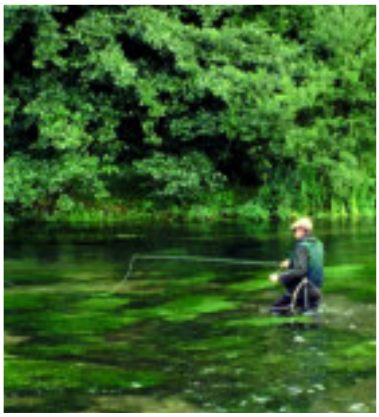
Catchment management: land-use and water





1. Introduction

A catchment is the land area from which all water drains towards a single watercourse. Since the 1970s the UK has gradually advanced towards managing the interactions between land-use and water on a catchment basis. A catchment management approach recognises that environmental problems in a catchment are best solved at their source and in a holistic manner. The health of a watercourse depends upon the wise use of land and other natural resources in the wider catchment. This is because there is a complex array of interactions between land, air and water. An integrated approach is therefore needed to manage the water environment effectively.

In the UK over 70% of the total land area is under agricultural use with similar proportions of arable, rough grazing and grass and smaller amounts of set-aside and other agricultural uses. This, combined with the fact that agricultural land is the source of around 70% of nitrate, 50% of phosphate and 50% of sedimentation in water bodies (Froment, 2005), explains why reforming agricultural practice is seen as key to improving the water environment.

2. The environment as a priority in agriculture

In 2003 fundamental reforms of the EU Common Agricultural Policy (CAP) were adopted. There is no longer a direct relationship between the quantity of production and financial support available to the producer. The new "Single Farm Payment" is instead linked to meeting required 'Cross Compliance' standards. There are two sets of requirements:

1. *Statutory Management Requirements* (complying with relevant statutory legislation)
2. Demonstrating that the land is in '*Good Agricultural and Environmental Condition*' (E.g. controlling overgrazing, maintaining protection zones along hedges and watercourses, protecting landscape features)

In addition to these CAP reforms, the UK governments have introduced new voluntary agri-environment schemes (see Table 1).

Table 1: Agri-environment schemes in the UK

Country	Agri-environment scheme	Management body
England	Environmental Stewardship	Defra
Wales	Tir Gofal	Countryside Council for Wales
Scotland	Rural Stewardship Scheme	Scottish Executive Environment and Rural Affairs Department
Northern Ireland	Separate schemes for farms within and outside of designated Environmentally Sensitive Areas. Discussions are underway regarding the future of agri-environment schemes	Department of Agriculture and Rural Development Northern Ireland

In England the Environmental Stewardship scheme rewards farmers for good land management. The priorities of the scheme are to conserve biodiversity, maintain and enhance landscape quality, protect the historic environment and natural resources and promote public access and understanding of the countryside. Farmers can enter into 5 or 10 year land management agreements and receive annual payments

based on the area of land under management. There are two tiers to the scheme depending on the level and complexity of land management undertaken - *entry level stewardship* (ELS) and *higher level stewardship* (HLS).

3. Key drivers for catchment management

The increasing prioritisation of the environment in agricultural policy is a key driver for catchment management in England and Wales. Other key drivers include:

European Directives: Member States of the European Union are required to implmenent and comply with Directives passed by the European Commission. Failure to do so can result in substantial fines.
The Water Framework Directive establishes a framework for managing the water environment in a holistic manner. Member States are required to undertake works to ensure that water bodies (including groundwater and coastal waters) achieve good ecological and chemical status by 2015.
The Habitats Directive requires Member States to undertake measures to protect or restore natural habitats and species of European importance to favourable conservation status.

Climate change: The UKCIP02 climate change scenarios produced for the UK government broadly suggest that over the next 80 years we will experience warmer, drier summers and milder, wetter winters. This will affect agricultural production and therefore land use. If extreme events such as droughts and floods become more frequent or intense, this may directly affect the quality and quantity of water in catchments. We are already beginning to experience some of the climatic changes that the model scenarios have predicted.

