Policy, practice and partnership: pragmatism or perfection in farming?

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ABSTRACT

In order to protect the environment, users of pesticides have been subject to changes in regulations, stewardship programmes, and strong consumer/political pressure to modify their usual practices. Farmers have been required to increase their own awareness of soil and water quality concerns and are now expected to fully comply with all statutory requirements, codes of practice and the guidelines or advice issued by a range of stakeholders with respect to the use of pesticides. The impact of these initiatives on farmers is difficult to assess but there has been a general acceptance of the need to protect soil and water and to co-operate with the various requirements in order to avoid inflexible legislation, revocation of active substances or other stringent restrictions. However there remains some uneasiness amongst many farmers concerning the successful implementation of measures due to conflicting advice, lack of evidence of impact, inflexibility, practicality and cost. There is also a need for regulators to acknowledge that immediate improvements in practice, which do not necessarily solve environmental problems, but do reduce impacts, are acceptable when part of the overall process of achieving a longer term objective of full compliance. UK farmers are key partners in a number of proposed initiatives which have been designed to protect soil and water quality.

INTRODUCTION

The use of pesticides is regulated to ensure that there are no unacceptable effects on the environment. As researchers, the agrochemical industry, policy makers and regulators begin to understand more about the interactions of chemicals with soil and water and their impact, a range of policies, practices or risk management strategies have evolved to mitigate any adverse effects. The farmers and growers who use these pesticides have had to respond to a number of external influences and in consequence have begun to change their systems and practices in order to comply with changes in statutory or voluntary regulations and best practice recommendations. Stakeholder interest in the way that farmers use pesticides range from the consumer, the retail supply chain, the water industry, environmental organisations, regulators of pesticides and the manufacturers/ distributors of pesticides.

Historically, concerns over the presence of pesticides in surface or groundwater are based on the risk of drinking water contamination and the ecotoxicological impact of residues on non-target aquatic organisms. In 1998, 15% of freshwater sites monitored by the Environment Agency for England and Wales failed at least one environmental quality standard (EQS) with

at least 32 pesticides failing at least once. Approximately 70 incidents were due to pollution related incidents, of which 44% were attributed to agricultural activities, many of which were related to use and/or disposal of synthetic pyrethroid sheep dips. Increasingly there is also concern for the impact of pesticides on soil quality, associated terrestrial organisms and its long-term sustainability. Even though scientific evidence suggests that general agricultural practices have a greater impact on biodiversity than crop protection itself, e.g. Furse *et al.* (1995), people continue to be concerned about the effect of crop protection chemicals on wildlife and the environment. In the UK, initial investment in water treatment costs for pesticides was estimated to be £1 billion with annual running costs of £100 million (Clarke 2001). Pretty (2000) calculated that in 1996 the external costs of pesticide use, in a range of countries, was between £2.20 and £8.60 per kilogramme of active substance used. This was considered to be a substantial burden on non-agricultural sectors of economies.

The mechanisms by which farmers and growers are influenced to make changes vary widely but they can be considered as 'carrots' (incentives) or 'sticks' (penalties). The pressure to make the 'polluter pay' was highlighted by the UK Government's proposal to introduce a pesticides tax (DETR 1999). However, complex interactions in the natural world mean that it is very difficult to separate out cause and effect and as a consequence it is impossible, in some cases, to identify the required measures or provide the necessary evidence to assist the implementation of changes and ensure compliance.

POLICIES TO PROTECT SOIL AND WATER

EC Directives and statutory legislation

A number of EC Directives and schemes have been implemented within national legislation in relation to minimising the potential contamination of water by pesticides. The report of the Pesticides in the Environment Group (PEWG 2000) identified that there are however, no specific policies in the UK, which refer to the protection of soil from the impact pesticides, with the exception of the regulatory directives.

