



The
Rivers
Trust

SAVING THE EARTH

A sustainable future for soils and water



ACKNOWLEDGEMENTS

This report was written by Catherine Moncrieff and Zoe Draisey on behalf of WWF. We would like to thank Arlin Rickard of the Rivers Trust, Mark Lloyd and Martin Salter of the Angling Trust, Dave Tickner of WWF and Simon Evans of the Wye and Usk Foundation for their help in developing the ideas in this report.

This is a joint WWF-UK, Angling Trust and Rivers Trust report. The content does not necessarily represent the views of each of the contributors.

For more information please visit wwf.org.uk/chalkstreams
If you would like any further information or have any feedback regarding this report, please contact cmoncrieff@wwf.org.uk or zdraisey@wwf.org.uk

Published April 2018 by WWF-UK.
Any reproduction in full or in part of this publication must mention the title and credit WWF-UK as the copyright owner.
© 2018 WWF-UK. All rights reserved.

Report design: Matt Wood
(madenoise.com)

Cover image:
© Richard Smith: Environment Agency

FOREWORD



Tanya Steele
Chief Executive, WWF-UK

The rivers and streams coursing through Britain are the veins that bring life to every corner of our country. It is our waterways that make the UK landscape so unique and they bring with them such rich and diverse wildlife: from pike and kingfishers, to otters and water avens.

As well as the nature they cradle, rivers are crucial for business, recreation and giving us an enhanced quality of life. It is alarming and depressing that the majority are under threat. This report lays bare the issues surrounding the management of our soils and land, but crucially shows the massive opportunity we have right now to make a difference.

Clean and healthy rivers allow nature to thrive. Protecting and restoring them will ensure future generations can enjoy their glistening waters and the teeming wildlife that count rivers as home.



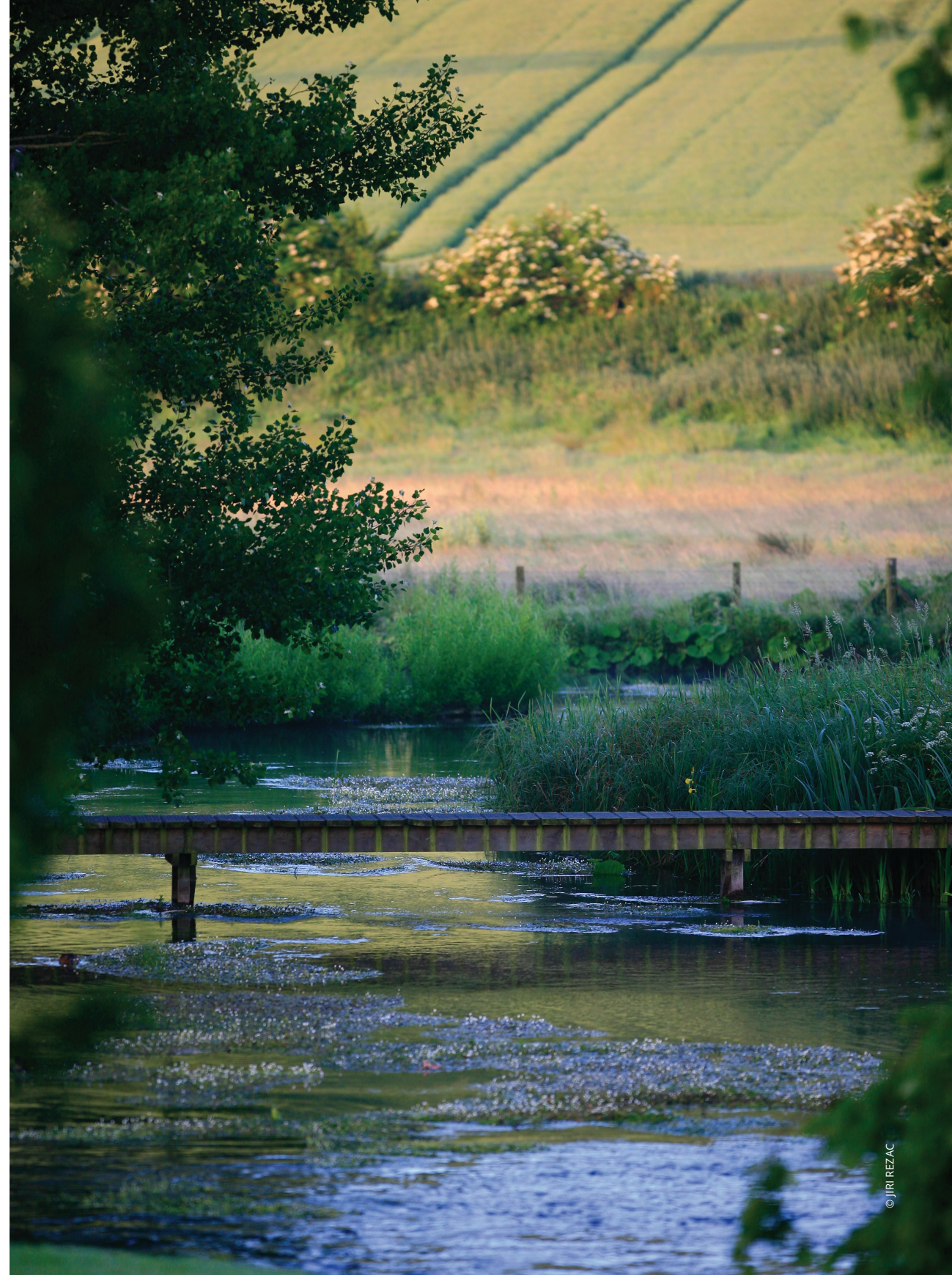
Mark Lloyd
Chief Executive, Angling Trust and Fish Legal

This report is about making an investment of a few million pounds to change the management of millions of acres of land and deliver billions of pounds of benefits to society. Managing soils and agricultural pollutants better would reduce flooding, lock up significant amounts of carbon, produce healthier food, cut water treatment costs and reduce the widespread and endemic pollution of rivers, lakes and coastal waters. It is a no-brainer staring us in the face. Making this a reality will require a mixture of regulation, enforcement and advice, as well as incentives to compensate farmers fully for land-use change in high-risk areas. Real political commitment and a shift in behaviour in the farming sector are needed to drive such change.



Arlin Rickard
Chief Executive,
The Rivers Trust

The government's 25 Year Environment Plan provides us with an opportunity to re-balance the management of farmland to address the often-competing relationship between food production and the provision of vital ecosystem services. These services include clean air and drinking water, flood risk reduction, fisheries and biodiversity, as well as healthy soils. Farmers must be fully rewarded for the delivery of these services but must first meet basic requirements around not polluting rivers and damaging soils. The report highlights how this can be achieved through a combination of free technical advice, underpinned by the firm but fair enforcement of basic regulations. This would provide a solid platform to develop a new outcome-based payment and support programme, where farmers are incentivised to change land use where key ecosystem services are being compromised.



SUMMARY

We are seeing an ongoing decline in river health and aquatic biodiversity. Only 14% of rivers in England are classed as healthy.¹ Poor farming and land management practices are among the main causes² and yet the taxpayer pays £2bn a year³ in subsidies to the agricultural sector. Leaving the Common Agricultural Policy (CAP) presents a unique opportunity to make this money work better for the environment. Governance reform is also required to set clear objectives, increase accountability and to get better value from the billions invested each year by water bill payers and taxpayers.

A range of political and economic pressures over the past 60 years have led to farming practices and land-use choices which are causing:

- Widespread soil degradation, reducing our future food security
- Increased flood risk to homes and businesses
- Pollution of our rivers from sediment, nutrients, chemicals and slurry from agriculture
- Increased costs for local authorities, water bill payers and port authorities.

There is strong evidence to support reform. Standing at £1.2bn, the costs of soil degradation in England and Wales are stark.⁴ There is an economic, environmental and farm productivity benefit in preventing soil degradation. Estimates suggest that soil is being lost at 10 times the rate it's being created.⁵

The government's target of ensuring three-quarters of rivers, lakes and wetlands in England are in good health by 2027 would boost the economy by a total of £8.4bn through increased tourism, recreation, improved flood resilience and enhanced quality of life.⁶

We must act now. If we don't, we risk jeopardising food production and the provision of clean water. Furthermore, leaving the CAP is a one-off opportunity to redirect farming subsidies for the public good. In the 25 Year Environment Plan⁷ and the agriculture bill consultation⁸ the government has signalled clear intentions for reforming agricultural land management to deliver a better and richer environment. This is very welcome and we urge the government to look to our recommendations as a roadmap for success.

This report sets out a framework for a new integrated land management policy for England that addresses this alarming issue and protects soils and water. Historic UK agricultural policy has had at its core the twin objectives of providing affordable food to consumers and maintaining a fair standard of living for farmers. Environmental objectives were later bolted on, meaning that agricultural and environmental policies have never been integrated. Brexit presents a once-in-a-generation opportunity to do things differently. If we are to properly integrate environmental and food productivity objectives, we need a land management policy where environment and food are given equal weight and equal priority.

This report builds on our 'six-point plan' submitted to the Secretary of State, the Rt Hon Michael Gove, by WWF-UK and the Angling Trust in February 2018. This plan included our vision for healthy soil and water:

- **Effective governance for soil and water through catchment-based coordination and delivery, overseen by a national expert decision-making body**
- **Firm but fair regulations for farmers, and credible enforcement**
- **World-leading, streamlined, impartial, expert farm advice**
- **Targeted incentives to enable land-use change on high-risk land.**

Our recommendations for achieving this vision are:

- 1 Establish a clearly defined set of basic environmental rules across all farmland. This would create a level playing field for farmers and create a baseline on which to build future agri-environment schemes. The new farming rules for water are a welcome step but there is no system for identifying those contravening the rules. This needs to be urgently addressed and the rules strengthened.**
- 2 By 2020, bring all exempt slurry storage facilities into the Water Resources (Control of Pollution) Silage, Slurry and Agricultural Fuel Oil (SSAFO) regulations 1991. Currently around 50% of slurry stores are exempt. This creates capacity issues for the storage of slurry and leads to spreading at inappropriate times, risking the health of farmland soils, watercourses and drinking water supplies.**
- 3 Take immediate regulatory action in areas where current measures are insufficient to achieve statutory conservation standards. Particular attention should be given to protected sites. Bespoke regulatory measures, that could take the form of a Water Protection Zone (WPZ), are likely to be needed.**

- 4 *Invest in a fair and effective enforcement regime. WWF research has shown that roughly 20-30% of farmers may be non-compliant with England's water protection legislation. There is already a working model for effective enforcement operating in Scotland which should be rolled out in England.*
- 5 *Introduce targeted environmental payment schemes with specific land-use change objectives. With an effective set of regulatory measures in place and enforced, incentive payments should be introduced weighted towards environmentally beneficial changes in land use. Taking strategic pockets of land out of production or de-intensifying production will not only improve the health of our rivers and reduce soil loss but will deliver a whole host of other benefits including increased biodiversity and carbon storage.*
- 6 *Create a properly funded, well-coordinated and streamlined advice service that adheres to a set of clearly defined objectives set at a local level. This is critical to help farmers and land managers manage the change ahead and for the successful implementation of basic rules and environmental incentives. Advice provision should be separated from enforcement activities, and the multiple advice initiatives should be rationalised to provide greater coherence and ensure high standards. Advice should be coordinated at a local level,*
- pooling skills and resources. To ensure soil and water objectives are met, it's important that this is done in conjunction with – or even by – Catchment Based Approach (CaBA) partnerships.*
- 7 *Government should recognise the significant cost savings associated with investing in enforcement, incentives for land-use change and advice. Against a backdrop of £2bn currently spent on agricultural subsidies in England and the £1.2bn cost associated with soil degradation in England and Wales, the estimated costs in England of enforcement at £5.8m per year, land-use change incentives at less than £500m per year and an increased advisory presence at £3.2m per year are good value for money.*
- 8 *Commit increased and sustained government funding to CaBA partnerships. Clearly mandate them to set objectives for soil and water management and help coordinate delivery and direct payments at a local scale through a single, coordinated planning cycle.*
- 9 *Establish a statutory decision-making body to set strategic objectives for water and land management at the national level. It would make expert judgment on priorities for natural capital enhancement and investment; mechanisms required to tackle serious environmental damage (e.g. WPZs); and gaps in policy and regulation.*

COSTS AND BENEFITS OF SAVING THE EARTH IN ENGLAND

- Our estimated annual cost for enforcement is £5.8m per year for a five-year period, at which point costs would reduce considerably.
- Payments to incentivise land-use change would equate to less than £500m per year based on a subsidy payment of £475 per hectare per year.
- Increasing the advisory presence in each of 50 priority catchments by an average of 1.5 full-time equivalent (FTE) roles would require an additional £3.2m investment per year.

All of these recommendations are critical to the success of the government's aspirations; however, there are actions that the government can take immediately which are achievable and affordable in the short term. These are related to **recommendations 4 and 7** – in ensuring that sufficient resources are provided to the Environment Agency to effectively enforce the farming rules for water starting in April 2018; and **recommendations 2, 3 and 6** – ensuring sufficient slurry storage, safeguarding protected areas through bespoke regulation, and reforming the advice system.

