Opportunities for Policy and Practice

The Demonstration Test Catchments (DTC) research project represents major UK soil/rainfall combinations found on typical English and Welsh farms. Thus, the data collected from this work can be applied to other locations. Water policy focuses on gathering a compelling evidence base for cost-effective mitigation measures. Programmes such as DTC can deliver this at the catchment scale, though it will take decades to confirm successful impacts from targeted on-farm pollution mitigation measures using monitoring data. However modelling techniques, using research data from projects such as DTC, can inform policy, in the short-term, about the technically feasible costs and effectiveness of pollution control measures.

In the context of the decision of the UK to depart the European Union, there remains widespread recognition that mandatory 'basic' measures should be retained as part of the mix of policies designed to protect aquatic resources.

A major barrier to the uptake of diffuse pollution mitigation methods amongst the farming community is a lack of a consistent clear message from a trusted messenger who they meet regularly. Typically, farmers have a strong preference for one-to-one advice delivered on their farm as this is both site-specific and relevant to the hugely varied nature of farms and the people that manage them.

A single one-off transfer of knowledge is insufficient, and advice is required as part of an iterative learning process. Whilst advisors conducting farm visits certainly helps to target interventions, ensuring continuity is essential to build a trusting relationship between the farmer and advisor. Our research indicates that depending on the catchment, different organisations were listened to more for advice, implying it is essential to know who to collaborate with where, to deliver successful extension services. Efforts should be made to ensure farm advisor continuity and to enhance communication and co-ordination amongst the various actors. Policy needs to facilitate and support advisors to collaborate and communicate between themselves to provide farmers with efficient, clear and effective advice.

Policy makers need to invest resources in a properly equipped extension service with the necessary technical and social skills to engage effectively with the agricultural sector. In a time of limited public-sector budgets, it is worth speculating whether resources could be made available from actors within the supply chain, all of which ultimately depend on a sustainable land management system for their continued existence.

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Further Information

Images used supplied by Adie Collins and Shutterstock.

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Acknowledgements

The Demonstration Test Catchment (DTC) project is a multi-partner collaborative research programme comprising academics, farmers, industry experts, environmental organisations and policymakers. DTC explores solutions to improving water quality in agricultural landscapes. The effects of different mitigation measures have been monitored from 2010/11 - 2019 in four river systems: Eden (Cumbria), Avon (Hampshire, Wiltshire), Wensum (Norfolk) and Tamar (Devon/Cornwall). As these catchments represent major UK soil/rainfall combinations found on typical English and Welsh farms the data collected from this work can be applied to other locations. The participation of farmers in the DTC attitudinal survey and the input of ADAS farm advisors in quality assuring the farmer returns from the Avon DTC is gratefully acknowledged.

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Demonstration
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More Information

Visit: **www.demonstratingcatchmentmanagement.net**

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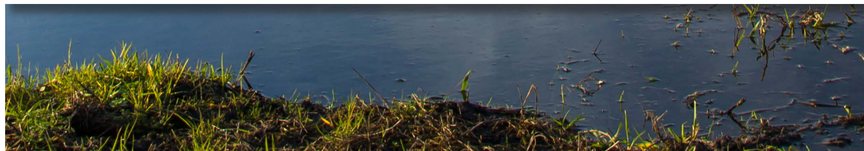
SCIENCE, POLICY AND PRACTICE NOTE 1

Cost-effective 'basic' on-farm measures to reduce water pollution



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The issue

Our fresh water systems need to support our growing population by providing clean water for drinking and food production. Unfortunately, they are being degraded by pollutants, faster than they can be restored, on a local, national and global scale. Typically, these contaminants are derived from urban and non-agricultural sources. However, in 2013, 33% of the UK's surface and ground water bodies failed to achieve 'good' status due to rural/agricultural land management practices that led to slurry, pesticides, fertilisers and soil being washed off farmland into rivers and streams. Excess amounts of diffuse water pollutants affects aquatic life by causing siltation or algal blooms. Currently, farming is the greatest contributor of diffuse water pollutants in England and Wales, accounting for 25% of phosphate, more than 50% of nitrate and 75% of sediment in our rivers.

