatory-partnership, results-based schemes to secure farmer engagement and reward outcomes achieved. The case for small-scale, locally-led approaches is also made by Cullen et al. (2018b) on the basis that many environmental public goods analysed are localised, which is consistent with previous work on the socioeconomic benefits associated with AES. This is of particular relevance in the context of a natural capital approach, where the ecosystem services that provide benefits to people (directly and indirectly) are valued.

However, results-based approaches still suffer from the constraints of fixed-price models as evidenced by Russi et al. (2014) in their review of the performance of MEKA-B4, the oldest CAP result-based agri-environment measures, introduced in 2000 in the German region of Baden-Württemberg to preserve species rich grassland. The authors found that payments do not fully compensate for the opportunity costs of all potentially involved farmers, notably intensive cattle raisers and biogas producers. Differential costs of participation in AES can be addressed through the use of reverse auctions, as explored by Elliott et al. (2015), who found that an auction approach can provide better cost-efficiency than an alternative scheme which offers a fixed price set around the centre of the cost distribution. However, the research also noted issues of perceived complexity of the bidding process by farmers and a number of possible unintended consequences.

AGRI-ENVIRONMENT SCHEMES IN IRELAND

The Rural Environment Protection Scheme (REPS) was Ireland's first major agri-environment scheme and operated from 1994. The scheme had a horizontal whole-farm focus and evolved through four iterations which gradually added more complexity, such as additional biodiversity options. It was succeeded in 2010 by a smaller Agri-Environment Options Scheme (AEOS) which took a more targeted approach, focussing on part-farm actions. The current AES in Ireland is the Green Low-carbon Agri-environment Scheme (GLAS), which has adopted a tiered approach and has a much stronger biodiversity focus, but also contains targeted actions for climate and water quality. It is a top-down, action-based scheme but operates alongside other schemes established outside the RDP that have sought to target specific Natura 2000 features. These include the Burren LIFE Programme (a catchment-level results-based scheme) and the Results-Based Agri-environment Pilot Scheme (RBAPS), as well as the Farm Plan Scheme (FPS) operated by the National Parks and Wildlife Service (NPWS) to target certain birds listed in the Birds Directive.

A review of REPS by Finn & Ó hUallacháin (2012) and the mid-term evaluation of the 2007-2013 RDP (Indecon, 2010) brought together a considerable volume of information about the effectiveness of REPS. These studies raised a number of issues such as the need to demonstrate national scale effectiveness in addressing GHG abatement and water quality over the long term, the need for further and more consistent work to investigate biodiversity effects, as well as the need for more studies on socioeconomic aspects of schemes. More recent studies on AES in Ireland were reviewed by Image (2016) and suggest a link between REPS participation and lower nitrate leaching rate and decreases in phosphorus enrichment observed in some catchments (Richards et al, 2015; O'Dwyer et al, 2013). The GHG emission abatement from a number of REPS actions has also been quantified (Schulte et al, 2012; Black et al, 2014). However, there is still a shortage of information on the effectiveness of Irish AES on designated biodiversity. The literature is more extensive on non-designated features such as field margins, riparian margins, and hedgerows; it suggests a positive effect for REPS on functional indicators of biodiversity such as invertebrate species richness (Roarty & Schmidt, 2013; Anderson et al, 2013) but only a limited effect on higher level indicators such as bird/vegetation species richness (McMahon et al, 2013; Ó hUallacháin et al. 2015). Interpretation of evidence is challenging as most studies are single-site only and do not have a pre-REPS baseline for comparison.

The recent review also found a wider literature on socioeconomic factors associated with scheme uptake. Regression analysis of the National Farm Survey (NFS) dataset by Murphy et al (2014) over all four iterations of REPS has indicated that participation is generally linked to farm type (less intensive) and economic situation (lower incomes including many that would be otherwise non-viable). The dairy sector only participated when limits on organic N were loosened or when farm incomes had been more volatile due to external factors (Vollenweider et al, 2011). Low uptake rates of riparian buffers in AEOS was also attributed to insufficient funding, representing only half the average actual cost of establishment (Buckley et al, 2012). Attitudinal survey work on REPS and AEOS has been more limited and a national scale study could not be identified. Finn & Ó hUallcháin (2012) make a case for a dedicated monitoring programme to understand the long-term impacts of AES on farmers' behaviour.