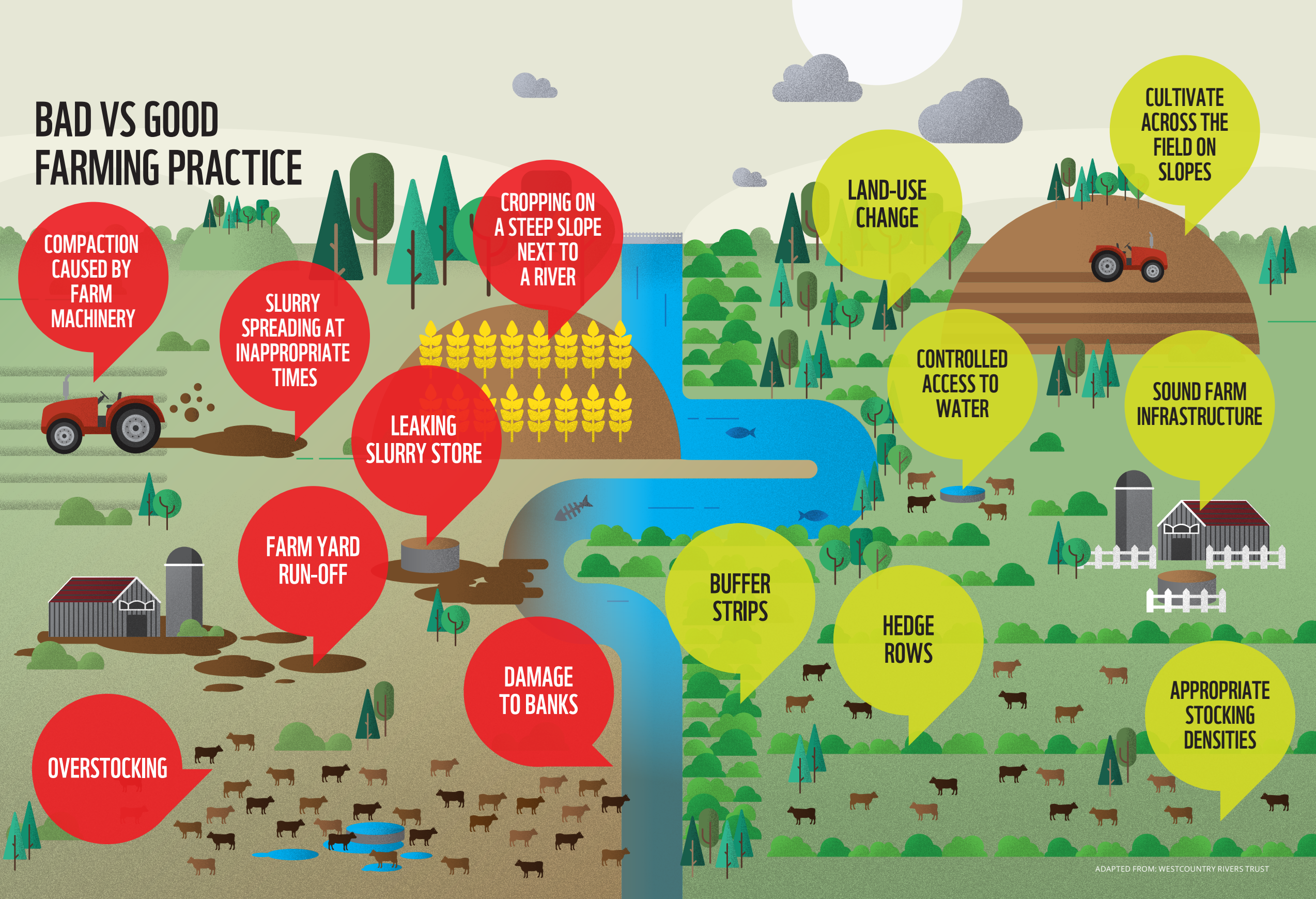




CONTENTS

SECTION 1	
INTRODUCTION	12
SECTION 2	
WHY ARE HEALTHY SOILS SO IMPORTANT?	15
Wildlife impacts	18
Socio-economic impacts	20
SECTION 3	
SOIL DEGRADATION	22
Why is this happening?	26
SECTION 4	
SAVING THE EARTH: A FRAMEWORK	28
Regulation	30
Incentives	40
Advice	47
SECTION 5	
DELIVERING THE FRAMEWORK	51
Resources	51
Resourcing enforcement	51
Resourcing land-use change	52
Resourcing advice delivery	53
Local coordination and delivery	53
National governance	55
REFERENCES	57

BAD VS GOOD FARMING PRACTICE



COMPACTION
CAUSED BY
FARM
MACHINERY

SLURRY
SPREADING AT
INAPPROPRIATE
TIMES

CROPPING ON
A STEEP SLOPE
NEXT TO
A RIVER

LEAKING
SLURRY STORE

FARM YARD
RUN-OFF

OVERSTOCKING

DAMAGE
TO BANKS

LAND-USE
CHANGE

CULTIVATE
ACROSS THE
FIELD ON
SLOPES

CONTROLLED
ACCESS TO
WATER

SOUND FARM
INFRASTRUCTURE

BUFFER
STRIPS

HEDGE
ROWS

APPROPRIATE
STOCKING
DENSITIES

SECTION 1

INTRODUCTION

Our precious rivers are the lifeblood of our society and economy. They are at the heart of our towns and cities, and offer places of recreation for fishing, birdwatching and walking. They provide water for drinking, industry and agriculture. And they are home to some of the UK's most iconic species such as the kingfisher, otter and salmon. England is also home to the majority of the world's chalk streams, unique habitats which are ours to enjoy and protect.

WWF's latest Living Planet Report shows that globally, populations of freshwater species have declined by 81% since 1970, faster than in any other type of habitat on the planet.⁹ Only 14% of our rivers in England are classed as healthy ('Good Ecological Status' as defined by the EU Water Framework Directive).¹⁰ The government's own target of ensuring three-quarters of rivers, lakes and wetlands in England are in good health by 2027 would boost the economy by £8.4bn¹¹ through increased tourism, recreation, improved flood resilience and enhanced quality of life.

Many factors impact the health of our rivers: sewage pollution, pollution from road run-off, and pumping out water for our homes and businesses. We recognise that all sectors need to play their part and work collaboratively to limit damaging abstraction and pollution of our rivers¹². However, the greatest concern, and the focus of this report, is pollution from agriculture.

Agriculture uses around 70% of the land area in the UK¹³ and so has a huge role to play in keeping our rivers healthy. The highest proportion (31%) of all pressures preventing England's waters reaching good health can be attributed to agriculture and land management.¹⁴

The agriculture and land management sector accounts for approximately 75% of the sediment load in watercourses, a widespread and persistent problem in many parts of England.¹⁵ When it rains, degraded soil is washed down farm tracks, through gates, and into field drains and rivers, along with any pesticides, chemical fertilisers and slurry applied to the land. Agricultural chemicals and nutrients also percolate deep into the ground, polluting groundwater.

This is not only bad for rivers and the wildlife that inhabit them, but also for the farms which are losing a valuable resource in the soil and nutrients that are washed away. It is estimated that 2.9 million tonnes of soil are lost from

fields in England and Wales every year, while the annual cost of soil degradation is an estimated £1.2bn.¹⁶ This risks our future food security: in some areas, agricultural output could drop from £480 to £30 per hectare over the next 60 years.¹⁷

Soil degradation causes other costs. Treatment to remove agricultural pollutants from drinking water is very expensive,¹⁸ putting upwards pressure on household water bills. Soil compaction increases rainfall run-off, while sediment in rivers decreases their capacity to carry water and blocks culverts.¹⁹ These things increase flood risk to homes and businesses, with flooding costing the UK £2.2bn a year.²⁰ The public subsidises the agricultural sector in England by approximately £2bn a year through the CAP and the majority of this money (approximately 80%) is spent on subsidising farm incomes.²¹ Redirecting these funds towards improving soil health could lead to substantial savings and benefits.

Improving soil health provides common ground and is our focus in this report. It's good for farm productivity and good for the environment. The condition of our freshwater resources is inextricably linked to the health of our soils. Well-managed soils reduce sediment and nutrient pollution of watercourses and have the capacity to absorb rainfall; this helps to alleviate flood risk in times of high rainfall and maintain base flows when rainfall is scarce. Healthy soils also underpin wider habitat resilience and ecosystem function on which so many of our terrestrial and aquatic species depend.

The importance of soil health is recognised internationally, as demonstrated by the launch of the '4/1000 initiative' at the UN climate talks in Paris in 2015.²² This pledged a commitment to increase soil carbon and stresses the link between soil health, improved agricultural production and the role soil plays in combating climate change.

This report sets out a framework for an integrated land management policy to facilitate the sustainable management of agricultural soils, many of which have been severely degraded since World War II. Our focus is England, although the recommendations have relevance to Wales and other UK nations.

We must act now. If we don't, we risk jeopardising the vital services that soils provide – including food production and clean water. The time is right. Leaving the CAP presents a unique opportunity to make public money work better for the environment. And what we are advocating chimes with the government's aspirations set out in the agriculture bill consultation²³ and the 25 Year Environment Plan²⁴: to bring in a new agricultural policy that is underpinned by public money for the provision of public goods, and achieve sustainably managed soils by 2030.

Protecting and enhancing our soils across the farmed landscape is an issue which requires urgent attention from all stakeholders, from the public, private and third sector. We seek cross-sectoral agreement on the policy mechanisms – financial, regulatory, and institutional – that will most appropriately facilitate a long-lasting solution.

This report builds on the discussion paper released by Wildlife and Countryside Link in September 2017 – *A Future Sustainable Farming and Land Management Policy for England*.²⁵



To retain water on the field and reduce surface erosion, machinery can be used that follows the tractor's tyres and pulls the earth up into dams.

SECTION 2

WHY ARE HEALTHY SOILS SO IMPORTANT?

Farming productivity and functioning ecosystems are underpinned by healthy soils.

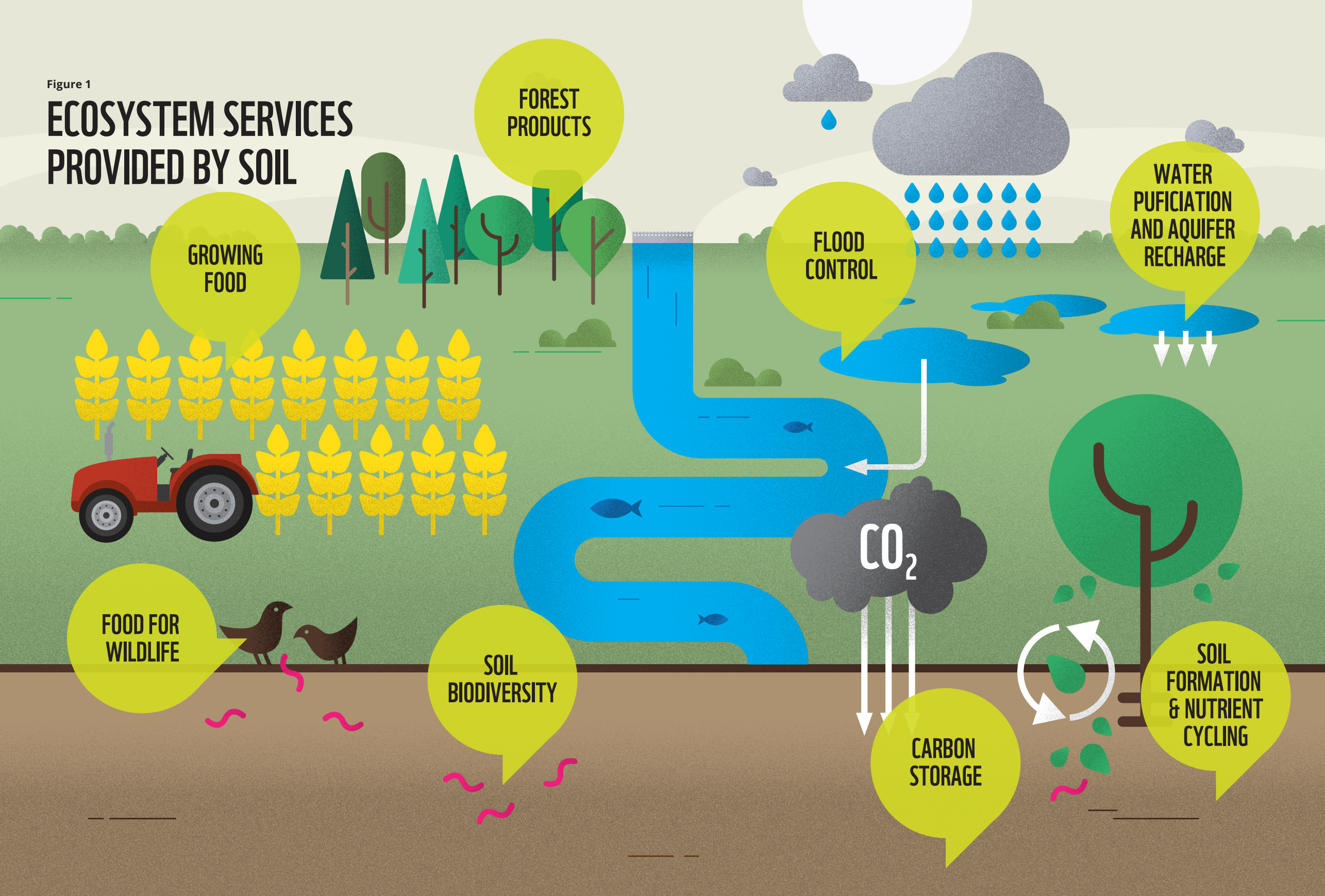
Farming is a crucial industry, providing the food on which we depend for our survival. Since humans began a transition from a predominantly itinerant hunter-gatherer existence to a more settled community structure, the growing of crops and the husbandry of livestock has enabled populations to expand and flourish. However, historical lessons suggest that the desire to increase food production must not outstrip the underlying capacity of nature – embodied in healthy soils – to sustain it. There are examples from around the world where excessive soil erosion has rendered food production systems unviable.²⁶ Ultimately, a fundamental dependency exists between food production and the physical, chemical and biological condition of the soils in which food is grown.

The value of soil extends way beyond its function as a growing medium for agricultural produce. Besides food production there are a host of other 'ecosystem services'²⁷ that flow from healthy soils, such as water purification, biodiversity and nutrient cycling (Figure 1). Sustainable management of this vital natural resource is therefore of crucial importance.

BESIDES FOOD PRODUCTION THERE ARE A HOST OF OTHER 'ECOSYSTEM SERVICES' THAT FLOW FROM HEALTHY SOILS SUCH AS WATER PURIFICATION, BIODIVERSITY AND NUTRIENT CYCLING

Figure 1

ECOSYSTEM SERVICES PROVIDED BY SOIL



WILDLIFE IMPACTS

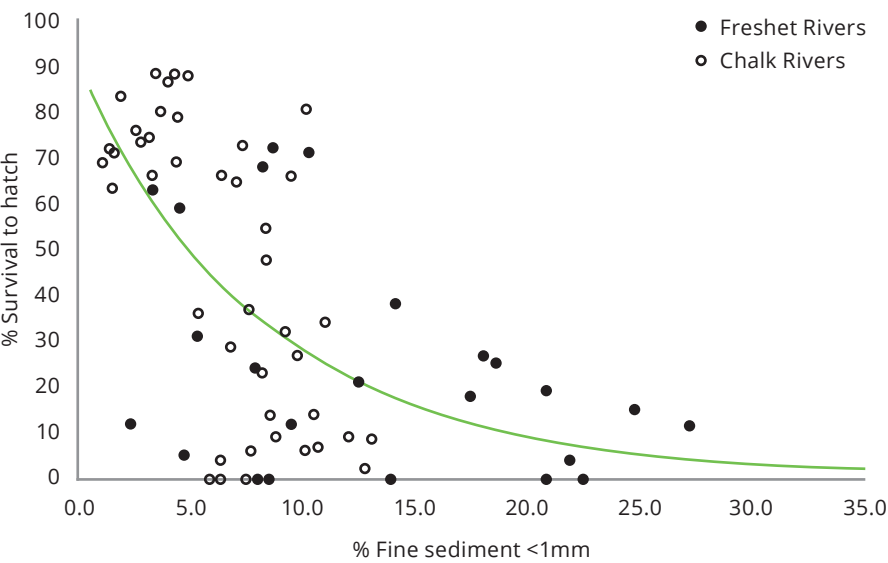
Soil degradation – in particular when fine sediment is washed off into watercourses – is damaging aquatic bugs, fish and plants, and damaging the ecological health of our rivers (Table 1).

