PILOT RIVER BASINS NETWORK ON AGRICULTURAL ISSUES (2008-2009)

Sharing experiences and views on:

- Effectiveness and acceptance of measures
- Public participation, involvement of farmers
- Monitoring and evaluation of measures
- Impact of climate change on River Basin Management Plans

Editor: E. Anguiano
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Foreword

Five months after the entry into force of the Water Framework Directive (2000), Members States and the Commission defined a Common Implementation Strategy (CIS) in order to address the challenges in a co-operative and coordinated way. The first outcome was a series of guidance documents. A network of Pilot River Basins (PRB) was charged to test and cross check them. Based on the conclusion of the first phase (2002-2004), agriculture was defined as one of the recurrent topics to be addressed in the Water Framework Directive (WFD) implementation. Thus, the Strategic Steering Group (SSG) on “WFD and Agriculture” was created.

In support to the SSG on “WFD and agriculture”, a network of nine PRBs was set up to provide practical information. The main “fil rouge” was to provide insight and practical examples on how to design and implement studies on pressures and impact analyses in view of compiling adapted mitigation measures; and to propose a pilot open-ended catalogue of measures (Cherlet, 2007).

Since the period 2008-2009 encompassed new deadlines regarding the WFD implementation, in January 2008, the Pilot River Basins network on agricultural issues entered into a new phase with the main purpose of information exchange during the ongoing preparation of the river basin management plans (RBMP) and the programme of measures (PoM). The objectives of the network were based on questions such as: What agricultural measures prove cost-effective and need to be promoted in RBMP and PoM? What are the key steps towards the setting up of the RBMP? How to ensure a right implementation of RBMP? How to raise farmers’ awareness and involvement? How can RBMP monitoring and evaluation be best organised? How are impacts of climate change and new technologies/crops taken into account in RBMP?

Three main objectives were defined:

1. Networking activity through a series of workshops (four in two years + a final meeting held in April 2010 in Spain) scheduled according to the WFD implementation steps. (Presentations and workshop documentation are available on the PRB-AGRI web platform, see point 3).

<table>
<thead>
<tr>
<th>WS</th>
<th>Topics discussed</th>
<th>Field trip</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-7 May 2008</td>
<td>Specific initiatives and actions led in the North Norfolk catchment</td>
<td>Farm visits: soil, meadow and run-off management</td>
<td>10 PRBs</td>
</tr>
<tr>
<td>WS</td>
<td>Topics discussed</td>
<td>Field trip</td>
<td>Participants</td>
</tr>
<tr>
<td>----</td>
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</tr>
</tbody>
</table>
| 8-9 October 2008 Sparti (GR) | - Water quantity  
- Setting up the RBMP  
- Low cost and efficient technologies | Environmental Measures in Evrotas (Riparian zone restoration, olive mill waste...) | 10 PRBs |
| 13-14 May 2009, Kirchdorf (DE) | -Identification of best measures  
-Implementation of the programme of measures  
-How to get the agriculture involved? | Practical experiences of a model farm, organic farm and trials on fertilizer methods | 8 PRBs |
| 7-8 October 2009, Odense (DK) | -Monitoring and evaluation of measures  
- Impact of climate change on RBMP | Pressures on water and most promising measures against nutrient pollutions (catch crops, biogas, wetland,...) | 6 PRBs |

2. The refinement of the catalogue of measures\(^1\) (CAOM) commissioned by the European Commission (DG ENV) to help the Member States in the implementation of the WFD in the field of Agriculture. The PRB-AGRI network was invited to provide information on case studies, costs, effectiveness and benefits of the measures.

3. The development of a tool to ensure a rapid exchange of information. The JRC took the lead on this task and launched a web platform\(^2\) in October 2008. It has been created firstly to simplify the members’ involvement and to offer them an overview of the issues addressed by the network and calls for contributions. In addition, access to relevant documents on agriculture and water, information on EU coming events are offered as well as the opportunity to interact directly with the network through the Forum. Furthermore, in order to enhance the dissemination of network’s results, a free access section was opened in September 2009.

Eleven countries have been involved in the third phase, represented by (see Map 1): Evrotas (Greece), Guadalquivir (Spain), Jutland and Funen (Denmark), Koros/Crisuri (Hungary and Romania), Morsa (Norway), Malta, Pandivere (Estonia), Piave (Italy), Upper-Tisza (Hungary), Weser (Germany) and a network of 10 catchments from the UK.

In early 2009, members of the PRB-AGRI network decided to go beyond the mandate and share better their experience on four specific topics: (i) Effectiveness and acceptance of measures; (ii) Public Participation and involvement of farmers; (iii) Monitoring and evaluation of measures and (iv) Impact of climate change on RBMP. Topics were identified based on river basin manager needs and their direct link to the PRB-AGRI workshops programme agreed in January 2008. It should be stressed that “funding mechanisms” were also mentioned initially as a further topic of discussion but then discarded, as there was no linkage with any of the scheduled workshops and because much more detailed information would be available in the near future.

This final report presents PRB-AGRI members’ contributions (articles) and the main conclusions of the related workshops for each topic. This document has been compiled and edited by the PRB-AGRI network coordinator (JRC). It should be mentioned that articles were drafted between April and November 2009. Chapters have been made available individually as soon as possible on the PRB-AGRI web platform.

\(^1\)http://circa.europa.eu/Members/irc/env/wfd/library?l=/framework_directive/thematic_documents/wfd_agriculture&cookie=1
\(^2\)http://prb-water-agri.jrc.ec.europa.eu/
Map 1: River basins involved in the PRB-AGRI network
Acknowledgements

Pilot river basins participate in the network activities on a voluntary basis. Workshops have been organised and self-financed by hosting PRBs. The Joint Research Centre (Rural, Water and Ecosystem Resources Unit, Institute for Environment and Sustainability), as network coordinator, would like to express its sincerest gratitude to all the members who contributed to the success of the workshops and made this report possible by sharing their experience with the river basin community.
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Chapter 1: Effectiveness and acceptance of measures

Experience shared by:
Evrotas (GR), Guadalquivir (ES), Upper-Tisza (HU), Weser (DE)

1.1 Introduction

The Water Framework Directive (WFD) innovates in different issues; one of them is the use of economic instruments to protect water in a sustainable manner and enhance the ecological status of water bodies in an efficient way. The Directive requires the elaboration of a river basin management plan (RBMP) for each river basin district, including the compilation of a cost-effective programme of measures. The cost effectiveness assessment (CEA) is the economic evaluation of alternative management and policy options by comparing the predicted benefices against the expected adverse effects of a given action, as mentioned in the guidance document on economics. According to the room document of the Water conference in April 2009, most of the draft RBMPs (dRBMPs) available at that date mentioned the use of CEA in the selection of the measures. Such analysis requires an identification of environmental objectives for each water body, an assessment of possible measures to meet these objectives and an estimation of their costs and of their impacts on the status of the water bodies.

