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Soil erosion in England and Wales: causes, consequences and policy options for dealing with the problem

Discussion Paper prepared for WWF

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The views of the author expressed in this publication do not necessarily reflect those of WWF.

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Executive Summary

The negative impacts of soil erosion due to inappropriate land management have become increasingly apparent in England and Wales since the 1970s. A number of factors are responsible for this increase, including animal and crop production on inappropriate land, overstocking, bad timing of agricultural practices, degradation of river banks by stock, and lack of ground cover in winter months.

Soil erosion has significant social, economic and environment impacts. In addition to reduced future farm productivity, soil entering freshwater ecosystems can cause major damage, for example choking spawning gravels used by fish. Soil pollution can often carry increased leads of phosphates into freshwater bodies and the marine environment, exacerbating the problems of eutrophication. Soil on roads blocks drains leading to localised flooding, while soil entering strategic reservoirs and ports can result in high dredging and disposal costs.

A range of policy options are in place to address soil pollution, including regulatory instruments, whole farm planning, farmer self-help groups, co-operative agreements and grant aid. It is likely that no one of these measures on its own will be sufficient, and a combination will be required in any given context. In particular, the use of participatory techniques in developing natural resource management solutions has proved increasingly successful in recent years, in developing countries, the EU, and Australia. Such participatory approaches offer considerable potential to address diffuse soil pollution, but have been little used in England and Wales.

This paper concludes:

1. The causes of soil erosion (and diffuse pollution more broadly) are complex and require a sophisticated policy solution involving a combination of regulation, whole farm planning, farmer self-help, advice provision and grant aid. Regulation alone is not regarded as sufficient or optimal.

2. In order to effect delivery of natural resource protection on the ground, it will be necessary to engage with farmers and wider stakeholders using a participatory approach capable of empowering people to take action; essentially ‘helping individuals and groups to help themselves’.

3. Given such a participatory and ‘bottom up’ approach has not been used extensively in the UK, it is recommended that a pilot study is established as a matter of urgency. Such a pilot should involve DEFRA, all relevant statutory agencies, the water companies and a selection of civil society organisations with sufficient resources and expertise to manage the process.

Contents

1. Foreword

Considerable policy debate is currently taking place over the most appropriate approach to addressing diffuse pollution problems in England and Wales. These discussions have been given added urgency by the requirement to decide by 2009 measures to meet Water Framework Directive (WFD) objectives. Diffuse soil pollution has been identified as among the key pressures on water bodies that may prevent them from achieving the WFD objective of good ecological status.

This discussion report has been prepared for WWF by Alex Inman of Tamar Consulting as a contribution to the debate over the most appropriate measures to address diffuse soil pollution. While this report does not represent WWF policy on the measures to tackle diffuse soil pollution, WWF hopes that it will stimulate debate over the range of alternative measures that can be adopted. In particular, it is hoped that it will stimulate debate over some of the more innovative participatory approaches to addressing diffuse soil pollution that are proving successful around the world.

2. Introduction

Soil erosion is a naturally occurring process involving the mobilisation and deposition of soil particles, mainly by water and air. However, whilst soil erosion is a feature of any natural ecosystem, the rate at which it is taking place has been significantly accelerated by anthropogenic influences, most notably inappropriate land use activities associated with agriculture. Worldwide, erosion rates as high as 390 t/ha/year have been recorded in the hilly area of the Loess Plateau of China which is the equivalent to a surface lowering of 3.1 cm/year (Chan and Luk 1989). Whilst not on the same scale, soil erosion in the UK has increased markedly in recent decades (Evans & Cook 1986; Robinson & Blackman 1990; Davidson & Harrison 1995; Frost & Speirs 1997). For example, in the Tamar catchment in South West England, it has been estimated that the gross erosion rate has reached 5.3 t/ha/year (Quine and Walling 1991).

The impacts of soil erosion have major implications for society from an economic, social and environmental perspective. In terms of ecological service provision, soil performs many ecological functions including nutrient cycling, regulating water and nutrient flows, filtering toxic compounds, providing a medium for plant roots and supporting the growth of a variety of animals and soil micro-organisms by providing a diverse physical, chemical and biological habitat. As such, it is a vital natural resource and forms a key building block upon which life on earth depends. In economic terms, soil erosion inflicts significant costs on society as the ecological services we derive from soil have an economic value; as soil is eroded, the economic value we are able to derive from it is diminished. The financial implications of soil erosion do not stop here. For example, soil erosion can transmit pollutants into water which have to be removed through costly processes. Eroded soil often needs to be removed from roads, reservoirs and estuaries which again can involve considerable costs to society.

This short paper focuses on soil erosion in England and Wales where, in common with many regions across Europe, the negative impacts of degraded soils and inappropriate land management have become increasingly apparent, particularly since the early 1970's. The aim is to provide input to the policy debate surrounding how best to tackle soil erosion from agricultural land, which constitutes 95% of all soil erosion in England and Wales. Novel strategies based around participatory processes will be suggested as a possible way forward. Section 3 provides a brief summary of the key agricultural practices that lead to soil erosion taking place, together with an inventory of the resulting impacts. Section 4 outlines the results of a desk research exercise undertaken to identify reputable studies of the economic costs (externalities) associated with soil loss to give an indication of the scale of the impacts in monetary terms. Section 5 provides an appraisal of the various policy instruments that could be adopted to tackle soil erosion whilst Section 6 briefly assesses current policy tools already in use (or soon to be adopted). Finally, Section 7 introduces an alternative approach to managing the issue involving a participatory approach and consensus building facilitated by organisations from within the charitable sector.

3. The causes and effects of soil erosion from agriculture

3.1 CAUSES

When considering appropriate policy instruments to address soil erosion from agriculture, it is vital to have a thorough understanding of the underlying causes of erosion; why it takes place, where it is most likely to develop in the short term and where it is most likely to occur in the future.

