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***Catchment sensitive farming: tackling diffuse water pollution from
agriculture in England – policies and drivers***

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CATCHMENT SENSITIVE FARMING: TACKLING DIFFUSE WATER POLLUTION FROM AGRICULTURE IN ENGLAND – POLICIES AND DRIVERS

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Abstract

Diffuse water pollution from agriculture (DWPA) is a significant contributor to the long-term degradation of UK rivers, lakes and groundwaters – 70 % of nitrates and 44 % phosphorus loads in UK surface waters comes from agriculture. Within the EC, the key driver for tackling DWPA is Water Framework Directive (WFD). The paper discusses the approach being taken in the UK to meet the challenging targets set by WFD through Catchment Sensitive Farming (CSF). The challenge is to identify appropriate and the most cost-effective measures for tackling the impact of farming on the environment while ensuring, in the long term a sustainable farming industry. This paper details the current policies in place including action under the EC Nitrates Directive, Environmental Stewardship Schemes under CAP and activity to encourage early voluntary action by farmers (CSF Delivery project). Details of the complementary work being taken forward on the use of other policy instruments such as regulation and analysis on development of an effective package of policy measures for tackling DWPA is also discussed.

Key words: Diffuse water pollution; Agriculture; Water Framework Directive; Catchment-Sensitive Farming.

Background

In the UK, Agriculture covers 76% of the land area of England and Wales - total land use area for agriculture in the UK is around 18,000,000 hectares with approximately 175,000 main farm holdings (Defra Farm Census 2001). It is not surprisingly therefore, that agriculture plays a key role in determining what the UK's landscape looks like, what happens on the land and consequently, impacts of land use on the environment.

Agricultural industry brings many benefits to society, not least of which is food production, but also through positive effects on habitat and species, and on landscape. However, there is also a negative cost of agricultural production - namely impacts on the environment. Agriculture contributes to carbon dioxide emissions (primarily through the use of fossil fuels and electricity as in other sectors) and accounts for over 40% of methane and nearly 66% of nitrous oxide emissions in the UK. Intensive farming of monoculture has resulted in losses in biodiversity and impacts on the water quality of UK rivers, lakes and ground water. In the UK it is estimated that 60% of the nitrogen load in surface waters comes from agriculture (WRC 2004) and 43% of the phosphorus (Morse et al. 1993). Everyday activities such as the tillage and ploughing of land, the spreading of slurries and farm yard manures (FYM), use of pesticides, veterinary medicines and fertilisers can all give rise to the inadvertent contamination of water supplies. Agriculture uses large amounts of inorganic nitrogen (N), phosphate (P) and potassium (K) fertilisers.

The value of the impact of agriculture on the environment

The costs of natural resource degradation and environmental pollution due to agriculture in the UK, both in monetary and environmental terms, are difficult to quantify precisely. However estimates have been made on the total cost of the problem and agriculture's contribution to it (Table 1).

Table 1. Costs of agriculture in England and Wales in £ million per year 2004-5 prices (adapted from EA (2002))¹.

<i>Environmental impact</i>	<i>Lower bound</i>	<i>Upper bound</i>
Nutrients in lakes	20	34
Recreation damage	10	24
Fisheries (freshwater angling)	14	37
Bathing water	23	44
Amenity loss (property prices)	5	5
Groundwater (costs to water companies)	94	94
Ecosystem (river) damage	156	389
Total	322	627

1. The Environment Agency report (2002) estimated the costs of natural resource degradation and environmental pollution due to agriculture in the UK by estimating the total cost of the problem and agriculture's contribution to each problem. These estimates have been updated using analysis done by the Environment Agency in the context of the periodic review of the water industry in 2004, and using figures from Defra's Framework for Environmental Accounts for Agriculture (Defra 2004)). A range of estimates exists because of uncertainty as to both the value of total damage, and the share of the damage that stems from agriculture. The methodology is acknowledged to be simplistic, and therefore the resulting estimates are indicative. However, it should also be noted that values were not estimated for all impacts, so the quantification of agriculture's contribution is likely to be conservative.

The figures indicate that the benefits of tackling water pollution from agriculture are potentially in excess of £300m per year and can be as high as over £600m.

Attributing figures to the financial cost of the damage to the water environment from agriculture is a difficult and complex process. It is not currently possible to disaggregate the figure shown in Table 1 further to attribute proportions to individual pollutants. A project currently funded by Defra is working to bring together as much information as possible on the link between farm practices, impacts on water quality and the categories of cost outlined in table 1.

The environmental impacts of water pollution from Agriculture

Over the last two decades, much effort has been put into cleaning up UK rivers and lakes. Since 1990, over £20 Bn has been spent upgrading the sewerage infrastructure in England and Wales in order to improve the quality of discharges and hence the quality of receiving water. Limit values control the amount of pollution that industries are allowed to discharge in order to meet Environmental Quality Standards and controls have been put in place to reduce or ban the use dangerous substances. All these improvements have lead to a steady increase in the quality of our waters (for more details see <http://defraweb>). For example, there have been significant improvements in drinking water quality every year since 1997 (99.88 % of the 2.97m drinking water tests samples taken in England and Wales in 2003 met stringent quality standards), in bathing waters (around 98% passing EU standards) about 69% of rivers in England are now of good biological quality. Despite significant improvements in the water quality of our rivers (mainly as a result of a reduction in point-source pollution) there are still valuable improvements to be made, particularly to the ecological health of our rivers and other waterbodies. The main challenge we face is to

address diffuse water pollution from agriculture – in the UK 60% of the nitrogen load and 43% of the phosphorus loads in surface waters come from agriculture.