Since the programme of measures needs to suit the regional level and its specific agro-economic and natural conditions, Pilot river basins were invited to share their own experience in the assessment of the effectiveness of the measures and their combination at local level. Since the costs are directly linked to the selection of measures, articles may consider also this dimension. It must be stressed that besides cost effectiveness, other criteria could be used in the selection process of the measures such as acceptance, technical and financial feasibility or time-span impacts. In that way, most suitable measures not only involve cost-effectiveness but also acceptance –in our case – by farmers, and should be easy to enforce and to control.

1.2 Articles from PRB-AGRI network members

Experience from Evrotas (GR)

Effectiveness and acceptance of measures in Evrotas River Basin

By Tzoraki O.4, Vardakas L.5, Nikolaidis N.4, Skoulidakis N.3, Economou A.3, Papadoulakis V.6, Tsakiris K.4, Th. Koussouris7 and Kalogerakis N.4

1. Introduction

The Water Framework Directive 2000/60/EC (WFD) set the goal to achieve good status in all European surface, groundwater, transitional and coastal waters by 2015. A European Life Environment project entitled ‘‘Environmental Friendly Technologies for Rural Development’’ in the river basin of Evrotas, southern Greece, is currently in its final stage. During the project implementation, the Evrotas basin was nominated as Pilot River Basin for Agricultural Development. The main project objective was to assist the implementation of the WFD by providing a management plan which includes among others a toolbox of environmental friendly technologies for the minimisation of pollution impact. In parallel to the establishment of the remediation technologies, a series of meetings, short conferences and speeches were organised by the National Centre of Social Research (NCSR) and had the tasks (a) to inform the public about the objectives and the results of the project and (b) to study the social implication of the project interventions.

A model for rural development has been applied in the river basin. The management plans were created according to the following six axes:


The aim of this communication is to present the preliminary management plans and in particular the effectiveness and acceptance of measures proposed.

2. Study area

Evrotas river basin (Figure 1.2.1) belongs to a large, mid-altitude Mediterranean basin in southwestern Peloponnese which drains a total area of 2017 km². The river originates from Taygetos Mountain (2407 m asl), flows southwards through the Laconia basin and discharges into the Laconikos Gulf.

Many sections of Evrotas River become dry during the summer due to overexploitation of ground and surface waters. Taygetos and Parnonas mountains cover a major part of the basin. The mean monthly precipitation in the area is 77.6 mm. The total population of the basin is approximately 63,000. Agriculture, farming and tourism are the main activities in the area. The basin is covered by natural (61%) and agricultural (38%) areas, mainly olive groves and citrus. As a result of distinct paleogeographical conditions, the river hosts endemic aquatic fauna. The dominant pressures in Evrotas River Basin derive mainly from agricultural activities and include

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4 Department of Environmental Engineering, Technical University of Crete
5 Hellenic Centre of Marine Research, Institute of Inland Waters
6 Prefecture of Lakonia, Land Reclamation Office
7 National Centre for Social Research
overexploitation of water resources for irrigation (posing a major threat for aquatic biota), disposal of agro-industrial wastes (mainly from olive oil presses and orange juice factories) and agrochemical pollution. Only one Wastewater Treatment Plant (WWTP) exists in the basin (city of Sparta), while villages are served by private cesspools. Environmental pollutants include organic matter, nutrients, phenols (from olive mill wastes) and pesticides.

Figure 1.2.1: Location of the Evrotas River Basin

3. Results

Main pressures, ecological status and identification of water bodies
One of the main tasks was to identify and assess the main environmental pressures affecting the qualitative and quantitative state of surface and ground waters in the basin. 38% of the basin area is covered by agricultural areas (olive and orange trees, vineyards, grains and garden truck). It was estimated that 24,641 tones of Nitrogen and 9,771 tones of Phophorous are used in the basin (from agriculture, livestock, wet and dry deposition, domestic wastewater and various point sources) (Nikolaidis N. et al., 2009). In the Prefecture of Lakonia there are 150 public wells and 7,000 private wells in operation. Approximately 3,550 private wells are located within the basin and unknown is the number of the uncontrolled private pumping places from the main corridor and the tributaries. The irrigation water demand for 2007 was 174 Mm³ when the annual precipitation was 944 Mm³. The overexploitation of the water resources threatens important natural habitats and affects negatively aquatic flora and fauna. Human induced physical disturbance (urban land use, removal of river bed substrate, construction of bridges and roads) and point and non point sources of pollution (chemical contamination, intensive agriculture) are responsible for the deterioration of lotic ecosystems.

The chemical status of groundwater and the ecological status of surface waters were assessed. The surface water ecological status was assessed based on the hydromorphological, physicochemical and biological quality elements (fish fauna and macroinvertebrates). The hydromorphological status ranged from high to good in the upper parts of Evrotas tributaries and from poor to bad in the middle and lower part of the Evrotas main course. The physico-chemical status ranged between high and moderate, with the majority of samplings sites (74%) classified as good. The ecological status based on macroinvertebrate communities showed high spatial and temporal variability depending on the distribution of point pollution sources. Assessments based on fish
fauna showed a generally poorer biological status, with more than half (52%) of the sampling sites classified as bad. This situation was largely the consequence of an unusual drought event which occurred in summer 2007 and, combined with overexploitation of the water resources, resulted to the complete drying of almost all tributaries and about 80% of the main river course. In the remaining part of the river, where summer flow was maintained, the biological status of fish fauna ranged between high and moderate.

Preliminary surface and groundwater bodies were determined. Overall, 41 surface water bodies (seven in the main course and 34 in its tributaries) and 14 groundwater bodies were identified. For each water body, specific measures were proposed for achieving and / or maintaining the good chemical and ecological status.

Social research
Following the completion of two surveys (initial and repetitive) the results suggest that Evrotas River is perceived primarily as a significant agricultural asset (55%) and secondarily as a source of natural wealth (31%). Only 14% of the respondents consider Evrotas as a historic and local cultural asset. Regarding the problems that Evrotas presents, respondents in the initial survey emphasised primarily the problem of pollution (total of relevant answers 65%) and secondarily the fact that most of the river’s development potential remains unexploited (23%). A significant fraction (12%) of the population recognises the problem of floods and draughts. The main conclusion was that the public perceives Evrotas River as a reservoir for irrigation needs and neglects completely the impact of non point sources into the river quality and ecology.