Periodic review of price limits for water and sewerage companies: In the price review Ofwat have made provision for water companies in England and Wales to undertake environmental improvements including land management. Water companies including Northumbrian Water, Wessex Water and United Utilities have worked with their local or tenant farmers to reduce nitrate and pesticide concentrations in their water supply catchments.

4. Catchment pressures

The specific pressures on a catchment vary depending on the type of agriculture, farming practices, geology and climate, land values and the environmental sensitivity of the catchment. Several of the most substantial pressures, common to many catchments in the UK are discussed below:

i. Soil erosion

When heavy rain falls on soil which is susceptible to erosion (either due to its structure or because of agricultural practices such as cross-contour cultivation) run-off water will carry away topsoil. Soil erosion can also be caused by livestock through overstocking and poaching of river banks and by strong winds. Removal of this valuable topsoil which is usually high in organic matter is likely to reduce agricultural yields and can cause rills and gullies to develop on slopes. It can also reduce carbon sequestration and increase flood risk (Environment Agency, 2002a).

Much of the eroded sediment ends up in watercourses where it is deleterious to water quality (see 2. *Diffuse water pollution*). A large amount of research has therefore

been carried out over the last few years aimed at investigating agricultural techniques that minimise soil loss. One example is the European project SOWAP (**SO**il and **WA**ter **P**rotection). The UK project sites are arable farms in the Parrett catchment in Somerset and the Eye Brook catchment in Leicestershire. The project aims to show the environmental impacts associated with "conventional" arable land use practices and how "conservation orientated" practices can help protect valuable soil resources, prevent deterioration in water quality in the catchment, promote biodiversity, and yet still be economically viable. Woodland sites not exposed to agricultural impacts have provided controls for the research.

A structural survey of soils in the Parrett catchment determined that 40% of sites showed signs of severe or high degradation (Oborn, 2005). The project managers decided to focus on high risk sites and provide specialist advice to farmers and land owners to help them manage soils and prevent erosion through better agricultural practices. One step that farmers have been encouraged to take is to draw up soil management plans which highlight areas at high risk of soil erosion at *field*-scale. It is already a requirement that farmers claiming the Single Farm Payment must complete a *farm*-scale review of their soil management (called a Soil Protection Review) as part of the 'Good agricultural and environmental condition' requirement of Cross compliance.

Another change in practice the project advocated is the use of conservation (minimum) tillage rather than ploughing where possible. Conservation tillage is where as little cultivation as possible is used to prepare a suitable seedbed. The aim is to minimise soil disturbance by not inverting the soil. So far results have shown that soil erosion is reduced by up to 90% at sites where conservation tillage is practiced rather than ploughing (ARET, 2005). Sediment loads in streams where land in the catchment has been conservation tilled are significantly lower than in catchments where conventional cultivation has been practiced. However results so far indicate that phosphorus and nitrate levels in streams are not reduced by the use of conservation tillage (Jones and Biggs, 2005).

An erosion plot at Loddington Farm, Leicestershire.

The government is now taking soil conservation seriously. There are management options within both the entry level (ELS) and higher level (HLS) of Environmental Stewardship which aim to prevent soil erosion.
They include:

- Fencing watercourses to prevent poaching by livestock (capital works – HLS)
- Buffer strips (ELS)
- Over-wintered stubbles (ELS)
- Beetle banks (ELS)
- Post harvest management of maize stubble (ELS)
- Arable reversion to grassland (HLS)
- Seasonal livestock removal on grassland (HLS)
- Avoid growing certain high risk crops in fields where soil erosion/run-off occurs or is likely to occur (ELS)
- Cultivating along the field contours (ELS)

ii. Diffuse water pollution

Nutrients (such as nitrogen and phosphorus), pesticides, sheep dip and sediment are all considered pollutants in water bodies. Although there are non-agricultural sources

of these pollutants (e.g. run-off from roads), it is diffuse water pollution from agriculture that has the biggest impact on water quality in rural catchments. The main source is chemicals and sediment carried in run-off from fields which have had excess fertiliser or pesticides applied or have experienced soil erosion.

Water quality is important because there are limits on the amount of pollutants such as nitrates that are allowed in drinking water in order to protect public health. Water companies are now beginning to protect the raw water quality rather than rely on water treatment to remove pollutants prior to distribution to customers.