Excess levels of nutrients in water contribute to the process known as eutrophication, which refers to the process of nutrient enrichment of either aquatic or terrestrial ecosystems. The higher levels of nutrients stimulate plant growth, which can adversely impact the productivity and biodiversity of ecosystems leading to excessive growth, or "blooms", of algae, which causes oxygen depletion, making waters uninhabitable for fish and other animal life. In freshwater systems, phosphorus as phosphate is considered the main nutrient limiting the rate of plant growth while in coastal waters, nitrogen as nitrate or ammonia is considered the limiting nutrient. The eutrophication of water and its contamination by material with high Biochemical Oxygen Demand (BOD), pesticides, veterinary medicines and soil all impact on the aesthetic, recreational, conservation and biodiversity value of water. Contamination by faecal microorganisms gives rise to human and animal health risks (for more details see (Defra 2004a)).

Long-term monitoring records, export coefficient modelling and palaeolimnological studies all indicate that nutrient concentrations in UK freshwaters are greatly enhanced above natural levels and have had considerable ecological effects, particularly in the last 50 years.

There are large regional differences in the degree to which lakes and rivers deviate from a 'natural/background' level in the UK, with less impacted sites predominating in less agriculturally-intensive (and less populated) landscapes, particularly Cumbria and the Scottish Highlands and Islands. The greatest ecological change is found in lowland regions in Northern Ireland and England where nutrient concentrations are often well in excess of background levels (Defra 2004a).

Catchment-Sensitive Farming & UK priorities for Water and Agriculture

The UK is looking to achieve reductions in diffuse water pollution from agriculture (DWPA) by promoting Catchment-Sensitive Farming (CSF). CSF is about managing land in a way that is sensitive to the ecological health of the connected water environments and helping the industry to work toward sustainability.

Governments priorities for water in England over the longer term are:

- Protecting the countryside and natural resource protection. This includes:
 - prudent use of water resources and keeping its use within the limits of its replenishment;
 - achieving better integration between water and other policies and between different aspects of water policy.
- Emergency preparedness – developing, setting and overseeing delivery for reservoir safety. Continuing to take steps to protect our drinking water from accidental or deliberate contamination.

UK's water policies are grounded in the Government's commitment to sustainable development, covering economic, environmental and social aspects. Key aspects of this relevant to water quality include:

- Enable viable livelihoods to be made from sustainable land management, both through the market and through payments for public benefits.
- Respect and operate within the biological limits of natural resources (especially soil, water and biodiversity).
- Achieve consistently high standards of environmental performance by reducing energy consumption, by minimising resource inputs, and use renewable energy wherever possible.

Achieving reductions in DWPA by promoting CSF is a key component of delivering this commitment.

Drivers for Catchment Sensitive Farming (CSF)

Many of the important aquatic plant and animal species in England need low levels of nutrients and silt to flourish. In addition to their conservation value, healthy and robust river systems provide many direct benefits, including clean drinking water, safe bathing water, healthy fisheries, reduced flood risk and an improved living environment. Good water quality also encourages recreation and tourism, contributing to use of the countryside and the viability of rural businesses. These are all key drivers for tackling diffuse water pollution from agricultural (DWPA).

Because of these benefits we have agreed and signed up to a number of international and EU commitments. Of our commitments, the Water Framework Directive (WFD) is the principal driver for action to address DWPA, though not the only one – others include the Bathing Waters Directive and the Birds & Habitats Directives.

Water Framework Directive

The European Union (EU) Water Framework Directive (WFD) (see http://europa.eu.int/comm/environment/water/water-framework/index_en.html) aims to ensure the integrity of the water environment and its associated eco-system functions by requiring the maintenance of ‘high ecological and chemical status’ of surface waters where it exists, and aiming to achieve ‘good ecological and chemical status’ for surface waters and ‘good chemical status’ for ground waters. The WFD applies to all waters (rivers, lakes, estuaries, coastal waters out to one nautical mile, and ground waters). The WFD must address both point source and diffuse source pollution where it impacts on achieving WFD objectives. The details of the WFD time table are shown in Table 2. Member states are required to split their countries into River Basin Districts (RBD) and produce draft River Basin Management Plan for each RBD by December 2008 – and finalise these plans by 2009. The Plans will bring together information relevant to each RBD including the environmental objectives for each water body and a summary of programme of measures which will be taken to achieve those objectives.