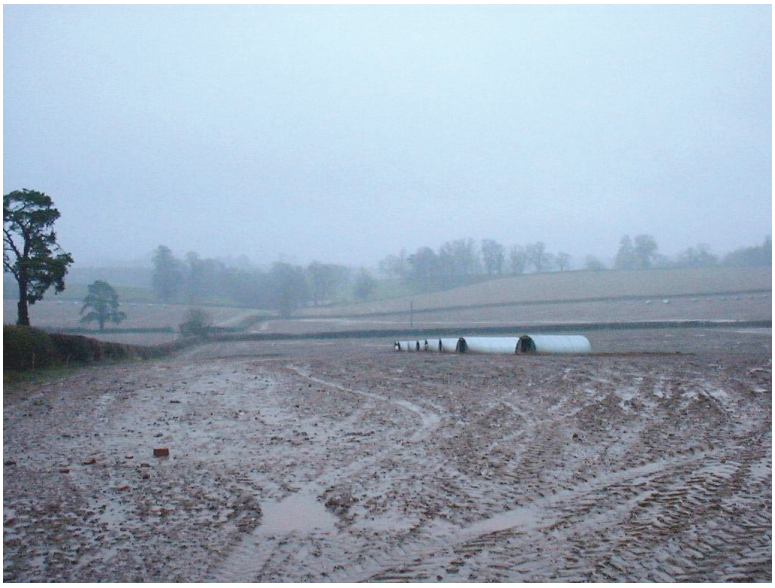
Many of the underlying causes of soil erosion relate to a complex mix of policy failure (e.g. Common Agricultural Policy subsidies leading to overstocking), declining levels of land husbandry skills within the agricultural sector and a whole host of other, often interrelating socio-economic factors. These fundamental problems need to be addressed if a genuinely long term solution to the soil erosion problem is to be found. The purpose of this section of the document is to outline some of the main *on-farm activities* that contribute to the erosion problem. These can loosely be grouped into two main categories: inappropriate cropping or livestock regimes, and bad management practices:

- **Growing crops on inappropriate land** - In many areas of the country, it is possible to identify cropping regimes that are inappropriate for the types of soil and topography present. For example, maize can often be found growing on steeply sided slopes adjacent to water courses. Given the fact that maize tends to be harvested in the autumn, it is often the case that harvesting takes place in wet conditions which leads to problems with soil compaction and an associated increase in run-off and soil mobilisation. Once maize is harvested, fields of bare soil are often left exposed to autumn and winter rainfall events which can result in extremely high rates of erosion taking place.

Plate 1. Maize stubble on a steep slope with bare soil exposed

- **Animal production on inappropriate land** - As with cropping patterns, inappropriate positioning of livestock production activities can also cause soil erosion to occur. Outdoor pig farming, whilst favourable from an animal welfare perspective, has been found to produce high levels of soil erosion, given the fact that pigs often expose soil to rainfall events due to their characteristic 'rooting' of the land. If land used for pig production is on sloping land, the impacts of soil loss on surrounding water courses can be dramatic.

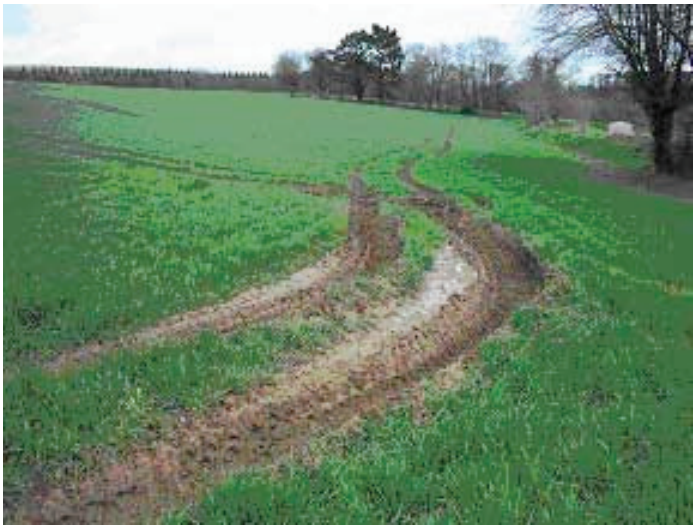
Plate 2. Exposed soil on an outdoor pig unit



- **Overstocking** - Excessive numbers of livestock on a given area of land can cause significant soil erosion problems due to overgrazing and poaching of the soil which can lead to high rates of soil exposure, capping and increased overland flow. Upland areas have proved particularly susceptible to soil erosion caused by sheep. Recent moves by the European Union to reduce stocking densities have involved switching livestock production subsidies from a 'per head' basis (i.e. number of animals owned) to an area basis in an attempt to reduce the incentive for farmers to concentrate too many animals into too small an area.

- **Bad timing of agricultural practices** - A significant cause of soil erosion is often down to inappropriate timing of agricultural practices, particularly ploughing or harvesting land in wet conditions. Such activities cause soil compaction and also lead to 'panning' of the soil, both of which lead to increased rates of run-off and associated soil erosion. Modern tractors have the power to plough land in wet conditions which simply wasn't possible with earlier models (e.g. in the 1960s) when the land had to be sufficiently dry for tractors to be able to pull a plough.

Plate 3. Compaction in tractor wheelings due to working land in wet conditions



- **Degradation of river banks by stock** - As well as soil erosion taking place 'in field', an increasing proportion of soil entering water courses in recent years has been caused by livestock denuding river banks of vegetation, thus making the banks susceptible to erosion during high water or flood conditions. Grazing animals also enter watercourses to drink during which they often destroy the bank structure. Fencing off river banks to preclude livestock from grazing and breaking down bank structures is a technique that has been used to good effect in many parts of the country.

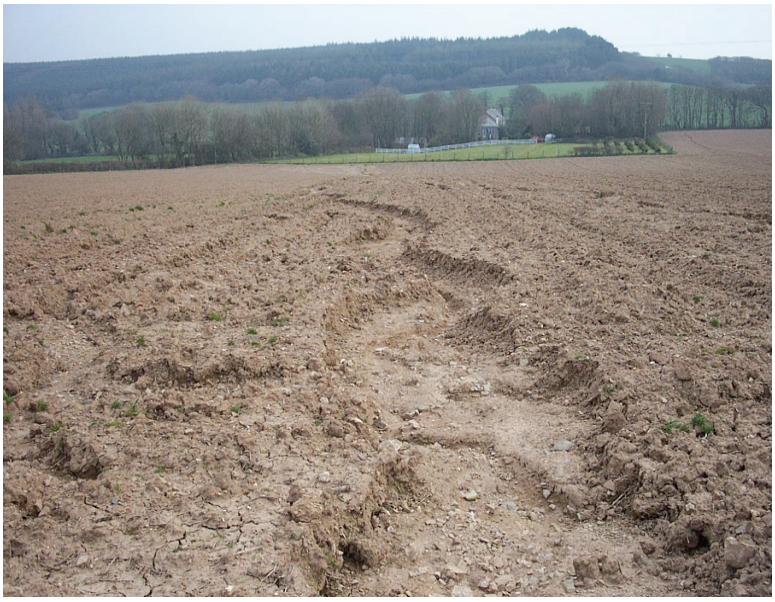
Plate 4. Bank erosion caused by dairy cows

- **Bad management of livestock feeding and drinking areas** - In livestock production areas, soil erosion can often occur around feeding and drinking areas where these are not rotated or moved often enough by farmers. Concentrations of animals over lengthy periods of time can cause a breakdown in soil structure which will increase the likelihood of soil erosion occurring.

