

# Catchment Sensitive Farming

## ECSFDI Phase 1 & 2 Full Evaluation Report



CSF Evidence Team  
Environment Agency  
June 2011



**A clear solution  
for farmers**

CATCHMENT SENSITIVE FARMING

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## Executive summary

The first five years of the England Catchment Sensitive Farming Delivery Initiative (ECSFDI) have been evaluated. Drawing on results from the different elements of our evaluation, there is clear evidence to demonstrate that the initiative has met its primary objectives, to:

- increase awareness amongst rural land managers and stakeholders of the impact of diffuse water pollution from agriculture
- improve soil and land management practices amongst farmers within Priority Catchments
- reduce the pollution of water caused by farming within Priority Catchments

Farmer engagement was highly effective, with some 9,023 farm holdings receiving advice directly. This represents 17 per cent of all farm holdings within Priority Catchments (38 per cent by area) and 45 per cent within targeted sub-catchments (62 per cent by area).

Additional pesticide advice was provided through specific programmes developed with the Pesticide Voluntary Initiative and ADAS. Partnership and Associate Catchment Sensitive Farming Projects, developed with government agencies, regional government, industry bodies, water companies and environmental NGOs, extended the reach of the initiative beyond the Priority Catchments.

Over 80 per cent of farmers receiving ECSFDI advice confirmed their knowledge of water pollution had increased and that they had taken, or intended taking, action to reduce water pollution. Over 90 per cent indicated the ECSFDI was the best way to learn about water pollution. Despite this increased awareness and understanding, there remains only limited acceptance from farmers that agriculture makes a significant contribution to water pollution. To date, the key drivers for change have been the financial incentives of free advice, reduced costs (for example, by more accurately calculating fertiliser applications) and grants.

The ECSFDI has brought about significant improvements to soil and land management practices through voluntary uptake of advice and a capital grant scheme. 93,360 farm-specific recommendations have been made for improving soil and land management, with an uptake rate of over 50 per cent.

Implementation of control measures resulted solely from ECSFDI advice in most instances (83 per cent). For the remainder, implementation was also influenced by one or more incentives, other schemes or initiatives. The Nitrates Action Programme, Environmental Stewardship and ECSFDI Capital Grant Scheme were most significant; the latter contributing towards £29 million of farm improvements.

Uptake of control measures providing a cost saving to the farmer was only slightly higher than for those with an associated cost. This indicates that the ECSFDI is helping target and accelerate changes that might be expected through general trends towards improved farm practice, whilst also delivering significant additional changes.

Modelling indicates that improvements in management practices will result in significant reductions in pollutant losses. Reductions from the first four years of

the ECSFDI are generally predicted to be between 5 and 10 per cent across Target Areas, but can be up to 36 per cent. These reductions translate into in-river decreases in pollutant concentrations of similar magnitude. Responses vary for different pollutants and Priority Catchments, due to variation in advice delivery and uptake and the significance of agricultural pollutant sources.

In some cases, predicted phosphorus reductions from the ECSFDI will help achieve compliance with Water Framework Directive (WFD) standards for Good Ecological Status. Where WFD standards are being met (through improvements at sewage treatment works) the ECSFDI will help reduce concentrations further towards guideline standards for Special Areas of Conservation.

Extension of ECSFDI activity across existing Target Areas will deliver significant further reductions in diffuse pollutants.

Water quality monitoring has demonstrated reductions in pollutant loads and concentrations resulting from the ECSFDI. These reductions were up to around 30 per cent across targeted sub-catchments within representative catchments and, for pesticides, across targeted catchments. We are confident these reductions represent real improvements associated with the initiative.

Longer-term datasets are needed to robustly analyse and confirm trends at the individual catchment scale. Sediment source tracing has demonstrated a beneficial response to the ECSFDI within the Dorset Frome. By focussing on assessment of pollution sources this technique overcomes the complexities of pollutant mobilisation, pathways and delivery that are inherent in conventional water quality monitoring.

Initial analysis of ecological monitoring data, from rivers within Priority Catchments, found no evidence of any response, with a clear need to assemble longer-term data records.

For an advisory initiative to provide a comprehensive evaluation of its performance using monitored and modelled data is unique. The results make an important contribution to addressing uncertainty over the uptake and resulting benefits of ECSFDI advice and demonstrate that voluntary advice can make a significant contribution to reducing diffuse water pollution from agriculture. Communication of the benefits will be important to secure future buy-in of stakeholders (especially farmers).

Targeting will be improved to maximise environmental outcomes from future phases of the ECSFDI. Using understanding gained from our evaluation, we have developed the capability to assess the geographic locations where CSF is most likely to be successful in influencing land owners to take action and where the mitigation measures themselves will make the greatest contribution to catchment improvement. The approach will be developed further to identify the most effective combinations of control measures for particular locations, as our evaluation shows there is scope to increase the impact of advice delivery.

Evaluation will remain a core element of the next phase of the ECSFDI. The approach developed can also inform how other initiatives are effectively evaluated, from the detailed design of, for example, water quality monitoring programmes to the use of an overall "weight of evidence" approach.

# 1. Introduction

This report summarises an evaluation of the effectiveness of the England Catchment Sensitive Farming Delivery Initiative (ECSFDI), an advice programme in England to reduce water pollution caused by farming operations. Evaluation is considered in terms of the primary objectives of the initiative to:

- increase awareness amongst rural land managers and stakeholders of the impact of Diffuse Water Pollution from Agriculture (DWPA)
- improve soil and land management practices amongst farmers within Priority Catchments
- reduce the pollution of water caused by farming within Priority Catchments

This summary assessment is backed up by technical reports and other outputs covering specific areas; for example, advice delivery; water quality monitoring and environmental modelling. These are available on an accompanying CD.

The report was produced during the second half of Year 5 of the ECSFDI. A significant amount of farm advice delivery was ongoing at this time and, as a result, the data on which the report is based do not cover the full five-year ECSFDI project. In the report we indicate what part of the project each aspect of the data covers.

## 1.1 ECSFDI overview

The ECSFDI was launched in December 2005. Phase 1 ran to March 2008 and Phase 2 to March 2011. The ECSFDI contributes to the Defra priority of helping enhance the environment and biodiversity to improve quality of life. Working with stakeholders, the initiative promotes voluntary action and encourages catchment sensitive farming (CSF), which:

- entails land management that keeps diffuse emissions of pollutants to levels that are consistent with the ecological sensitivity and uses of rivers, ground waters and other aquatic habitats
- includes the following farmer behaviours and practices: limiting the use or optimising the application of fertilisers, manures and pesticides; promoting good soil structure and rain infiltration to avoid run-off and erosion; protecting watercourses from faecal contamination, sedimentation and pesticides; reducing stocking density or grazing intensity, and reverting to grassland, etc

ECSFDI is part of the national response to meet the requirements of the Water Framework Directive (WFD) and contributes towards achieving Natura 2000 and Site of Special Scientific Interest (SSSI) objectives. It is delivered in partnership by the Environment Agency and Natural England.

The primary focus for the initiative was to deliver advice on priority DWPA issues within 50 Priority Catchments (40 in Phase 1). In most catchments, delivery focussed primarily on sub-catchments of highest priority (Target Areas) or key farming sectors (Target Sectors), identified through a Catchment Appraisal process. The ECSFDI also worked with key partners through 20 Associate

CSF projects (Phase 1); 4 National Partnerships (Phase 2); and 10 Catchment Partnership projects (Phase 2). Specialist pesticide advice was provided through the Voluntary Initiative and ADAS.

The locations of the Priority Catchments, Catchment Partnerships; Associate projects; and pesticide catchments are shown in Figure 1.1 (page 7).

Each Priority Catchment had a Catchment Sensitive Farming Officer (CSFO), who communicated and worked with farmers and promoted CSF. CSFOs provided, or co-ordinated the provision of, a range of advice, support and incentives including:

- farmer workshops, meetings, demonstrations and walks
- one to one advice either on-farm or through farmer 'clinics'
- grants towards the cost of DWPA control measures
- workshops and seminars for farming advisers

Catchment Steering Groups brought together farmers and other key stakeholders to help shape advice delivery within each of the Priority Catchments. They were important for ensuring strategies for targeting and delivering advice were appropriate for each catchment.

## 1.2 Monitoring & Evaluation

Monitoring and evaluation is an essential part of the ECSFDI. It is designed to measure progress towards the achievement of objectives and assess the effectiveness of the measures adopted in bringing about desired changes. Within this report, monitoring and evaluation is considered on five levels (Figure 1.2).

**Figure 1.2 The five levels of monitoring and evaluation**

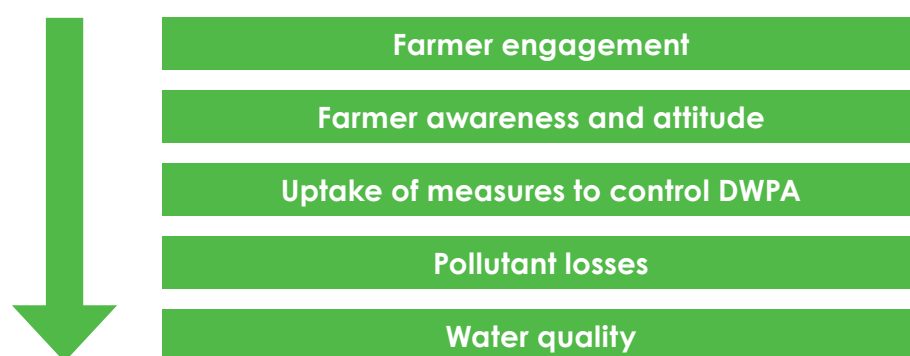


Figure 1.1 Location of ECSFDI Priority Catchments, Catchment Partnerships; Associate project catchments; and pesticide advice catchments

## England Catchment Sensitive Farming Delivery Initiative (ECSFDI) catchments

### Phase 1 Priority Catchment

- 1 River Aire & Wharfedale
- 2 River Ure
- 3 West Midlands Meres & Moors
- 4b Tyne
- 5 Rivers Aire & Ouse
- 6 East Riding of Yorkshire & North Lincolnshire
- 7 River Trent
- 8 Yorkshire Coast, Huddersfield & Leeds
- 9 North Norfolk Rivers
- 10 Little Ouse (Hertford Ouse)
- 11 River Great Ouse
- 12 Somerset Levels and Moors
- 13 Skipton Gap, Solihull to Kingsbridge, Devon Avon & East Lincolnshire Coast Rivers
- 14 Deben, Alde & Ore
- 15 West Cornwall Catchments
- 16 River Exe
- 17 River Eas
- 18 River Great Ouse
- 19 River Great Ouse
- 20 River Great Ouse
- 21 Yorkshire Dales
- 22 Trent - 1000
- 23 River Great Ouse
- 24 Frome, Avon, Great Ouse & Great Ouse
- 25 Great Ouse
- 26 River Great Ouse & Great Ouse
- 27 River Great Ouse & Great Ouse
- 28 River Great Ouse
- 29 Rivers Great Ouse & Great Ouse
- 30 Frome, Great Ouse & Great Ouse
- 31 Gipping & Great Ouse
- 32 River Great Ouse & Great Ouse
- 33 Rivers Great Ouse & Great Ouse
- 34 Bassett-Walker Lake
- 35 East River & Wetland Marsh
- 36 North Somerset Moors
- 37 The Stour
- 38 Yealm and Erme Estuaries
- 39 River Exe
- 40 Frome

### Phase 2 Priority Catchment

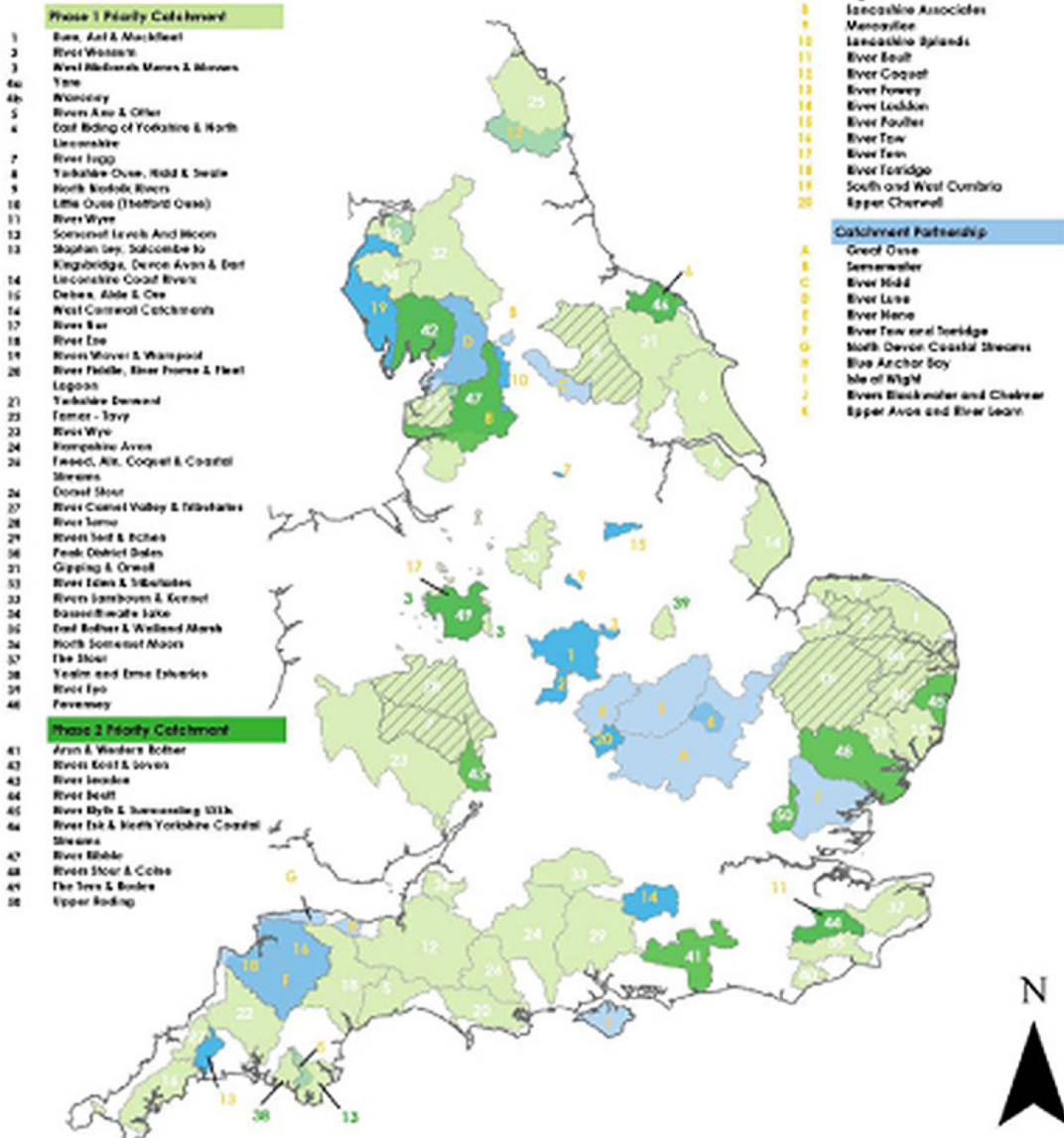
- 41 Avon & Western Cotswolds
- 42 Rivers Great Ouse & Great Ouse
- 43 River Great Ouse
- 44 River Great Ouse
- 45 River Great Ouse & Great Ouse
- 46 River Great Ouse & Great Ouse
- 47 River Great Ouse
- 48 Rivers Great Ouse & Great Ouse
- 49 The Trent & Great Ouse
- 50 Upper Trent

### Associate project

- 1 Upper Trent
- 2 Meres, Bylve, Arise and Teme
- 3 Charnwood
- 4 Colne North Area
- 5 Devon Avon
- 6 Eik Valley and North Yorks coast
- 7 Inghamworth
- 8 Lincolnshire Associates
- 9 Meres
- 10 Lincolnshire Associates
- 11 River Great Ouse
- 12 River Great Ouse
- 13 River Great Ouse
- 14 River Great Ouse
- 15 River Great Ouse
- 16 River Great Ouse
- 17 River Great Ouse
- 18 River Great Ouse
- 19 South and West Cumbria
- 20 Upper Trent

### Catchment Partnership

- A Great Ouse
- B Somerset
- C River Great Ouse
- D River Great Ouse
- E River Great Ouse
- F River Great Ouse
- G North Devon Coastal Streams
- H Blue Anchor Bay
- I Isle of Wight
- J Rivers Blackwater and Chelmer
- K Upper Avon and River Trent



- Phase 1 Priority Catchment
- Phase 2 Priority Catchment (additional to Phase 1)
- Pesticide Advice Catchment
- Catchment Partnership
- Associate project catchment

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Map Reproduced to Scale 1:3,250,000

The complexity by which the ECSFDI translates into changes in agricultural management and hence environmental benefits makes the measurement of success a difficult process:

- the confidence with which measured changes can be linked back to the ECSFDI (i.e. cause and effect) decreases in moving down through the levels above, due to the compounding effects of errors in estimation
- external factors such as weather variations, crop selection patterns and other water quality pressures like point-source discharges add further complexity
- the response time lengthens moving through the levels, since each is dependent on a response at previous levels

Monitoring at all five levels maximises our ability to measure changes and to relate them back to the primary objectives of the ECSFDI.