Table 2. Water Framework Directive implementation timeline (for more details see Defra web site (<http://defraweb>))

<i>Year</i>	<i>Requirements under WFD</i>
March 2005	Reports to be submitted to EU Commission showing first assessment of risk (characterisation) of water bodies not meeting the environmental objectives of the WFD. This work is to be refined in a second phase of characterisation in 2005-07, and carried forward in a monitoring programme from 2006 to 2008.
2008	Draft river basin management plans (RBMPs) to be prepared at the regional (river basin district) level, with active involvement of interested parties, showing proposed environmental objectives for each water body. RBMPs must also summarise programmes of measures (POMs) to be applied, including addressing DWPA. The WFD states expressly that measures shall consist, ‘for diffuse sources liable to cause pollution, measures to prevent or control the input of pollutants’.
2009	RBMPs to be published in final form
2012	POMs summarised in the RBMPs to be made operational
2015	Environmental objectives in RBMPs to be met (except for water bodies where an extended deadline has been set); start of second round of RBMPs to achieve outcomes in 2021
2021	Start of third round of RBMPs to achieve outcomes in 2027.

WFD also repeal several existing and older EU water directives dating back to the 1970's. By encompassing previous water directives WFD effectively sets a strategic framework, which should ensure sustainable management of water in the long term. The repeal of the older Directives will take place in either in 2007 or in 2013 after which WFD will offer at least the same level of protection as the repealed directives. The Directives to be repealed include the Surface Water Abstraction Directive (in 2007); Freshwater Fish Directive (in 2013); Shellfish Waters Directive (in 2013); Groundwater Directive (in 2013); and the Dangerous Substances Directive (in 2013).

Implementing WFD is complex and requires new ways of working across the EU. It is also unique amongst water directives as economic analysis is also written into its requirements - cost-effective analysis (CEA) is one of the criteria for choosing the measures to be used to achieve WFD objectives. There are also a number of exemptions that may be used when defining the objectives to be met during River Basin Management planning. These include setting less stringent objectives if the water body is Heavily modified (HMWB) or is an artificial water body (AWB). Instead of aiming to achieve good ecological status, the aim must be to achieve good ecological potential. Exemptions may also be used in cases where (1) costs of achieving the status are disproportionately expensive, (2) the time scale for achievement of the objectives is technically infeasible or natural conditions do not allow timely improvement of the water body. All exemptions have detailed criteria which must be met for the alternative objectives to be applied.

Bathing Water Directive

The Bathing Water Directive (76/160/EEC) (see http://europa.eu.int/water/water-bathing/index_en.html) aims to protect public health and the environment from faecal pollution in bathing waters. The Directive requires Member States to identify popular beaches and monitor the bathing waters for indicators of microbiological pollution. The microbiological quality of bathing waters has improved considerably in the UK following substantial capital investment at inland and coastal sewage treatment works. Compliance with the current mandatory coliform standard of the European Bathing Water Directive at coastal waters in the UK was 98% in 2003, compared with 77% in 1990. However, proposed revisions to the Bathing Water Directive, with stricter water quality standards, will result in reduced compliance (see Defra web site for more details).

Water quality failures occur principally following times of high river flow, when there is increased runoff from diffuse agricultural sources and potentially releases of untreated sewage from combined sewer overflows and storm tanks. The relative contributions of diffuse agricultural and urban associated point sources depends upon the land use and hydrology of a catchment. A number of recent studies have quantified this impact in a number of UK catchments. Intensive monitoring of discharges and water quality on the Island of Jersey, the Staithe catchment (North Yorkshire), the Ayrshire beaches in south-west Scotland and the Nyfer catchment (Pembrokeshire) established that during storm flows c.60% of the FIO budget was contributed by diffuse sources from within the catchments, rather than to known sewer and storm over-flows (Defra 2004a).

Although a number of detailed catchment investigations have now been carried out, an overall picture of the agricultural contribution to bathing water quality failures has not been formed. Defra is currently funding a project to enhance an existing methodology for estimating faecal pollution arising from manure spreading on agricultural land and determining agriculture's contribution to failure of bathing waters to meet the requirements of the Directive.

Birds & Habitats Directives

At the EU level, the 1979 Birds Directive (79/409/EEC) (see http://europa.eu.int/comm/environment/nature/directive/birdshome_en.htm) and 1992 Habitats Directive

(92/43/EEC) (see http://europa.eu.int/comm/environment/nature/nature_conservation/eu_nature_legislation/habitats_directive/index_en.htm) have established Special Protection Areas (SPAs) and Special Areas of Conservation (SAC) that Member States are committed to protect and improve.

The 1979 Birds Directive requires the maintenance of favourable conservation status of all wild bird species across their distributional range and, as already stated, the establishment of SPAs for rare or vulnerable bird species. In the UK, 237 SPAs have been classified covering 1.25m ha. Other requirements include a general scheme of wild bird protection, restrictions on the sale and keeping of wild birds and hunting restrictions.

The 1992 Habitats Directive requires Member States to introduce a range of measures including the protection and surveillance of habitats and species listed in the Directive. Each Member State has had to put together a list of national sites containing the 189 habitats and 788 species listed in the Directive (567 UK sites covering 2.16m ha have been listed). These sites are designated as SAC. The Directive applies the precautionary principle to SAC so development projects are only permitted in these areas if it is ascertained that there is no adverse impact.

More recently SPAs and SAC have been used to create a European-wide network of protected areas known as Natura 2000. This network of protected sites, which represent areas of the highest value for natural habitats and species of plants and animals, which are rare, endangered or vulnerable in the European Community is essentially a re-commitment to the preservation and protection of these SPA and SAC sites.