Plate 5. Loss of soil structure around a feeding station

- **Lack of ground cover over winter months** - Modern farming systems have increasingly favoured the use of winter sown cereal varieties, due to the high yields these produce. The problem with winter cereals is that unless they are sown early enough in the autumn, there is not time to establish sufficient crop cover to protect the soil from erosion by winter rainfall events. A crop rotation involving Spring cereals will usually result in fields being protected by crop stubbles over the autumn and winter months. The problem with Spring cereals, from the farmers perspective, is that they tend to produce lower profit margins and are, therefore, less attractive than the winter varieties.

Plate 6. Gully erosion on arable land



3.2 EFFECTS

The effects of soil erosion can be sub-divided into on-farm and off-farm impacts. On-farm impacts are predominantly borne by the farmer and are essentially related to loss of production capacity. As soil erosion takes place, the ability for cereal crops and grass to flourish is reduced which, in turn, has a direct impact on the productivity of the land. The upper soil horizon or 'top soil' is the most productive component of any soil series and it can take upwards of 150 years for 1cm of topsoil to develop.

Off-farm impacts of soil erosion are largely inflicted on wider society and take a number of forms such as flooding, declining water quality and pollution of air; involving emissions of greenhouse gases such as carbon dioxide, methane and nitrous oxide. The scope of this paper precludes an examination of air related pollution but readers should note this is an issue that should not be underestimated and requires further research and exploration by policy makers.

Soil eroded from agricultural land will often find its way into a main river channel from where it can be transported downstream as far as the sea. In order to illustrate the off farm impacts of water induced soil erosion in a logical manner, it is helpful to visualise a hypothetical ton of soil as it moves from land situated in the headwaters of a catchment progressively downstream into the marine environment. By tracking the pathway of soil erosion in this way, it is possible to identify some of the main impacts of eroded soil at each stage of the journey. These impacts are briefly outlined below:

- **Loss of Biodiversity e.g. siltation of fish spawning gravels** - Many fish species, particularly salmonids, require clean gravels within which to lay their eggs successfully. Pristine gravels ensure that eggs receive sufficient oxygen to develop correctly. Soil erosion can have a devastating impact on fish stocks because in-stream soil particle deposition can smother spawning gravels, thereby preventing the eggs from receiving sufficient oxygen to survive.

Plate 7. Excessive sediment deposition smothering gravel beds

- **Damage to roads and footpaths** - When significant quantities of soil are eroded from agricultural land, roads and footpaths can become blocked which has a negative impact on motorists and walkers. Soil deposition on roads can induce traffic accidents due to the creation of slippery surfaces and can also increase localised flooding when drains become blocked by excessive sediment loads.

Plate 8. Soil movement from field to public highway

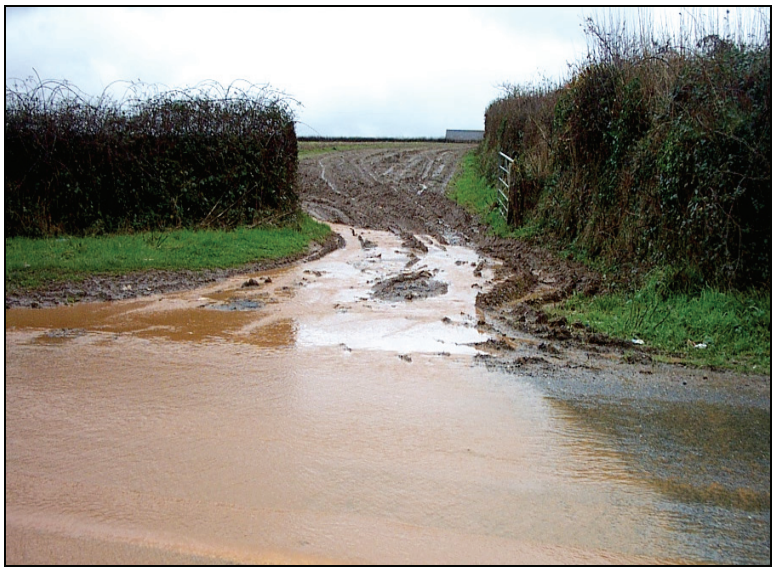
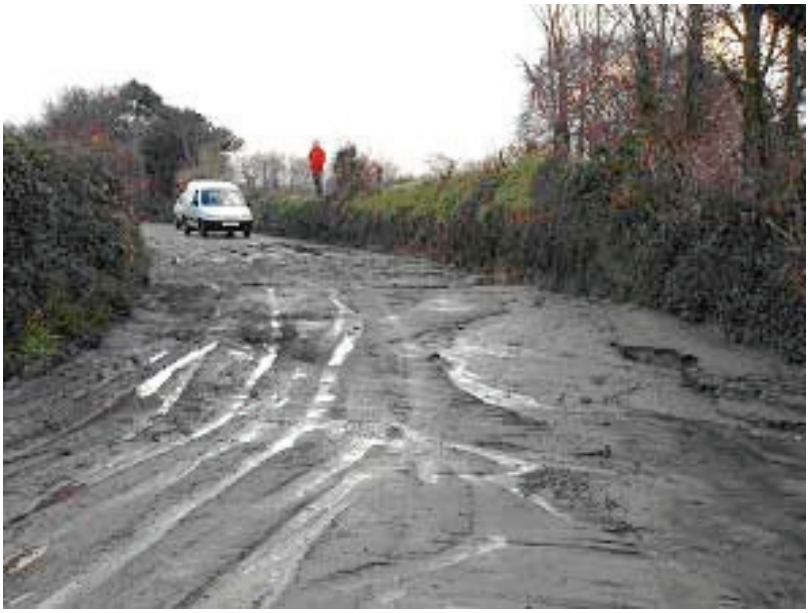


Plate 9. Public highway blocked due to soil movement



- **Impacts on strategic reservoirs** - Sediment entering reservoirs can reduce storage capacity and can also create infrastructural difficulties e.g. blocking outlet valves. Management solutions take many forms from the creation of up-stream silt traps ('ponds') through to dredging, all of which have cost implications. The process of transporting and disposing of silt can be particularly costly.

