The delivery of ecosystem services through results-based agri-environment payment schemes (RBPS): three Irish case studies

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THE DELIVERY OF ECOSYSTEM SERVICES THROUGH RESULTS-BASED AGRI-ENVIRONMENT PAYMENT SCHEMES (RBPS): THREE IRISH CASE STUDIES

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ABSTRACT

A number of European Innovation Partnerships (EIPs) were funded by the Department of Agriculture Food and the Marine through the 2013–2020 Rural Development Programme (RDP). Their objectives relate to restoring, preserving and enhancing ecosystems. Three of the EIPs—Caomhnú Árann, the Hen Harrier Project and the Pearl Mussel Project—have varying targets and scale but they all pay for the delivery of ecosystem services whilst also supporting vibrant, rural farming communities. This is achieved by using a results-based payments approach where farmers are rewarded for the quality of habitat that they maintain on their farms in addition to the food products that they produce. The EIPs allow for an adaptive approach, which means programmes can be tailored to meet the specific needs and challenges of a particular biogeographical area. In this way, vital ecosystem services such as biodiversity, conservation of nationally rare species and habitats, carbon sequestration and storage, improved water quality, agricultural biodiversity, flood resilience and fire resilience can be delivered, protected and conserved while farmers are rewarded for doing so. These three EIPs provide a model by which this wide range of ecosystem services can be delivered through a results-based agri-environment (AE) payments approach, using habitat quality as a result indicator or surrogate for these services to which payment levels are linked.

INTRODUCTION

ECOSYSTEM SERVICES AND AGRICULTURE

Ecosystem services are the contributions of ecosystems to human well-being (Haines-Young and Potschin 2013). They support human survival (directly or indirectly) and quality of life, and have been categorised in four main types: provisioning services, regulating services, habitat services and cultural services in a report on the economics of ecosystems and biodiversity (TEEB 2010) whereas the Common Classification of Ecosystem Services (CICES) defined three categories: provisioning, regulating and cultural services. Important examples of ecosystem services are climate regulation, water purification and biodiversity (Haines-Young and Potschin 2013). Agriculture plays a major role in the provision of ecosystem services (García-Feced et al. 2015) and creating a mosaic of habitats dominated by semi-natural vegetation or low intensity farmland, often referred to as High Nature Value farmland (HNVf). HNVf is defined as land dominated by semi-natural vegetation or low intensity farmland with a mosaic of habitats. In particular, semi-natural

and cultivated land and small scale features (EEA 2004) can deliver on all four aforementioned ecosystem services if managed correctly (Maes et al. 2013). HNVf is extensively managed farmland with high biodiversity that is crucial for the conservation of semi-natural habitats and the plants and animals linked with them (Oppermann et al. 2012). These farmlands are of strategic importance for European Union (EU) policy since they are reservoirs of biodiversity and provide many ecosystem services (Oppermann et al. 2012; Gardi et al. 2016). Matin et al. (2020) mapped the likely occurrence of HNVf in Ireland using national data for a set of surrogate indicators. Around a third of the tetrads in Ireland is likely to be HNVf based on national-scale data. Throughout Ireland, and indeed Europe, there is a strong connection between Natura 2000 and HNVf (Olmeda et al. 2018; Matin et al. 2020), as many species and habitats listed on the Habitats Directive annexes (CEC 1992) depend on the traditional land-use patterns and landscape structure that are characteristic of HNVf. While agroecosystems have traditionally been considered primarily as sources of provisioning services, ecosystem processes within agricultural systems can provide

services that support regulating services, including pollination, pest control, genetic diversity for future agricultural use, soil retention, regulation of soil fertility and nutrient cycling (Power 2010).

The current agricultural economy has developed around payment for production of commodities such as food, while all the other services that are vital to human well-being and survival are seldom rewarded in the marketplace (Kelly *et al.* 2016). In Europe, the concept of paying farmers for producing ecosystem services is a relatively new idea, and often the ecosystem service payment is an add-on rather than as a valuable commodity in its own right. Agricultural policy in Ireland is moving towards improved environmental management within the requirements of core farm payments (e.g. single farm payment) (McEldowney and Kelly 2018). Additionally, over 13% of Irish farmland has been entered into agri-environmental (AE) schemes where farmers receive payments to protect features of environmental and biodiversity value (DCHG 2019). Payments are supplemented for farmers with holdings in Natura 2000 areas or who have signed up for the National Parks and Wildlife Service (NPWS) Farm Plan Scheme, which focuses on areas of HNVf. The main objective of the NPWS Farm Plan Scheme is to trial novel approaches to farming for the environment, to safeguard particular habitats and species, and to meet conservation measures required under the EU Birds and Habitats Directives (Anon 2020). In addition, there is a positive move towards results-based AE payment schemes where farmers have more say in the design of projects and are based on conservation results. This trend has been underpinned by EU LIFE projects such as BurrenLIFE[1] and AranLIFE[2] and, more recently, European Innovation Partnerships (EIPs), which are funded by the Department of Agriculture Food and the Marine (DAFM) through the Rural Development Programme (RDP) (DCHG 2019). EIPs are partnerships that aim to better co-ordinate existing financial instruments and initiatives in a number of key areas including agriculture sustainability and productivity (EIP-AGRI). EIP-AGRI was launched in 2012 to contribute to the EU's 'Europe 2020 Strategy' of smart, sustainable and inclusive growth[3]. This paper presents an overview of traditional and results-based AE and EIP-AGRI schemes, followed by details of three results-based EIP case studies in terms of targets, programme and implementation, and lessons learned.

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[1] https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2661

[2] https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4728

[3] https://ec.europa.eu/eip/agriculture/en/about

AGRI-ENVIRONMENTAL SCHEMES

TRADITIONAL AE PAYMENT SCHEMES

AE schemes have existed in Europe since the 1980s (CEC 1998). The current AE scheme in operation in Ireland—the Green, Low-Carbon, Agri-Environment Scheme (GLAS)—is part of the Rural Development Programme (RDP) 2014–2020. It is a prescription/actions-based scheme designed to compensate farmers for the costs incurred and income foregone from adopting practices that promote biodiversity, protect water quality and combat climate change (DAFM 2015a). This typically means a farmer will be required to carry out a range of actions or follow a management prescription on their farm in order to receive payment. The payment remains the same for all farmers, regardless of their level of success. As with all previous measures-based AE Schemes (REPS and AEOS), participants join the scheme for a period of five years. Approximately 49,000 farmers are currently participating in GLAS; payments to farmers totalled €232m in 2018, with an average payment of ~€4,000 (McDermott 2019). GLAS participation is highest among mid-size farms of 30–50 hectares (42%); small farms of 0–20 hectares have a 22% participation rate, while larger farms of over 100 hectares have a 27% participation rate (DPER 2019). Some actions are targeted towards geographical locations with predefined ecological targets, e.g. rare bird species (DAFMb 2015).

The National Parks and Wildlife (NPWS) Farm Plan Scheme is also a targeted AE scheme that is generally measures-based and focused on habitats and species of conservation interest in Natura 2000 sites. More than 800 NPWS Farm Plans have been approved since the scheme was launched in 2006[4].