At the national level, the 1981 Wildlife and Countryside Act (see <http://www.defra.gov.uk/wildlife-countryside/cl/>) implemented the obligations of the Bern Convention and EC Birds Directive in England and Wales and established Sites of Special Scientific Interest (SSSIs) as well as making it an offence to kill wild animals and birds. There are currently 4113 SSSIs in England covering 7 % of the country – all SAC, SPA and Ramsar sites are designated SSSIs. Defra has a challenging Public Service Agreement (PSA) target to get 95% of SSSIs into a favourable condition by 2010.

On an area basis, 1.5% of SSSIs (62 sites) in England are in an unfavourable condition because of water quality and DWPA. In 2003, of the 43% of SSSIs in an unfavourable condition, on rivers and streams, 70% were affected by diffuse pollution. Diffuse pollution also impacts 35% of standing water/canals, 15% of fen, marsh and swamp, as well as 5% of lowland neutral grassland.

The size of the problem in the UK

- Phosphorus

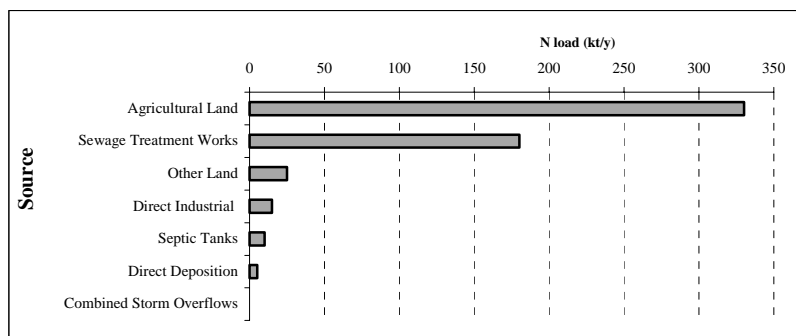
Agriculture is responsible for about 43% of phosphorus inputs to surface waters in the UK. Human and household waste is responsible for some 24%. Detergents were responsible for about 19% of inputs and industry and background sources account for the remaining 14 % of phosphorus inputs in the UK (Morse et al. 1993).

- Nitrogen

For nitrogen (N), agriculture's contribution is roughly 60%, while that of sewage treatment works (STW) remains at roughly 30% (Defra 2004c). The contribution of point and diffuse sources of nitrogen to both marine and inland waters in England and Wales amounted to some 558 ktN/yr. In England and Wales, N levels have increased by about 15% from 287 kt N to 330 kt N, and the estimated inputs from sewage treatment works (STW) have declined by about 15% – from 216 kt N to 184 kt N (Fig.1). This decrease

has come about primarily as a result of improvements in STW discharges to the marine environment, undertaken to meet legislative requirements.

Figure 1. Nitrogen Sources in England and Wales, year 2000 nominal (ktN/yr) (from WRc (2004))



- Silt

The highest proportion of suspended solid loadings to rivers derives from diffuse sources and that in rural catchments this is heavily dominated by agriculturally-derived soil erosion. However, no national source apportionment is yet available. Where arable lands are under drained, 50% and more of the silt load that leaves a catchment can be agriculturally derived. Soil loss by erosion from pastureland can also provide the dominant source of silt in streams, particularly where under drainage is present and where poaching of soils has occurred (Defra 2004a).

- BOD

Livestock in the UK produce about 2.5 million tonnes of BOD every year. If just 2% of this were to escape into water it would be equivalent to the total BOD from human excrement that is discharged via sewage treatment works each year (Defra 2004a).

- Faecal indicator Organisms (FIOs)

Numerous studies (see Defra 2004b) have demonstrated the importance of diffuse agricultural sources to the faecal loadings at bathing waters. Extensive work in Scotland has shown the important role that livestock management can play in influencing the quality of bathing waters. Direct access to watercourses and poor management of livestock and slurry have all been implicated in high bacterial loads in rivers. The lack of adequate on-farm storage facilities for manures and slurries was shown to be a major contributing factor. They reported a direct positive correlation between river water bacterial loading and intensity of livestock management. In-stream concentrations of faecal indicator organisms in two areas of high livestock intensity were four to eight times higher than in two corresponding areas of low livestock intensity.

River Basin Characterisation Maps

River Basin Characterisation (RBC) was the first stage in the WFD management cycle. It describes the water environment and the human pressures on it, so that the risk of failing the WFD targets or objectives can be assessed. Characterisation work for WFD in England and Wales found the following:

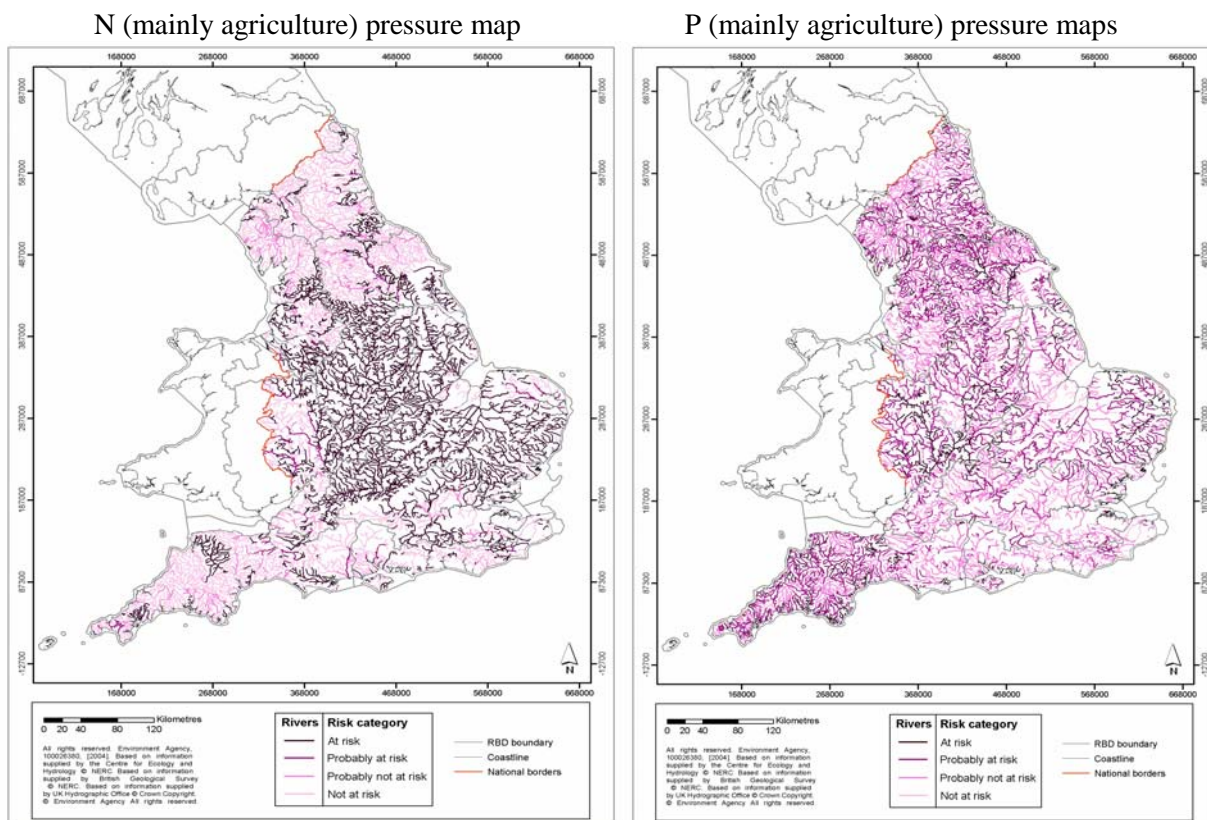
- nitrate is a risk for drinking water supplies in 49 per cent of rivers, particularly in England.

- phosphate is a risk for 38 per cent of rivers and 23 per cent of lakes (by area).
 - sediment (from eroded soil) is a risk for 21 per cent of rivers.
 - 85 per cent of groundwater boreholes monitored in 2003 show rising nitrate concentrations. Many in England are above or approaching the upper limit for nitrate in drinking water.
- (For further details and information see <http://defraweb/environment/water/wfd/article5/index.htm>).

As part of this work the EA estimated the pressures contributing to these risks (see Figure 2). With regard to agriculture:

- diffuse pollution causes a risk of not achieving WFD objectives by 2015 in 82.4 % of rivers, 53 % of lakes, 25 % of estuaries, 24 % of coastal waters and 75.3 % of ground waters;
- nutrients such as nitrogen (mainly from agriculture) put almost 40 % of rivers, nearly 20 % of estuaries and over 50 % of groundwaters at risk of not achieving good ecological and chemical quality by 2015;
- phosphorous accounts for nearly 50 % of rivers and 25 % of lakes being at risk. Agricultural pesticides and sheep dip also put 20 % of rivers and groundwaters at risk.

Figure 2. Maps of Diffuse Nitrogen & Phosphorus Pressures: rivers at risk of not meeting WFD objective of Good Ecological Status.



Agricultural sources of DWPA

Significant resources have been committed to understanding the pathways of nutrient losses from land and the impacts of these nutrients and other pollutants on the water environment. However, although we have

a good understanding of N loss pathways, our understanding of P loss is still limited. In addition, until recently little was done to understand the impact of nutrients on the ecology of receiving waters.

Pollutants can either be transported in solution or in suspension, and either in drainage water moving through the soil or in water moving across the soil. Pathways differ between pollutants. The mechanism for water movement through soils with little structure is relatively straightforward: water drains downward through the soil with a generally uniform wetting front, carrying solutes in the soil profile towards the groundwater. In more structured soils, such as clays and loams, water generally moves laterally, either across the surface as ‘overland flow’ (sometimes called surface runoff) or through the surface layers via cracks, channels and, ultimately if installed, drains; collectively known as ‘soil water drainage’.