Our evaluation is based on comprehensive data sets, generated specifically for the ECSFDI, and a combination of existing and new data analysis methods, including:

- a database of farmer engagement and advice delivery activity (Ref. 1)
- telephone surveys (Refs. 2 to 5); feedback forms from advice recipients (Ref. 5); and case studies examining farmer awareness and attitudes (Ref. 6)
- follow-ups with farmers to ascertain the extent of advice uptake (Ref. 1)
- water quality monitoring within nine representative catchments and five targeted catchments for pesticides (Refs. 7 and 8)
- modelling to assess reductions in pollutant losses and improvements in water quality across a range of indicators (Ref. 9)



## 2. Farmer Engagement

The success of the 'supportive approach' promoted through the ECSFDI relies on effective farmer engagement. The engagement process is therefore an important aspect of our overall evaluation, along with more 'outcome-based' measures (Sections 3 to 5).

### 2.1 Awareness of the ECSFDI

Over the course of the ECSFDI, local and national communications significantly increased awareness of the initiative across the Priority Catchments. Between the baseline farmer survey of early 2007 and the March 2011<sup>1</sup> survey:

- the proportion of farmers aware of the ECSFDI increased from 25 to 48 per cent<sup>2</sup>
- the proportion of farmers indicating they knew a lot about the ECSFDI increased from 9 to 19 per cent
- the proportion aware their area had a CSFO increased from 18 to 39 per cent, and the proportion that had met them rose from 8 to 19 per cent<sup>3</sup>

Those farming larger farms (>100 ha) became significantly more aware of the ECSFDI. This is probably because they are generally better networked into external sources of advice and because CSFOs tended to target advice delivery to larger farms (see Section 2.2).

The actual level of awareness of the ECSFDI is almost certainly higher than indicated as some farmers who engaged with the initiative were not familiar with its full title; ECSFDI often being shortened to CSF in local promotional activities and other written and verbal communications<sup>4</sup>.

### 2.2 Advice delivery

At the end of February 2011, the ECSFDI had delivered advice to 9,023 holdings covering an area of 1,320,400 hectares (Figure 2.1). This equates to<sup>5</sup>:

- 45 per cent of targeted farm holdings (and 62 per cent of the total area occupied by these holdings)

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1 Quoted figures are for the original 40 Priority Catchments

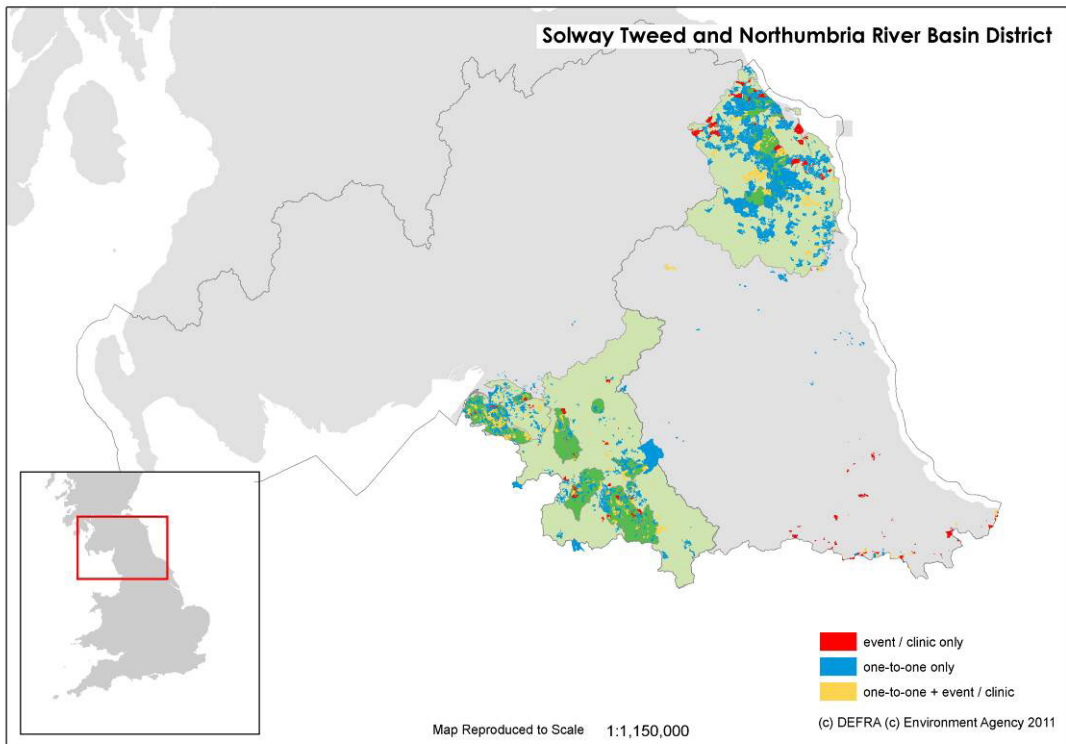
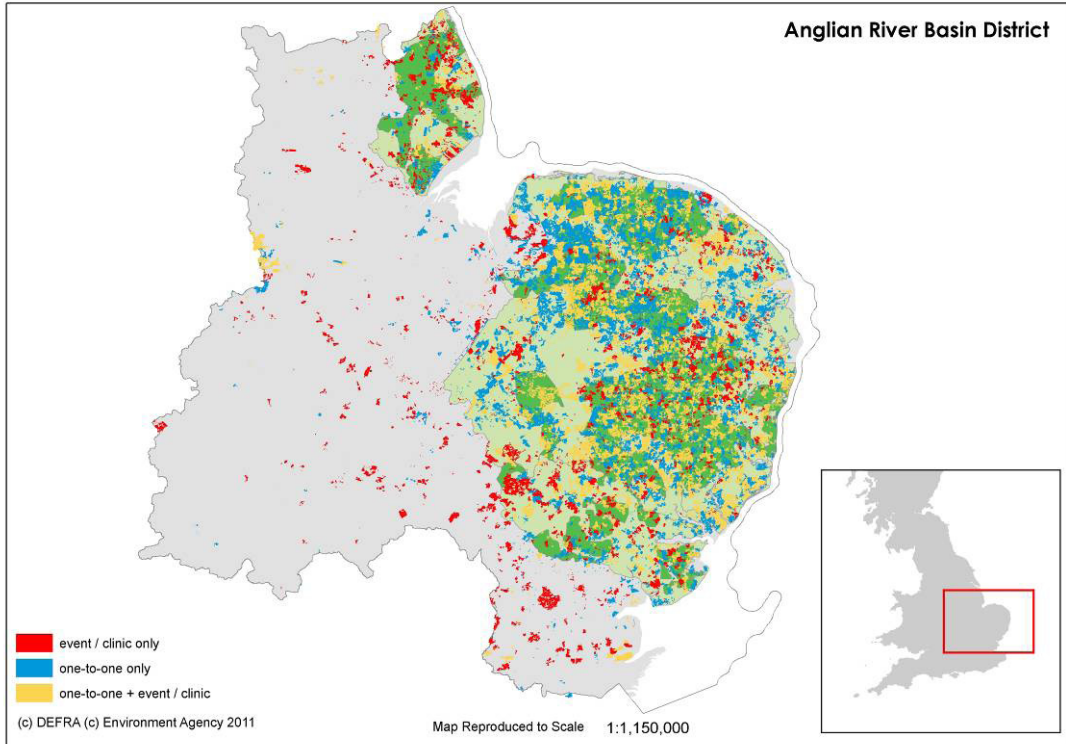
2 Although the initiative operated across Priority Catchments, the primary focus for activity was within smaller Target Areas (Section 2.2)

3 Across the Priority Catchments approximately 50 per cent of advice was delivered by CSFOs and 50 per cent by advisors acting on their behalf

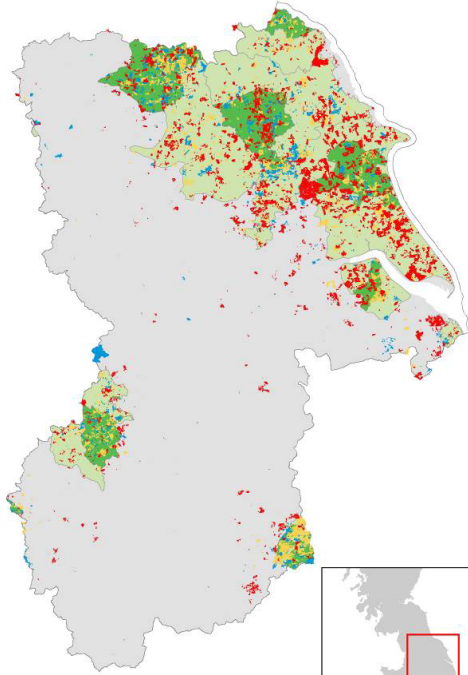
4 In Phase 3 the project will be known as CSF, addressing the highlighted confusion

5 Quoted percentages are for holdings over 10 hectares, based on the 2008 Rural Land Registry (targeted holdings and Priority Catchment holdings) or 2007 Agricultural Census Data (holdings across England)

**Figure 2.1 Extent of advice delivery (farm holding engagement) across River Basin Districts** (Priority Catchments shaded pale green and Target Areas dark green)



**Humber River Basin District**

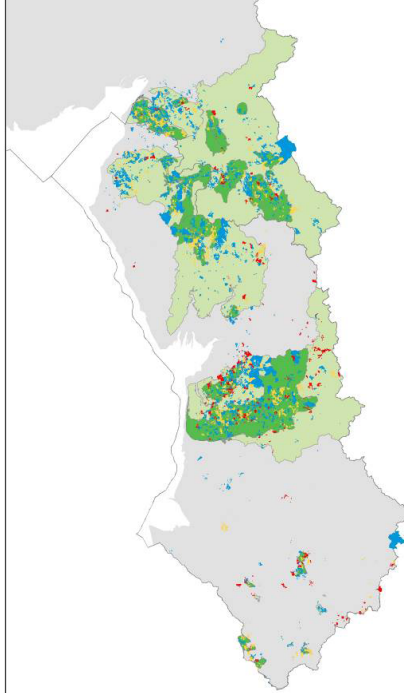


- event / clinic only
- one-to-one only
- one-to-one + event / clinic

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Map Reproduced to Scale 1:1,150,000

**North West and Solway Tweed River Basin District**

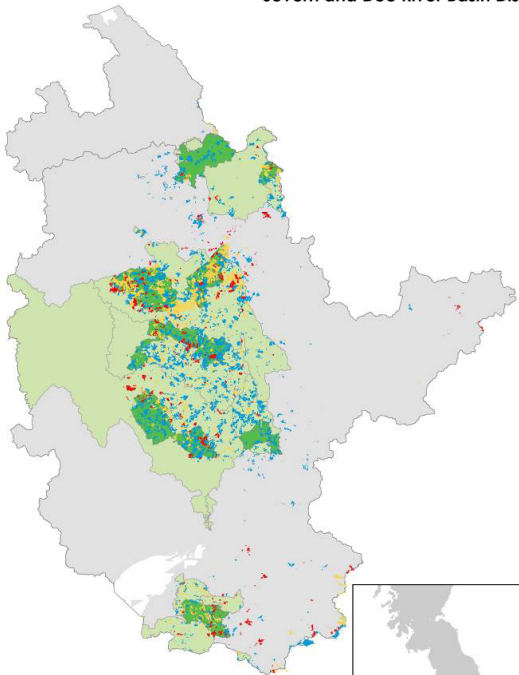


- event / clinic only
- one-to-one only
- one-to-one + event / clinic

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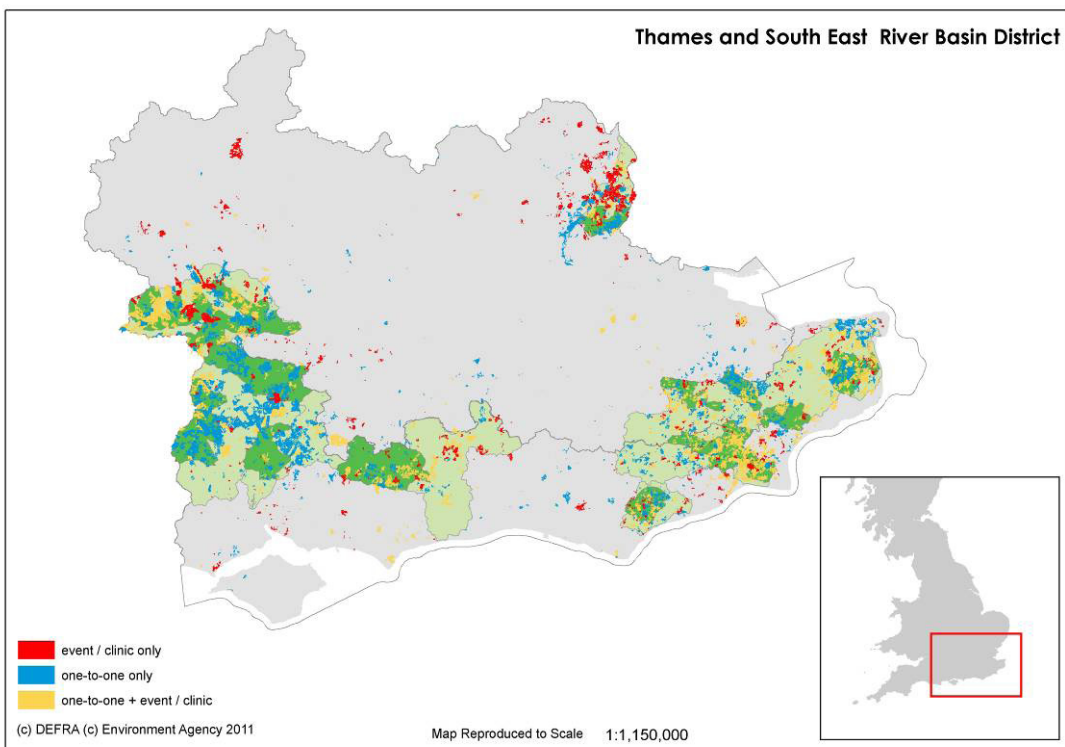
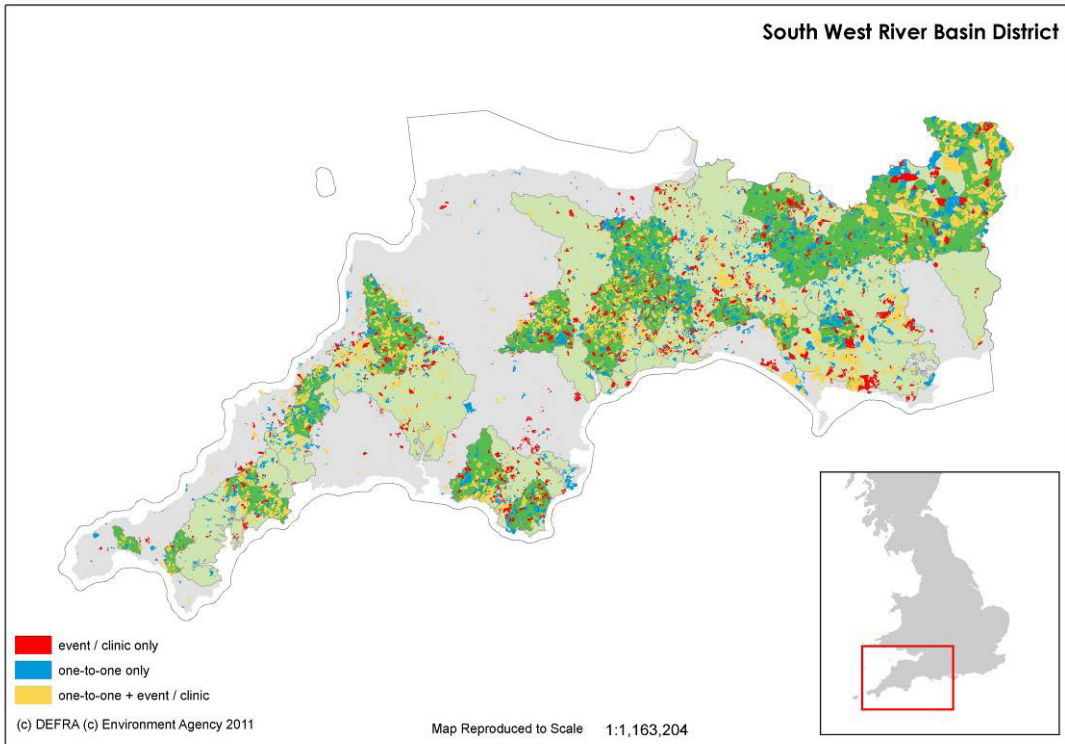
**Severn and Dee River Basin District**



- event / clinic only
- one-to-one only
- one-to-one + event / clinic

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- 17 per cent of holdings located within the 50 Priority Catchments (and 38 per cent of the total area occupied by these holdings)
- 10 per cent of holdings across England (and 15 per cent of the total area occupied by these holdings)

The higher percentages for holding area reflect the fact that in many catchments, and particularly those with large numbers of holdings, CSFOs targeted advice to larger holdings to maximise the land area adopting CSF.