Despite the significant spending in recent decades on national AE schemes aimed at relieving agricultural pressures on biodiversity and water quality through an actions-based approach, continued declines in biodiversity and water quality have been reported throughout Ireland (ADAS 2018; O'Boyle *et al.* 2019). The list of species and habitats at risk today indicate the impact of changes in land use in Ireland (NPWS 2019). The decline in bees, butterflies and other insects has largely resulted from the effect of monoculture and the drive to ever higher levels of agricultural productivity, which is also characterised by a loss or neglect of hedgerows, farmland edges and scrub (Hallman *et al.* 2017; Merckx *et al.* 2012). The decline of once familiar breeding bird species such as the curlew and lapwing as well as many flowering plants is indicative of long-term trends in the drainage of ponds, wetlands and the conversion of remaining meadows into agriculturally intensive grassland (DCHG 2019).

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[4] www.NPWS.ie/farmers-and-landowners/schemes/npws-farm-plan-scheme

Ireland's Habitats Directive Article 17 report showed that 91% of listed habitats were assessed as being in 'Unfavourable Conservation Status' and 31% of Irish protected habitats are deteriorating in condition, particularly peatland and grassland habitats (DCHG 2019). The resulting consequence of terrestrial habitats in poor condition is reflected in deteriorating water quality, with the number of pristine rivers decreasing ten-fold since the 1980s (O'Boyle *et al.* 2019).

Traditionally, AE schemes in Ireland have been on a national scale, with little incentive for farmers to improve the ecological quality of the land and with no local adaptions. Until recently, the wide diversity of ecosystem services provided by farmers (such as water quality, flood and fire resilience and soil quality) has not been acknowledged in payments to farmers. This lack of connection between farming enterprise and the provision of services results in a disproportionate level of reward being granted to the food service. This practice ultimately comes at the cost of the other ecosystem services.

Results-based AE schemes

Results-based Agri-environment Payment Schemes (RBPS) are quite different to 'measures-only' schemes. In a RBPS, a farmer's payment is linked to the desired deliverables of the programme: the higher the quality of product delivered, as defined by habitat quality scorecards (result indicators), the higher the farmers payment (Byrne 2018). If the quality increases over time, the farmer receives an increased payment; this provides an opportunity and strong incentive to manage land to a higher environmental standard and offers increased flexibility to the farmers in choosing how they deliver ecosystem services. The longest running RBPS is the Burren Programme based in Co. Clare (Dunford and Parr 2020). It was developed with a small number of farmers in the early 2000s through EU LIFE funding, and in 2010 was rolled out as a mainstream agri-environment scheme within the Rural Development Programme; by 2018, it had ~320 participants.[5] The same approach was taken for the AranLIFE project (McGurn *et al.* 2020). RBPS represent better value for money for the taxpayer as payments are only made on the verifiable delivery of ecosystem services and increases the likelihood of achieving environmental targets (Byrne 2018). To ensure the ability of a farmer to improve their ecological score, many RBPS also fund supporting actions, which are targeted actions with typically one-off payments that assist in increasing scores, e.g. fencing and gates to facilitate more targeted grazing, water delivery systems to assist grazing of upland areas with no nearby water source, drain-blocking on peatlands or scrub removal from calcareous grasslands.

EIP-AGRI and Ecosystem Services

EIPs are partnerships that aim to better co-ordinate different levels of existing financial instruments and initiatives in a number of key areas including agriculture sustainability and productivity (EIP-AGRI) (EC Website 2020). EIP-AGRI was launched in 2012 to contribute to the EU's 'Europe 2020 Strategy' of smart, sustainable and inclusive growth. The DAFM has used the EIPs to address the five priorities of section 4.2 of the 2014–2020 Rural Development Programme including restoring, preserving and enhancing ecosystems (DAFM 2015a). A budget of €59 million was set aside for these projects, which are developed by operational groups that bring together farmers, researchers, advisors and agri-business to identify innovative solutions to particular challenges facing the agri-food sector and rural economy (DAFM 2019). DAFM was unusual in its decision to use EIP-AGRI funding to address the restoration, preservation and enhancement of ecosystems, as most other member states (MS) focused this mechanism on productivity. Several of the 23 funded projects aim to improve ecosystems with different approaches, targets and regions[6]. The Hen Harrier Project is currently the largest EIP in Europe (Table 1).

CASE STUDIES

The case studies described here (Caomhnú Árann, the Hen Harrier Project and the Pearl Mussel Project) are all European Innovation Partnerships (EIPs). These locally focused projects follow the core elements of supporting the socio-ecological viability of HNV farmlands (Lomba *et al.* 2019), one of which is the rewarding of HNV farmers for the delivery of ecosystem services. Although their individual targets vary, the results-based approach is common between them as is the design ethos (Figure 1) that ensures flexibility for farmers to farm their land appropriately, based on the local conditions, whilst delivering a wide range of measurable eco-system services. The location, target, results-indicators and ecosystem services co-delivered are summarised in Table 1.

CAOMHNÚ ÁRANN EIP AND ITS FORERUNNER ARANLIFE

Background

Caomhnú Árann EIP runs from 2019 to 2021 and follows on from the core work of the 2014–2019 AranLIFE EU LIFE+ co-funded project that focused

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[5] http://burrenprogramme.com/

[6] Details of all the 23 EIP projects are available at www.nationalruralnetwork.ie/eip-agri/.

Table 1—Projects with European Innovation Partnership funding in Ireland.

EIP project	Funding (€m)
Locally led scheme for the conservation of the hen harrier	25.0
Pearl Mussel Project – Farming for nature in a vibrant rural economy	10.0
Sustainable uplands agri-environment scheme (SUAS)	2.0
Blackstairs farming futures (BFF) Sustainable farming project in the Blackstairs Mountains	1.5
Allow Project – Duhallow farming for Blue Dot catchments	1.5
Caomhnú Árann managing the habitats of the Aran Islands to maximise their agricultural and ecological output	1.5
North Connemara locally led agri-environmental scheme	1.4
Protecting farmland pollinators	1.2
Mulkear EIP-Innovation, tech and KT for farmer led enhancement of water quality, Instream habitat and Riparian management	1.2
Biodiversity regeneration in a dairying environment (BRIDE)	1.1
The conservation of breeding curlew in Ireland	1.1
Enable conservation tillage (ECT) – Wider adoption of sustainable conservation tillage systems	1.0
Biomass to biochar for farm bioeconomy (BBFB)	1.0
Small biogas demonstration programme (SBDP)	1.0
Inishowen Upland Farmers Project	1.0
Farming Rathcroghan Project- Sustainable farming in the Rathcroghan archaeological landscape	1.0
A sustainable agricultural plan for the MacGillycuddy Reeks – Conservation and restoration of upland habitat	1.0
Biorefinery Glas – Small-scale farmer led green biorefineries	0.9
Maximising organic production system (MOPS) Maximising organis production through integrated cropping systems	0.6
Cúlra Créafóige – Cultivation renewal programme	0.6
The Duncannon Blue Flag Farming & Communities Scheme	0.6
OviData Increasing sheep genetic gain in Ireland through scientific data capture and analysis	0.5
Danú Farming Group – Project plan for a biological farming transition programme	0.4

on the challenges of farming on the Aran Islands while simultaneously bringing 1011ha of semi-natural grassland habitat into favourable conservation status. AranLIFE worked with 67 farmers on the three Aran Islands and was a successful demonstration project contributing to the implementation of the objectives of the Habitats and Birds Directives. Caomhnú Árann continues this work and also includes innovative elements that have the potential to aid in the delivery of locally led programmes by reducing the administration costs, trialling new avenues for increasing farm income and improving herd health. Caomhnú Árann has a budget of €1.45M and works with 125 farmers to improve the conservation status of 1500ha of EU Annex I priority habitat.

