New markets for land and nature

How Natural Infrastructure Schemes could pay for a better environment

green alliance...

National Trust

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How Natural Infrastructure Schemes could pay for a better environment

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Green Alliance
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Executive summary

Agriculture is under pressure to increase production, reduce its environmental impact and eliminate its dependence on public subsidy.

Many farming businesses are operating at the limit of their profitability, often to the detriment of soil health, water quality and biodiversity.

Farmers are in a unique position to restore and protect the natural environment, but there is no commercial basis for the provision of natural services from farmland.

This report sets out a mechanism for establishing natural markets to bring new income streams into farming, supporting a fundamentally different approach to land use.

The costs of degrading important ecosystem services are high and increasing. There are many places where natural markets could play a useful role but the crippling cost of floods and water treatment, along with the growing body of evidence around cost effective natural engineered solutions, means flood prevention and cleaning up water is a good place to start.

We calculate the cost of floods and treatment for water pollution to be £2,373 million a year, equivalent to £24 million a year for each of the one hundred water catchments in England.

According to this analysis, a land management scheme delivering natural filtration and flood risk management ought to have many potential customers, to who it could offer a lower cost way of managing exposure to flood and water quality problems. We believe there could be a considerable market in avoiding these costs.

There are a number of reasons why this market does not currently exist. Payments for ecosystem services (PES) pilots, run by the Department for Environment, Food and Rural Affairs (Defra), have identified a number of non-financial barriers to creating an effective payment mechanism. These include economic challenges, such as ensuring a fair contribution is made by those who benefit and that payment rewards additional service delivery, rather than preventing bad practice. There are also the practical challenges of establishing hydrological and ecological standards for natural engineering and developing contracts that enable counterparties to specify standards of service delivery and define its limits.

The Natural Infrastructure Scheme

To respond to these challenges, we propose a new payment mechanism, the Natural Infrastructure Scheme (NIS). The NIS is an area based market in avoided costs, delivering environmental improvements by bringing together groups of land managers to sell ecosystem services to groups of beneficiaries. It is a multi-buyer multi-seller consortium contract for large scale interventions in the upper reaches of a catchment.

On the seller side, this would involve enough land managers in a catchment to ensure the effectiveness of their offer. On the buyer side, this would include all the major institutional beneficiaries of flood mitigation and improved water quality.

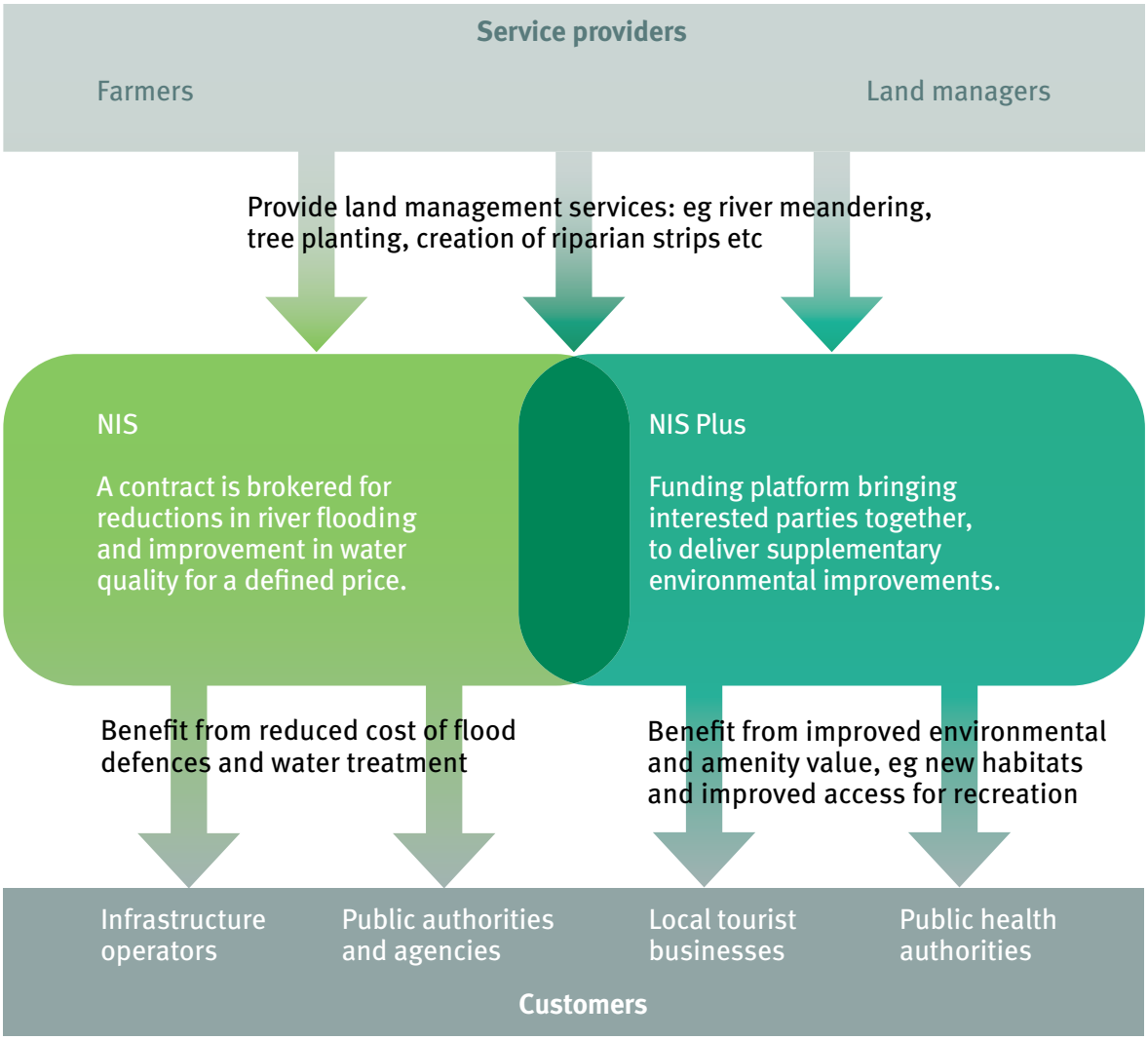
Prospectus designers would work with the land managers to identify the most efficient and effective natural engineering options, market the proposals to buyers and broker the contract that would increase income for landowners and reduce costs for downstream beneficiaries.

How a NIS would work

Landowners in a catchment enter into a NIS contract with downstream businesses and public sector organisations to increase the ecosystem services provided by their land and reduce costs incurred by those downstream.

What a NIS Plus would offer

An online NIS Plus funding platform enables local people, tourism businesses, local and national companies and others to fund a set of supplementary land management changes which increase the level of environmental benefits provided under the original NIS.



In relation to catchment management, a NIS has the following distinctive features:

It is farmer-led
Farmers and land managers are put at the forefront of developing and designing the scheme, which opens up a wider potential for delivering ecosystem services alongside other income streams.

Payments incentivise change
Long term and significant scale contracts move ecosystem services from a peripheral activity to something that could fundamentally change land managers' approach to farming.

It is designed for catchment scale delivery
Co-ordinated land manager intervention enables the NIS to deliver a solution that reduces costs downstream for organisations facing increasing flood and water pollution problems.

It sells a service based on results
Contracts are specified around solutions, within defined limits, that land managers, who own the assets, are responsible for delivering.

Our recommendations

The National Trust and Green Alliance will continue to work with partners to develop and test this concept. There are legal and regulatory barriers to delivering the NIS but, as the UK leaves the EU, it is time to take a fresh look at what kind of support would enable a more sustainable and market oriented farming sector.

The following actions by government, alongside private endeavour, would accelerate the creation of viable markets for ecosystem services:

- **Provide seed funding** by offering development grants to fund the initial costs of setting up institutional arrangements for land managers and the area based purchasing consortia.
- **Remove policy and regulatory barriers** by providing the derogations and licences required at the demonstration stage, and by working with project partners to create the legal framework for mainstream delivery.
- **Create space for markets** by considering the potential role of ecosystem services as it assesses and devises its replacement of the Common Agricultural Policy in the UK.

Getting a better deal from land

The declining health of UK land is reducing our ability to withstand and defend against problems like flooding and climate change.

Prevailing land management practices have resulted in degraded soils, falling biodiversity, lower resilience to flood and drought, and increased water contamination. As well as the direct environmental losses, this is also extremely costly, increasing the need for expensive remedial measures, such as flood defences and water treatment infrastructure. Continuing environmental decline means these costs are likely to rise still further.