Diffuse pollution also affects biodiversity. Many species of aquatic macro-invertebrates, fish and aquatic plants are adapted to specific environmental conditions and cannot tolerate pollution. Sediments, particularly fine ones like clay are known to damage spawning grounds for fish like salmon that lay their eggs on gravel. The fine sediments can also smother invertebrates and affect the growth of aquatic plants. Excess nitrates and phosphates will increase algal blooms in a waterbody leading to reduced availability of oxygen for other living organisms (eutrophication), killing invertebrates and the fish that feed on them.

The benefits of dealing with diffuse water pollution from agriculture are estimated to exceed £250m per year (Environment Agency, 2002a). Until recently the problem was mainly solved through water companies investing in costly treatment programmes at water treatment plants. The cost of treating water to remove pesticides and nutirents from drinking water is £7 per year for every water consumer (Defra, 2005b) and the Water Industry as a whole is thought to spend around £39 million per year removing nitrates from drinking water (Defra, 2004). There is now a general consensus however that it is more sustainable (and arguably more cost-effective) to solve the problem at its source rather than relying on so-called 'end of pipe' treatment solutions. Water companies are therefore keen to promote catchment management to deliver raw water quality improvements.

One example of water company investment in catchment management is 'SCaMP' (**S**ustainable **Ca**tchment **M**anagement **P**rogramme). The SCaMP 'hilltop to tap' environmental improvement project is being run in association with RSPB on United Utilities-owned land in the uplands of North-West England. Although from the perspective of United Utilities as a water supplier one of the principal drivers for the project is to safeguard raw water quality in areas owned by the company for water supply purposes, the regulators saw the main driver being biodiversity improvements rather than drinking water quality improvement so funding had to be secured through OFWAT rather than DWI (ENDS report, 2006). OFWAT allowed United Utilities to raise £10 million through their customers' bills to fund the programme. Working with their tenant farmers, the company have begun resorting areas of eroded peat, fencing off watercourses from livestock, improving waste management facilities to reduce run-off and constructed new buildings to allow the indoor wintering of livestock (United Utilities, 2006). These improvements should reduce both diffuse water pollution from agriculture and soil erosion, leading to higher raw water quality at the inflow of the company's water treatment plants.

Defra have compiled a list of projects aimed at reducing diffuse water pollution from Agriculture in England which is available here:
http://www.defra.gov.uk/farm/environment/water/csf/pdf/dwpa-report.pdf

Information on other catchment projects in the UK can be found on the UK-ADAPT (**A**gricultural **D**iffuse **A**quatic **P**ollution **T**oolkit) website: http://www.uk-adapt.org.uk/.

iii. Water quantity

The amount of flow in a watercourse has a major impact on the water environment: affecting effluent dilution, navigation, recreation and aquatic and terrestrial biodiversity.

At low flows algae growth can decrease the dissolved oxygen levels which aquatic organisms depend on. Low flows also allow settling of suspended sediment which damages fish spawning gravels and chokes aquatic plants. Another effect is to reduce the dilution of effluent from wastewater treatment works, causing higher nutrient concentration levels and an increase in algal blooms.

Low flows will occur naturally in the summer months when there is less precipitation and more evapo-transpiration; but they can also be caused by overabstraction from the watercourse. In England and Wales abstraction from watercourses is regulated by the Environment Agency through the issuing of licences to abstract. The licensing system aims to balance the competing demands for water abstraction with the need to protect the water environment (Environment Agency, 2002b). What is a sustainable level of abstraction will vary from catchment to catchment and is outlined in documents called Catchment Abstraction Management Strategies which describe current local water resource availability and their management.

Around 50% of water abstraction licences in England and Wales are for agricultural use (Defra, 2005a). As we experience higher mean summer temperatures and periods of extended drought become more regular, many farmers are requiring extra water for their crops. In many catchments there is already pressure on the water environment hence there is no spare capacity in abstraction licences for farmers to use. Farmers in such circumstances are trying to secure more water from alternative sources and beginning to move away from irrigation-reliant crops towards those that are rain-fed (Weatherhead *et al*, 2005). This results in cost-savings for the farmer (from not having to pay abstraction charges) and importantly also helps prevent the quantity of water in watercourses from diminishing further. Practices promoted in the new agri-environment schemes are helping farmers make the most of the rain that does fall (for example infiltration can be increased by good soil management - minimising compaction, breaking surface crusts and maintaining good soil structure).