Table 1 Impacts on aquatic ecology²⁸

Bugs ²⁹	<ul style="list-style-type: none">• Sediment particles suspended in the watercourse can scratch and damage body parts such as gills and mouthparts.• Fine particles can clog gills, making respiration difficult.• Sediment fills gaps between gravel, reducing the habitat available for bugs to hide from predators.• Sediment deposition affects the chemical environment. Where it has a high organic content, microbial activity can lead to oxygen depletion and a build-up of potentially toxic substances to which many species are sensitive.
Fish	<ul style="list-style-type: none">• Species such as salmon, trout and grayling are particularly susceptible at the egg stage when sediment can smother riverbed gravels.
Plants	<ul style="list-style-type: none">• Suspended particles reduce levels of light in the water column, affecting photosynthesis.• Deposited particles alter the structure and stability of the riverbed, affecting the ability of plants to anchor.• Sediments also carry nutrients which cause eutrophication. This can cause prolific algal growth which depletes the oxygen and light supply for other plants.

Fine sediment has been linked to the significant decline of Atlantic salmon populations in many rivers. As demonstrated in Figure 2, there is a strong negative correlation between embryo survival and the increased volume of fine sediment in host rivers.

Figure 2 Effects of soil degradation on Atlantic salmon populations



Source: Kemp et al. (2011) Hydrological Processes³⁰

Excessive application of organic fertiliser (slurries and manures) and inorganic (chemical) fertiliser which can be washed away with the soil has been shown to have significant negative effects. Eutrophication caused by high concentrations of nutrients from fertilisers reaching the watercourse is a particular problem, causing prolific algal growth.³¹ Algae depletes oxygen supply for aquatic organisms and prevents light entering the water column, compromising photosynthesis and other crucial biological processes. Eutrophication in fresh water is generally caused

by excessive phosphorus, while in estuaries and coastal waters it is often a result of excessive nitrogen.³² Both are linked to fertiliser and soil pollution. An example of the latter problem is Poole Harbour in Dorset where concentrations of nitrogen in the main rivers feeding the harbour (the Frome and Piddle) have increased from an average of 4mg/l in the 1970s to approximately 6mg/l today.³³ This has resulted in mats of algae in the estuary causing a number of well-documented ecological problems such as a reduction in biodiversity and food supply for protected bird species.³⁴

SOCIO-ECONOMIC IMPACTS

The costs of soil degradation are felt at the farm level in terms of reduced productivity, but are mainly experienced by wider society through increased flooding, road accidents, and other impacts. One of the most significant impacts is on water treatment: fertiliser and pesticides can contaminate drinking water resources, resulting in costly treatment to avoid health risks and meet the UK's drinking water standards.

A detailed investigation of soil erosion control measures suggests that the off-site costs of soil erosion exceed the onsite costs of controlling it by a ratio of 30:1.³⁵ The total cost of soil degradation in England and Wales was estimated to be £1.2bn a year according to research undertaken for Defra by Cranfield University in 2011.³⁶ The research quantified a range of impacts in monetary terms, including reduced output of food production, impacts from greenhouse gas emissions, increased flooding and reduced water quality.

Specific examples of sectoral costs include:

- **Harbour dredging:** between 35,000 and 50,000 tonnes of silt are dredged from Fowey Harbour each year with a cost of £90,000.⁴¹ Similar situations to Fowey exist along the length and breadth of the British Isles.
- **Water treatment:** Between 2004-05 and 2008-09, water companies in England spent £189m removing nitrates and £92m removing pesticides from water supplies in order to meet drinking water standards.⁴² The cost of sediment removal is in addition to these costs. For example, in a single catchment, Severn Trent Water spent £160,000 between April 2010 and March 2011 removing sediment to meet drinking water standards.⁴³
- **Damage to roads and flooding:** soil erosion and run-off leaves soil residue on roads (which has to be cleared away) and blocks road drains, flooding adjacent properties and businesses. Data from local authorities indicates that dealing with these impacts costs up to £30m per year.⁴⁴

Box 1 East Anglia – A regional example of the impacts of soil loss

More than half of the most productive farmland in England and Wales is found in East Anglia.³⁷ However, over the last 200 years, 84% of the peat soils in East Anglia have been lost³⁸ and the remainder could disappear in as little as 30 years due to intensive farming practices and a changing climate.³⁹ In some areas, agricultural output could drop from £480 per hectare to £30 per hectare.⁴⁰

Soil running off fields, down farm tracks and onto roads after heavy rain.



SECTION 3

SOIL DEGRADATION

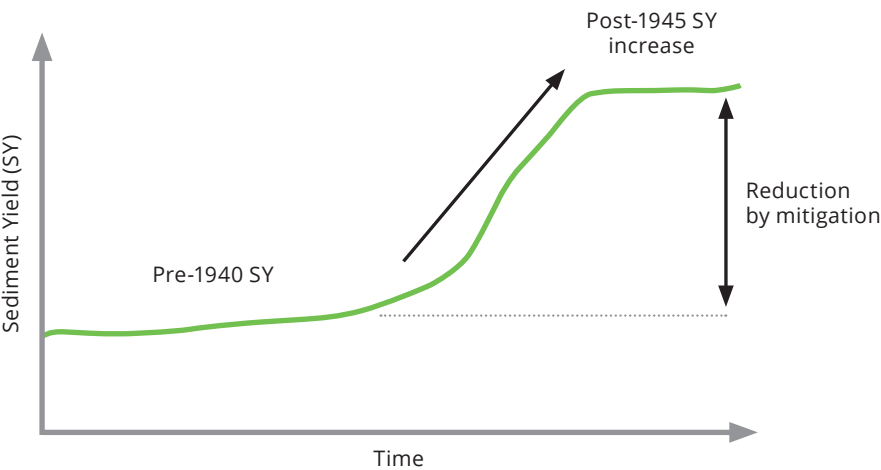
Soil is being lost due to a lack of strategic land management.

We are losing soil at a faster rate than it is being created. Erosion rates in the UK are estimated at <1–20 Mg/ha/yr⁴⁵ compared to typical soil formation rates across Europe of 0.3–1.4 Mg/ha/yr.⁴⁶ Taking the median of these ranges, soil is being lost at approximately 10 times the rate it’s being created. Defra estimates farmers across England and Wales lose 2.9 million tonnes of soil every year, the weight of around 240,000 double-decker buses.⁴⁷ Rates of erosion have increased markedly since 1945 which has coincided with an increased intensification of agricultural production systems.

Soil degradation, in common with many other environmental issues, has become a problem because farmers – in many but not all cases – are effectively working ‘against the grain’ of the natural biophysical capacity of the soils they are managing.

Soil degradation takes many forms including erosion, compaction, loss of organic matter, loss of soil biodiversity, contamination and surface sealing – caused by a variety of agricultural practices⁴⁹ (Table 2). In general non-clay soils, particularly sandy soils, account for a large proportion of erosion costs and clay soils account for a large share of compaction costs.⁵⁰

Figure 3 Soil erosion timeline



Source: Foster et al. 2011⁴⁸

Table 2 Types of soil degradation

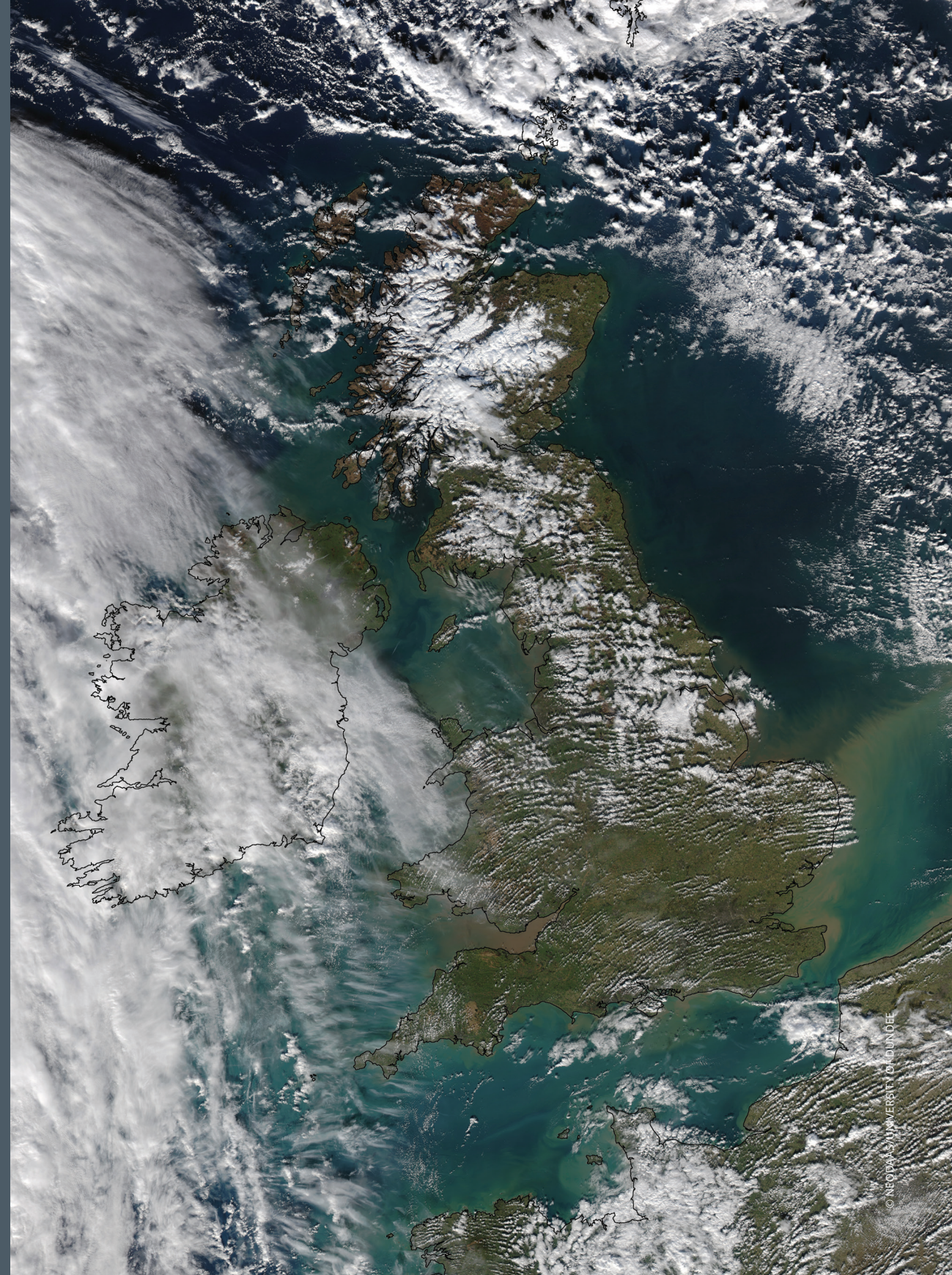
PROBLEM	DESCRIPTION	EXAMPLES OF CAUSES
Erosion	Physical loss of soil from fields	Cultivating high-risk crops such as maize on steep slopes; leaving soils bare after harvest ⁵¹
Soil compaction	Damage to soil structure – e.g. reduced air space and ability to hold water and nutrients; this can also lead to surface sealing, where water is prevented from percolating into the soil	Operating heavy farm machinery over fields in wet conditions, particularly when ploughing or harvesting; ⁵² overstocking grazing animals
Loss of organic matter	Soil organic matter includes all living soil organisms together with the remains of dead organisms in their various degrees of decomposition; it is an important store of carbon ⁵³	Removal of crop residues; mixing oxygen into soil through ploughing, contributing to increased decay of organic matter ⁵⁴
Loss of soil biodiversity	A vast community of living organisms create and refresh soil, keeping it fertile. ⁵⁵ It is estimated that soils are home to over a quarter of all living species ⁵⁶	Application of chemicals such as pesticides and fertilisers, which can affect the reproduction, growth and survival of soil organisms ⁵⁷

Individual parcels of land will each contain different combinations of geology, soil type and topography, and are exposed to different weather patterns and climate. These variables, together with land use, dictate the risk of soil degradation. It is common for farmland to be employed for uses which – for the combination of soil type/slope/climate – lead to soil degradation. Problems will often

arise irrespective of how well the land is managed and how much effort is expended ‘getting the soil right’. An example is growing maize on sloping land with less cohesive soil and high rainfall. Maize is harvested in late autumn, resulting in bare soils at a time of year when exposure to rainfall and associated sediment run-off is very likely.

**DEFRA ESTIMATES FARMERS
ACROSS ENGLAND AND WALES
LOSE 2.9 MILLION TONNES OF
SOIL EVERY YEAR, THE WEIGHT
OF AROUND 240,000 DOUBLE-
DECKER BUSES.**

Satellite image taken on 16 February 2014 following heavy rains. Sediment can be seen being washed out to sea. Poor farming and land management practices are a big contributing factor to sediment loss.



WHY IS THIS HAPPENING?

Farmers do not cause soil degradation deliberately; rather, a range of market forces (such as a drive for cheap food) and technological developments (such as bigger, more powerful tractors) have led them to work the land harder than was the case before 1945. The UK has never had a truly strategic land management policy capable of supporting farmers to deliver a multifunctional and sustainably farmed landscape. Shortfalls in public policy have been fourfold:

- 1 Farmers have not been properly incentivised to protect ecosystems, and the services they provide, due to the lack of integrated policies with regards to the environment.
- 2 Environmental protection regulations have evolved in a haphazard manner, and have failed to penalise the worst offenders while introducing a significant administrative burden on the law-abiding majority.
- 3 Advice available to farmers to manage their land in a more environmentally friendly manner has increasingly become under-resourced and disjointed.
- 4 There has been an absence of guidance on appropriate land-use choices for environmentally vulnerable locations.