- **Nutrient enrichment of freshwater waterbodies** - Soil particles often have phosphate attached to them due to a chemical bond between phosphates and clay fractions within the soil. If phosphate levels in waterbodies become too high, excessive nutrient loadings can occur resulting in eutrophication taking place and a corresponding depletion in oxygen levels. This can have fatal effects on macrophytes, fish and other freshwater flora and fauna. Certain forms of algae are toxic to humans which means their proliferation due to nutrient enriched waters is less than desirable on human health grounds.

Plate 10. Blue- Green algae in a reservoir

- **Contamination of drinking water** - Soil erosion has a significant effect on the quality of potable drinking water supplies. Not only do suspended sediments affect the taste of water but the associated phosphate loads also have to be removed by water companies to provide drinking water fit for human consumption.

Plate 11. Heavy sediment loads after a rainfall event

- **Siltation of waterways impeding navigation** - Soil emanating from agricultural land will often end up in estuaries or harbours. When the level of soil deposition reaches a certain threshold, navigation by ships and boats becomes impossible and it is necessary to dredge impacted areas. This is a costly and difficult process

- **Nutrient enrichment of marine waterbodies** - The phosphate loadings associated with soil erosion do not just impact freshwater waterbodies as discussed above. Phosphate also reaches marine waters which are increasingly suffering from high levels of nutrient enrichment, much of which emanates from agricultural land. It is unfortunate to note that much of the sediment dredged from estuaries and harbours is dumped out to sea, thereby contributing to nutrient enrichment in marine waters

4. An assessment of the economic costs of soil erosion

When assessing the negative impacts of soil erosion, it is helpful to consider the financial costs imposed on society by soil erosion processes. By assessing these costs, it becomes possible to provide an economic analysis of the scale of the problem and to develop a rationale for society financing adequate policy measures to reduce the impacts of soil erosion. It follows that measures introduced to combat soil erosion should aim to achieve net cost savings to society.

The costs borne by society as a consequence of soil erosion are known as externalities by economists because they are costs which are not taken into account either by producers or consumers of agricultural goods and services. When such externalities are not included in prices, they distort the market by encouraging activities that are costly to society even if individual (private) benefits are large (Baumol and Oates 1998, Pearce and Turner 1990).

Pretty et al (2001) describe an externality as any action that affects the welfare of, or opportunities available to, an individual or group without direct payment or compensation. In the agricultural sector, externalities are regarded as having five characteristics or features: 1) their costs are often neglected; 2) they often occur with a time lag; 3) they often damage groups whose interests are not represented; 4) the identity of the producer of the externality is not always known and; 5) they result in sub-optimal economic and policy solutions.

Whilst it is relatively straight forward to identify generic externality categories, as we have done in Section 3.2, quantifying many of these categories in monetary terms is extremely difficult. Firstly, it is necessary to know the value of nature's goods and services, and what happens to these when they are impacted. Secondly, many externalities are associated with non-market goods. For example, how do we value soil-water chemical interactions which produce clean water. Several observers (e.g. Abramovitz 1997) believe current mechanisms for valuing externalities significantly underestimate the current and future value of natural capital.

Having conducted a review of the economics literature, it is apparent that very few studies have attempted to value externalities associated with soil loss. Given the methodological difficulties and data collection requirements involved, this is perhaps not surprising. It has, however, been possible to identify a small number of examples that provide cost estimates for various soil erosion externalities. These are outlined below.

Example 1 **- Impacts on Fisheries**

Soil erosion can have a major impact on freshwater fish populations which, in turn, can have serious negative economic impacts. A good example is the impact reduced salmon populations can have on local businesses which depend on recreational fishing for their income. It has been estimated that a rod caught salmon can be **worth in the region of £5,000 to a local economy** which includes direct expenditure on fishing along with associated expenditure on accommodation, food and fuel. The economic value of the Esk fishery, for example, is estimated at **£1.5m**. Research has shown that soil erosion can reduce salmon egg survival

significantly and in some cases can result in 100% egg destruction. Given the high levels of soil erosion in some areas of England and Wales, it is likely that the impact of soil erosion on related fisheries is running into **many millions of pounds each year in lost earnings**.

Example 2 - **Damages to roads and footpaths**

It has been estimated from Local Authority data that the impacts on property and roads from soil erosion has cost UK society up to **£30m/year** in recent years.

Source of data:

Evans R (1995). *Soil Erosion and Land Use. Towards a Sustainable Policy*. Cambridge Environmental Initiative, University of Cambridge

Evans R (1996). *Soil Erosion and its Impact in England and Wales*. Friends of the Earth Trust, London

Example 3 - **Contamination of drinking water**

A research study conducted by University of Essex suggests the costs of soil and phosphate removal from drinking water are significant; in 1996 for example, it is estimated that **£55m** was spent on this activity.

Source of data: Pretty J N, Brett C, Gee D, Hine R E, Mason C F, Morison J I L, Raven H, Rayment, M D and van der Bijl G. (2001). *An Assessment of the Total External Costs of UK Agriculture*. Agricultural Systems 65 (2), 113-136

Example 4 - **Siltation of waterways impeding navigation**

In the Fowey harbour in Cornwall, between 35,000 and 50,000 tons of silt is dredged each year at an annual cost of **£90,000**.

Source of data: Jane Smith, Environment Officer, Fowey Harbour Commissioners

Based on the available data, it is very difficult to assess how much soil erosion is costing society in England and Wales. We believe the absence of such analysis severely limits the ability to develop appropriately funded policy options to deal with soil erosion effectively. This position is succinctly stated in a June 2003 report of an OECD expert meeting on agricultural soil erosion and soil biodiversity indicators:

'*Off-site costs of erosion and sediment redistribution are probably at least an order of magnitude greater than on-site (private) costs. It should be noted that there is considerable ambiguity in quantification of off-site costs, and especially in how to quantify the impact of agriculture on soil and other natural resources (air and water). This ambiguity needs to be addressed. It was also noted that our capacity to model and characterise off-site impacts remains rudimentary*.'

However, it seems plausible to suggest from the information that does exist that externalities associated with soil loss are substantial and warrant further investigation by policy makers.

In social welfare terms, it makes no sense for society to pay millions of pounds in clean-up/impact costs for soil erosion because this is effectively paying a bill for a process which benefits no-one. All that is happening is that water bills, insurance premiums and a plethora of other direct and indirect levies are gradually increasing whilst soil erosion continues to rob society of one of its most valuable resources. Clearly, in the interests of maximising social welfare, anything that can be done to cost-effectively reduce the externalities caused by soil erosion constitutes a rational way forward.

