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EXPLORING ECOSYSTEM MARKETS FOR THE DELIVERY OF PUBLIC GOODS IN THE UK

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Executive summary

- It is widely recognised that environmental restoration and conservation challenges go beyond what can be financed publicly and there are significant opportunities for private investment in the delivery of public goods, benefitting both commercial organisations whose business relies on ecosystem services, as well as landowners, land managers and the general public. Thus, public-private financing of natural capital improvement presents an opportunity to increase the availability of funding for payments for ecosystem services that provide environmental and societal benefits.
- Public-private partnerships for the financing of ecosystem services is in its infancy in the UK. Several schemes are in the theoretical stages of development, or in the early stages of developing trades. However, the number of public-private partnerships and the ecosystem services market is increasing in scale and scope.
- This research explores the voluntary ecosystem services market in the UK. It does this by identifying key actors involved in payment for ecosystem services schemes, trading platforms and supporting modelling tools. This is achieved by developing an understanding of how these actors operate, and by identifying possible synergies, examples of good practice and challenges to implementation.
- Topics covered include, understanding how the identified actors account for the social distribution of ecosystem services, how values are attributed to ecosystem services, and the legal obligations linked to ventures' operation.
- An online review of the UK's ecosystem services market was conducted, identifying several UK public/private schemes and partnerships, as well as platforms and modelling tools that facilitate the delivery of and act as a driver of the UK's voluntary ecosystem services market. These are collectively referred to as 'ventures' throughout the report. In-depth interviews were conducted with two ecosystem services schemes (the Woodland Carbon Code (WCC) and the Peatland Code (PC)), two stakeholder engagement initiatives (Landscape Enterprise Networks (LENs) and the Natural Infrastructure Scheme (NIS)), the trading platform EnTrade and biophysical modelling tool, Viridian Logic.
- We find that organisational structures that ensure transparency and reduce the potential for power asymmetries are important for successful implementation (p.7).
- Farmer/landowner engagement presented a challenge for all ventures. Treating farmers/landowners as equal transactional partners was recognised to be fundamental in ensuring a long-term commitment to the delivery of mutually beneficial ecosystem services (p.8).
- Additionality presents a concern, with potential for private investment to stall if it is not possible to demonstrate (through evidence) that interventions would not happen without it. Stakeholder engagement initiatives need to supply more evidence on achieving additionality, perhaps adopting similar additionality tests to that used by the Woodland Carbon Code and Peatland Code schemes (p.18).

- Explicit integration and consideration of the wider social distribution of ecosystem services was low and there is limited evidence that the ventures are actively considering the wider social distribution of the ecosystems services or defining wider beneficiaries of the public goods that they deliver (p.10).
- The value of a given ecosystem service across all schemes was negotiated between demand and supply side actors based on market demand and 'willingness to pay' (p.14). However, for LENS and NIS which consider a range of public goods, the quantification of benefits is still challenging.
- The legal instruments used to deliver each scheme varied within and between ventures, with direct contracts used in most cases. Ventures were mindful that binding legal arrangements (e.g. environmental covenants) could be a barrier to participation but recognised that contracts needed to be both robust and flexible, particularly in the case of long-term landscape interventions where suppliers and/or the interventions may change over time (p.16).
- Understanding how ventures operate and the synergies and differences between different schemes, trading platforms and stakeholder engagement initiatives will support better integration of public and private finance within ecosystem markets, broadening the range of outcomes and the scale at which these can be delivered.

Definitions

Additionality

Additionality refers to the additional impact of interventions, an activity is deemed 'additional' if it would not have happened in absence of the payment provided by the PES system (English Partnerships, 2008).

Aggregator

A business/organisation or individual that negotiates on behalf of a group of suppliers or buyers.

Ecosystem market

Commercial market for the trade between demand and supply side actors (farmers/landowners) in ecosystem services with environmental and societal benefits.

Ecosystem services

The benefits that we derive from the natural environment and include, for example, the provision of food, water, timber and fibre; the regulation of air quality, climate and flood risk; opportunities for recreation and cultural development; and underlying functions such as nutrient cycling (Smith et al., 2013).

Ecosystem services venture

Collective term used to refer to all actors in the ecosystem services market. Including, ecosystem services schemes, stakeholder engagement initiatives, platforms and modelling tools that facilitate the delivery of and act as a driver of the UK's voluntary ecosystem services market.

Marketplace

The enabling conditions and mechanisms to support the sale and purchase of ecosystem services, fundamental to which, are the public and privately funded payment for ecosystem services schemes and marketplaces that pool funding from a range of sources to pay farmers/landowners for the delivery of ecosystem services delivering a range of environmental outcomes with societal benefits.

Payment for Ecosystem Services (PES)

'PES schemes involve payments to the managers of land or other natural resources in exchange for the provision of specified ecosystem services (or actions anticipated to deliver these services) over-and-above what would otherwise be provided in the absence of payment. Payments are made by the beneficiaries of the services in question, for example, individuals, communities, businesses or governments acting on behalf of various parties. Beneficiaries and land or resource managers enter into PES agreements on a voluntary basis and are in no way obligated to do so.' (Smith et al., 2013, p.9)

Public-private finance

Obtaining funds from multiple sources, including public funding, philanthropic donation and private investment (i.e. business to whom the landscape is core to business operations), to increase the availability of funding for ecosystem services.

Stakeholder engagement initiative

A scheme that can be classed as an immature scheme due to still being under development and being not yet fully operationalised. In this report, stakeholder engagements initiatives can be in various stages of development.

Abbreviations

APR	Agricultural Property Relief
BPR	Business Property Relief
BPS	Basic Payment Scheme
CAP	Common Agricultural Policy
CSR	Corporate Social Responsibility
Eftec	Economics for the Environment Consultancy
EIA	Environmental Impact Assessment
ELS	Entry Level Scheme
ELM	Environmental Land Management
CSS	Countryside Stewardship Scheme
ES	Ecosystem Services
GERG	Government's Environmental Reporting Guidelines
GHG	Green House Gas
HLS	Higher Level Stewardship
ICROA	International Carbon Reduction Offset Alliance
IPCC	Intergovernmental Panel on Climate Change
LENS	Landscape Enterprise Networks
NIDC	Natural Infrastructure Delivery Company
NIS	Natural Infrastructure Scheme
OFG	Organic Farmers and Growers
PC	Peatland Code
PES	Payment for Ecosystem Services
SDG	Sustainable Development Goals
SSSI	Sites of Special Scientific Interest
WCC	Woodland Carbon Code
UKAS	United Kingdom Accreditation Service
UNFCCC	United Nations Framework Convention on Climate Change

1 Background

Climate change represents one of the most pressing global challenges of our time. Agriculture is a key contributor of greenhouse gas emissions, land degradation and reduced soil and water quality, placing significant pressures on the landscapes in which they are embedded (Willet et al., 2019; Committee on Climate Change, 2020). Climate action and sustainable land management represent key Sustainable Development Goals (SDG) (see SDG 13 'Climate Action' and SDG 15 'Life on Land') (United Nations, 2020) and land managers and farmers are recognised to have a fundamental role to play in the delivery of ecosystem services and activities that deliver environmental outcomes ('public goods') alongside production imperatives. Such interventions include activities that improve soil health, air and water quality, reduce greenhouse gas emissions, provide carbon sequestration, flood mitigation as well as deliver conservation and habitat restoration outcomes. There is growing recognition of both public and private responsibilities and business cases for the financing of ecosystem services that deliver 'public goods' and sustainable landscapes upon which multiple stakeholders rely.

In the UK, public funding of rural development and agri-environment activities have largely been financed via 'Pillar 2' of the Common Agricultural Policy (CAP). The CAP has received heavy criticism for prioritising agricultural productivity to the detriment of the environment, with a lack of consideration on the need to reduce climate change stress on ecosystems, with conservation accounting for only a small proportion of CAP's overall budget (Allen and Hart, 2013). To date, conservation and regeneration of English and Welsh rural landscapes has been delivered by landowners and farmers primarily via a two-tier 'Countryside Stewardship Scheme' (CSS), within which operates the 'Entry Level Stewardship' (ELS) and the 'Higher Level Stewardship' (HLS) scheme. As voluntary schemes, financial incentives are offered to farmers and landowners to deliver environmental services that enhance local landscapes and ecosystems, although adoption has been low (Defra, 2018a). Low levels of engagement have been influenced by a number of factors, including the direct payments received under 'Pillar 1' of the CAP, that have acted as a disincentive to the delivery of public goods, and bureaucratic barriers, for example overly prescriptive options as well as complex and burdensome application and monitoring processes. The available options are often seen as unfitting for the geographic context or individual farm, and the levels of compensation underestimate farmers' real or perceived losses (Smith et al., 2003; Wilson and Hart, 2000).