Overall, 70 per cent of advice (by area) was delivered to holdings within Target Areas and 30 per cent across the wider Priority Catchments. Target Areas were the primary focus for the initiative, but there are good reasons why a significant amount of advice was delivered across a wider area. These include targeting specific holdings, where CSF advice was particularly beneficial, on the advice of others (for example, Environment Officers from the Environment Agency); filling otherwise vacant places at events; and individual farmers being responsible for holdings located in both Target Areas and the wider Priority Catchments. Advice delivery outside of Target Areas contributed to the overall geographic coverage of advice, which was an important factor in determining the resulting environmental benefits (Section 5.1).

Different delivery mechanisms were used by the initiative, tailored to the particular messages being communicated. These included one-to-one farm visits; group events (farmer workshops, meetings, farm walks and on-farm demonstrations) and clinics (typically at auction marts).

11,157 one-to-one visits provided farm-specific advice for reducing DWPA. A further 2,988 farm visits were undertaken to collect soil, manure and foliage samples for nutrient analysis. They were an important mechanism for initially engaging farmers with the Initiative (Section 3.1). 1,257 group events covered a wide range of topics from general advice on CSF through to specialist advice aimed at particular target audiences or sectors, and 373 clinics provided farmers with the opportunity to seek advice.

The numbers quoted above include a large number of repeat engagements, with 60 per cent of holdings being engaged on two or more occasions. This reflects the fact that behavioural change can take time. Typically a farmer might first attend an introductory event on CSF and DWPA, followed by a more specific workshop (for example, on soil management planning) before receiving farm-specific advice through a one-to-one farm visit. In some cases, additional visits might also be appropriate; for example, to explore opportunities to make farm improvements through the ECSFDI Capital Grant Scheme.

The significant variation in advice delivery across the Priority Catchments (Figure 2.2, pages 15 to 16) reflected differences in:

- catchment size (River Eye at 182 km<sup>2</sup> to Little Ouse at 2,600 km<sup>2</sup>) and numbers of farm holdings (134 for the River Nar to 3,783 for the Somerset Levels & Moors)
- farm type – most advice was targeted to cereals or general cropping, except in the North West (grazing livestock), Severn (mixed farming) and South West (dairy), with different sectors requiring different engagement strategies and different advice
- farm size - engaged holdings in Anglian, Thames and Solway Tweed were, on average, twice the size of those in the Severn and South West, requiring more time and resources for provision of farm-specific advice

- water quality issues – priority pollutants (phosphorus, nitrate, sediment, pesticides or Faecal Indicator Organisms) and environmental receptors (for example, bathing waters or abstractions)
- duration of advice delivery – five years for the original 40 catchments and two to three years for those added for Phase 2
- profile and continuity of those responsible for advice delivery

A more detailed regional breakdown of advice delivery is provided in an accompanying technical report (Ref. 1).

### **2.3 Farmer satisfaction with advice and advisers**

Farmer case studies (Ref. 6) provide a useful insight into the farmers' view of the ECSFDI. Those who engaged were positive about the initiative, and in particular valued the face to face relationship they developed with their CSFO or adviser. They believe the approach shows understanding of their individual situation; that they are being listened to; and that the CSFO understands them.

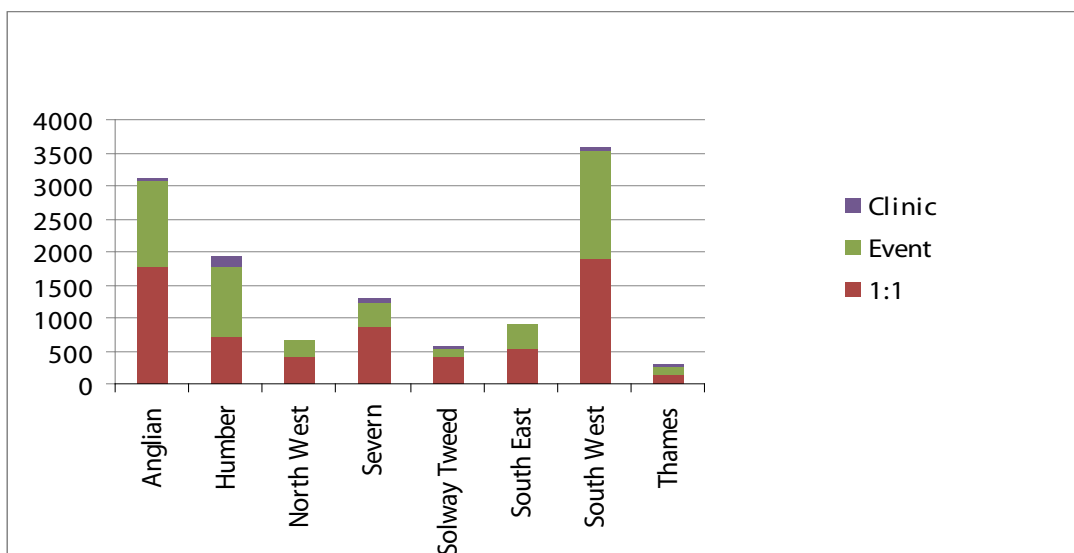
Feedback through telephone surveys and feedback forms indicates that overwhelmingly farmers were satisfied with the advice received from the ECSFDI. Satisfaction levels were slightly higher among those receiving one-to-one advice than those attending events which, by their nature, provide more general advice.

94 per cent of farmers who met their CSFO, and completed a feedback form, found them helpful and 98 per cent receiving one-to-one advice visits rated the quality of the advisor as excellent or good; for group events the figure was 83 per cent.

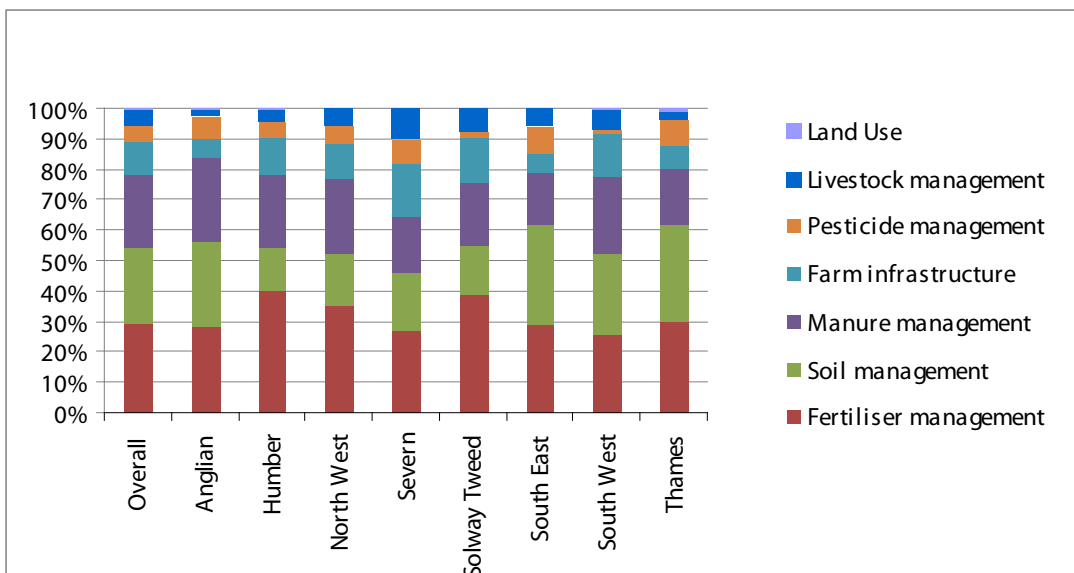
Of those receiving one-to-one advice, who took part in the 2011 telephone survey and had met their CSFO, 93 per cent felt the CSFO had a good understanding of DWPA; 76 per cent felt they provided practical solutions, and 91 per cent felt they understood the needs of their farm. Comparable figures for farmers attending events were 90 per cent, 72 per cent and 72 per cent.

**Figure 2.2 Variation in (a) method of advice delivery; (b) nature of advice delivered; (c) advised farm type; and (d) advised farm size across the River Basin Districts**

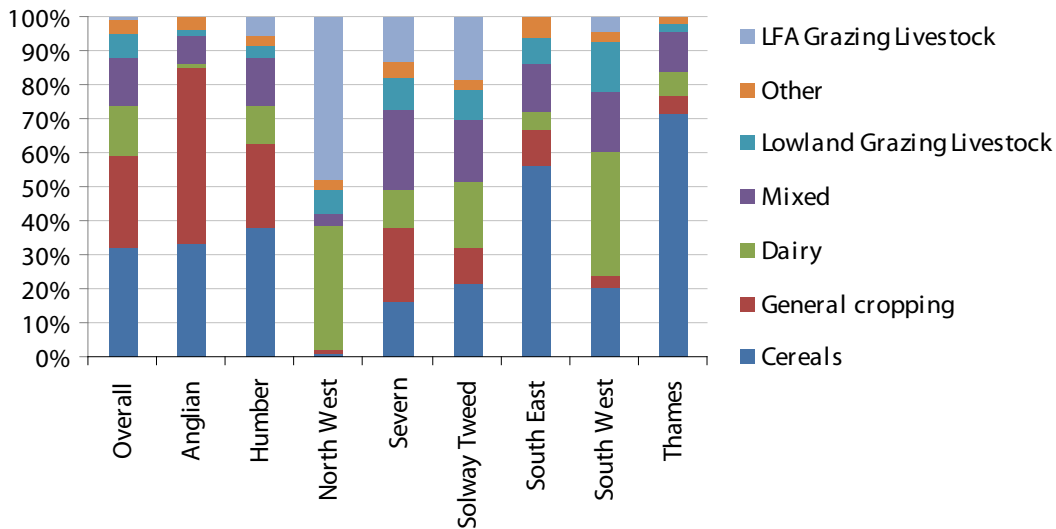
(a) Scale of advice delivery through the main delivery mechanisms (numbers relate to individual advice activities not the number of farmers attending)



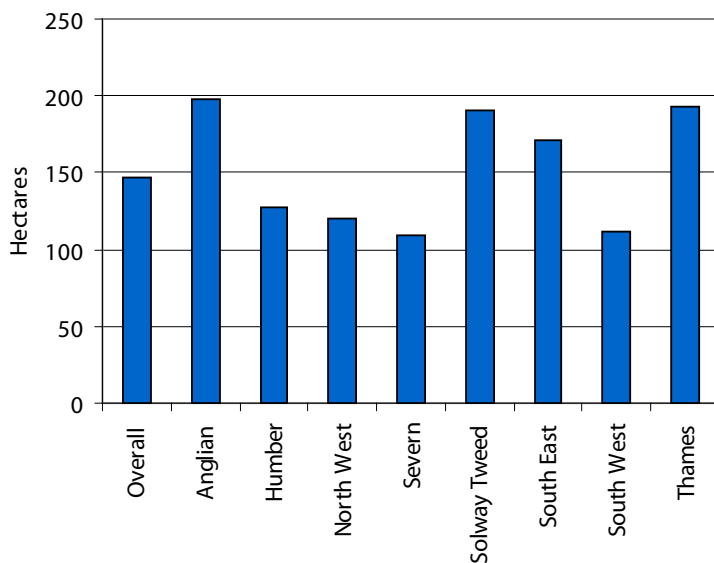
(b) Recommended categories of DWPA control measure (by holding area)



(c) Farm types receiving ECSFDI advice (by holding area)



(d) Average holding size



In terms of reducing DWPA, farmers receiving one-to-one advice and completing a feedback form indicated that they were satisfied with the advice received (86 per cent); that the advice provided was relevant to their farm (80 per cent); that they received enough information to introduce new ideas or changes on their farm (79 per cent); and that the initiative encouraged them to reduce water pollution (73 per cent). Corresponding figures for those attending events were 83 per cent, 69 per cent, 72 per cent and 71 per cent respectively.

94 per cent of farmers receiving one-to-one advice visits and completing a feedback form indicated that this was the best way to learn about water pollution from agriculture. For group events the figure was 90 per cent.



## 2.4 Pesticide advice delivery in association with ADAS/VI

A targeted programme of pesticide advice was provided by the VI and ADAS, working closely with CSFOs, in 7 Priority Catchments (Refs. 10 and 11). Advice focussed primarily on agronomists and other key influencers of crop protection practice and on farmers themselves in the largely grassland River Wyre catchment. The format was based on that used successfully as part of the VI pilot catchment project but set specifically within the ECSFDI context. It included workshops; on-farm demonstrations; and other communications to reduce pesticide losses to water, including:

- updates on latest research on pesticide pathways to water; pesticide legislation; and monitoring data
- advice on best practice pesticide application and integrated crop management to reduce reliance on pesticides
- demonstration and advice for hand-held sprayer calibration and use; pesticide handling; and disposal
- decision trees for use by agronomists and farmers, providing guidance on product choice and most appropriate timing of applications
- weekly text messages providing specific advice on weather and soil conditions and the likelihood of pesticide loss via drain flow or soil run-off
- monthly dissemination of water quality monitoring results highlighting the occurrence of pesticides in the 7 catchments (see Section 5.2.2)

Events were attended by 377 agronomists, advisers and farmers and 196 agronomists received the weekly text messages and monthly bulletins summarising the latest water quality monitoring results.

## 2.5 Wider CSFO engagement and advocacy

In addition to core farm advice delivery, CSFOs were involved in a range of wider engagement and advocacy activities. The scale and impact of these activities is difficult to quantify, but they help raise awareness of DWPA and encourage others to play a part in tackling it.

In the same way that working with the VI and ADAS promoted pesticide best practice, CSFOs have worked with numerous agricultural advisory organisations, agronomist groups and agricultural supply groups to promote CSF. CSFOs also worked closely with a wide range of other organisations, projects and initiatives. This has allowed them to establish themselves in catchments and use existing communication routes and contact networks to engage farmers more efficiently and effectively.

## 3. Farmer awareness and attitude

Increasing farmers' awareness of, and changing their attitudes to, DWPA are key aspects of the ECSFDI. Securing acceptance that DWPA is an issue that affects farmers helps drive changes in farming practices to control the problem. Furthermore, to be effective many of the methods for controlling DWPA rely on farmers making appropriate judgements and decisions; for example, when to spread manure or apply pesticides. With an understanding of, and a will to control, DWPA the effectiveness of such measures will be greater.