The measures for the minimisation of point and non point pollution were discussed, proposed and implemented into the framework of management plans. Specific measures were proposed for the achievement and / or maintaining of the good chemical and ecological status of groundwater and surface water bodies, respectively. Some of these measures have been implemented in the past successfully in Evrotas basin such as the biological farming system.

4. Approach/Solution and Implementation

The fundamental challenge in the development and management of environmental policies is the sustainability of the objectives of these policies. The objectives for sustainable development require decisions that satisfy the needs for this generation and provide a chance to future generations to satisfy their needs as well.

The strategic objective is the integrated management of water resources of Evrotas River Basin that will contribute to the

- improvement of the environment,
- social cohesion,
- added value to the local economy, and
- Improvement of the quality of life.

The objective is to create the conditions for sustainable rural development while the chemical and ecological quality of surface and ground waters is improved according to the Water Framework Directive 2000/60/EC. Evrotas can be the comparative advantage that would lead the Prefecture of Lakonia to the 21st Century. The Strategic Plan was developed around the six axes presented in Table 1.2.1. A database was created for each water body on pressures and impacts on the ecological status, and on the measures for the protection and restoration of water bodies. The corresponding municipalities were informed concerning the status of their water bodies and the respective measures. In Table 1.2.2 the effectiveness of each demonstrated technology is presented.
Table 1.2.1: Main environmental measures proposed in Evrotas River basin.

<table>
<thead>
<tr>
<th>Axis</th>
<th>MEASURES</th>
</tr>
</thead>
</table>
| Axis 1 | Modify Farming System | Mixed farming systems\(^3\), Biological farming system\(^1\)  
Integrated farming systems\(^3\)  
Establish organised pasture areas\(^1\) |
| Axis 2 | Fertiliser Control & Reduction | Phytoremediation\(^1\), Drainage canals management\(^1\),  
Vegetation management on river banks\(^3\)  
Use of Fertiliser recommendation system\(^2\) |
| Axis 3 | Drip Irrigation and Drainage system | Estimation of the real irrigation needs, Switching irrigation methods, Change Charges for water abstraction\(^3\), Water re-use (municipal and industrial treated wastewater)\(^3\) |
| Axis 4 | Alternative choices for water supply | Inter-municipalities companies of drinking water supply\(^3\),  
Wise Cost estimate\(^3\) |
| Axis 5 | Estimation of zones vulnerable to flooding | Riparian zone stabilisation\(^1\), Measures for fire disaster prevention\(^2\),  
Natural hazards procasting\(^2\), Management plans for drought and flood protection\(^2\) |
| Axis 6 | Riparian forest protection | River bed protection, Remediation /Protection of flooded areas\(^1\),  
Ecological effective discharge quantification (during dry period)\(^1\),  
Extension of protection areas to ensure the integrity of biodiversity cores\(^3\) |

\(^1\) active; \(^2\) has been studied and actions are on the way; \(^3\) under discussion.

The environmental measures proposed were partly the result of demonstrations performed in the LIFE-EnviFriendly Project. The technologies demonstrated were low cost (less than 30000 Euros each), environmentally friendly practices that have significant pollutant removal effectiveness. In particular: (1) in “Tzinakos olive mill” the wastewater is stored in evaporation ponds and is used during the summer for the irrigation of a corn field and for compost production, (2) in “Kokkolis olive mill” the underground disposal of olive mill waste and phytoremediation with poplar trees are used, (3) in an orange juice factory, an electrocoagulation unit was installed for the improvement of the wastewater effluent, (4) the management of drainage canals as a low cost agro-environmental measure was also demonstrated (drainage canals are areas of accumulation of organic debris due to erosion and growth of plants such as Phragmites australis and the appropriate timing of cutting reeds maximise the removal of pollutants by plant uptake), (5) river bank management by creating a riparian forest of poplar trees, (6) monitored natural attenuation of nutrients at the basin scale. It was proved that Evrotas basin has high capacity to attenuate pollutants such as nitrate and phosphorous. As part of the LIFE project, the National Centre for Social Research conducted surveys to evaluate the acceptance of the measures by the farmers.
Table 1.2.2: Evaluation of technologies demonstrated in the Envifriendly project.

<table>
<thead>
<tr>
<th>Pollution</th>
<th>Location</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olive Mill Waste Water Treatment</td>
<td>Tzinakos (Surface Irrigation of a Corn Field)</td>
<td>The study has shown that there is no adverse effect in the soil and groundwater from the application of diluted olive mill waste for the irrigation of the corn field. The corn production has increased since the OMW application and additional benefits arise also from the extra reserve of water supply during the dry period (May-August).</td>
</tr>
<tr>
<td>Technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kokolis (Subsurface Disposal and Phytoremediation with Poplar Trees)</td>
<td></td>
<td>The study has shown that during the two years of demonstration that there is no impact of OMW to the groundwater or toxicity issues to the poplar trees. Monitoring of the effectiveness of the technology will be continued in the future.</td>
</tr>
<tr>
<td>Orange Juice Waste Water</td>
<td>Lakonia (Electro-coagulation)</td>
<td>An electrocoagulation unit was installed at the end of the wastewater treatment plant of the orange juice factory to reduce the color in the treated water. Specific alteration in the existing treatment scheme was suggested to improve the appearance and turbidity of the wastewater. Monitoring of the effectiveness of the technology will be continued in the future.</td>
</tr>
<tr>
<td>Drainage Canals Management</td>
<td>Skala (Phytoremediation with Reeds)</td>
<td>The analysis of monthly samples of reeds suggested that a significant accumulation of N and P was achieved of the order of 20 and 3 g/Kg respectively. The reeds have a maximum accumulation of N and P during spring. The drainage canal sediments have also a significant reductive capacity reducing by 88% the concentration of nitrate from groundwater. The study showed that proper management of the drainage canals can reduce fluxes to surface waters by over 90%.</td>
</tr>
<tr>
<td>River Bank Management</td>
<td>Sparta (Riparian Zone Restoration and Phytoremediation by a Poplar Forest)</td>
<td>Restoration of the riparian zone by the creation of a riparian forest was shown to be an effective technology for the combined reduction of non-point source pollution fluxes and bank erosion protection. In the first two year of the study, significant reductions in nutrient concentrations were observed. Monitoring of the effectiveness of the technology will be continued in the future.</td>
</tr>
<tr>
<td>Monitored Natural Attenuation</td>
<td>Basin</td>
<td>Natural attenuation of nutrients in the basin was shown to be a very effective technology. Monitoring and modelling studies estimated that nitrogen and phosphorous were reduced in the basin by 86% and 92% respectively.</td>
</tr>
</tbody>
</table>

Conclusions

Residents believe that the most important function of Evrotas is to satisfy irrigation needs for agriculture. Secondarily, Evrotas is perceived to be a source of natural wealth. Its historic, ecological and cultural role is almost neglected. Local community is concerned with water
pollution problems only when drought events followed by severe odour problems occur, pressuring local authorities to react for possible solutions.