In April 2018, new government 'Farming Rules for Water' came into effect to mitigate agricultural diffuse water pollution. Tackling these contaminants at their source, on farms, is challenging and potentially costly as pollution risks vary spatially (e.g. manure/slurry stores, soil types, steepness of slope) and temporally (i.e. more likely during wetter months). We need new efficient targeted pollution control measures to enable farmers and land managers to deliver demonstrable environmental outcomes. Our research indicates that if these methods are cost-effective for both the farmer and the public purse they are more likely to be implemented.

Why is soil important?

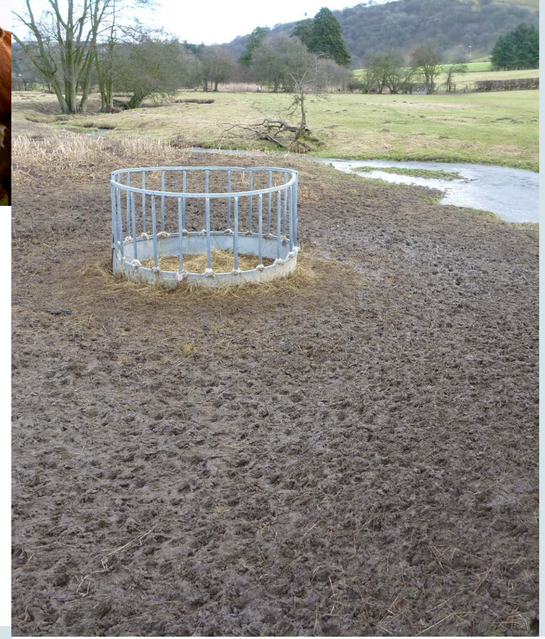
25% of the world's biodiversity is found in soil making it an essential natural resource. Unfortunately, poor soil management causes compaction, run-off, erosion and, consequently, the depletion of organic matter, nutrients and biodiversity, and the degradation of water quality.

Know your soil type

Different soil types have distinctive hydrological properties that characterise the speed and direction of their dominant water pathways. Soil moisture content profoundly affects the soil's bearing strength. Naturally wet soils are often not suited to arable cropping or intensive use of grassland. Instead, they could be used to create habitats which can slow the run-off after rain. Vegetation can also help to indicate the status of the soil: if rushes are present the soil has been waterlogged for long periods of time. Dry soil has sufficient internal strength to support most farm implements. However, wet soil readily compresses to become dense, structureless and slowly permeable. If the soil does not have sufficient bearing strength to support the weight applied to it, radical changes in its porosity can occur in one machinery pass causing the soil to become compacted.

How damaging soil structure influences water run-off

There is increasing evidence that modern farming has a profound influence on the natural ability of soil to absorb rainfall. The soil structure can be changed quickly if, during wet conditions, the land is worked or travelled across or trampled by livestock. The pressure applied by these activities to the soil causes it to be compressed reducing its porosity. This can cause the soil to become impermeable, the consequence of which is unnatural or enhanced run-off as the soil layers above the zone of compaction become more readily saturated after rainfall.



Activities that cause soil compaction include:

- Harvesting crops during late autumn/winter (vegetables, maize, potatoes)
- Late crop drilling in the autumn, particularly where the last machinery pass compresses the soil (e.g. by discs, rollers, power harrow)
- Winter slurry and manure spreading when stores are full
- Out-wintering of livestock
- Winter farm traffic along headlands, tracks and buffer strips

Soil compaction can be subtle and is not necessarily obvious. Less severe compaction occurs within fields and can be found at various levels in the soil profile. All compaction restricts downward water movement and can lead to surface saturation and the potential for the generation of surface run-off. This may not necessarily radically affect crop yield so may not be a high priority for the farmer, but it can have major consequences off the farm such as flooding and water pollution.

For more details refer to Future Farming and Environment Evidence Compendium and Soils and Natural Flood Management under Further Information.