A generalised and simplified summary of pathways and states of solution or suspension, for the different pollutants are:

	Solution	Suspension
Overland	NH ₄ ⁺ , BOD	TP, FIO, Sediment
Subsurface	NO ₃ ⁻	

Both the risk of loss and pollutant pathways vary between farming sectors. Table 5 illustrates the main practices/issues within 3 representative farming sectors contributing to diffuse losses of N, P and FIOs in England and Wales.

The most effective on-farm mitigation measures fall into three activity categories – nutrient management, soil erosion and runoff prevention, and farm landscape and infrastructure changes. The most effective mitigation measures for tackling N and P pollution relate to manure management. Soil management measures are shown to be comparatively less effective (Defra 2005)).

Table 5 Summary of the perceived main issues contributing to diffuse pollution of Nitrates, total phosphorus, and faecal indicator organisms for the three farm system types from England and Wales (adapted from Defra 2005)

<i>Farm Systems</i>	<i>Diffuse Pollutants</i>		
	<i>Nitrates</i>	<i>Total Phosphorous</i>	<i>Faecal indicator organisms</i>
Intensive Grassland ¹	<u>Nutrient overload and risk of leaching</u>	<u>Nutrient overload, incidentals and detachment</u>	<u>Transfer of excreta and manures</u>
	1. Inappropriate fertilizer and manure management 2. Overstocking 3. Maize	1. Soil phosphorus accumulation 2. Improper manure and fertilizer management 3. Maize 4. Poaching and compaction	1. Improper manure management 2. Direct defecation to streams 3. Uncontained losses from hard standings and manure heaps
Outdoor Pigs ²	<u>Nutrient overload</u>	<u>Increased runoff and detachment</u>	<u>Increased runoff and detachment</u>
	1. High stocking rates 2. Lack vegetative cover 3. Nutrient hotspots	1. Poaching and compaction 2. Lack vegetative cover 3. Foraging damaging soil structure	1. Poaching and compaction 2. Lack vegetative cover 3. Foraging damaging soil structure
Arable Systems (heavy soils) ³	<u>High nutrient inputs and high hydrological connectivity</u>	<u>High runoff soils with high inputs</u>	<u>Manure imports</u>
	1. Injudicious fertilizer applications and manure management where relevant 2. High risk crops i.e. rape	1. Soil phosphorus accumulation 2. Inappropriate fertilizer and manure management	1. Improper manure storage 2. Inappropriate manure application 3. Preferential pathways through cracks and drains

3. Preferential pathways through cracks and drains

3. Preferential pathways through cracks and drains

1. Intensive grassland – is characterised by being typically overstocked, leading to poaching, soil erosion, manure management problems and related losses to watercourses. Soils are often subject to nutrient surpluses. Where maize occurs, leaching and erosion increases.
2. Outdoor pigs – is characterised by high stocking rates and difficulty in maintaining green cover, leading to capped, poached soils. Nutrient hotspots such as feeding and defecation areas are a problem in terms of surface runoff and leaching losses through typically light soils.
3. Arable systems (heavy soils) – is characterised by drainage and surface runoff that can lead to rapid movement of pollutants to water courses by surface and preferential pathways. Surface runoff can also lead to erosion of exposed soils.

Current and planned policies for tackling DWPA

There are currently a number of policy levers in place for tackling DWPA – the most significant are the Nitrates Directive and CAP reform.

Nitrates Directive

The Nitrates Directive (91/676/EEC) (see http://europa.eu.int/comm/environment/water/water-nitrates/index_en.html) is concerned with the protection of waters against pollution caused by nitrates from agricultural sources. The directive was adopted by the Commission on 19 December 1991. It seeks to reduce or prevent the pollution of water caused by the application and storage of inorganic fertiliser and manure on farmland. It is designed both to safeguard drinking water supplies and to prevent wider ecological damage in the form of the eutrophication of freshwater and marine waters generally.

Since 2002 55% of England has been designated a Nitrate Vulnerable Zone. Farmers in this area have been required to follow an Action Programme to comply with the requirements of the Nitrates Directive. This means that farmers have to: restrict nitrogen use to crop need, observe closed periods for inorganic and organic nitrogen subject to risk of run off, spreading controls, appropriate storage to match closed periods and keep records of nitrogen use.

Farmers located within the existing NVZs designated in 1996 have been required to adhere to a lower limit of 170 kg/ha total N per year for spreading manure on arable land since 19 December 2002. From 19 December 2006, farmers located in the new NVZs will also be required to adhere to this lower limit rather than the current 210 kg/ha.

The Government encourages farmers outside of the NVZs to follow voluntary Codes of Good Practice (Defra 1998), for the protection of the environment. The Code also helps to reduce other pollution, including phosphate losses, microbiological contamination of bathing waters and pesticide losses.

The UK is currently in the process of reviewing the Action Programme and possible changes include:

- Extending the closed period for manures to all soils
- Extending manure classification to other types of manure
- Setting a 170kg N/ha
- Compulsory nutrient management plans for N

Any changes will come into effect in mid-2006 after wide consultation in late 2005. (see Defra website (<http://defraweb/default.htm>) for detail).

Common Agricultural Policy (CAP) Reform

The most significant policy currently impacting on the agricultural industry is the recent reform of the Common Agricultural Policy (CAP) and the de-coupling that is taking place from production led to demand/market led (see Defra website (<http://defraweb/default.htm>) for detail).

