
Evaluating Economic Policy Instruments for Sustainable Water Management in Europe

# WP3 EX-POST Case studies

## Cooperative agreements between water supply companies and farmers in Dorset

Deliverable no.: D3.1 - Review reports
14th December 2011

Grant Agreement no. 265213
FP7 Environment (Including Climate Change)

| | |
|---|---|
| Deliverable Title | D3.1 - Review reports |
| Filename | Cooperative agreements between water supply companies and farmers in Dorset |
| Authors | Christophe Viavattene, Joanna Pardoe, Simon McCarthy, Colin Green - Flood Hazard Research Centre – Middlesex University |
| Date | 14/12/2011 |

Prepared under contract from the European Commission
Grant Agreement no. 265213
FP7 Environment (including Climate Change)

| | |
|---|---|
| Start of the project: | 01/01/2011 |
| Duration: | 36 months |
| Project coordinator organisation: | FEEM |

| | |
|---|---|
| Deliverable title: | Review reports |
| Deliverable no. : | D3.1 |

| | |
|---|---|
| Due date of deliverable: | Month 11 |
| Actual submission date: | Month 12 |

*Dissemination level*

| | | |
|---|---|---|
| X | PU | Public |
| | PP | Restricted to other programme participants (including the Commission Services) |
| | RE | Restricted to a group specified by the consortium (including the Commission Services) |
| | CO | Confidential, only for members of the consortium (including the Commission Services) |

*Deliverable status version control*

| Version | data | Author |
|---|---|---|
| 1.0 | October 2011 | Christophe Viavattene, Joanna Pardoe, Simon McCarthy, Colin Green |
| 1.1 | 15th of November 2011 | Christophe Viavattene, Joanna Pardoe, Simon McCarthy, Colin Green |
| 1.2 | 14th of December 2011 | Christophe Viavattene, Joanna Pardoe, Simon McCarthy, Colin Green |

# Executive Summary

## Definition of the analysed EPI and purpose

This case study is a classic example of a water company facing increasing nitrate contamination of its groundwater resources. The pollution is mainly the result of farming activities in the catchment. Potential "cheap" solutions such as blending the water from different sources are increasingly difficult to undertake due to the extent and increase in contamination. As a result the water company has two options: the treatment option or a catchment management approach.
In this case to avoid the high Operational & Maintenace and construction costs of the treatment option the water company (Wessex Water) has approached the farmers in order to cooperate to improve the water quality by promoting better practices. The cooperation involves information and education support but also phasesd incentive payments. Such an approach is generally defined as a cooperative agreement (Heinz *et al*, 2002) following four criteria:

- It is established on a voluntary basis between farmers and at least one water supplier and relying on the self-interest of the parties involved
- It is based on self-regulation among the key actors
- It includes an important role of the water supplier, either in the negotiation process and/or in the provision of financial resources
- It is targeted to a specific area (e.g. water catchment area; groundwater protection zone)

## Introduction

The case study area is located in the county of Dorset, part of the South West region of the UK. The total case study area covers approximately 500km$^2$. Dorset is a predominantly a rural region, where agriculture occupies the majority of the land (79%). This includes 39% arable, 34% grassland and 6% rough grazing. In the last 10 years following the foot and mouth disease crisis there has been a decline in livestock farming and an increase in fruit and vegetable farming. The water company, Wessex Water, supplies approximately 370Ml/d of drinking water to a population of 1.2 million. The predominant sources of this water are the aquifers underlying this region. Abstraction from aquifers accounts for 80% of Wessex Water's domestic supply with reservoirs and rivers providing 22% and 0.2% respectively. Groundwater quality is therefore central to securing the long term future of public supplies. The water in these aquifers is of a high quality, however, the main issue that threatens the quality of water in the catchments is nitrate pollution.

## The approach

In UK the economic regulation system of the water industry is the most significant barrier to the development of cooperative agreements in terms of both the polluter payer principle and consumer's protection. So the cooperative agreement approach developed by Wessex Water is quite unique in the UK and has for a long time been considered as a pilot case study for the institutions. In its early stage the approach was part of an EU life project called WAgriCo, but now the operation is now exclusively led by the water company.

The catchment managment approach is primarly focused on advising the farmers to optimise their practices. The advice is based on a risk assesment approach and monitoring N levels at various points within the system (farm, crop, soil, water). The catchment officers work closely with the farmers facilitating the discussion regarding potential individual solutions to reduce the risk. The approach largely favours the development of relationships, trust and a common knowledge of understanding between the catchment officers and the farmers. Grants were phased being mainly used as an incentive at the start of the initiative. The use of compensation can be discussed as part of the solutions but it is limited to individual confidential arrangements between the water company and the farmers.

## Brief description of results and impacts of the proposed EPI

- ✓ The farmers' participation in the different catchments can be considered as a success; between 80% and 100% of the catchments at medium and high risk are now engaged with Wessex Water.
- ✓ The current Soil Mineral Nitrogen values sampled in the field following the establishment of EPI indicates similar values as that observed in the average national scale Nitrogen Vulnerable Zones, indicating good farming practices and appropriate fertilizer uses.
- ✓ So far there has not been a change in the groundwater concentrations. This can be attributted to the the slow response of the hydrosystem.
- ✓ The annual cost of the catchment management approach is very low at approx. 8% of the treatment cost options. The costs mainly include the catchment officer costs and the sampling costs. However, these costs per farm are 20 times higher than the one observed for a standard catchment management approach.
- ✓ The main impact of the EPI is on social capital: trust, social connections and relationships between the farmers and the water company. A common knowledge of water catchment management and diffuse pollution is enhanced.
- ✓ Impacts on the economic side are difficult to measure, but the employment of catchment officers is a strong positive contribution of the EPI.

- ✓ The cooperation approach is flexible allowing a focused, tailored and adaptive approach to specific geographic areas which might be more difficult to achieve by a national approach. Such an approach may also easily harmonize with on-going environmental policies.

## Conclusions and lessons learnt

The EPI appears to be well-designed answering the needs and the goals of Wessex Water and the farmers involved in the cooperation. The following points try to highlight the key aspects that have enabled the Wessex Water approach to be successful in terms of cooperation:

- ✓ No red tape, no polluter approach. Wessex water went to the farmers explaining the problem and that the farmers could help to solve it.
- ✓ Investment in social capital rather than financial capital.
- ✓ The catchment officers are committed to a limited number of farmers.
- ✓ Risk assessment approach involving yearly field sampling is an important diagnostic tool and negotiation tool.
- ✓ Flexibility in the engagement – no official agreement. If necessary, only simple measures are promoted.
- ✓ Grant involvement but only in the first phase as an incentive instrument.

The transferability of this approach in its current form to catchments with high nitrates concentrations is questionable if changes in crop patterns or a reduction of profits are required. The current case study was limited to a win-win approach. It is therefore difficult to establish if the cooperation is strong enough to support such changes inducing losses for one or both parties.

.

# Table of Contents

# Proposed headings for the case studies

## 1 EPI Background

This case study is a classic example of a water company facing increasing nitrate contamination of its groundwater resources. The pollution is mainly the result of farming activities in the catchment. A command control policy is in place (e.g. Nitrate Vulnerable Zone for UK) but this has not reduced the problem. Potential "cheap" solutions such as blending the water from different sources are increasingly difficult to realize due to the extent and increase in contamination. The water company has thus two options: the treatment option or a catchment management approach.
In this case to avoid the high O&M and construction costs of the treatment option the water company has approached the farmers in order to cooperate to improve the water quality by promoting better practices. This cooperation involves information and education support but also incentive payments. In the second case this is generally defined as a cooperative agreement (Heinz *et al*, 2002) following four criteria:

- It is established on a voluntary basis between farmers and at least one water supplier and relying on the self-interest of the parties involved
- It is based on self-regulation among the key actors
- It includes an important role of the water supplier, either in the negotiation process and/or in the provision of financial resources
- It is targeted to a specific area (e.g. water catchment area; groundwater protection zone)

In 2005 Wessex Water Utilities decided to apply such an approach[1] within three geographically bordering pilot catchments (Frome, Piddle and Wey river catchments) in England. To improve the situation on eight water supply sources classified as 'endangered water bodies', Wessex Water decided to pursue its efforts of co-operation with the farmers. This initiative was supported by a Life Project (2005-2010) called WAgriCo (LIFE05 ENV/D/000182). The current assessment framework will focus mainly on the documents available from this period. However, further interviews with the persons involved in this project will complete any gaps in information for the assessment framework and will also to investigate what has happened following completion of the project.

[1] The farmers have entered the agreement in 2007.

**Four N baselines for a better assessment of the EPI**

*Brouwer et al.* (2003) define three aims associated with CAs regarding the pollution situation: remedial statutory (drinking water standard is exceeded), preventative statutory (drinking water standard is at risk of being exceeded in the future) or discretionary (no risk but a desire to obtain the purest water). These three situations and the potential future threat to the resources are very important to consider as they may impact on the negotiation process. In the case of nitrates two types of pollution values have to be considered: the yearly average concentration in the groundwater and the seasonal peak. Both have to be considered as a baseline.

The yearly average concentration in the groundwater (figure 1) reveals the long-term contamination trends in the groundwater. Infiltration and horizontal flow within the groundwater are slow processes and therefore any change in the surface activities (pollution input) may take decades to be seen at the outlets (source, boreholes). In figure 1 the estimated average nitrate groundwater trend has been rising since the 1975 and is expecting in most cases to exceed the drinking water limit of 11.3mgN/l by 2015.

The second baseline is the reduction of seasonal peaks due to the leaching of residual nutrients in the soil during the winter (runoff and subflow run off, rapid transfert). Such peaks may require a treatment or a temporary cessation of the use of the resource.