Many of the land management practices responsible arise from farm businesses becoming more specialised and intensive. The current system is propped up by subsidies via the Common Agricultural Policy (CAP), which does very little to address environmental problems or support markets in the other services that land provides. By providing most of its subsidy as an area based payment, CAP raises rents for tenant farmers, fails to encourage sustainable production and can act as a disincentive for farmers to develop other income streams. We will always need land for food. But the way we farm needs to evolve, to provide more of the services we need from healthy land, alongside profitable agriculture.

Our current approach to land use is a colossal failure of private markets. Markets only recognise a tiny fraction of the value of services provided by land. Farmers earn money by selling goods, such as food, produced from their land. Other 'non-productive' land uses, such as woodland, reed beds and peatlands, which provide habitats, hold water in the catchment and provide natural filtration, are not rewarded. Consequently, they are under-supplied by land managers, not integrated into farming, and are reliant on grant funding and conservation management.

A better way is possible. Farmers could be selling their land's ecosystem services alongside food.

Developing a market in natural services would drive environmental restoration and create new income streams, ending the trade-off between economic profit and environmental health for farmers, and reducing the costs of living in a degraded environment for their customers. The UK has the opportunity to replace CAP with a new and better system of agricultural subsidies which could sit alongside and complement markets in ecosystem services.

In this report, we explore the conditions under which a market for these services could succeed, and outline a trading mechanism which we have named a Natural Infrastructure Scheme.

Understanding and overcoming market failures

The benefits we get from land are, or have been, freely and abundantly available to us, via complex and interlinked systems. This abundance and complexity is why their provision is subject to market failure and a number of ecosystem services are not paid for. And producers don't tend to produce things that nobody pays for.

One of the most basic market failures occurs when the transmission mechanism: price, does not exist or does not fully reflect the value of a good or service. In these cases the normal demand signals fail, and we get less of the good or service that we would like.

A beautiful landscape is a public good, ie something we all derive value from but do not individually pay for. We all appreciate it and much of our tourist industry relies on it, but no-one directly pays for the land management that creates and maintains it. Beekeeping has positive externalities, in that it is an activity with multiple benefits. Beekeepers get paid for the honey they sell but few people, even with recent declines in the bee population, are paying for the pollination services they also provide.

Businesses and private individuals can help to fill these gaps in the market by exercising their preference for goods and services produced in a particular way, such as buying sustainable forest timber; voluntarily adhering to corporate social responsibility codes, such as natural capital accounting; or contributing to environmental good causes, by volunteering or donating to habitat conservation.

These private initiatives can move the market by changing attitudes, developing alternatives and building a mandate for government intervention.

Government intervention can take the form of state provision, legislation or regulation, increasing or decreasing the market price through a tax or subsidy, or simply information, whichever is the minimum intervention necessary to make the market work effectively.

Ultimately, a combination of business and government action is likely to be necessary to ensure we get the services from land that we need. And landowners and managers have a particular role in making markets for all the products from land work better.

Creating a market for ecosystem services

Farmers are in a unique position to restore and protect the natural environment, but there is currently no scope for the provision of ecosystem services from farmland on a commercial basis.

In recent years, significant effort has gone into building the evidence base for the value of ecosystem services, and developing approaches to paying for them. We have seen less focus on new payment mechanisms and institutions for selling ecosystem services, and as a result, the potential for farmers to become commercial providers of environmental goods remains conceptual, rather than a practical possibility.

The Department for Food and Rural Affairs' (Defra's) Payments for Ecosystem Services (PES) pilots have identified the challenges in constructing viable and equitable long term payment approaches for complex natural systems. If PES is to offer meaningful additional income streams for land managers and support land use change, new market mechanisms will need to address these challenges.

For many environmental issues, such as carbon storage or biodiversity, creating a financial incentive to tackle them relies on government intervention, because the full costs of not doing so have not reached us yet.

However, some ecosystem services already have significant associated financial costs and benefits, but none of the money flows to the land manager. For example, the food and drink industry is built on farming but prices within the food sector do not reflect the long term value of maintaining healthy soils. The tourism industry and homeowners, who benefit from beautiful scenery, are not investing to maintain the landscape.

Even when the deficit in the provision of ecosystem services is placing a significant cost on society, the problem is not easy to solve. The level of pollutants in water courses costs water companies in England £1,065 million every year. While some have been working with farmers to create markets for clean water, it is not yet mainstream practice.

Similarly, flooding costs £642 million a year in insurance pay outs, public agency and local authority rebuilding of infrastructure, on top of the £526 million spent by the Environment Agency and others on hard defences for cities, towns and key infrastructure. However, little is spent on holding water in the upper catchment to reduce the flood risk.

For this report we have chosen to focus on the potential for trialling payment mechanisms to land managers for ecosystem services like these, where there are already directly attributable financial flows, either costs or benefits, but there is no existing payment mechanism.

The payment mechanism

Building on the work of previous PES schemes and ecosystem service provisions, we are looking at the market development challenges. These require an understanding of the customer and their willingness to pay, as well as the nature of the product, and the structures on the buy and sell sides most likely to support a functioning market.

We propose some significant departures from the way ecosystem services have been delivered to date:

- **Farmer-led:** PES schemes, to date, have primarily been led by the beneficiary (the buy side). For instance, a water company wanting to avoid the cost of water contamination, or the Environment Agency wanting to reduce flood risk, has engaged with relevant landowners to propose and contract for naturally engineered assets on their land or changes in their farming practice. Markets normally operate the other way around, and work better when producers offer goods and services that meet their customer's requirements. Land managers need to become experts in the services they can provide, and organise themselves to supply what their potential customers want.

- **Payments incentivise change:** Government and charity funded environment and conservation programmes maximise the

environmental benefits they can support by making grant and charitable funds stretch as far possible. This often means their engagement with land managers is focused around land use change that can be achieved for minimal payment, which severely limits the way land managers provide ecosystem services. It only allows low value land to be used in schemes and it is not a useful basis for understanding how a market might develop.

Land managers should always be incentivised to deliver ecosystem services at least cost and, ideally, alongside food production, but proper payment for that service will enable them to assess the opportunity cost of larger scale changes and consider a much more fully integrated approach to farming for the environment.

Pricing the priceless: a market in avoided costs

Importantly, the price assigned to a service does not have to reflect its true value. Economists and environmentalists can get hung up on calculating the right value for natural assets or ecosystem services. We suggest that it is useful to think about these services in terms of avoided cost, rather than the wider sense of their value to society, which is conceptually interesting, but not necessarily a helpful basis for constructing a payment mechanism.