The over-exploitation of Evrotas River water resources and the pollution originated from agro-industry have created ecological implications that must be taken under consideration when designing environmental measures. The integrated water resources management is a difficult and multidisciplinary process. This study identified the dominant pressures and assessed the impacts and the chemical and ecological status of the river. Based on these studies, preliminary management plans were proposed and were specified for each municipality. The proposed measures faced fully public acceptance. The effectiveness of measures, i.e. the impact on the ecological status of Evrotas River, will be further evaluated in the near future. However, preliminary results concerning the proposed measures have shown positive results.

Concluding, designing an appropriate management plan for the Evrotas basin demands the participation of a wide range of scientists from additional fields (e.g. local agronomists, sociologists and economists). The public dialogue has been the cornerstone in the development of the management plans in the basin and the process of public participation is explained in detailed way in chapter 2.

Acknowledgements

This project has been partially funded by the EU LIFE-ENV program (LIFE05ENV/Gr/000245).

References

1. Background

The Water Framework Directive (WFD) is essentially an environmental law which relays up the use of economics as a key discipline to fulfil its objectives. This approach is one of the Directive’s most novel and interesting aspects. Cost-effectiveness analysis (CEA) has been proposed as the general method for decision making complemented in exceptional cases by cost-benefit analysis (CBA) (European Commission, Wateco, 2003). The analysis of published basin plans by Member States shows the exclusion of more thorough techniques such as multicriteria ones. CEA is a form of economic analysis that compares the relative expenditure (costs) and outcomes (effects) of two or more courses of action. Cost-effectiveness analysis is often used where a full cost-benefit analysis is inappropriate and is proposed in the context of the aforementioned Directive to evaluate the measures proposed in the Program of Measures (PoM) to bridge the gap between the current status of water bodies and the ecological goal of the WFD (article 11). Meanwhile, the CBA is proposed as a tool to deal with possible derogation of the environmental objectives (article 4), i.e. when the benefits of achieving the good ecological status do not offset the costs of the measures.

CEA is used to generate a list of measures ranked by the ratio between equivalent annual cost/reduction of impacts (or pressures). These measures are to be included in the Program of Measures for the River Management Plans. The use of CEA implies a certain lexicographic ranking which seeks to minimise the financial cost, once the environmental goals set for each water body are fulfilled (see Kranz et al. (2004) for a case in Germany, and Tremolet Consulting (2006) for a review of EU practice). The lexicographic approach prevents the analysis of “trade-offs” between environmental and social objectives, which enriches the analysis and improves decision-making and public participation. Munda (2006) and Martínez-Alier et al. (1998) review the role of multi-criteria evaluation in public participation in environmental decision making.

The purpose of this paper is to review the practice of CEA analysis, illustrated by a case study in the Guadalquivir River Basin (GRB) in Southern Spain, and to explore the effects of introducing uncertainty in the analysis, which has not yet been done in the existing examples at the European level. For the purposes of this analysis, we propose that cost is defined as the direct cost of the measure, including annualised investment costs, maintenance costs and other economic costs. For a discussion on other cost definitions see Jacobsen (2007).

The cost-effectiveness analysis is performed by first considering the direct costs of the measures, about which there is great uncertainty in many cases. The direct costs valued at the local scale represent the most suitable approach and the calculation is done as follows:

\[ EAC = I \cdot \alpha_{n,i} + MC + \Delta R \]

\( EAC \) = Equivalent annual cost; \( I \) = Investment cost;
\( \alpha_{n,i} \) = Depreciation factor and annual interest, for a period \( n \), at a reduction rate \( i \)
\( MC \) = Maintenance and exploitation cost (recurrent);
Other criteria to consider for analysing the measures would be:
\( \Delta R \) = Increase or loss of the net income or increase/decrease in costs.

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9 Ayesa
For the purposes of this analysis, effectiveness of a measure is defined as a reduction of the impact. An example might be the reduction of net water drawn from a water body. There are other cases where, unable to work with impact (like, for example, increased concentration of nitrogen in surface water), one would work with pressure (e.g. increase of nitrogen discharged into surface waters). Usually the effectiveness is measured through a continuous variable; although it would be possible in some cases to describe the effectiveness as the probability of achieving a positive result, but the latter interpretation is not employed in this study of the Guadalquivir.

The principle behind reviewing the economic-financial regime is to find a more efficient use of resources, especially in the irrigation sector, the main consumer in Spain [see Martín-Ortega et al. (2008)]. The combination of technical measures (eg. improvement of efficiency, counselling, among others) with the use of economic instruments (pricing, volumetric rates), makes possible to meet the same needs with lower allocations for consumption, reducing vulnerability to drought and pollution of water, and contributing to fulfilment of the Directive goals. However, in recent years the hypothesis that the higher prices of the resource (through pricing) would moderate consumption (proposed in the Dublin Declaration, 1992) is being put into question by some authors in the international context [see for instance Molle and Berkoff, (2007)]. In Spain it remains a key principle accepted by all agents concerned, including irrigators, who argued that higher prices would lead finally in some less favoured areas unable to invest in modern irrigation systems to an abandonment of irrigation.

2. CEA in Spanish WFD implementation

The Spanish normative, the Water Planning Instruction or IPH (MIMAM, 2008), specifies mandatory cost-effectiveness analysis in all PoM. It determines the following:

♦ For every measure that might be included in the program, its cost and its effectiveness will be estimated in terms of indicator improvement and ranked from the lowest to the highest cost-effectiveness index (ratio between the equivalent annual cost of the measure and the improvement achieved). For each indicator, measures with the lowest index score and that prove sufficient to reach a value of this indicator in line with the environmental objectives set will be selected.

♦ Effectiveness will be evaluated, preferably by reducing the impact measured on water bodies. In the event that there is no information available on the improvement of the indicators, the degree of pressure reduction could be used.