### 3.1 Awareness and understanding of DWPA

As a result of advice provided through the ECSFDI, 83 per cent of farmers who received one-to-one advice indicated their knowledge of water pollution improved. In general, farmers think slurry / organic matter (28 per cent) and inorganic nutrients / fertilisers (20 per cent) are the most important agricultural pollutants. Following interaction with the ECSFDI there is, however, greater recognition of other "less obvious" types of pollution, including dirty water run-off, soil erosion and sedimentation.

With this improved understanding of DWPA, there was also some greater acceptance that agriculture contributes to water pollution. 88 per cent recognised agriculture makes at least "a little" contribution to water pollution in the 2011 telephone survey, compared to 69 per cent in the baseline survey<sup>6</sup>.

However, the majority of farmers (including those that engaged with the ECSFDI) do not believe agriculture makes a significant contribution to water pollution and they are even more dubious that the contribution from their own farming activities is significant. Although the evidence for DWPA is well established at the national scale, CSFOs have, in many cases, had to address a lack (or suitable form) of specific 'local' evidence to successfully engage farmers. The approaches used include presenting photographs of erosion and run-off events; presenting existing environmental data; establishing bespoke monitoring programmes; and engaging farmers in developing and implementing water quality monitoring (Refs. 12 and 13). The approaches have been compiled as a set of case studies (Ref. 14) and shared across the project, as well as more widely. However, the limited acceptance of the contribution of agriculture to water pollution indicates that more needs to be done to develop and communicate the evidence to farmers.

CSFOs have, however, often successfully encouraged farmers to take action without full acceptance of the significance of DWPA. Case studies show that farmers have been motivated to take action for a variety of reasons, including:

- provision of soil analysis, advice and expertise
- help with development of nutrient and fertiliser management plans
- keeping up with regulatory requirements or keeping one step ahead of future potential requirements
- advice and financial support for changes they already planned to make

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<sup>6</sup> Based on the original 40 Priority catchments

The financial incentives of free advice; reduced running costs (for example, through reduced fertiliser applications); and capital grants have therefore been important drivers of change.

### 3.2 Awareness of available help

The ECSFDI has revealed a high level of confusion amongst farmers over what is required of them in relation to controlling DWPA. However, the initiative is helping to overcome this. Across the original 40 Priority Catchments, the proportion of farmers citing the ECSFDI as a source of advice for control of DWPA has risen significantly, from 3 per cent in early 2007 to 17 per cent in the March 2011 telephone survey. Farmers that have engaged are far better informed about how the initiative aims to help them tackle the causes of water pollution and they are more aware of the financial help and grants the initiative provides.

Farmers that have received advice through the ECSFDI are also more aware of other sources of support. This can be attributed, at least in part, to CSFOs 'sign-posting' farmers to them. In the case of Environmental Stewardship, CSFOs have actively promoted uptake of Resource Protection options to help control DWPA.

### 3.3 Understanding of actions required to control DWPA<sup>7</sup>

Farmers receiving one-to-one advice visits or attending events are better informed about how to adapt their farming practices to control water pollution; 40 per cent receiving advice indicated they are 'very or fairly well informed' compared with 35 per cent in the baseline telephone survey. In addition, 79 per cent receiving one-to-one advice indicated they were aware which control measures were a priority for their farm.

Farmers receiving one-to-one advice visits indicated that the advice helped in terms of understanding what they should be doing and also how they should progress with changes they had already planned. Specifically, the advice:

- provided the ideas of what to do to reduce DWPA (77 per cent)
- confirmed changes already planned would be effective (77 per cent)
- helped make planned changes more effective (66 per cent)
- helped make planned changes more quickly (63 per cent)

For those attending events the figures were 82 per cent, 78 per cent, 68 per cent and 52 per cent, respectively; reflecting the more general nature of the advice provided.

Farmers that engaged with the ECSFDI are also more likely to think that a wide range of control measures will help reduce DWPA. These include: the way organic manure and slurry are used and stored (39 per cent receiving one-to-one advice); the way inorganic nutrients and fertilisers are applied (38 per cent); the way livestock are managed and housed (38 per cent); changes to cultivation planning and soil management (33 per cent); controlling livestock

<sup>7</sup> Figures in this section of the report are based on responses from the 2009 telephone survey, because some aspects were not included in the reduced survey conducted in 2011.

access to watercourses (32 per cent); and the controlled disposal of waste water (30 per cent). This finding is consistent with the increased awareness of DWPA and potential impacts of different farming practices (Section 3.1).

### **3.4 Attitudes to controlling DWPA<sup>8</sup>**

Of those farmers receiving one-to-one advice, 85 per cent said they had taken or intended taking action to reduce water pollution; 78 per cent had or intended taking action on manure management; 75 per cent on nutrient management; 73 per cent on soil management; 69 per cent on waste management; and 32 per cent on pesticide management. Responses from those receiving one-to-one advice were generally higher than from those attending events, except for pesticides where the main emphasis for action was from group events.

#### **3.4.1 Benefits from action to control DWPA<sup>8</sup>**

Overall, farmers are not convinced they obtain benefits as a result of making changes to reduce water pollution. This is to be expected given the limited acceptance that DWPA is an important issue (Section 3.1). However, those farmers that have engaged with the ECSFDI are more likely to feel they have obtained benefits (69 per cent compared to 58 per cent of farmers across the original 40 Priority Catchments).

Farmers that engaged with the ECSFDI are also more likely to expect to see further benefits as a result of making future changes. 48 per cent of those receiving advice expect to see such benefits, compared to just 30 per cent across the Priority Catchments as a whole. Farmers receiving capital grants are particularly positive about the benefits they expect to see (Section 4.3).

#### **3.4.2 Obstacles to change**

Across the original 40 Priority Catchments, 24 per cent of farmers felt there were obstacles preventing them from taking (more) action to reduce DWPA in the 2011 telephone survey. Among those that engaged with the ECSFDI, the figure was significantly higher (45 per cent for those receiving one-to-one advice). Of those indicating there were obstacles, financial constraints were cited by 81 per cent receiving one-to-one advice and 75 per cent across the original 40 Priority Catchments as a whole.

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<sup>8</sup> Figures in this section of the report are based on responses from the 2009 telephone survey, because some aspects were not included in the reduced survey conducted in 2011.

## 4. Measures to control DWPA

This section summarises DWPA control measures recommended through ECSFDI advice delivery and their subsequent implementation by farmers. A series of case studies has also been developed illustrating how the Initiative has changed farming practices across the Priority Catchments (Ref. 15).

### 4.1 Recommended measures

The 9,023 farm holdings receiving ECSFDI advice by the end of February 2011 received a total of 93,360 individual recommendations for controlling DWPA. Recommendations were based on the mitigation measures outlined in 'An inventory of methods to control Diffuse Water Pollution from Agriculture (DWPA)' (Ref. 16), which provides estimates of the effectiveness of each measure in terms of reducing losses of the main DWPA pollutants. The list of measures was added to over the course of the initiative to encompass all of the methods CSFOs were recommending. This resulted in a list of 86 measures.

There was significant regional variation in the nature and scale of recommendations, reflecting the variation in advice delivery (Section 2.2; Figure 2.2). Overall, measures effective for nitrate and phosphorus were recommended most extensively (median coverage greater than 40 per cent of Target Areas, as at May 2010). Sediment measures were recommended to slightly less area, with least coverage of Faecal Indicator Organism (FIO) measures (median coverage approximately 20 per cent). This is to be expected as FIOs were only targeted in areas draining to bathing or shellfish waters.

On average, dairy farms received the greatest range of advice (8 measures per one-to-one advice visit) and horticulture the least (5 measures per one-to-one).

Although only 9 of the 86 measures were each advised to over 30 per cent of holdings; 52 measures were each advised to between 5 and 30 per cent; and only 25 measures were recommended only occasionally (less than 5 per cent of all holdings). This clearly demonstrates that the advice provided through the initiative was highly tailored to specific situations.

### 4.2 Implemented measures

Overall, 58 per cent of individual measures recommended through one-to-one advice had been implemented by early 2011 and 64 per cent of holdings had implemented at least half of the one-to-one advice they received (Ref. 1)<sup>9</sup>. These estimates were based on a robust sampling method (Ref. 17).

Uptake of ECSFDI advice was affected by time; cost; farm type; location; the nature of the advice; and the interaction with other initiatives and schemes:

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<sup>9</sup> Based on advice delivered up to April 2010 (for measures with a direct environmental benefit)

Uptake was highest for cereals and general cropping (73 per cent); intermediate for dairy (63 per cent); and lowest for less favourable area and lowland grazing livestock (45 per cent). This, in part, explains differences in regional uptake, which was highest in Anglian, Humber, Severn and South West RBDs (71 to 74 per cent); intermediate for Thames (54 per cent) and South East (48 per cent); and lowest in the North West (40 per cent) and Solway–Tweed (35 per cent).

Looking at implementation over time, it is clear that (at least over relatively short timescales) implementation increases with time and further engagement. For example, between 2008 and 2010 there was a 15 per cent increase in implementation of advice initially provided between 2006 and 2008. This underlines the importance of the farm adviser role and the need to develop a working relationship with the farmer through, for example, repeat farm visits in order to deliver behavioural change (Section 2.2).

Implementation rates for the different individual control measures ranged from 21 to 88 per cent. Uptake of control measures providing a cost saving to the farmer was slightly higher (64 per cent) than for those with an associated net cost (60 per cent). However, it is notable that those measures with the highest overall uptake had an associated net cost (for example, avoiding spreading manure and fertiliser to high risk areas and at high risk times and reducing overall fertiliser application rates). This indicates that the ECSFDI is helping target and accelerate changes that might be expected through general trends towards improved farm practice, whilst also delivering significant additional changes.

In most cases (83 per cent), implementation of measures resulted solely from ECSFDI advice. For 17 per cent, implementation was also influenced by one or more incentives, other schemes or initiatives:

- Nitrates Action Programme – 6 per cent
- ECSFDI Capital Grant Scheme – 5 per cent
- Entry Level Stewardship – 3 per cent
- Higher Level Stewardship – 2 per cent
- Farm assurance schemes – 2 per cent

These figures indicate that most of the benefits of the ECSFDI are achieved through the project alone. Anecdotal evidence suggests that the influence of the Capital Grant Scheme is greater than reflected in these figures as it acts as an incentive for farmers to initially engage with the initiative (Section 4.3). It is possible that other incentives, schemes and initiatives interact with the ECSFDI in a similar way.

The overall uptake of measures advised through events and clinics was 51 per cent. This corresponds with the telephone survey results, which indicated a similar level of action from farmers receiving 'group' and one-to-one advice (Section 3.4)<sup>10</sup>. The slightly lower uptake of group advice may reflect the slightly less positive response of advice recipients (Sections 2.3 and 3.3) and / or its generally less farm-specific nature.

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<sup>10</sup> The figures quoted may be over-estimates of the true uptake as they are derived from holdings that also received one-to-one advice, albeit for different DWPA control measures (i.e. they exclude holdings that were solely engaged through events or clinics).

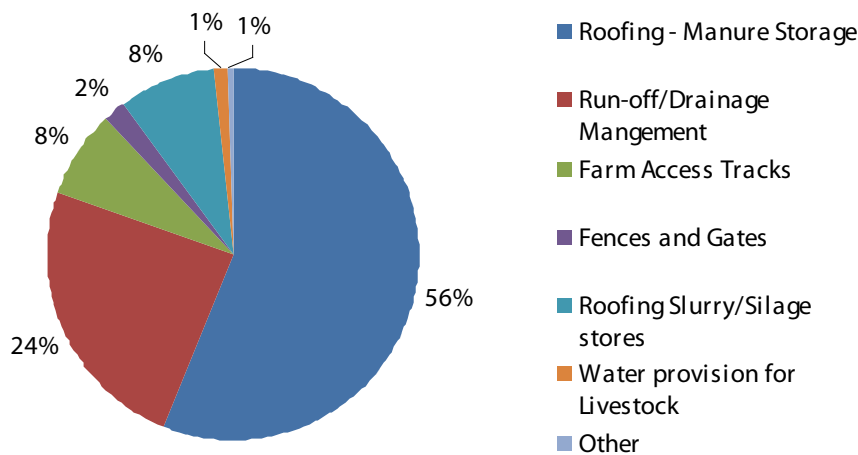
### 4.3 ECSFDI Capital Grant Scheme

The ECSFDI Capital Grant Scheme provided an important financial incentive for farmers to engage with the Initiative and take action to reduce DWPA. The annual scheme provided funding for farmers to make relatively low-cost infrastructure investments for priority issues and areas within each Priority Catchment (Figure 4.1). In total, the scheme contributed to approximately £29M of improvements between 2007 and 2011, with uptake highest in the South West.

Feedback from CSFOs indicated that many farmers initially engaged with the Initiative because of the Capital Grant Scheme. The influence of the scheme therefore went well beyond the improvements it directly funded. Farmers' enthusiasm for the scheme and a willingness to commit their own money were reflected in the scheme being significantly oversubscribed.

Feedback from those receiving grants indicated that 31 per cent expected the improvements to considerably reduce their farm's contribution to water pollution, 52 per cent felt any reduction would be moderate and 13 per cent slight. Only 2 per cent felt there would be no reduction, whilst 1 per cent were unsure.

**Figure 4.1 Summary of improvements receiving funding through the ECSFDI Capital Grant Scheme (by value)**



## 5. Pollutant losses and water quality

Reductions in pollutant losses and improvements in water quality were assessed in order to measure the success of the ECSFDI in terms of reducing water pollution caused by farming.

The assessment included:

- modelling reductions in losses of DWPA pollutants resulting from changes to farming practices
- monitoring and modelling in-river pollutant loads and concentrations

The complexity of diffuse pollution sources, mobilisation and pathways makes the determination of loads and concentrations of pollutants delivered to watercourses, as well as any reduction to them, difficult. By its very nature diffuse pollution arises from numerous, often individually minor, sources across the landscape. Pollutants are frequently mobilised during rainfall events and the amount of pollution delivered to watercourses is often highly variable, from hour to hour, from season to season and from year to year. Furthermore, once mobilised, pollutants can travel along a range of environmental pathways which can involve considerable delay, and they may undergo significant change along the way (for example, through binding with sediment).

The assessment of water quality change resulting from measures to control DWPA presents a significant challenge. Water quality is monitored routinely by the Environment Agency across the ECSFDI Priority Catchments. However, complementary approaches are needed to provide accurate estimates of pollutant loads and concentrations; to provide early indications of change; and to disaggregate the causes of change.

Environment Agency routine monitoring was 'enhanced' at key sites across nine representative Priority Catchments and five targeted Priority Catchments for pesticides. The frequency of regular 'spot' sampling was increased (from monthly to weekly or twice-weekly) and automatic water quality samplers collected additional samples during high flow events (in more 'flashy' catchments). This approach ensured significant high flow events were adequately sampled, improving the accuracy and precision of pollution estimates: without weekly spot and event-based sampling, pollutant loads would have been under-estimated by an average of 17 per cent and subject to additional uncertainty of at least +/- 40 per cent (Refs. 18 and 19).

Data from the Enhanced Water Quality Monitoring Programme (Ref. 7) were used to develop and calibrate water quality models and provide a direct assessment of initial water quality improvements.

The following sections summarise analyses of the modelling and monitoring data. Greater detail of the analyses is available in accompanying technical reports, referenced in the text.



## 5.1 Modelling assessments<sup>11</sup>

Reductions in losses of diffuse pollutants resulting from the changes in farming practices (Section 4) were estimated using the Catchment Change Matrix (CCM), developed specifically for the ECSFDI. The CCM starts from a modelled baseline, looks up estimates of likely pollutant reductions for the relevant control measures (as defined by the DPI Manual (Ref. 16)) and calculates their cumulative effect. Reductions were translated into in-river changes in pollutant concentrations using statistical models developed from the Enhanced Water Quality Monitoring Programme. Simcat models were also developed to investigate the water quality response in greater detail within the Enhanced Water Quality Monitoring Programme and other selected catchments. As well as modelling the effects of the current ECSFDI project, a range of scenarios were examined in order to place the results in context.