© RICHARD SMITH/ENVIRONMENT AGENCY

Box 2 A historical perspective on the agri-environmental policy landscape

Post-war agricultural policy in the UK, both immediately after World War II and since the UK's membership of the European Union, has had at its core the twin objectives of providing affordable food to consumers and maintaining a fair standard of living for farmers. The vehicle for doing this has been subsidies, initially paid on agricultural output and more latterly on the area of agricultural land owned or managed.

Environmental protection was never a feature and this has hampered integrated policy development ever since. A combination of lobbying from environmental groups and a political need to defend the CAP budget against other demands has led to environmental objectives being bolted on. These reforms began in 1992 with the 'MacSharry reforms' where a small proportion of the CAP budget was channelled into environmental schemes, such as Countryside Stewardship. This subsequently became formalised within the 'second pillar' of the CAP. Further increases to the environmental budget followed through Agenda 2000 to the 2005 reforms. However, few of these initiatives focussed on the health of soil and even fewer on water.

These reforms have always been undertaken within the shadow of the 'first pillar' of the CAP – with its core objectives of managing consumer price inflation and assisting farm incomes. Pillar 1 still accounts for approximately 80% of all CAP income received by English farmers.⁵⁸ The majority of farmers signed up to environmental schemes see them as an add-on to the main business of food production.⁵⁹ Thus, along with other EU countries, the UK has never had a strategic policy framework that rewards farmers financially for producing services most appropriate to the land they manage – irrespective of whether these are food or non-food services such as clean water.

SECTION 4

SAVING THE EARTH: A FRAMEWORK

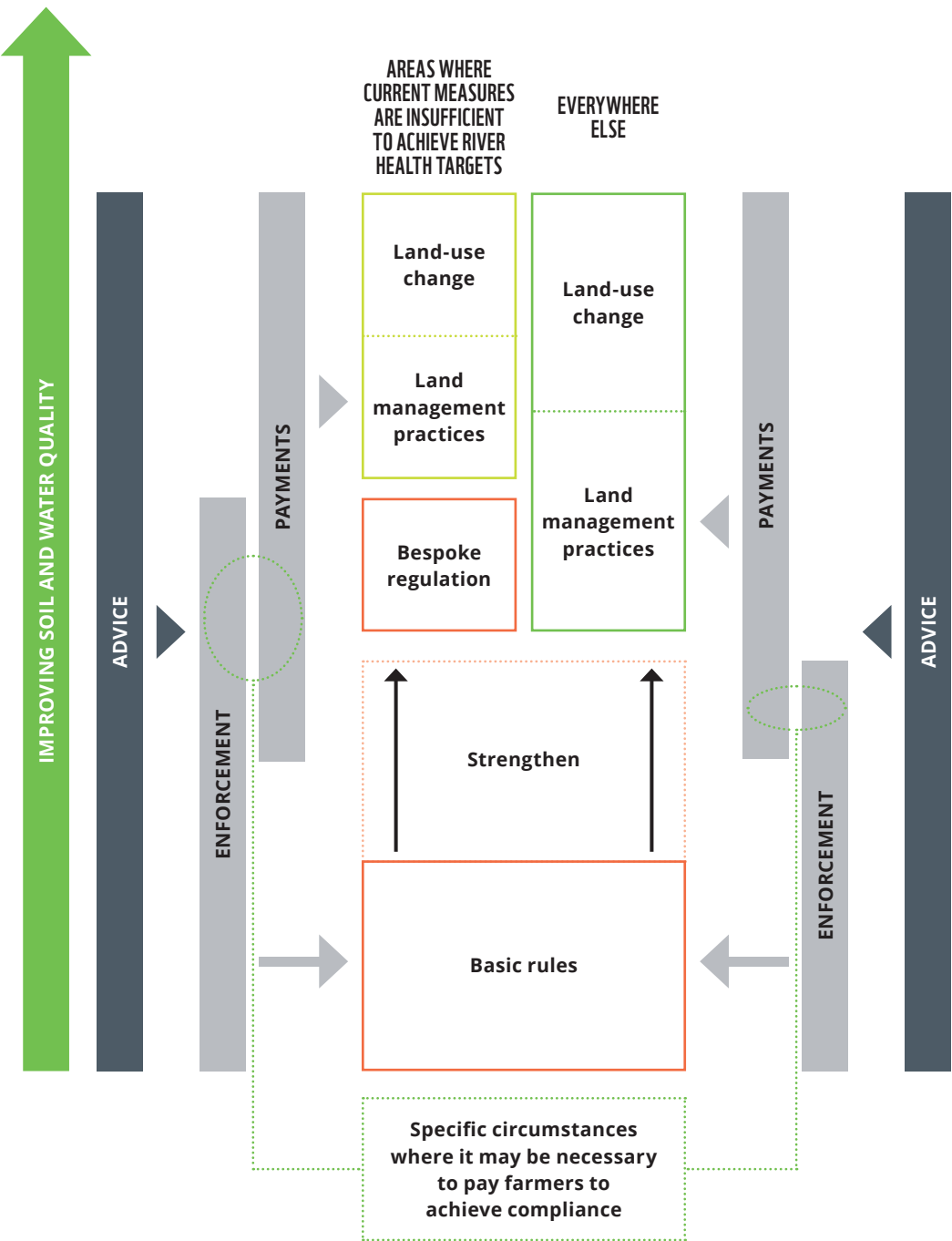
If we are to integrate environmental and food production objectives properly, we need a land management policy where environment and food are given equal weight and equal priority.

In the following sections we set out a suggested framework (Figure 4) – which integrates regulatory, financial and advisory tools – for translating policy goals into on-the-ground delivery. The framework is described through a soil and water management lens, but it is relevant to all aspects of the conservation agenda. For example, planting appropriately managed woodland will provide highly stable

soils with low degradation risk; but will also absorb rainfall which helps to reduce flooding, provide valuable habitat for a variety of fauna and flora, and sequester carbon from the atmosphere. In another example, planting cover crops over the winter months will help to protect soils from winter rainfall and associated run-off, but will also provide a valuable habitat and food source for farmland birds.

IF WE ARE TO INTEGRATE ENVIRONMENTAL AND FOOD PRODUCTION OBJECTIVES PROPERLY, WE NEED A LAND MANAGEMENT POLICY WHERE ENVIRONMENT AND FOOD ARE GIVEN EQUAL WEIGHT AND EQUAL PRIORITY.

Figure 4 Saving the earth: A framework



In summary, our framework delivers the following:

1 Effective governance for soil and water:

- Catchment-based coordination and delivery
- An integrated planning approach that aligns water company, flood risk and river basin plans, overseen by a national expert decision-making body
- Accountability through the new environmental regulator

2 Firm but fair regulations for farmers, and credible enforcement:

- Strengthened farming rules for water with clarified terms and additional rules
- Investment in enforcement of a ‘two strikes’ policy to ensure compliance and drive uptake of farm advice
- Implementation of bespoke regulations such as WPZs where existing measures are insufficient to achieve statutory conservation targets
- Removal of exemptions from slurry regulations

3 World-leading, streamlined, impartial, expert farm advice:

- Rationalisation of the multiple advice initiatives to provide coherent advice targeted at high-risk areas to achieve clear objectives set at a catchment scale

- Provision of training to raise standards
- Separation of advisors from regulators

4 Targeted incentives to enable land-use change:

- Use of farm subsidies to compensate farmers fully for changing land use in areas of highest risk to meet clear objectives to reduce pollution and flooding, and deliver other public goods.

REGULATION

Environmental regulation of the agricultural sector, and its enforcement, has evolved over the years in a haphazard manner. Arguably, it has been driven by political imperatives to justify continued subsidy payments to farmers rather than a genuine desire to incorporate environmental practice within the farming sector. This has often resulted in poorly designed regulatory instruments which are not fit for purpose and frustrate both farmers and regulatory agencies. The most recent example of this is the cross-compliance regulations, introduced in 2005 under the CAP. These regulations have been heavily criticised for burdening the vast majority of law-abiding farmers with onerous inspection procedures and associated paperwork, while failing to target the relatively small number of farm businesses that generate the largest pollution impacts. This approach is both inequitable and economically inefficient.



The use of cover crops between the planting of main crops in the arable rotation can significantly reduce soil loss and nutrient run-off.

Table 3 Summary of current water pollution mitigation measures

	OPTION	DESCRIPTION
Statutory regulations	The Nitrate Vulnerable Zone (NVZ) Regulations (England and Wales)	Require areas of land that drain into waters polluted by nitrates to be designated as Nitrate Vulnerable Zones (NVZs). Farms within NVZs have to follow mandatory rules to tackle nitrate loss from agriculture.
	Anti-Pollution Works Notices (England and Wales)	The Environment Agency has powers to serve notice to remediate or mitigate on “any person who has caused or knowingly permitted poisonous, noxious or polluting matter or any solid waste to be present in controlled waters”.
	Water Protection Zones (England and Wales)	The Secretary of State has the power to designate a Water Protection Zone with a view to controlling the entry of any poisonous, noxious or polluting matter into controlled waters, or to prohibit or restrict those activities that are likely to result in pollution of those waters.
	The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) ‘SSAFO’ Regulations. Under the Water Resources Act (England and Wales)	Require any person who has custody or control of slurry, silage or agricultural fuel oil to keep such materials in appropriate storage and to take precautions for preventing pollution of waters by these materials.
	The Groundwater Regulations (England and Wales)	Under these regulations, it is an offence to discharge a hazardous substance or non-hazardous pollutant to ground waters without a permit. The Environment Agency has powers to serve notices prohibiting activities.
	Integrated Pollution Prevention and Control (IPPC) Directive (England and Wales)	Environmental Permitting Regulations 2010 (EPR) specify that large pig and poultry units have to comply with the IPPC Directive. Producers are required to apply best available techniques and prevent, or reduce, emissions to air, land and water from their activities.
	Farming rules for water (new for 2018) (England only)	Require farmers to manage their land to avoid water pollution (see Table 4). They include a checklist to ensure fertilisers are spread to meet crop and soil needs. Other rules safeguard water quality by requiring farmers to manage the storage of manures and avoid pollution from soil erosion.
	Cross-compliance	A set of environmental management standards farmers must abide by in order to claim payments under the CAP.

Table 3 continued

Incentives	Countryside Stewardship	Provides grants to farmers to undertake management and capital works designed to deliver improvements to habitats, species and natural resource protection. This includes: <ul style="list-style-type: none">• Mid Tier – which offers options, supplements and capital items to achieve simple, but effective environmental benefit (this includes Catchment Sensitive Farming grants)• Higher Tier – this covers the most environmentally significant sites, commons and woodlands• Capital grants.
	Water company grants (e.g. South West Water’s ‘Upstream Thinking’)	Some water companies fund farmers to adopt management practices and capital infrastructure improvements specifically targeted at improving water quality in surface waters from which they abstract water.
Advice	Catchment Sensitive Farming (CSF)	A voluntary initiative providing free advice to farmers, land managers and their advisors on how to reduce diffuse water pollution from agriculture. It was established in 2005 and is delivered by Natural England in partnership with Defra and the Environment Agency.
	A variety of private sector and NGO advice providers (e.g. Rivers Trusts, FWAG, Wildlife Trusts)	These organisations provide similar advice to the CSF, and in some cases deliver advice on behalf of CSF.

The current suite of legal instruments (Table 3) are theoretically capable of dealing with many of the soil degradation and water pollution issues highlighted, but they have not been effectively applied. In particular, regulatory agencies appear to have been reluctant to deploy and/or enforce these instruments fully on account of cost and the politically preferred option of being ‘light touch’ on the farming industry. With the exception of Scotland, there has been no systematic process in the UK for proactively identifying farmers contravening statutory requirements. WWF research in 2014 estimated that 20-30% of farmers may be non-compliant with England’s water protection legislation.⁶⁰

Evidence suggests that cross-compliance has not proved very successful in addressing pollution. The selection of farms for inspection does not appear to be sufficiently risk weighted and the inspection process has largely comprised a paper-based exercise without detailed field-scale observations.⁶¹ For example, WWF research found that the majority of non-compliances registered by the Rural Payments Agency (RPA) related to failure to provide sufficient and/or accurate paperwork;⁶² such failures accounted for 91–98% of all non-compliances against fertiliser management regulations.⁶³

Recommendation 1 – Establish a clearly defined set of basic environmental rules across all farmland. This would create a level playing field for farmers and create a baseline on which to build future agri-environment schemes. The new farming rules for water are a welcome step but there is no system for identifying those contravening the rules. This needs to be urgently addressed and the rules strengthened.

Regulation alone will not enable us to reach soil and river health objectives and other environmental targets, but if implemented, it provides a good start. Importantly, basic rules will set a standard of farm practice that will help secure the status of farmers as ‘good citizens’.

Basic rules underpinning minimum environmental performance are required, with clear definition of the line between ‘polluter pays’ (i.e. those causing pollution bearing the costs of managing it to prevent damage to human health or the environment) and ‘provider gets’ (i.e. those who provide environmental goods and services that go beyond mandatory requirements receiving payments from the public or private sector). This is important for a number of practical and political reasons:

- It clarifies the threshold of minimum good practice, placing farmers and land managers on an equal footing. Many farmers adhering to environmental regulatory requirements express frustration that they ‘do they right thing’ while their neighbours ‘take short cuts and get away with it’. This does not make for a cohesive sector

and it is unfair on the vast majority of farmers who are keen to protect the integrity of their industry.

- It would enable schemes delivering environmental services, funded by the private sector, to flourish. It is difficult for private sector customers and shareholders to sanction expenditure on farming activities while fundamental poor practice continues unabated.
- Taxpayers, the ultimate funders of public sector payments, legitimately want reassurances that they are not subsidising poor environmental practice.
- It underpins the principle of ‘public payments for public goods’.

What constitutes minimum environmental performance and therefore defines the threshold for a set of basic rules is a political football which has been kicked around for years. We believe any set of basic rules should be strengthened as much as possible without placing a substantial cost burden on the farmer. However, there may be certain situations where farmers are unable to comply with even basic regulations (for example, with respect to slurry storage – Box 3) and some grant assistance is needed.

In 2015, Defra consulted on the farming rules for water (applicable to England only). These rules took effect in April 2018 and specify mandatory requirements for the management of nutrients and soils, including the timing of fertiliser applications and other agricultural operations which can have a significant impact on soil degradation and run-off.