GLAS BASELINE EVALUATION

The monitoring and evaluation of GLAS started in late 2015 and will complete in 2021. It comprises a baseline analysis and follow up surveys, and an interim evaluation of the scheme. Three discrete approaches were taken to establish a baseline and monitor change, namely:

i. a longitudinal field survey of actions on a sample of over 300 GLAS participant farms, focusing on biodiversity and bird actions;
ii. a baseline and follow-up survey of attitudes to sustainable land management, covering the 300 GLAS participant farms and a counterfactual sample of over 100 non-participants; and
iii. a baseline and impact analysis of actions on water quality and GHG emissions using the FARMSCOPER model at country level.

The work is led by ADAS with field survey work undertaken by Scott Cawley and telephone surveys for the attitudinal analysis undertaken by B&A. The baseline analysis of actions under GLAS was completed and reported in early 2018 and provides the basis for discussion of AES design in this paper. An overview of the detailed method is set out below.

Field survey. A sample size of 30 sites was used for the majority of the bird and habitat actions and a lower sample size (10 sites) was used for Commonage habitat areas. On this basis a sample of over 300 farms was selected; initially a random selection approach was used but this was refined to accommodate efficiencies in site monitoring through a degree of clustering of sites (taking out outliers) and selecting farms with multiple actions. A total of 26 actions have been monitored. For some actions involving the creation of new habitats, such as arable margins and bat boxes, implementation checks were used to establish the baseline status. The number of farms and parcels visited or contacted by surveyors for the baseline survey was 313 and 650 respectively.

Protocols were developed by the research team, including a set of 'measures of success', derived from the specific management requirements for individual actions and based on a knowledge of the ecology of the individual species or habitat. The measures of success are intended to provide an overall indication of the success (or otherwise) of the action in relation to achievement of outcomes and are intended to be easily and consistently assessed to facilitate comparison with future surveys at each sample site. These data will provide the evidence to measure extent of change by site over time, and across the whole sample set, to understand variations in change across space. Presence of sufficient target fauna (for a specific species or group) is not a measure of success as target species abundance at the point of survey could be reflective of many factors outside the scope of the management itself. However, where feasible, surveyors have also recorded the presence and quantity of the target species.

Attitudinal survey. A questionnaire was developed to establish key characteristics of the sample farms and farmers, their experience of the GLAS scheme (GLAS participants only) or reasons for not participating (non-participants only), and their attitudes to managing the environment (participants and non-participants). The survey was carried out by telephone for both groups and uploaded onto an online portal (Bristol Online Survey) for data collation and analysis.

A statistical analysis of the results from both scheme participants and non-participants was undertaken, including a comparison of farm and farmer characteristics, attitudes to the environment and in particular, participation in AES. Using the survey data for both samples, a probit regression analysis was used to identify the influencing factors of GLAS scheme participation, following the methodology outlined by Lastra-Bravo et al. (2015). Lastra-Bravo et al. categorised key drivers into five broader categories: economic factors (income structure, payment rates etc.), farm structure and characteristics (farm size, location, production system etc.), land manager's characteristics (age, education, presence of a successor etc.), land manager's attitudes to AES and environment (environmental awareness, past experiences with other AES etc.), and social capital (advice from public and private advice provision, social networks etc.).

Modelling of water and climate impacts. The methodology is based on Anthony et al. (2008; 2009) and involves the derivation of a meta-model of export coefficients from the output of more detailed process-based models applied to common descriptions of representative farm systems/practice. The models are spatially explicit, driven by data on local soil and climate conditions affecting runoff and drainage and the mobilisation of pollutants. A number of spatial environmental datasets have been created as part of this project in order to enable agricultural pollutant modelling, including elevation and slope, climate, soils data, landscape connectivity and land cover and land use.