The UK's withdrawal from the EU (and therefore the CAP) presents an opportunity to re-orientate land management in the UK, with greater focus on the delivery of sustainable landscapes - a principle referred to as 'public money for public goods' in the public sector (Defra, 2020). Public funding for the delivery for ecosystem services will be channelled via post-Brexit agricultural payments schemes such as those set out in the Agriculture Bill 2020 and the proposed Environmental Land Management scheme (ELMs) for England. Replacing the CSS, ELMs, alongside the gradual elimination of direct payments, aims to transform the agricultural sector by rewarding land managers and farmers for the delivery of public goods, essentially, paying land managers and farmers to adopt more environmentally sustainable farming practices and enhance natural capital. However, it is recognised that whilst environmental restoration and conservation challenges go beyond what can be financed publicly, there are significant opportunities for the commercialisation of the delivery of natural capital (Defra, 2018b) benefitting both commercial organisations, whose services rely on landscapes, as well as farmers and land owners.

2 Research purpose

A broad range of public-private partnerships have emerged in the UK that seek to harness natural capital from landscapes whilst also providing vital conservation services. The focus on business-to-business transactions, facilitated by such ventures, has the potential to improve farmer and landowner engagement with PES schemes and support the sustained delivery of ecosystem services. Private investment may therefore operate increasingly alongside public financing to support the delivery of sustainable and multi-functional landscapes. Understanding the UK PES market and its actors is particularly pertinent given the significant changes in agricultural policy as a result of the UK's withdrawal from the European Union, and the important role that PES is expected to play in driving a productive and sustainable agricultural sector. This is of particular relevance to a range of actors including agricultural policymakers, those developing PES schemes, and farmers/landowners, and in articulating future research directions for both academia and government. Specifically, the research aims to:

Understand how different UK privately funded PES schemes and facilitating platforms operate by;

1. Exploring the synergies between different privately funded PES schemes in the UK;
2. Understand if and how UK privately funded PES ventures account for:
 - a. how values are attributed to ecosystem services;
 - b. the social distribution of ecosystem services;
 - c. the legal obligations or challenges surrounding the implementation of ventures.

The research adopted a two stage design. In Stage 1, an online review of the UK's ecosystem services market was conducted to map the UK's PES landscape and evaluate the quality of publicly available information regarding privately funded PES schemes and the market based mechanisms that operate in the UK's ES market. Two schemes, two stakeholder engagement initiatives, a facilitating platform and a biophysical modeller that are prominent contributors to the delivery of the UK's ES market (collectively referred to as 'ventures') were identified and selected as the focus of this research (see Figure 1). In stage 2, each venture was contacted and a nominated representative of each was interviewed to explore the issues outlined above.

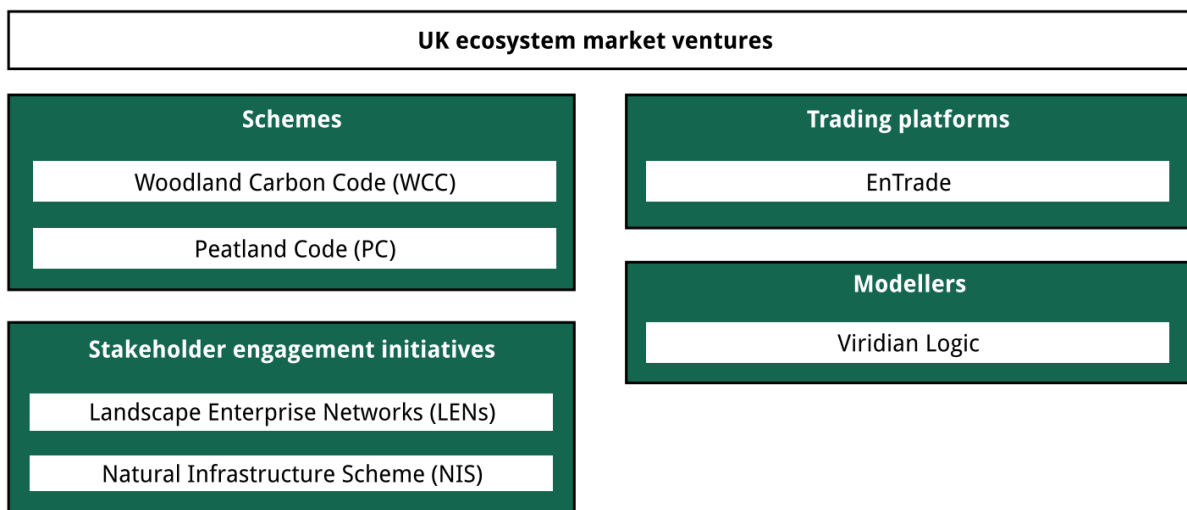


Figure 1: UK Ecosystem market ventures (research focus).

This research aims to enhance understanding of how UK PES ventures are structured and operate. An improved understanding of the ventures and facilitators of ES markets will help improve the system and ultimately increase the supply of ecosystem services. Based on the findings of the research we reflect upon the contributions of private financed PES ventures within the UK payment for ecosystem services market and make recommendations on how the private financing within the UK's PES system could be advanced.

3 Methodological approach

The research adopted a two stage design. In Stage 1, a review of UK ecosystem markets was conducted and scoped online to determine the extent and quality of publicly available information regarding the UK's market for ES, and PES or PES like ventures. The review identified a number of categories of actors that facilitate the delivery of ES in the UK, this included PES schemes that provide financial reward for the delivery of a range of ES schemes, such as, Defra Biodiversity Credit Metric 2.0, used in Biodiversity Net Gain/ No Net Loss policies (Biodiversity offset Credits), Wessex Water's scheme for cover crops (Nitrogen credits), Affinity Water's scheme for Oil Seed Rape Substitution (Pesticide Credits) and United Utilities' Maize under-sowing scheme (Nitrogen Credits). The review identified two PES schemes for further analysis, the Woodland Carbon Code (WCC) and the Peatland Code (PC). The PC and WCC were selected as case studies for further analysis (Stage 2) as they represent the first voluntary standards for woodland creation and peatland conservation and management in the UK and have enabled conditions for a market for carbon sequestration.

Stakeholder engagement initiatives were identified that seek to identify demand within a landscape for assets and generate commercial interest in buying ES, as well as facilitating supply networks to fulfil demand. The Natural Infrastructure Scheme (NIS) and Landscape Enterprise Networks (LENs) were examples of such initiatives and were included in the analysis as illustrations of a framework for the delivery of a broader range of ES.

Platforms that facilitate and act as a driver for the overall voluntary ES market were also identified. EnTrade was identified in the review process as creating a market for ES beyond carbon sequestration. EnTrade provides a mechanism that allows farmers to propose land use change, to convert this into environmental credit (using the rules of schemes) and then broker contracts and payments for those credits, between land managers and credit buyers via an online marketplace. The review identified other platforms operating in this space, including for example, Nature Bid. Finally, modellers were identified as supporting the implementation and delivery of payment for ecosystem service schemes, by for example, modelling landscapes and identifying need for ecosystem services, optimal positioning of interventions, and beneficiaries within a given landscape, and included tools such as, InVEST, EcoServ-GIS and Co\$ting Nature. Viridian Logic was identified for inclusion within the second stage of the research owing to their links with the PES ventures identified, and therefore, the insights that they were able to provide regarding working with these actors. A synopsis of each actor identified in Stage 1 and included in this research, is presented in Table 1. This includes identification of the number of operational projects and those in the planning process.

Following identification, a more comprehensive analysis of the existing information available online for each actor was undertaken. This analysis was framed by seven questions:

1. Who is involved in the venture (organisations)?
2. Is there private and/or public funding involved?
3. Who makes decisions and what is the decision-making process?
4. What is the history of the venture?
5. How do farmers engage with the venture?
6. What are the specifics of the venture (e.g. payments and options)?
7. What is the experience of the venture so far?

The findings from this scoping exercise were used to guide discussions with three subject-specific experts (Professor Julia Ortega, Professor Chris Rodgers and Dr Gordon Mitchell) regarding the complexities of environmental justice, economics and valuation, and law within ES markets. Information generated via conversations with experts in combination with the output of the initial scoping work were then used to inform the development of a semi-structured interview guide. An overview of the discussion guide is shown in Table 2.