It is important to recognise that the results presented in this section are inherently linked to the methods used to estimate pollutant reductions. This should be considered when looking at any CCM, and wider modelling, results. There is uncertainty at each stage of any assessment that looks to summarise widespread activity. At the most basic point of this assessment, the DPI Manual suggests each measure has a range of potential reductions based on the distribution of reductions observed in other studies. The smallest range is between 0 and 25 per cent and the largest is between 10 and 80 per cent. We then add the uncertainty about how measures combine and our own assumptions about which measures affect some farm sources and not others. We have attempted to illustrate this as part of a series of tests on the CCM method and this shows that, by ignoring some of our key assumptions, we might expect to see nearly double the amount of predicted pollutant reductions. It is therefore unwise to look at any results in isolation, and though we present summary results here, the full results are included in an accompanying modelling technical report (Ref. 9).

### **Pollutant reductions from advice delivered to May 2010**

Based on ECSFDI advice delivery to May 2010 (the cut-off point for modelling runs), pollutant loadings from agricultural sources are generally predicted to decrease by between 5 and 10 per cent across Target Areas. For individual Target Areas, predicted reductions were up to 18 per cent based on 'typical' reductions and up to 36 per cent based on 'maximum' reductions, with the greatest reductions predicted for sediment<sup>12</sup>. These reductions in agricultural loadings are predicted to translate into reductions of in-river pollutant concentrations of similar magnitude; up to 20 per cent (typical) and up to 34 per cent (maximum).

In general, the largest reductions are predicted for sediment and smallest reductions for FIOs and ortho-phosphate. Lower FIO reductions result from the low impact of control measures (as indicated in the DPI Manual)<sup>13</sup> and the limited

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<sup>11</sup> Modelling results presented in this report replace those reported at the end of Phase 1 following review and, where necessary, revision of methods.

<sup>12</sup> 'Typical' and 'Maximum' estimated reductions reflect uncertainty over the effectiveness of individual DWPA control measures outlined in the DPI Manual (Ref. 16).

<sup>13</sup> Estimates are based on expert judgement and individual case studies suggest much higher reductions than the DPI Manual indicates.

targeting of FIOs to catchments with bathing and shellfish waters. Lower predicted ortho-phosphate reductions are due to the more even distribution of pollutant losses across multiple farm sources (manure, fertiliser, farm yards, etc), requiring action on multiple sources to deliver large farm-scale reductions.

There is significant variation in the predicted reductions between different Target Areas (Figure 5.1). Analysis of this variability, indicated that the ECSFDI has been most effective (i.e. greatest reductions are predicted) in areas where:

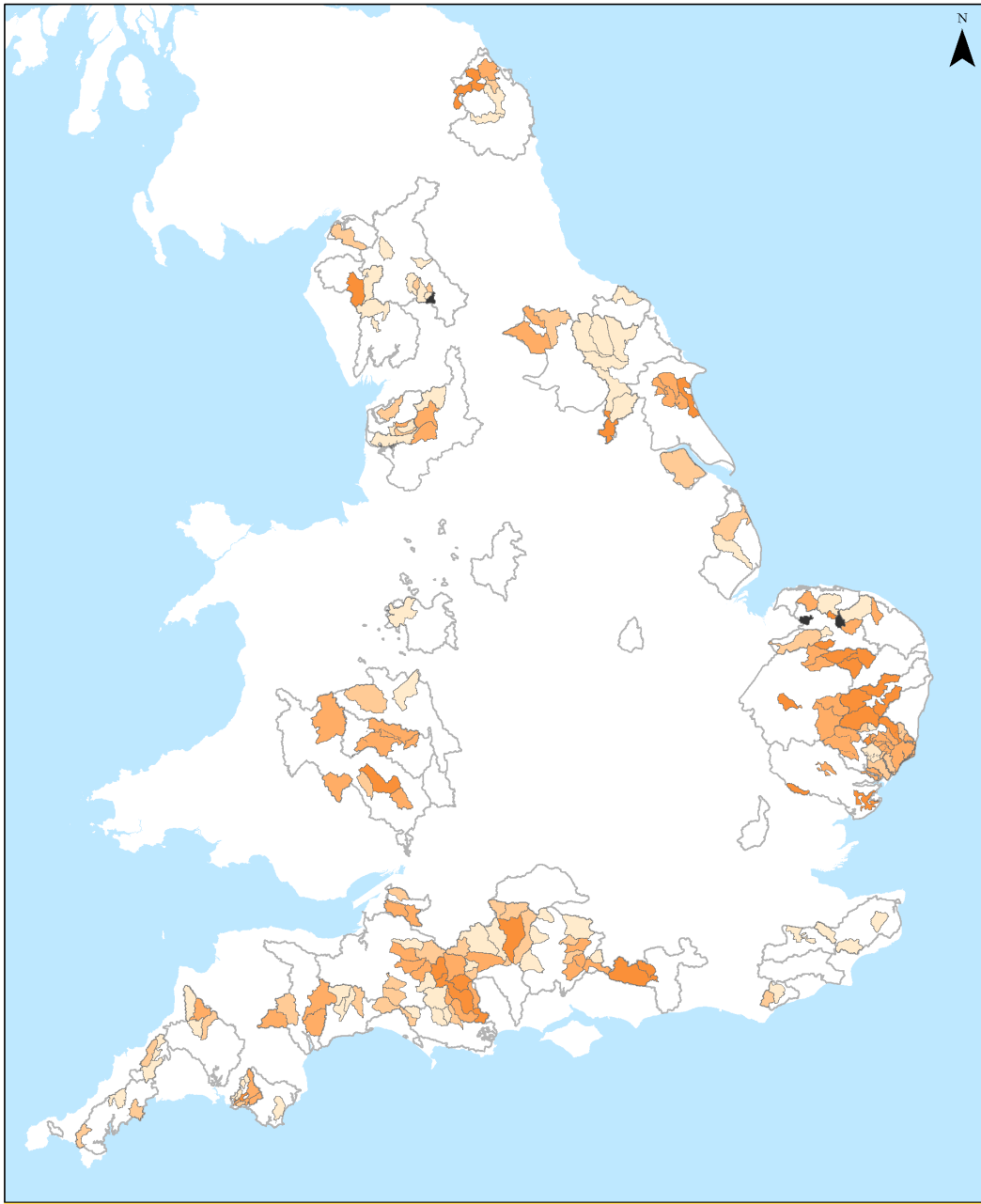
- there was extensive geographic coverage of DWPA control measures
- a range of measures were promoted targeting multiple pollutant sources and pathways
- the promoted measures have high uptake rates

In addition, loading reductions translate into largest changes to in-river concentrations where agricultural pollutant sources are more significant (in relation to other sources).

Differences in estimated reductions across the Priority Catchments must be placed in the context of the extent of catchment covered. Some of the catchments, and even the Target Areas themselves, are much larger than others. In catchments with large Target Areas (for example, the Hampshire Avon and Yorkshire Derwent), estimated reductions are lower than for some smaller catchments. This does not necessarily mean the initiative has been less successful; it simply means it will take longer to have a significant effect. For example, low coverage within the River Eden means this catchment is consistently at the bottom of our analyses. However, when we extrapolate current activity to the remaining farms in the catchment, this shows the initiative can deliver an important reduction in phosphorus levels.

**Figure 5.1 Predicted load reductions for hydrological units within Target Areas of Priority Catchments (from Statistical models)**

**(a) Total oxidised nitrogen**



**TON Current (% Change)**

- 0.00 - 0.50
  - 0.51 - 1.00
  - 1.01 - 2.50
  - 2.51 - 5.00
  - > 5
- ECSFDI Phase 2 Priority Catchments