♦ The cost of the measures will be expressed as equivalent annual cost (of annualised investment and maintenance and operation). Also to be considered, whenever quantifiable in monetary terms, “the environmental costs and indirect costs” as part of the equivalent annual cost.

♦ The Spanish normative defines as basic measures not subject to cost-effectiveness analysis, those necessary to ensure compliance with the objectives laid down in Community directives on water protection.

The cost-effectiveness of a measure is calculated as the ratio of the divided annual cost and annual effectiveness, examples of CEA analysis in Spain are the Cidacos sub-basin (Government of Navarra MIMAM, 2002) or the Jalón sub-basin (Confederación Hidrográfica Ebro-MIMAM, 2008a).
3. Guadalquivir River Basin case study

The Guadalquivir River Basin is the longest in Southern Spain (around 650 km) covering an area of 57,527 km² with a population of over 4 million people. The basin has a Mediterranean climate with a heterogeneous precipitation distribution. Annual average temperature is 16.8°C and average precipitation 630mm. The most important land uses are forests (49.1%), agriculture (47.2%), urban areas (1.9%) and wetlands (1.8%). Natural annual flow levels are 6,900 GL for surface water and 2,576 GL for groundwater (Confederación Hidrográfica del Guadalquivir, 2008). About half of these water flows are used mainly in agriculture (80% of volume). Per capita water consumption in the GRB in 2005 was 1,600 m³. Water consumption is expected to increase by 5 percent in the coming years (Martín-Ortega et al., 2008). Figure 1.2.2 illustrates GRB location with an indication of the irrigated areas.

![Figure 1.2.2: Schematic representation of irrigated areas in the Guadalquivir River basin](Source: Adapted from Confederación Hidrográfica del Guadalquivir, www.chguadalquivir.es)

The variability in water resource availability, the increasing demand from different water users and the recurrent droughts lead to episodes of cyclical scarcity. Local and seasonal drought causes aquifer salinisation and environmental stress. Water quality is also a significant problem throughout the river basin. The main sources of pollution include urban and industrial wastewater discharge, erosion, nutrients and pesticide runoff from agricultural land. Concentration levels of Nitrogen, Phosphorus, heavy metals and organic pollutants in surface and groundwater are expected to increase by about 30 percent in the near future (Berbel et al, 2008). Table 1.2.3 summarises irrigation according to source and consumption.

![Table 1.2.3: Irrigated area and consumption according water origin in Guadalquivir (2008)](Source: Draft PoM (forthcoming 2010) version December 2009.)
The following model for the Guadalquivir River Basin, showing the application of measures and cost-effectiveness analysis, is a simulation based on data that include the Outline of Important Issues (ETI for Esquema de Temas Importantes) which is part of WFD implementation for Guadalquivir River Basin (CHG-MIMAM, 2008). In particular it accounts for the interaction between the economic measures (increased prices and volumetric rates) and a subset of technical measures (providing counselling, changing of irrigation systems and other measures to save irrigation water). All measures are computed at water body level, and aggregated through AQUATOOL model at basin scale [Andreu et al. (1996); Andreu et al. (2008) and (2009)]. AQUATOOL is a decision making support tool for planning of hydraulic resources that has already been applied in the context of the WFD10. Gross (also called wet savings) direct reduction on pressure (water abstraction) is converted in global net water savings (also called dry savings) by considering reduction on return flows. Table 1.2.4 summarises the main points of cost-effectiveness of the PoM in relation to quantitative aspects which are explained in detail later on.

Table 1.2.4: Model cost-effectiveness analysis, quantitative savings in the Guadalquivir

<table>
<thead>
<tr>
<th>Basic measures II</th>
<th>Effectiveness (GL)</th>
<th>Equivalent Annual Cost (10^6 €)</th>
<th>Index C/E (€/m^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regulated surface water</td>
<td>Non-Regulated surface water</td>
<td>Ground waters</td>
</tr>
<tr>
<td>Modernisation of drinking water piping</td>
<td>17,74</td>
<td>0,54</td>
<td>4,78</td>
</tr>
<tr>
<td>Cost recovery (urban)</td>
<td>9,94</td>
<td>0,3</td>
<td>2,68</td>
</tr>
<tr>
<td>Irrigator counselling</td>
<td>8,63</td>
<td>1,59</td>
<td>0,44</td>
</tr>
<tr>
<td>Modernising irrigation</td>
<td>178,48</td>
<td>36,74</td>
<td>14,92</td>
</tr>
<tr>
<td>Cost recovery (irrigation)</td>
<td>16,34</td>
<td>1,14</td>
<td>4,08</td>
</tr>
<tr>
<td>Volumetric rates</td>
<td>31,9</td>
<td>6,19</td>
<td>1,25</td>
</tr>
<tr>
<td>Strict control of abstraction</td>
<td>0</td>
<td>57,4</td>
<td>72,6</td>
</tr>
<tr>
<td>Sum</td>
<td>263,03</td>
<td>103,9</td>
<td>100,75</td>
</tr>
</tbody>
</table>

The model summarised in Table 1.2.4 shows the estimated savings potential of applying “global” measures and different legal instruments. These measures are promoted at State level in general, and the Andalusian Guadalquivir river basin region in particular, and are included in the Guadalquivir Water Agreement (CMA-Andalusian Water Agency, 2009). It can be seen that the effectiveness of the measures are cumulative although the effects of some of the measures are linked to others in a greater or lesser extent, such as volumetric rates and extra charges for irrigation cost-recovery (and modernisation of irrigation systems).

Returning to the cost-effectiveness analysis, one can see that the most cost-effective measure is the strict control of abstraction that may reduce 10% of abstraction in groundwater and non-regulated rivers (as regulated waters are under control of central management of reservoirs), the cost of increased control is similar per hectare to advisory services. The second most cost-effective measure is about generalising volumetric rates (C/E: 0.11 euro per m^3). It should be mentioned that prior implementation of “modernisation of irrigation systems”, although not strictly necessary, would facilitate the introduction of volumetric rates, on providing optimum control of the volumes used. For this reason, this has been included as a related measure in this model. With regard to measures concerning rating structures, gradual introduction of financial

10 AQUATOOL developed by Polytechnic University of Valencia (http://www.upv.es/aquatool/)
cost recovery is considered, followed by the internalisation of environmental costs. The measure on “establishing rates for groundwater users” is contemplated, which, if implemented in the end, would require major changes in legislation.