An intermediate method to measure the effectiveness of the change at the surface is to measure the quantity of nitrates at the field level, i..e N concentration in the soil and in the subsoil area . Such sampling constitutes a third baseline. However, this sampling method is expensive and may be limited to a few fields. Thus an alternative is to assess the N balance at the farm level.

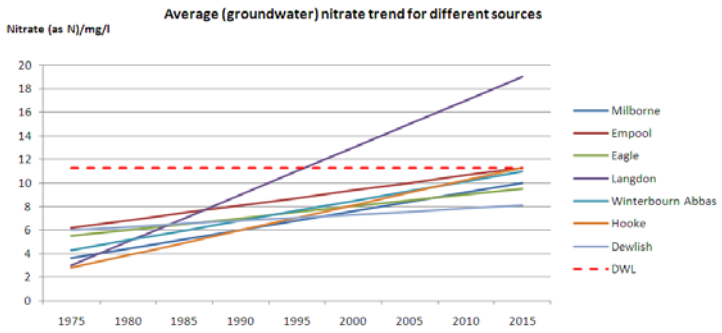



*Figure 1: Long-term trends of nitrates in the groundwater (from WAgriCO 2008,d)*[2]

**The cooperative agreement : aims and approaches**

Clearly the primary policy objectives are environmental and health related, i.e. the respect of WFD standards and the provision of good water quality. In this case the objectives are an inversion of the N trend or at least a stabilisation of the N level in

[2] The other baselines are available in Annex 1

the long-term and the reduction of seasonal pollution peak to an acceptable level in order to protect the public water supply sources (WAgriCO, 2008 a) . However, due to the complexity of the system response, recognisingthe long-term response of groundwater to changes on the land surface, the objectives have to be redefined in agronomic terms, i.e. the objective becomes the reduction of N quantity in the soil by the adoption of better practices by a maximum of designated farmers. The term "Designated" means that farms presenting high risks of N loss are usually targeted for more efficiency.

The approach has two phases: the preparation of the agreement and the agreement itself. The preparation phase aims to identify farmers in the areas presenting the highest risks (hydrology and farms activities) and to identify the potential solutions for the farmers to reduce the loss of N, the practicality of solutions and their costs. On this basis the farmers may agree to adopt certain practices in exchange for a grant[3]. One of the recommendations for the implementation of primary measures in the WAgricO report is that *simple and flexible measures are essential for acceptance (under voluntary measures).* A potential issue (Busca *et al.*, 2008) with such an approach is that the targeting a large number of farmers may lead to a negotiation on the type of measures proposed and therefore a temporary reduction of the environmental objectives. In their report the authors clearly state that the nitrate loss can be reduced by 5 to 15% with such measures and that, beyond this, drastic management may be required. The selected measures are reviewed each year based on the field N samples. The catchment officers play a central role in the management of the cooperative process. After the WAgrico project the approach has been maintained by Wessex Water. However the use of a legal agreement and of the grants have stopped. The cooperation is limited to verbal agreements mainly for exchanging free advice with farmers granting access to their land for N sampling. In some discreet cases financial exchanges are realised.

[3] See Annex 3.2

## 2 Characterisation of the case study area (or relevant river basin district)

**Environmental characterisation**

The case study area is located in Dorset, part of the South West region of the UK. The total case study area covers approximately 500km² within the county of Dorset. Dorset is typical of the South West in that it is a predominantly rural region, where agriculture occupies the majority of the land (79%). This includes 39% arable, 34% grassland and 6% rough grazing (WagriCo 2008e). The remainder of the area comprises forested land (11%), urban (9%) and water and wetland (1%) (Figure 2).

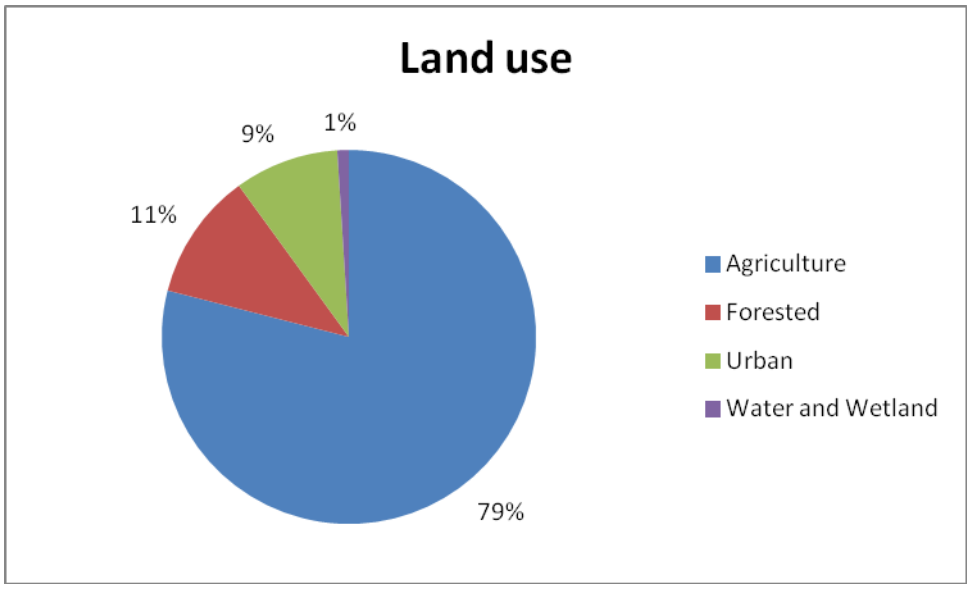



*Figure 2 Land use in case study area*

**The Hydrology**

The case study considers 2 catchments: The Frome (198km²)(Environment Agency online a), The Piddle (107km²) (Environment Agency online b). The geology under these catchments includes Cretaceous Chalk which provides excellent conditions for aquifers of high quality water suitable for domestic supply.

**Pressures and impacts**

Wessex Water supplies drinking water of approximately 370Ml/d to a population of 1.2 million. The predominant sources of this water are the aquifers underlying the two catchments described above. Abstraction from aquifers accounts for 80% of Wessex Waters' domestic supply with reservoirs and rivers providing 22% and 0.2% respectively (OFWAT online). Groundwater quality is therefore central to securing the long term future of public supplies. The water in these aquifers is of high quality, however, the main issue that threatens the quality of water in the catchments is

nitrate pollution. Nitrate pollution originates from more intensive farming practices which have developed over the past decades. Given the extent of agricultural land in the catchment area combined with the shallow layer of land between the surface and the aquifer, nitrates are able to penetrate into the water supply (WagriCo 2008e). Where aquifers are particularly close to the surface, transmission of nitrates can be rapid.

**Economic characterisation**

Land in the South West region comprises approximately 650 farm holdings (WagriCo, 2008e) and one in four farms is located in the region. However, land utilised in farming is decreasing over time. In the last 10 years there has been a decline from 9,263,000ha to 8,874,000ha. As Table 1 below demonstrates, in the Bournemouth, Poole and Dorset area, the number of holdings has declined by 13% in the last year (Defra, 2010c). Considering the catchment area specifically, from 1990 to 2002, there was a 32% decrease in employment and 28% decrease in income in the agriculture sector. The dairy industry declined by 34% and the beef industry by 21% (WagriCo, 2008e). However, counteracting this decline in livestock farming, the case study area has seen an increase in fruit and vegetable farming of 44% from 2009 to 2010 (Defra, 2010 d). In addition, the farming sector has seen further influences from consumer markets for organic produce. In England, from 1996 to 2009 the total area of land used for organic farming rose from 82,000ha to 740,000ha. This marks a shift in the application of pesticides and inorganic material onto farms (UK Agriculture [online]).

| Number of holdings | | |
|---|---|---|
| **2009** | **2010** | **% difference** |
| 2577 | 2241 | -13.0 |