Baseline pollutant emission footprints were estimated for the farm types, land uses and delivery pathways for pollutants, including spatial variations in pollutant losses across Ireland. A degree of verification of modelled pollutant loads was undertaken by reference to empirical date from OSPAR reporting (16 monitoring sites), the Agricultural Catchments Programme (6 catchments) and other published studies. GLAS options are mapped to one or more mitigation actions and characterised in terms of effectiveness, applicability and efficiency. Catchment scale impact is based on the level of uptake spatially and by farm type for each of the c. 3,200 WFD waterbodies at Ireland level.

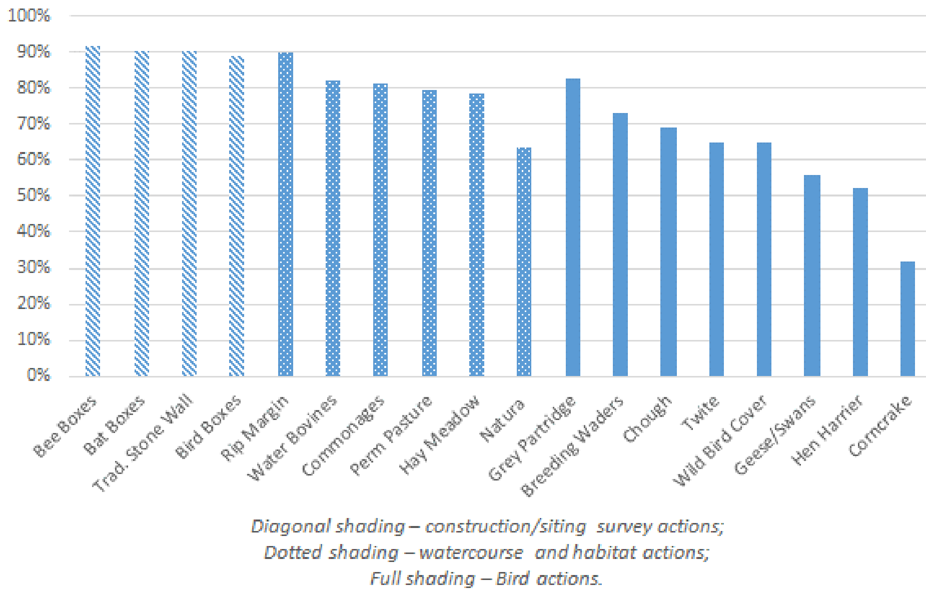
RESULTS

The results from the baseline field survey, modelling and attitudinal survey reports are reported separately below and then in aggregate.

Field survey

Of the 26 actions under investigation, 8 (arable margins, bee sand, fallow land, orchards, tree groves, and the three hedgerow actions) did not require a site visit to examine the state of the baseline environment and a simple yes/no implementation check was sufficient. The vast majority of these (between 90-100% of sites) had completed the implementation by the prescribed date. For the other 18 actions, the proportion of the measures of success completed is shown in Figure 1.

Figure 1: Baseline assessment of GLAS actions – measures of success. Average proportions of sites meeting Measures of Success across the sample – surveyed actions only.



For construction and siting survey actions (bat/bird/bee boxes and stone walls) the work was almost always done to the desired prescription. Implementation appeared to be very good on the two watercourse stock exclusion actions (fencing and riparian margins) with only a few sites not meeting management criteria. Implementation of the more straightforward habitat actions (low input permanent pasture and hay meadows) was also very good with most sites meeting criteria for vegetation management and sward composition. Baseline scores on measures of success for the more complex habitat actions (Natura grassland and heathland) were more mixed: undesirable species and rush were well controlled, but scrub encroachment is currently an issue as is sward diversity for grassland.

As with the habitat actions the baseline sward composition for bird sites was more varied. Chough, Grey Partridge and Geese/swan sites generally scored well indicating the presence of the right type of plant cover. However, several Hen Harrier and breeding wader sites were deemed either to be too improved overall to be suitable, or too dense in terms of thick rush cover and/or gorse. Few wild bird cover or Twite sites met the requirements for the desired species composition, whilst Corncrake sites have insufficient herb, nettle and rush cover. The results suggest an association between the success of the action (in terms of how well it was implemented) and its complexity. This is not a surprising finding, and indeed for some of the more complex habitat and bird actions, most of the issues present at inception would be addressed by the continued application of the management prescription over the lifetime of the agreement. However, where grassland is already in a highly improved condition, any change in higher level indicators (species richness) is likely to take many years and may not be picked up within the current 5 year monitoring window.