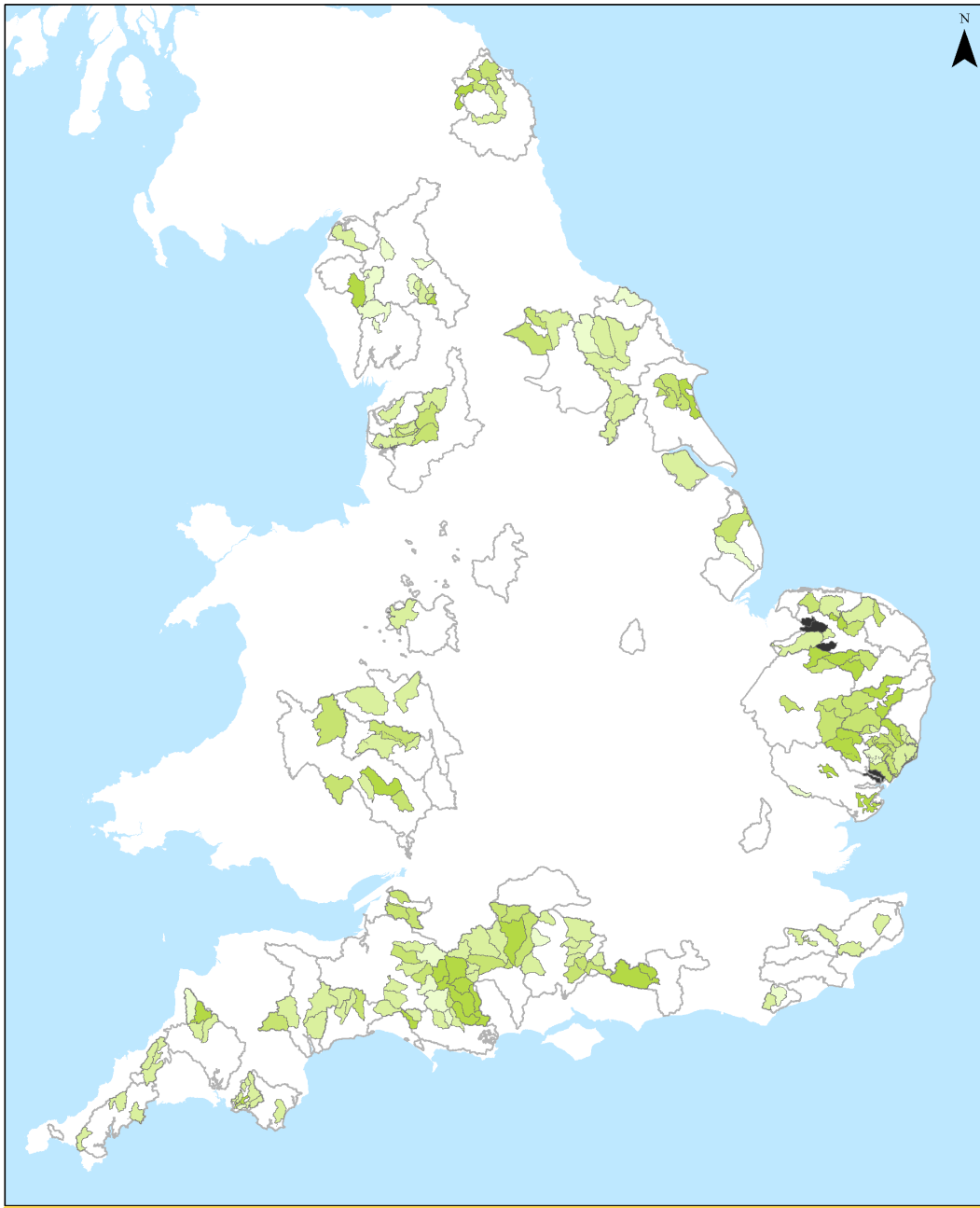


Evidence Directorate, Risk and Forecasting

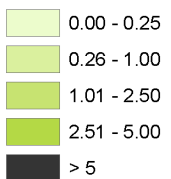
(c) DEFRA (c) Environment Agency 2011

Map re-produced at scale: 1:2,893,136

**(b) Total phosphorus**



**TP Current (% Change)**



ECSFDI Phase 2 Priority Catchments



**A clear solution  
for farmers**  
ENGLAND CATCHMENT SENSITIVE  
FARMING DELIVERY INITIATIVE

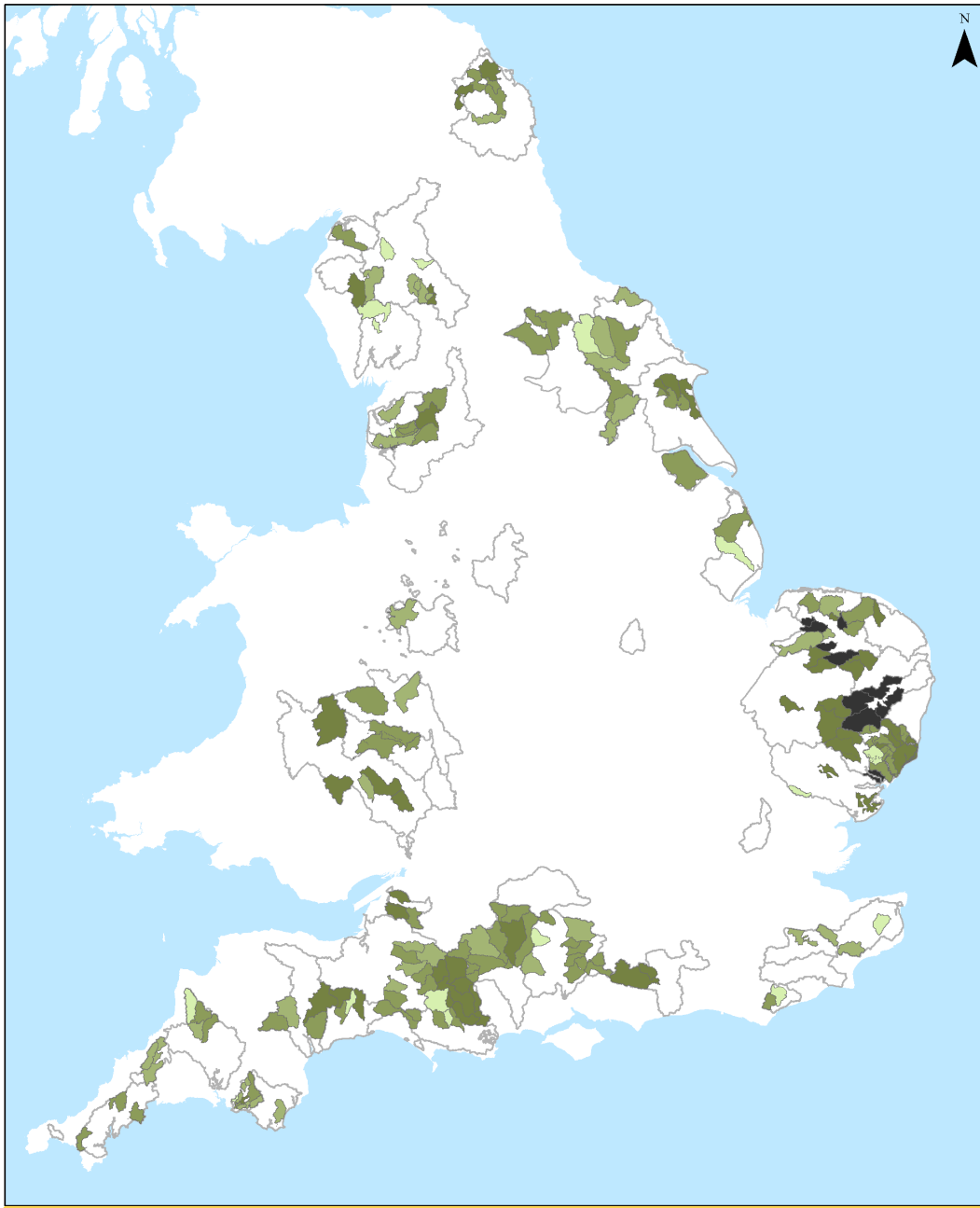


Evidence Directorate, Risk and Forecasting

(c) DEFRA (c) Environment Agency 2011

Map re-produced at scale: 1:2,893,136

(c) Ortho-phosphate



**OP Current (% Change)**

- 0.00 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.50
- > 2.50

ECSFDI Phase 2 Priority Catchments



**A clear solution  
for farmers**  
ENGLAND CATCHMENT SENSITIVE  
FARMING DELIVERY INITIATIVE

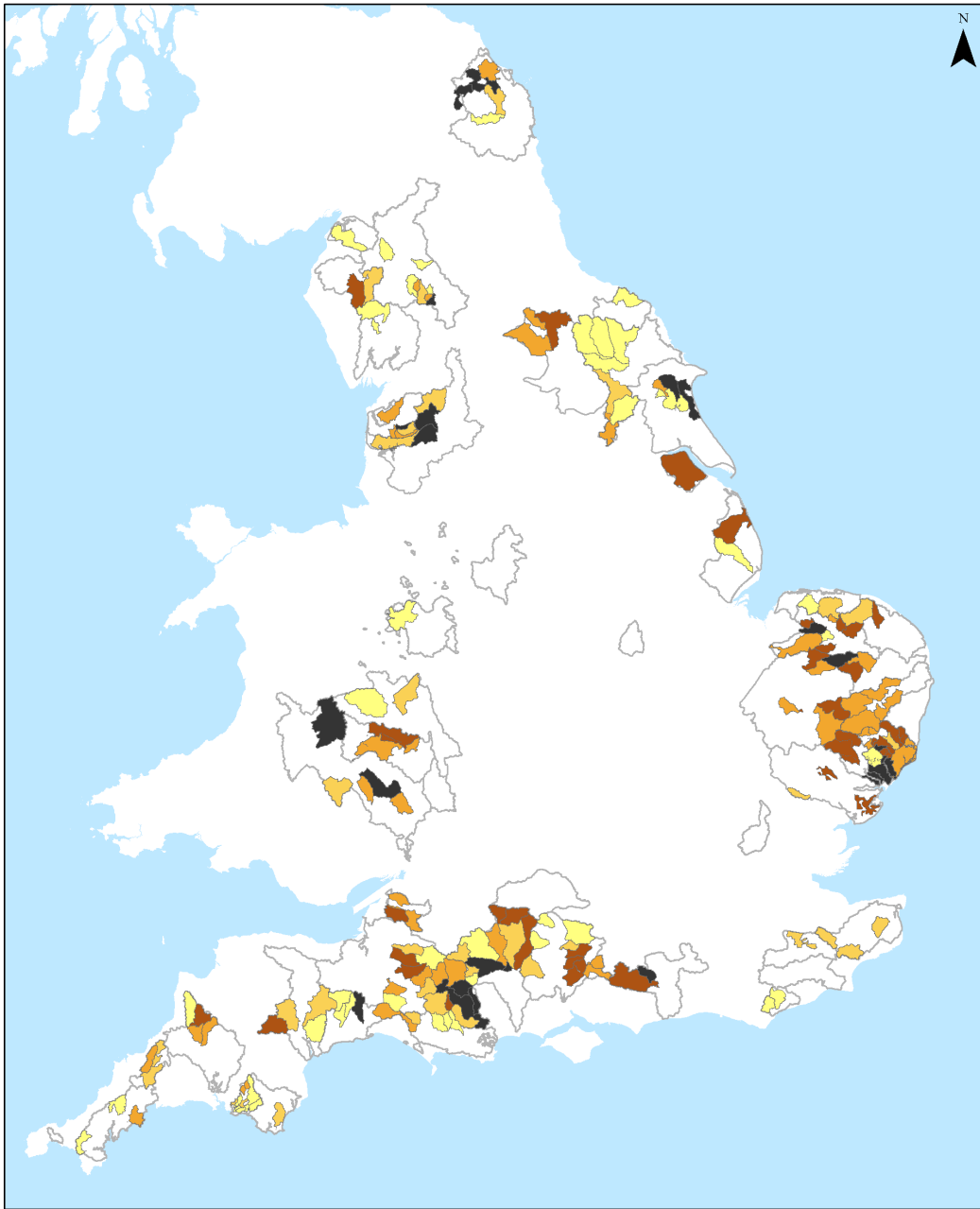


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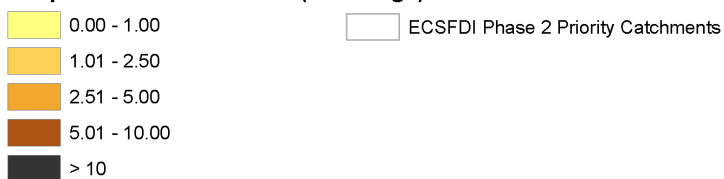
(c) DEFRA (c) Environment Agency 2011

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(d) Sediment (suspended solids)



**Suspended Solids Current (% Change)**



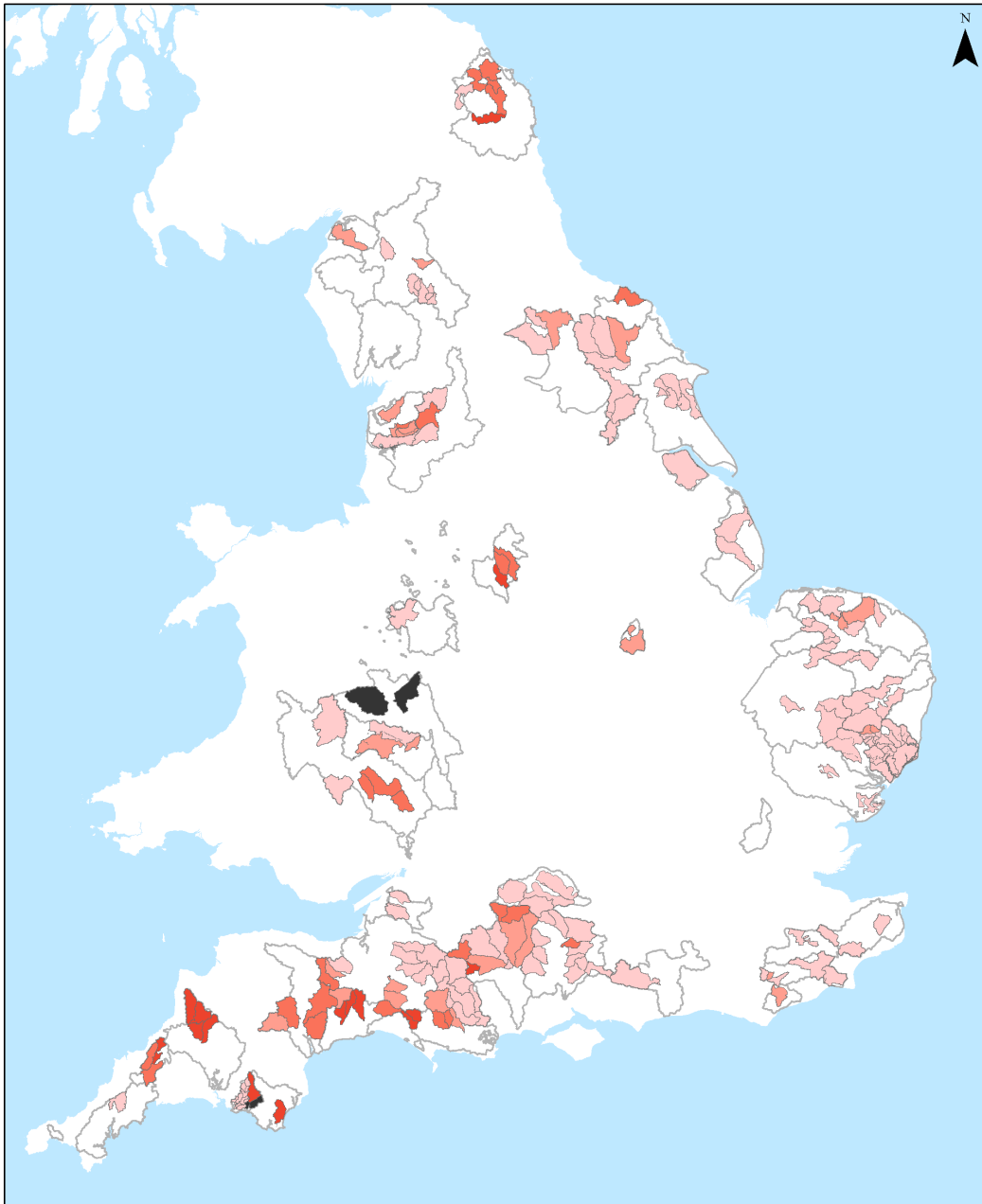
(c) DEFRA (c) Environment Agency 2011



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Map re-produced at scale: 1:2,893,136

(e) FIOs



**FIO Current (% Change)**

- 0.00 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 2.50
- > 2.50

□ ECSFDI Phase 2 Priority Catchments



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(c) DEFRA (c) Environment Agency 2011

Map re-produced at scale: 1:2,893,136

## Modelling scenarios

Using the CCM and statistical models, we estimated pollutant reductions across Target Areas for a range of scenarios (Table 5.2). It is important to recognise that these scenarios are theoretical and the reductions probably could not be realised in practice. The reasons for this include the fact that it would be unlikely that a voluntary initiative such as the ECSFDI could achieve 100 per cent coverage of advice. A number of CSFOs are reporting increasing difficulty increasing engagement above around 70 per cent. In addition, the scenarios assume the relevant control measures would be applied to all relevant farms when, in reality, the measures would already be in place at some farms. The scenarios are therefore likely to over-estimate the reductions that would actually be achieved, but they are useful for placing the predicted ECSFDI reductions in context:

- Scenario 1 Extension of current advice activity and uptake across Target Areas
- Scenario 2 Optimises current advice activity applying the most effective control measures to the most significant pollution sources and extends this across Target Areas, assuming current uptake rates
- Scenario 3 Aims to place a realistic upper limit on the amount of change possible (through management options that fall short of widespread land use change) by applying the most effective control measures to every farm source on every farm and assuming full uptake of measures

The ranges of estimated reductions quoted in Table 5.2 include significant variation across the different catchments (see modelling technical report for further details).

**Table 5.2 Summary of modelling scenario results** - range of percentage reductions using "typical" effectiveness figures from the DPI Manual ("maximum" figures in parentheses)<sup>14,15</sup>

(a) Reductions in farm losses estimated using the CCM

Scenario	Nitrate	Total phosphorus	Dissolved phosphorus	Sediment	FIOs
Current activity	0-7(19)	0-9(18)	0-5(14)	0-18(36)	0-4(16)
Scenario 1	2-15(45)	2-15(30)	1-7(24)	2-27(51)	1-6(26)
Scenario 2	5-21(46)	7-20(45)	6-13(38)	6-46(77)	5-20(40)
Scenario 3	18-24(47)	22-34(55)	16-23(47)	19-46(80)	14-21(40)

<sup>14</sup> Predicted reductions of in-river concentrations can exceed reductions in Target Area farm losses where hydrological units are smaller than Target Areas; have higher advice coverage; and have very few non-agricultural pollutant sources.

<sup>15</sup> Minimum quoted reductions (often zero) occur when mitigation measures are not targeting a specific pollutant (for example, because it is not a priority in a particular Target Area) and/or, for FIOs, because the model assumes that hydrological units draining to lakes and reservoirs will not deliver FIOs to coastal waters.



(b) Reductions of in-river concentrations estimated using statistical models

Scenario	Total oxidised nitrogen	Total phosphorus	Ortho-phosphate	Sediment	FIOs
Current activity	0-8(22)	0-8(16)	0-3(11)	0-20(34)	0-5(12)
Scenario 1	0-10(25)	1-10(22)	0-7(23)	2-26(45)	0-8(20)
Scenario 2	0-22(58)	3-15(43)	2-25(54)	3-41(53)	0-17(33)
Scenario 3	0-43(86)	4-23(43)	3-30(54)	10-41(68)	0-29(39)

The results from Scenario 1 indicate that extending current activity across existing Target Areas should significantly increase pollutant reductions. For nitrate and phosphorus, this results from the widespread sources of pollutants (according to the models), which mean that large reductions can only be achieved through the high geographic coverage simulated in this scenario. As of May 2010, coverage of nutrient measures was on average 40 per cent of the Target Areas (Section 4.1) and we could therefore expect to see an approximate doubling of reductions once measures are widely applied. The smaller increase in FIO reductions under Scenario 1 results from the much more limited focus on FIO-specific measures (as of May 2010).

Scenario 2 indicates that significant further reductions could be achieved through implementation of more effective combinations of control measures. These potential reductions are generally of much greater magnitude than extending the area of current activity alone, highlighting the importance of an effective advice delivery strategy tailored to the specific circumstances and objectives within each Target Area. For example, focussing on measures targeting a single farm source (such as riverside fencing for FIOs) is estimated to be much less effective than promoting control measures across all farm sources. Comparing reductions from current activity with those from Scenario 2, it is apparent that in some catchments the estimated reductions are much more similar than in others. This suggests that current advice strategies are more effective in some catchments than others.

Scenario 3 attempts to estimate the theoretical maximum potential benefit achievable through CSF measures. The scenario highlights that even with widespread adoption of the most effective control measures (excluding widespread land use change), the overall pollutant reduction is less than 50 per cent (based on 'typical' reductions). It also demonstrates that it is potentially much more difficult to reduce some pollutants than others. This is especially apparent for ortho-phosphate and FIOs. The scenario only considers agricultural losses and in reality the significance of other pollution sources is also important (see below).

### Combined impact with reductions from other sources

Simcat models allow us to assess predicted pollutant reductions from the ECSFDI in combination with reductions from other sources. Catchments selected for this summary were those where the model output was most responsive to agricultural measures; where there are (or will be) significant ortho-phosphate reductions from improvements at sewage treatment works (STWs); and where existing water quality is close to meeting in-river standards (after STW improvements are taken into account).

The results show a similar pattern to that observed at a wider scale from the statistical models (Table 5.3). Based on current activity, reductions for ortho-phosphate (1 to 2 per cent) were generally lower than those for total oxidised nitrogen (1 to 7 per cent). These reductions double if we use the 'maximum' predicted reduction per measure indicated in the DPI Manual.

**Table 5.3 Percentage reductions of in-river pollutant concentrations estimated using the Simcat model – selected catchments only**

Scenario	Ortho-phosphate (annual average)		Total oxidised nitrogen (annual average)		Total oxidised nitrogen (95th percentile)	
	Mean	Maximum	Mean	Maximum	Mean	Maximum
Current activity	1	2	1	7	1	6
Scenario 1	1	22	12	22	12	22
Scenario 2	13	24	15	28	14	22
Scenario 3	23	37	34	46	33	47

In most modelled river reaches, the majority of the in-stream ortho-phosphate is derived from point sources, with agricultural contributions being around 20 to 40 per cent. In some tributaries and headwaters, in excess of 80 per cent of ortho-phosphate is derived from agricultural sources, and it is here that the greatest impact of ortho-phosphate reductions can be achieved.

A number of catchments have seen, or will see, significant ortho-phosphate reductions from improvements at STWs. Our modelling indicates that in these catchments main rivers should meet WFD standards for Good Ecological Status<sup>16</sup> but some tributaries will not. In some cases, predicted ortho-phosphate reductions from the ECSFDI will help achieve WFD standards. For example, in the River Nadder (Hampshire Avon), reductions from STW improvements will bring this river close to the WFD standard and the additional reduction from the ECSFDI will make compliance more secure. Where WFD standards are met through STW improvements, reductions through the ECSFDI will reduce concentrations further towards guideline standards for Special Areas of Conservation (SACs).

Although ammonia and nitrates are released from STWs, in most of the modelled river stretches more than 80 per cent of the measured nitrogen is derived from diffuse sources. There is therefore potential for larger reductions in nitrate from ECSFDI measures than for ortho-phosphate.

Most of the ECSFDI catchments are below the Nitrates Directive threshold of 11.3 mgN/l, but the Wensum and parts of the Rother and Eden are not and are included in Nitrate Vulnerable Zones in which nitrate reduction measures from agriculture are or will be in place. In some instances, reductions predicted for Scenario 1 bring a stretch of river below the threshold, and in other stretches, could reduce the mean nitrogen concentration to 3 to 4 mgN/l, which has been suggested as a guideline standard for SAC rivers.

<sup>16</sup> Ortho-phosphate is the only relevant pollutant for which an in-river standard has been set under the Water Framework Directive.

## DWPA Control Measures

As outlined in Section 4.1, advice provided through the ECSFDI is highly tailored to individual farm holdings, although 25 of the 86 potential DWPA control measures were recommended to a limited number of holdings. Using the CCM, we have identified those measures that contribute most to predicted ECSFDI benefits, based on their take-up; targeting; and effectiveness at reducing key pollutants. Please refer to the modelling technical report to see the assumptions which will influence the estimated effectiveness of the measures.