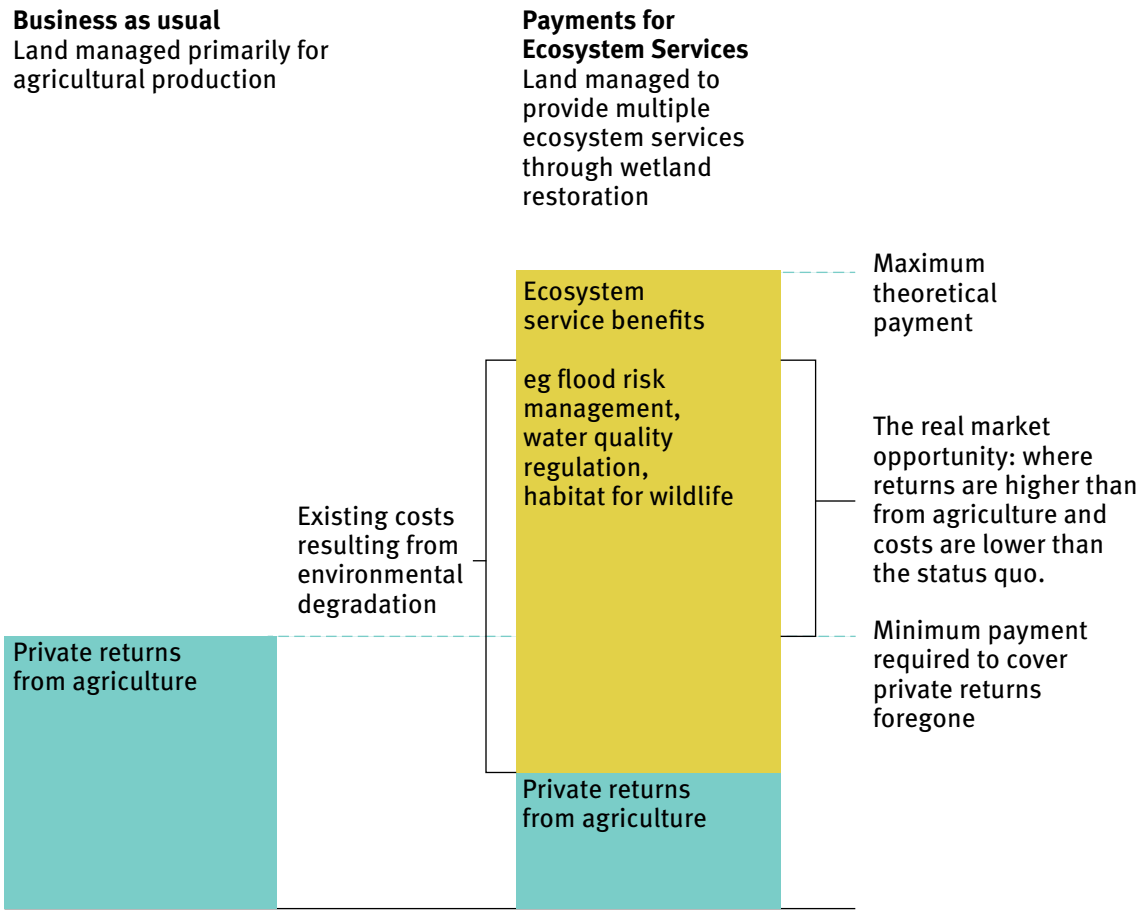
In this model, the price needs to be sufficient to incentivise a change in behaviour. That means it has to be enough to beat the next best option for land use.

Setting the right price can be an emergent process, moving the price up and down depending on initial supply and subsequent innovation as the market finds the cheapest and most effective ways to respond.

Our concept of a market in avoided costs is a development of the PES payment range concept set out in Defra's best practice guide.[1] It suggests the payment floor would cover profits foregone, and the ceiling would be the value of the external benefits of the ecosystem service provided, which is often not known.

We suggest that the payment floor remains the same, but a more realistic ceiling is the value of the costs avoided by having the ecosystem service, eg the amount saved by avoiding damaging floods. The illustration opposite is a modification of Defra's PES model, to show that the maximum payment achievable is defined by the existing costs that can be avoided.

Building on Defra's payment model: increasing revenue with a market for avoided costs



A market for slow clean water

The costs of water contamination and flooding are so great that it is possible to design a new market where landowners are paid to invest in different land management practices, to hold water in the upper catchment for longer.

The costs associated with flooding and contamination are already separately monitored and reported, and the land uses and management practices that can improve or worsen flooding and water quality are well understood.

Holding back water and slowing its flow through the catchment can reduce river flood peaks. Slower and less turbid water reduces treatment costs; additional changes to farming practices can boost natural water filtration and reduce sediment loss, and nitrate, phosphate and pathogen contamination. Therefore, this is the best place to start developing new markets for ecosystem services. We propose a new payment mechanism focused on avoiding the costs of river flooding and poor water quality, essentially a market in 'slow clean water'.

Assessing the demand for slow clean water

The downstream costs of not having slow clean water include water treatment, tackling diffuse and point source pollution, reinstating infrastructure damaged by floods and building hard defences to increase resilience. Recording and reporting of the costs of water contamination and flood is improving for regulated businesses. Infrastructure damage and resilience costs are now attributed to a particular cause: flood, storm, snow event etc, enabling better calculation of the full impact of current catchment management. The costs we have identified so far are likely to be added to as reporting improves, but are known to be increasing as a result of climate change, as events once considered extreme are now happening more frequently.

Savings are possible if natural engineering alternatives to end of pipe water treatment and hard defences can be delivered more cheaply. This would require costs to be truly avoidable. The natural engineering alternative has to deliver a reduction in the incidence of flood events and, therefore, in resilience spending downstream.

Resilience spending has variable and fixed components. Operating pumps are variable, but the costs of building holding tanks for turbid water or defences around an electricity substation are fixed and harder to avoid. Over the long term, even fixed costs become variable as infrastructure needs to be replaced at the end of its life, and there is a significant saving if operators can avoid having to constantly increase site resilience in response to rising flood risks.

Part of the calculation challenge is that downstream costs are interlinked. For instance, river flooding can be one of the factors in sewer flooding, as flood waters enter and overwhelm the sewage system. Water companies are liable to provide no quibble restoration payments to customers affected by sewerage flooding no matter what the cause; the resilience costs for sewer treatment plants, often sited next to rivers, increase with flood risk.

Separating the costs of flooding caused solely by water company infrastructure and that caused by external factors can be very difficult. Nevertheless, water companies have an interest in supporting catchment management approaches that slow water as well as clean it, which is where their involvement in PES schemes has focused to date.

Water companies are also exposed to the costs of drought because they are required to limit abstraction in dry periods when it would damage the environment. This exposes them to the costs of limiting customer water use or bringing in water resources from elsewhere in the country. Interventions that slow water in the catchment also lead to higher recharge of underground aquifers which reduces drought risk. This effect is very difficult to measure and, therefore, it is not easy to design a payment system around it. But, again, it increases water companies' interest in buying water filtration in a combined slow clean water scheme, as opposed to via end of pipe filtration which would have none of these benefits.

Costs to the Environment Agency and water companies are most often cited in relation to water contamination and flood, but other organisations are also exposed to significant costs. For example, energy and electricity network companies need to defend their assets from flood or replace them after a flood happens. These include the cost of building defences for their assets, reinstating infrastructure damaged by flood and potential fines for outages. Flood costs for generation stations or National Grid are not available but distribution network operators' costs are.

For many downstream organisations like local authorities, utility and infrastructure providers, there is a wider relationship with their customers and residents. Ensuring resilience through natural mechanisms, rather than via hard defences for a town or individual bits of strategic infrastructure, has additional benefits for customers. Flood resilience and water quality can be improved, with environmental benefits to the local community. And that improvement can be delivered more cheaply, meaning smaller towns and villages that did not qualify for expensive hard defences could still have their risk of flooding reduced through natural engineering. For larger towns and cities, which are currently well defended, the life of those defences could be extended cost effectively by natural engineering in the upper catchment.

The size of the opportunity

We can calculate the effective demand for slow clean water from the cost of not having it. The costs of decontaminating water, protecting ourselves from flooding and the repairs after a flood, give us an indication of how much we would be willing to pay to avoid the water quality and flood issues we currently face.

Our estimate of water quality and flood costs associated with catchment management and river flooding in England, is set out in the table opposite.

Based on the latest available data, the costs of river flooding and water contamination are in excess of £2,373 million per year, equivalent to £24 million annually for every catchment in England. These are costs paid by all of us in our taxes, utility bills and insurance premiums..

Even with optimal catchment management, some costs for water treatment and resilience would always remain. But, a relatively modest assumption of a 25 per cent reduction in costs would still represent up to £6 million per catchment per year, enough to fund up to a £120 million 20 year catchment scale scheme to reduce flood risk and water contamination.

Adding value with supplementary benefits

Once landowners have invested in slow clean water, further value can be added by enhancing the natural features required to reduce flood risk or enhance water quality, so that they also provide additional ecosystem services such as access, landscape or wildlife benefits. The costs of providing the additional services would be limited to the marginal costs of the additional features required on the land already being managed to provide slow clean water, putting it within reach of purchasers who would not otherwise have been able to afford to invest.

Water quality and flood costs per year in England

Beneficiaries	Water quality		Flood	
	Cost of treatment (£m)	Investment in resilience (£m)	Cost of events (£m)	Investment in resilience (£m)
Water companies	1,065[2]	Unknown	29[3]	246[4]
Environment Agency		140[5]	135[6]	209[7]
Local authorities			1.6[8]	26[9]
Internal Drainage Board				12[10]
Highways England			110[11]	Unknown
Insurance pay outs			337[12]	
Network Rail			29[13]	11[14]
Power companies			0.81[15]	› 22[16]
Grid companies				
Total	£1,065	£140	£642	£526
Grand total	At least £2,373 million			
Average per catchment	For 100 catchments in England this is equivalent to £24 million per catchment per year			

Changing land management

The knowledge that catchment management can reduce flood risk and water contamination is as old as the hills. The emphasis now is on codifying and measuring the effectiveness of different interventions.