Finally, the quantitative gap is no bridged by the savings generated through the measures classified as “Compulsory-National Basic Measures” (measures included in all Spanish PoM but not related to any specific EU Directive) and has a certain degree of social consensus. It should be noticed that the ‘quantitative gap’ includes two very different concepts: on one hand, the actual environmental gap, and on the other the so-called ‘water deficit’ (of administrative nature). Nevertheless, in this work, criteria have been adopted to group both gaps together, the strictly environmental and meeting demands, justifying this decision in the tradition of meeting demands quantitatively, which was characteristic of water planning in the past. Therefore, in the Guadalquivir, according to this preliminary model, to reduce the gap it is necessary to resort to additional measures, such as rescue or reduction of concessions. These measures, however, do not meet the social consensus that enables them to be applied without conflict, so it may be necessary to introduce certain exceptions for water bodies in cases where they must be used. The interested reader can consult the approach by Maestu and Berbel (2009).

The ‘ceiling’ in expenses may be justified by two methodologies (a) Willingness to pay (WTP) of population for reaching the good ecological status (see Martin-Ortega et al., 2009) (b) Affordability or capacity to pay estimated as the possibility to expend budget by administrations plus the private expenses that can be assumed by the population. Nevertheless, the analysis of a ceiling in the cost of implementation of WFD is a complex theme to be treated in a specific document about ‘disproportionate cost’ analysis. In this document, it is introduced as an illustration for ceiling expenses either because society is not willing to pay a higher cost for WFD implementation (this is our case) or alternatively because the available budget is limited for a financial constraint in the expenses related to WFD (this is a frequent situation in PoM).

4. Dealing with uncertainty in CEA

Uncertainty in analysis of public investment in environmental economics and in the area of health has been dealt with in numerous works [Arrow and Lind (1970); Graham (1984); Asian Development Bank (2002)]. However, these studies fall within the framework of the cost-benefit method, while, as argued in this paper, the WFD opts for a cost-effective method to select the best combination of measures to achieve environmental goals. Berbel et al. (2009) describe types of measures according to uncertainty in cost and efficacy.

There are some measures such as “Establishing a water bank”, where costs are known quite accurately; however, impact on water consumption is more uncertain. At the other extreme, impact of water rights revision may be known with certainty although the costs of the measure is uncertain as they are dependent on the reaction of farmers and crop productivity, which can change from one harvest to another.

The works available on Spanish and European river basins do not deal with uncertainty, and although the Spanish Ministry of Environment has a program underway in this respect there are still no specific results. There are several alternative ways to introducing uncertainty in the CEA, including the method proposed by Brower and de Blois (2008) based on Monte Carlo simulation; fuzzy logic; or increase the knowledge of measures impact and cost in other regions.

Next, we show an example of quantitative measures for the Guadalquivir and propose using the free triangular function defined by three parameters: minimum, mode and maximum, taking the SICMACE database (Information System for Characterisation of Measures for the Analysis of Cost-effectiveness of the Spanish Ministry of Environment, 2008) as reference where possible. This system proposes three values, ‘optimistic, realistic and pessimistic,’ for the costs and
effectiveness of the measures. For those measures where SICMACE does not provide information, a sufficient interval based on the opinion of experts has been considered to provide for possible variations due to uncertainty, generating extreme values that define the confidence range of the estimation, as shown in Table 1.2.5 and Figure 1.2.3.

Table 1.2.5: Range of values for cost-effectiveness analysis with uncertainty

<table>
<thead>
<tr>
<th>Measure code</th>
<th>Effectiveness (hm³/year)</th>
<th>Equivalent Annual Cost (10⁶ €)</th>
<th>Index C/E (€/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>worst</td>
<td>mode</td>
<td>best</td>
</tr>
<tr>
<td>Urban modernisation</td>
<td>21,9</td>
<td>23,1</td>
<td>24,2</td>
</tr>
<tr>
<td>Cost recovery urban</td>
<td>12,3</td>
<td>12,9</td>
<td>13,6</td>
</tr>
<tr>
<td>Extension services</td>
<td>8,5</td>
<td>10,7</td>
<td>10,7</td>
</tr>
<tr>
<td>Irrigation modernisation</td>
<td>216,8</td>
<td>230,1</td>
<td>236,2</td>
</tr>
<tr>
<td>Volumetric Tariff</td>
<td>20,5</td>
<td>21,6</td>
<td>22,6</td>
</tr>
<tr>
<td>Cost recovery irrigation</td>
<td>26,2</td>
<td>39,3</td>
<td>52,5</td>
</tr>
<tr>
<td>Abstraction control</td>
<td>97,5</td>
<td>130,0</td>
<td>162,5</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>403,7</strong></td>
<td><strong>467,7</strong></td>
<td><strong>522,3</strong></td>
</tr>
</tbody>
</table>

Figure 1.2.3: Uncertainty ranges for cost-effectiveness of the measures

The model of analysis proposed here follows the idea underlying the Spanish Water-Planning Instruction (MARM, 2008) with respect to the treatment of uncertainty in cost-effectiveness analysis. However, it is urgent and important to improve the measures database (SICMACE) with a larger number of observations in order to apply this analysis with greater confidence.

5. Final comments and further developments

WFD stipulates that any basin’s PoM to be approved should be subjected to a process of public participation and analysis of disproportionately costs. Models and data shown here are the results of a first analysis for Guadalquivir River and aimed at triggering an urgent and necessary debate...
about the role of cost-effectiveness analysis and the economic instruments used in water management. Further developments are thus necessary in a close future.

The global model explained here is only an approximation to real impact of measures at water body level, some differences between partial and global figures should appear in the final version of the PoM expected after the publication of this article. Quantitative good status should be reached in all water bodies so that the presented ‘global basin analysis’ is only a first approximation to real complexities of the final PoM and even if water saving can solve apparently the global gap (see Figure 1.2.3, vertical lines), a partial deficit may still remain.

Besides, the complexity of the natural and social world brings with it major difficulties in the process of decision making in water-resources planning, which must be taken into account in the economic analysis. One of the main mechanisms to address environmental conflicts according to their social complexity is public participation. In this sense, the WFD has among its aims to further enhance transparency and legitimacy of water management and provide avenues for dialogue between users to facilitate conflicts resolution.

6. Disclaimer and acknowledgements

Data and opinion presented in this document are the unique responsibility of the authors. The authors acknowledge the collaboration of the personnel in companies Guadalgua and Ayesa and the members of Dirección de Planificación de Confederación Hidrografica del Guadalquivir. This research was financed by CICYT project ECO2009-12496-C03-01.