For nitrate and phosphate, 80% of the potential pollutant reduction could be achieved from a sub-set of 10 to 15 most effective measures. For sediment and FIOs, less than 10 measures are required to achieve a similar reduction. Table 5.4 lists the most effective ECSFDI measures across all pollutants. Simplifying the list of measures in this way should help provide the main focus for future CSF activity.

Some measures providing potentially large benefits are not currently used to a significant extent within the initiative (Table 5.5). A number of these could be considered for inclusion in future capital grant schemes, whilst others may be more appropriate for other delivery mechanisms; for example, because of the difficulty, or high financial cost, of implementation.

**Table 5.4 DWPA control measures that contribute most to overall ECSFDI benefits**  
 - separate lists of measures for each pollutant are provided in the accompanying modelling technical report (Ref. 9)

Construct bridges for livestock crossing rivers/streams
Move feeders at regular intervals
Cultivate land for crops in spring rather than autumn
Reduce field stocking rates when soils are wet
Reduce dietary N and P intakes
Fence off rivers and streams from livestock
Establish riparian buffer strips
Reduce overall stocking rates on livestock farms
Do not apply P fertiliser to high P index soils
Integrated fertiliser and manure nutrient supply
Minimise the volume of dirty water produced
Establish in-field grass buffer strips
Adopt reduced cultivation systems
Manage over-winter tramlines
Do not apply manure to high risk areas
Do not apply fertiliser to high risk areas
Cultivate and drill across the slope
Incorporate manure into the soil
Increase the capacity of farm manure (slurry) stores to improve timing of slurry applications
Establish cover crops in autumn
Allow field drainage systems to deteriorate
Change from a slurry to solid manure handling system
Loosed compacted soil layers in grassland fields
Establish new hedges
Site solid manure heaps away from watercourses/field drains
Use a fertiliser recommendation system
Do not spread slurry or poultry manure at high-risk times
Early harvesting and establishment of crops in the autumn
Transport manure to neighbouring farms
Avoid spreading fertiliser to fields at high risk times
Establish and maintain artificial wetlands
Cultivate compacted tillage soils

**Table 5.5 Effective DWPA control measures used to a limited extent in the ECSFDI and potentially better suited to other delivery mechanisms**

Grow biomass crops
Establish and maintain artificial wetlands
Adopt phase feeding of livestock
Convert arable land to unfertilised grass
Use liquid/solid manure separation techniques
Construct troughs with a firm but permeable base
Early harvesting and establishment of crops in the autumn
Transport manure to neighbouring farms
Irrigate crop to achieve maximum yield
Use a fertiliser recommendation system
Avoid spreading fertiliser to fields at high risk times
Arable reversion to low fertiliser input extensive grazing
Use fertiliser placement technologies
Cultivate compacted tillage soils

## 5.2 Enhanced Water Quality Monitoring Programme

### 5.2.1 Nutrients, sediment and FIOs

Data from the Enhanced Water Quality Monitoring Programme were examined to seek evidence of an improvement in water quality. Analyses focussed on sites where there was the best chance of detecting an improvement (i.e. those immediately downstream of Target Areas), using monitoring data from January 2007 to September 2010.

A simple descriptive analysis identified no discernible trends in loads or concentrations for most of the pollutants assessed, whilst for others it was uncertain whether observed changes were due to the ECSFDI, or just fluctuations caused by year to year variation in rainfall and flow (Ref. 20).

A more detailed statistical analysis was therefore undertaken, which controlled for, and factored out, the influence on water quality of random variations in flow (Ref. 21). The analysis sought to relate differences in the intensity and/or timing of advice activity to observed changes in water quality. Even with intensive monitoring, it can be difficult to detect subtle changes in water quality at individual monitoring sites. The analysis therefore adopted a weight-of-evidence approach, using results from a number of sites in order to draw general conclusions. This was considered to be the most robust and meaningful indicator of the effectiveness of the ECSFDI.

The main challenge was to control for temporal variation in flow that might otherwise mask or exaggerate changes in pollutant concentration resulting from the ECSFDI. A classical solution is to use a Before-After-Control-Impact (BACI) approach, which compares a manipulated 'impact' site with a non-manipulated 'control' site before and after implementation of a mitigation measure. In this case, the BACI approach

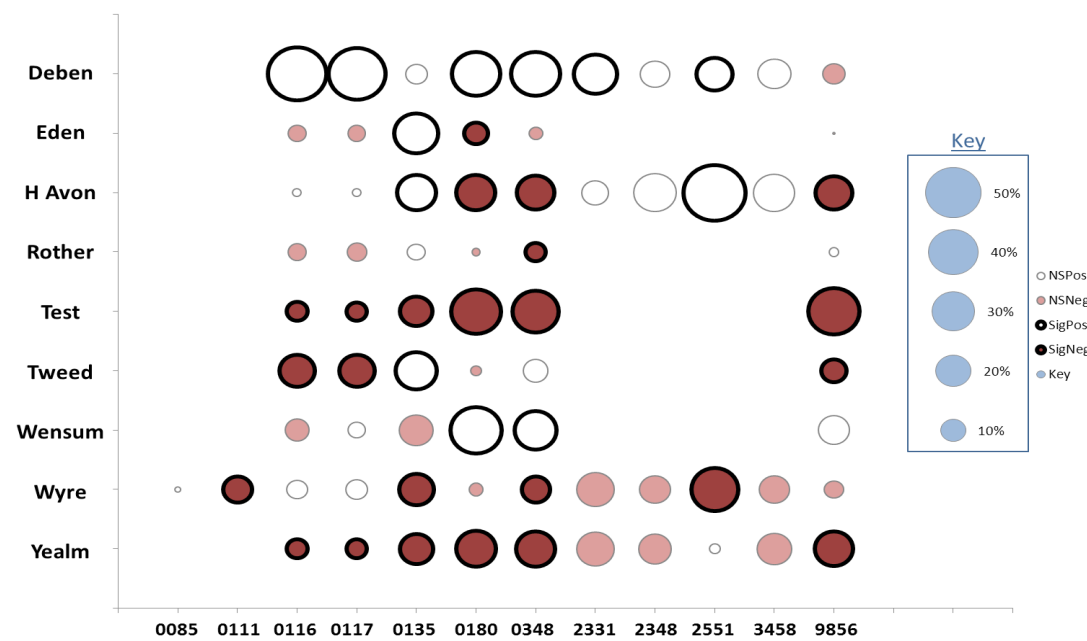
was adapted to allow data from more than two sites to be analysed. The reason for this was two-fold. First, changes in the location of Target Areas meant that by the end of 2010 there were relatively few control sites with no upstream advice activity. Second, preliminary analyses revealed that the results from a paired-site analysis were very sensitive to the location of the control and impact sites. This is not surprising since the effect of the ECSFDI is likely to vary among sub-catchments and the use of just two sites makes the result vulnerable to unknown local factors that might also be influencing water quality. By including sites from more than two sub-catchments, the analysis was able to provide a catchment-wide assessment of the impact of the ECSFDI and the results should be more robust to idiosyncratic sub-catchment effects. A separate analysis was therefore undertaken for each monitored catchment and the results synthesised used to assess the overall effectiveness of the ECSFDI.

Figure 5.6 summarises the sub-catchment level water quality responses to ECSFDI advice activity after controlling for year to year variation in flow. The area of the circles is proportional to the average percentage change in mean pollutant concentration across monitored sub-catchments. Filled circles indicate that concentrations decreased with increasing advice activity during the monitoring period; darker circles with thick borders indicate a statistically significant decrease in mean concentration whereas lighter circles with thin borders denote a non-significant effect. Unfilled circles indicate that mean concentration increased with increasing advice activity, with thicker borders indicating a statistically significant effect. A gap means that a pollutant was not a priority issue in a particular catchment.

**Figure 5.6 Influence of ECSFDI advice activity on pollutant concentrations at selected locations within nine monitored catchments, after adjusting for temporal variation in flow (source: Ref. 21)**

Key to pollutant codes:

0085 – Biochemical Oxygen Demand; 0111 – Ammonia; 0116 – Total Oxidised Nitrogen; 0117 – Nitrate; 0135 – Suspended Solids; 0180 – Total Reactive Phosphorus; 0348 – Total Phosphorus; 2331 – Total Coliforms; 2348 – E. Coli; 2551 – Faecal Streptococci; 3458 – Faecal Coliforms; 9856 – Soluble Reactive Phosphorus



Overall, the results were encouraging; more than half of the 72 tests showed a decrease in pollutant concentration and more tests showed a statistically significant decrease in concentration than would be expected due to chance. Six of the nine catchments showed a reduction in pollutant concentrations for more than half the pollutants monitored, while nine of the 12 pollutants showed a reduction in at least half of the catchments. Taking the results from the nine catchments as a whole, the weight of evidence indicates that ECSFDI has delivered a net improvement in water quality in the nine monitored catchments.

At the sub-catchment scale, improvements in water quality were up to 30 per cent. The effects were catchment and pollutant specific, with the Test; Wyre; and Yealm showing a strong and consistent decrease in concentration across a range of pollutants whilst in the Deben, Alde & Ore; Hampshire Avon; and Wensum concentrations tended to increase more often than decrease<sup>17</sup>. Overall, the most consistent effect was apparent for phosphorous, with seven out of the nine catchments showing a reduction in mean concentration, while nitrogen and suspended solids showed a more variable response. Faecal Indicator Organisms were only monitored in four of the nine catchments and the results were highly variable.

### 5.2.2 Pesticides

Five Priority Catchments targeted for pesticide advice were monitored consistently for nine pesticides for the crop years 2006-07 to 2009-10 (River Wensum; Yare & Waveney; Yorkshire Ouse, Nidd & Swale; River Lugg; and River Teme) (Ref. 8)<sup>18</sup>. The monitored pesticides were some of those considered most likely to appear in rivers from usage patterns, physico-chemical properties and the results of previous studies.

During the monitoring period usage of three pesticides changed directly or indirectly as a result of regulatory measures. Isoproturon (IPU) and simazine were banned and chlorotoluron use increased to replace IPU. Results for these pesticides were therefore excluded from the analysis as the ban masked any positive influence from the ECSFDI.

The results provided clear evidence of a reduction in pesticide levels. Total Annual Load (26 per cent); Time Weighted Mean Concentration (28 per cent); and Flow Weighted Mean Concentration (31 per cent) all reduced significantly for the total of the six indicator pesticides between the 2006-07 and 2009-10 crop years. The proportion of samples exceeding 0.1 µg/l<sup>19</sup> also reduced from 5.5 to 5.9 per cent in the first three crop years to 2.2 per cent in 2009-10 (Figure 5.7). Excluding 2,4-D, 2009-10 had the lowest proportion of samples exceeding 0.1 µg/l for all individual pesticides.

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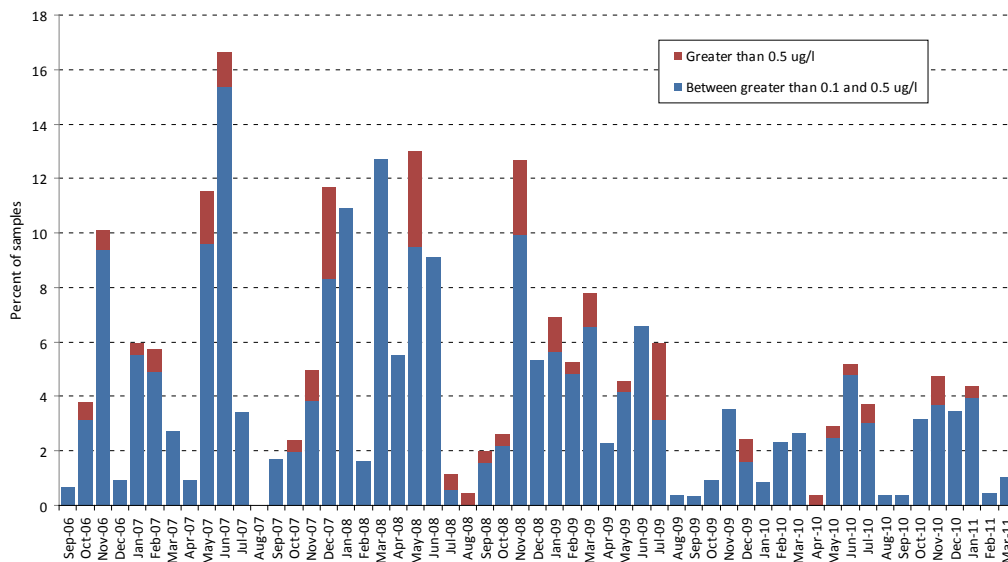
17 The assessment often relied on comparing water quality at sites with similar levels of advice activity which can render the result sensitive to exactly when the measures were recommended and implemented (the latter being not fully documented). This may account for the reported lack of improvement for the Deben, Alde and Ore and Wensum catchments.

18 Although 7 Priority Catchments were targeted for pesticide advice (Section 2.4), this analysis considers monitoring at 6 sites within the initial 5 catchments (including one site for the Yare and one for the Waveney, within the Yare & Waveney Priority Catchment).

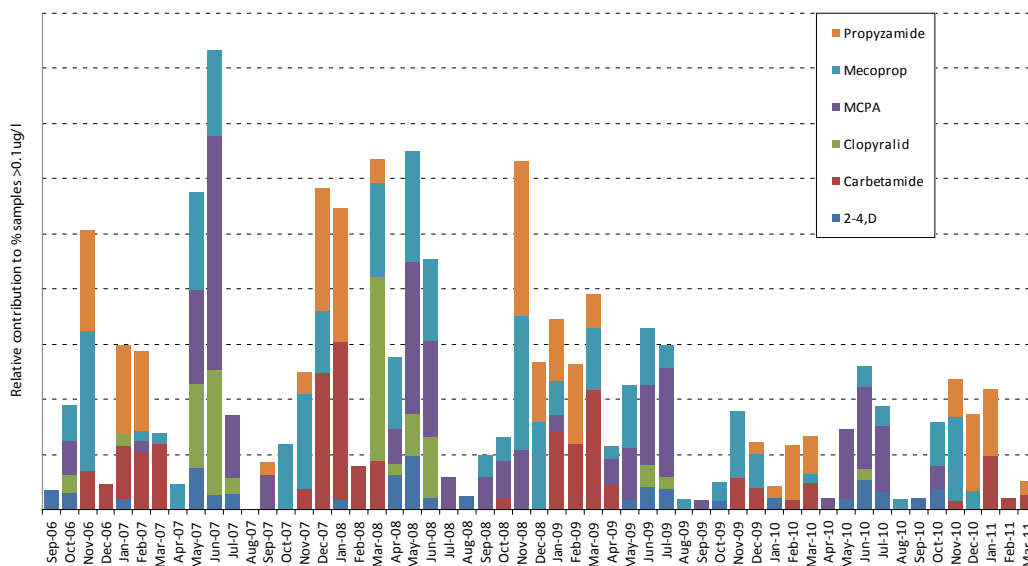
19 0.1 µg/l<sup>1</sup> is the EU tap water standard for any individual pesticide and as such it is relevant for comparison. However, the results do not represent exceedences of this standard, because we are monitoring rivers.

**Figure 5.7 Pesticide level indicators – composite of six pesticides across five monitored Priority Catchments**

**(a) Proportion of samples greater than 0.1 ug/l (and 0.5 ug/l)**



**(b) Relative contribution of the six pesticides to the proportion of samples greater than 0.1 ug/l**



We are confident that these reductions represent real improvements associated with the initiative. A survey of farmers within the five catchments<sup>20</sup> indicated that 51 per cent had changed their behaviour regarding pesticide use as a result of the advice they received (Ref. 22), and every effort was made to isolate and exclude the effects of other influences which could otherwise contribute to (or conceal) improvements:

<sup>20</sup> 169 farmers were surveyed by telephone in November/December 2009.



- The total area of arable land in England increased between 2006 and 2010, mainly due to the conversion of set-aside to cropped land. The reported reduction therefore coincides with pesticide use over a larger area of arable crops.
- Although reliable data were not available at a catchment scale, overall use of the six indicator pesticides increased by about 5 per cent between 2006 and 2010.
- Spatial patterns, amounts and timing of rainfall (in relation to pesticide applications) can potentially have a great influence on the levels observed in rivers. Analysis of the annual rainfall data for the catchments shows that 2006-07 was a wet year while the other years were more typical. The important autumn and winter periods for the first (2006-07) and last (2009-10) years were, however, very similar. The spring periods of 2008-09 and 2009-10 were both unusually dry, but this period is of less importance than the winter since less run-off is experienced from fields.