*Table 1 Number of farm holdings 2009 and 2010*

**Map of case study area**

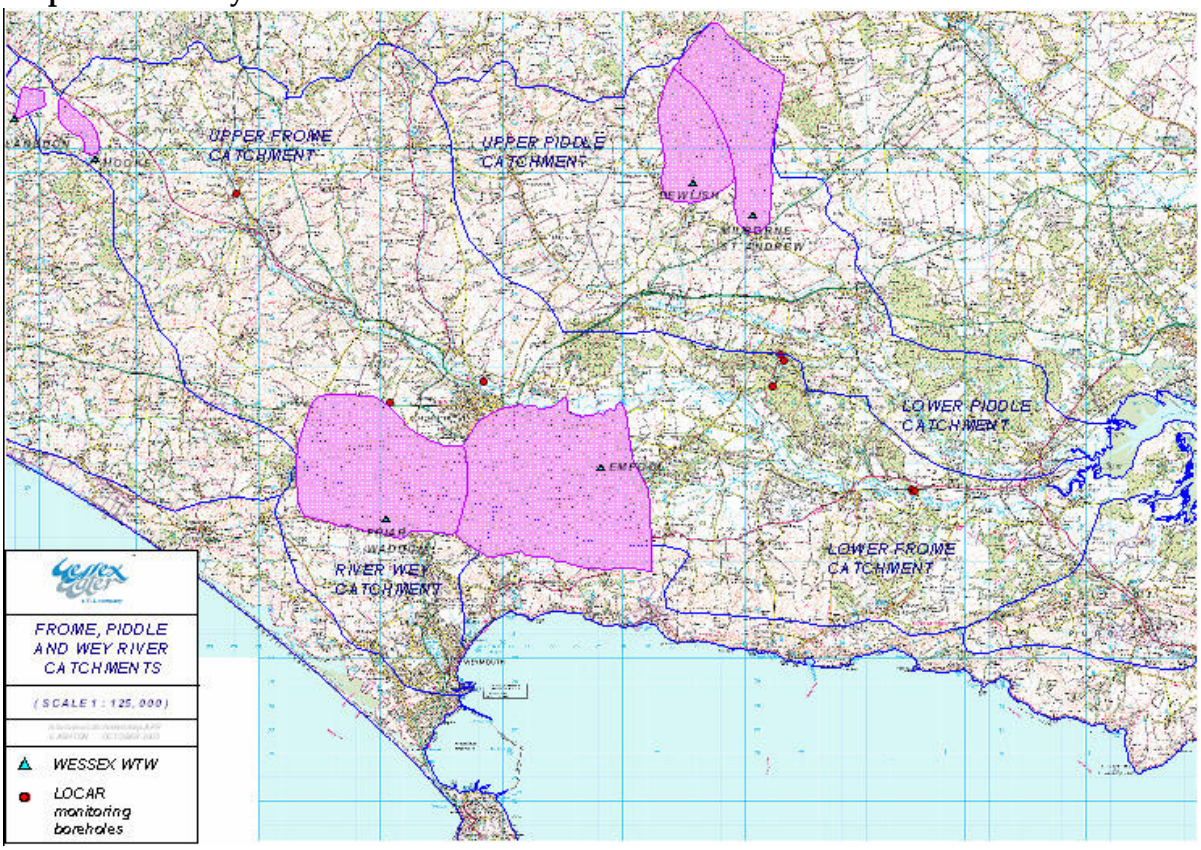



*Figure 2: Map of case study area*

# 3 Assessment Criteria

## 3.1 Environmental outcomes

**What were the farmers' effective responses to the EPI in terms of change of practices**

*Table 2: Farmers' participation (H for HighRisk, M for medium risk. L for low risk) (WAgriCo, 2008a)*

| | |
|---|---|
| Total farmers | 74 |
| Preliminary assessment | 45 farms (10H,17M,18L) |
| Farm –gate nutrient | 28 farms (9H,9M,4L) |
| Agreements | 52 |
| Fertiliser recommendation | 38 |
| Manure management plan | 24 |
| Cover crops | 16 (410 ha) |
| Fertiliser spread calibration | 19 |
| Poultry and manure autumn to spring | 5 |
| N efficiency | 32 |

During the WagriCO period, 45 farms of 74 farms (Table 2) have agreed to participate in a preliminary assessment and 28 farms agreed to a farm-gate nutrient assessment. Following these assessments a set of measures were proposed to the farmers, i.e. fertiliser recommendation, manure management plans and farms waste audits, use of cover crops, fertilizer best recommendation, moving application of slurries and poultry manure and the calculation of N efficiency. 52 farms agreed to participate and received a grant (please refer to section 3.2 for details) in exchange for adopting some of these practices. The number of farmers adopting the different practices is indicated in the table 2 [4].

Preferred measures were fertliser recommendations and manure management plans. However, it was highlighted that the farmers were already using these existing recommendations as some regulations were already in place. As such the EPI aims to optimise these practices. Fertilizer calibration and N efficiency calculation were also appreciated by the farmers.

Cover crops had a good uptake considering that this approach is not applicable on every field. However many of the farmers have indicated that they would not grow

[4] In Annex 3.2 the reduction effectiveness and the associated cost of the different measures are also indicated.

cover crops unless they were paid to do so as these practices present some inconveniences (such as weed growth and then spray off action).
Following the WAgriCO project, the participation of farmers has been maintained without the grants. The surface area covered by the farmers engaged with Wessex Water represents 80% to 100% of the medium and high risk catchments[5]. The rate of uptake of the different measures may have changed but no information was available on this.

**How did these changes in individual behaviour translate into lower pressures on water?**

The reduction of the pressures on the water can be measured in two different ways at the soil interface: by sampling the quantity of N in the soil after the harvest (Soil Mineral N) and by sampling the concentration of N in the leaching water (Porous Pots)[6]. Following the change of practices a reduction of 55 % of the SMN values is observed in average between 2006 and 2007 for the different crops (Annex 3.2). The quantities of SMN after the EPI are more or less similar as the one observed on Nitrate Vulnerable Zones at national scale (Annex 3.2). Since 2007 the reduction of N in the soil has been maintained apart from 2009 (Figure 4). The 2009 crop year for the region is described, in general terms, as a difficult year with high rainfall observed for the third successive year (DEFRA, 2010). This may explain low yields and higher SMN values. However the spatial identification of such risk in the autumn by the catchment officer is crucial as it can be follow if possible by the implementation of cover crops to mitigate the risk[7].

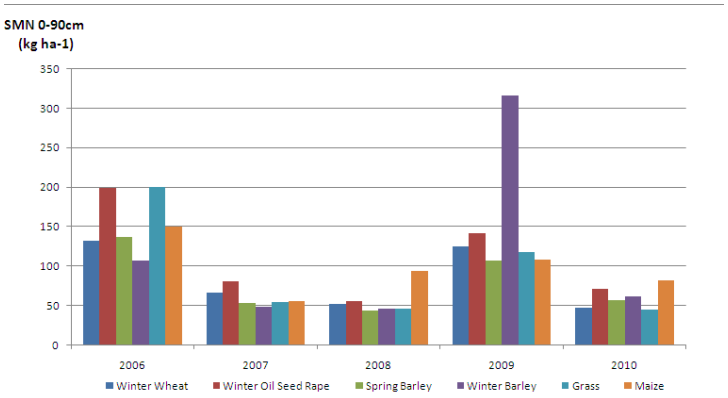



*Figure 3: Winter SMN values for different crops (From Wessexwater, 2011)*

**What were the impacts of changes in pressure on the quality of the groundwater?**

[5] Source: Wessex Water internal data

[6] Sampling the concentration of N in the leached water is a better indicator of the pressures on water. Unfortunately this data was not accessible at the time of this research.

[7] For the risk assesment please refer to the maps in Annex 3.2.

The hydro and geologic survey and modelling on the catchment have highlighted that there were no general trends indicating future increase of nitrates concentration. Phenomena of plateau are mainly observed (WagriCo, 2008b; DeVial, 2008). Plus the authors, *indicate that background concentrations may be due to historical land use and farms practices. Therefore, the mitigation measures may potentially help to reduce peak concentrations but will not affect the high background levels for a considered number of years.* The current samplings (Figure 5) tend to confirm this assumption: no particular change have been observed in the current groundwater concentration since the EPI implementation. However the current management reduces the amplitute of the short-term pressure (peak of nitrates) . The EPI induces therefore, as it has been designed for, an improvement of the provision of good water quality. It may induce other water-related ecosystems benefits due to an improvement of rivers and estuary quality. But such aspects have not yet been investigated.

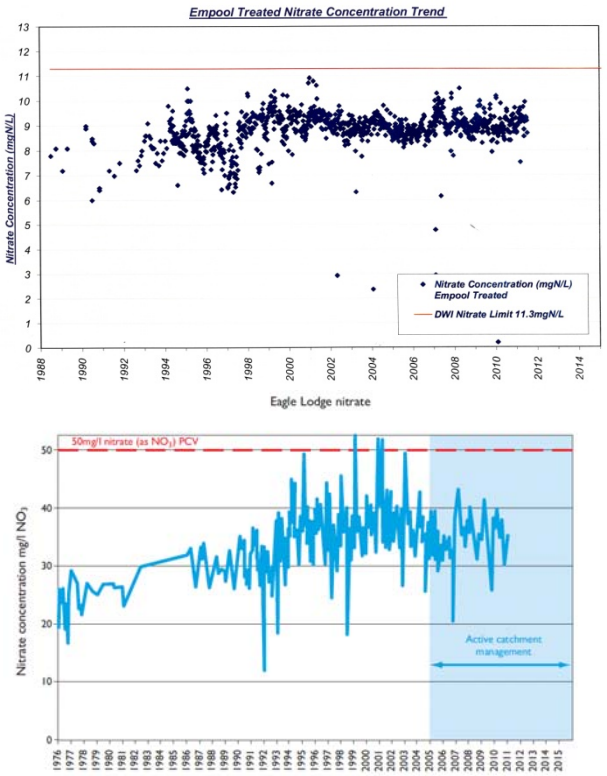



*Figure 4: Nitrates concentration observed on the Empool borehole and on the Eagle Lodge source (Wessexwater, 2011 a and b)*

## 3.2 Economic Assessment Criteria

**Alternative approach comparison**

The catchment management approach (advice only) was compared with a treatment approach alternative and with a catchment management approach involving grassland reversion (see annex 3.2) for different catchments. The annual treatment costs per catchment depend on the water quantity to be treated and ranges between 0.2 and 1.5 £millions (DeVial L., 2008). Catchment management approach (advice only) annual costs range from 0.02 to 0.15 £millions and the catchment management approach involving grassland reversion ranges from 0.04 to 1 £millions. In average Catchment management approach (advice only) annual costs represent 8% of the annual treatment costs and 18% of the grassland reversion options.

**Cost-effectiveness?**

In terms of effectiveness, the treatment options guarantee a good drinking water quality as soon as operational. Due to the lack of response of the hydro system and the uncertainties associated with climates, agricultural practices and future land use changes, catchment management measures tends to reduce the risk but do not ensure a constant water quality in the short-term and in the long-term. Yet Wessex Water owns number of water sources and has the possibility of not using temporally a contaminated borehole or of mixing the water from different sources. By maintaining the risk at its minimum level by the management approach and by combining it with simple technical solutions Wessex water can therefore deliver a good water quality and obtain similar effectiveness than treatment options.

The risk for the farmers in economic terms is very low. Indeed the change in practices is very limited (e.g. cover crop) and most of the approach tends at improving their fertilizer use without reducing their yield.