Since January 2005, the Single Payment Scheme replaced most existing crop and livestock payments. The new scheme has broken the link between production and support. Instead, farmers will be asked to demonstrate that they are keeping land in Good Agricultural and Environmental Condition (GAEC) and complying with a number of specified legal requirements relating to the environment, public and plant health, animal health and welfare, and livestock identification and tracing (SMRs). Meeting these requirements is described in the Common Agricultural Policy (CAP) legislation as “cross compliance”.

The CAP Regulations (Council Regulation 1782/2003) set out a framework of GAEC standards within which each Member State decides its own detailed rules. The GAEC framework, and hence the standards for England, focus upon two areas: soil management and protection; and maintenance of habitats and landscape features. It is generally held that GAEC standards will contribute to raising the environmental performance of agriculture. GAEC requirements will apply to all land managers in receipt of the Single Payment.

As well as changes to the direct farm payment, in 2005 farmers, in England,¹ can also apply to Environmental Stewardship Schemes (ES) that pay farmers to farm in a greater environmental sensitive manner, beyond that of what is required in Cross Compliance. This forms part of England’s funding from the EU’s Rural Development Regulation (RDR) application, which amongst other things provides funding so that environmental issues are taken into account in farming policies.

Environmental Stewardship (ES) is a new agri-environment scheme which aims to secure widespread environmental benefits. The scheme has three elements:

- *Entry Level Stewardship* (ELS) is a ‘whole farm’ scheme open to all farmers and land managers with conventional land. Acceptance will be guaranteed providing you can meet the scheme requirements. ELS aims to encourage large numbers of farmers and land managers across England to deliver simple yet effective environmental management that goes beyond the Single Payment Scheme (SPS) requirement to maintain land in Good Agricultural and Environmental Condition (GAEC). If ELS is taken up across large areas of the countryside it will help to improve water quality and reduce soil erosion.
- *Organic Entry Level Stewardship* (OELS) is a ‘whole farm’ scheme similar to ELS, open to farmers who manage all or part of their land organically.
- *Higher Level Stewardship* (HLS), which will be combined with ELS or OELS options, aims to deliver significant environmental benefits in high priority situations and areas. HLS is discretionary and concentrates on the more complex types of management, where land managers need advice and support and where agreements need to be tailored to local circumstances.

The five primary objectives of Higher Level Stewardship are:

- Wildlife conservation
- Maintenance and enhancement of landscape quality and character
- Natural resource protection
- Protection of the historic environment

¹ In Wales, Tir Gofal (like Higher Level Stewardship) and proposed new schemes such as Tir Cynnal (like Entry Level Stewardship) are available under Environmental Stewardship Schemes.

- Promotion of public access and understanding of the countryside

There are two secondary objectives – flood management and conservation of genetic resources where spin-off benefits are sought from management designed to achieve the five primary objectives.

CSF Delivery project

There remains a mixed response from farmers to the question of whether farming contributes to diffuse pollution. Some accept that farming practices cause pollution others do not, or at least challenge the extent to which they do compared to other, usually fixed point, sources of pollution. Getting farmers to accept or realise that farming causes pollution – that is it by its day in and day out activities – remains a big problem, particularly if they feel they are observing best practice or if the impacts are off-farm.

The CSF Delivery Project (CSFDP) is raising awareness and promoting voluntary activity and best practice to tackle this issue. It comes in on the back of CAP Reform, which at a minimum should make farmers realise that the old system of subsidised production is over, that gives CSFDP a new platform to begin its work.

As already highlighted in this paper, the cross compliance requirements and standards of the Single Payment Scheme, and numerous options of the Environmental Stewardship Scheme (both Entry Level Stewardship and Higher Level Stewardship) will make an important contribution to tackling DWPA. The Resource Protection options of HLS are of particular importance. HLS will be particularly important in priority catchments.

The Project has so far put significant funding (£2.5million) into a pollution minimisation advice contract being delivered by RDS/ADAS, to improve the environmental performance of farming. Most of this work is geared at DWPA.

We have also secured £10 million in 2006-07 and £15 million in 2007-08 of Government funding to spend on tackling DWPA. This is on top of agri-environment money and the ADAS advice contract. The key elements of our model for CSF delivery include the following:

- Prioritisation of catchments within river basin districts
- Creation of a network of Catchment-Sensitive Farming Officers within a Natural England/ Environment Agency partnership
- Detailed knowledge of catchments and of farming activity within them
- Shared understanding of practices which cause DWPA and of mitigating measures
- Establishment of inclusive and dynamic catchment steering groups
- Involvement of key stakeholders, in particular farmers
- Targeting of farms for advice, including 1:1 farm visits
- Support and incentives through enhanced uptake of agri-environment schemes, and possible capital grants.

Preparations to deliver these elements are well advanced.

Impact of current policies on water quality

Defra have funded studies to provide projections of estimated quantitative percentage changes in key arable and livestock activities to 2015 (Defra 2004 d, e). These scenario based studies have indicated that there are a number of uncertainties about the impact of CAP reform but the research to date indicates that

CAP reform won't do enough to deliver the scale of reductions in nutrient levels required to meet our water quality targets in most catchments in England. The key findings were:

- Although a number of pressures and drivers have been identified that would affect land use up to 2015, overall land use is not projected to change dramatically. Key projected trends include an increase in cropland as land that was previously set aside returns to production, and declines in livestock numbers.
- However, projections may mask potentially significant structural changes and changes in production intensities, which could have significant economic and environmental implications.