The impact of the EC harmonisation directive (1991/414/EC) for plant protection products in protecting the environment is yet to be fully determined. The process of re-registration is slow and few active substances have attained approval or Annex I listing to date. Pesticides with persistent characteristics, potential to contaminate water, toxicity to non-target organisms or the potential to bioaccumulate, have caused concerns in Member States. Manufacturers or users on the basis of agricultural need have made cases for the retention of approval of some of these active substances and consequently the regulatory authorities have been required to consider risk and benefit in detail. However, the rigorous data registration requirements of the Directive which are relevant to environmental protection have led to the withdrawal of a number of new active substances at an early stage of their development or during the re-registration process, restricting the choice available to farmers.

In the UK, the Local Environmental Risk Assessment for Pesticides scheme (LERAP) was devised in response to representations by farmers' organisations, that the prevailing pesticide buffer zone regulations were too restrictive. In addition, environmental organisations had expressed concern about the low level of compliance with pesticide buffer zones. The scheme's requirement to record spray decisions when carrying out a LERAP addressed this

concern by ensuring that operators were given a framework for planning their spraying near watercourses. The scheme was implemented in March 1999 and it provided farmers with the flexibility of narrowing pesticide buffer zones for certain products but retained fixed zones for organophosphate and pyrethroid pesticides.

The implementation of the Water Framework Directive (2000/60/EC) will rationalise the existing body of water legislation established under a range of European Directives since the 1970's. It will lead to the repeal of a number of directives and provides a framework for the remaining legislation. The objectives of the Water Framework Directive are:

- Protection of aquatic ecosystems and the water needs of terrestrial ecosystems.
- Promotion of the sustainable use of water resources (contributing to the provision of adequate drinking water and water for other economic uses).

Fundamental to the directive is the prevention of deterioration in water quality and the establishment of environmental objectives for all surface waters and groundwaters. The competent authority will designate surface water catchments as the management unit. Priority substances, which include some agricultural pesticides, which impact on the aquatic environment and cause transgressions of environmental quality standards, will be targeted for remedial action or change of land use activity.

The Groundwater Directive protects underground water resources from different contaminants, and prevents or limits discharges (applicable to many pesticides) to underlying reserves. In the UK, a license is required to dispose of washings and waste pesticides to a designated area, which has been assessed by the applicant and then approved by the relevant environment agency with regards to the vulnerability of water resources to contamination.

Other proposed legislation, the Waste Framework Directive and the Waste Incineration Directive will influence how pesticide containers are disposed of (Rose *et al.* 2001). Currently non-returnable containers can be rinsed and then buried (though this is not encouraged) or incinerated on the farm. It is unlikely that the required emission standards for smoke and airborne contaminants will be met by the proposed incineration directive. Specialist waste disposal of contaminated materials, through a licensed waste contractor is prohibitively expensive at approximately £4.50/kg (BAA, 1999).

Voluntary Agreements

Many of the pollution prevention initiatives have been voluntary and have often developed to avoid inflexible legislation. Examples are listed below:

- Quality assurance schemes
- National and European promotion of integrated farm management e.g. LEAF in the UK (Linking Environment and Farming) and EIF (European Initiative for Integrated Farming).
- Codes of Good Agricultural Practice.
- Stewardship campaigns

Quality assurance schemes are mainly driven by the grower or more rigorously by the retailer and can be extremely influential (more so than legislation in some cases) in determining farming or grower practice. At present, the schemes are primarily established for competitive

advantage and the need for 'due diligence', but environmental objectives are implicit in many of the requirements. Integrated Farm Management (IFM) is recognised throughout Europe and organisations like LEAF in the UK or EIF at the European level aim to achieve a sustainable agriculture whilst minimising the impact on the environment. A number of Member States have developed codes of good agricultural practice, with advice based on the outcome of previous research. In the UK revised statutory codes were issued by MAFF the Ministry of Agriculture Fisheries and Food (1998a, b, c). Separate Codes of Good Agricultural Practice for the Protection of Soil, Water and Air were distributed to all UK farmers and contain practical advice and information to help farmers and growers avoid pollution of soil, water and air. The 'Green' Code (MAFF 1998d) provides practical guidance to farmers and growers concerning all aspects of pesticide use including tank mixing, spray application and disposal.