**Consumer cost savings?**

The EPI aims at keeping the water quality in the groundwater level below the norm value. If it is considered that the EU State members are in charge of addressing the problem, the costs of the catchment management approach supported by the water users can be considered as an extra-cost. From the perspective that the costs will be higher if a treatment was applied, the costs savings for the water users can be evaluated at a level of 90%.

**Reducing risk when compared with the best command-and-control alternative?**

The approach in this case can be classified as preventative statutory, i.e. the drinking water standard is at risk of being exceeded in the future. The aim of the EPI is to

reduce the risk. By working with the farmers in a closer relationship than in the case of command and control approach and by monitoring deeply the field, the catchment officers can better identify the risks and therefore define potential solutions for mitigating the risk during the winter.

**Right incentives**

If we consider as a right incentive the fact that trust and dialogue are built between farmers and the water company to improve the water resource quality, then the current EPI is satisfying this principle. However it can be noticed that the use of discretely-make payment on a case to case basis can be counterproductive if creating a feeling of unfairness amongst farmers.

**Asymmetric information**

There is no evidence of asymmetric information. In fact it is the opposite as the approach aimed at gathering and sharing information with the farmers for a better management of the resources.

## 3.3 Distributional Effects and Social Equity

To assess the Distributional and Social equity impacts of the EPI, interviews were conducted with key stakeholders to represent both the Wessex Water and Farmers perspective. The four people interviewed were involved in the EPI as Wessex Water employees; however, they worked in different roles. One interviewee was a senior manager and provided a clear overall perspective from Wessex Water. The three other interviewees were able to add to this Wessex Water perspective but as catchment advisers and managers, were able to provide more of an insight into the impacts of the EPI on farmers. Ideally, with further time and resources, farmers directly involved would have been consulted to provide a robust assessment from their perspective. In lieu of this, the objective of this assessment has been to test the methodology for this section.

**Farmers**

**Material Living Standards/Profitability**

From the perspective of Wessex Water, the overwhelming impression is that farmers will not change their practices if they will be less profitable or worse off financially. As such it was felt that the EPI could be judged to have no overall negative impact as it would not have been a success if this were the case.

In many ways the measures were deemed advantageous to the farmers. For example, the involvement of catchment advisers provided free information and expertise that would allow them to tailor their fertiliser application so as to ensure less wastage, thus potentially saving the farmers money.

The catchment managers and advisers are keen to ensure that they do not impact the farmers businesses negatively. They understand, for example, that if they are encouraging farmers to apply less fertiliser, they need to ensure that the yields are not reduced as a result. This may require other action to compensate and ensure that yields are maintained.

**Education**

Educating farmers on the benefits of reducing their nitrate application has been central to changing attitudes and practices to reduce nitrate pollution in drinking water supplies. The interviewees commented that through their contact with farmers they had been able to improve farmers' understanding of how their practices influence local drinking water quality. Once this had been established, the Wessex Water interviewees found that farmers were generally keen to cooperate and help.

The message is reinforced by the process of monitoring and tailoring advice to farmers to optimise nitrate application. The catchment advisers regularly sample and feedback data on soil condition to help farmers reduce their nitrate application. Over

time this enables farmers to see how their practices influence the soil and thus ground water. The farmers have come to value this information and now many actively seek the data and consult with the advisers before taking a decision.

The approach facilitates a subtle form of knowledge transfer and education. It was felt that the farmers may not be aware of how much they have learned, but catchment advisers had noticed a distinct improvement in knowledge and understanding over the course of the EPI.

**Personal Activities (time budgets)**
It was accepted that through the cooperative approach the farmers were required to input time that may have been spent on other things. However, the catchment advisers were keen to avoid impacting negatively on the farmer's time budgets. As such the advisers compensated for any time lost to farmers in this cooperation process by carrying out work in kind (such as soil sampling).

**Security**
There is a risk to farmers in allowing catchment advisers access to their land and data. There is a risk that the advisers may spot issues that could be reported to authorities for sanctions. As such Wessex Water has worked hard to build the farmers trust by helping farmers resolve a problem rather than simply bringing it to the attention of sanctioning agencies to deal with.

It was felt that over time this trust is able to build up and the farmers begin to feel secure. Where Wessex Water has been working with farms for two or three years it was felt that security was very high.

**Social connections and relationships**
Strong connections between Wessex Water and the farmers are an essential and a major element of the project. The project proved successful at providing opportunities to develop strong working relationships between Wessex Water and the farmers which have proved mutually beneficial. In addition, the farmers themselves often have social connections between each other. This can be problematic where a varied and tailored approach is taken between farms. If one farm receives one set of benefits, other farmers may find out and expect the same. As such it is important for Wessex Water to ensure that they take a discreet or consistent approach.

**<u>Wessex Water</u>**
**Education**
From the Wessex Water perspective, the project was very useful for education. It was felt that through the work and data collection a better understanding of how nitrates move through the soil has been established. In addition, the catchment advisers in particular have learnt the value of taking a softer, cooperative approach rather than

being more forceful. This is something that they have transferred to other areas of their work to achieve success.

**Employment**
Employment was deemed to have been positively influenced by the project as it had resulted in the employment of six additional persons to work as catchment advisers and managers. However, as a treatment plant was not required there was not this additional work for the engineers which could be viewed as negative in terms of employment for the engineers. One engineer, however, felt that there was still sufficient work for engineers to be involved in through the catchment management approach in terms of work on new and existing boreholes.

**Environment**
The catchment management work in reducing nitrates is seen by Wessex Water to have improved the quality of the wider environment. As a result of encouraging and helping farmers to reduce their nitrate and pesticide application it was considered that this would reduce the presence of such toxins in the wider aquatic environment. Although the link is less direct as the focus has been on ground water, it was felt that this was a definite environmental benefit.

**Security**
For Wessex Water there are risks in taking a catchment management approach relying on cooperative agreements as these agreements are largely informal and dependent on voluntary support. There is a risk that farmers may not comply or may choose to stop cooperating. If this were to happen Wessex Water would need to find another solution and possibly still construct a treatment plant.

**Political Voice**
The Wessex Water approach has become a well known example of an alternative to dealing with nitrate pollution. This has enabled Wessex Water to gain interest from other groups including policy makers. Wessex Water are now consulting with Defra on their White Paper on water and are gradually influencing OFWAT's approach too.

**Social connections and relationships**
The cooperative agreements and catchment management approach is dependent on Wessex Water developing and maintaining strong connections and relationships with farmers. They have, over the course of the WAgriCo project and the years of contact before and since, developed very close working relationships with the farmers which strengthen the success of their approach. The catchment advisers visit the farms on a weekly basis maintaining regular contact. Wessex Water feel this is vital to remaining in close cooperation with farmers and reminding them of the importance of the work.

The catchment advisers emphasise the importance of time in building relationships with the farmers. They report negative experiences when first approaching farmers as the farmers resent the intrusion into their activities, but the interviewees comment that this can improve over time with effort to develop a connection. Furthermore, they highlight that such voluntary agreements improve the farmer's impressions of Wessex Water and result in more positive feelings compared to the regulatory approach.

## 3.4 Institutions

**Institutions affecting the creation of the EPI**

The existing pattern of rules means that only the water supply companies (which in this area are combined with wastewater services) have any power to directly seek to encourage farmers to reduce nutrient flows to groundwater, although the various agri-environment programmes may have an indirect effect. However, the incentive for the water company to intervene is determined by the formula used in the quinnenial price review[8]. This formula has two components:

1. Well run companies are entitled to earn a fair return upon their regulatory asset capital; over time, the price regulator has sought to drive the return down to a fair return but the current allowed return is arguably generous. Thus, the price rules encourage them to adopt capital intensive strategies.
2. The formula is based upon rpi – x + k where rpi is the rate of inflation, x is the anticipated improvement in operating efficiency, and k is the allowance for the capital investment required for the agreed programme of improvements over the next five years.

**How did these institutions affect the design, implementation and/or operations of the EPI?**

The first element of the formula encourages the companies to make capital investment s whilst the x factor in the overall formula encourages them to drive down operating costs (and shift from operating costs to capital costs). Hence, there are strong disincentives to the water companies in adopting the catchment management approach as the costs involved are all operating costs and add nothing to their regulatory asset capital. This may be one reason why the catchment approach has not been more widely adopted by water companies and why payments to farmers have now been discontinued.

The farming community is however relatively heterogeneous, differing in farming patterns (e.g. arable, livestock, mixed) but all depending heavily upon the single farm payments for income. Farm incomes are both relatively low and volatile. At the same time, fertiliser usage in the UK is relatively low compared to other countries; therefore, there is very limited scope for improvements in application efficiency and changing cropping patterns will result in losses in income. As a consequence, any effective EPI would have to compensate farmers for a reduction in incomes associated with changing cropping patterns.

[8] OFWAT regulates the English privatised water industry. As part of its duties, OFWAT is responsible for approving water pricing tariffs and reviews these on a five yearly basis.

**Did the EPI have an impact on existing institutions or establish new ones?**

There has been no direct effect; the incoming government has promised a White Paper on water management and all parties are lobbying hard for the White Paper to set out a framework for promoting a transition to sustainable water management. A change to the price formula is strongly considered as a precondition to promote a shift to sustainable urban water management. Such change may require primary legislation.

**If the EPI failed, then can that failure be traced to an existing institution?**

The failure of the approach either to be replicated by other water companies or compensation payments to continue to be made by Wessex Water can reasonably be associated with the much wider failure to develop the integrated institutional framework to deliver sustainable water management in England. It is one failure amongst many, there being neither an integrated approach nor a framework of powers and associated rules to deliver such an integrated approach (Green & Anton, in press, Green, 2010).

## 3.5 Policy Implementability

The EPI, cooperative agreements, is used by Wessex Water as a highly flexible instrument which is tailored to individual farms and farmers via interactions with the catchment advisers from Wessex Water. Through ongoing contact with the farmers, the advisers monitor the measures through sampling and data collection, the results of which are fed back to the farmers along with tailored advice.