The three Aran Islands cover 40km^2 in area and approximately 75% of the islands is designated as Special Areas of Conservation (SAC) because of their farmed species-rich priority habitats: orchid-rich calcareous grassland (*6210), limestone pavement (*8240) and machair (*21A0) (Figure 2). The islands support approximately 500 plant species (nearly half the total number of species within the whole island of Ireland) (Browne 2018). These grasslands have been managed from generation to generation through low-intensity farming methods. The traditional farming system of winterages, whereby cattle are out wintered on specific pastures that are grazed throughout the winter. This winter grazing results in short turf grassland in springtime, rich in herbs, which flower and then set seed, free
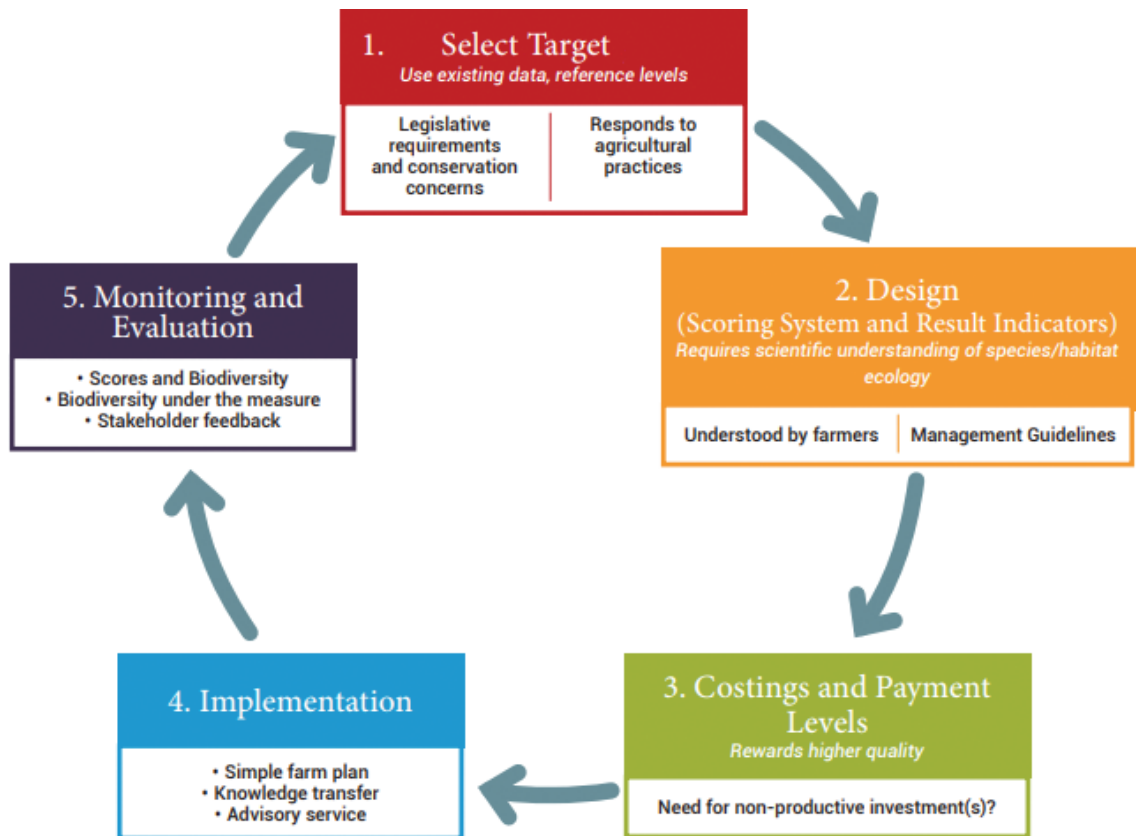
Fig. 1—Common design process across the three projects (Maher *et al*. 2018).

from grazing in the summer months. This system conserves and enhances the species richness of the priority grasslands.

Like many farms in HNVf areas, farm size (island farms range from 6ha to 20ha, compared to 32ha nationally) and herd size (most herds having less than 10 cattle) on the islands are small. Typically, the farms consist of many small fields that may be scattered throughout the island (Figure 3). This dispersed arrangement makes island farming labour intensive with low income output. There are no rivers or streams on the islands and lack of water availability has been identified as one of the main reasons why fields are left ungrazed, which allows scrub to develop (Browne 2018).

The targets and programme

The islands' farms are dominated by three aforementioned internationally important priority habitats and these are the target habitats for Caomhnú Árann EIP. While the Aran Islands is a stronghold for these habitats, their conservation status nationally is poor (orchid-rich calcareous grassland) or inadequate (limestone pavement and machair) (NPWS 2019).

The AranLIFE project had a two-prong approach to sustaining island farming and improving the conservation status of the priority grasslands, and this approach is continued in Caomhnú Árann. First, it addresses the issues that hinder appropriate grazing (supporting actions), and second, it aims to achieve optimal grazing levels (results-based measures). The supporting actions implemented by farmers participating in AranLIFE are also funded by Caomhnú Árann. The supporting actions include:

1. improving access to the fragmented farmland and grazing management: AranLIFE cleared 28km of boreens and installed 40 gates assisting access to approximately 460ha of land (AranLIFE 2018a). Caomhnú Árann is continuing to work with farmers to maintain access to land and keep boreens open to enable optimum grazing regimes.