Catchment partnerships were established in 2006 to take a catchment wide perspective of water management. Defra PES pilots were launched in 2011 to test the extent to which specific ecosystem services can deliver environmental benefits and who might pay for them. Increasing recognition of the cost effectiveness of certain land management practices, in reducing flooding and water contamination, has resulted in a growing number of schemes investing in these activities.

At the same time, research is demonstrating how natural pest management, pollination, nitrogen capture and precision technologies make it possible to reduce chemical inputs, lower costs and maintain yields, paving the way for new models for integrating ecosystem service delivery with farming.

The UK already has good hydrological models, hydrographs of catchment water flow, robust data on the effect of attenuation ponds and water holding measures, but more work is needed on their effect at scale.

Similarly more evidence is needed to quantify the effect of less compacted soil, tree planting and other interventions known to slow and filter water.

The Environment Agency's Working with Natural Processes project is collating existing evidence on natural engineering, and it is developing projects at scale to address the evidence gap for interventions over 10km^2.

Environmental monitoring in the UK is also well advanced and there are a number of good tools for quantifying the carbon sink impact of woodlands and wetlands. Industry standards and consistent methodologies would help the development of a market, as would expanding measurement standards to other ecosystem services.

Techniques for measuring the effectiveness of natural engineering in addressing the particular needs of a catchment are well developed and improving all the time.

The table on pages 18 and 19 summarises land management changes that have been shown to deliver flood and water contamination benefits.

Type of land management change	Impact on flooding	Impact on water quality	Additional ecosystem services and benefits
Planting trees	Trees reduce surface run-off. In Pontbren, it was found that reducing soil compaction and planting trees reduced run-off and increased infiltration of water by soils. However, the effectiveness of trees in helping to reduce run-off varies and is strongly influenced by the age of the trees, soil type and the scale of planting.[17]	To the extent that tree planting slows down water, it can encourage particulates to settle out of run off; and where trees increase infiltration they divert water through soil, enhancing filtration and contaminant removal.	Biodiversity Recreation Carbon sequestration Air quality Soil quality
Attenuation ponds	Attenuation ponds are used to divert and store excess flows to prevent flooding downstream. The evidence for their effectiveness is fairly robust, for instance, a hypothetical pond network capable of storing 19,250m^3 of water can reduce peak flows by 15 to 30 per cent during storm events in small modelled catchments.[18]	Attenuation ponds can help reduce diffuse pollution and sedimentation, by preventing some contaminants flowing downstream. Whilst water quality is not usually the primary focus of attenuation ponds, improved water quality is a significant co-benefit.[19]	Biodiversity Recreation
Woody debris dams	Woody debris dams, often used alongside woodlands, slow the flow of water in channels.[20] For example, Slowing the Flow at Pickering found that the combination of planting in the floodplain and riparian woodland and having woody dams reduced peak flows by four to eight per cent.[21]		Biodiversity
Peatland restoration	Peatlands are often described as 'sponges' that absorb water, helping to reduce run-off. The capacity of peatlands to hold water can be exceeded, but, by absorbing and then releasing water, they delay and reduce the flood peak, giving valuable time to prepare for flooding downstream.	Peatland restoration has significant water quality benefits, removing water colour and organic carbon lost from degraded peat. Water companies, are now investing in peatland restoration to save downstream water treatment costs. For example, United Utilities' Sustainable Catchment Management Programme (SCaMP) has restored 27,000 hectares of peatland since the project began in 2005, resulting in water quality improvements.[22]	Biodiversity Recreation Carbon sequestration Air quality Soil quality

Type of land management change	Impact on flooding	Impact on water quality	Additional ecosystem services and benefits
Naturalised river pathways	Rivers have historically been canalised to improve navigation and access to the floodplain. However, canalised channels speed water through catchments, increasing flood peaks. Rivers that flow naturally are slower and less prone to flash floods.	In naturalised rivers, slow stretches can encourage particulate settling and channel vegetation can take up nutrients, but this is only a marginal contribution to water quality in rivers with high pollutant loadings entering the watercourse.	Biodiversity Recreation Landscape
Water course buffer strips	The vegetation that forms buffer strips can help to stabilise river banks, reducing erosion and associated sedimentation of rivers.	As well as being havens for flora and fauna, buffer strips of sufficient width also help reduce the volume of contaminants entering water courses by trapping them in vegetation. And, by reducing erosion of river banks, they help reduce sedimentation in rivers.	Biodiversity
Reduced stock levels	High grazing stock levels can compact soils. When soils become compacted, they are less able to absorb water and so result in run-off. Reduced stock levels following soil restoration measures can prevent future damage.	Intense stocking of grazing animals can result in the run-off of nutrients and pathogens from animal waste into water features. Extensifying grazing reduces nutrient loading, but watercourses still need protection from pathogen contamination where stock have direct access.	Biodiversity Soil quality
Stopping the production of crops, particularly maize, on steep slopes	Growing crops on steep slopes can result in high levels of run-off. Maize, in particular, leaves soil bare for much for the year and requires heavy machinery which compacts soils. On steep slopes, this can cause severe run-off. In the heavy rainfall of 2013-14, it has been estimated that for every ten hectares of land under maize stubble, additional run-off equating to 15 Olympic swimming pools resulted.[23]	Run-off from arable land carries nutrients, pesticides and particulates, which can be avoided by maintaining higher soil cover on slopes.	Soil quality

Catchment systems management: Belford, Northumberland

Records stretching back to the 19th Century show the town of Belford has suffered regularly from flooding. In the summer of 2007, some of the most severe flooding to hit the town forced the Environment Agency to consider how to protect Belford from further flooding in the future. Traditional hard defences were proposed, which would have cost £2.5 million. The Environment Agency concluded that this investment would not offer sufficient returns, due to the low number of properties that would benefit, and so it looked for alternative solutions.

Newcastle University proposed a natural flood management approach and worked with the Environment Agency on the project. This involved implementing a number of run-off attenuation features to help slow and divert run-off within the 6km^2 catchment. These features included bunds disconnecting flow pathways, diversion structures in ditches to spill and store high flows, large woody debris structures within the channel, and riparian zone management.

These features also have the additional benefit of helping to reduce diffuse pollution, which has resulted from intense agriculture within the catchment. Detailed analysis of the run-off attenuation features has shown that they reduced peak flows by around 35 per cent and have reduced local run-off within the catchment as intended.[24,25] The total cost of the catchment systems approach was £200,000. This was a twelfth of the cost of the hard defences originally proposed and a saving of 92 per cent.[26]

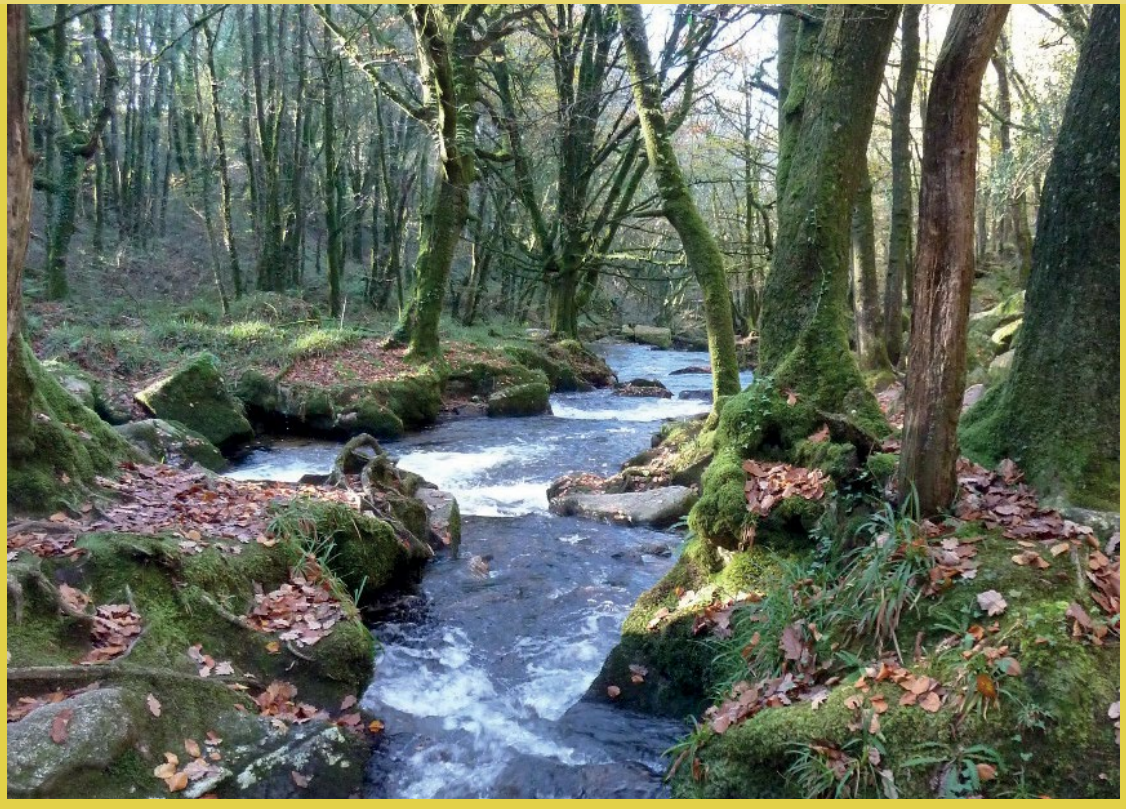
Upstream thinking: Fowey River, Cornwall