In some cases it is necessary to take a slightly different approach of actually paying farmers in particularly high risk locations where there is a significant danger of exceeding pollution limits. In these case farmers may be paid directly to not apply fertilisers or pesticides. This method is controversial, even within Wessex Water and as such much thought is given as to whether this approach is appropriate for a particular farm. There is concern that other farmers may expect payment if they become aware that some recieve payment.

With regards to targets and deadlines, these were particularly flexible for the farmers. Wessex Water has targets to ensure that their water supplies don't exceed the limits for nitrates. The farmers are made aware of the nitrate limits, however, there is very little emphasis on specific targets for the farmers and no deadlines are provided as this is seen as an ongoing, long term process of engagement. Deadlines and targets have not been necessary to see success in the approach. The farmers have modified their nitrate application based on the data and advice provided to them instead.

**Public participation and stakeholder engagement**

The participation of farmers was central to the effectiveness of the EPI. As such farmers have been fully engaged and highly influential as they are effectively responsible for the actual implementation of changes. In terms of public participants specifically, these played a much less significant role in the design and implementation of the EPI and as such they are not viewed as an important stakeholder in the process. The public has not been involved in a participatory process or even consultation but they have been made aware of the work that Wessex Water has been involved in with farmers through limited advertising.

The most successful strategies for engaging the farmers have been "softly softy" approaches whereby catchment advisors persevere in establishing contact with farmers to develop working relationships with them. The catchment advisers asked farmers to assist with their (Wessex Water's) nitrate problem, rather than blaming farmers and critising them. The approach was deemed highly successful at encouraging the initial participation of farmers.

The cooperative agreements were accepted by the farmers and catchment advisers as a novel but sustainable means to achieve the goal. They were very popular as

alternatives to regulation and some farmers have become keen advocates of the approach, willing its success in order to prove that 'red tape' and further regulation is not necessary. From a national perspective, this approach is quite novel and as such there are few mechanisms in place at the national level, such as in the regulatory body (OFWAT) or in the Ministry (Defra) that recognise the value of it. This situation is gradually changing as the regulatory body and ministry adapt their policies.

In terms of compliance, the cooperative agreements are fully voluntary. The fact that those farmers participating in the EPI remain involved even after several years demonstrates the success of the EPI approach from the farmers perspective. The EPI's safeguarding mechanisms can be considered as the work in kind that the catchment advisers carry out (i.e. soil sampling) which offset the negative impacts such as having to spend more time in discussion with the catchment advisers.

Fully embedded into the EPI are mechanisms for monitoring the effectiveness of the approach. These mechanisms are monitoring nitrates through regular soil sampling and monitoring boreholes and nitrates in water storage sites.

**Cooperation and coordination between ministries**

By its very definition, cooperative agreements require cooperation and coordination between the protagonists (Wessex Water and the Farmers). The EPI has been particularly successful in fostering this cooperation and strong working relationships between Wessex Water and the local farmers have developed.

In addition to this obvious level of cooperation, the EPI has also resulted in cooperation between the protagonists and other groups. In particular, the Environment Agency (EA) and Wessex Water have developed an understanding of cooperation with regards to their work in the area. The EA is tasked with conducting inspections on farm but as they have to cover such large catchment areas, they are unable to maintain the level of regular contact that Wessex Water catchment advisors can achieve. As such the EA does not interfere in Wessex Waters' work recognising how they reduce some of the burden of the EA's work.

**Policy synergies**

In terms of barriers to the achievement of the objectives of the EPI in this case study there is no clear evidence of policies that provide such obstacles. For policies that Wessex Water could take advantage of, there are regulatory policies such as Nitrate Vulnerable Zones which restrict farmer's fertiliser use. However, the catchment advisers are reluctant to use this policy as they believe they will have greater success in achieving continued compliance by working with farmers in a voluntary approach.

- England Catchment Sensitive Farming Delivery Initiative (ECSFDI)

The Wessex Water approach supports 'Catchment Sensitive Farming' under the ECSFDI. The ECSFDI encourages voluntary action to achieve the goals of the Water Framework Directive by managing land and optimising fertiliser use to reduce pollution. The mechanisms for achieving this are monitoring, evaluation and advice to farmers. These mechanisms are the same as those used by Wessex Water, however, Wessex Water's catchment advisors are at an advantage over the ECSFDI advisers as they cover smaller areas and therefore have greater contact with farmers, fostering cooperative relationships. The Wessex Water approach, therefore, has a strong synergy with ECSFDI.

- Nitrate Vulnerable Zones/ Nitrate Pollution Prevention Regulations 2008

Nitrate Vulnerable Zones (NVZs) are designated where important water sources are identified as being polluted. The NVZ designation restricts the types, quantities and timing of fertilisers application. The Wessex Water cooperative agreements support this policy and are enhanced by a desire amongst the farmers to have their NVZ status lifted.

| EPI: Objective | "To reduce diffuse inputs (primarily nitrates) caused by the agricultural sector"[9] | |
|---|---|---|
| | EPI delivery mechanism | |
| | Delivery mechanism 1<br>Participation with farmers | Delivery mechanism 2<br>Assessment of environmental and economic outputs (monitoring) |
| England Catchment Sensitive Farming delivery Initiative ECSFDI (encourages participation with farmers, promoting voluntary action and land management to optimise nitrate application | ++<br>The Wessex Water approach strongly supports the objectives and delivery mechanisms of the ECSFDI as participation with famers and voluntary cooperative agreements are central to the Wessex Water approach. In addition the two policies share the same objective and centre on providing advice to farmers. | ++<br>The ECSFDI encourages assessment and monitoring of the effectiveness of the strategy. This is the same as Wessex Water's approach, only the Wessex Water approach enables more frequent monitoring as the advisers work on a smaller area. |
| Nitrate Vulnerable Zones (NVZs) (Restrictions on fertiliser use are placed on designated areas to reduce nitrate levels) | The NPVs are regulations, there is little provision within them to encourage participation with farmers. The Wessex Water approach achieves the same objectives but using a different delivery mechanism. | Once zones are designated there was a limited time for appeal. After this NVZs could be lifted if the water is no longer identified as polluted. The regular monitoring by the Wessex Water catchment |

[9] WAgriCo Technical Final Report

| | | |
|---|---|---|
| | | advisors could allow the NVZ to be lifted if the approach is successful at reducing nitrate levels. |
| WFD<br>(aims to improve the quality of water bodies, including a reduction in pollutants such as nitrates) | ++<br>The WFD encourages a participatory approach to achieving the objectives. Wessex Water's cooperative agreements achieve this goal. | ++<br>The WFD assesses water bodies for nitrate pollution. Regular monitoring by Wessex Water can assist in this. |

## 3.6 Transaction Costs

**The actors and their roles**

The WagriCO project was a Life EU project and in this sense was a research project involving two countries and number of partners (five German partners and five UK partners). The cooperative approach actually began before this project and continues to run now that the Wagrico project has finished. Therefore we have to be cautious in considering the costs of the WagriCO project in the transaction costs assessment. The project has probably facilitated and has speeded up some aspects of the cooperation process but this may not be applicable on other case study and therefore will not be considered it. Actors involved in the approach in its simple form are the water company and the farmers. The catchment advisors of Wessex Water represent the key actors. They have a clear role: to monitor, control, advise and report to the farmers and the water company.

**The EPI approach and its transaction costs**

Wessex Water initiated its approach in 2005. The approach of catchment management was chosen on the principles that building treatment plants was not profitable for the environment or their customers and that the catchment approach would be cheaper and more sustainable (WessexWater, 2011 b). The first agreement with the farmers began in 2007. The EPI is focused on catchment officers working with the farmers to better tailor their practices. The procedure for approaching the farmers involves:

- Meeting and gain cooperation with farmers
- Borehole and stream sampling points
- Initial(qualitative)risk assessment
- Detailed audits on farm nutrient balance
- Working with farmers to identify potential methods for reducing nitrate losses (use of a farm pack)
- Gathering data to determine the practicality and costs of mitigation measures
- Monitoring in winter and spring to discuss the risks and adapt the practices

The annual costs of the catchment officer are detailed on Table 3.

*Table 3: Cost of the catchment advisor (WAgriCo, 2008 c)*

| Costs category | In Pounds 2008 |
|---|---|
| Catchment officer, office, travel and overhead costs | 36,300 |
| Training courses | 668 |
| Follow up group meetings | 113 |
| Newsletters | 144 |
| Telephone hot line | 0 |
| Website | 3,000 |
| Reports to funding sources | 0 |
| Total per year | 40,225 |

Monitoring on nitrogen value is an important part of the cooperation as it helps:

- To better assess the risk of nitrate leaching based on the residual nitrogen in the soil in autumn and therefore to plan future practices.
- To discuss with the farmer the options to reduce the risk in the short term and in the long term
- To measure and to model the change in nitrates concentration in the water bodies.

Monitoring is done at various levels: at the farm level, fields and water sampling. Sampling and recording the data is part of the catchment advisor's wage. However the costs of materials and analysis can be expensive due to the high number of samples required. No detailed cost figures were available but the number of samples can be used as an indicative value. For a 168 km² catchment with 61 farms the following yearly figures are provided (Wessexwater, 2011 b):

| Samplings | | Number |
|---|---|---|
| | Sampling points | 270 |
| Water quality | Samples | 7,000 |
| | Fields | 241 |
| Soil Mineral Nitrogen | Samples | 1,446 |
| | Fields | 241 |
| Leaf analysis in crop | Samples | 482 |
| | Sets of 5 pots | 57 |
| Porous pots | Samples | 684 |

During the WAgriCo project period cooperative agreements were explicitly used. Since then the agreements are no longer widely promoted. This means that the cooperation exists but without new incentives[10] or payment from the water company. It also means that no legal or associated administrative costs exist between the farmer and the water company.