5. Integrated approach

To prevent soil erosion, diffuse pollution and low flows caused by overabstraction and achieve a health water environment an *integrated* catchment management approach is needed. One of the big challenges in achieving this is the difficulty of integrating work which has traditionally been carried out by individuals working in discrete sectors (water resources and water quality; agriculture and land management; biodiversity; flooding) within different organisations.

Research amongst delegates at a recent conference on catchment management has shown that integration is an issue that deeply concerns professionals involved in catchment management. Delegates were asked their views on whether they consider integration to be a problem or not:

- between sectors (e.g. farming, flood risk management, fisheries, water abstraction)

- between work at different scales (national, catchment, and farm scale)

- between organisations (e.g. Government departments and agencies, local authorities, the voluntary sector)

Integration between sectors was deemed a problem by all respondents with over 86% considering it a *major* problem. Similarly approximately 60% of respondents considered integration between work at different scales and between organisations to be *major* problems (CIWEM and CMS, 2006). Table 2 outlines the main solutions suggested that could help achieve this integration.

Table 2: Suggested solutions for developing better integration in catchment management work

Aspect of integration	Solutions to develop integration
Integration of work in different sectors	▪ Promote the benefits of integrated working ▪ Disseminate best practice ▪ Need clear leadership from one body ▪ Involvement of *non*-farming sectors and people (e.g. planning & local authorities, wetlands, local residents…) ▪ Recognise and overcome 'silo mentality'/breakdown 'functional silos'
Integration of work at different scales	▪ Disseminate best practice ▪ More research to determine what is effective ▪ Better understanding of the local scale to inform regional and national scale
Integration of work in different organisations	▪ Promote the benefits of integrated working ▪ Convene more joint projects/teams/working groups/partnerships/networks ▪ Encourage recognition of silo mentality and instil a more outward-looking focus ▪ Move away from ad-hoc integration/communication to more planned and more local integration

6. Catchment approach

Flooding and water resources are already managed on a catchment basis (through Catchment Flood Risk Management Plans and Catchment Abstraction Management Strategies respectively); and now farming is being managed likewise through the introduction of the Catchment Sensitive Farming programme. Whilst agriculture is a devolved issue and hence the Catchment Sensitive Farming programme is focused in England only, a similar pilot project is being undertaken in two pilot catchments in Pembrokeshire and Gwynedd in Wales.

The Catchment Sensitive Farming programme aims to reduce diffuse water pollution to meet the requirements of the Water Framework Directive. The initiatives produced for the Catchment Sensitive Farming programme should help formulate the required 'Programmes of Measures' that outline how the Water Framework Directive 'good status' objectives can be met.

The England Catchment Sensitive Farming Delivery Initiative is trying to raise awareness of the problem of diffuse water pollution from agriculture in 40 priority catchments through the deployment of catchment sensitive farming officers. The officers will give workshops, demonstrations and one-to-one advice to farmers to show them the benefits of taking early voluntary action to tackle the problem of diffuse water pollution through land management.

7. Conclusions

Good soil and land management benefits farmers, water companies, fisheries, biodiversity, flood management, and importantly the public (who avoid paying for the costly effects of soil erosion, increased flooding and expensive water treatment and benefit from the enjoyment of a clean and biodiverse water resource). There is therefore widespread support for an integrated approach to managing the interactions between land and water in catchments.

The difficulty is that institutionally the management of land and water have been managed by separate groups of individuals who are unused to working together and occasionally even distrusting of the benefit that each other can bring. Nonetheless key drivers like the agri-environment schemes and European Directives are helping to bring together different parties to solve common problems. There are a large number of cooperative catchment management projects already underway and successful outcomes from these projects would provide good evidence as to the tangible benefits from integrated working.

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