The changes in levels of pesticides varied between individual pesticides, catchments and crop years. With only four years of monitoring data, it was not practical to undertake a statistical analysis of trends for each pesticide in each catchment. We cannot therefore be sure that the effects are the same across all pesticides or across the different catchments. It was notable that the greatest reductions occurred in the latest monitoring year. However, given the significant inertia in the system, it is not surprising that reductions were not as apparent in earlier years.

### 5.3 Catchment studies: Dorset Frome and River Teme

Two ECSFDI catchments were subject to sediment monitoring programmes that began prior to the Initiative itself. These monitoring programmes were extended to provide datasets for assessing the impact of the Initiative at an individual catchment scale.

#### Dorset Frome

Sediment monitoring on the Dorset Frome (within the River Piddle, River Frome & Fleet Lagoon Priority Catchment) was established in 2002 as part of the NERC LOCAR (LOWland CATCHment Research) community research programme. An existing conventional water quality (quasi-continuous turbidity) monitoring programme was supplemented with sediment source tracing studies (Ref. 23). The latter are founded upon the link between the geochemical properties of suspended sediment and those of its sources. Assuming different sources can be distinguished on the basis of their constituent properties or "fingerprints", the provenance of sediment can be established using a comparison of its properties with those of the individual potential sources. By comparing sources before and after mitigation, it is possible to identify changes in the importance of different sediment sources resulting from DWPA control measures (Ref. 24).

Although positive changes in the frequency of both low and high sediment concentrations were suggested by the water quality monitoring results at sites within the Frome catchment, it was apparent that longer-term data records are needed for a robust analysis of trends. The Dorset Frome monitoring represents a useful dataset moving towards this end.

During Phase 1, sediment fingerprinting was used to help target on-farm advice and mitigation within the River Win sub-catchment (Target Area). As a result a range of control measures targeting agricultural top-soils as a potential sediment source were implemented at two large farm holdings. Repeat sediment source tracing during Phase 2 detected a statistically significant shift in the source of in-river sediments. The relative contribution from cultivated top-soils decreased from 80 to 4 per cent; that from pasture top-soils decreased from 11 to 5 per cent; and that from roads decreased from 8 to 1 per cent. In contrast, the relative contribution from channel banks increased from 1 to 90 per cent. These changes in the relative importance of different sediment sources were associated with a 60 per cent reduction in the typical magnitude of sediment pressure, as represented by channel bed storage. In combination, the results indicate a significant response from the uptake of DWPA control measures in the River Win Target Area.

The increased sediment inputs from channel banks may reflect increased poaching due to an increase in livestock numbers, indicating that river bank fencing has not been a major contributor to controlling diffuse sediment inputs, or greater channel scour in response to the reduction in surface-derived sediment inputs. The reduction in road sediment most probably reflects the reduced amount of sediment from agricultural fields following targeted mitigation.

The study showed that repeat sediment source apportionment surveys provide a more sensitive means of demonstrating a shift in signal resulting from targeted mitigation measures due to their emphasis on pollution sources.

## **River Teme**

The River Teme analysis focussed on five sites located across ECSFDI Target Areas that have been monitored intermittently since 2006 (Ref. 25).

The complex relationship between flow and suspended solids concentrations combined with gaps in the monitoring data made a comparison of concentrations and loads from one year to the next difficult. A statistical modelling approach was therefore used to analyse the data, focussing on (i) periods of dry weather, to identify any impact from mitigation measures such as fencing to reduce livestock access, and (ii) periods of wet weather, to assess the impact of measures reducing run-off.

The analysis provided some evidence that CSF activities may have reduced the frequency of peak suspended solids concentrations under low flow conditions, possibly by preventing the access of cattle to the river. However, the majority (60 to 88 per cent) of the suspended solids load was transported during high flow periods, and the assessment of any reduction in peak concentrations during these periods was inconclusive.

Although the approach developed for this study represented a significant advance over those used in many previous studies, it was not sufficient to robustly test for improvements resulting from catchment management activities. More comprehensive data and more sophisticated analyses are likely to be needed.

## 5.4 Ecological assessment

Although the primary emphasis of our water quality assessment was to look for evidence of changes in water chemistry, a review of available ecological monitoring data was also undertaken. Diatoms (unicellular algae) were chosen as the basis for this assessment as they are likely to respond rapidly to certain types of water quality change.

The results of detailed monitoring of streams within the Bassenthwaite Lake Priority Catchment between 2006 and 2009 were available (Ref. 26). However, the study did not detect any change in diatom community composition or Trophic Diatom Index (a biotic index of nutrient status) across the study period, although all monitored sites were already of good ecological status.

A wider analysis of Environment Agency river diatom monitoring data was also undertaken to identify any early indication of an ecological response within the ECSFDI Priority Catchments (Ref. 20). This involved a Before-After comparison at selected sites with sufficient numbers of samples. For other sites with very sparse monitoring data, a simple descriptive analysis was performed. Overall, the analysis found no clear evidence of a response, although the dataset available was geographically limited and the frequency of sampling was too low to permit a robust statistical analysis. The analysis demonstrated a clear need to assemble longer-term data records.

## 6. Partnerships and Associate CSF projects

Partnerships (Phase 2) and Associate CSF projects (Phase 1) extended the availability of ECSFDI-type advice beyond the Priority Catchments.

### 6.1 Partnerships

Four National Strategic Partnerships delivered advice on specific topics and ten Catchment Partnerships delivered advice in specific catchments (Ref. 27). National Strategic Partnerships principally targeted advice to agronomists and Catchment Partnerships to farmers. A total of 18 organisations were involved in these partnerships, including government agencies, regional government, industry bodies, water companies and environmental NGOs.

The National Strategic Partnerships, with existing advice delivery organisations, delivered advice and made advice materials and tools widely available to farmers and their advisers via workshops, printed material, and websites. They also built capacity for further advice delivery through training agricultural trainers, advisers and Rivers Trust staff:

- The Professional Nutrient Management Group developed, disseminated and promoted the Tried and Tested Nutrient Management Plan, an industry-led aid to make nutrient planning and recording simple and practical ([www.nutrientmanagement.org](http://www.nutrientmanagement.org)).
- The Agriculture and Horticulture Development Board promoted precision farming; developed a cost : benefit tool; and delivered farm walks, workshops, and an industry conference ([www.hgca.com/beprecise](http://www.hgca.com/beprecise)).
- The Association of Rivers Trusts provided information and advice on reducing DWPA through the PINPOINT project ([www.associationofrivertrusts.org.uk/pinpoint](http://www.associationofrivertrusts.org.uk/pinpoint)). This included training on provision of farm advice and support for setting up 'Angling Passport' schemes.
- The Voluntary Initiative delivered workshops and disseminated pesticide best practice, including the H2OK Water Protection booklet, posters and media articles ([www.voluntaryinitiative.org.uk](http://www.voluntaryinitiative.org.uk)). A self-assessment tool on pesticide handling was also developed.

The ten Catchment Partnerships delivered advice within specific catchments. They targeted priority DWPA issues impacting Natura sites, SSSIs, water supply sources and WFD status. Phosphorus, sediment and nitrate were the main pollutants targeted, with soil, fertiliser and nutrient management the most common advice themes.

By the end of December 2010, 855 one-to-one advice visits had been completed and 94 group events had been attended by over 1260 farmers. Newsletters were also used to promote the partnerships and provide advice.

Using the combined resources, funding and expertise of the ECSFDI and partners, Catchment Partnerships were effective for setting up and delivering farmer engagement. In particular, they facilitated a sharing of resources and

information and presented a united approach to tackling DWPA. Partnerships were able to engage farmers quickly because of the partners existing local presence or profile and networks, whereas many CSFOs initially had to work on developing their profile within a catchment.

In the future, Catchment Partnerships could be improved in two principal ways. Firstly, through a capital grant scheme to encourage farmer engagement and assist farmers in making necessary infrastructural improvements; and secondly, by simplifying partnership agreements so they can be established more quickly. By expanding the initiative's formal evaluation to the Catchment Partnerships, we will be better placed to report on their effectiveness in the future.

## **6.2 Associate CSF projects**

During Phase 1, the ECSFDI provided support to 20 existing projects. Most focussed on specific catchments and adopted a similar approach to that of the Catchment Partnerships and Priority Catchments. Each had a dedicated 'project manager' and offered a range of awareness raising, demonstration and advisory activities. They focussed on a range of DWPA issues across different farming sectors. The projects were led by a variety of organisations from the public and private sectors, environmental NGOs and research institutions or a consortium of the above.

The Associate Programme provided one-to-one advice to approximately 450 farmers. Additional advice was delivered through around 150 group events (attended by 1,800 farmers) and 130 clinics (attended by 780 farmers). Other activities included distributing newsletters and information cards; soil testing; establishing demonstration farms; and hosting events for the general public. An evaluation of six Associate projects (Ref. 28) informed the Catchment Partnership approach adopted in Phase 2.

## 7. Future targeting of CSF to maximise outcomes

Using models and datasets developed for the evaluation of the ECSFDI, a method has been developed for assessing the geographic locations where CSF is most likely to be successful in influencing land owners to take action and where the mitigation measures themselves will make the greatest contribution to catchment improvement (Ref. 29).

The method considers three factors:

- the scope for reduction of farm pollution – based on modelled assessment of the scale of pollution from agricultural sources
- the likelihood of success of CSF – based on measured uptake of mitigation measures by farm type within existing catchments (Section 4.2)
- the priority of an area for environmental improvement – based on Water Framework Directive objectives

The method is being used to help target Phase 3 of the initiative to maximise resulting environmental outcomes.

This approach will be developed further, in order to identify the combination of control measures that would be most effective (based on those for which the ECSFDI is effective) in a particular location. This will help address the highlighted importance of having effective advice delivery strategies tailored to specific circumstances and objectives in order to maximise resulting pollutant reductions. The approach will also consider the relevant environmental objectives; for example, identifying what action would be needed to achieve a 5 per cent reduction in ortho-phosphate in order to achieve a water quality standard in a particular location

## 8. Conclusions

The overall success of the ECSFDI is assessed in relation to its three key objectives:

### **Objective 1 – To increase awareness amongst rural land managers and stakeholders of the impact of diffuse water pollution from agriculture**

The ECSFDI has delivered a significant programme of advice on diffuse water pollution from agriculture and related farming practices across 50 Priority Catchments. Some 9,023 farmers received advice by the end of February 2011, representing 17 per cent of all farm holdings within the catchments (38 per cent by area) and 45 per cent within targeted sub-catchments (62 per cent by area).

Supported by ADAS and the Voluntary Initiative, further targeted pesticide advice was provided through the ECSFDI. This has focussed primarily on seven Priority Catchments. High levels of engagement with agronomists and other key influencers of crop protection practice were achieved, providing the necessary basis needed for behavioural change.

Outside of the 50 Priority Catchments, a significant additional programme of advice was delivered through National and Catchment Partnership Projects and Associate CSF Projects. These projects utilised the combined resources, funding and expertise of a wide range of organisations with well-established links to farmers and farm advisers.

The ECSFDI has helped address confusion amongst farmers over expectations and requirements for the control of diffuse water pollution. Those that have engaged are not only more aware of the support the ECSFDI offers but also that available from other sources. Over 80 per cent of farmers receiving advice from the ECSFDI confirm their knowledge of water pollution has increased and that they have taken, or intend taking, action to reduce water pollution. Over 90 per cent indicate the ECSFDI approach is the best way to learn about water pollution.

Despite this increased awareness and understanding, there remains only limited acceptance from farmers that agriculture makes a significant contribution to water pollution. The key drivers for change have been the financial incentives of free advice, reduced costs (for example, by more accurately calculating fertiliser applications) and grants.

### **Objective 2 – To improve soil and land management practices amongst farmers within Priority Catchments**

The ECSFDI has brought about improvements to soil and land management practices through the voluntary uptake of targeted advice and through a dedicated capital grant scheme.

93,360 recommendations were made for improving soil and land management to control diffuse water pollution. Overall, 58 per cent of recommended control

measures (from one-to-one advice) have been implemented and at 64 per cent of farms at least half of the recommended measures have been implemented.

Implementation of measures was highest for cereals and general cropping farms and in Anglian, Humber, Severn and the South West.

In most cases (83 per cent), implementation of measures resulted solely from advice received through the initiative. In 17 per cent of cases, implementation was also influenced by one or more incentives, other schemes or initiatives; the Nitrates Action Programme (6 per cent) and ECSFDI Capital Grant Scheme (5 per cent) being most important.

Uptake of advice increased significantly over time and with further engagement. This is to be expected because behavioural change takes time and because farmers need to integrate changes into their farming operations.

The uptake of control measures providing a cost saving to the farmer was only slightly higher than those with an associated net cost, despite many farmers indicating financial considerations prevent them from doing more. This confirms that the initiative is both helping target and accelerate changes that might be expected through general trends towards improved farm practice and delivering significant additional change.

A number of potentially effective control measures, that were used to only a limited extent, were identified. Some of these should be considered for inclusion in future capital grant schemes, whilst others may be more appropriate for other delivery mechanisms as a result of the difficulty, or high financial cost, of implementation.

The ECSFDI Capital Grant Scheme contributed towards approximately £29 million of priority farm improvements. The influence of the scheme went well beyond the improvements it directly funded. Many farmers initially engaged with the Initiative because of the scheme and farmers' enthusiasm for it and a willingness to commit their own money were reflected in the scheme being significantly oversubscribed.

### **Objective 3 – To reduce the pollution of water caused by farming within Priority Catchments**

Modelling results indicate that improvements in management practices will result in significant reductions in agricultural pollutant losses. Reductions from the first four years of the ECSFDI are generally predicted to be between 5 and 10 per cent across Target Areas, but can be up to 36 per cent. These reductions translate into in-river reductions of pollutant concentrations of similar magnitude. Responses vary across the different DWPA pollutants and Priority Catchments, due to variation in advice delivery and uptake and the significance of agricultural pollutant sources.

Extending current ECSFDI activity across existing Target Areas would significantly increase pollutant reductions to a predicted maximum of around 25 per cent, although in some circumstances reductions may be higher. In practice, 100 per cent advice delivery would probably be unachievable for a voluntary scheme, but significant further gains are clearly possible within many existing Target Areas.



In some cases, predicted ortho-phosphate reductions from the ECSFDI will help achieve WFD standards for Good Ecological Status. Where WFD standards are met through improvements at sewage treatment works, ECSFDI reductions will reduce concentrations further towards guideline standards for Special Areas of Conservation.

Significant further pollutant reductions could potentially be achieved through implementation of more effective combinations of control measures. These potential reductions are generally of much greater magnitude than extending the area of current activity alone and, in some cases, there would appear to be scope to improve current advice delivery strategies to increase resulting pollutant reductions.

Water quality monitoring has demonstrated reductions in pollutant loads and concentrations resulting from the ECSFDI. These reductions were up to around 30 per cent across targeted sub-catchments within representative catchments and, for pesticides, across targeted catchments. We are confident these reductions represent real improvements associated with the initiative.

At the individual catchment scale, it is clear that longer-term datasets are needed to robustly analyse and confirm trends. Sediment source tracing has successfully demonstrated a beneficial response to the ECSFDI within the Dorset Frome. By focussing on assessment of pollution sources this technique overcomes the complexities of pollutant mobilisation, pathways and delivery that are inherent in conventional water quality monitoring.

Initial analysis of ecological monitoring data, from rivers within Priority Catchments, found no evidence of any response, with a clear need to assemble a longer-term data record.

Communication of the benefits delivered through the first two phases of the ECSFDI will help address uncertainty over the significance of DWPA and the benefits resulting from initiatives to reduce it. This will be important for securing future buy-in of stakeholders (especially farmers).

Using models and datasets from our evaluation, we have developed a method that has been used to help target Phase 3 of the initiative to maximise resulting environmental outcomes. This method will be developed further in order to identify the most effective combinations of control measures for particular locations.

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Catchment Sensitive Farming (CSF) is delivered in partnership by Natural England, the Environment Agency and Defra.