**Was any guidance provided to decisions makers?**

Wessex water's experience was a first in UK. Again the opportunity offered by the WAgriCo project to involve experts in the design and also to share experiences with others (in this case, the German case study) has provided guidance for decision makers. Modelling instruments were used to assess future trends and to compare scenarios. Mapping tools were used to integrate the monitoring data, to assess the risks and to provide information to discuss with the farmers

[10] For information on the incentives value please refer to table annex 3.2

## 3.7 Uncertainty

The uncertainty pedigree rating was tested for the case study through questioning the stakeholders.

1. **Environmental Objectives**

| | Target (How much) | Deadline (When) | Reference |
|---|---|---|---|
| Cooperative Agreement | Maximum 50 mg/l | | Continual monitoring |
| Pedigree | 1 | 3 | 1 |

In this case study cooperative agreements with the farmers attempt to influence ground water nitrate levels. It was considered by Wessex Water (from interviews) that cooperative agreements were more suitable to locations where the long term maintenance of good practice was required. If nitrate levels were measured above the maximum permissible level (50 mg/l) then other interventions with more immediate results (treatment or balancing) were considered by Wessex Water to be more appropriate. In this case the EPI attempted to maintain low nitrate levels rather than reduce the levels below the specified target. That is to improve and maintain good practice. Continual monitoring communicated to the farmer was clearly set against the target however, deadlines were not set except the measurements themselves. The reference in this case could be the first borehole measurement even if it was not an enforcement concern or it could be taken as the maximum permitted level.

## 2. Performance Policy Instruments

### Environmental outcome

In terms of uncertainty three proxies have been identified:

| **Environment** | Farmers participation | Soil Mineral N | N concentration |
|---|---|---|---|
| Proxy | 3 | 2 | 1 |
| Comment | Practice not dependant on an agreement | Possible other sources of change | Possible other sources of change |
| Empirical | 3 | 3 | 4 |
| Method | na | na | na |
| Comment | Not just the number of farmers but also their change in practices | Reliable source of data | Known robust sampling |

In order of decreasing ability to define the EPI the proxies are; farmers participation (3) as a good measure of the EPI's application, followed by soil mineral nitrate (2) content and then weakly correlated (1) the nitrate concentration. Farmers participation was not considered to be an exact measure because other activities could influence their engagement. For all three proxies direct empirical measurement could be made. For farmer participation and soil mineral nitrate content relatively small sample measurements were involved (3) but for nitrate concentration larger robust sampling improves the certainty pedigree (4).

### Economic Assessment Criteria

The three proxy variables identified were treatment costs (4), catchment management cost advice (3) and catchment management grassland reversion (3).

| **Economic** | Treatment Cost | Catchment Management Cost Advice | Catchment Management Grassland Reversion |
|---|---|---|---|
| Proxy | 4 | 3 | 3 |
| Comment | Direct measure | Other costs involved (water balancing, temporary loss of source) | Other costs involved (water balancing, temporary loss of source) |
| Empirical | na | na | na |
| Method | 2 | 2 | 2 |
| Comment | Unknown how calculated but source reliable | Unknown how calculated but source reliable | Unknown how calculated but source reliable |

The treatment cost is a direct measure applying an acceptable Method (2). The same is true for the other two proxies identified where the complete calculations are unknown but the source is reliable.

**Distributional Effects and Social Equity**

The distributional effects are derived from the Wessex Water perspective:

| | Material Living Standards | Health | Education | Personal Activities | Employment | Environment | Security | Political Voice | Social connections and relationships |
|---|---|---|---|---|---|---|---|---|---|
| Proxy company | 1 | 0 | 3 | 0 | 4 | 0 | 1 | 1 | 4 |
| Comment | Part of profitability | Not applicalble | Clearly defined in interview | Not applicable for EPI | Need a role to administer | Not applicable for EPI | Other influences | Other influences | A key approach |
| Proxy view of farmers | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 4 |
| Comment | Part of profitability | ‚Insignificant' | Other influences | Not in the current form | Low impact | Not applicable for EPI | Related to improved relationship and data access | Not the EPI specifically | A key approach |

Looking across the distributional attributes the key attributes describing the EPI were Employment (4) and Social Connections and Relationships (4). These were followed by Education (3) then Material Living Standards (1), Security (1) and Political Voice (1). Health (0), Personal Activities (0) and Environment (0) were not clearly related to the EPI. While again from the Wessex Water perspective they considered Social Connections and Relationships to be a key variable for farmers (4) employment was viewed this time to not be clearly related (0). Education (2) and Political Voice (0) were less well related as thought for the company security was viewed to have stronger relationship with the EPI for the farmers (2). The remaining attributes were the same. The method of interviewing the stakeholders was empirical in approach their views were either reliable as expert opinion (2) about the company or acceptable (2) for most attributes regarding the farmers.

# 4 Conclusions

This case study is focusing on a specific economic policy instrument called cooperative agreements involving farmers and Drinking Water Company. It is the only example of such approach dealing with groundwater resources in UK. The main aim of the EPI is for the water company to provide a good water quality to its customers by maintaining an acceptable level of nitrates in their water sources by a catchment management approach rather than by using expensive treatment plants. The long-term objective is to maintain or reduce the N trends in the groundwater in different catchments. A short-term objective is to reduce the risk of N peaks in the spring. The catchment approach is currently limited to a recommendation approach for an optimal use of the fertilizers and for the adoptions of mitigation measures such as grass cover when necessary. No change in crops patterns or on type of crops such as conversion to grassland and extensification are promoted. The method differs for other UK approaches as the catchment officers are working closely with the farmers to better tailor with them their use of fertilizers in accordance with the national recommendations ((DEFRA,2010 b; DEFRA,2009).

## 4.1 Lessons learned

The cooperation started in 2007. It is therefore too early to judge of the effectiveness of the instrument in terms of change in the groundwater quality. For the water company perspective the resort of a treatment plant in the future will indicate the failure of the EPI.

EPI are first designed to change the behaviour of individuals. In the problematic of diffuse pollution of groundwater resources the uptake of measures is therefore a good indicator of the the effectiveness of the EPI. Farmers' participation in the different catchments can be considered as a success; between 80% and 100% of the catchments at medium and high risk are now engaged with Wessex Water. The level of cooperation has also been maintained after the suspension of the grants indicating a strong cooperation between both parties. The measures proposed in the cooperation are not too restrictive for the farmers and may also explain the high participation. The current Soil Mineral Nitrogen values sampled on the field following the establishment of EPI indicates similar values as the one observed in average at national scale for the Nitrogen Vulnerable Zones, stressing good farming practices and appropriate fertilizer uses. It is difficult to conclude empirically in which proportion the EPI contributes by itself to these good practices[11]. However, in the principle, the close winter monitoring (SMN values and nitrates leaching pots) on

[11] Record of SMN values not involved in the cooperation or not adopting the same practices in similar fields with similar meteorological conditions will be required to conclude on the contribution of the EPI.

various fields and their use as a risk assement tool seems very appropriate to discuss with the farmers the options to reduce the risks of nitrates leaching and to find common solutions. The use of compensation can be discussed as part of the solutions.

The annual cost of the catchment management approach is very low compare to the treatment costs options, circa 8%. The costs mainly include the catchment officer costs and the sampling costs. These costs per farm are 20 times higher than the one observed for standard catchment management approach[12] . The needs of secondary measures such as grassland conversion will increase the costs of the approach if compensations were paid by the water company.

The EPI has mainly a high impact on social capital: trust, social connection and relationship between the farmers and the water company are enhanced as well as their common knowledge on water catchment management and diffuse pollution. Impacts on the economic side are difficult to measure, but the employment of catchment officers is a strong positive contribution of the EPI.

The system of economic regulation of the water industry is still the most significant barrier to the development of such approach (Brouwer et al., 2002). The approach works in harmony with environmental policy such as the England Catchment Sensitive Farming Delivery Initiative and the Nitrate Vulnerable Zone by supporting similar objectives. The cooperation approach allows having a very focus, tailored and adaptive approach on specific areas which could not be achieved by national approach. If required, the EPI could also be used to support farmers in entering schemes promoting greater environmental benefits such as the Entry Level Stewardship or the High Level Stewardship.

## 4.2 Enabling / Disabling Factors

The EPI appears to be well-designed answering the needs and the goals of Wessex Water and the farmers involved in the cooperation. The following points try to highlight the key aspects that have enabled the Wessex Water approach to be successful in terms of cooperation:

- ✓ No red tape, no polluter approach. Wessex water went to the farmers explaining the problem and that the farmers could help to solve it.
- ✓ Investment in social capital rather than financial capital.
- ✓ The catchment officers are committed to a limited number of farmers.
- ✓ Risk assessment approach involving yearly field sampling is an important diagnostic tool and negotiation tool.
- ✓ Flexibility in the engagement – no official agreement. If necessary, only simple measures are promoted.
- ✓ Grant involvement but only in the first phase as an incentive instrument.

[12] In a standard approach a catchment officer will manage 2000 farms (WagriCo, 2008c).