The big questions, of course, are which measures should be introduced, how much will they cost and what effects will they have on reducing soil erosion externalities? Are current UK environmental policy initiatives targeting soil erosion issues appropriate or does more need to be done? Soil conservation and natural resource management feature strongly within initiatives such as the Sustainable Strategy for Farming and Food and Catchment Sensitive Farming but how can policy intentions be converted into practice?

These questions will form the basis of the discussion and analysis outlined in the remaining sections of this paper.

5. Potential policy options to tackle soil erosion

The economics literature and the many consultation documents refer to a number of potential policy options for combating soil erosion and diffuse agricultural pollution more widely. In broad terms, these policy options can be classified into three categories: regulation, market measures and advice/education. More specifically, it is possible to highlight a number of individual policy instruments that could be used to address the issue of soil erosion;[1] including:

- Regulatory Instruments
- Whole Farm Planning
- Farmer Self-Help (Voluntary Initiatives)
- Co-operative Agreements
- Grant Aid

Ideally, a formal analysis is required for each potential instrument against a set of standard criteria including *cost effectiveness and economic efficiency, fairness, dynamic efficiency (whether an incentive exists to improve performance over time)* and *enforceability*. However, such an undertaking lies outside the scope of this paper. What is presented here is an outline of the issues we believe need to be taken into account when considering the potential application of each option, together with a qualitative appraisal of the strengths and weaknesses of each.

In certain countries in Europe and in the US, governments have taken the step of buying land from farmers, the aim being to stop agricultural production in areas considered to be at high risk from pollution. This option is not considered within the context of this paper because it is felt land purchase is unlikely to be a feasible option within the current UK political climate.

5.1 REGULATORY INSTRUMENTS

Within the arena of environmental policy making, the use of regulation has proved the most widely used instrument for environmental protection objectives. The rationale for using a 'command-and-control' approach is essentially based around guaranteed outcomes i.e. stated environmental goals or standards can –theoretically – be hit with certainty. Incentive based instruments leave it to market forces whether environmental objectives will be exactly met, thus introducing an element of uncertainty and risk which, in certain situations, can be regarded as unacceptable.

Whilst regulation has proved very effective in controlling point source pollution, where the sources of pollution are relatively easy to trace and monitor, it is debateable whether regulatory measures are sufficient for combating diffuse pollution of which soil erosion is a part. There are a number of issues to take into account:

[1] Trading Schemes and Taxes are potentially viable for issues such as pesticide and fertiliser reduction but are not considered applicable for managing soil loss

- Soil erosion is a problem which stems from many thousands of individual landholdings situated across a very broad geographical area. In order to monitor soil erosion regulation effectively, a large enforcement resource will be required which has significant cost implications to society. Given the diffuse nature of the soil erosion issue, tracing the specific source of the problem to an individual farm is extremely difficult, compounding difficulties with enforcement.

- Regulation can lead to economic inefficiencies, depending on the geographical scale of implementation. National regulations involve establishing national, uniform standards for farm practices and infrastructure. Whilst such regulations may seem equitable, they can often lead to unnecessary costs being incurred by producers, given that the action required in some geographical areas to meet required standards might be minimal whilst the costs of undertaking such actions in other areas might be high. This is economically inefficient. Targeted area based regulation, involving specific standards for defined regions, farms or fields is likely to be a better option as this will minimise unnecessary costs and produce the best ratio of benefits to costs. The problem with targeted regulatory measures is that the administrative costs will be high and they can be construed as unfair.

- As pointed out in Section 3.1, a significant underlying cause of soil erosion is inappropriate timing of agricultural operations e.g. ploughing, cultivating, harvesting in wet conditions. Whilst it is theoretically possible to introduce regulations banning farmers from undertaking certain agricultural operations in the wrong conditions, monitoring compliance with such regulations will be very difficult, if not impossible, in practice.

- Lack of organic matter in soils is a major factor behind poor soil structure in many areas which, in turn, contributes significantly to the soil erosion problem. As with timing of operations, it is theoretically possible to introduce statutory obligations to incorporate farm yard manure and other inorganic matter into soils. However, it is hard to see how such legislation can be rigorously enforced.

- A significant body of anecdotal evidence suggests that regulation is unlikely to gain farmer 'buy-in' to the process of tackling the soil erosion problem, thereby securing attitudinal change amongst farmers which is vital to bring about behavioural change on an on-going basis.

In the case of soil erosion, it is feasible that regulation could most appropriately be used in relation to land use planning, specifically to determine the type of land use permissible within a given location. For example, regulation could be used to prevent maize growing in specific areas such as sloping fields adjacent to water courses. Alternatively, it might become a statutory obligation to 'under sow' maize or sow a catch crop to provide soil cover over the winter months. This system would be enforceable given the tangible nature of the item being assessed but inevitably, the monitoring and enforcement costs would not be inconsiderable.

On balance, given the complex nature of the soil erosion problem, there are strong arguments to suggest that regulation alone is not the best solution to the issue and that some alternative needs to be found.

5.2 WHOLE FARM PLANNING

Whole farm planning is a concept that has received growing interest in recent years. Whilst there is no commonly accepted definition, whole farm planning involves an assessment of the farm as an integral unit taking into account issues such as livestock numbers, land area, soil types, topography, farm infrastructure, labour availability, machinery requirements, access to financial resources and individual farmer aspirations and goals.

The main idea behind whole farm planning is to enable each farming unit to develop an agricultural system that maximises economic returns whilst protecting natural resources and habitats in the process. For example, whole farm planning can involve assessing levels of inorganic fertilisers created on farm and where best to apply this fertiliser to maximise crop yield whilst minimising nutrient loss to the environment.

A distinct advantage of the whole farm planning approach is that it allows a non-prescriptive 'bottom-up' assessment of problems such as soil erosion and possible solutions to these problems. In effect, it provides farmers with the opportunity to identify solutions 'for themselves', thus giving them ownership of the issue. In addition, farm planning is possibly the only way to identify individual farm or field-level problems and the most appropriate measures to remedy these problems. From this perspective, whole farm planning enables a cost efficient solution.