This work is now being further refined and further analysis will be carried out on the impacts of new policies not only on land use changes but also on land management changes and their impacts on water quality. The research will revisit the considerations arrived at in previous studies, set a new policy baseline and re-examine the drivers of change as well as being able to flesh out policies that in 2004 were still in process of negotiations.

In addition to this work Defra is funding a longer term project – the Agricultural Change and Environment (ACE) Observatory – which will monitor the impact of CAP reform over a number of years, 2005-2008, in England. It will consider information on:

- Farmer's intentions and any resulting changes in patterns and practices
- Actual and predicted environmental outcomes which result from these changes
- To establish links between the changes observed
- Extrapolate future environmental changes on the basis of what has been observed or intended behavioural changes and the best available information on the casual links between these and longer term impacts

Our evidence to date, therefore, indicates that current regulatory controls, including the Nitrates Directive, and softer measures such as advice, voluntary and supportive approaches (including CAP reform and funding through RDR and CSF Delivery project), although valuable instruments with real benefits, will not be sufficient, on their own, to allow us to meet WFD targets and objectives. Stronger measures will be needed to encourage farmers to take up activities which have financial implications for their business and we are looking to identify the most cost-effective of our options.

Additional measures required and analysis of most cost-effective packages of measures for tackling DWPA

Further analysis is required to enable us to make informed decisions about the most appropriate additional measures required and hence the most appropriate package of measures for inclusion in WFD PoMs.

We are currently in the process of identifying the most cost-effective additional policy options required to enable us to tackle DWPA effectively to meet WFD objectives. Options being considered include the extension of existing Defra policies as well as the development of brand new approaches for tackling DWPA. As part of this work we are currently examining a range of new and existing regulatory powers that could potentially tackle DWPA. Over ten existing regulatory powers were identified as having potential for tackling DWPA. A small number that could be extended or modified to address DWPA have now been identified including provisions under the Water Resources Act 1991 and the use of Waste Regulations to control phosphorus. The Water Resources Act 1991 is a domestic policy which currently provides a framework for controlling the abstraction and impounding of water resources in England and Wales. It ensures that any existing rights to abstract water are protected, sufficient water flow remains in rivers and the water environment itself is properly protected. The Waste Framework Directive Regulations ensure that waste is recovered or disposed of without endangering human health and without using processes or methods that could harm the environment.

In addition, several possible new powers, including provisions for General Binding Rules that restrict or prohibit polluting farming activities, have also been identified and are now under consideration. General Binding Rules (GBRs) are sets of mandatory rules that can be applied to a particular activity. Authorisations under GBRs will set out the scope of the activity under the GBR and the conditions that apply to carrying out that activity.

Our overall approach is based on determining the cost-effectiveness of the various options for controlling farm practices that lead to DWPA, whether regulatory, supportive or otherwise. These will then be taken forward for consideration as components in the various packages of DWPA policy measures.

The cost-effectiveness analysis is being taken forward in 2 steps: first, analysis of cost-effectiveness of single policy options followed by analysis of the cost-effectiveness of a combination of policy packages (it is unlikely that one instrument alone will be sufficient or the most cost-effective approach to tackling the issue). The analysis will consider costs both to the farmer and industry as well as costs to the tax payer for enforcement and other economic costs.

To determine how far various packages will take us to meeting WFD, the most cost-effective packages will be assessed for their impact on reducing the risk across the UK (England & Wales) of failing to meet WFD objectives by analysing the impacts of the policies on the characterisation analysis carried out by EA for WFD) (see Figure 2). This work will enable us to make judgements on the impact of various policy packages on water quality objectives under WFD i.e. it will allow us to see how effective various packages are in filling the gap between where we are now (in relation of risk to waterbodies) and where we would be if a policy package was implemented. We will also take forward cost-benefit analysis of the various packages.

This programme of work will enable us to consult with a wide range of stakeholders on a range of potential packages of policy instruments, provide the costs and benefits of each, and information on how effective the package is at helping to reduce the number of water bodies at risk of failing to meet WFD objectives. We plan to formally consult on how we will tackle DWPA in 2006. This will ensure that effective measures for tackling DWPA (including necessary powers if required) will be available for inclusion into draft River Basin Management Plans by 2008/9.

Conclusion

- Agriculture is a significant contributor to diffuse pollution and to eutrophication of UK waters.
- Our policies are aimed at a sustainable farming industry – looking to improve the environmental performance of the industry without compromising the economic and social benefits.
- It is important in the short term to make farmers aware of their contribution to the problem and support them in adapting their farming practices.
- Longer term it may be necessary, and more cost-effective, to use stronger legislative measures to ensure the industry plays its part in protecting the environment.

The principal challenge is to identify appropriate and the most cost-effective measures for tackling the impact of farming on the environment while ensuring, in the long term a sustainable farming industry.

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