USE OF PESTICIDES IN PRACTICE

Point sources

Rose *et al* (2001) reviewed current pesticide handling and washdown practices in the UK and identified that farmers had a restricted awareness of the water quality problems which might arise when pesticide is spilt or incorrectly disposed of in the farmyard. A number of surveys were identified concerning current practices and key issues that were identified included the lack of clear advice concerning disposal of waste and spill clean up materials. Recent data suggest that point sources might be responsible for a major portion (possibly as high as 50%) of contamination and some research is underpins validity of this hypothesis (Spiteller *et al.*, 1999; Mason *et al.*, 1999). The Groundwater Directive does not specify a *de minimus* for pesticide concentrations discharging to groundwater and in the absence of data to prove no impact, 0.1µg/L is used as a surrogate. There is currently insufficient evidence to prove the effectiveness of the use of waste treatment systems such as biobeds, constructed wetlands, and activated carbon or similar systems at the farm scale and therefore their use cannot be fully endorsed by environmental regulators. This inflexibility restricts the potential for improvement in current practice due to the difficulty in proving compliance with the Directive. Even if soil and water contamination is reduced by several orders of magnitude, users of pesticides cannot currently adopt improved practices and guarantee that their efforts will not be penalised. As an example, in England and Wales, a farmer can invest in sophisticated, expensive treatment systems which sorb most pesticides from waste and washings but he still officially requires a license to dispose of the effluent to a consented area. The resulting discharge would pose little risk to the soil or aquatic environment. Disposal of untreated waste and washings still requires the same consent procedure yet the impact could be far greater.

Diffuse Sources

Most pesticide users recognise that pesticide spray drift to surface water is the main diffuse source of surface water contamination. Spray Operator compliance with buffer zones was not actively monitored in the UK but was generally considered to be very low. A recent survey (Pesticides Safety Directorate web site - www.pesticides.gov.uk) to assess farmer's understanding of, and compliance with, the LERAP scheme highlighted the following points:

- Awareness of LERAP was high but detailed understanding was more variable. For example, some did not realise that they could reduce the buffer zone and others did not understand the star rating system for sprayer nozzles.
- Two-thirds of the farmers contacted had carried out a LERAP assessment themselves (or via contractors) before spraying areas requiring buffer zones. Most of these farmers understood the definition of the two different categories of pesticides and the correct procedure when using a mixture of the two.
- Manipulating the choice of pesticides (to avoid those restrictions) and/or the use of low-drift (star rated) nozzles was considered by most to offer the best scope for reducing buffer zone requirements under LERAPs. Reducing the dose rate of pesticides was only considered suitable by a small minority of respondents.
- Compliance with LERAPs was less than awareness of it. For example, most farmers in the survey did not have information on the width of watercourses but relied on their knowledge and observations. About a quarter did not keep the required record of the LERAP decision, 8% said they ignored the rules.
- Few of those surveyed were judged to be compliant in all aspects of LERAPs, although most were taking some steps to implement the buffer zone regulations.
- Many farmers cited various drawbacks associated with LERAPs, the most common complaint being over-complexity of the scheme and the burden of paperwork. There was a general feeling that the scheme needed to be simplified and made more practical to use.
- Many farmers would prefer the provision of LERAPs information in published form such as booklets/leaflets, letters or press articles.
- Farmers are using 2 or 3 star nozzles across the whole field, rather than just along the headland. This could have a negative effect on pest control over the field as a whole

The spray operator is currently responsible for carrying out a LERAP assessment. Incorporation into long-term farm management plans would benefit long-term water protection goals since land managers could make strategic use of set aside, countryside stewardship grants or even change cropping alongside water courses.

PARTNERSHIP

The UK Government has recently accepted a voluntary package put forward by the Crop Protection Association, the National Farmers Union and other agricultural and farming organisations (CPA 2001) which replaces the proposed pesticide tax (DETR 1999). It was estimated that the proposed tax would have cost farmers and growers £125 million a year and much of the evidence indicated that environmental benefits would have been minimal. The NFU has committed to a credible alternative to the tax and believes it will make a material difference to the environment whilst allowing farmers to continue to produce safe, affordable food. Three key goals have been proposed:

- To reduce the potential environmental effects of pesticide use
- To improve farmland biodiversity
- To prevent water contamination by pesticides

A reduction in the overall amount of pesticide applied was not seen to be a sensible way forward to achieve these goals since environmental impacts may not be minimised.