2. provision of water for grazing livestock in the absence of rivers and mains water supply. Building or repairing rain tanks and ensuring adequate water for livestock is vital in the conservation of species rich grasslands. AranLIFE funded the construction
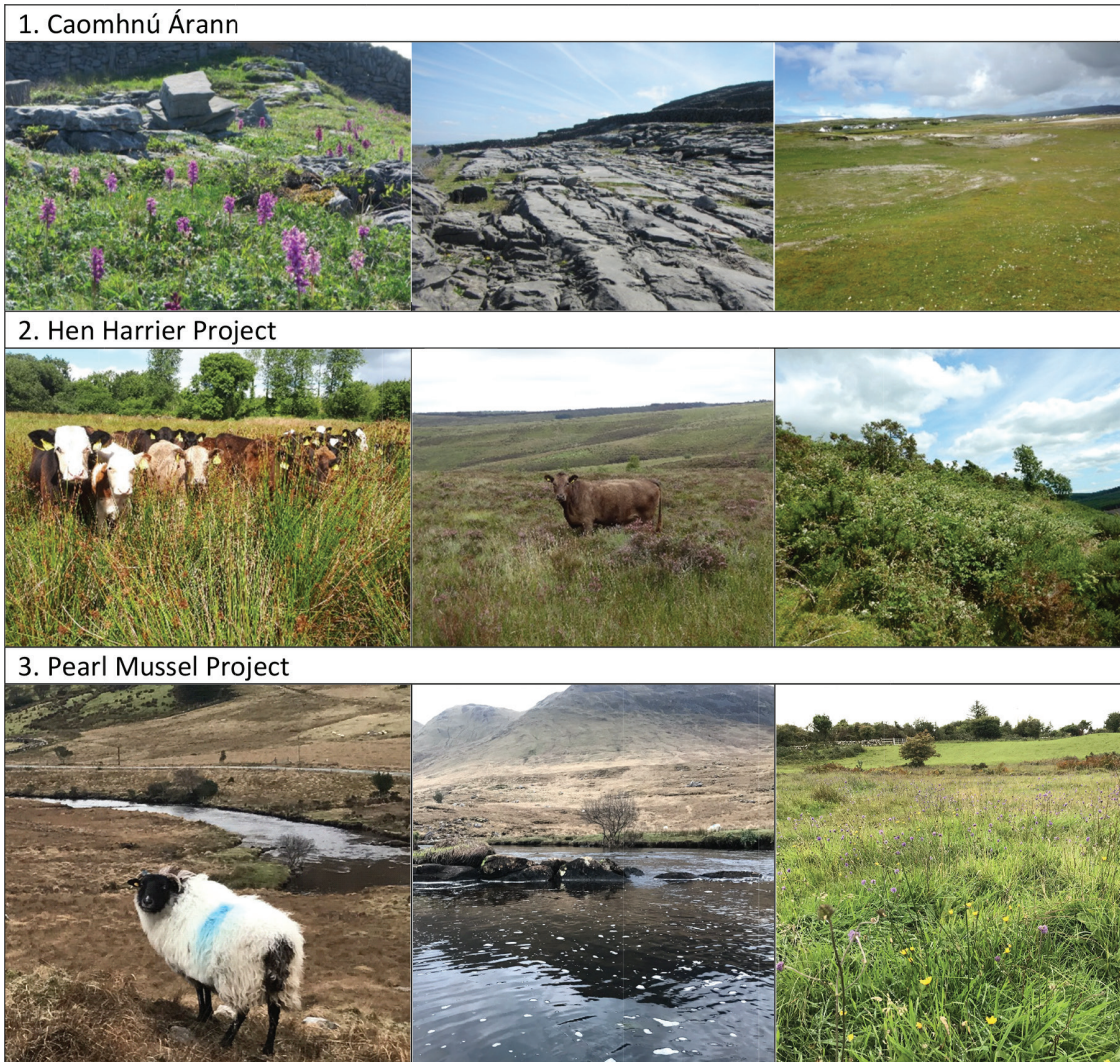
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Fig. 2—Some of the farmed habitats that are the target habitats of the case studies: Row 1: Caomhnú Árann (from left to right); orchid-rich calcareous grassland limestone pavement, machair. Row 2: Hen Harrier Project (from left to right); wet grassland, peatland, scrub. Row 3: Pearl Mussel Project (from left to right); peatland, catchment in Co. Kerry, wet grassland.

of 131 new rain tanks and the repair of 107 existing rain tanks. Caomhnú Árann plans to construct 200 new rain tanks.

3. removal of encroaching scrub. A reduction or cessation of grazing leads to an increase in scrub, particularly *Rubus fruticosus* agg. (Briar), *Prunus spinosa* (Blackthorn) and *Pteridium aquilinum* (Bracken). Therefore, initial removal of scrub and bracken is the first step in the restoration of the priority habitats. Once the scrub is removed, these areas can be further enhanced by optimal grazing regimes. AranLIFE funded 91ha of scrub and bracken control (AranLIFE 2018a). Caomhnú Árann has mapped a further 90ha of scrub to be cleared.

Results based element for assessing grassland condition and achieving optimal grazing

Once the factors limiting grazing (such as access issues, scrub encroachment and water provision) are rectified, optimal grazing levels are then required to ensure favourable condition of the priority grasslands, and a grazing score payment for optimal grazing outcomes is the results-based element of both the AranLIFE project and Caomhnú Árann EIP. Aran-LIFE developed a simple scoring system that reflects both the quality of the habitat and level of grazing. A score of 1 to 5 was applied to land parcels based on the condition of the habitat and grazing level, where a score of 5 reflects optimally managed species-rich

Fig. 3—The characteristic network of stone walls enclosing small fields on the Aran Islands (left) and a typical scattered structure of land parcels (in blue) within an island farm (right).

grasslands, and score of 2 reflects semi-improved species-poor grassland. This was a visual assessment method, which was intuitive and quick to apply in the field and linked in with the scientific monitoring across the range of habitats. Full details of the scoring system are given in AranLIFE (2018b). A high number and a high frequency of plant species in a field produced a higher score. This simple scoring system was fit for purpose and enabled the habitat to be put in bands of quality. Monitoring results showed that the scoring system reflected the quality of the habitat and enabled farmers to improve lower scoring habitats. Owing to the scattered nature of Aran farms, all farms have some land supporting species-rich habitat with potential for high scores as well as more fertile land of lower conservation value, which would receive a lower score. In Caomhnú Árann, the AranLIFE scoring system continues to be developed and the potential of scoring land parcels using remote sensing is being investigated. Initial results indicate that the simple five-point scoring system works well with this innovation.

Implementation, results and monitoring

Details of supporting actions to be completed and grazing scores attained were contained within a farm plan that was drawn up by the AranLIFE team and the participating farmer. The plan detailed where scrub should be cut, which boreens should be cleared and where rain tanks should be built or repaired. A similar approach was taken in Caomhnú Árann, with farm plans issued in December 2019.

In a relatively short period, improvements in habitat quality were observed, with land parcels receiving higher scores with changes in management over time. Comparison of grazing scores from 2014 and 2016 on the three islands shows a substantial increase in areas scoring 5 (Figure 4). These results
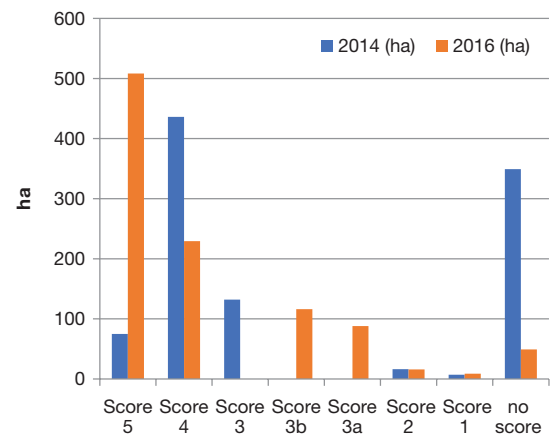
Fig. 4—Changes in grazing scores between year 1 of AranLIFE in 2014 and year 3 in 2016. Grazing scores 3a was introduced in 2016 to take account of priority habitat that was not being grazed. Score 5 area increased by 315ha from 2014 to 2016, and most of this improvement is from score 4 fields that had scrub removed and implemented optimal grazing.

show that changes in management can produce a tangible improvement in habitat quality, from less than favourable condition (Score 4) to favourable condition (Score 5) (Aranlife 2018a).

Monitoring the impact of the project was an important element of AranLIFE and continues to be an important feature of Caomhnú Árann. Many of the AranLIFE actions were designed using the best available knowledge but these were untested in the specific context of the Aran Islands. Given this, a monitoring programme (AranLIFE 2018a, 2018b, 2018c) was developed to test the effectiveness of the project actions and make recommendations that

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could be developed for other programmes in the Irish Rural Development Programme.