Table 1: Case study overview (information accurate May 2020).**(a) PES Schemes**

Woodland Carbon Code (WCC) Voluntary standard for the UK woodland creation projects that sequester carbon. The code encourages a consistent approach to woodland carbon projects, providing a transparent platform for engaging private investment of carbon unit trading. It provides assurances to purchases that carbon sold is real, measurable and additional.			
Started: Scheme launched in 2011	Projects in operation: Projects validated: 241	Projects in planning: Projects registered but not yet validated: 152	Contact details: info@woodlandcarboncode.org.uk www.woodlandcarboncode.org.uk

Peatland Code (PC) Voluntary certification standard for UK Peatland restoration projects. Provides a platform for engaging private funding in the purchase of ecosystem services and climate benefit, emanating from peatland restoration. The code sets out best practice requirements and a standard method for the quantification of GHG benefit and provides buyers assurances that the climate benefits being sold are real, quantifiable, additional and permanent.			
Started: Officially launched in 2015 after a pilot phase	Projects in operation: Projects validated: 4	Projects in planning: A further 6 projects which are registered and with others in the pipeline	Contact details: info@iucn.org.uk www.iucn-uk-peatlandprogramme.org

(b) Stakeholder engagement initiatives

Landscape Enterprise Network (LENs) A regionally focused approach that harnesses commercial interest in the function of the landscapes on which their businesses rely and coordinates commercial investment into strategic assets, such as soils, hydrology of landscapes, and habitats.			
Started: Scheme started 2016 Money flow - 2018	Projects in operation: 8 (2 active trades and 6 in the negotiation process)	Projects in planning: 4	Contact details: Tom Curtis Tom.Curtis@3keel.com www.LandscapeEnterpriseNetworks.com

Natural Infrastructure Scheme (NIS) A theoretical avoided cost-based model to harness commercial investment in the delivery of natural flood management. Brings together demand and supply side actors to procure natural flood management interventions that are monitored and maintained for up to 15 years.			
<i>Scheme currently in development (no active trades)</i>			Contact details: ga@green-alliance.org.uk www.green-alliance.org.uk

(c) Trading platforms and modelling support

EnTrade EnTrade facilitates online marketplaces through a platform and associated services for the sale of environmental services to business. It provides a transparent platform for the trade of environmental service that pools finances from public, private, and philanthropic sources. The online marketplace aids the discovery of optimal prices for the delivery of specific environmental outcome and identifies farmers/landowners in specific locations that can deliver the outcome at the specified price.			
Started: 2016	Projects in operation: As of May 2020, 29 marketplaces have been run across 10 locations	Projects in planning: 20 further markets planned for 2020-21, covering 10 new locations	Contact details: David Baxter David.Baxter@EnTrade.co.uk www.EnTrade.co.uk

Viridian Logic Biophysical modelling service that provides natural flood management and ecosystem support solutions that can be applied to valuation, planning and decision support to identify what interventions should be done and in what locations.			
Started: 2017	Projects in operation: 5	Projects in planning: 6 (estimated)	Contact details: Angus Middleton angus@viridianlogic.com www.viridianlogic.com

In Stage 2, each of the respective ventures were contacted by email to request a semi-structured telephone interview. The discussion guide was shared so that they could prepare in advance and self-elect a representative to participate. Semi-structured telephone interviews were conducted with a representative from each of the respective ventures. Interview notes were compiled to aid analysis and were used as the basis for synthesis. The final report was shared with participants in order to ensure that it was an accurate reflection of their responses.

Table 2: Stage 2 interview discussion guide

Section number	Section title	Question areas
Section 1	Background information	<p>Understand how the venture operates, specifically:</p> <ul style="list-style-type: none"> • Decision makers and decision-making process • Public funding • Land manager and farmer interaction • Interventions • Land manager/farmer compensation • Digital methods/technologies to facilitate interaction • Challenges • Difficulties resolved
Section 2	Social distribution of ecosystem services	<p>Understand the distributive effects of interventions adopted, specifically;</p> <ul style="list-style-type: none"> • How are beneficiaries identified • How does the venture evaluate and balance the needs of different beneficiaries? • Consideration of social distributive effects on different populations • Identification of impacts of different population groups • Arrangements for measuring impacts
Section 3	Economics/valuation	<p>Understand how the valuations placed on ecosystem services were identified, specifically;</p> <ul style="list-style-type: none"> • Conceptualisation of the ecosystem service and their values • What valuation approach is used and who makes the valuation (i.e. primary data, benefit transfer) • Definition of payments
Section 4	Legal issues	<p>Understand the legal structures surrounding the implementation of AES, including;</p> <ul style="list-style-type: none"> • Legal 'vehicle' for scheme delivery • Additionality of outcomes • Legal enforceability • Legal arrangements i) adequate ii) flexible iii) robust • Monitoring and evaluation • Long-term delivery mechanisms
Section 5	Other viewpoints	Complementary/alternative viewpoints

4 Findings

Responses were collectively reviewed by the authors, with commonalities and important aspects extracted to form a synthesis of the interview data. The following sections represent the responses of participants and therefore, reflects the individual perspectives of those interviewed regarding their individual venture, how they operate and the contributions that they make to the UK's ES market.

4.1 Venture backgrounds

4.1.1 Decision making and the decision-making process

The decision-making structures varied across each scheme and stakeholder engagement initiative. The WCC and PC are administered by executive boards and guided by advisory committees comprised of external experts and stakeholders. The PC is owned and administered by the International Union for the Conservation of Nature (IUCN)'s UK Peatland Programme. The WCC executive committee comprises of forestry authorities of the devolved administrations of the UK and is administered by the Scottish Forestry commission on behalf of the UK. Executive committees manage the day-to-day running, with advisory boards consulted regarding any developments of the respective venture.

In contrast to the WCC and the PC where landowners/farmers initiate the project development process and sale process, both LENS and NIS are initiated by demand side need, presenting potential for power asymmetries. Within LENS, decision making is driven by demand and supply side consortia, facilitated by aggregators as part of trading transactions, although driven principally by the supply chain needs of demand side actors. It was suggested that as LENS develops, power may become more balanced between demand and supply side actors within landscapes as supply side actors are supported to come forward with asset propositions. In both Cumbria and the river Avon catchment (Hampshire), where LENS has active partnerships, LENS were moving towards establishing a 'regional entity' to balance power and ensure accountability for the development and brokering of LENS trades.

At the time of interviewing, the NIS was in theoretical development, similarly to LENS proposed the creation of an independent entity they refer to as 'a natural infrastructure delivery company (NIDC)' comprised of stakeholders from both the demand and supply side, as well as wider stakeholders, to preside over decision making, relationships, and legalities, addressing the potential for power asymmetry. Within EnTrade and Viridian Logic, decision making resided with the respective trades, schemes, systems and markets that they supported. It was not clear from the data which structure was most effective, although, interviewees suggested that structures that ensure transparency and reduce the potential for power asymmetries are likely to be important.

4.1.2 Involvement of public funding

Public funding can be leveraged in the development of a venture, in projects applying to be part of a venture and in the day-to-day management of these. Public funding had been leveraged in the original scheme development of the PC, WCC and NIS. For the PC, public funding is not required, as projects can be fully financed privately, although in practice this is rare. Public funding can be used for 100% of the capital costs of peatland restoration work but a proportion of additional funding must be required and secured through private funding to make the project meet additionality criteria (see Box 2) in line with greenhouse gas accounting rules. Under the Peatland Code, up to 85% of total costs can be leveraged from public sources. Within the WCC, projects can combine public and private funding, but the financial additionality tests (Box 2) must be passed in order to demonstrate that the project would not have proceeded in the absence of the private carbon funding. NIS and LENS were exploring potential and desirability of integrating public funding with private via post-Brexit agricultural payments schemes as part of an ongoing Defra Test and Trials project in Cumbria.

In LENS, public funding has supported initial consortium development. Public funding is used to fund the management of the PC and WCC. For the WCC this was used by Scottish Forestry staff to manage/develop the WCC and provide governance. For the PC, grants from Defra and the devolved administrations were used to support PC staff within IUCN UK Peatland Programme. Public funding also enables both the PC and WCC to conduct further research and supports the provision of a transparent carbon unit registry.