The Fowey River Improvement Auction forms part of South West Water's Upstream Thinking programme. Upstream Thinking delivers improved water quality by changing how land is managed upstream, as this approach is much cheaper than treating contaminated water downstream.

The Fowey River project was a collaboration between South West Water, the University of East Anglia and the West Country Rivers Trust to address water quality issues in the area. The project was based on an auction system, whereby farmers within the catchment could bid for funding from South West Water to implement environmental improvements on their land.

Through the auction, farmers could present their proposed environmental improvements, the cost and the grant they would need from South West Water to implement them. Importantly, the bids had to demonstrate an environmental improvement score that the project would offer and so the projects with the best value for money (ie the greatest environmental improvement) were selected.

Previously, South West Water had used a fixed price mechanism to fund Upstream Thinking projects. But they found that the auction approach offered significantly higher environmental improvements and value for money was 20-40 per cent higher compared with previous schemes. South West Water has found that reducing pollution at source, rather than treating water downstream, has a benefit to cost ratio of 65:1.[27]



Challenges to trading slow clean water

Given the potential financial advantages of buying slow clean water from land managers and farmers, it is perhaps surprising that it has not already developed into a mainstream market.

However, there are many practical co-ordination and information failures that exist around markets for water, that present non-financial barriers to trade. Water is not 'owned' by anyone, it is affected by many complex processes and it passes through a catchment where is hard to assign responsibility and assess impact. And, on a practical level, there are a large number of stakeholders, so co-ordination is a challenge. Plus, natural engineering is a new approach which has to overcome all the normal barriers any new system faces.

These are six challenges we've identified in designing a payment mechanism for slow clean water:

1. Making contributions fair

Slow clean water is a public good, its delivery would benefit everyone downstream and it would be impossible to exclude people from receiving the benefit whether they contribute or not. Even if we focus on major organisations like local authorities, water companies, electricity and rail companies, who could represent their own interests and that of local residents, we are still left with the problem that they are all exposed to different costs from flooding and water quality. This means agreeing how much they each pay for a naturally engineered solution. Each organisation would be incentivised to pay as little as possible, or nothing, and free-ride on the contributions of others. Good faith negotiating on the contributions from each beneficiary is critical to securing a contract. The Fowey PES project (see page 21) found that an institution that enabled potential purchases to make binding commitments on their contributions was necessary to avoid participation being limited to a single purchaser.[28]

2. Going beyond compliance

Some poor land management practices, like the overuse of fertilisers and pesticides or not safeguarding against run-off, contribute to poor water quality and flooding. Customers should only pay for additional benefits, not compliance with expected standards. To avoid contravening the polluter pays principle, the payment mechanism needs to demonstrate it is rewarding activities that go beyond compliance with the law or good practice that should be expected without payment. If land managers and farmers can demonstrate a basic level of compliance and good practice, they can then access the market for additional paid services.

3. Providing payment upfront

Interventions to deliver slow clean water require significant earthworks and natural engineering in the catchment, as well as ongoing revenue costs for maintenance, land to be set aside and the adoption of alternative farming practices. Contracting, eg for 15 to 20 years, would provide for upfront costs and ongoing maintenance of the scheme and the banking of future savings or revenues could provide the means to finance upfront capital costs.

4. Expertise in engineering and monitoring

Customers need to have confidence in any scheme to deliver the level of water holding capacity and water quality specified. Techniques to model and evaluate the effectiveness of natural infrastructure are still developing and it is likely early schemes would have to include a level of contingency and over-engineering to build confidence. Hydrologists, land engineers and researchers at the forefront of monitoring and specification need to be recruited to calculate how a scheme could be designed and specified. Plus additional expertise would be needed to subject any scheme to independent assurance.

5. Providing confidence to contract

Slow clean water will only be attractive to potential customers if they have confidence in its delivery against a range of different weather events. Building a very high level of flood resilience in the upper catchment does not guarantee there will never be a flood or a water quality issue.

A naturally engineered scheme needs to be designed and monitored so that it is possible, contractually, to assess whether the scheme performed to the standard specified. That is, if the scheme is intended to ensure existing defences function effectively for a one in 100 year event, they will be designed so the high water mark is consistent with defences not overtopping a maximum specified level of rainfall.

6. Capturing the wider environmental benefits

Customers of slow clean water would need to be assured that their purchase was delivered with no net loss to other ecosystem benefits, ie the impact on carbon sequestration, biodiversity and other benefits of the proposed scheme were at least as good as those delivered previously. However, given the type of natural engineering proposed, it is highly likely this will be the case and the focus will be on calculating the additional benefits that could be attributed to the purchasers of slow clean water through natural engineering.

A comprehensive ecosystem assessment of the catchment pre and post-delivery would be necessary to assess the wider environmental benefits it offers. Techniques to model and evaluate environmental benefits are well advanced and would need to be applied at the proposal stage and with a regular programme of monitoring as part of the scheme.

Lessons from around the world

There is a lot of activity in natural engineering around the world, some of it market oriented and some grant funded, but all providing useful intelligence on the effectiveness of various interventions, who the relevant stakeholders are and the challenges faced in delivery.

A US charity, Resources for the Future, has grant funded projects examining the impact of natural infrastructure changes at scale in the Missouri, Mississippi, and Meramec rivers.[29] The World Resources Institute is focused on the stakeholders and existing cost of grey infrastructure and the role forested landscapes could play in source water protection in the US.[30] And the World Business Council for Sustainable Development has launched a Natural Infrastructure for Business platform which helps individual businesses make the case for investment in natural infrastructure.[31]

The International Union for Conservation of Nature and the International Water Association project, Natural Infrastructure in the Nexus, examined the barriers to natural engineering and highlighted that decision makers often lack the information to evaluate and compare natural infrastructure options to business as usual and, therefore, tend to default to hard engineering solutions they understand. It revealed that natural engineering also introduces complexity and uncertainty into system design that engineers are not equipped to address, because it often requires multi-stakeholder engagement and longer time horizons.[32]

Introducing the Natural Infrastructure Scheme

The Natural Infrastructure Scheme (NIS) we are proposing is an area based market in avoided costs , delivering environmental improvements by bringing groups of land managers together to sell environmental services to groups of beneficiaries.

The scheme is a mechanism for delivering multi-buyer and multi-seller contracts for large scale interventions in the upper catchment, which result in slow clean water for downstream customers.

The avoided costs of defending before a flood event and repair afterwards, along with joint contracting that shares the cost amongst the beneficiaries, delivers a saving to all. The stream of future savings can be banked to fund upfront capital investment and long term maintenance of the NIS.