Project adaptations

AranLIFE was developed by the island community, which was concerned about the changing landscape due to changes in farming practices. There was a strong recognition that the links between the island's landscape—particularly landscape character and biodiversity—and the tourist industry. In this regard, AranLIFE was not a project developed by government agencies and then rolled out to the islands, but was from the outset an effort by local groups to meet the needs of the different stakeholders.

Both AranLIFE and Caomhnú Árann are administered by a three-person project team. Unlike other similar projects, neither AranLIFE nor Caomhnú Árann has access to locally based farm advisors to contract out the work of farm plan production. This means that the farm plan work for the 67 farmers in AranLIFE and the 127 farmers in Caomhnú Árann is carried out by the project team. The benefit of this is that the farm plan process is completed in-house and farmers do not have to pay independent advisors to devise farm plans. There is regular direct contact between the project team and the participating farmers; project team members are familiar with the issues and status of all participating farms and there is a high level of farmer engagement with the project team. Ultimately, the aim is to train participating farmers to score their own fields, combined with inspection of a proportion by the project team. This process was initiated with some success in AranLIFE and will be continued in Caomhnú Árann, which is facilitated by farmer workshops. In general, farmers in AranLIFE found the simple five-point scale of the scoring system relatively straight forward to apply to their land and the work completed to improve the conservation status of the grassland habitats.

Caomhnú Árann is currently considering the potential uses of aerial photographs and drone imagery combined with some ground truthing to assist in the production of farm plans and reduce administration costs.

Recognising the low financial income from extensive grassland systems, Caomhnú Árann is investigating whether Aran's species-rich grasslands can be used as a wild flower seed source to supply a growing market, where seed is collected without negative impact to the overall grassland biodiversity.

HEN HARRIER PROJECT (HHP) EIP

BACKGROUND

The Hen Harrier Project Ltd., a private company, won the DAFM tender to design and administer the Hen Harrier Programme (HHP) across six breeding hen harrier Special Protection Areas (SPAs) (Table 1). The tender, with a budget of €25 million, was awarded in April 2017. Thirteen development farms were used to design the programme, representing the range of farm enterprises, the size and proportion of designated land likely to be encountered in the SPAs, i.e. dairy, suckler, sheep farms, all land designated, most land designated, half or less land designated, small, medium and large areas (ha). The project team also considered input from over 30 local consultation meetings with farmers across all six SPAs from early July to the end of August (HHP 2017) when designing the programme. Farmer input, local land types and team assessment of the dominant habitats, deliverable ecosystem services and hen harrier requirements were all considered when designing the programme. Agricultural, ecological and socio-ecological issues were all taken into account while also adhering to the budget.

The six SPAs are quite diverse but the farmed habitats are predominantly wet grassland and peatlands. Several farm enterprises are also represented across the SPAs but suckler beef is dominant with sheep and dairy enterprises frequent in some areas. The proportion of the farm designated also varies across the SPAs. Only SPA land is eligible for payment in the programme. Some, such as the Slieve Aughty Mountains SPA would commonly have 100% of the farmland designated whereas the Slieve Bloom Mountains SPA had much lower proportions of designated land.

Targets and programme

The hen harrier is a rare ground-nesting bird of prey that has a specific range of ecological requirements. The habitats that the bird depends on were created and are sustained by agriculture. In recent times, land-use change and intensification have resulted in habitat quality deterioration at a landscape level (Ruddock *et al.* 2012). This has had a negative impact on a predatory species like the hen harrier as it needs large territories that provide adequate breeding, foraging and wintering habitats (Ruddock *et al.* 2012). Hen harrier populations have been declining for a number of decades. A national survey of breeding hen harriers in 2010 estimated 128 to 172 breeding pairs (Ruddock *et al.* 2012). More recently, the 2015 national survey recorded further national declines with an estimated 108 to 157 breeding pairs (Ruddock *et al.* 2016) with declines in four of the six SPAs, which are the strongholds for breeding hen harrier. Overall, the breeding population in the SPAs declined by 27% since the 2005 survey. Afforestation, human disturbance and wind energy developments have had a dramatic impact on Irish upland habitats (Ruddock *et al.* 2012, 2016).

Table 2—Details of the three case study EIP projects.

Case study	Location	Target/result indicators[7]:	Eco-system services co-delivered
Caomhnú Árann EIP	Aran Islands (Inis Oírr, Inis Meáin and Inis Mór), off the west coast of Ireland	Orchid-rich calcareous grassland, Limestone pavement, and machair grasslands.	Enhanced grassland habitat biodiversity; Carbon sequestration and storage; Improved water quality.
Hen Harrier Project (HHP) EIP	Six breeding hen harrier SPAs: 1. Slieve Beagh SPA, Co. Monaghan 2. Slieve Bloom Mountains SPA, Co. Laois and Co. Offaly; 3. Slieve Felim to Silvermines Mountains SPA, Co. Limerick and Co. Tipperary; 4. Slieve Aughty Mountains SPA, Co. Galway and Co. Clare; 5. Stacks to Mullaghereirk Mountains, West Limerick Hills & Mount Eagle SPA, counties Limerick, Kerry and Cork 6. Mullaghanish to Musheramore Mountains SPA, Co. Cork.	Wet grassland, Species-rich grassland, bog/heath habitats and scrub woodland habitats.	Carbon sequestration and storage; Improved water quality; Agricultural biodiversity; Flood resilience; Fire resilience; Conservation of the nationally rare hen harrier bird species.
Pearl Mussel Project (PMP) EIP	Eight highest quality freshwater pearl mussel catchments in Ireland (Moorkens 2010), in counties Donegal, Mayo, Galway, Kerry and Cork.	Semi-natural grassland, bog/heath and scrub/woodland habitats, whole-farm score.	Protection and rehabilitation of peatlands, grasslands and scrub/woodlands and associated biodiversity including pollinators; Carbon sequestration and storage associated with paying for high-ecological quality peatland; Improved water quality; Flood alleviation; Conservation of the globally important populations of freshwater pearl mussel.

Details of the websites are provided before the reference list.

The Hen Harrier Programme aims to build strong partnerships with farmers to deliver sustainable upland farming with benefits for biodiversity (especially the hen harrier), upland ecosystems and a vibrant local rural economy. Farmers in any of the six SPAs may be eligible to apply. There are three possible payments in a given year: the habitat payment, the supporting actions payment and the Hen Harrier payment. The majority of HHP payments are habitat-based and relate to the quality of the farmland habitats. There are four main habitat categories: Bog/Heath, Wet Grassland, Species-rich Grassland and Scrub/Woodland (see Figure 2); each

of these has an associated scorecard. Each field on the farm is eligible for a set number of points and a point receives a fixed payment. The more points accrued, the bigger the payment. A score of 10/10 will draw down the maximum number of points whereas a 5/10 will draw down half that; scores less than four receive no payment. Several mechanisms of payment were considered during the design process including incorporating a higher payment for scores of 8 or more but the team decided against this due to the unknown nature of the programme for the farmers and the added complexity of implementation for so many participants. The farmer is provided with details on how a field's scores and its corresponding payment rates are calculated; a budget is available that facilitates farmers to improve the quality of their habitats. The HHP also includes

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[7] A result indicator is a surrogate (direct or indirect) used to assess the quality of the biodiversity target (Maher *et al.* 2018)

a unique hen harrier bonus payment that is based on the achievement of minimum habitat quality to be eligible. The payments are based on SPA level targets being achieved and/or supporting local nest or roost sites (HHP 2019).