However, the basic measures incorporated into the farming rules for water will not be able to deliver the scale of improvement our soil and water resources require. Modelling suggests that applying these rules will achieve only a small percentage reduction (<10%) in phosphorus pollution,⁶⁴ contributing only a very modest improvement to our freshwater environment. These rules should therefore be strengthened with additional measures before their review in three years’ time.

In addition, clear guidance is needed so that farmers understand what is expected of them, and the rules are not too onerous to enforce. The new rules have significant overlap with cross-compliance, and clarification of the interplay between these regulatory regimes is required to avoid confusion and increase compliance.

Table 4 New farming rules for water

Rule 1	planning use of manures and fertilisers
Rule 2	storing organic manures
Rule 3	applying manures or fertilisers
Rule 4	where not to apply organic manures
Rule 5	where not to apply fertiliser
Rule 6	reasonable precautions to prevent soil erosion
Rule 7	protecting against soil erosion by livestock
Rule 8	position of livestock feeders

Recommendation 2 – By 2020, bring all exempt slurry storage facilities into the Water Resources (Control of Pollution) Silage, Slurry and Agricultural Fuel Oil (SSAFO) regulations 1991. Currently around 50% of slurry stores are exempt. This creates capacity issues for the storage of slurry and leads to spreading at inappropriate times, risking the health of farmland soils, watercourses and drinking water supplies.

Urgent action is needed to tackle the problem of excessive application of slurry and manure, which is largely driven by insufficient on-farm storage infrastructure (Box 3). Appropriate storage of slurry and manure, which are highly toxic substances, should be a basic requirement on every livestock farm. To prevent further pollution all exempt slurry storage facilities must be brought into the SSAFO regulations. These set standards for slurry storage facilities but give an exemption for facilities built or upgraded before 1991. Facilities which pre-date 1991 are a significant source of pollution and create an uneven playing field which disadvantages farmers who have invested in complying. This repeal should be undertaken by 2020, accompanied by financial support for farmers. In England, we believe funding could be made available for this via the Rural Development Programme.

Box 3 Soil degradation and slurry management

When soil is lost from fields, substances that are applied to these fields are lost too. In recent years improvements in precision application of chemical (or inorganic) fertiliser has significantly reduced the risk of nutrient leaching from agricultural land. However, run-off from organic fertilisers (slurries and manures) is still a widespread problem,⁶⁵ largely because the high cost of establishing sufficient storage is driving their application to land at inappropriate times. To prevent storage facilities overflowing, farmers are forced to spread their slurry/manure frequently, including when the ground is wet or frozen and when crops do not take up the applied nutrients. Spreading at these times is also associated with soil compaction due to heavy machine traffic over wet soils. Any stores built after 1991 are supposed to have at least four months' storage capacity. Increased stocking densities over the last three decades mean many do not.⁶⁶ Targeted farm visits in one catchment indicate that, of those visited, less than 10% of farms are compliant with SSAFO,⁶⁷ and experience suggests that this is not uncommon in the dairy sector. In addition, a large proportion of slurry stores (around 50%⁶⁸) were built before 1991 and are therefore exempt from the storage capacity regulations. This derogation is considered a major barrier to reducing pollution from organic fertilisers.

One of the key drivers of lack of compliance with SSAFO is the difficulty in securing funds for building slurry stores. There are no government grants, and anecdotal evidence from farmers suggests that banks are unwilling to lend, likely because there is no prospect of a quick payback, and there is no threat of the farm being shut down as a result of enforcement. We suggest that an amnesty with a grant programme is needed to bring all farmers into compliance, followed by ongoing strict enforcement.

Recommendation 3 – Take immediate regulatory action in areas where current measures are insufficient to achieve statutory conservation standards. Particular attention should be given to protected sites. Bespoke regulatory measures, that could take the form of a Water Protection Zone, are likely to be needed.

A balance of evidence and expert judgement should be used to identify areas for regulatory action – i.e. where existing regulations and voluntary measures by farmers and water companies are likely to be insufficient.

Box 4 Protected areas and agricultural pollution

Diffuse pollution from agriculture is the most significant pressure on precious freshwater conservation sites included in the Natura 2000 network of protected areas.⁶⁹ Not only are these rivers and wetlands protected by law, but the government was required to ensure they were healthy by December 2015, a requirement it did not meet. Defra's analysis has repeatedly shown that voluntary action by farmers alone will not come close to dealing with the scale of the problem.⁷⁰ Despite this, in 2015 the government had failed to implement anything other than voluntary approaches, and had not met its legal commitments. So, in 2015 WWF and the Angling Trust sought judicial review of the government's actions.

The resultant court order means that the government has to produce plans detailing how 36 Natura 2000 sites will reach favourable conservation status. However, over two years on, we have seen little progress in identifying what needs to be done at these sites, let alone any new regulations to address the pollution problem.

Recommendation 4 – Invest in a fair and effective enforcement regime. WWF research has shown that roughly 20-30% of farmers may be non-compliant with England's water protection legislation. There is already a working model for effective enforcement operating in Scotland which should be rolled out in England.

Key to the success of the new farming rules for water will be how they are enforced. The Environment Agency will be the regulator for these rules, with current Defra guidance stating that it “will check compliance through its existing programme of work with farmers”. However, existing protocol is that enforcement officers will respond reactively to a serious incident but it is not common practice for them to undertake systematic checks to identify farmers

contravening the rules. Recent data obtained by WWF highlights that the Environment Agency's current resources only allow for visits to <1% of farms each year.⁷¹ Michael Gove, Secretary of State for Environment, Food and Rural Affairs, indicated at the 2018 NFU Farming Conference that the farm inspection regime will be subject to review.⁷²

There are pockets of good enforcement practice in England and Wales – for example, in Herefordshire (Box 5). In Scotland, there is already a working model for enforcement of basic environmental measures with the implementation of the General Binding Rules by the Scottish Environment Protection Agency (SEPA). This collaborative approach combines advice with enforcement through a ‘two strikes’ model. It includes:

- undertaking a thorough baseline assessment of compliance (for

THERE HAS BEEN NO SYSTEMATIC PROCESS IN ENGLAND FOR PROACTIVELY IDENTIFYING FARMERS CONTRAVENING STATUTORY REQUIREMENTS.



Box 5 An approach to enforcement in Herefordshire

In 2015, the Wye catchment partnership initiated the Safeguarding Soils Project in collaboration with the Environment Agency. The project has developed a more effective approach to enforcement of Good Agricultural and Environmental Condition (GAEC) standards. (These GAECs set cross-compliance requirements for farmers to safeguard soils, habitats and landscape features on their farmland, including measures to limit soil and bankside erosion.) In the winter of 2015/2016 Environment Agency staff identified 63 breaches of GAECs.

Initially the approach included soil awareness workshops for minor offences and referrals to the RPA for more serious breaches. However, no action was taken by the RPA to withhold single farm payment and in 2016 this approach was replaced by issuing warning letters to all offenders. The letters stated that if land managers wanted to avoid being issued with Anti-Pollution Works Notices they could contact the Wye and Usk Foundation, who were working with farmers to reduce soil loss. In 2016, satellite imagery in conjunction with risk maps were used to identify farms causing soil erosion, verified by deploying enforcement officers in the field on wet days. Drones were trialled last year.

In 2017, 13 warning letters were issued to landowners. 12 went on to contact the Foundation within 48 hours for advice on how to solve the problem. This demonstrates the power of regulatory presence and consequences for bad practice in prompting non-compliant land managers to take action.

© RICHARD SMITH, ENVIRONMENT AGENCY

example via catchment walkovers), using this to target enforcement and assess uptake (there is potential here to use remote sensing technology such as drones or satellites);

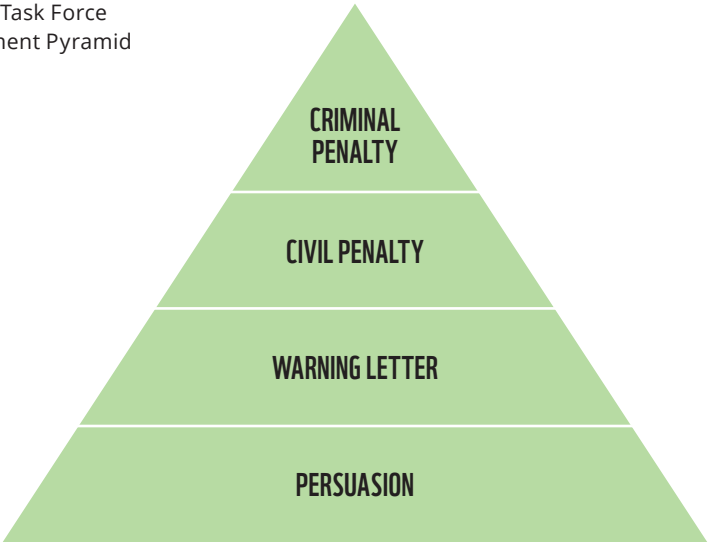
- issuing warnings to polluters and encouraging them to take advantage of free advice to correct problems, followed up by a repeat visit to ensure compliance;
- issuing civil sanctions or prosecutions for failure to address issues, and serious or repeat offences;
- rewarding good practice with fewer inspections.

SEPA’s approach is regarded as equitable and balanced by farmers in Scotland.⁷³ This model would meet the recommendations developed by the Independent Farming Regulation Task Force,⁷⁴ established in 2011 by the coalition government, which are illustrated in Figure 5.

The task force recommendations strongly advocated the use of the Hampton Principles,⁷⁵ which state that the regulatory system should use risk assessment to concentrate resources in the areas that need them the most. It should use performance indicators and allow ‘earned recognition’ to develop, whereby farmers with a proven track record in regulatory compliance receive fewer inspections.

There is also a strong case for integrating private sector inspection regimes (e.g. farm assurance schemes) with state-managed schemes to prevent farmers experiencing multiple inspections. Private schemes should have mandatory standards in place to reinforce adherence to statutory regulations. Complications with data protection and privacy protocols should be resolved so that farm assurance and public agency enforcement regimes can coordinate effectively.

Figure 5 Task Force Enforcement Pyramid



INCENTIVES

Where farmers have complied with the basic regulations, they should move into a situation (as shown by the green boxes in Figure 4) where they can receive payments for conducting land management or land-use changes that further protect soil health and reduce water pollution, as well as delivering other environmental outcomes.

Payments for farmers to undertake environmental activity have been in existence in England for many years, characterised by various ‘stewardship’ schemes. While having biodiversity as a strong driver from the start, these schemes have gradually evolved to incorporate resource protection goals, for example soil and water management. An additional impetus to this aim was provided by CSF capital grants, specifically focussed on improving water quality. These capital grants have now been incorporated into the ‘mid-tier’ category of the new Countryside Stewardship scheme. The key variations in these schemes over the years have related to the degree to which they are ‘broad and shallow’ (measures involving small changes in farming practice on many farms) or ‘narrow and deep’ (measures involving large changes on a few farms), competitive (open to all farmers or selective) and spatially targeted (to address particular geographically relevant outcomes). In essence, the thinking behind the schemes has wrestled with the conundrum of whether to focus available money on specific high-value habitats/landscapes/protection

zones or spread the resources more thinly to provide basic environmental enhancement at scale and involve as many members of the farming community as possible. A balance clearly needs to be struck between encouraging broad participation in these schemes while ensuring farmers are not being paid for doing something that requires little effort, and delivering environmental outcomes to the taxpayer.

These schemes have never set payment rates high enough to incentivise farmers to take up more challenging options on their farms, including land-use change. Research undertaken by WWF in 2011 found that available payment rates of around £210 per hectare for returning cropland to permanent grassland or woodland simply were not sufficient to interest the vast majority of farmers interviewed.⁷⁶ In a 2015 study on the costs and benefits of various erosion control measures in the UK, Posthumus et al⁷⁷ pointed out that while the costs to the farmer of arable reversion options may vary, the payments from the Higher Level Stewardship Scheme are not sufficient compensation on any level.

Recommendation 5 – Introduce targeted environmental payment schemes with specific land-use change objectives. With an effective set of regulatory measures in place and enforced, incentive payments should be introduced weighted towards environmentally beneficial changes in land use. Taking strategic pockets of land out of production or de-intensifying production will not only improve the health of our rivers and reduce soil loss but will deliver a whole host of other benefits including increased biodiversity and carbon storage.

The evidence of need for strategic land-use change is compelling (Box 6); there are several other recent studies⁷⁸ which paint a similar picture. A fundamental change in land use, properly supported by enhanced policy instruments, has to be considered if we are serious about maintaining and restoring functioning ecosystems. Land-use change can include arable reversion, planting of woodland, creation of wetland habitats and moving from temporary to permanent grass.

With careful land-use planning, it should be possible to reduce agricultural production intensity on certain parcels of land while increasing intensity on others, leading to little or no net loss⁷⁹ of food production output.⁸⁰

Box 6 The evidence for land-use change

Over the last decade, significant progress has been made in understanding the efficacy of various mitigation measures on soil erosion and water quality.

Rothamsted Research⁸¹ explored the likely impact of on-farm mitigation measures supported by Countryside Stewardship and CSF grants on reducing sediment in rivers across England and Wales. The study indicates that the current uptake of sediment mitigation measures by farmers is delivering only marginal reductions in sediment loads and the environmental damage costs associated with this. It infers that even doubling or tripling the uptake of existing mitigation measures will be unlikely to reduce levels of sediment to anywhere near target levels for river health.

Another study in the River Rea catchment in Shropshire during 2012⁸² paints a similar picture. The study measured phosphorus levels in watercourses – a pollutant closely associated with soil degradation. This analysis indicates that uptake of existing measures by farmers (including a mix of regulation and agri-environment schemes) will be insufficient to meet legal river health targets. Even with 100% compliance with regulation as well as increased uptake of measures funded under current agri-environment schemes, the model indicates that targets are unlikely to be met.

These studies strongly suggest that in some locations achieving river health targets will not be possible by changing land management practices alone, and to restore our watercourses to good health will, in some cases and areas, require farmers to change the use of the land they farm.

Public payments for such change must be directed at where it will be of greatest value in the provision of biodiversity and ecosystem services – not just where farmers are willing to offer it.

The current emphasis within the new Countryside Stewardship Scheme on targeting payments to deliver local environmental priorities, and putting in place a certain level of competition to facilitate good quality applications and value for money, is a sensible way forward.

But a fundamental shift is required to measures that involve land-use change. To continue along a business-as-usual path is not going to bring about the scale of change that is required to deliver the 25 Year Environment Plan (Figure 6).

Land-use change often involves more complex modifications to farm businesses than changes in land management measures. For example, in the case of a livestock farmer, it could mean less access to grass and/or land for feed cereals, and a need to reduce livestock numbers. However, this does not always have to be the case – particularly where land-use change involves a relatively small percentage of land or land of only marginal productivity.