The sites surveyed represent only a sample of the overall agreements and it is too early to draw conclusions about the effectiveness of the targeting in the GLAS scheme. However, the observations about the baseline conditions on the sites visited does suggest that, barring a few isolated examples, the individual actions were generally appropriate to the actual site selected. For example, Hen Harrier sites are in or close to Special Protection Areas (SPAs) established for this species.

Attitudinal survey
Just over half (51%) of the sample of GLAS participants interviewed were part-time farmers and the predominant farm types of participants were cattle rearing (37%) and mixed livestock (31%). The principal decision maker for three quarters of the farms interviewed was over 45 years old and more than half of the sample farms (56%) received less than 50% of their household income coming from agriculture. More than a third (36%) of the farmers interviewed have identified a successor. Nearly half (49%) of the GLAS sample farms have Natura 2000 or designated sites and 77% were previously in an agri-environment scheme (REPS/AEOS). The key drivers of participation in GLAS were financial although environmental reasons are also important.

Based on reported changes made to land management by the GLAS participant sample and their attribution of change to participation in GLAS, the additionality of individual actions was estimated (Table 1). The actions undertaken by the respondents are listed in terms of uptake (as a percentage of the sample total). Additionality is measured on the basis of the percentage of farmers who claimed they have made changes in land management due to participation in the GLAS scheme or calculated as 100% less the percentage of those who stated 'no changes made'. Note that some of these figures should be interpreted with caution due to small number of responses.

Table 1: GLAS Action Uptake and Additionality

GLAS management option	No. of respondents	Uptake	Additionality
Arable grass margins / riparian margins	58	19%	62%
Commonage	70	22%	24%
Catch crops	32	10%	Not estimated
Hedgerows (coppicing / laying / planting new hedgerows)	75	30%	20%
Farmland birds	245	78%	33%
Farmland habitats	74	24%	25%
Low input permanent pasture	140	45%	41%
Minimum tillage	9*	3%	67%
Protection of watercourses from bovines	91	29%**	52%
Traditional hay meadow	62	20%	31%

*Note: * Small number of responses. ** This is lower than in the GLAS agreement population (approx. 40%) and was driven by the sampling framework which oversampled bird actions and under-sampled this action.*

From the 168 GLAS non-participants that opted into the counterfactual survey, 124 interviews were completed. Just over one fifth of these (21%) had applied to join GLAS but were unsuccessful with their applications. For those that did not apply to join GLAS, reasons given for not applying included: not worthwhile/payment levels too low (63%); scheme too complicated (50%); and fear of inspections (24%). Nevertheless, over 75% of the non-participant sample reported that they carried out at least one of the following activities: Species rich grassland/Low input permanent pasture; Maintenance of traditional hay meadows; Arable grass margins; Maintenance of traditional hay meadows; Reduced cultivation of soils; Species rich grassland/Low input permanent pasture; Green cover crops (catch crops) and Management of commonages). This suggests a relatively high level of deadweight for funding these options through GLAS, although there may be a legacy effect from participation in previous AES (approximately a quarter of non-participant sample farms were in REPS). More than a third (39%) of non-participants claimed that they were likely or very likely to join any future agri-environmental schemes.

In comparison to the GLAS participant sample, there were distinct differences in farm type, size and status as detailed in Table 2. Nearly two thirds (82%) of the non-participants interviewed were full-time farmers and the predominant farm types are tillage (39%) and cattle rearing (27%). There was a greater representation of predominantly rented land and a greater reliance on income from agriculture.