The programme includes a number of innovations such as the hen harrier bonus payment, small farm incentives, monitoring, feeding supports for livestock and a local action fund. The bonus payment ensures that the hen harrier is seen as a resource—rather than a penalty—within the SPAs. The payment has two components: an SPA-level component where every participating farmer with at least one habitat score of 6 or higher qualifies for the payment if the SPA reaches a population target. This makes the overall SPA habitat quality important to all participants. There is also a local component that is paid to farmers within a set distance of a nest or roost site. If the nest is successful, the payment is doubled. This not only makes the local hen harrier population a valuable resource, but may also encourage a reduction in cases of persecution towards the species that have been reported. Any element of the payments may change as the programme progresses and the value of such payments is reassessed.

Hundreds of farms eligible for the programme had less than 10ha of SPA land. Given the time required to engage with the HHP team, and any training and management changes it would recommend, it was likely that farms of 10ha or less would decide against joining the programme. It was considered that this would be an undesirable result, not least because the combined total land area of all these smaller SPA areas would be considerable. The social benefits of including all farmers in the community that wanted to participate was also taken in to account. A minimum payment was introduced for farms of 5ha or less with a decreasing contribution for every hectare over 5ha up to 19ha. While not all small farmers felt this was sufficient, the minimum payment did facilitate a higher uptake of small farms in the programme. The beneficial effect on habitat quality of such a payment, which was introduced in the second year of the programme, will be monitored over the next number of years.

While the majority of payments are made for the delivery of improved quality of habitats, the programme may have to change its focus as the hen harrier population changes. Thus, the programme has a monitoring team that conducts fieldwork from early April until fledging in July or August. The team provides valuable information on landscape use by the birds and locations of nest and roost sites. The flexibility of the EIP framework allows such a vital part of a results-based programme to run in parallel with the farmer deliverables.

A major objective of the HHP has been to make farming in HNVf areas more sustainable. The dominant farm enterprise across the SPAs is suckler beef grazing. Although there is abundant rough grazing (primarily comprising wet grassland and heathlands) in these areas, the use of this grazing has been declining due to an increase in part-time farming and the risk of losing an animal on large commonages (HHP 2017). Lack of grazing results in reduction in biodiversity, succession to scrub and an increased fire risk in these areas. The HHP worked with nutrition company Devenish to produce a feed block to encourage targeted use of these rough grazing areas by the livestock. The block also complements the available grazing to optimise animal health. It was trialled with farmers in the summer of 2018 and 2019 and yielded some good results with positive condition gains for the cows and calves using them while also reducing *Molinia*-dominance (and the associated fire risk) on sites.

Wider local communities of the SPAs can apply for the Local Actions Fund. Although its purpose will likely change over the course of the programme, this fund will be available to implement plans that support biodiversity, sustainability, local business development and promotion.

IMPLEMENTATION

The HHP team endeavoured to reduce administrative burdens wherever possible; it was decided to avoid online-only applications to the HHP on the basis of the age profile of the farmers in the SPAs. Simple one-page postal application forms that could be posted directly to the HHP office were provided. Similar to Caomhnú Árann, the HHP team created the farm plan for the participants to reduce costs from the outset and to facilitate entry into the programme. The farmers did have to hire HHP advisors to walk and score their fields.

A key part of rolling out a results-based programme on a large scale is advisory capacity. With over 1500 participants, the HHP team could not assess all $c.20,000$ plots in the programme. Commonage lands were assessed by the project team and private lands were assessed by one of 80 HHP trained and approved agricultural advisors. The advisor training took place over four days and was delivered in two phases; one focused on hen harrier ecology and sustainable farming in HNVf areas and the second field-based session focused on the habitat score cards and how to assess each field. As a results-based programme was a new concept for the advisors, the HHP project officers also spent time in the field with them at the beginning of the season. In the first year, $c.700$ participants' plots were assessed (~9000 fields). To make data collection more efficient a mobile application (app) with full offline functionality was designed to store information on

the advisor's clients and the fields that had to be scored. The use of the app considerably increased the efficiency and quality of data transfer; in the second year of the programme more than twice the number of fields were assessed in less time (and all payments were also made in a shorter timeframe).

Other examples of innovations in the delivery of the HHP include comprehensive database systems, landscape fire resilience and beef marketing initiatives. The flexibility afforded by the EIP mechanism make these innovations work. While the project can be considered unique, the principles and framework within which those principles sit could be applied to the delivery of payments for ecosystem services.

PEARL MUSSEL PROJECT (PMP) EIP

Background

The Pearl Mussel Project (PMP) is a voluntary results-based programme that seeks to improve the quality of watercourses to benefit the endangered freshwater pearl mussel. It focuses on the top eight highest quality freshwater pearl mussel catchments in Ireland, in counties Donegal, Mayo, Galway, Kerry and Cork. The programme, which is run by the Pearl Mussel Project Team, has a budget of €10 million, funded by DAFM and the EU.

Target and programme

The freshwater pearl mussel (FPM) *Margaritifera margaritifera* is a globally endangered species. Ireland has over a third of the EU population, of which 80% occur along the western seaboard across eight catchments (Moorkens 2010; NPWS 2011). These catchments are predominantly semi-natural habitats and retain a relatively intact hydrological system with extensive wetlands (blanket bog and associated seepage areas in particular). They are amongst Ireland's least modified river catchments. Each of the catchments has a lake on the system, which acts as a buffer for nutrients, sediment and flow. Despite their relatively intact nature, all of these catchments are undergoing a slow FPM population decline due to the low survival of juvenile mussels leading to ageing populations. Juveniles are extremely sensitive to changes in environmental conditions and depend on a clean, well oxygenated gravel riverbed with little silt or algal growth and moderate flows. Activities that cause changes in river flow, increased levels of silt and increased levels of nutrients can contribute to FPM decline. In addition to this, changes to river channel morphology and increased intensification of land use in the catchments threaten future survival of FPM. Agricultural intensification within these catchments has led to increased pressures on FPM, particularly through land conversion and drainage of semi-natural habitats, and subsequent use of fertilizers, pesticides and increased stock levels.

Farming in PMP areas is dominated by sheep and suckler beef enterprises from lowland grassland pastures to mountain blanket peatlands over 800m above sea level. The average farm size across all catchments is *c.*65 hectares. Approximately 27% of all the farmlands are commonage with between 2 and 70 shareholders. Natura 2000 lands comprise more than 85% of the catchments including 12 SACs and 2 SPAs, with an average of over 2m of rainfall per year falling on the predominantly peat soils (blanket bog, wet and dry heaths and wet grassland). The high rainfall provides ideal conditions for the development of peatland and wet grassland habitats and important aquatic species such as salmon and FPM.