From a farmer's perspective, whole farm planning can initially represent a complex process which he may not necessarily have sufficient knowledge and expertise to undertake. For this reason, it is considered necessary by many observers to introduce a policy of whole farm planning in conjunction with expert advice provision via some form of extension service. Advice provision will add significant expense to the whole farm planning process; however, these costs can be offset by more cost effective and targeted solutions being adopted by farmers as outlined above.

One of the potential shortfalls of whole farm planning is that there is no guarantee that plans will be implemented by farmers. There is also no guarantee that the measures incorporated within a plan will be sufficiently robust to properly tackle soil erosion and other diffuse pollution activities. It may, therefore, be necessary to introduce a programme of whole farm planning in conjunction with a series of regulatory and financial measures. For example, it could become a statutory requirement to implement farm plans, once actions have been agreed by the farmer. In specific regions, it might become a statutory obligation for farmers to incorporate specific actions within their farm plans, in return for grant aid where such actions involve income foregone.

5.3 FARMER SELF HELP (VOLUNTARY INITIATIVES)

The principle behind voluntary approaches is similar to whole farm planning in that the emphasis is placed on farmers solving problems for themselves, rather than being forced to adopt 'top-down' regulatory measures. By way of an example, the Pesticides Voluntary Initiative co-ordinated by the Crop Protection Association has been established to develop a solution to the impact of pesticides on the environment.

As such, voluntary approaches can enable buy-in to an issue from farmers which, as already discussed, is vitally important to policy implementation. In the case of soil erosion, it is likely that through a process of self-help and knowledge transfer between farmers, several cost neutral of even cost saving measures could be developed to tackle erosion issues. For example, machinery and labour rings could potentially be mobilised to enable better timing of agricultural operations. Methods of developing under sowing techniques could be trialled and evaluated collectively, with the cost implications assessed to ascertain the viability of this approach.

The difficulty with voluntary policy instruments is that they cannot, on their own, guarantee sufficient action from farmers. It is likely farmers will adopt practices that are cost neutral of that can save money but they will be less willing to agree to practices which cost them money. It is also likely that farmers will not organise themselves into voluntary working groups but will need a facilitator to bring them together.

For these reasons, any voluntary initiative policy would most likely benefit from being supplemented by other policy instruments, for example grant aid schemes and the introduction of advisory personnel with sufficient facilitation skills to bring farmers together to take collective action.

5.4 CO-OPERATIVE AGREEMENTS

As pointed out in Section 4.0, soil erosion is an externality which imposes costs on society. For example, members of the public have to pay the costs of extracting soil and phosphates from drinking water supplies and have to pay for soil to be dredged from estuaries and harbours. Rather than continue to suffer the negative effects of soil erosion, those groups most impacted may consider it prudent to enter into a co-operative arrangement with farmers, whereby farmers are paid for any income forgone from implementing practices capable of preventing soil erosion from taking place. Such a system will be economically efficient as long as the benefits derived by society exceed the cost of funding the farmers to take action.

For example, a community within a specific catchment particularly prone to erosion from late harvested maize could pay farmers not to grow maize; or could pay for farmers to adopt earlier yielding maize varieties that can be harvested earlier in the year, thereby reducing damage at harvest and allowing the establishment of a catch crop e.g. rye corn.

A policy of co-operative agreement has a number of distinct advantages. In economic terms, funding provided by local communities will help to enhance existing grant aided schemes, thereby providing additional resources to tackle soil erosion problems at source. In social cohesion terms, co-operative agreements between farmers and wider society would help to build a sense of common ownership of both the problems and solutions relating to soil erosion.

There are difficulties with such approaches. Firstly, impacted parties are likely to be unsure how effective their financial contributions will be in reducing the problem. They may well be hesitant to get involved in the process as a result. In addition, actions taken by farmers to reduce soil loss may take time to produce measurable (quantifiable) reductions; if the time lag is excessive, funders may well withdraw their support.

Secondly, there are legitimate concerns that such an approach involves paying farmers not to pollute, a reversal of the 'polluter pays' principle. It is not clear why farmers should be paid not to pollute, while this is a legal duty on other sectors of the economy. Such payments to farmers would suggest that they have a 'right to pollute' of some form.

5.5 GRANT AID

In certain situations, it may be the case that actions to reduce soil erosion will involve considerable costs to the farmer e.g. fencing riverbanks, introducing buffer strips etc. Given these cost implications, farmers are unlikely to undertake such actions without some form of financial compensation or incentive. In these instances, an argument exists to provide grant funding as long as the benefits accruing to society from the resulting actions outweigh the sum of the grant. Again, however, there are concerns over paying farmers not to pollute.

In order to maximise the cost effectiveness of grant aid, it is essential that resources are targeted at funding actions and geographical regions most likely yield the greatest results. Targeting can only be achieved through a detailed knowledge of the causes of soil erosion within a given area which, in turn, relies on an assessment of land use, local land management practices, topography, soils and a broad range of other factors. Skilled advisors can add value to this process provided they have sufficient skills and training.

5.6 SUMMARY OF POTENTIAL INSTRUMENTS

There are a number of policy options which potentially could be adopted to deal with the soil erosion problem. It is our belief that the best approach needs to involve not one, but several policy instruments. Crucially, given that the underlying drivers behind soil erosion will vary from region to region, it seems sensible to deliver a 'policy mix' suitable to the needs and unique economic, social and environmental circumstances within each region. For example, it may be possible to implement significant changes in one region through a combination of voluntary initiatives and targeted grant aid assistance in selected sub-catchments. In another region, a programme of targeted publicly funded grant aid might be supplemented by a co-operative arrangement between farmers and local water users who might provide funds to tackle one specific issue. In regions where soil erosion has reached critically high levels, there may be no alternative but to introduce regulations curtailing certain land uses in specific sub-catchments.

In particular, there is strong evidence to suggest that a collaborative approach involving partnership between farmers, government and intermediary groups can yield results and should be explored as part of a suite of measures. A possible approach is outlined in 7.0.

6. Assessment of current government strategy

Having taken a look at the potential policy options available to tackle soil erosion from agriculture, it seems logical to assess the policy instruments currently being used or scheduled for implementation. In particular, we need to ask are these policies appropriate and are sufficient resources being channelled into them?

6.1 A BRIEF HISTORY OF POLICY

Historically in the UK, environmental policies relating to the agricultural sector have tended to focus on the protection of biodiversity (habitats and species), with natural resource protection and environmental service provision receiving less attention within both regulatory and market instruments. The preponderance of habitats and species conservation measures within the various agri-environment schemes (e.g. Countryside Stewardship Scheme, Environmentally Sensitive Areas scheme) provides a good example of this. There are various and complex reasons why this situation has arisen. For example, conservation measures such as hedgerow creation and tree planting are tangible outputs which demonstrate easily quantifiable results for tax payer's money (Potter, 1998). There has also been an on-going resistance to use public money to fund soil conservation schemes on account of the polluter pays principle. This argument is based on the premise that public funds should not be given to farmers for protecting soils because this should be undertaken as part of everyday land husbandry activities.