Alternatives to chemical control can also impact on soil and water quality *e.g.* steam sterilisation, flaming, mechanical weeding methods. The proposals therefore identify those aspects of crop protection which pose the greatest risk to the environment and biodiversity. Practical and effective techniques will be developed to reduce or mitigate these risks and rapid adoption of these techniques on farm through a comprehensive technology transfer programme will be essential. Three 'pillars of support' will allow implementation of the proposal:

- Survey of current practice
- Crop protection management plans
- Commitment of resource to the development of farm biodiversity

It is recognised that for implementation to be successful that all growers must learn how they can apply the measures to their advantage and the benefit of the environment. Because of the scale of measures a big challenge will be to keep the message simple to avoid confusion and overload in the minds of farmers.

A review by EUREAU the European organisation which represents the water and waste water industry reports degradation of catchments by pesticides (EUREAU 2001). Water UK, assessed the extent of contamination in the UK and identified ways of reducing pesticide leaching and identified examples of best practice in pesticide use. The report suggests problems in the UK can be resolved by collaboration with stakeholders such as the Crop protection Association, the NFU and the Environment Agency. Examples of the measures identified to address pesticide contamination of raw water included:

- Assessing the need to ban or severely restrict the use of certain pesticides
- Use of financial incentives and regulatory instruments to promote good practice
- Encouraging best practice in farming and weed control on roads, railways and everywhere
- A European task force to combat pesticide pollution whose members are the water industry, regulators, farmers, pesticide manufacturers, food retailers, consumer and environmental groups, and the European Commission.

There is a clear opportunity for all stakeholders to work together to minimise pesticide contamination at the catchment scale. The implementation of the Water Framework Directive will provide environmental agencies with regulatory tools which were previously lacking but it will also focus the attention of all stakeholders on achieving the overall objectives. The development of farm management plans and the adoption of best management practices at the catchment scale will undoubtedly lead to overall improvements in water quality.

Table 1. Measures proposed and their impact on soil and water quality

Action plan	Content	Possible implications for soil and water quality
Improving crop protection application practices	Best practice, waste disposal, nozzle selection, sprayer testing. Incorporate into crop management plans	Targeted application, minimisation of use, decrease point source losses and drift. Improved timing of application, reduced soil losses
Sprayer operator training and certification	Improved application practice, statutory training, register of operators, updates with new equipment	Improved handling and use of pesticides. Reduced point and diffuse sources of contamination
Improving farmer's own crop protection decisions	Maintenance of BASIS register and training certification for farmers who make their own decisions	Improved awareness of impact of use of pesticides on soil and water and appropriate risk management options
Sprayer testing	Independently validated, annual testing scheme for spray machinery	Correct application rates, reduction of spillages, decrease in overall loading to soil and water
Environmentally aware and BASIS registered advisers	Increase the environmental training and continuous professional development for those on professional advisory registers	Greater awareness and sensitivity for soil and water protection - influence over farmer decisions
Environmental Information Sheets	Provision of independently validated environmental information for products. Awareness of risks and their management. Training in their use	Opportunity for choice of products for soil and water protection. Ability to take into account vulnerability and site specific problems
Water industry collaboration	Working group with the water industry to develop catchment protection plans and local campaigns. Water protection will be key in the CPMP	Identification of specific problems of water contamination, local solutions and site specific solutions to leaching and run-off from fields, yards etc
Supporting research programmes	Commitment to part fund relevant research e.g. optimising spray applications	Reduction of drift

PRAGMATISM OR PERFECTION?