4.1.3 Farmer/land owner engagement

Farmer/landowner interactions varied across the ventures. Within the WCC, PC and EnTrade, initiatives on the ground were used to stimulate farmer/landowner interest and awareness and stimulating engagement, encouraging farmers/landowners to develop project propositions and register on the respective online platforms. Projects could be developed independently or be supported by project developers. This is very different to stakeholder engagement initiatives (LENS and NIS) where interest in developing trades is generated from the demand side. Within LENS and NIS, farmer and landowner engagement was facilitated by the development of supply side consortia supported by supply aggregators and/or proposed delivery companies to facilitate consortia development and support the negotiation process. Across the schemes there was a recognition of the need for dialogue with 'supply side' actors (namely farmers/landowners), treating them as business partners and giving them a primary role in developing trade as well as taking care to ensure that schemes are not prescriptive in their requirements. Treating farmers and landowners in this way was perceived by interviewees to be important to give farmers and landowners autonomy. Within the PC and the WCC, farmers/landowners had the ability to define their own projects with or without the assistance of project developers. In both instances a project's scope was not influenced by purchasers other than the need to deliver specified amounts of carbon. Within LENS and NIS interventions were defined by the requirements of the market, whilst farmers/landowners did not have a role in determining demand, the approaches promoted collaboration and were co-developed with farmers/landowners as suppliers of ES to ensure the acceptability of options.

4.1.4 Farmer compensation for interventions

All schemes were voluntary open marketplaces and the level of compensation for interventions were negotiated between the supplier and buyer, with prices driven by demand. The exception is for the Woodland Carbon Guarantee in England where the government offers a contract for the option to sell Woodland Carbon Units to them via an auction. The WCC noted that increased demand for carbon offsetting had resulted in significant increases in the price per tonne of CO₂. The WCC determines price on a one-to-one basis between supplier and buyer. WCC projects can run for 100 years and there is no minimum length, but rotation lengths dictate a typical minimum of 45 years for a conifer clear fell project or 65-75 years for a native woodland project with minimum intervention. Peatland Code projects can last 30-100 years. Given the length of projects in both the PC and WCC, farmers/landowners are able to sell carbon upfront or within the first few years of the project, although the farmer/landowner responsible for delivery has to ensure capital for long-term maintenance, monitoring and verification. Within LENS and NIS, the supply aggregator acting as a broker on behalf of the supply side actors (farmers/landowners), negotiates a deal with demand side actors for the delivery of interventions. Currently, it appears that there is no consensus on the 'best' compensation mechanism; payments could vary by types of intervention/measure, and be paid up-front, yearly, or as revenue payments over-time. Variation in payment may be necessary, as the 'best' solution is likely to be dependent on the nature of individual transactions.

4.1.5 Digital mechanisms and technologies

EnTrade is continually developing their platform, guided by the market and the needs of clients. The online platforms can be customised for individual schemes and respond directly to demand for the types of technical requirements of the schemes.

The WCC and PC use digital mechanisms to support their joint project registry, the primary mechanism for ensuring transparency, with every tonne of carbon sold, or available for sale, made visible in real time. The decision to share a registry was taken to enable cost sharing between the two schemes. There was a recognised role for digital technologies to support self-monitoring and verification of established projects, although this did not eliminate the role of site visits and manual verification of project delivery, which was noted to be particularly important at the start of projects. Within an active LENS trade located in Cumbria UK, farmers/landowners are able to evidence that they have undertaken an intervention by uploading evidence to a web portal owned by the demand side consortia. The web-portal is unique to the scheme operating in Cumbria and currently LENS does not support project evaluation or verification centrally.

4.1.6 Challenges and difficulties

Supply side

There are challenges reported from both buyers and sellers (farmers/landowners) in the development of their respective ventures. On the supply side, farmer/landowner engagement was a pertinent issue for all ventures. Specifically, the schemes (PC/WCC) reported lacking data, such as contact details of relevant farmers to engage, challenging their ability to extend schemes at scale. There was therefore a need to engage with the farmers via alternative, often resource intensive means, e.g. on-the-ground staff or private aggregators. For peatlands, publicly funded landscape scale facilitators drive engagement with Scottish Government's Peatland Action restoration programme, and it is anticipated that Defra's Nature for Climate Fund will employ similar facilitators to drive engagement with publicly funded restoration options in England. Within LENS and NIS, supply side challenges were identified around willingness and ability to self-organise, cooperate with others to offer joint services and willingness to take on the risk of delivering interventions. The NIS (based on an avoided cost model) identified potential supply side concerns regarding failure to deliver contracted outcomes. This highlighted the importance of the role of intermediaries to support collaboration and represent the collective interests of supply side actors.

There was an awareness that ventures should avoid being overly prescriptive in terms of the interventions and importance of treating farmers as business partners in order to avoid them feeling demoralised or disenfranchised, leading to suboptimal outcomes. Treating farmers/landowners as equal transactional partners was recognised as being fundamental to ensuring long-term commitment to the delivery of mutually beneficial ecosystem services. Ventures identified a reluctance from farmers to sign up to long-term agreements; this was particularly problematic for the WCC and PC which require permanent and long-term land use change commitments. There are concerns from landowners that peatland restoration under the PC could lead to areas of wetland and scrub that would: i) not be eligible for, although soon to be retired, Basic Payment Scheme (BPS) payments; ii) not be eligible for Agricultural Property Relief (APR) or Business Property Relief (BPR), increasing liabilities under Inheritance Tax law; and iii) lead to designation of Sites of Special Scientific Interest (SSSI), leading to increased statutory obligations and commitments on the land.

Demand side

On the demand side, for LENS, NIS and EnTrade, sensitivities around the freedoms and willingness of businesses to share financial data to enable the establishment of consortia was identified as a challenge to the establishment of initial co-procurement arrangements. Additionally, many businesses were reluctant to pay for interventions that farmers/landowners

should be doing as part of compliance and/or that could be paid for by public finance. Changes in the UK's agriculture policy as a result of withdrawal from the European Union and the introduction of the post-Brexit agricultural payments schemes, such as ELMs in England, was perceived to present further market uncertainties. Finally, the PC and WCC are currently limited to quantifying climate mitigation benefits, although there is potential to expand the delivery model in order to account for multiple ecosystem service benefits.

4.2 Economics and valuation

4.2.1 Ecosystem services and their values

Within the WCC and the PC, the identification of direct units (e.g. carbon equivalents) are guided by the latest available science and units are often defined by a regulatory requirement needed for compliance. The price attributed to units are driven by demand and buyers 'willingness to pay' and is specific to each project. The price is determined in a 1:1 deal, negotiated between each project developer and buyer, often via intermediaries. Market demand drives the price up when available carbon is low and when demand increases farmers/landowners hold out for higher prices. However, deals are only secured if a buyer is willing to pay the price offered by the supplier. In contrast, there are more limited quantities of peatland restoration projects for sale and these have wider associated benefits than just carbon. Consequently, peatland carbon commands a price premium. It was recognised that some buyers might be interested in the unique characteristics of peatland carbon, whilst others may seek carbon credits without an interest in the project from which they are created (Woodland Carbon Code, 2019a).

LENs and NIS are similar in how they conduct valuations. Evaluations are conducted independently by demand side and supply side actors. The value of a given ecosystem services is negotiated between both parties, from the demand side this represents an identified price and 'willingness to pay' for a given ecosystem service outcome and from the supply side the identified cost of delivery. In this sense it takes a price discovery approach, rather than relying on economic valuation. The NIS proposes a 'market in avoided costs', a project becomes viable where the cost to the potential beneficiaries (e.g. of flood repairs or hard flood defences) is greater than the cost to land managers of implementing measures on land (e.g. attenuation ponds and bunds) which would avoid the business as usual costs to beneficiaries. This creates a 'trading space' between the cost of business as usual, and the cost of implementing measures on the land. The parties negotiate an agreement for the delivery of the ecosystem service somewhere between these two values. In LENs, for example, their active trade in Cumbria (between Nestle, United Utilities and First Milk) represents a conventional bilateral price negotiation between the supplier (First Milk, acting on behalf of farmers) and a customer (Nestle/United Utilities).

EnTrade provides a platform that helps determine the optimal process for delivering specific ecosystem services via its online market place. EnTrade operates reverse auctions and its twenty trades (e.g. marketplaces) to date, have taken a price discovery approach, with the competition between 'suppliers' (farmers/landowners) being more akin to a competitive tendering scenario (e.g. reverse auction). The synergistic relationship between the schemes and trading platforms is important to highlight. For example, LENs was key to partnership forming and creating engagement for the Hampshire Avon catchment. The buyers (Wiltshire Council and Wessex Water) then used EnTrade to negotiate joint contracts between the joint parties and the farmers.

4.2.2 Use of valuation methods

Each venture adopts different approaches and methods of valuation. The WCC and PC are similar as they are limited to the sale of carbon units, with prices defined by the market as outlined above. The PC can only sell emissions reduction benefits, i.e. units of carbon dioxide equivalent that would have been emitted to the atmosphere if restoration had not taken place.