Recent research involving survey data from the Demonstration Test Catchments (DTC)

At the scale of Water Management Catchments, agricultural water pollutant pressures from excess phosphorus, sediment and nitrogen are localised. There are 93 Water Management Catchments in England. Of these, 88 are adversely affected by phosphorus pollution, 77 by sediment and 52 by nitrate. Nearly half the catchments have pressures from all three contaminants, under 30 have pressures from a combination of sediment and phosphorus, whilst the remainder are suffering from other pollutant combinations. The presence of multiple pollutants in many areas highlights the need for targeted on-farm mitigation strategies. To help achieve this, we recommend detailed site-specific on-farm assessments to target the relevant individual measures to prevent these pollutants cascading into water.

Table 1: The 12 most effective on-farm diffuse pollution mitigation methods in descending order

New 'alternative' mitigation methods	
1 Use a fertiliser recommended system	3 Move feeders at regular intervals
2 Do not apply manufactured fertiliser to high P index soils (with an Olsen soil P index of 4 or higher)	4 Leave over winter-stubbles
Current NVZ or Cross compliance regulations	
5 Do not apply manufactured fertiliser to high-risk areas	9 Do not apply manure to high risk areas
6 Site solid manure heaps away from watercourses and field drains	10 Increase the capacity of farm slurry stores to improve timing of slurry application
7 No overgrazing of natural or semi-natural grassland	11 Incorporate manure into the soil
8 Do not spread slurry or poultry manure at high risk-times	12 Avoid spreading manufactured fertiliser at high-risk times

To identify the key sources of the diffuse pollution problem we searched the Water Framework Directive's (WFD) Reasons for Failure database. The most important identifiable on-farm sources, in descending order were arable fields (26%), mixed agricultural run-off (21–24%) and dairy/beef fields (13%). Additionally, management of arable and grass fields and farmyards could help to reduce water quality failures.

'Basic' measures are the minimum control practices required to reduce pollution within existing EU regulation and WFD guidelines. As these measures are not having the desired effect, we compiled and reviewed a list of over 700 'alternative basic' measures we believe could reduce nutrient and sediment pollution from livestock or arable farms across England. Consequently, we defined our 'alternative basic' measures as *reflecting good farming practice, effective at reducing losses of specified pollutants commonly associated with water quality failing WFD standards*. Working with the agricultural industry we short-listed 63 'alternative basic' pollution mitigation measures that scored highly in terms of acceptability, practicability and applicability. To refine this list further, we used a modelling tool, containing data and information collected through our DTC farm surveys to help identify the 12 most effective mitigation measures at a national scale (Table 1).

What we learnt

Using our modelling, we shortlisted 12 of our 'alternative basic' measures for livestock and arable farms. Implementing these would reduce the national diffuse pollution load of phosphorus, sediment and nitrate delivered to our rivers from agricultural land by ~12%, ~6 % and 2% respectively (Figure 1). We estimate that the cost of applying these 12 'alternative basic' measures across England, at an implementation rate of 95% would be £450 M/yr. This is equivalent to £52/ha. The work presented here fed into a broader exercise that resulted in the introduction of the New Farming Rules for Water in England.

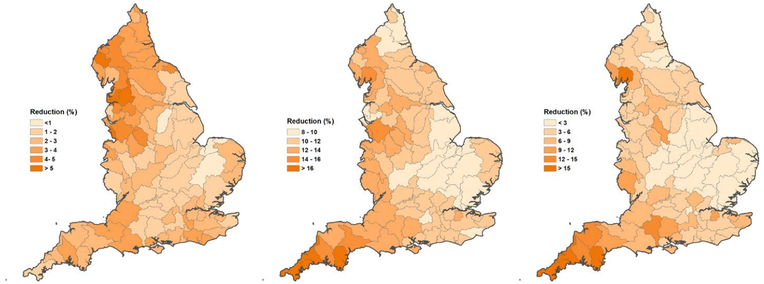


Figure 1: Projected impacts of the suite of candidate 'basic' measures on agricultural loads of a) nitrate, b) phosphorus and c) sediment for the WMCs across England.