7. Bibliography


Cost-efficiency analysis of phosphorus load reduction measures

Adrienne Clement11, Ádám Kovács11, Judit Rákosi12 and Gábor Ungvári13

1. Introduction

The Water Framework Directive prescribes for the Member States the setting of good status of waters by 2015. According to the water quality assessment carried out in Hungary, approximately half of the surface water bodies (rivers and lakes) do not meet the criteria of good ecological status because of different types of water pollution (ÖKO Ltd, 2009). Phytobenthos, phytoplankton and general physico-chemical parameters (which are supporting the biological elements) were used as indicator parameters for organic and nutrient pollution. In most of the cases (about 35% of water bodies) nutrients, mainly phosphate (PO₄-P) and total phosphorus (TP), concentrations exceed the WFD limit values corresponding good status. Typically, the status of smaller watercourses and ponds is significantly worse than that of the larger rivers and lakes.

Sources of phosphorus load and its control

The main sources of phosphorus emissions are twofold: discharge of biologically treated wastewater to rivers and non-point (diffuse) load mainly from agricultural origin. Phosphorus content of treated waste waters contributes to almost half of the total P emissions to surface waters (ÖKO Ltd, 2009). The diffuse P load is significant in the hilly areas attributable to high erosion potential, while problems are caused rather by wastewater discharges in the case of the small rivers and lakes in the lowland area of the country. The load is important in those flatland agricultural fields from which excess water is drained off.

As a result of the implementation of the Urban Wastewater Directive (91/271 EEC) in the settlements over 2000 population equivalent (PE), the ratio of flats served with sewerage increased from 51% in 2000 to 70% by 2007. The collected wastewaters are treated biologically nearly everywhere up to 100% (except for Budapest, where this ratio is below 50%, but this situation will notably improve from 2010 onwards), while one-third of the existing wastewater treatment plants have tertiary treatment. Consequently, the tendency of decreasing point-source ratio and increasing diffuse load ratio can be observed.

Best management practices (BMPs), as measures and activities to control the diffuse water pollution, have become a cornerstone of watershed management plans. Numerous BMPs reducing the diffuse phosphorus (P) emissions and loads have been published (Novotny, 2003; Campbell et al., 2004). Interventions have two main groups: source and delivery control. Source control includes minimising the introduction of pollutants into the environment and preventing mobilisation of pollutants. Delivery or transport control tries to reduce the transfer of pollutants from soil to water bodies. Efficiency of applied practices has been evaluated in different case study areas (Campbell et al., 2004). Besides modelling, the practical application of the BMP concept must be accompanied by a cost-benefit analysis and economical feasibility study as well.

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11 Budapest University of Technology and Economics, Department of Sanitary and Environmental Engineering
12 ÖKO Co.Ltd.
13 Corvinus University of Budapest, REKK Water Economics Unit
as legal regulation. There are BMP alternatives at nearly the same emission reducing efficiency, therefore costs can play an important role in decision making. There can be areas with high economic or natural value, where land use form should not be changed. Finally, farmers should be interested in changing their management practices by economic and/or legal programs.

Objectives of the paper
The aim of this paper is to evaluate the impacts of different load reduction measures on the water quality improvement, including (i) supplementary P removal applied at WWTPs, (ii) reduction of P load with change of land use and cultivation techniques (e.g. forestation, erosion control); (iii) floodplain rehabilitation and establishment of riparian buffer zones along the riverbed, (iv) location of constructed wetlands. Nutrient balances calculated from the county fertilizer statistics do not indicate such nutrient excess on the basis of which it would be realistic to suppose the further reduction of nutrient input.

2. Methods

Diffuse P load model
PhosFate (Kovacs et al, 2008) model was developed for the estimation of annual diffuse P emissions into surface waters. Impact of land use conversion measures (e.g. reforestation, pasture or wetland development from agricultural land, etc.) on P load reduction was estimated by the adjustment of certain model parameters (e.g. USLE soil erodibility and cover factors). Particulate P transport was calculated based on a relief model taking into account the 2D accumulation on cell level. Field and river retention were computed based on the average travel time in the cell and a constant retention coefficient. No retention was assumed in the case of dissolved P. Combining the cell emission model with the transport algorithm, total annual P exports at any points within the catchment can be quantified. This enabled the observance of the impacts modifying transport routes (e.g.: application of buffer zones). We estimated the P retention efficiency of wetlands based on literature data (Novotny, 2003).

Case study areas
The emission and transport model was performed well in selected case study areas, 500 – 1000 km² catchments located on the Upper Tisza River Basin in Hungary (see Figure 1.2.4 and Table 1.2.6). The model catchments served as the base for the assessment of cost-effectiveness. Location of potential P source areas (hot spot cells) with exceeding annual soil loss of 15 mm/ha (approximately 15kg/ha) and with total annual P load exceeding 2 kg/ha were designated for the application of BMP measures.

Table 1.2.6: Main characteristics of the case study catchments

<table>
<thead>
<tr>
<th>Name of the case study area</th>
<th>Area (km²)</th>
<th>Average slope (-)</th>
<th>Mean flow at the mouth section (l/s)</th>
<th>Estimated annual average total phosphorus load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Related to soil loss (kt/ha/a)</td>
</tr>
<tr>
<td>Laskó-creek</td>
<td>379</td>
<td>3.5</td>
<td>622</td>
<td>6.5</td>
</tr>
<tr>
<td>Eger-creek</td>
<td>971</td>
<td>5.9</td>
<td>1300</td>
<td>24.2</td>
</tr>
<tr>
<td>Bán-creek</td>
<td>252</td>
<td>10.4</td>
<td>722</td>
<td>22.1</td>
</tr>
<tr>
<td>Vadász-creek</td>
<td>237</td>
<td>5.0</td>
<td>452</td>
<td>14.9</td>
</tr>
<tr>
<td>Kálplai-creek</td>
<td>401</td>
<td>0.5</td>
<td>325</td>
<td>1.1</td>
</tr>
<tr>
<td>Bereg-canals</td>
<td>355</td>
<td>0.1</td>
<td>300</td>
<td>1.6</td>
</tr>
<tr>
<td>River Túr</td>
<td>540</td>
<td>0.03</td>
<td>794</td>
<td>2.6</td>
</tr>
</tbody>
</table>
Cost estimation

Annualised specific costs of measures were estimated. The measures were characterised by the annualised cost, including the investment and operation costs calculated next to the life-span and real discount rate.