The marketing of projects often includes the narrative of other benefits e.g. landscape, culture, biodiversity, water quality, etc. which are not quantified, but often given as justification for prices that are higher per tonne than the voluntary carbon market. For example, wider economic benefits analysis of the WCC was conducted by Economics for the Environment Consultancy (Efec, 2016), although additional benefits are not sold, co-benefits of peatland restoration are used to justify the cost (per tonne of carbon) of some PC projects.

LENs and NIS operate similarly and identified a sequence of evaluations that are conducted, building upon an understanding of businesses operational needs and the cost of delivery. Within LENs and NIS, valuations are conducted independently on the demand side and supply side. On the demand side this is based on an identification of a business need from the landscape, an understanding of where those needs are at risk from the environmental quality of the landscape and an estimation of how much a given outcome is worth to their business. On the supply side, farmers/landowners calculate their cost base (i.e. their minimum price for delivery of a given intervention) and this is the basis upon which price negotiations are conducted. Both supply and demand sides have an informed idea of what constitutes a 'good deal' for them, although the extent to which this represents a formal valuation process is open to discussion. The NIS model is based on avoided costs; demand side payment is calculated based on costs experienced down-stream, for example, what real-life costs are being experienced by businesses as a result of flooding and the absence of an ecosystem service that is preventing flooding, how much of this cost could be avoided by a natural flood management intervention and what it would cost to landowners/farmers to implement this. The NIS is yet to test this in fully in practice (this is currently being explored in the Eden catchment), although in theory, businesses, infrastructure operators, and government agencies, should have an idea about their costs (i.e. building, improving and maintaining hard defences) and exposure to risk (i.e. likely cost of recovering from a flood event). In both cases the gap represents the trading space in which suppliers and demand-side actors can trade, where negotiations can take place and a price can be reached, which satisfies both parties.

The metrics used by EnTrade to define values for ecosystem services are not defined by the platform but rather the client, such as those defined by WCC and PC. This gives greater flexibility within trades, as it allows the market to define the appropriate price for a given ecosystem service.

Viridian Logic does not currently value benefits from natural interventions, although this ability is in development. Currently it identifies and ranks the efficiency of all interventions that could be implemented across landscapes, considering how much impact they would have on water-related issues. It compares how much more or less effective an intervention will be compared to all the other options. This helps to ensure targeted deployment of appropriate interventions, offering farmers/landowners multiple options so that they can blend these theoretical answers with their practical knowledge of and preferences for their land. The ranking also allows payments to be scaled depending on how effective the interventions proposed by farmers/landowners are. For example, a hedgerow planted in the best place for mitigating phosphate pollution could cost more than the same hedge planted in a location where it will do little to help.

4.2.3 Who conducts the valuations?

Field survey and independent valuation (through validation and verification) can be conducted before a project starts. For LENs, NIS, WCC and PC this was reached via negotiations between demand and supply side actors. Deliberative monetary valuation has been conducted with sellers and interested local stakeholders for potential PC projects, incorporating capital costs, income foregone, ongoing maintenance, opportunity costs, time/labour costs and ecosystem service payments (Reed et al., 2017). However, in practice, monetary valuation for the PC is typically conducted by a broker, with initial estimates made using project tools based on desk survey information.

4.2.4 Use of primary data

All ventures currently used limited primary data for valuing ES. However, methodologies for projecting and verifying carbon sequestration and GHG emission reductions were developed in accordance with globally recognised standards in each case. For example, in the case of the WCC, the methodology for determining carbon sequestration units was derived from mechanisms used to underpin global standards (e.g. Gold Standard, the American Carbon Registry, Verified Carbon Standard and Clean Development Mechanism) adapted to the UK context. Methods for the PC were developed initially on the template of the WCC, but with significant adaptations to enable projects to estimate and then validate GHG emission reductions rather than carbon sequestration. This was done by developing emissions factors based on the analysis of GHG emission data from peatlands of different types and stages of degradation or restoration, in line with the UK's Intergovernmental Panel on Climate Change (IPCC) Tier 2 methodology used to calculate emissions in the United Nations Framework Convention on Climate Change (UNFCCC) GHG inventory. Within the PC and the WCC during the development stages and at the start of a project, validation is performed via on-site survey visits to assess the quality and condition of the land and inform the assessment of climate benefits that can be obtained, assess risks to the project and confirm the eligibility of project. For LENS and NIS, price negotiations could be based on data regarding the effectiveness of a given intervention and the value of a given service, based on published evidence of the effectiveness of an intervention (sometimes by proxy on the basis that it is included in existing agri-environment schemes). Evidence based for the effectiveness of interventions may not be robust. Research is being conducted to determine the effectiveness of some LENS interventions via the Resilient Dairy Landscapes project, which may inform future iterations of LENS.

4.3 The social distribution of ecosystem services

4.3.1 Beneficiaries

Other than the identification of immediate beneficiaries of the ventures, there was limited evidence that they were actively considering the wider social distribution of the ecosystems services or defining wider beneficiaries of the public goods that they deliver, although, there was recognition of its importance in identifying regional societal benefits and supporting Corporate Social Responsibility (CSR) goals. No ventures were directly considering or measuring the societal impacts of their initiatives or the interventions that were implemented as part of these.

There was some evidence of this being integrated by compliance with broader standards in the respective scheme domains. For example, the WCC is compliant with the UK Forestry Standard (Forestry Commission, 2017) that sets out minimum standards on a variety of criteria including socio-economic factors (See Box 1). Adherence to this meant that individual projects were not required to monitor or evaluate the social distributive effects, though there is a lack of consensus of whether meeting this standard could be improved. The WCC use the UK Forestry Standard as the 'de minimis' standard which aligns with international standards. It was recognised that the standard may change in the future and there may be more appetite for monitoring of the impacts of forestry creation on wider beneficiaries if, for example, this was to increase the sale price of carbon. The WCC also adopts a 'Woodland Benefits Tool' to provide a consistent way of evaluating the likely benefits of woodland creation in relation to four aspects; water, community, biodiversity and the economy. While the tool does not quantify the benefits delivered, it provides a consistent way of evaluating the likely benefits and relative merits of each project by allowing project developers to score their projects out of 5 for likely benefits to arise in the four respective aspects¹.

¹ The Woodland Benefits tool can be found at: <https://www.woodlandcarboncode.org.uk/standard-and-guidance/5-social-responsibility>

The lack of consideration of the social distribution of ecosystem services across the ventures was perhaps a factor associated with the level of development, for example NIS is in theoretical development and at the time of interviewing had no active trades, whilst LENS is in the early stages of application with 2 active trades and a further 6 at varying stages in the negotiation process. LENS is underpinned by the argument that driving multiple investments in multiple landscape functions makes landscapes more responsive to societal needs, however, the emergent outcomes (or their social distribution) are not currently measured. LENS were reportedly looking at the social impact investment potential within some of their peri-urban LENS trades that are currently being negotiated, specifically in Bolton and Bristol. The PC only stipulates the need for a 'statement of environment' in the management plans of projects, which can include the delivery of additional ecosystem services.

Whilst not currently considered, there was recognised potential for further development and for ventures to include the identification of wider beneficiaries and monitoring of impacts for a wider range of stakeholders. The WCC and the NIS recognised the potential of 'stacking' (cumulating) multiple ES benefits, that would enable farmers/landowners to sell multiple ES from their land or a given intervention and therefore allowing the full value of land to be realised. The WCC have internally considered their position/approach regarding 'stacking' additional benefits along with WCC carbon. Whilst the integration of data of this nature was identified to be technically possible, concerns were raised that it may not be financially feasible to do so.

The PC requires projects to identify, notify and consult relevant stakeholders or their representatives, where feasible, to account for potential trade-offs, for example in neighbouring properties, and although methods have been developed for PC projects to include multiple costs and benefits in a 'fair price', although this approach has not been used widely in practice.

LENS recognised that delivering social benefits through market methods can be controversial and it requires good governance and debate. LENS adhered to the underlying Theory of Change, and is focused on delivering multi-functional landscapes, identifying private investment in landscapes that deliver benefits to the investor directly but also deliver multiple benefits for society, relying on two aspects of its design to achieve positive social impact and value:

1. Through driving multiple investments in multiple landscape functions, LENS seeks to:
 - (a) make landscapes more reflective of the complex needs of society; and (b) set up 'trade-offs' and 'checks and balances' that reduce the risk of the adverse consequences of 'single outcome focused' land management systems. This is in contrast to the status quo, where landscapes are driven and managed for an often narrow range of (commodity production oriented) outcomes, downstream impacts are paid for by other businesses or society, and wider landscape outcomes are treated as marginal considerations.
2. The second means of securing social impact within LENS is via the establishment of locally accountable, non-profit-distributing, governance vehicles or 'regional entities', to develop and manage LENS trades and 'curate' the balance of trades within a region helping to reflect regional needs in an equitable manner.