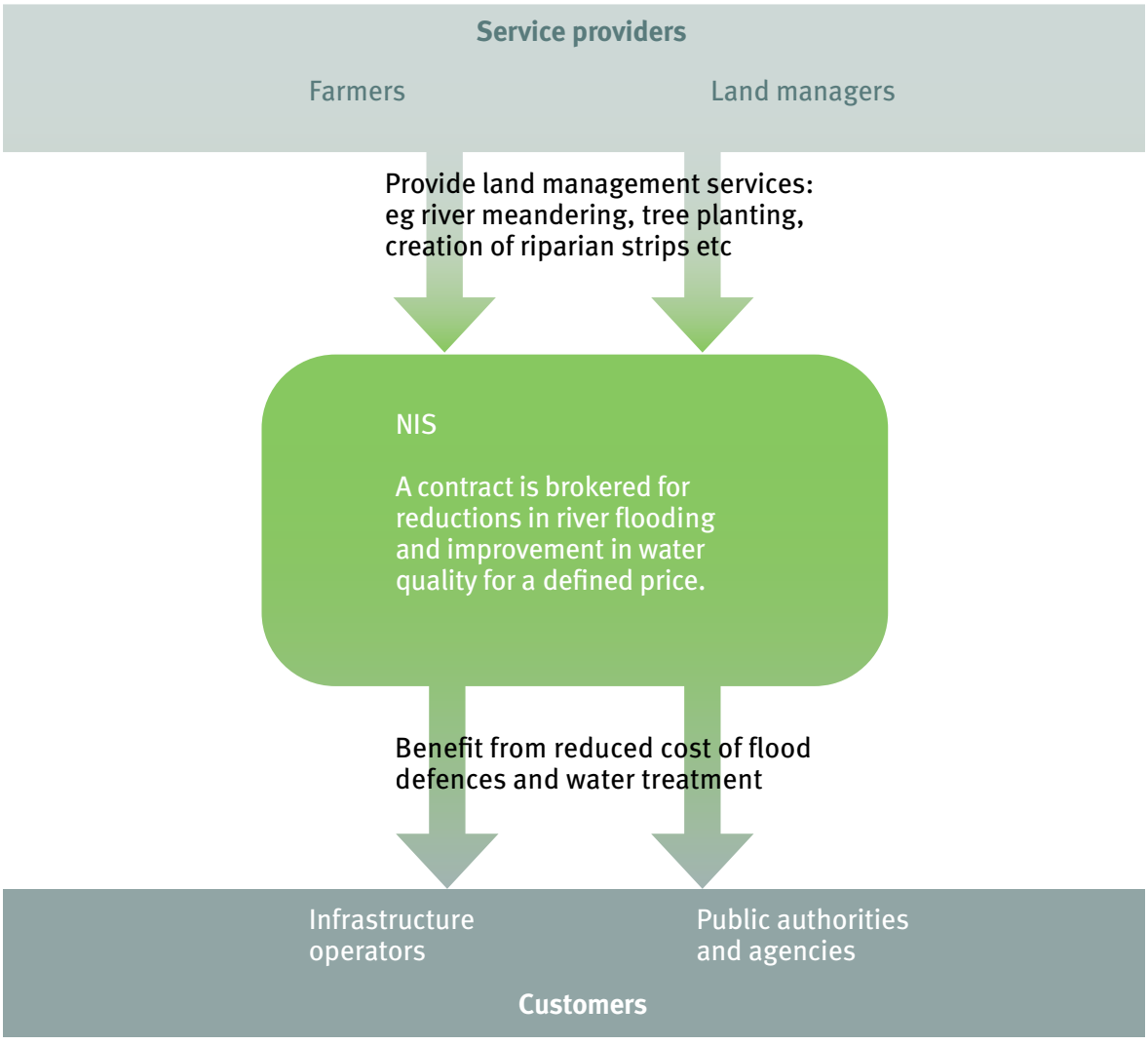
The buy and sell sides are both organised into consortia. On the sell side, the consortium comprises enough land managers in the catchment to ensure the effectiveness of their offer. On the buy side the consortium would include the major institutional beneficiaries of flood mitigation and improved water quality downstream, eg Network Rail, the Highways Agency, water companies, energy companies and electricity network operators, local authorities, the Environment Agency and reinsurers.

To develop a NIS, a designer works with and on behalf of a land managers' consortium to identify the most efficient and effective natural engineering solutions in the catchment. They then create a prospectus that meets the needs of downstream beneficiaries, in terms of risk reduction and water standards, as well as calculating the additional ecosystem benefits delivered by the scheme.

The price for the NIS is the result of bilateral negotiation between the two contracting parties. The contract increases income for land managers and reduces costs for downstream beneficiaries.

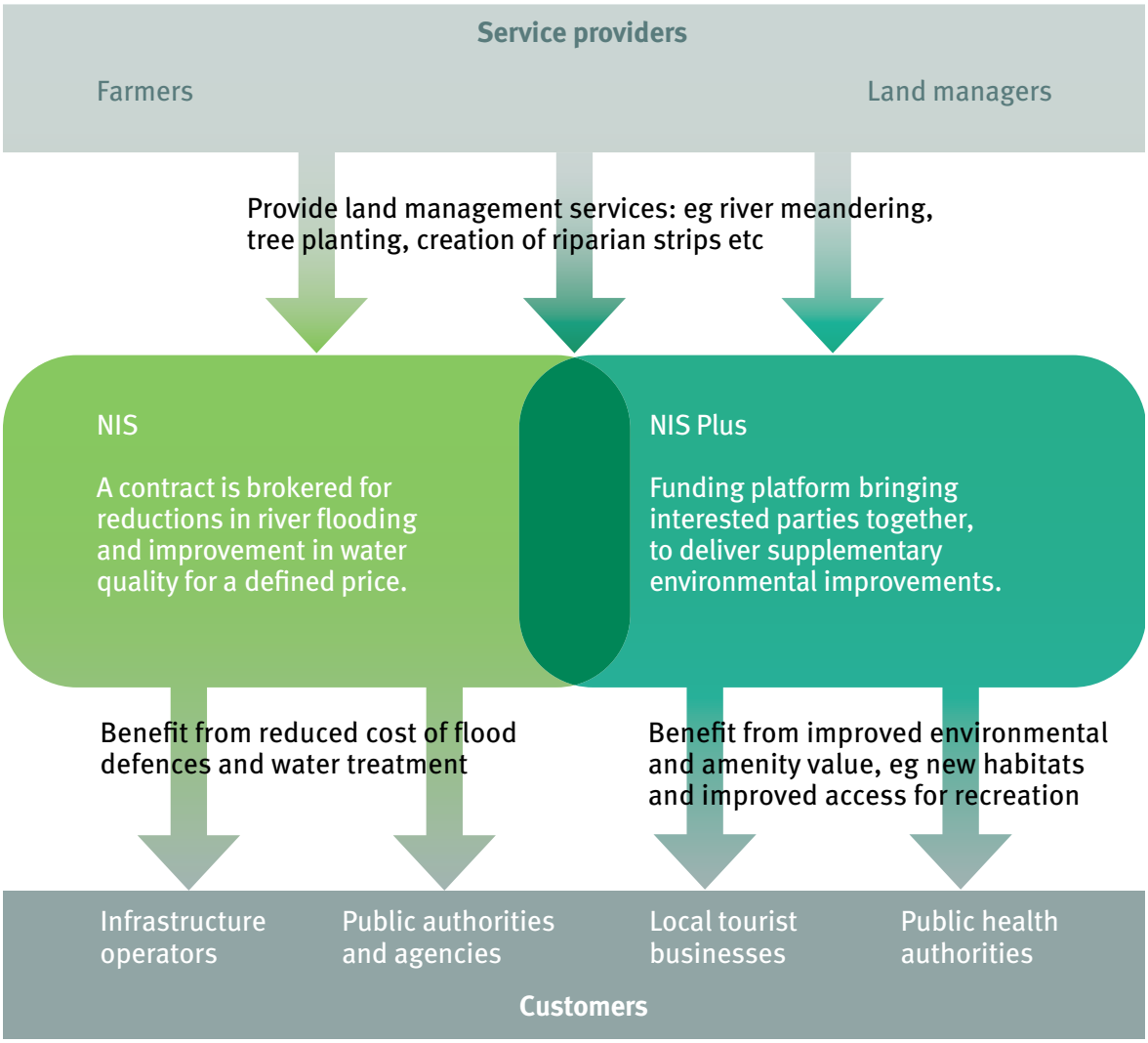
How a Natural Infrastructure Scheme would work

Landowners in a catchment enter into a contract with downstream businesses and public sector organisations to increase the ecosystem services provided by their land and reduce costs incurred by those downstream.



What a NIS Plus would offer

An online NIS Plus funding platform enables local people, tourism businesses, local and national companies and others to fund a set of supplementary land management changes which increase the level of environmental benefits provided under the original NIS.