The development of a results-based AE programme for an aquatic pollution-sensitive target species is extremely challenging, particularly for a target species such as FPM, which will often live for more than 120 years. A key factor for the success of an AE scheme is that the farmers' core payment level should be within their control and not influenced by impacts from other land uses within the catchment, e.g. forestry or domestic dwellings. In addition, linking farmers' payment with water quality requires the practicable detection of impacts to be possible. The influence of land use on water quality is well recognised (Curtis and Morgenroth 2013). Relatively low-intensity agriculture can provide positive benefits to water quality through management of intact wetland habitats that can provide clean water and food for freshwater juvenile pearl mussels. Conversely, higher levels of agricultural activity, particularly in high rainfall catchments can result in higher risks of negative impacts on water quality. The PMP uses habitat quality as a surrogate for the ecosystem services produced including clean water, hydrological stability that reduces flood risks, provision of pollinator habitats and general biodiversity. Habitat scorecards were developed by adapting those of the RBPS project (www.rbaps.eu) and the Burren Programme to capture the risks and benefits to water quality. These scorecards were tested on nine pilot farms across the eight catchments during the development phase of the PMP. Further minor changes were made following the first year of scoring by advisors across over 1500 plots across 343 farms. All lands within the participants' ownership were given a score using scorecards ranging from 0 to 10, depending on the quality. The key habitats were peatland and wet grassland (Figure 2). The scores equate to a quality-based payment with no payment for a score of less than 4. This habitat quality payment forms the basis for the farmer payment for the programme and is similar to the HHP, despite the differences in overall target. As of 2020 a total of *c.*450 farmers are participating in the PMP.

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Table 3—Pearl Mussel Project whole-farm quality scores and correction factors.

Quality	Correction factor
Poor	0.3 – the overall results-based payment is reduced by 70%
Inadequate	0.6 – the overall results-based payment is reduced by 40%
Good	1 – no reduction applied to the overall results-based payment
Excellent	1.2 – a bonus payment of 20% is applied to the overall results-based payment

Floodplains perform a vital function in flood management and serve to reduce the flood peak and delay its arrival further downstream. In the context of the FPM, flood plains are extremely important during high-flow periods as they act as a pressure-release valve to dissipate the elevated potential for riverbed and bank-side erosion. Farmers who maintain active floodplains without flood defenses such as berms are contributing to flood protection of downstream land. Participants of the PMP receive an additional annual payment that is based on the habitat quality score of lands that are prone to flooding alongside main channels with FPM populations.

A unique feature of the PMP is the whole-farm assessment, which is designed to capture the overall contribution a farm holding makes towards water quality within FPM catchments. This assesses potential water quality risks and impacts originating on the farm which are categorised as poor, inadequate, good and excellent. Each category has an associated correction factor that is applied to the farmers' habitat payment as shown in Table 3. Although low scoring plots do not attract a habitat quality payment, the whole-farm scoring approach ensures that where low scoring plots pose a risk to water quality through siltation, nutrient loss or drainage, that this is captured in the appropriate adjusted payment.

PAYMENT MODEL

The PMP uses two approaches to incentivise improvement in ecological quality of their overall farm holding, including land habitats. The first of these is the digressive banding of payments based on area. Payment rates decline across the three bands as participant area increases as follows: 0–30ha, 30–70ha and >70ha bands. In calculating the results-based payments, the lowest scoring lands are paid at the highest rate. The second approach is the varying steps in payment scale across increasing score. Where a plot scores 0–3, no payment will be made; payments increase gradually from 4 to 7, and a significant increase occurs for a score of 8 (Figure 5). This is to incentivise farmers to try to obtain a score of 8, which is considered ideal habitat quality for FPM.
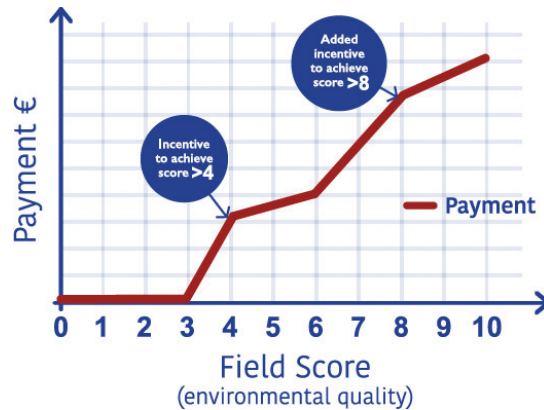

Fig. 5—Payment model for field scores from 0 through 10 used in the Pearl Mussel Project.

Implementation

The PMP used a similar approach to that of the Hen Harrier Project through attempting to simplify the farmer application process as much as possible. Farm plans simply detail potential results-based payments at a range of scores to give the farmer an idea of potential payment levels for their lands prior to joining, along with a map of their lands delineating habitat plots. Following completion, a simple form was returned to the office to confirm participation in the programme. All participants with commonage lands, or private lands >5ha, required a PMP-trained and approved agricultural advisor. The advisor was responsible for scoring private lands every year and commonage lands every second year using the PMP habitat quality app and online mapping system. As with the HHP the development of online database and app was an essential innovation in order to process the myriad variables across 450 farmers. In addition to scoring habitat quality, it is the role of the advisor to provide management advice to the farmer and suggest potential supporting actions that would facilitate a higher ecological score and payment to the farmer.

An essential component of a successful AE programme is incentivising farmers to increase the ecological quality of their farm, and thereby increase their payment. In order to facilitate improvement of scores, each participating farmer has a budget

with which they can implement supporting actions. These may include measures such as drain blocking, fencing of water courses, provision of water troughs and conversion to lighter breeds of cattle.

Where PMP participants are achieving a payment far below their potential due to, for example, high stocking rates, high fertiliser inputs or turf cutting activities, the PMP offers a funded discussion group that comprises environmental and farm viability workshops facilitated by the PMP team. The purpose of the PMP environmental workshop is to assist farmers in developing the skills necessary to make well informed management decisions for their farm, taking due consideration of environmental issues with the view of migrating towards a more sustainable farm enterprise. The key focus areas of the workshop include improving environmental outputs, farming economics and increased efficiency in farming. There is an action-based task for participants to complete to illustrate an understanding of the project goals. This involves the participant farmer implementing an action that will result in a score increase on their own farm.

Approximately 27% of the PMP catchments comprise commonage, many of which have more than 40 shareholders. Where issues arise on commonages that results in a commonage unit (whole farm score for commonages) score of 0.3 or 0.6, shareholders have an option to engage in a recovery project whereby defined actions are agreed in order to increase the commonage score. The agreement of entering a recovery project results in the automatic allocation of a commonage unit score of 1.

The key message with the approach of the PMP is to focus on the result of the farming practices, rather than the prescription of how these practices should be carried out. This model has been adapted from results-based programmes developed for other ecological targets including the Burren Programme, EU RBAPS pilot project and the Hen Harrier Project EIP.