Both Viridian and EnTrade identified capacity within their analysis and platform for the inclusion of more sophisticated metrics for understanding the social distributive impacts of ecosystem services. Although possible, they had not been requested by the schemes.

Box 1: UK Forestry Standards

The United Kingdom Forestry Standard (UKFS) is the reference standard for sustainable forest management in the UK and are divided into legal and good forestry practice requirements. The requirements are categorised into 8 elements (e.g. general forestry practice, biodiversity, climate change, historic environment, landscape, people, soil and water) each with supporting guidelines for forest managers. The social distribution of ecosystem services, as part of forestry projects, is considered under the guidance around 'people' and includes the following specific guidance:

- Consider engaging with the local community by seeking their views, developing proposals that are responsive to them and building co-operative partnerships.
- As part of the forest planning process, consider which individuals and organisations from all groups in society may have an interest in the formulation of forest management proposals, or something to contribute.
- Aim to communicate forestry proposals and their operational impacts clearly; consider presenting several options and try to accommodate local needs where they are compatible with management objectives.
- Ensure all members of society, including hard-to-reach groups, those with protected characteristics and those who may not have been traditional users, are considered when planning the provision of access
- Consider providing, or encouraging others to provide, opportunities for volunteering in woodlands, particularly from groups who would benefit most, such as young, old or disabled people, or those who have not traditionally used woodlands.
- Consider the potential for developing sustainable woodland-based businesses and livelihoods and how this might be explored with interested parties and through local co-operation.

Source: adapted from The UK Forestry Standard, Forestry Commission (2017).

4.3.2 Balancing needs between companies and society

Consideration of the balance between companies and society was not explicitly defined by most ventures. LENS reported this to have been addressed through driving multifunctional landscapes as well as allowing government (central or local) to procure outcomes via the LENS network, either in public-private LENS value chain consortia, or as their own discrete public sector trades within LENS. The WCC addressed this via the scheme's compliance with UK Forestry Standard (outlined above) (Forestry Commission, 2017), negating the need for individual projects to address concerns about the role of companies in the national forest estate; e.g. see concerns around the privatisation of forestry in 2010 which prompted widespread public protest (Hodge and Adams, 2013). The PC balances these needs by retaining the ability to refuse investment by certain companies, at the discretion of its Executive Board, and rules regarding statements that companies can make about their investments. Although not currently incorporating this data, Viridian Logic identified that they had the capacity to build socio-demographic data into their modelling to inform the prioritisation of interventions.

4.4 Legal issues

4.4.1 Legal obligations and contractual arrangements to deliver schemes

The legal obligations and contractual arrangements used to deliver varied across each of the ventures. Direct contracts between buyers and sellers were used in most cases, although there was evidence that there were different contractual arrangements being used within ventures. Direct contracts in LENS depends on the individual trade, although in the future, LENS envisages that funds and contracts might be pooled, rather than transacted in parallel. Within the WCC and the PC, as voluntary schemes, there was no requirement to purchase or take part, although all companies in the UK are encouraged to voluntarily offset their emissions in line with UK Government's Environmental Reporting Guidelines (GERG) (HM Government, 2019), and they can come to a net figure with WCC or PC units. To participate in the WCC and PC, farmers and landowners are required to sign a commitment statement, a pledge that they understand the requirements of the scheme and their commitments for engaging. Typically, standard contracts that form the basis of a legal agreement between the supplier (i.e. farmer/landowner) and the purchaser were used between buyer and sellers. These were used within the WCC, PC, LENS and EnTrade (NIS currently has no active trades). Both the WCC and PC operate a shared 'buffer' of unsold carbon units which can be drawn upon by a project should there be an unanticipated loss of verified carbon credits or failure to achieve projected sequestration or GHG emissions savings. This protects a buyer of verified credits, and forms part of the standard contract. If a landowner is unable to deliver carbon credits sold upfront from their own projects, they have the choice to either compensate the buyer in cash, or provide them with credits from another project in the scheme. To date there have been a very small number of WCC credits sold up front that were not delivered at verification. There is some uncertainty over what will happen to buffer credits if projects consistently deliver without needing to use the buffer. Technically these are owned by WCC and PC, but there have been discussions within the PC Executive Board about whether these would be distributed among projects for sale, and the size of buffer reduced if verification consistently shows the buffer is not required.

Within the WCC there was evidence that some projects had also adopted conservation covenants in England and Wales² and conservation burdens in Scotland³ setting out legally

² Conservation covenants are private and voluntary agreements between landowners and the responsible body (e.g. local authority) who is responsible for monitoring and enforcing the obligations of the covenant (Defra, 2019).

³ Conservation burdens were established under the Title Conditions (Scotland) Act 2003. The Act codifies the kinds of restrictions or burdens that can be included in titles to land and property, and establishes conservation burdens as a voluntary instrument that can be used to protect, enhance and maintain aspects of natural and cultural heritage.

binding obligations on the land for present and subsequent land owners should land be sold. Although this was not a universal requirement of the scheme. Covenants and burdens in Scotland can only currently be agreed by 'responsible bodies' who hold the covenant on behalf of the public, and in England the National Trust is currently the only body with formal covenanting power. However, Part VII of the Environment Bill 2019-2020 includes provisions that will enable a wider range of responsible bodies to enter into and hold benefit of a conservation covenant. This would mean covenants would pass to future land buyers, so the intervention is upheld. This would in turn enable a wider range of ecosystem service buyers to use conservation covenants instead of, or in addition to, contracts under the WCC and PC (Rodgers, 2019). Schemes reported the desire for simplicity of legal arrangements, the WCC reported that at the outset it was thought that requiring a covenant would act as a barrier to participation in the scheme. The WCC was aware of the need to ensure consistency in legal arrangements across the projects that it facilitates and is undergoing a review of their legal practices to establish the most effective approach to adopt across the scheme. In the case of woodland creation, the underlying presumption is that once land is converted to woodland, it remains woodland. Therefore, under the Forestry Act (1967) an unconditional felling licence from the relevant forestry authority⁴ is required to remove trees. This may also apply to projects assessed under Environmental Impact Assessment regulations, depending upon the scale and likely significant impact of any forestry project. This offers an additional level of protection that is not afforded to other landscape interventions, although whether felling (without the buyers approval) is still a possibility needs further exploration.

LENs is currently developing the legal framework to support its delivery at scale. Presently, it operates on the basis that a group of demand-side players come together to agree to procure a certain proportion of assets from a landscape and form a memorandum of understanding to achieve this. At this stage this is not a contract, although, they are working towards a process where there would be a chain of contracts between all parties. LENs suggest that in the future a 'regional entity' could be established to centrally manage multiple contracts. The legal delivery mechanisms for NIS are under development, although, similar to LENs they identify a potential role for a centralised entity to manage contractual arrangements. There was also a recognition that contracts were required to be robust, whilst also being flexible, particularly in the case of long-term landscape interventions where there may be requirements for suppliers and/or the interventions to change over time, for example, in the case of flood risk management to accommodate emerging climate change challenges.

EnTrade can facilitate a contract between buyer and seller for the delivery of ecosystem services. There are often several legal aspects to a facilitated trade, first, there is a legal agreement between the platform and farmers/landowners regarding how the EnTrade platform is used, this is issued at the point of registration and is an agreement defining interactions for the trade with which suppliers (farmers/landowners) are required to agree to. Second, farmers and landowners agree to take responsibility for ensuring a legal framework (i.e. approvals and compliance) for the delivery of the projects that they are bidding to undertake. There is then a contract between purchaser and supplier, this contract is signed by both parties and stored on the platform.

4.4.2 Additionality

Ensuring additionality⁵ was an important issue for all ventures. The PC and WCC⁶ have clearly defined rules to test for additionally, and these are outlined in Box 2. Although these are similar in scope, the PC differs to the WCC in that it is not creating/changing the habitat type; rather it is improving the condition of an existing habitat from degraded to functioning peatland.

⁴ Forestry Commission in England, Scottish Forestry in Scotland, Natural Resources Wales in Wales, and Northern Ireland Forest Service in Ireland

⁵ Additionality refers to the additional impact of interventions (English Partnerships, 2008).

⁶ WCC and PC are based on CDM additionality tool (Woodland Carbon Code, 2019b).