Adding value with a NIS Plus

Having contracted for the primary service of slow clean water, it would be possible to add additional ecosystem services to the NIS, such as access provisions, more specialist habitat management or landscape enhancement, at relatively low marginal cost, turning it into a NIS Plus.

These services would be offered to a wider set of purchasers to increase revenues to land managers and the environmental value derived from the NIS. The relatively low cost of the supplementary benefits, compared with the cost of buying the same outcomes without the land use change already secured by the NIS, would open up the NIS Plus to a potentially much wider pool of buyers.

How a NIS builds on PES schemes

The NIS builds on the lessons of other Payments for Ecosystem Services schemes but its distinctive features are:

- **It is farmer-led:** It positions land managers, as the sellers of the service, at the forefront of designing natural engineering solutions and delivering the service required by their customers. This differs from most existing conservation and PES schemes, which are buyer-led and require the beneficiary to take on all the intellectual and transactional costs of identifying potential interventions in a catchment, and engaging land managers. A farmer-led NIS draws on the model of existing agricultural co-operatives, marketing groups and similar consortia, and allows land management expertise to lead in delivering outcomes.

- **Payments incentivise change:** Schemes which cannot provide sufficient incentive for the land manager will always function at the periphery of the market. A long term contract for services associated with significant new and reliable income streams has the potential to change land managers' approach to farming. Land managers should always be incentivised to bring forward proposals that offer the least opportunity cost; but the prospect of new income streams supports a more fundamental assessment of opportunity costs and interventions that would most effectively deliver slow clean water.

- **It sells a service based on results:** Naturally engineered assets are owned and managed by the land manager and are, therefore, better integrated into other uses for land. The services sold are contracted on results. Contracts are specified around solution delivery, up to a defined standard, and the risk of non-delivery is borne by the land manager.

- **It is designed for catchment scale delivery:** A catchment scale scheme can be comprehensive in its impact and can deliver a significant change that saves customer money. Schemes that slightly reduce the frequency or extent of flooding or the level of contamination, but do not fundamentally reduce costs downstream, do not release funds by avoiding costs. By reverse engineering the water holding and filtration capacity in the catchment to significantly reduce flood risk and eliminate the need for the most costly elements of water filtration, the NIS is able to offer solutions at scale.

Other applications for a NIS

We have built the NIS concept around the opportunity provided by the scale of avoided costs in slow clean water, but other NIS applications could be possible. All that is necessary is for land managers to provide an ecosystem service to a group of primary purchasers, for less than it costs them to go without it.

If the physical and mental health benefits of nature were better understood, it is possible to imagine local health and social care trusts funding an access and recreation based NIS. The introduction of carbon or biodiversity taxes could support NISs for carbon sinks and habitats.

Similarly, a NIS could be designed to accompany new housing developments in water stressed areas, funded by developer contributions and a proportion of rates. If such a NIS was designed, based on the anticipated impact of the new development on local water supplies, it would also encourage the developer to include water impact minimisation features in the first place.

Bringing Natural Infrastructure Schemes to life

The opportunities in creating a market for ecosystem services from farmland are huge. Realising them will depend on new institutional arrangements on the seller and the buyer sides, and overcoming a number of legal and regulatory barriers.

Land managers' consortium

Institutional arrangements need to be established, particularly on the land managers' side. The consortium needs two capabilities: to design a land management scheme able to deliver slow clean water to a specified standard, and to negotiate an agreement with purchasers.

For farmers to sell water quality and flood resilience they need to understand the market for those services in just the same way as they understand markets for their crops and livestock.

Setting up a NIS is likely to require an agent, acting on behalf of land managers, to co-ordinate all the specialists involved in specifying and designing a NIS, and to negotiate with the buyers.

NIS consortia could build on and learn from current collective agri-environment or catchment management schemes about approaches to delivery planning, and from agricultural co-operatives about joint sales and purchasing.

Area based local purchasing partnership

Water companies, the Environment Agency and local authorities have already begun to work together on flood risk and clean water. But catchment scale action is hindered by no single organisation being able, or willing, to take on an area based responsibility and the costs of managing flood and water quality.

More formal, area based, local purchasing partnerships could be trialled in catchments where traditional defences are unaffordable, according to the standard Environment Agency assessment of costs and benefits. In these catchments, flood resilience can only be delivered through partnership funding. The Environment Agency could be a contributor to funding and perhaps a consortium co-ordinator, expanding on existing partnership funding models for flood defences.

Legal and regulatory barriers

Changing land use and enabling state or regulated organisations to buy ecosystem services will require some special permissions or derogations from normal regulation.

Identifying and addressing the legal and regulatory barriers will be fundamental to the scheme.

On the buy side, regulated businesses, although they typically invest in assets to increase their resilience, are already able to buy resilience as a service instead, so long as those services are cost effective and do not impose an undue share of the cost of public goods on customers.

Price reviews could go further by encouraging regulated bodies to offer customers further savings by participating in area based consortia and purchasing resilience through land use change. A change in regulation or tax rules may be necessary to enable the Environment Agency or local authorities to purchase natural infrastructure services in this way.

On the supply side, CAP derogations, changes to existing agri-environment schemes tenancy agreements or tax relief may be necessary to make a NIS possible. These could be incorporated into the redesign of agricultural subsidies as the UK replaces CAP.

Some of the practical and policy barriers to the natural engineering features that might be required in a NIS include eligibility of land in semi-natural management for agriculture support payments, streamlining planning permission and licensing requirements, and assurances that natural engineering will not increase flood risk elsewhere.

From concept to reality

We envisage the development of a NIS to have three main stages, with three steps in each, designed to overcome the barriers to creating a market in natural engineering. (Further detail is supplied in the annex on page 36.)

The components of the NIS are:

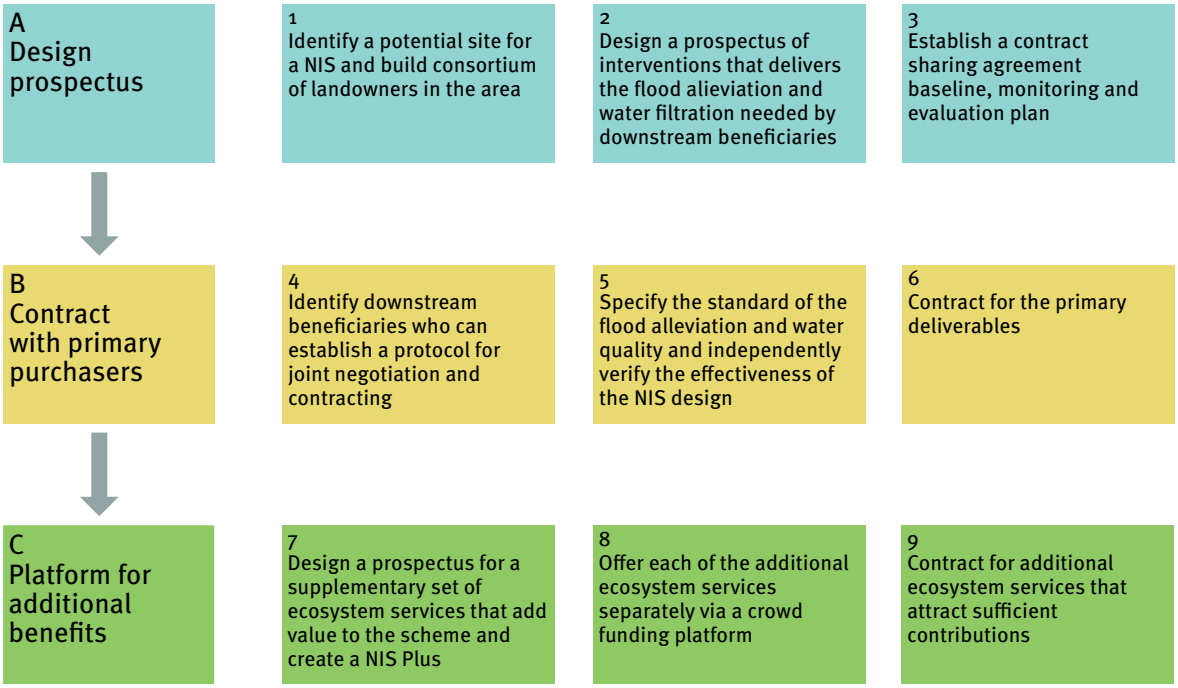
A A scheme prospectus
B A contract with the primary purchasers
C A platform for additional benefits

How informal agricultural co-operatives work

Co-ops account for 80–99 per cent of milk production in Norway, New Zealand and the USA, and 40 per cent of agriculture in Brazil. UK farming co-operatives, like Fram Farmers in Suffolk and Woldmarsh in Lincolnshire, are owned and operated by their members and exist to provide administrative and professional support services, as well as joint negotiating power for crop and livestock inputs and farm machinery. Similarly, farmers can pool their products and sell as a co-operative. United Dairies and First Milk are farmer-owned co-operatives in the UK dairy industry.