Table 2: Comparison of characteristics between GLAS participants and non-participants

Variables	**Value range**	**Mean value (std. dev.)**		
		Non-participants	Participants	Diff. (non-participants-participant)
Role of farmer	1=Full-time; 2=Part-time	1.21 (0.48)	1.54 (0.53)	-0.33 (-6.34)***
Presence of environmental features on farm	1=Yes; 0=No	0.84 (0.36)	0.85 (0.35)	-0.01 (-0.16)
Actions influenced by existing regulations	1=Yes; 0=No	0.95 (0.22)	0.94 (0.23)	0.01 (0.39)
Participated a previous agri-environment scheme	1=Yes; 0=No	0.54 (0.50)	0.79 (0.41)	-0.25 (-4.99)***
Will apply for future programme	1=Yes; 2=No	1.27 (0.81)	1.70 (0.50)	-0.44 (-5.61)***
Land area	1<under 50 ha; 2=50-100ha; 3=>100ha	1.90 (0.81)	1.44 (0.70)	0.45 (5.43)***
Land ownership	1=Mainly owned; 2=mainly rented; 3=mainly other	1.27 (0.48)	1.13 (0.37)	0.14 (2.97)***
Age band (farmer)	1=under 44; 2=45 and older	0.68 (0.47)	0.76 (0.43)	-0.08 (-1.58)
Education level (farmer)	1=school education; 2=diploma; 3=university degree and above	1.79 (0.78)	1.86 (0.78)	0.08 (0.93)
Income structure	1=less than 50% from agriculture; 2=more than 50%; 3=100%	2.58 (0.76)	1.92 (0.79)	0.66 (-8.08)***
Experience in farming	1=under 20 years; 2=more than 20 years	1.61 (0.49)	1.63 (0.48)	-0.02 (-0.38)
Successor	1=Yes; 2=No	1.86 (0.95)	1.96 (0.86)	-0.10 (-1.04)

* Significant at 90% confidence level; ** Significant at 95% confidence level; ***Significant at 99% confidence level.

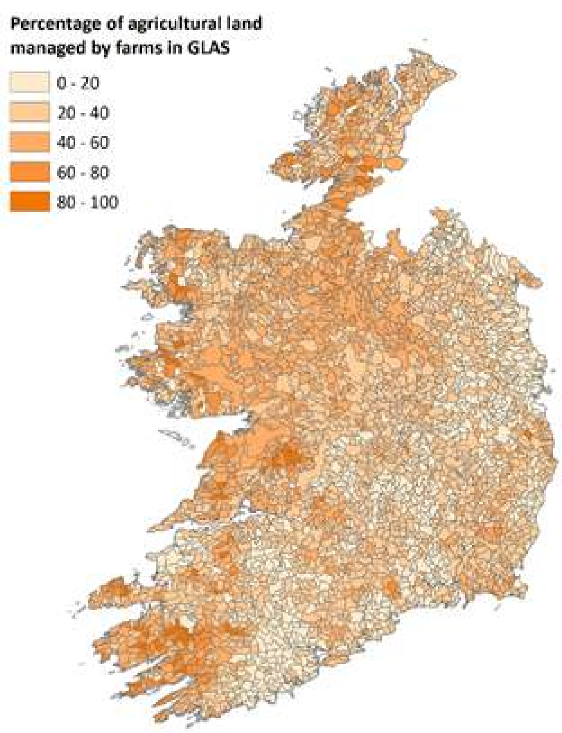
The data was also subject to a probit regression analysis and the results suggest that the following characteristics are associated with participation in GLAS:

- part-time farmers;
- farms of smaller farm size;
- farms with a lower percentage of household income from agriculture;
- farms that have a successor plan in place;
- farmers who previously participated in an agri-environment scheme; and
- farmers who intend to join future agri-environmental schemes.

Modelling of water and climate impacts

To date, the project has determined the areas of GLAS uptake and baseline pollutant loss from participating farms (and the proportion of regional and national totals). The baseline losses are explicitly disaggregated by source, source area, method of mobilisation and delivery pathway, allowing a transparent evaluation of the limits to pollution control under GLAS. Figure 2 shows that approximately 32% of all agricultural land in Ireland is managed by participating farms but GLAS actions are not located on all land on these farms and not all options have any impact on diffuse pollution. The percentage of the national pollutant load from this land is generally lower (27% for N; 23% for methane) as dairy farms, which typically have the highest pollutant footprints, are less likely to participate in GLAS (13% specialist dairying farms).