The establishment of baselines are an alternative to additionality tests. Baselines allow the impacts of interventions to be determined. In the case of the PC this is crucial in determining the impact of peatland restoration.

LENs and NIS did not have defined measures for ensuring additionality, although both considered it an important issue. LENs stated that organisations are typically paying for the implementation of measures as opposed to outcomes per se. Data from farmer interviews suggests that many farmers were already implementing LENs interventions prior to engaging, but as these interventions were extended using programme funds, it is likely that they were still additional (Coynes et al., under review).

Box 2: Tests for Additionality

The Woodland Carbon Code		The Peatland Code	
1. Legal	There are no laws, statutes, regulations, court orders, environmental management agreements, planning decisions or other legally binding agreements that require its implementation, or the implementation of similar measures that would achieve equivalent levels of sequestration or other greenhouse gas emissions reductions.	1. Legal compliance	There is no legal requirement specifying that peatland within the project area must be restored.
2. Contribution of carbon finance test	Projects are required to demonstrate that income from the sale of carbon units, over the project lifetime, equates to at least 15% of the project's planting and establishment costs up to and including year 10.	2. Financial feasibility	Carbon finance shall be required to fund at least 15% of the project's restoration and management costs over the project duration.
3. Investment test	The investment test is used to demonstrate that, without carbon finance, that woodland creation is either (a) not the most economically or financially attractive option for that area of land (e.g. woodland creation is profitable, but less so than grazing or other likely non-woodland use) or (b) is not economically or financially viable on that land at all (e.g. woodland creation is not profitable).	3. Economic alternative	Without carbon finance the project shall not be the most economically attractive option for that area of land, or shall not be economically viable on that land at all.
4. Barrier test	If the Test (3) is not passed, there may be cases where other barriers prevent a woodland creation project from taking place (i.e. economic, social or environmental). Test 4 aims to demonstrate that barriers exist which prevent a project going ahead and show how such barriers would be overcome (e.g. through technical support, re-design of financing etc.).	4. Barriers	Barriers that prevent the implementation of the project (legal, practical, social, economic or environmental) shall have been overcome.

Source: International Union for the Conservation of Nature (IUCN) (2020) and Woodland Carbon Code (2019b).

EnTrade was clear that additionality was important, especially when trades wanted to comply with regulatory compliance, with for example, habitat regulations or the Water Framework Directive (European Commission, 2019). Prior to the bidding process as part of preparatory work, farmers/landowners or a client typically commission surveys to establish a baseline. EnTrade helps to facilitate an ongoing discussion between clients and regulators around what constitutes valid ways of measuring environmental gain. However, there is a need to be mindful that regulatory baselines can shift, and anything that is or becomes a regulatory requirement cannot then be sold.

4.4.3 Legally enforceable exchanges between parties

Legal enforceability of contracts is dependent upon how contracts are drafted between the competent parties involved. Within LENS and NIS, supply aggregators and a proposed 'regional entity' (LENS) or 'NIDC' (NIS) are intended to be used to provide third party oversight of contractual agreements. The 'regional entities' or 'NIDCs', proposed by LENS and NIS respectively, act as a third-party and are suggested as a potential way to share risk between suppliers and buyers. These bodies would also have monitoring and evaluation responsibilities and be responsible for handling disputes should they arise. Current arrangements within one of LENS active trades, mean that the demand side actors (buyers) stipulate within the contract that they require third party verification of delivery. The supplier then has to identify the verification body and demonstrate how this will happen. In the future, it would be desirable for LENS to have a list of approved verifiers/auditors. The WCC have a disputes committee comprised of two executive and two advisory board members that provide a formal review process for dealing with disputes relating to the interpretation of the standard. In the PC this is done by the Executive Board.

4.4.4 Ensuring Transparency

WCC requires projects to be checked at the outset by a third party (validation), then both the PC and WCC require projects to be monitored at year 5 and every 10 years thereafter (verification) to confirm the amount of carbon dioxide sequestered or emissions avoided. Validators/verifiers have to be accredited by the United Kingdom Accreditation Service (UKAS) to validate/verify projects to ISO 14065 and ISO 14064/3 (Greenhouse Gas accounting) and be competent in assessing sustainable forest management. Presently the Soil Association and Organic Farmers (OFG) and Growers are accredited by UKAS to validate/verify WCC projects. This third-party assessment of projects ensures a robust scheme and generates buyer confidence. The WCC is also endorsed by the International Carbon Reduction Offset Alliance (ICROA), the global body for sellers of voluntary carbon credits. This endorsement is key to encouraging wider market confidence in the credits generated through WCC projects.

Smaller trades within LENS are managed through auditing requirements from the different outcomes and scrutiny from a regulator. For more complex future trades, governance structures are being developed as previously discussed. The development of a governance structure will enable transparent management of trades ensuring that trades strike an equitable balance between the different needs of demand and supply side players as well as representing the needs of society. Possible governance structures for LENS and the NIS are currently being developed and evaluated as part of a project undertaken funded by a Defra Test and Trials project in Cumbria.

4.4.5 Permanence of provision of ecosystem services

Long-term provision of services is dictated by contract length, how it is set up regarding maintenance costs, ongoing verification of outcomes, and maintenance of interventions. There is often potential to extend projects, whilst both the PC and WCC require permanent land use change. There are a number of measures to promote permanence under the WCC. Forestry Legislation in the UK requires an Environmental Impact Assessment (EIA) for deforestation (depending on scale and location) and an unconditional Felling Licence from the relevant

forestry authority. Felling, when not part of an agreed long-term management plan for a carbon project, would not be considered as 'good forestry practice' in accordance with the UK Forestry Standard. Under both the WCC and the PC, projects can only sell a portion of carbon credits – the remainder is stored in a shared 'buffer' to compensate in the event of losses. Under the WCC, landowners are required to sign a statement committing to inform potential future owners of their commitment under the WCC, and to maintain the relevant level of carbon stock in their woodland for the project duration (up to 100 years) and beyond. WCC projects are available as a 'constraint layer' in publicly available land information searches so that prospective buyers and solicitors could ascertain a project's status upon sale of the land.

Within LENSs, longevity is ensured by having a system of transactions which drive stable land management outcomes. The suite and balance of these will shift over time. This is driven by three potential mechanisms: first, contractual arrangements that ensure ongoing payments and interest in delivering outcomes, second, ensuring that real value is being procured and delivered, for a fair price, and finally, the potential 'phase shift' in farming system that may come about due to LENSs trades, which reduces the tendency to revert back to previous practices. However, private finance interest may fluctuate as business and revenues change and this may act to destabilise the delivery of ecosystem services deliver LENSs.

4.4.6 Ensuring permanence

Legal 'wrappers' such as conservation covenants or long-term management agreements⁷ can be used to make the obligations to provide ecosystem services binding on the land involved for long periods (in the case of management agreements) or (in the case of conservation covenant) in perpetuity. Ventures welcomed their use in certain situations although not universally. For interventions that require significant upfront investment and changes to the landscape, there are advantages to contractual arrangements that act to lock in demand and supply side interests. This also provides reassurances to demand side actors that changes made will not be reversed shortly after implementation. However, their implementation is not without technical challenges, for example, any legal arrangement will often need both the legal documentation and ongoing commercial interest. Conservation covenants can be a helpful tool but will likely bring an additional cost to the project to ensure that this is legally enforceable and that the agreement is monitored which will only be acceptable if ongoing maintenance did not affect the ongoing core business of the farm.

⁷ For example, entered into by Natural England under section 7 Natural Environment and Rural Communities Act 2006.

5 Conclusions and recommendations

The UK ecosystem market includes a number of actors categorised here as PES, or PES like, schemes, stakeholder engagement initiatives, trading platforms and modellers. Each plays an important role in channelling investment into the delivery of ES and expanding the market. For example, trading platforms have a vital role in driving the creation of ES marketplaces and trade and are an important mechanism for extending the functions, whilst stakeholder engagement initiatives generate commercial interest around multiple natural capital opportunities (i.e. beyond PES schemes, WC and PCC, which currently focus exclusively on carbon). This report has provided an in-depth exploration of six case study ventures operating in the UK's voluntary ES market. Commonalities and differences between actors in terms of approach and challenges to the delivery of ES via payments were identified. Given the post-Brexit transition in UK agricultural policy, and greater focus on the delivery of ecosystem services within this, understanding how these ventures operate is important in order to support understandings of how public-private financing might co-exist, or indeed integrate, in order to maximise the potential for delivery of ES.