**IMPROVING AT LEAST
THREE-QUARTERS OF OUR
WATERS TO BE CLOSE TO
THEIR NATURAL STATE**

**ADDRESSING FACTORS
IN SOIL DEGRADATION**

Figure 6 The 25 Year Environment Plan⁸³

The 25 Year Environment Plan makes the government's intentions clear in its aspiration to address issues of soil loss and water pollution. Some of these ambitions are shown here.

**ACHIEVING SUSTAINABLY
MANAGED SOILS
BY 2030**

**ENHANCING OUR NATURAL
CAPITAL - THE AIR, WATER,
SOIL AND ECOSYSTEMS THAT
SUPPORT ALL FORMS OF LIFE**

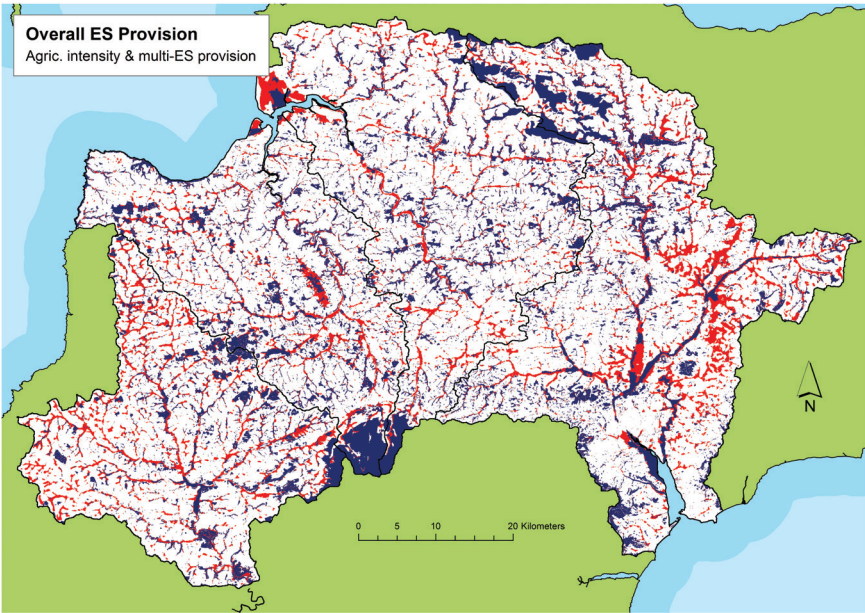
**SUPPORTING FARMERS
TO TURN OVER FIELDS TO
MEADOWS RICH IN HERBS AND
WILDFLOWERS, PLANT MORE
TREES, RESTORE HABITATS
FOR ENDANGERED SPECIES,
RECOVER SOIL FERTILITY AND
ATTRACT WILDLIFE BACK**

With increasingly sophisticated ecosystem service mapping technologies it is possible to define geographical zones and associated measures which are capable of delivering multiple ecosystem benefits simultaneously. For instance, planting a 10-metre belt of woodland either side of a river running between two existing stands of woodland protects the watercourse and provides connectivity between populations of birds, invertebrates and mammals.

Figure 7 outlines a map of four catchments situated on the Devon/Cornwall border in South West England (Tamar, Torridge, Taw and Exe). Units of land coloured red represent land used intensively for

food production while units coloured blue have been identified as land which has the potential to provide multiple ecosystem services. Where the red and blue areas overlap are the strategic areas for land-use change; this represents 7% of the intensively farmed land. While turning these areas to grassland or woodland may present conflict, it will be of far greater benefit than in areas where change is easier but which do not provide the same level of ecosystem services. Change would need to be negotiated, rather than unilaterally imposed. Our suggestions for how such a dialogue might be achieved through suitable governance arrangements are outlined in Section 5.

Figure 7 Map illustrating potential land-use change scenario in South West England



Source: Westcountry Rivers Trust, 2011
Development of a collaborative ecosystem service mapping approach to facilitate the use of strategic evidence in partnership working (2011)
Westcountry Rivers Trust.

- Intensively farmed land
- Land with multiple ecosystem service delivery potential

In some catchments, the case for land-use change will be greater than others. Based on the example above, a 10% shift of intensively farmed land to low intensity or non-farmed land could make a profound contribution to ecosystem protection goals and the aspirations set out in the 25 Year Environment Plan. A survey of landowners assessing the feasibility of a one-off payment for long-term restrictions on marginal farmland in South West England suggested three-quarters would be potentially receptive.⁸⁴

For farmers to adopt land-use change, they will need to be appropriately remunerated. Research undertaken for WWF in 2011⁸⁵ consulted extensively with farmers on this issue and the results were clear: the payments available via agri-environment schemes were simply not sufficient to incentivise land-use change. Then as now, payment levels for publicly funded schemes are based on the concept of income forgone, which does not take into account transaction costs (such as the costs

involved with scheme management) or the economic value of new ecosystem services delivered (such as reduced flood risk). This must change if greater numbers of farmers are to make fundamental changes in how they use their land.

There is an increasing opportunity to leverage private sector funds to co-finance public sector subsidies for changing land management practices and land use. In the short term, an obvious possibility exists within the water industry, where water companies want to invest in protecting raw water resources through catchment management. But there are other sectors which derive benefits from the land that may be prepared to engage, including food/drinks supply chains, energy, transportation, insurance and construction.⁸⁶ There is an opportunity to develop a funding base through private sector payments for the delivery of ecosystem services. An example is the water sensitive farming work funded by Coca-Cola in East Anglia (Box 7).

Silt trap construction on the Salle Estate, Norfolk, to capture agricultural run-off before it enters the River Wensum. This reduces sediment and phosphorus loads entering the watercourses.



Box 7 Scaling water sensitive farming in East Anglia through business engagement

WWF, Coca-Cola and the Norfolk Rivers Trust have been working collaboratively in large areas of East Anglia since 2012 to reduce agricultural pollution affecting three major catchments. This helps to meet Coca-Cola's corporate sustainability "replenish" targets, but also to increase the sustainability of its supply chain. The programme has been working with sugar beet farmers – from some of whom Coca-Cola source sugar for their drinks – to promote water-sensitive farming practices. This has included advice and funds to install silt traps to reduce sediment running off fields into rivers; grow cover crops more widely during winter months; and rehabilitate farm tracks and gateways which have become pathways for water and sediment run-off. Over 100 farmers have embraced these techniques to date, often reporting there are economic benefits to their farming business as well. Respected farm advisors have been key to the success of the programme: they have built good rapport with farmers and used events and various communications channels to promote the techniques, engaging 2,500 farmers across East Anglia.

The programme has supported the development of the Water Stewardship Service within the Rivers Trust, which is bringing together businesses with supply chains in particular catchments to fund collective initiatives that improve river health, as well as improve business sustainability. The idea is that, by pooling effort and the resources of a number of businesses, transformation of farming practice at scale can be achieved. The Courtauld Commitment 2025 Water Ambition, which contains an objective on collective action, is being used to draw in other businesses that might not otherwise engage at the catchment scale and create a critical mass.

© WATER MANAGEMENT ALLIANCE

ADVICE

A lack of historical integration of food productivity with wider environmental objectives is a problem with not only CAP payments but also farm advice provision. Evolution of farm advisory capacity in the UK emerged from the hugely successful efforts to stimulate domestic food production during World War II. Successive post-war governments invested significant resources in developing an agricultural extension service which eventually resulted in the formation of the Agricultural Development and Advisory Service (ADAS) in 1971. Well-resourced, highly skilled in soil management and county-based, with direct links from scientific research through to the individual farmer in the field, ADAS was widely trusted and respected by the farming community. Advisors often worked in the same patch for extended periods of time and consequently had significant social capital with their local farming constituents. However, environmental concerns and the explicit delivery of multiple ecosystem services were not a priority; its expertise was almost entirely focussed on raising food production, in which it was very successful.

Due to changing political ideologies, ADAS was dismantled as a universal state-funded advice service in 1983. At present, advice is delivered by a plethora of different organisations – from the private, public and third sectors. They deliver a variety of environmental advice to farmers, but often without the link to agricultural productivity and farm business

economics which ADAS had excelled at and which resonated with farmers. Funding has been sporadic for these organisations, resulting in staff retention and quality issues.⁸⁷ Importantly, staff turnover has not facilitated building of trust with farmers, who have struggled to engage with a multitude of advisors from different organisations, often with diverging interests, messages and agendas.

Catchment Sensitive Farming (CSF) advice, run by Natural England, is increasingly trying to make the link between environmental and food productivity goals and is also making efforts to coordinate advisory organisations within the areas in which the programme operates. However, CSF funding is still plagued with uncertainty and staff continuity is a significant problem in some areas; coordinating effort between different advice providers has not always proved easy.

There is significant evidence to suggest that those farmers in most need of advice are least likely to be exposed to the advice available. WWF research (2011)⁸⁸ found that very few CSF officers and advisory staff from other extension suppliers undertake any form of cold-calling to locate hard-to-reach farmers. Yet there is substantial anecdotal evidence which links these farmers to high-risk farming practices and associated negative environmental consequences. This is not a criticism of the current advisory personnel in place, more an indication of the limitations in current resource availability and a lack of targeting to reach those doing the most harm.

Recommendation 6 – Create a properly funded, well-coordinated and streamlined advice service that adheres to a set of clearly defined objectives set at a local level. This is critical to help farmers and land managers manage the change ahead and for the successful implementation of basic rules and environmental incentives. Advice provision should be separated from enforcement activities, and the multiple advice initiatives should be rationalised to provide greater coherence and ensure high standards. Advice should be coordinated at a local level, pooling skills and resources. To ensure soil and water objectives are met, it's important that this is done in conjunction with – or even by – Catchment Based Approach (CaBA) partnerships.

Box 8 The Catchment Based Approach (CaBA)

The Catchment Based Approach (CaBA) is a community-based multisector approach that engages people and groups from across society to help improve the water environment. The approach was initiated in 2011, when the government signalled that more locally focussed decision-making and action should sit at the heart of improvements to the water environment. Catchments were considered the natural scale at which to coordinate action on water and land management. The pilot phase was concluded in 2013, and in June 2013 CaBA was launched by Defra Minister Richard Benyon.

CaBA's capacity has grown considerably since its inception, and there are currently CaBA partnerships established to varying degrees in each of the 100+ Water Framework Directive management catchments across England, including those across the Welsh border. CaBA partnerships are hosted or co-hosted by different organisations in each catchment which bring together other stakeholder interests. Hosts include local Rivers Trusts, Wildlife Trusts, county councils and water companies. All partnerships have engaged their local water company, and almost all have developed a catchment vision and action plan.

CaBA partnerships have proved successful in coordinating and delivering environmental initiatives, acting as a bridge between the ambitions described in the river basin management plans and on-the-ground delivery within a wider socio-economic context. CaBA partnerships have a reputation for effective stakeholder engagement and the ability to act as an ethical broker. CaBA represents a good return on investment: for every £1 directly invested by government, the partnerships have raised £8.63 from non-governmental funders.⁸⁹

More information can be found on CaBA's website: www.catchmentbasedapproach.org. Defra's initial framework for a Catchment Based Approach (2013) can be found here: www.gov.uk/government/publications/catchment-based-approach-improving-the-quality-of-our-water-environment

Farmer knowledge exchange events and field walks can be a very effective means of disseminating agricultural best practice, such as the use of cover crops by the Salle Estate, Norfolk.



Managing land to deliver multiple food and ecosystem benefits is not easy. To implement the types of changes outlined in this paper successfully, farmers will need help from a properly funded advice service, fronted by people on the ground who they know and trust. Bringing the various advice initiatives under one coherent service will avoid multiple visits by multiple advisors with conflicting priorities. It will also pool money, skills and effort between government, water companies, agricultural supply chains, CaBA and NGOs. We propose that all of the advisory bodies should come together for a national meeting to draw up an action plan for reform.

At the local level, there is a need for a stable and experienced resource which coordinates advice provision. Its role would be to ensure farmers are receiving consistent and quality advice under a profitable farming banner, and that different advice organisations are not contacting the same farms and providing conflicting advice. This would avoid inefficient use of resources which can cause frustration and confusion for farmers. Importantly, it would ensure advisors reflect the core objectives identified for the areas they are operating in. This local ‘broker’ could be a CSF resource working in close consultation with local CaBA partnerships, the CaBA partnerships themselves, or another suitable local coordinating body. There is no need to reinvent the wheel: where suitable local partners exist with the requisite skills and trusted relationships with the farming community, we suggest these entities are properly funded to coordinate and deliver advice.

The actual delivery of advice is best undertaken by those individuals with the skills and social capital required to engage effectively with farmers, irrespective of who employs them, be it Natural England, NGOs such as the Rivers Trusts, or private sector players such as water companies.

This advice service should:

- Focus resources on high-risk farms, identified with river health data, new satellite technology, drones, local knowledge and catchment walkovers.
- Include a fund for training advisors across a wide range of issues to reduce the number of farm visits but raise their quality.
- Align advice with earned recognition and/or receipt of environmental payments.
- Be better aligned with enforcement activity, so high-risk farms identified by enforcement personnel are signposted to advisors. (However, advice must be separated from enforcement, and carried out by different individuals and organisations; it is too difficult for advisors to build rapport with farmers if they are associated with regulatory enforcement.)

SECTION 5

DELIVERING THE FRAMEWORK

Our framework outlines a long-term land management policy for England which we believe will deliver a thriving farming industry within a functioning ecosystem. This will require collaboration and compromise.

RESOURCES

The resources required to deliver our proposed framework are well within the bounds of economic and political feasibility. We do not seek funding above and beyond that which we believe is already available, though institutional budgets may need to be reallocated and/or re-profiled to deliver the required change.

Recommendation 7 – Government should recognise the significant cost savings associated with investing in enforcement, incentives for land-use change and advice. Against a backdrop of £2bn currently spent on agricultural subsidies in England and the £1.2bn cost associated with soil degradation in England and Wales, the estimated costs in England of enforcement at £5.8m per year, land-use change incentives at less than £500m per year and an increased advisory presence at £3.2m per year are good value for money.