Policy makers have also proved resistant to the notion of introducing regulation to address soil erosion, largely due to the reasons already highlighted in Section 5.0 of this document. As a result, the soil erosion issue has remained a policy dilemma for government which, according to many observers, has resulted in superficial measures being adopted thus far. These are briefly summarised below:

- **Distribution of the Codes of Good Agricultural Practice** - The three Codes of Good Agricultural Practice for the protection of water, air and soil respectively (the 'Codes') provide the farming industry with a benchmark of good agricultural practice and guidance on how to avoid polluting activities while continuing to farm profitably. The Codes are targeted at farmers, advisers, consultants and enforcement agencies and were first published between 1991 and 1993. Revised Codes were launched in October 1998, together with a summary leaflet highlighting the key messages contained in the Codes. This leaflet is intended to provide a more reader-friendly document for farmers, encouraging them to make further reference to the Codes as necessary. The Environment Agency and ADAS actively promote the revised Codes on behalf of DEFRA.

  All three Codes are useful reference documents and contain excellent information on a range of best farming practices. The problem with the Codes is that they are not particularly succinct (The Water Code is 109 pages long) and they are regarded by farmers as too generic. They also lack detailed information on the cost (and cost saving) implications involved with adopting best farming practice techniques. Consequently, usage of the Codes by farmers has remained limited and the effect they have had on bringing about attitudinal and behavioural change is unlikely to have been substantial.

- **Provision Of Advisory Services** - It has been government policy for many years to fund extension services capable of providing farmers with advice on soil management and other natural resource management issues. However, since the privatisation of ADAS in the late 1980s, the availability of free advice to farmers on natural resource management issues has been significantly reduced across the country. ADAS has continued to receive public funds on a reduced scale to provide pollution advice and FWAG also receives funds to deliver advice to farmers, although until very recently, this has tended to focus on biodiversity issues rather than natural resource management.

  The total financial cost of free advice programmes in 1999-2000 was 2.6 million. 7,356 visits were undertaken, with an average financial cost of £355 per visit. This resource allocation has been identified by various commentators (e.g. Dobbs and Pretty 2001) as insufficient to provide a comprehensive public agricultural extension service in the UK.

6.2 FORTHCOMING POLICY INSTRUMENTS

At the time of writing, there are a number of policy instruments currently in development which the government intends to use to tackle soil erosion. A summary of these is provided below:

- **Cross-compliance** - Reform of the Common Agricultural Policy has de-coupled subsidies from production and has introduced a Single Farm Payment. To qualify for this payment, farmers are required to meet a basic level of standards in relation to environmental protection, public, plant and animal health and animal welfare. This requirement is called cross compliance.

  Cross compliance regulations require farmers to maintain their land in Good Agricultural and Environmental Condition (GAEC). The management of soil is an important requirement under GAEC and will be phased in over a three year period. From 2005, farmers were required to adhere to a soil management guidance booklet that will be sent to every land holding number by DEFRA. In 2006, farmers will be required to produce a soil management plan and in 2007 they will be required to implement this plan. The process of producing a soil management plan will involve farmers having to assess risk on a field by field basis and then put steps in place to minimise the problem.

  There will be penalties for failing to meet the cross compliance standards which will be enforced by a Rural Payments Agency. In some cases, farmers may not be penalised for minor infringements but in general, the Single Farm Payment will be reduced by 3%-5% for any non-compliance as a result of negligence. Where a farmer repeatedly fails to comply with a particular standard, the penalty may reduce payment by up to 15%. Where non-compliance is intentional, the reduction in payment will be at least 20% and may be as high as 100%. There will be an appeals process.

- **Entry Level Agri-Environmental Scheme** - As a result of agri-environment schemes being criticised for their conservation bias, as noted in Section 5.1, significant debate has taken place in recent years regarding the incorporation of natural resource measures within the agri-environment programme. This has resulted in the formulation of an 'Entry Level

Scheme' (ELS) which has been introduced during 2005 and will be available to all farmers irrespective of farm type, size or location.

The scheme involves a range of payments for various management practices, some of which will offer protection against soil erosion e.g. buffer strips, forage crop management, management of high erosion risk land. The application process for the scheme requires farmers to identify areas on their land which represent high soil erosion risk. The scheme has an annual budget of approximately £150m in addition to administration costs.

The problem with the ELS, from a soil protection perspective, is that only a proportion of available measures will support soil management practices. In addition, the ELS scheme enables farmers to choose which measures they wish to adopt from a range of biodiversity, animal welfare and resource protection options. It is, therefore, possible for a farmer to qualify for the scheme without adopting any, or very few, tangible soil protection measures.

- **Higher Level Agri-Environment Scheme** - The Higher Level Scheme (HLS) funds activities which are considered to go beyond the basic farm practices fundable under the Entry Level Scheme. It is possible for farmers to apply to both the Entry Level and Higher Level schemes. Approximately 10% of the available options available under HLS can be considered relevant to soil erosion.

  The funding for HLS will gradually be diverted from existing agri-environment schemes (Countryside Stewardship Scheme and the Environmentally Sensitive Areas Scheme) which currently have a budget of £125m.

  As with the Entry Level Scheme, it is not possible to predict the relative uptake of soil protection measures by farmers relative to the other measures available. As a result, it is not possible to determine what impact HLS will have on reducing soil erosion at this stage.

- **Catchment Sensitive Farming** - DEFRA announced details of the Catchment Sensitive Farming (CSF) scheme in December 2005. The scheme will provide free farm advice on reducing pollution to the freshwater environment in 40 key catchments in England and Wales. The scheme is scheduled to last for 2 years.

  The CSF approach follows many of the principles outlined in section 7.0. However, it appears farm advice may principally be provided by DEFRA employed CSF officials, rather than facilitated through civil society organisations. It also remains unclear whether the approach will extend beyond an advice scheme into a more thorough-going participatory approach.