A similar combined model which jointly buys in expertise and sell services would be necessary for a NIS.

NIS development



Flood defence partnerships

Lead local flood authorities have responsibility for partnership approaches and encouraging local engagement in flood risk management. However, most funding is now allocated through the Environment Agency using a partnership funding model. Introduced as part of a multi-year capital funding settlement between Defra and Treasury, this requires 15 per cent of total funding to come from non-government sources, equating to roughly £345 million over six years, from 2015-16 to 2020-21. Where private contributions can be raised, more schemes are likely to go ahead than under the previous all or nothing funding system. But, so far, only relatively small amounts of private sector contributions have been secured.[33]

Recommendations

We propose Natural Infrastructure Schemes as a way to create a new market in environmental services from farmed land.

The National Trust and Green Alliance will continue to work with our partners to develop and test this concept.

In due course, a market should be able to function in the absence of special policy or private input, and we have shown that there is a potential market in avoided costs which can, in theory, provide a viable source of funding.

However, for the market to develop and begin to function, additional policy support would enable and greatly accelerate progress.

The following recommendations, if implemented, would accelerate the creation of viable markets for ecosystem services:

Provide seed funding

This would be public and private funding for the initial land manager consortium and area based purchasing partnership costs. Grants to cover the costs of creating institutional arrangements for a number of trial NIS consortia, including a managing agent, technical design advice and brokering services, could be supplied from private interests and public agricultural development funds. This seed funding would not cover capital and maintenance costs of the land management changes, which should be covered by the NIS contract.

Remove policy and regulatory barriers

The government should support policy arrangements to set up NIS consortia and deliver land management objectives. This could include agreement to facilitate the derogations and licences required, and a commitment to consider area based solutions as a component of the resilience requirements placed on public bodies and utilities.

Create space for markets

The government should consider ecosystem services in designing its replacement for CAP in the UK. Any subsidy regime should be carefully targeted to support farming where necessary, whilst incentivising a competitive industry responsive to market opportunities for food and other ecosystem services.

Annex Practical steps to develop a Natural Infrastructure Scheme

1 A Natural Infrastructure Scheme prospectus for slow clean water

The prospectus is the offer from landowners and land managers to the downstream beneficiaries of slow clean water. It specifies a NIS to deliver a level of flood alleviation and water quality in a designated area or river basin, the cost of the scheme to the clients and a contract period. The co-ordination of the supply side, as well as the design and costing, would require an agent working on behalf of the landowners.

Steps	Criteria
1 Identify a potential site and build a consortium of landowners	Market research showing water quality and flood costs faced by downstream customers and the level of protection and water quality that would be consistent with a financial saving. High potential for supply of, and demand for, slow clean water and scope to add value, ie sites with significant local flood, drought and water quality issues, as well as the potential for land management change. Land managers recruited to the scheme should hold a contiguous area of land large enough to affect flooding and water quality outcomes downstream. Land managers may wish to form a consortium, or some other institutional arrangement, to receive joint payments, distribute them amongst themselves and employ the necessary services and skills for the development and delivery of the scheme.
2 Design a prospectus of interventions that delivers the flood alleviation and water filtration needed by downstream beneficiaries	Slowing and filtration of water should be additional to simply complying with existing standards and law. Design should factor in the expectation of changes in land use, climate and hydrology over the contract period. Costs should cover initial capital costs plus ongoing maintenance, and the opportunity cost of land taken out of productive use for the contract period. The scheme should be specified to deliver slow clean water with, at least, no net loss to carbon sinks, biodiversity and recreational amenity of the land before the scheme and, ideally, with significant environmental benefits.
3 Establish contract sharing agreement, baseline, monitoring and evaluation plan	Land managers are to be rewarded in proportion to costs incurred and there is potential for a consortium bidding process to collate offers to contribute to the NIS. Provision needs to be made to limit and cope with parties withdrawing from the deal within the contract period via covenants and other arrangements. An environmental statement covering pre-scheme land use and post-scheme land use and the accompanying environmental conditions, indicators and an evaluation schedule with opportunities to amend land use and management.

2 The contract with primary purchasers

The process of contracting with downstream beneficiaries requires the identification of entities, for instance two to four, most exposed to significant costs from the absence of slow clean water from the initial market research, ie water companies, power companies, the Highways Agency, the Environment Agency, local authorities, reinsurers and large businesses in the local area.

The contract needs to be specified in a way that meets the needs of the beneficiaries, and can be independently verified by them, ie the water holding capacity of the NIS in relation to its ability to maintain the high water mark below X metres or to keep sediment or phosphate levels at less than X parts per million at a particular point in the river. The contract also needs to limit the risks borne by land managers, as flooding and water contamination cannot be completely eliminated, by assuring effectiveness up to a certain level of rainfall consistent with, for example, a one in 100 event.

Downstream beneficiaries will jointly purchase the NIS so, in addition to negotiating the prospectus price with landowners, they will have to negotiate amongst themselves the level of their respective contributions.

Steps	Criteria
4 Identify downstream beneficiaries who can establish a protocol for joint negotiation and contracting	Identify local beneficiaries and engage them on the prospectus offer and its ability to reduce their costs now and over time. A group of beneficiaries may need to enter into a good faith agreement or establish some institutional arrangement to allocate contract costs proportionately amongst themselves. Provision needs to be made to limit and cope with parties withdrawing from the deal within the contract period.
5 Specify flood alleviation and water quality standard in the required and independently verify the effectiveness of the NIS design	Specify the results sought and align with beneficiaries' preference for reduction in risk, eg raising the current level of protection or reducing the high water mark in the river. Similarly, water quality needs to focus on specific pollutants that are a cost to the beneficiary. Beneficiaries should satisfy themselves of the robustness of the scheme proposed. An independent assessment may be necessary to calculate future savings to raise finance and to demonstrate they have taken reasonable actions to exercise their duty of care in respect of their assets, staff etc by using a NIS.
6 Contract for the primary deliverables	Any contract needs to be based on payment by results but allow for the banking of future savings or income, to allow for funding upfront capital costs of the scheme. The negotiated price would be greater than 'the cost of delivering and maintaining the natural interventions in the catchment' + 'the opportunity cost of the land taken out of production' + 'prospectus designer and consortium manager's fee' + 'land managers' profit'. But it would be less than 'the aggregated avoided cost of the purchases' – 'buyers consortium management costs'.

3 Scaling up the benefits with a NIS Plus

Once the primary contract for NIS delivery is agreed there is potential to add value to the scheme and turn it into a NIS Plus. By designing additional components into the scheme it is possible to secure additional income for land managers by offering ecosystem services delivered alongside the NIS. This NIS Plus could have its own prospectus and would be offered to a wider set of beneficiaries, potentially via a crowdfunding platform. To avoid double counting, the services offered would have to be demonstrably additional to those delivered via the original NIS.

Steps	Criteria
7 Design a prospectus for supplementary ecosystem services that add value to the scheme and create a NIS Plus	The service offered will depend on the opportunities in the catchment but would include carbon sinks, biodiversity or health and recreation assets. Each additional ecosystem service should have a minimum scale below which it cannot be delivered and a maximum scale that is feasible within the scheme.
8 Offer each of the additional ecosystem services separately via a crowdfunding platform	Costs should cover the initial capital cost, maintenance and opportunity cost of land taken out of productive use, plus the profit margin for the land managers and the agent's fee. The contract for additional ecosystem services should not be longer than the primary purchaser's contract. Contributions can come from local stakeholders who directly benefit and from purchasers of carbon or biodiversity offsets.
9 Draw up a contract for supplementary services that attract sufficient contributions	Landowners will be rewarded in proportion to costs incurred. The level of funding achieved for each ecosystem service would operate like a threshold for delivery. There is no negotiation, as soon as the funding raised meets the price set the NIS is contracted and payments made.

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