In 1998, 42,860,976 hectares of arable crops were sprayed or treated with pesticides in Great Britain (Garthwaite and Thomas 1999). Each arable crop received an average of 4.6 spray rounds and an average of 11.3 active substances. With such a large number of pesticide users to influence, practical, efficacious, inexpensive solutions are required which will take time and resource to implement. Complete solutions to the problem are not possible and perfection *i.e.* compliance with statutory and voluntary measures cannot be attained overnight or probably ever. Regulatory systems need to recognise that immediate improvements in practice, which do not necessarily solve environmental problems, but do reduce impacts are acceptable when part of the overall process of achieving a longer term objective of full compliance. Awareness of the natural environment in which the farm is located needs to be assessed and understood. Information on the environmental properties of products needs to be available so that choices can be tailored to specific circumstances. Table 2 identifies the different sources of pesticide contamination to water and proposes measures to reduce levels of pesticides in water for each (Carter 2000). Those highlighted in bold are the most pragmatic, most likely to have an impact, relatively easy to implement and are not considered to be expensive relative to the overall costs described by Pretty (2000).

Most on farm actions listed can be implemented quite cheaply and effectively by the farmer himself. A major task is to identify the means by which information can be transferred effectively to land managers and spray operators. Uptake, compliance and goodwill would be greater if 'carrots' or incentives were offered and a consistent, transparent approach to the interpretation of legislation agreed. In the UK, a number of regulatory authorities currently influence how pesticides are used and disposed of and there is often confusion or different interpretation of the statutory and voluntary legislation which applies at the farm scale.

The UK Pesticide Forum aims:

- to bring together all those stakeholders with interests in the use and effects of pesticides
- to identify their common interests and to assist in the dissemination of best practice, advances in technology and research and development results
- to advise government on the promotion and implementation of it's policy relating to the responsible use of pesticides.

The success of the Forum depends crucially on the efforts of its member organisations and also relies on using established channels between Forum members and the farming community. In 1998/99 UK government expenditure on the pests and pesticides research programme, totalled £8,132 million. Recent Forum efforts have focussed on the development or support of indicators to monitor impacts, to ensure that the implementation of research findings is effective in the environment.

A flexible, pragmatic approach to the environmental impact of farming is advocated. The needs of all stakeholders need to be considered and where appropriate agreements and compromises reached. The short-term objective of improvement, working towards long-term compliance is the most realistic approach which can be taken.

Table 2. Methods to reduce pesticide levels in water

Entry Route	Reduction Method
Diffuse sources	
Drainflow and interflow	• restrict flow when peak losses are anticipated to increase time for degradation • manage soil structure e.g. to optimise tilth to increase sorption/water retention • incorporate additives to soil surface e.g. organic material or stabilisers • **restricted application areas e.g. protection zones** • reduce drain intensity • **optimisation of application rates** • target timing of applications to avoid potential loss periods
Surface flow	• **buffer zones with various surface treatments e.g. grass strips** • **contour cultivations** • manage soil surface e.g. reservoir tillage, minimal tillage
Leaching	• **restricted application areas** • **restrict application to products with appropriate properties to minimise leaching** • manage soil structure e.g. create fine tilth to increase sorption and retention • incorporate additives to soil surface e.g. organic material or stabilisers
Precipitation	no specific measure
Spray drift	• **no-spray zones e.g. LERAPS** • **manage vegetation adjacent to water e.g. hedges, interception plants** • **low drift application technology** • **education of operator to choose optimal conditions**
Point	
Tank filling	• **container modifications e.g. anti-glug necks, pack size, returnable packs** • **add container rinsate to the tank mix** • **engineering solutions e.g. tank full alarm, direct injection** • **remove operations from drained impermeable areas** • biobeds • interception areas drained to waste collection site • **education of operator**
Spillages	• **remove operations from drained impermeable areas** • biobeds • interception areas drained to waste collection site • **use of sorbent pads/material to intercept spills or clean up** • use of licensed hazardous waste contractors • **immediate incineration of empty containers/store under cover** • **education of operator**
Faulty equipment	• **regular maintenance and servicing of sprayer** • **sprayer testing**
Washings and waste disposal	• biobeds • other on farm treatment systems e.g. Sentinel system • **authorised waste disposal** • **dispose of tank sump contents appropriately**
Sumps, soakaways and drainage	• requirement for licensing • diversion from direct discharge to water
Direct contamination including overspray	• **avoidance** • **education of operator**
Consented discharges	• **requirement for licensing and compliance with Environmental Quality Standards**

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