LESSONS LEARNED

Results-based payment schemes in Ireland (common themes)

The principle of a habitat scoring system was applied to each of these case studies with adaptations and innovations depending on the unique objectives being targeted, i.e. a reduced scale of score values (1 to 5 rather than 0 to 10) for the Aran Islands, a whole farm multiplier for the PMP, a range of core habitat types for HHP and PMP. The fact that these diverse areas can employ a single framework across a large spatial range indicates that results-based programmes, with some minor adaptations, could be rolled out across the country for various ecosystem services targets. Each project operates on the principle of a specialised project team consisting of managers and scientists that are skilled in farming knowledge, database management, communication and financial administration. Because the biodiversity target must be present in order to deliver the outcome, results-based measures are, in effect, self-targeting and such schemes have the ability to fit local conditions and circumstances. Similar to prescription-based schemes, the results-based approach needs to be supported by farmer (and advisor/inspector) training, with advice on optimal delivery and tailored farm plans, along with appropriate monitoring and evaluation. However, the farmer is free to choose the methods most suited to them and their farming conditions to deliver the desired result. A habitat-focused programme can deliver for the habitat, a specific species or water quality etc. In fact, managing a large HNVf area appropriately can deliver a range of valuable ecosystem services. While the empirical results of agri-environment programmes take a number of years to be realised, there is evidence from the Burren Programme and AranLIFE (Dunford 2016; AranLIFE 2018a) that they will be delivered. The HHP has only been fully operational for 18 months for farmers and the PMP has been operating for even less time. These pilot programmes are expected to deliver positive measurable results within their respective timeframes. Each project has detailed monitoring programmes that record the rate of improvement of the conservation status of the target habitat and species. Such comprehensive monitoring programmes have been absent to date from national AE schemes. This is an inherent aspect of the results-based approach and indeed is what incentivises farmers to improve ecological quality. The focus is on delivering ecosystem services in tandem with—rather than in spite of—producing food products. Programmes that do not use habitats as indicators for ecosystem quality payments risk missing an opportunity to provide multiple co-benefits, and indeed risk potential negative impacts of some other ecosystem services. Both the species-focused programmes in this paper use a holistic approach to deliver multiple ecosystem services (including the target).

A knowledgeable team with a diversity of experience is essential to work with farmers to develop a programme that is locally suitable. Each project also invested a lot of resources into engaging farming communities at the outset on the basis that continued engagement is the only way to facilitate local adaptations and the necessary fluidity required to achieve the project objectives in the long-term.

Results-based approaches should be used to incentivise delivery of higher quality biodiversity and associated ecosystem services from farmland. Assessing the ecological condition of the programme target and making payments related to this condition

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is more reliable than broad prescriptions. It provides a circular system where farmers are incentivised to achieving better results and therefore seek to improve conditions for the programme target.

Although there have been a number of European results-based schemes in operation over the past 25 years, widespread adoption of this approach (whether alone or in conjunction with an underlying prescription-based scheme), remains outside the norm in EU member states (EU Commission 2020). This reluctance to implement a wider roll-out of results-based approaches may be related to perceived barriers such as the assumption of higher costs than prescription-based schemes, that they only work in areas of high habitat quality or biodiversity importance, and that they may be administratively burdensome to implement (discussed further below). There is a strong opportunity to use the principles demonstrated through the three case studies and deliver results-based programmes across all HNVf landscape with possible future applications in more intensive agricultural landscapes. By 2020, scorecards and administrative capacity will have been developed and rolled out to almost 2500 farmers across the country (including the Burren Programme).

The RBPS approach has the effect of creating a market for nature, and provides an opportunity and incentive for farmers to manage their farm habitats to produce higher-quality biodiversity. Decisions for farming practices rest with the farmer who decides to continue current practices or increase their nature value score. Through results-based programmes they now have the opportunity to be rewarded for the ecosystem services provided through farming.

PAYING FOR PROVISION OF ECOSYSTEM SERVICES (ADMINISTRATION AND COSTING)

The case studies described in this paper are pilot programmes whose aim is to develop innovative AE schemes for the delivery of important ecosystem services. The administration budget for PMP and Caomhnú Árann is 20%, and HHP is 15%. Directly comparing the cost of scheme administration between results-based and measures-based AE schemes can be misleading for a number of reasons. First, to date, measures-based schemes in Ireland do not have any monitoring data and so it is impossible to verify value for money. In contrast results-based programmes, as described here, have clear quantified ecosystem deliverables that are paid for accordingly. Second, pilot programmes have predefined budgets to cover a wide range of administration and development functions, including specialist monitoring of target species, agri-product and community development, and should not be compared to national-scale programmes rolled out on a much larger scale. Both HHP and PMP developed comprehensive administrative and database capabilities to administer their respective number of farmers.

These systems can deal with much greater numbers of farmers, with minimal additional administrative costs. Finally, state-run national-scale schemes can often underestimate the total cost for administration, for example staffing costs, etc., as opposed to being completely outsourced in the case of the EIPs.

In line with commission guidance on the implementation of agri-environment-climate measures (EU Commission 2014) there are a number of different approaches to the calculation of payments for payment schemes. Results-based measures are not defined in terms of specific production methods or inputs (i.e. not prescriptive) (Maher *et al.* 2018). As a result, calculations are based on the income foregone (opportunity costs and the full costs of management) for carrying out the required management, even though payments based on the value of what is being delivered would be more suitable. The areas in Ireland best positioned for delivering ecosystem services are generally those characterised by low-intensity farmland. Three key threats to extensively farmed land are abandonment, commercial afforestation and intensification. Farming in these HNVf areas provides a number of ecosystem services that may be lost if land was abandoned or converted for alternative uses. Where abandonment is the key threat, the full cost of farming as an 'additional cost' in itself is calculated. Opportunity costs for the planting of both coniferous and deciduous forestry are considered. Both 'income foregone' and 'additional costs' have been used where intensification is the primary threat.

All three programmes described above integrate EIP payments with existing national schemes, in all cases this was with GLAS. An example of a risk of double funding was under the Low Input Permanent Pasture (LIPP) action of GLAS. The sward can be maintained by grazing with a maximum chemical nitrogen usage on the parcels of 40kg N/ha/annum. Under all three programmes, such management would be unsuitable to maintain the high species diversity found in fields with higher scores, as they need higher management requirements. Therefore, a farmer participating in GLAS could also receive the AranLIFE payment on the higher scores 4 and 5 only (McGurn *et al.* 2020). Both PMP and HHP reduced its payment where its participant was also in particular GLAS actions. Where a PMP participant's field is also in either LIPP or traditional hay meadow (THM), the EIP programme payments are reduced accordingly. For the HHP, there is a reduced payment that considers the management that GLAS is paying for. This is a complicating factor in costing these programmes that is necessary due to the current RDP regulations. Going forward, if these programmes are to be mainstreamed, a simpler and more flexible framework should be proposed: one that recognises the value of the ecosystem services delivered would be preferred. The payments in the pilots do not reflect the true costings due to double payment and funding constraints.

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CONCLUSION

Farmers in some of the most ecologically sensitive areas of Ireland have for many years received payments that only reflect their agricultural output often at the expense of complex ecosystems such as species-rich grasslands and rare species such as freshwater pearl mussel and hen harrier. Their interaction with environmental authorities has often been associated with penalties and prohibition, without clear communication as to why certain activities should be avoided or require consents. A farmer in one of the programmes observed 'we are only ever told what we can't do. Nobody has ever actually told us how to manage our land for a higher nature value'. Many protected species and habitats in Ireland are in either bad or unfavourable status. The number of rivers with 'pristine' water quality has declined tenfold in 30 years. It is clear that new approaches are required to effectively meet targets for protecting Ireland's most sensitive habitats and species. Using results-based agri-environment payments, these case study programmes have been tailored to a wide range of land types and local farming practices, engaging the farming community in a way that has never happened with conventional broad-brush AE schemes. A farmer-focused approach with financial incentives for higher scores, and strong support from trained advisors and the programme teams can deliver a wide range of ecosystem services including biodiversity, clean water and carbon sequestration and storage amongst others for the Irish and European taxpayer and for future generations.

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