In order to know if the approach is transferable to other catchments, it is necessary to understand how these key aspects might be weakened in other situations. In the UK case study the aim associated with the EPI is preventive statutory, i.e. a risk of drinking water standard being exceeded is expected in the future. There are already some boreholes temporary contaminated but the number of resources available allows a blending of the water, cheap technical solution. Plus in most situations the N trends in the water indicate a recent stabilization, the seasonal peak being the main concerns. The pressures from the agriculture exist but are not as problematic as in other EU regions. The "what if" scenario is therefore the presence of high concentration of N involving an EPI reducing the incomes as a result of changing cropping patterns or as a result of reduction of yearly yields. The key aspects of the cooperation, i.e. investing in social capital, role of catchment officers and risk assessment approach, may not change; the discussion with the farmers will be obviously more difficult, being more powerful with high interest at stake they may be less willing to participate too. However the absence of agreement, the limited grants, and the high flexibility is very questionable if major land use changes are required. On the basis of this case study the question is still open, yet further reading may partially answer these questions (Salzman, 2005; Perrot-Maitre, 2006; Heinz et al., 2002; Barraque et al., 2008; Salles et al., 2006).

# 5 References


Brouwer F., Heinz I., Zabel T., 2003, *Governance of water-related conflicts in Agriculture: new directions in Agri-environmental and Water Policies in the EU*, Kluwer academic publishers. Environment and policy – vol.37. 225 p.

Barraqué B., Bosc C., Doussan I. Viavattene C., 2007. *L'Eau des Villes et l'Eau des champs : pour une évaluation adaptée a la démarche du développent durable.* MEDD-D4E.184 p.

DEFRA, 2010, *Agriculture in the South West of England 2009/2010,* http://farmbusinesssurvey.co.uk/regional/GOR.asp.

DEFRA, 2010 b, *Fertiliser manual (RB2009)*, ISBN 978 0 11 243286 9.

DEFRA, 2010 c, *County level crop areas/livestock numbers and labour force 2010,* available at http://www.defra.gov.uk/statistics/foodfarm/landuselivestock/junesurvey/junesurveyresults/

DEFRA, 2010 d, *Local Authority Level key land areas/livestock numbers/labour force 2010,* available at http://www.defra.gov.uk/statistics/foodfarm/landuselivestock/junesurvey/junesurveyresults/

DEFRA, 2009,*Protecting our water, soil and air: a code of good agriculture practice for farmers, growers and land managers, ISBN* 978 0 11 243284 5

Perrot-Maitre, 2006, *The Vittel payments for ecosystem services: a "perfect" PES case ?* IIED-DFID

DeVial L.,2008, *Bargaining with farmers to protect drinking water resources*, powerpoint presentation – Paris Preliminary seminar to the Fontainebleau Seminar : bargaining with farmers to protect drinking water resources?

Environment Agency [online] a *Guaging station: Frome at Ebley Mill (54027)*, available at http://www.environment-agency.gov.uk/hiflows/station.aspx?54027, accessed 8/9/11

Environment Agency [online] b *Guaging station: Piddle at Briantspuddle (44810)*, available at http://www.environment-agency.gov.uk/hiflows/station.aspx?44810 , accessed 8/9/11

Green C.H., 2010, The transition to sustainable urban water management:the London case study. SWITCH EU project http://www.switchurbanwater.eu

Green C.H. and Anton B. (In Press), *Why is Germany thirty years ahead of England ?*, Onternational Journal of Water

Heinz I., Brouwer F., Andrews K., Zabel T., 2002, *Co-operative agreements in agriculture as an instrument to improve the economic and environmental effectiveness of the European Union water policy*. Final report

OFWAT [online] *2008 – 2009 Wessex Water figures (annual submission)*, available at: http://www.ofwat.gov.uk/regulating/junereturn/jrhistoricdata/, accessed 8/9/11

Salles D., Barraque B., Busca D., Garin P., 2006, *L'eau des villes et l'eau des champs negptiation territoriale et genie de l'environnement*, MEDD-D4E.

Salzman J. ,2005, *Creating Market for ecosystems services: Note from the field*, NewYork University Law Review, vol.80.

UK Agriculture [online], *UK Agriculture- Farming statistics* available at http://www.ukagriculture.com/statistics/farming_statistics.cfm?strsection=Fertiliser

WAgriCo, 2008a, *Technical final report*, LIFE05 ENV/D/000182 WAgriCo project.

WAgriCo, 2008b, *Results from monitoring and an evaluation of mitigation Methods*, Annex 51-Uk Interim report – LIFE05 ENV/D/000182 WAgriCo project

WagriCo, 2008c, *Micro- and macro economic analysis,* Annex 39-Uk Interim report – LIFE05 ENV/D/000182 WAgriCo project

WagriCo, 2008d, *Justification for the Inclusion of Pilot Areas,* Annex 16-Uk Interim report – LIFE05 ENV/D/000182 WAgriCo project

WagriCo, 2008e, *Diffuse pollution control in England,* Annex 7-Uk Interim report – LIFE05 ENV/D/000182 WAgriCo project

WessexWater, 2011a, *Wessexwater a YTL company*, internal document.

WessexWater, 2011b, *Catchment management: managing water-managing land*, internet document.
http://www.wessexwater.co.uk/workarea/linkit.aspx?linkidentifier=id&itemid=7201

# 6 Data Sources

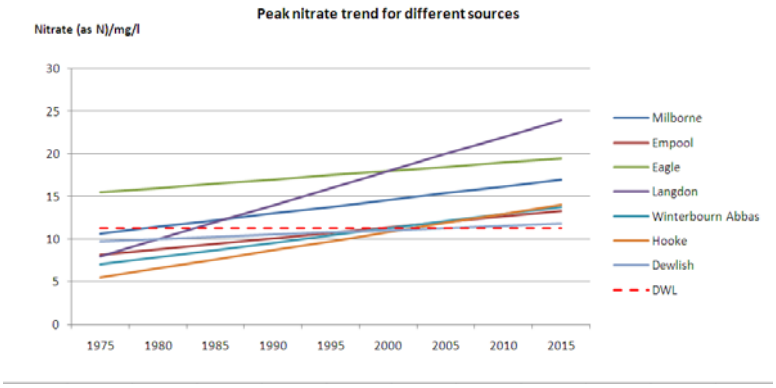
This initiative was supported by a Life Project (2005-2010) called WAgriCo (LIFE05 ENV/D/000182). The current assessment framework will focus mainly on the documents available from this period http://www.wagrico.org/content/default.asp?PageId=231&LanguageId=0

Stakeholder interviews with Wessex Water

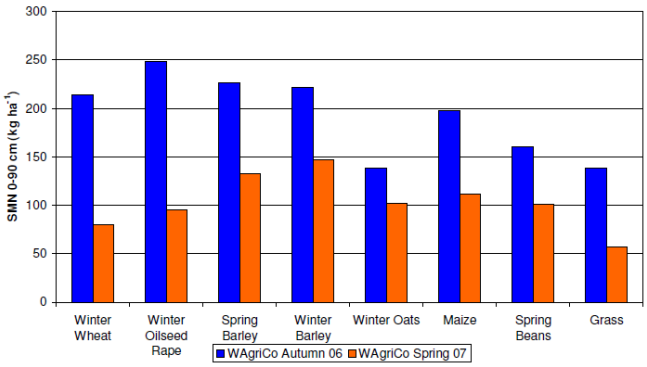
# 7 Annexes

**Annexes section 1:**

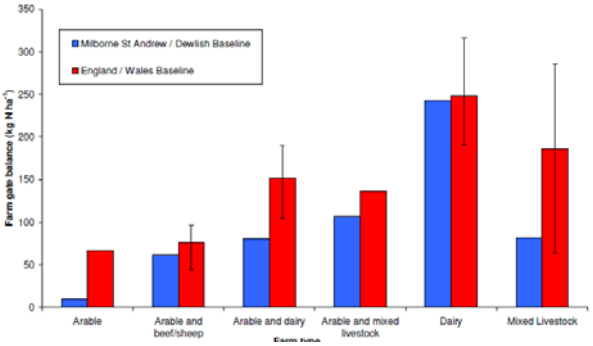
**Groundwater and peak nitrate trends for different groundwater sources in the Rivers Frome and Piddle catchments (from WAgricO 2008c)**