Figure 2: Agricultural land managed by farms participating in GLAS



The impact of key actions on reducing pollutant loads have been mapped (Table 3). Estimates will be calculated from available data and spatial analysis as part of the evaluation work.

Table 3: Mapping of likely impact of key actions on pollutants

GLAS action	Pollutant impacted				
	N	P	sediment	N_2O	CH_4
Arable grass margins	✓	✓	✓		
Catch crops	✓	✓	✓		
Fallow land	✓	✓	✓		
Farmland habitat	✓	✓	✓	✓	✓
Low emission slurry spreading	✓	✓			
Low input permanent pasture	✓	✓	✓	✓	✓
Minimum tillage	✓	✓	✓		
Planting new hedgerows	✓	✓	✓		
Protection of watercourses from bovines	✓	✓	✓		
Riparian margins	✓	✓	✓		
Wild bird cover	✓	✓	✓		

These datasets will be used to assess the impacts of the current uptake of GLAS agreements on agricultural pollution at whole catchment / national level, allowing for farms not in scheme.

SUMMARY AND POLICY IMPLICATIONS

The architecture of GLAS and investment in a monitoring and evaluation programme are a direct response to design strengths and limitations of previous AES schemes in Ireland. In particular, the fact that GLAS incorporates a targeted approach with mandatory adviser involvement should improve scheme effectiveness and uptake. The establishment of a baseline and use of a longitudinal field survey for monitoring actions will provide important evidence on action efficacy while the attitudinal surveys are also important in understanding participation and offer the opportunity for cross-evaluation (e.g. to link attitudinal data to environmental outcomes observed). There is no provision for a counterfactual field survey of GLAS but the modelling work allows for 'policy off' analysis and the non-participant attitudinal survey is helpful.

The literature highlights potential limitations for national, top-down, action-based AES around issues of geographical dispersion, adverse selection and complexity. The evidence to date from the GLAS monitoring and evaluation project is that the scheme has been sufficiently easy for farmers to participate in to be fully subscribed. This reflects a positive process, with the involvement of advisers being key, but also a high level of demand. A key question is whether effectiveness has been traded-off for ease of access. The field survey analysis represents the baseline condition only and no conclusions can yet be drawn about the effectiveness of the scheme on biodiversity. However, implementation appears to have been generally good in terms of the measures of success used to evaluate each action. Even where the baseline condition is more mixed, only a very small proportion of the sites would not be expected to show a positive change over the lifetime of the scheme. A wider analysis of the GLAS population-level data will be undertaken as part of the evaluation in 2019 and should provide more evidence on the success of scheme targeting to priority assets such as sensitive habitats/species. This will also test the extent to which the tiered approach has been effective.

A further risk in easy-to-access fixed-payment schemes is low additionality, whereby uptake reflects the lowest cost of provision rather than the highest level of environmental benefit, as outlined by Fraser (2008). The attitudinal baseline surveys of GLAS participants and non-participants highlight an element of deadweight across actions. Actions with particularly low additionality include commonage, hedgerows, farmland habitats and traditional hay meadows – all established assets where the emphasis is on maintenance and improvement rather than creation, so a degree of deadweight is expected. The attitudinal survey also suggests a degree of persistence of impacts based on willingness to take up future schemes. Later surveys will detect any extent of GLAS participation on environmental behaviours, relative to the non-participant sample.

A universal challenge for national-scale programmes is observing any impacts in national data, as there are considerable effects from other drivers such as changing land use and farming practice as well as wider effects from climate change. Evaluation of impact therefore relies on detecting changes at farm and catchment/landscape scale and a key question for GLAS is whether it can deliver biodiversity effectively at a more localised scale. Comparison of GLAS impact with that delivered by locally-led and results-based initiatives will provide useful evidence on this.

An apparent weakness of GLAS is the lack of participation of larger, more commercially driven farms with particular reference to water quality and climate mitigation. The modelling work will provide evidence on the impacts where there has been uptake but thought should be given to how the scheme might be developed to support action in high risk areas such as vulnerable water areas (beyond the regulatory baseline).

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