Resourcing enforcement

Robust enforcement of regulations cannot happen without sufficient investment in on-the-ground enforcement officers. Indicative costs can be extrapolated from figures obtained from SEPA in Scotland relating to enforcement of the General Binding Rules, which started in 2015. There, 10 enforcement staff, amounting to an annual cost of approximately £420,000, work on 57 priority catchments. SEPA predicts these catchments will be fully compliant with the General Binding Rules by 2019, at which point the resources required to regulate these catchments will significantly reduce. If we project these resource requirements and associated costs to all 790 operational catchments in England, this equates to an estimated annual enforcement cost of £5.8m per year for a five-year period, at which point costs would reduce considerably. It would only take a 0.5% reduction in the annual £1.2bn costs associated with soil degradation to cover the expense of this enforcement activity. Assuming full or near-full compliance with our proposed regulatory package

outlined in the previous section, the reduction in costs associated with soil degradation is likely to be far greater.

Resourcing land-use change

Financial support will be required to incentivise farmers to make the land-use changes necessary to enable our soils and waters to recover and thrive. How much land-use change will be needed to deliver the desired results is a complex question requiring further scientific analysis. However, scientific teams in the UK are developing workable tools for this purpose.⁹⁰

The area of agricultural land in England is approximately 9.1 million hectares, with around 54% or 4.9 million hectares considered to be ‘croppable land’ in an arable rotation of crops, bare fallow or temporary grassland.⁹¹ Land in an arable rotation tends to be, although not always, associated with higher risks to the natural environment; with land outside a rotation, such as permanent grass, woodland and wetland, being less so.

As an example, if England was to take 10% of land out of arable rotation (around 490,000 hectares) into permanent grass, the compensation due to farmers would equate to around £230m per year based on a subsidy payment of £475 per hectare per year.⁹² Given that conversion of land to woodland or wetland may cost more, and that the transaction costs of delivering such schemes, such as administration and running costs, have not been factored in, this is likely to be a minimum. However, it gives an order of magnitude, and we can say that costs for strategic land-use change are likely to amount to less than £500m per year.

Farmers in England currently receive around £2bn per year from the CAP budget through both direct payments and ‘second pillar’ payments including agri-environmental grants.⁹³ The government has signalled its intention to phase out direct payments in England and move to a new environmental land management system which will be underpinned by payment of public money for the provision of public goods.⁹⁴ Assuming that farm support is not reduced, the current £2bn a year would easily provide for a 10% land-use shift and leave significant room for investment in other environmental objectives as well as farm business productivity. In addition to public money, there is also potential for land-use change to be supplemented by finance from the private sector through payments for ecosystem services.

Farmers should be encouraged to coordinate their activities across multiple holdings to enable ecosystem connectivity at a landscape scale where possible.⁹⁵

We have not focused on the detail of how schemes oriented around land-use change would work; considerable discussion involving a multitude of stakeholders will be required, with the farming sector taking a lead role. However, long-term agreements with landowners – of the order of 25 years plus – would be preferable⁹⁶ to ensure stable ecosystem protection. Payment rates could be indexed to the length of time a farmer is prepared to engage their land: for example, the longer the agreement, the higher the payment. Innovative mechanisms such as reverse auctions might also be an option to

ensure economic efficiency – for example, Wessex Water’s Entrade scheme, where farmers offering the greatest reductions in nitrate pollution at the lowest cost are awarded funding.⁹⁷

Resourcing advice delivery

An assessment undertaken⁹⁸ in England indicates that the need for additional advice resources will vary significantly depending on the scale and complexity of different geographical contexts. An estimation of the human resources and costs necessary for CSF to deliver appropriate levels of service was undertaken within three very different study catchments, the Caudworthy (Cornwall), Rea (Worcestershire) and Lugg (Powys/Herefordshire). This analysis suggested no increase was needed in the Caudworthy, an increase from 0.3 to 0.6 full-time equivalent (FTE) roles in the Rea, and an increase from 0.5 to 2.4 FTE in the Lugg. Using these figures to provide an illustrative estimate, increasing an advisory presence in 50 catchments (approximately half of those in England) by an average of 1.5 FTE would require an additional investment of £3.2m per year.⁹⁹ Given the proven ability of advisors to make a significant impact on farming practice,¹⁰⁰ there is a strong case that this is an investment worth making.

LOCAL COORDINATION AND DELIVERY

Significant coordination and collaboration is needed to make the proposed policy framework a reality on the ground. Farmers need to understand and buy in to the activities to which they are being asked to adhere. Those parcels of land best suited to land-use change need to be identified and agreed by all relevant parties. And the advice available to farmers needs to be targeted at those individuals in most need of it.

Recommendation 8 – Commit increased and sustained government funding to CaBA partnerships. Clearly mandate them to set objectives for soil and water management and help coordinate delivery and direct payments at a local scale through a single, coordinated planning cycle.

We propose that the delivery of our framework is best achieved through local multistakeholder partnerships, and that the catchment scale is the most appropriate scale at which to manage soil degradation and water pollution. An integrated, streamlined planning process is needed that identifies the key priorities in particular catchments to deliver national objectives.

CaBA partnerships have the potential to act as the beating heart of our suggested framework. We propose that the government clearly mandates – and commits increased and sustained funding to – CaBA (or similar partnerships) to set objectives and coordinate delivery for soil and water management at a local scale. Our aspiration is that planning activities such as water company business plans, river basin management plans, local authority local plans and flood risk management plans are better aligned and synchronised. CaBA partnerships or similar should have a key role in integrating water-related planning activities taking place at the catchment scale with those planning processes occurring at other levels – for example, Nature Improvement Areas, Local Nature Partnerships, Biosphere Reserves, and Area of Outstanding Natural Beauty (AONB) plans. Only through such horizontal integration between different geographies and interest groups will it be possible to secure land-use planning which works at different scales to deliver multiple ecosystem services and which considers the trade-offs that may need to be made.

To operate effectively, CaBA partnerships need a mandate to influence how agri-environment expenditure is targeted locally, and a role in coordinating advice provision. This will ensure incentives and advice are properly integrated with the agreed objectives for soil and water management of the catchment, and that partnerships provide a joined-up offering to farmers so that they are clear what they are being asked to deliver and are not confused by different interest groups' agendas.

Ultimately, a multifunctioning ecosystem at a landscape scale can only be delivered by the owners/managers of the land, so it is crucial they are on board with objectives and heavily engaged in the design and delivery of initiatives that affect them.

The current funding for the CaBA partnerships is insufficient to perform the complex coordinating and facilitation role they have the potential to perform. Extensive international experience of integrated catchment management has shown that genuine cross-sectoral and multistakeholder engagement takes time and requires well-resourced staff. The current funding arrangements of £15,000 per CaBA host should be reviewed as soon as possible.

To maximise the benefits of synergy, revenue streams such as subsidies to landowners, water company investments, natural flood management finance and grants-in-aid should be directed to the collaborative delivery of catchment objectives. There is also much scope for innovative finance mechanisms – for example, use of funding linked to enforcement undertakings issued by the Environment Agency for environmental offences, or reverse auction schemes such as Wessex Water's Entrade scheme described above.

NATIONAL GOVERNANCE

Better governance at a national level is needed. Our collective experience working with multiple stakeholders over several decades indicates there is a lack of strategic decision-making with respect to land and water. As witnessed with the response to the 2015 court order on WPZs (Box 4) and our previous judicial review in 2010, the Environment Agency spends significant resources gathering evidence and engaging stakeholders, yet does not have the mandate and resources to drive significant improvements. River basin management plans are merely progress reports and lists of problems, rather than strategic plans which set a clear direction, timetable and priorities.

Recommendation 9 – Establish a statutory decision-making body to set strategic objectives for water and land management at the national level. It would make expert judgment on priorities for natural capital enhancement and investment; mechanisms required to tackle serious environmental damage (e.g. WPZs); and gaps in policy and regulation.

There needs to be a statutory decision-making body to set strategic objectives for water and land management at the national level. This could be a role for an independent body or embedded within an existing organisation such as the Natural Capital Committee or the Environment Agency. It would review spatial/temporal information on river and soil health; outputs from modelling of land-use measures; flood and drought risk; and information on natural capital assets in order to make expert judgment on:

- priorities for natural capital enhancement and investment
- mechanisms required to tackle serious environmental damage (e.g. WPZs)
- gaps in policy and regulation.

The proposed new environmental watchdog would scrutinise delivery of strategic objectives and hold government to account publicly and potentially through the courts.



REFERENCES

- 1 WWF. 2017. The percentage of rivers at 'good ecological status' in 2016, provided by email on request by the Environment Agency.
- 2 Environment Agency. 2015. Update to the river basin management plans in England National Evidence and Data Report. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/514944/National_evidence_and_data_report.pdf [accessed 12 March 2018].
- 3 Environment Agency. 2015. Update to the river basin management plans in England National Evidence and Data Report. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/514944/National_evidence_and_data_report.pdf [accessed 12 March 2018].
- 4 Cranfield University. 2011. Cost of soil degradation in England and Wales. Report for Defra. Available at: sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16992 [accessed 12 March 2018].
- 5 Defra. 2009. Safeguarding our soils – A strategy for England. Available at: www.defra.gov.uk/environment/quality/land/soil/documents/soil-strategy.pdf; [accessed 27 March 2018]; and: Verheijen, FGA, Jones, RJA, Rickson, RJ and CJ Smith. 2009. Tolerable versus actual soil erosion rates in Europe. *Earth-Science Reviews* 94: 23–38.
- 6 Environment Agency. 2014. Water for life and livelihoods. A consultation on the draft update to the river basin management plan. Part 3: Economic analysis. Available at: www.bawag.co.uk/1/documents/economic-analysis-extended-report.pdf [accessed 27 March 2018].
- 7 HM Government. 2018. A Green Future: Our 25 Year Plan to Improve the Environment. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf [accessed 27 March 2018].
- 8 Defra. 2018. Health and Harmony: the future for food, farming and the environment in a Green Brexit. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/684003/future-farming-environment-consult-document.pdf [accessed 27 March 2018].
- 9 WWF. 2016. Living Planet Report. WWF, Gland, Switzerland.
- 10 WWF. 2017. The percentage of rivers at 'good ecological status' in 2016, provided by email on request by the Environment Agency.
- 11 Environment Agency. 2014. Water for life and livelihoods. A consultation on the draft update to the river basin management plan. Part 3: Economic analysis. Available at: www.bawag.co.uk/1/documents/economic-analysis-extended-report.pdf [accessed 27 March 2018].
- 12 See WWF reports on abstraction and sewage: WWF. 2017. Water for Wildlife: Tackling Drought and Unsustainable Abstraction; and WWF. 2017. Flushed Away: How Sewage is Still Polluting the Rivers of England and Wales.
- 13 Defra. 2015. Farming Statistics: Provisional crop areas and livestock populations. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/468190/

- structure-jun2015prov-UK-15oct15.pdf [accessed 12 March 2018].
- 14 Environment Agency. 2015. Update to the river basin management plans in England National Evidence and Data Report. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/514944/National_evidence_and_data_report.pdf [accessed 12 March 2018].
 - 15 Collins, AL & Zhang, Y. 2016. Exceedance of modern 'background' fine-grained sediment delivery to rivers due to current agricultural land use and uptake of water pollution mitigation options across England and Wales. *Environmental Science & Policy* 61: 61–73; and Environment Agency. 2015. Update to the river basin management plans in England National Evidence and Data Report. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/514944/National_evidence_and_data_report.pdf [accessed 12 March 2018].
 - 16 Cranfield University. 2011. Cost of soil degradation in England and Wales. Report for Defra. Available at: sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16992 [accessed 12 March 2018].
 - 17 Tipper, WA. 2017. Protecting our assets: Using Natural Infrastructure Schemes to support sustainable agriculture. Green Alliance. Available at: www.green-alliance.org.uk/resources/protecting_our_assets.pdf [accessed 27 March 2018].
 - 18 Environment Agency. 2014. Progressing towards WFD objectives – the role of agriculture.
 - 19 SEPA. 2010. Engineering in the water environment: good practice guide – sediment management. Available at: www.sepa.org.uk/media/151049/wat-sg-26.pdf [accessed 20 March 2018].
 - 20 Government Office for Science. 2004. Foresight Future Flooding Report.
 - 21 Defra et al. 2016. Agriculture in the United Kingdom. Available at: www.gov.uk/government/collections/agriculture-in-the-united-kingdom [accessed 05 April 2018].
 - 22 Further information available at: Lima-Paris Action Agenda. 2018. Available at: newsroom.unfccc.int/lpaa/agriculture/join-the-41000-initiative-soils-for-food-security-and-climate [accessed 28 March 2018].
 - 23 Defra. 2018. Health and Harmony: the future for food, farming and the environment in a Green Brexit. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/684003/future-farming-environment-consult-document.pdf [accessed 27 March 2018].
 - 24 HM Government. 2018. A Green Future: Our 25 Year Plan to Improve the Environment. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf [accessed 27 March 2018].
 - 25 Wildlife and Countryside Link. 2017. A future Sustainable Farming and Land Management Policy for England. Available at: www.wcl.org.uk/docs/Link%20farming%20and%20land%20use%20policy%20paper%20FINAL%20Sep%202017.pdf [accessed 27 March 2018].
 - 26 Southgate, D and Whitaker, M. 1992. Promoting resource degradation in Latin America: Tropical deforestation, soil erosion, and coastal ecosystem disturbance in Ecuador. *Economic Development and Cultural Change*. 40: 787–807.
 - 27 UK National Ecosystem Assessment. 2011. The UK National Ecosystem Assessment:

- Synthesis of the Key Findings. UNEP-WCMC, Cambridge. Available at: uknea.unep-wcmc.org [accessed 27 March 2018].
- 28 Further details on impacts can be found at the Centre for Ecology and Hydrology. See: www.ceh.ac.uk/our-science/science-areas/water-resources [accessed 27 March 2018].
 - 29 Jones, JI et al. 2011. The Impact of Fine Sediment on Macro-Invertebrates. *River Research and Applications* 8(2): 1055-1071.
 - 30 Kemp, P, Sear, DA, Collins, AL and Jones, JI. 2011. The Impacts of Fine Sediment on Riverine Fish. *Hydrological Processes*. 25(11):1800-1821.
 - 31 See World Resources Institute: www.wri.org/our-work/project/eutrophication-and-hypoxia/sources-eutrophication [accessed 27 March 2018].
 - 32 Natural England. 2015. Diffuse water pollution theme plan. Developing a strategic approach to diffuse water pollution for England's Natura 2000 sites. Available at: www.gov.uk/government/publications/improvement-programme-for-englands-natura-2000-sites-ipens [accessed 28 March 2018].
 - 33 Environment Agency. 2016. DATASHEET: Nitrate vulnerable zone (NVZ) designation 2017. – Eutrophic Waters (Estuaries and Coastal Waters). Available at: apps.environment-agency.gov.uk/static/documents/nvz/NVZ2017_ET1_Poole_Harbour_Datasheet.pdf [accessed 28 March 2018].
 - 34 Diffuse Water Pollution Plan Workshop, 1 February 2018, London. Presentation by the Environment Agency. Restoring Poole Harbour – Evidence Summary.
 - 35 Extrapolated from Posthumus, H et al. 2015. Costs and benefits of erosion control measures in the UK. *Soil Use and Management* 31 (Suppl. 1): 16–33.
 - 36 Cranfield University. 2011. Cost of soil degradation in England and Wales. Report for Defra.
 - 37 Environment Agency. 2009. Water resources strategy. Regional action plan for Anglian region.
 - 38 Tipper, WA. 2017. Protecting our assets: Using Natural Infrastructure Schemes to support sustainable agriculture. Green Alliance. www.green-alliance.org.uk/resources/protecting_our_assets.pdf [accessed 28 March 2018].
 - 39 CCC. 2013. Managing the land in a changing climate. Committee on Climate Change. Available at: www.theccc.org.uk/publication/managing-the-land-in-a-changing-climate [accessed 28 March 2018].
 - 40 Tipper, WA. 2017. Protecting our assets: Using Natural Infrastructure Schemes to support sustainable agriculture. Green Alliance. www.green-alliance.org.uk/resources/protecting_our_assets.pdf [accessed 28 March 2018].
 - 41 WWF. 2006. Soil erosion in England and Wales: causes, consequences and policy options for dealing with the problem. Available at: assets.wwf.org.uk/downloads/soilerosionengwales.pdf [accessed 27 March 2018].
 - 42 National Audit Office. 2010. Tackling diffuse water pollution in England. Report by the Comptroller and Auditor General. London, National Audit Office. HC 188 Session 2010-2011.