**Soil Mineral N (SMN) measurement (from WAgricO, 2008 b)**




**Baseline farm N balance results (from WAgricO, 2008b)**



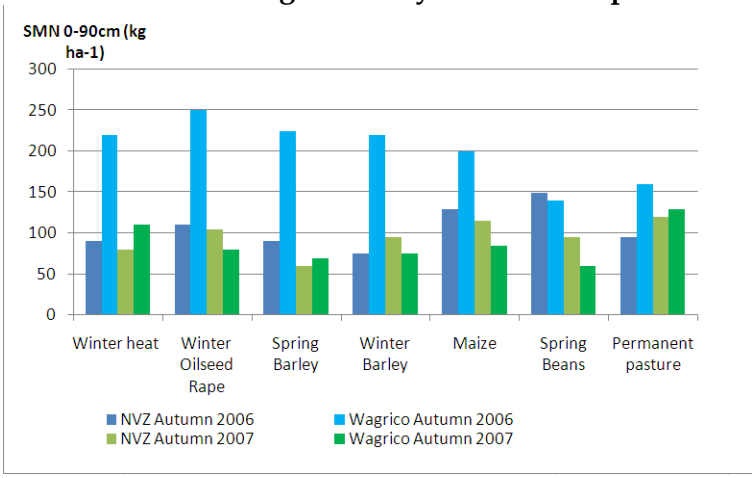

**Annexes section 3.1:**

**Measures, costs, effectiveness and uptake (WAgriCo, 2008a):**

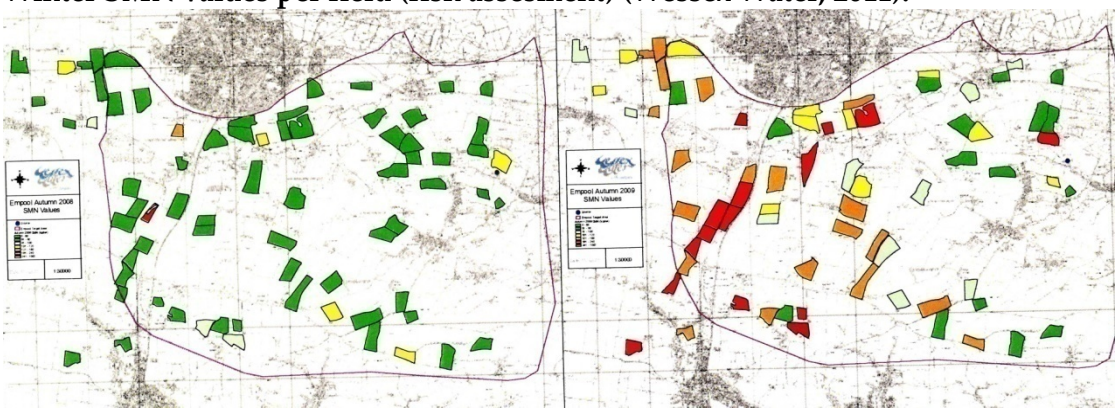
| Type of measure | Description | Average cost /ha (£) | Typical N loss reduction % (model) | % of uptake |
|---|---|---|---|---|
| Fertiliser recommendations . | Apply recommended fertiliser levels based on soil sampling, analysis and advice. | -3.72 | 4.5 | 81 |
| Manure management plan. | Prepare and apply a manure management plan within the scope of existing investment in plant. | -9.3 | 8.4 | 46 |
| Cover crops for spring sown crops. | Introduce cover crops for spring sown crops – maintain until February 15th . | 68.8 | 28 | 31 |
| Fertiliser spreader calibration. | Calibrate spreaders. | -14.2 | Varies | 37 |
| Moving from autumn to spring application for slurries and poultry manure. | No spreading between October 15th and January 31st . | Unknown | Unknown | 10 |
| N efficiency calculation. | Calculate a nitrogen balance | 2 | Varies | 62 |

| | | | | |
|---|---|---|---|---|
| | for the farm. | | | |

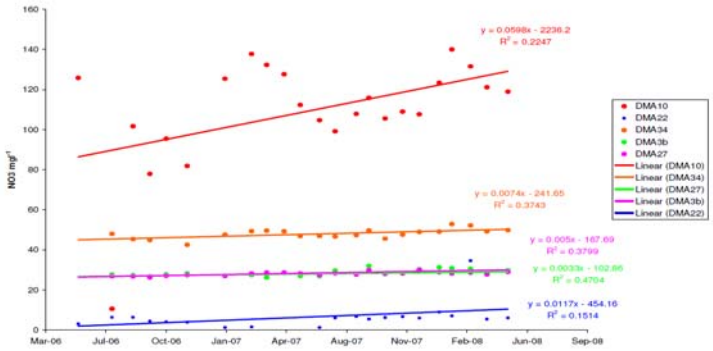
**SMN value following the first year of the cooperation (WAgriCo, 2008b):**




**Winter SMN values per field (risk assesment) (Wessex Water, 2011):**



**Trends in groundwater concentration (WAgriCo, 2008b)**

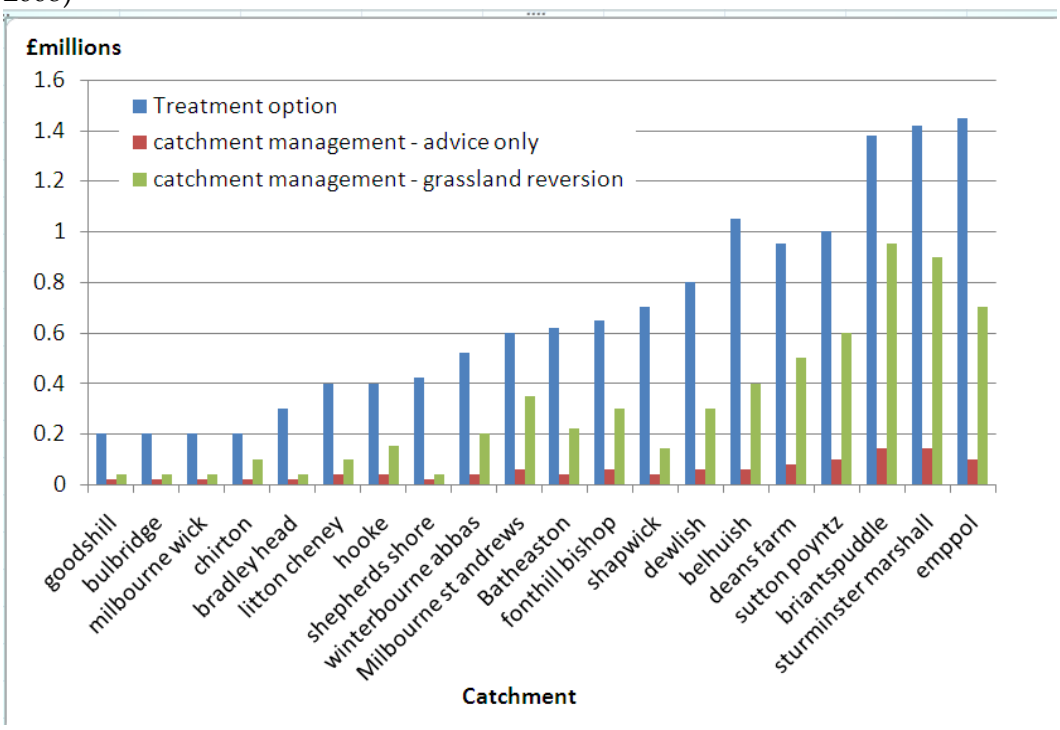



**<u>Annexes section 3.2:</u>**

**AgriCo payment per type of measure (WAgriCo, 2008c)**

| Type of measure | Description | WAgriCo payment |
|---|---|---|
| Fertiliser recommendations. | Apply recommended fertiliser levels based on soil sampling, analysis and advice. | £5 per ha (but sampling and advice provided free) |
| Manure management plan. | Prepare and apply a manure management plan within the scope of existing investment in plant. | £250 |
| Cover crops for spring sown crops. | Introduce cover crops for spring sown crops – maintain until February 15th . | No cultivation until February 15th -£60 per ha. No cultivation until December 31st-£30 per ha. |
| Fertiliser spreader calibration. | Calibrate spreaders. | Contractor cost |
| Moving from autumn to spring application for slurries and poultry manure. | No spreading between October 15th and January 31st . | £1000 |
| N efficiency calculation. | Calculate a nitrogen balance for the farm. | Payment based on improved efficiency |

**Costs comparison between different options (annual costs)** (from DeVial, 2008)




**Annexes section 3.3:**

**Farmers**

(Based on three interviews with catchment managers)

| Indicator | Direction of change | | | | |
|---|---|---|---|---|---|
| | -- | - | 0 | + | ++ |
| Material Living Standards | | | | | |
| Health | | | | | |
| Education | | | | | |
| Personal Activities | | | | | |
| Employment | | | | | |
| Environment | | | | | |
| Security | | | | | |
| Political Voice | | | | | |
| Social connections and relationships | | | | | |

Key

Grades assigned directly by interviewees
Grades verbally indicated by interviewees
Direction of change over time

**Wessex Water**
(Based on four interviews with catchment managers and coordinators)

| Indicator | Direction of change | | | | |
|---|---|---|---|---|---|
| | -- | - | 0 | + | ++ |
| Material Living Standards | | | | | |
| Health | | | | | |
| Education | | | | | |
| Personal Activities | | | | | |
| Employment | | | | | |
| Environment | | | | | |
| Security | | | | | |
| Political Voice | | | | | |
| Social connections and relationships | | | | | |

Key
Grades assigned directly by interviewees
Grades verbally indicated by interviewees
Direction of change over time

**Annexes section 3.5:**

| EPI: Objective | "To reduce diffuse inputs (primarily nitrates) caused by the agricultural sector"[13] | |
|---|---|---|
| | EPI delivery mechanism | |
| | Delivery mechanism 1<br>Participation with farmers | Delivery mechanism 2<br>Assessment of environmental and economic outputs (monitoring) |

[13] WAgriCo Technical Final Report

| | | |
|---|---|---|
| England Catchment Sensitive Farming delivery Initiative ECSFDI (encourages participation with farmers, promoting voluntary action and land management to optimise nitrate application | ++<br>The Wessex Water approach strongly supports the objectives and delivery mechanisms of the ECSFDI as participation with famers and voluntary cooperative agreements are central to the Wessex Water approach. In addition the two policies share the same objective and centre on providing advice to farmers. | ++<br>The ECSFDI encourages assessment and monitoring of the effectiveness of the strategy. This is the same as Wessex Water's approach, only the Wessex Water approach enables more frequent monitoring as the advisers work on a smaller area. |
| Nitrate Vulnerable Zones (NVZs) (Restrictions on fertiliser use are placed on designated areas to reduce nitrate levels) | ?<br>The NPVs are regulations, there is little provision within them to encourage participation with farmers. The Wessex Water approach achieves the same objectives but using a different delivery mechanism. | ?<br>Once zones are designated there was a limited time for appeal. After this NVZs could be lifted if the water is no longer identified as polluted. The regular monitoring by the Wessex Water catchment advisors could allow the NVZ to be lifted if the approach is successful at reducing nitrate levels. |
| WFD (aims to improve the quality of water bodies, including a reduction in pollutants such as nitrates) | ++<br>The WFD encourages a participatory approach to achieving the objectives. Wessex Water's cooperative agreements achieve this goal. | ++<br>The WFD assesses water bodies for nitrate pollution. Regular monitoring by Wessex Water can assist in this. |

## Annex II: Contributors to the report/Acknowledgments

We would like to acknowledge all the members of the EPI consortium especially the WP2 task leaders for their useful comments and supports.

Acknowledgement to the personal of Wessex Water for their contributions to this work