The WCC and PC represent established PES schemes that are underpinned by globally recognised standards. The WCC is one of the world's leading domestic carbon standards with a proven track record in developing carbon sequestration projects and a large pipeline of future projects. In both schemes, projects are initiated by supply side actors (farmers/landowners) that develop carbon sequestration projects. Although, they are focused on carbon sequestration, measures undertaken could have benefits beyond carbon and have potential to deliver additional functions, which could be 'stacked' in order that more of the full value of the land can be realised, moving towards the delivery of more multifunctional landscapes.

In contrast, the stakeholder engagement initiatives considered in this report are in the early stages of development and application. They are in the process of developing and refining their processes and protocols, with NIS yet to road test the approach (i.e. having no active trades). In both instances, interventions were demand-led, and co-developed with farmers/landowners to ensure acceptability. Stakeholder engagement initiatives, such as LENs, guided by the delivery of multifunctional landscapes, can provide a variety of ES benefits that are of interest to a range of demand side actors within a landscape. From the supply side, this creates increased revenue from the land which, as the UK moves away from direct payments (CAP) towards ELMs (Agricultural Bill 2020) is likely to become increasingly important to farmers/landowners.

Despite differences in design and scope, a number of common themes emerged from our synthesis which should be considered when developing ES markets. All parties identified the challenges associated with engaging farmers/landowners as suppliers of ES. Several factors were identified to improve engagement, including treating farmers/landowners as equal transactional partners, simplifying the engagement process, supporting engagement via project developers and/or aggregators, avoiding overly prescriptive options, and creating flexibility to recognise the individual needs of farmers in terms of interventions and payment options.

It was apparent, across ES actors, that there is a limited consideration for the wider beneficiaries arising from the ES delivered by ventures, and where this was considered it was not quantified or marketed for sale. There is scope for broader analysis and inclusion of a wider range of beneficiaries to ensure the multifunctionality of landscapes. Despite adding additional layers of complexity to transactions, this will help to ensure that landscapes are not managed to realise a narrow range of ES benefits, avoid outcomes being dictated by corporate need and reduce the likelihood of ecosystem service trade-offs. There is a role for the integration of modelling data in order to identify beneficiaries and possible co-benefits that can be derived from a landscape and interventions, these appear to be 'advanced' elements that are not regularly included due to the overall immaturity of the ecosystem markets.

Prices and values for ES were negotiated between demand and supply side actors (individuals or aggregators) based on market demand and willingness to pay. This presents potential for power asymmetries, and there was a recognised role for aggregators to support farmer/landowners in the negotiation process to avoid this. LENS and NIS identified a role for independent bodies to manage financial and contractual arrangements. Similarities to Coasian bargaining can be seen in LENS and NIS approaches, whereby parties strive towards a more Pareto efficient allocation through negotiation rather than other more familiar instruments (such as Command and Control regulation, or Pigovian tax/subsidy). Bargaining is not without its drawbacks, and may be hampered by high transaction costs (i.e. the negotiation can be expensive, particularly where many parties are involved), a lack of bargaining culture, and unclear property rights. However, trading platforms assist here, and act to increase demand for ES by opening up the market and increasing the availability of funds for ES. On the supply side, they increase the autonomy of farmers/landowners in the sale of assets from their land, and increases competition between suppliers for the provision of ES. On the demand side it helps to ensure the real market value of ES interventions is determined, as well as reducing the likelihood of power asymmetries in negotiations. Trading platforms have an important role to play in opening up the UK's ES market, increasing investment and opportunities for farmers/landowners to trade their environmental assets, which is going to become more important as the UK leaves the CAP.

Contractual obligations were primarily captured via standard contracts between demand side actors and suppliers. A need to limit complexity in legal arrangement was recognised, with concerns voiced that complex legal obligations could be detrimental to engagement. Equally, contracts were required to be robust, whilst also having flexibility to account for changes in supply. There were currently no contractual arrangements to account for how/if interventions are maintained after the contracted period or if obligations are tied to the land if land is sold during the duration of a contract period, although for the WCC and the PC contract lengths secured permanency. Conservation covenants (England) and conservation burdens (Scotland) could be useful in situations where significant upfront investment and changes to the landscape are required, providing reassurances to demand side actors that interventions would not easily be reversed and concerns around enforceability and additional costs to the projects identified. Contractual obligations should also build in mechanisms for enforcement and dispute resolution. The WCC and the PCC have dedicated mechanisms for handling disputes, which are important mechanisms for building confidence and transparency between trading partners.

Ensuring additionality (i.e. that the intervention would not have occurred without investment) was important for all actors, although different actors had different approaches to ensuring this. The WCC and the PC have clearly defined measures and rules to ensure projects demonstrate additionally. LENS and NIS have less structured approaches to quantifying additionality, although, still recognised its importance. There appeared to be a balance between ensuring additionality and investor confidence, whilst also not stifling interest and investment in ES.

The research has identified a range of mechanisms that are aimed at delivering landscapes that provide multiple benefits to a diversity of beneficiaries. To move towards the enhanced delivery of ecosystem services in the UK there are two potential options. First, ventures could explore the potential of 'stacking' outcomes in order to realise the full value of the land, or second, the potential to integrate schemes is considered. The WCC, PC and LENS represent very different types of natural capital mechanisms however, there is scope for integration which could increase the amount of funding available for sustainable landscape management, as well as broadening the range of outcomes and the scale at which these can be delivered and avoid duplication, including the ability to design into schemes a range of co-benefits. Whilst integration could be highly beneficial, it would not be without challenge. This would include the difficulties associated with integrating ventures at different levels of development (for example, integration would need to ensure that rigorous standards (i.e. WCC) are maintained)

and the complexity that this adds to the system. Whilst several different ES ventures have been interviewed as part of this report; there is scope for further interviews to be conducted with additional representatives of the existing ventures and with other public/private finance initiatives, both in the UK and internationally.

A number of open questions emerged from the synthesis that need to be explored by future research. This would in turn support the development of the ES market and be important in any attempts to integrate private PES initiatives or creating other public/private partnerships. Future research should consider: (1) management structures; (2) the need for quantification of societal benefits; (3) building the evidence base regarding environmental impacts of initiatives; (4) payment mechanisms; and (5) legal issues. These are elaborated below:

(1) Difference in management, decision making and governance structures emerged across the ventures. It was not possible to draw conclusions around which approach was best. In part this was because of the differences in level of development of the respective ventures, which varied considerably from the NIS in theoretical development to established schemes like the PC and WCC, with active projects. It was, therefore, difficult to draw conclusions around which were most effective approaches. It would, however, be useful to explore best practice, understand the advantages of the different management structures and the challenges that they present in terms of governance. This would be fundamental in supporting any future attempts to integrate private and public investment in natural capital.

(2) The social distribution of the ecosystem services delivered appeared not to be considered in detail across all ventures. This may be due to an emphasis on carbon, where the benefits of net carbon emission reduction are global, not local. There was some misinterpretation of this being the consideration of the balance between demand and supply side actors rather than assessments of the broader impacts of the ES delivered by ventures on wider beneficiaries. A part of this was covered via compliance with standards. However, there is a need for research on how social distributive effects (including direct and indirect benefits and externalities) of the ecosystem services delivered from interventions could be measured in an understandable and implementable way, as an approach seen to be overly complicated or resource intensive may result in a limited uptake. Thus there is a need to consider how best to include social distribution of benefits assessment in ES ventures (such as promoted in HM Government's (2018) Green Book; in this respect the role of modelling merits further investigation.

(3) While there is still a need to improve the evidence base underpinning carbon sequestration and emission avoidance estimation in the WCC and PC, these schemes are comparably more scientifically tested, and include internal risk mitigation (in the form of a 'buffer' of carbon credits), whereas NIS and LENs require more work to build a robust approach to quantification and valuation of ES they deliver.

(4) Payments for the delivery of ecosystems services was shown to vary according to types of interventions/measures and they were being paid in a variety of ways (i.e. upfront, annually and revenue payments overtime). Future research could usefully explore the utility of different approaches, developing a suite of solutions, rather than a 'one size fits all' approach.

(5) More insights are also needed to understand the legal underpinnings of all ventures, including greater understanding of the nature of the contracts, and particularly whether they are legally binding and enforceable, and through what mechanisms (e.g. do they include arbitration or breach clauses?). There is also a need to consider the potential implications of the UK's post-Brexit environmental policy on the delivery of public/private financing of ecosystem service schemes (for example, the new Environment Bill 2019-2020 aiming to change English law to create binding conservation covenants). There is a need to consider which legal instruments, including covenants, are most likely to ensure contracted services are additional and verifiable.

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