- 43 For more information see: Moors for the Future Partnership. 2018. Available at: www.moorsforthefuture.org.uk/water-regulation [accessed 28 March 2018].
- 44 WWF. 2006. Soil erosion in England and Wales: causes, consequences and policy options for dealing with the problem. Available at: assets.wwf.org.uk/downloads/soilerosionengwales.pdf [accessed 27 March 2018].
- 45 Defra. 2009. Safeguarding our soils – A strategy for England. Available at: www.defra.gov.uk/environment/quality/land/soil/documents/soil-strategy.pdf [accessed 28 March 2018].
- 46 Verheijen, FGA, Jones, RJA, Rickson, RJ and CJ Smith. 2009. Tolerable versus actual soil erosion rates in Europe. *Earth-Science Reviews* 94: 23–38.
- 47 Defra Consultation. Department for Environment, Food and Rural Affairs. 2015. New basic rules for farmers to tackle diffuse water pollution from agriculture in England: Impact Assessment. Available at: consult.defra.gov.uk/water/rules-for-diffuse-water-pollution-from-agriculture [accessed 27 March 2018].
- 48 Foster, IDL, Collins, AL, Naden, PS, et al. 2011. The potential for palaeolimnology to determine historic sediment delivery to rivers. *Journal of Palaeolimnology* 45: 287–306.
- 49 For a detailed overview of soil degradation activities see WWF. 2006. Discussion Paper – Soil erosion in England and Wales: causes, consequences and policy options for dealing with the problem. Available at: assets.wwf.org.uk/downloads/soilerosionengwales.pdf [accessed 27 March 2018].
- 50 Cranfield University. 2011. Cost of soil degradation in England and Wales. Report for Defra.
- 51 WWF. 2006. Soil erosion in England and Wales: causes, consequences and policy options for dealing with the problem. Available at: assets.wwf.org.uk/downloads/soilerosionengwales.pdf [accessed 27 March 2018].
- 52 WWF. 2006. Soil erosion in England and Wales: causes, consequences and policy options for dealing with the problem. Available at: assets.wwf.org.uk/downloads/soilerosionengwales.pdf [accessed 27 March 2018].
- 53 European Communities. 2009. Sustainable agriculture and soil conservation project: Fact sheet number 3: Organic matter decline. Available at: eusoils.jrc.ec.europa.eu/projects/SOCO/FactSheets/ENFactSheet-03.pdf [accessed 28 March 2018].
- 54 European Communities. 2009. Sustainable agriculture and soil conservation project: Fact sheet number 3: Organic matter decline. Available at: eusoils.jrc.ec.europa.eu/projects/SOCO/FactSheets/ENFactSheet-03.pdf [accessed 28 March 2018].
- 55 European Commission. 2010. The factory of life. Why soil biodiversity is so important. Available at: ec.europa.eu/environment/archives/soil/pdf/soil_biodiversity_brochure_en.pdf [accessed 28 March 2018].
- 56 European Commission. 2010. The factory of life. Why soil biodiversity is so important. Available at: ec.europa.eu/environment/archives/soil/pdf/soil_biodiversity_brochure_en.pdf [accessed 28 March 2018].
- 57 European Commission. 2010. Soil biodiversity: functions, threats and tools for policy makers. Available at: ec.europa.eu/environment/archives/soil/pdf/biodiversity_report.pdf [accessed 28 March 2018].

- 58 Defra et al. 2016. Agriculture in the United Kingdom. Available at: www.gov.uk/government/collections/agriculture-in-the-united-kingdom [accessed 05 April 2018].
- 59 Burton, J, and Wilson, G. 2006. Injecting social psychology theory into conceptualisations of agricultural agency: towards a post-productivist farmer self-identity. *Journal of Rural Studies* 22: 95–115.
- 60 WWF. 2014. Compliance with Existing Water Protection Legislation and Regulations. Research Report.
- 61 Defra Strategic Evidence And Partnership Project (Component B Report). 2011. A Review Of Current Policy Tools And Funding Mechanisms Available To Address Water Pollution From Agriculture In England.
- 62 WWF. 2014. Compliance with Existing Water Protection Legislation and Regulations. Research Report.
- 63 These include Statutory Management Requirement (SMR) 4, Good Agricultural and Environmental Condition (GAEC) 1 and 19.
- 64 Defra. 2015. Consultation on new basic rules for farmers to tackle diffuse water pollution from agriculture in England. Available at: consult.defra.gov.uk/water/rules-for-diffuse-water-pollution-from-agriculture/supporting_documents/Consultation%20document_New%20basic%20rules%20for%20farmers.pdf [accessed 28 March 2018]. (The <10% estimate is based on modelling undertaken at the consultation phase for the new rules in 2015 which showed between a 2.4% and 6.6% reduction in phosphorus losses from agriculture. The final set of rules are a subset of those rules consulted on (apart from the soil testing, which is new), so they are likely to result in phosphorus losses somewhere between these figures. We are expecting estimates of the contribution of the final set of rules to phosphorus in April 2018, published as part of the impact assessment accompanying the Statutory Instrument.)
- 65 For example see: Wessex 'Reducing Diffuse Pollution from Agriculture' Programme. 2017. Joint Position Statement. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/664749/Reducing_pollution_from_agriculture_position_statement_20170815.pdf [accessed 28 March 2018].
- 66 Defra. 2013. Report of the Joint Government and Industry Slurry Management and Storage Project. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/260397/pb14044-slurry-management-storage-report.pdf [accessed 28 March 2018].
- 67 Environment Agency, 2018. Personal Communication.
- 68 Defra. 2013. Report of the Joint Government and Industry Slurry Management and Storage Project. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/260397/pb14044-slurry-management-storage-report.pdf [accessed 28 March 2018].
- 69 Natural England. 2015. Diffuse water pollution theme plan. Available at: publications.naturalengland.org.uk/publication/5848526737113088 [accessed 12 March 2018].
- 70 WWF-UK, Angling Trust and Fish Legal. 2015. Briefing: WWF-UK, the Angling Trust and Fish Legal take the government to court to stop pollution of our most precious rivers and wetlands. Available at freshwaterhabitats.org.uk/wp-content/uploads/2015/11/WWF-briefing-Judicial-Review-19-20-Nov-2015.pdf

- 71 Freedom of Information request submitted to the Environment Agency, sourced by WWF – Autumn 2017. January 2018.
- 72 Rt Hon Michael Gove MP. 2018. “A Brighter Future for Farming”. Speech at the NFU Farming Conference 2018. Available at: www.gov.uk/government/speeches/a-brighter-future-for-farming [accessed 28 March 2018].
- 73 Feedback provided by Stephen Field, Land Unit Manager, SEPA.
- 74 The report of the independent Farming Regulation Task Force. 2011. Striking a balance: reducing burdens; increasing responsibility; earning recognition. A report on better regulation in farming and food businesses. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/69201/pb13527-farm-reg-task-report.pdf [accessed 28 March 2018].
- 75 For details on the Hampton Principles see: National Audit Office. 2018. Regulatory quality: How regulators are implementing the Hampton vision. Available at: www.nao.org.uk/wp-content/uploads/2008/07/hampton_regulatory_quality.pdf [accessed 28 March 2018].
- 76 Defra Strategic Evidence And Partnership Project (Component B Report). 2011. A Review Of Current Policy Tools And Funding Mechanisms Available To Address Water Pollution From Agriculture In England.
- 77 Posthumus, H et al. 2015. Costs and benefits of erosion control measures in the UK. Soil Use and Management 31 (Suppl. 1): 16–33
- 78 See for example: Rayment, M. 2017. Assessing the costs of Environmental Land Management in the UK. Final Report. A report for the RSPB, the National Trust and The Wildlife Trusts. Available at: www.nationaltrust.org.uk/documents/assessing-the-costs-of-environmental-land-management-in-the-uk-final-report-dec-2017.pdf [accessed 28 March 2018].
- 79 See for example: Phalan, B, Onial, M, Balmford, A and RE Green. 2011. Reconciling Food Production and Biodiversity Conservation: Land Sharing and Land Sparing Compared. Science 333 (6047): 1289-1291.
- 80 Readers should note that the desirability or otherwise of maintaining UK food production at current levels (or increasing production), and how this links to UK food security, is a policy question which goes beyond the scope of this paper and incorporates a necessary debate on diet and health. We simply suggest here the theoretical possibility of adopting a land-sparing model without a loss in agricultural production.
- 81 Collins, AL and Zhang, Y. 2016. Exceedance of modern ‘background’ fine-grained sediment delivery to rivers due to current agricultural land use and uptake of water pollution mitigation options across England and Wales. Environmental Science & Policy 61 (2016): 61–73
- 82 University of East Anglia. 2012. RELU briefing note: Predicting nutrient inputs into rivers.
- 83 HM Government. 2018. A Green Future: Our 25 Year Plan to Improve the Environment Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf [accessed 27 March 2018].

- 84 Smith, L, Inman, A and R Cherrington. 2012. The potential of land conservation agreements for protection of water resources. Environmental Science and Policy 24: 92-100.
- 85 Defra Strategic Evidence And Partnership Project (Component B Report). 2011. A Review Of Current Policy Tools And Funding Mechanisms Available To Address Water Pollution From Agriculture In England.
- 86 See for example: Inman, A. 2013. Market Research for Peatland Conservation. Presentation to IUCN Conference 10 September 13. Available at: www.iucn-uk-peatlandprogramme.org/sites/www.iucn-uk-peatlandprogramme.org/files/MarketResearchPeatlandConservation_Inman.pdf [accessed 28 March 2018].
- 87 For example, the well-respected Farming and Wildlife Advisory Group (FWAG) was forced into administration in 2011. It has managed to re-establish itself under a new legal entity but a stable funding base remains difficult to achieve.
- 88 Defra Strategic Evidence And Partnership Project (Component B Report). 2011. A Review Of Current Policy Tools And Funding Mechanisms Available To Address Water Pollution From Agriculture In England.
- 89 Catchment-Based Approach Monitoring & Evaluation. CaBA Benefits Working Group. November 2017. Available at: <https://catchmentbasedapproach.org/images/2017/CaBA-Monitoring-and-Evaluation-Full--Report-2017.pdf>
- 90 Of note, scientists from various research institutes and universities working on the Defra Test Catchment programme are developing modelling tools capable of predicting the efficacy of various land-use/management change scenarios at local, regional and national scale.
- 91 Defra. 2017. Farming statistics - final land use, livestock populations and agricultural workforce as at 1 June 2017, England. Available at: www.gov.uk/government/statistics/farming-statistics-final-land-use-livestock-populations-and-agricultural-workforce-as-at-1-june-2017-england [accessed 10 April 2018].
- 92 This represents the costs to the farmer of arable reversion. Figure based on (1) initial cost of £115/ha to establish grass (annual cost of £23/ha/yr for first five years); (2) ground let for grazing at £150/ha/yr; (3) a reduction in farm margin by 10%; (4) no changes to fixed costs assumed; (5) no additional support payments included. Data from ADAS and Rothamsted Research as part of the Defra Demonstration Test Catchments (DTC) project. Harris, D. “Economic cases to support ‘effective but unpopular’ farming diffuse pollution measures” [PowerPoint presentation].
- 93 Defra et al. 2016. Agriculture in the United Kingdom. Available at: www.gov.uk/government/collections/agriculture-in-the-united-kingdom [accessed 05 April 2018].
- 94 Defra. 2018. Health and Harmony: the future for food, farming and the environment in a Green Brexit. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/684003/future-farming-environment-consult-document.pdf [accessed 27 March 2018].

- 95 Prager, K. 2015. Agri-environmental collaboratives for landscape management in Europe. *Environmental Sustainability* 12: 59-66.
- 96 For example, see the CLA's 'Land Management Contract' concept. *New Opportunities: How to establish a new land management contract between farmers and society*. Available at: www.cla.org.uk/sites/default/files/HowTo_LMC_Doc2.pdf [accessed 28 March 2018].
- 97 Entrade. 2017. info.entrade.co.uk [accessed 28 March 2018].
- 98 Defra Strategic Evidence And Partnership Project (Component B Report). 2011. *A Review Of Current Policy Tools And Funding Mechanisms Available To Address Water Pollution From Agriculture In England*.
- 99 These costs are based on CSF personnel. Delivery by other organisations might be lower or higher.
- 100 CSF Phase 3 Evaluation Report. Natural England et. al. 2014. *Catchment Sensitive Farming Evaluation Report - Phases 1 to 3 (2006 - 2014)*. Available at: publications.naturalengland.org.uk/publication/6510716011937792 [accessed 28 March 2018].





For a future where people and nature thrive | wwf.org.uk

© 1986 panda symbol and ® "WWF" Registered Trademark of WWF. WWF-UK registered charity (1081247) and in Scotland (SC039593). A company limited by guarantee (4016725)