6.3 SUMMARY OF POLICY INSTRUMENTS

Having identified the policy initiatives outlined above, it appears – in broad terms – that many of the building blocks necessary to successfully implement a range of policy measures are being laid. DEFRA is advocating a whole farm planning approach (e.g. soil plan under cross compliance) and a programme of grant aid is being put in place through the Entry Level and Higher Level schemes. Provision is also being made for to farmers on soil management and

other natural resource protection activities through the CSF programme. In addition, attention is being given to awareness and education raising issues; for example, DEFRA is currently piloting a methodology to develop farmer self-help groups where farmers are brought together to develop joint solutions to area specific problems.

The use of participatory techniques in developing natural resource management solutions has been common within a developing country context for many years and has begun to be implemented in Europe, Australia and the US. To date, use of participation in the UK has remained embryonic which we believe represents a serious barrier to developing long term resource management solutions. In order to aid policy development, the following and final section of this report outlines a potential model for participation which we believe offers a robust and cost effective way forward and, as such, is worthy of further investigation and research by policy makers.

7. A Participatory Approach to natural resource management at the catchment scale

To conclude this paper, we outline some ideas relating to a participatory methodology for tackling soil erosion and other forms of diffuse pollution from agriculture.

7.1 THE CASE FOR A PARTICIPATORY APPROACH

The approach is based on a rationale that diffuse pollution is too complex to be dealt with using a standardised 'top-down' or technocratic framework and that a more subtle system is required based on consensus building and knowledge transfer at a number of levels. A summary of the factors that favour a participatory approach are outlined below:

- Policy makers from around the world are increasingly discovering that successful policy implementation depends on those groups impacted by a given policy having a say in how that policy is developed and implemented. Agricultural policy is no exception to the rule. There is considerable evidence to suggest that whatever policy instruments are used to instigate change in the agricultural sector, they are more likely to succeed if farmers play a major role in developing them. This requires the establishment of a participatory process which proactively involves the grassroots farming community from an early stage.

- Developing solutions to the diffuse pollution problem is going to involve costs. At the current time, it is likely that some of the financial burden will be borne by farmers but a significant proportion of the costs will be paid for by wider society, either through grant aid or by paying higher prices for food production systems which do not create 'negative externalities'. In order to enable an informed debate to develop regarding 'who should pay what', farmers, water companies, water user groups and members of the general public need to be brought together – within a participatory process – to generate consensus and mutual understanding. Members of the public need to gain a better understanding of the benefits (including 'non food production' benefits associated with environmental service provision) that farming provides society, whilst farmers need to develop better knowledge of what products and services are expected from them. It is possible to envisage the development of a 'social contract' between farmers and society capable of producing an agricultural system which protects natural resources rather than pollutes the environment.

- If farmers are to implement farming practices that result in natural resource protection, they will need to be provided with sufficient information in the correct format to enable them to make the changes required of them. It is widely recognised that the correct format for information transfer is practical demonstration and on-going dialogue, both between farmers, policy-makers and respected technical experts and between farmers themselves. Some form of participatory process is required to encourage farmers to attend demonstration sites and learn from each other.

There are, therefore, a number of strong arguments in favour of a participatory approach. Key questions that need to be considered relate to costs and implementation. How should

participation be encouraged and managed, who should facilitate the process and how much would such a process cost; and who should pay the bill? These issues require detailed debate and consideration by policy makers.

7.2 DELIVERING CATCHMENT SCALE PARTICIPATION AND KNOWLEDGE TRANSFER USING THE CIVIL SOCIETY SECTOR

Developing an effective strategy for combating diffuse pollution from agriculture will involve communicating with, and understanding the viewpoints of, a diverse set of stakeholders, many of whom have vested interests in maintaining the status quo by remaining disengaged form the process of change. Suspicion of one group by another can often prevent solutions being found to a common problem, a situation which becomes exacerbated where no mechanism exists for conflicting groups to discuss differences of opinion in a considered way.

In order to build consensus and enable 'joined up thinking', it will be necessary to bring various parties together, preferably at the catchment or sub-catchment scale. Whilst the ideal would be for groups to come together 'organically' without any form of intervention, it is extremely unlikely this will happen without some form of facilitated process, initiated and managed by a third party organisation. The status of such a facilitating organisation is crucial in that it will need to be deemed impartial by all parties in order to gain trust and credibility.

It is here where an argument exists for civil society organisations (CSOs) assuming the role of facilitator, mediator and general co-ordinator between the various parties involved in a given process. The definition of CSO needs further discussion but for the purposes of this paper, we refer to charitable trusts such as FWAG, the Agricultural Colleges and the emerging number of Rivers Trusts which are forming across the UK. In all cases, facilitators should have a firm grasp of soil and water management, rather than being focussed solely on biodiversity issues i.e. their culture should be 'brown' or 'blue' rather than predominantly 'green' in outlook.

The strength of charitable organisations is that they are capable of assuming the role of a neutral broker, providing the opportunity to bring groups with different values and opinions together. The premise here is that CSOs have the ability to act as 'impartial actors' with no agenda other than to improve the environmental integrity of a given geographical area within which they exist. To provide the process with democratic accountability, it is suggested that CSOs could assume a facilitation role in conjunction with representatives from statutory agencies (and /or elected bodies). Such a partnership would enable public bodies to maintain control over, and ultimate responsibility for, the process. The leading role played by the civil society sector would help to build trust between stakeholders, particularly between public and private sector actors where relationships need to be strengthened.

A crucial point to note about the proposed participatory model being outlined is that the role of the facilitating organisation should be to bring stakeholders together and, where appropriate, provide knowledge transfer and technical support services. The aim of the facilitator must be to enable groups and individuals to come together to develop plans 'for themselves' and have control over implementation 'by themselves'. Ultimately, unless stakeholders - particularly farmers - are empowered to deal with the problems of diffuse pollution, it is unlikely that a sense of ownership of the issue will develop which is vital if attitudinal and behavioural change is to take place.

8. Conclusions & Recommendations

1. This paper has highlighted that the causes of soil erosion (and diffuse pollution more broadly) are complex and require a sophisticated policy solution involving a combination of whole farm planning, farmer self-help, advice provision and grant aid. Regulation alone is not regarded as sufficient or optimal.

2. In order to effect delivery of natural resource protection on the ground, it will be necessary to engage with farmers and wider stakeholders using a participatory approach capable of empowering people to take action; essentially 'helping individuals and groups to help themselves'.

3. Given such a participatory and 'bottom up' approach has not been used extensively in the UK, it is recommended that a pilot study is established as a matter of urgency. Such a pilot should involve DEFRA, all relevant statutory agencies, the water companies and a selection of civil society organisations with sufficient resources and expertise to manage the process.

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