In the case of agricultural cost, farming is basically determined by the subsidy system of the sector. It was assumed that the farmer enters into the corresponding agro-environment programme package. Considering this, we correlate the costs of agricultural measures to the budget position in which the farmer is carrying out the present general arable land cultivation. Costs were calculated on the basis of the Single Payment Scheme (SPS) and the Agricultural Environmental Management (AEM) payments. Annual costs of the different management practices were collected from the “New Hungary Rural Development Plan” (Tar, 2006). Costs of other measures, including wetland construction and introduction of additional P removal at wastewater treatment plants, were derived from the experiences of the designer engineers.

3. Results

There are significant differences between the various agricultural measurements concerning costs and impacts as well. The main results of the cost-efficiency analyses are presented in Tables 1.2.7 and 1.2.8, in case of hillside and lowland areas, respectively. Cost-efficiency indicator values serve only for information about the order of magnitudes, taking into account the priority of pollution prevention. Naturally these can be varied in a wide range depending on local conditions.

It is unambiguous that the most efficient way of decreasing the existing P loads into rivers is the intensification of existing wastewater treatment plants. Assuming 90% P removal efficiency and
2 g P/day population equivalent (PE) specific P emission, the approximated annualised cost in Hungary was 10 – 30 €/kg P, depending on the capacity of the treatment plant and the applied technology. This range fits the lower bound of the costs introduced in the literature (SCOPE, 2008), nevertheless we have to consider that the specific cost of P removal is extremely increasing with decreasing size of the treatment plant and with rigorous (P < 1 mg/l) effluent limit (Jiang, 2005). However, no solution resulting in the decrease of load from diffuse sources can be considered as an alternative of wastewater treatment, not even in the case when its costs are more advantageous from the viewpoint of P removal. Namely the P emission from wastewater discharge cannot be compared to the diffuse sources neither by its biological characteristics nor by its seasonal character, since (i) it is biologically available practically up to 100% (therefore its impact on water quality is much more harmful), (ii) it occurs continuously in time, resulting in high concentrations in the recipient in a significant period of the year (under low flow conditions).

In the case of the measures to be applied for the agricultural areas, conversion of arable land to pasture is significantly more cost effective from among land use changes than afforestation. On the other hand, its application is rather determined by the ecologically preferable landscape ratios and less by the costs. In arable lands located in hilly areas, P and sediment load can be reduced by 50-80% with erosion control, cost-efficiency varies depending on the applied means (mulching is more favourable than the complex erosion control including strip cropping and contouring). The efficiency of riparian buffer zones is significantly higher than that of regional measures, but this measure only reduces loads arriving from the direct catchment area. The widening of the floodplain has an impact on the sediment and associated P load arriving from the whole catchment area by increasing retention capacity of the riverbed.

In flatlands water erosion is negligible and diffuse P load can be significant in the areas from where excess water drainage takes place. Thus, it is important to keep the water excess within the area in wetlands and retention ponds. As a consequence of much less diffuse P emission originating from arable lands located in flatlands, the cost efficiency of P load reduction measures is generally lower than in hilly regions.

**Table 1.2.7: Cost-efficiencies of phosphorus load reduction measures that can be applied on hillside river basins (at 2007 price level)**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Average load reduction for TP</th>
<th>Annualised specific cost, €/ha</th>
<th>Cost-efficiency indicator, €/kg P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land use change</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversion of arable land to grassland/pasture (without grazing)</td>
<td>70 %</td>
<td>22</td>
<td>13</td>
</tr>
<tr>
<td>Conversion of arable land to forest</td>
<td>75 %</td>
<td>112-180</td>
<td>60-100</td>
</tr>
<tr>
<td><strong>Erosion prevention– soil conservation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation buffer strips along the arable land (6 m with in 1 ha arable land)</td>
<td>50 %</td>
<td>36</td>
<td>30</td>
</tr>
<tr>
<td>Mulching, conservation tillage</td>
<td>65 %</td>
<td>56</td>
<td>35</td>
</tr>
<tr>
<td>Crop rotation</td>
<td>45 %</td>
<td>13</td>
<td>120</td>
</tr>
<tr>
<td>Complex erosion control including strip cropping and contouring</td>
<td>65 %</td>
<td>210</td>
<td>130</td>
</tr>
<tr>
<td>Trench, terrace</td>
<td>35 %</td>
<td>1720</td>
<td>1900</td>
</tr>
</tbody>
</table>

Effectiveness and acceptance of measures
<table>
<thead>
<tr>
<th>Measure</th>
<th>Average load reduction for TP</th>
<th>Annualised specific cost, €/ha</th>
<th>Cost-efficiency indicator, €/kg P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transport control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riparian buffer strip with 2x6=12m grassland, for a length of 100 m</td>
<td>50 %</td>
<td>3.6</td>
<td>5.6</td>
</tr>
<tr>
<td>(assuming that 1 ha belongs to the 100 m river stretch)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riparian buffer strip with 2x6=12m forest, for a length of 100 m</td>
<td>50 %</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>(assuming that 1 ha belongs to the 100 m river stretch)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floodplain widening + a 40 m wide vegetation buffer strip along the</td>
<td>70 %</td>
<td>180</td>
<td>21</td>
</tr>
<tr>
<td>bank, with expropriation, for a length of 100m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment of constructed wetland (assuming that the area of the</td>
<td>30 %</td>
<td>4500</td>
<td>38</td>
</tr>
<tr>
<td>wetland is 1% of the river basin)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1.2.8: Costs, degree of load reduction and cost-efficiency indicators of phosphorus load reduction measurements that can be applied on flatland river basins (at 2007 price level)

4. Summary and conclusions

The research covered the cost-efficiency comparison of measurements serving for phosphorus reduction. The most cost-effective measure is the P removal applied at WWTPs, but its unique application is usually not sufficient for achieving good status, thus comparison of measures against diffuse pollution from agricultural origin is important as well. Among measures of changing land use the conversion of the arable land to grassland/pasture (efficiency: 10-90€/kgP/a) is significantly more cost effective than forestation (60-500€/kgP/a). However its application is rather determined by the preferable ratios in land use pattern and less by the costs. In hilly arable lands, load can be reduced by 50-80% with erosion control. Cost-efficiency varies depending on the applied means (mulching is the most favourable: 35€/kgP/a, complex erosion...
control including strip cropping and contouring: 130€/kgP/a). The efficiency of buffer zones is significantly higher than that of regional measures, but this measure reduces only loads arriving from the direct catchment area (20-160€/kgP/a). However, the widening of floodplain has an impact on the load arriving from the whole catchment area by increasing retention capacity. In lowland fields, erosion is negligible, loads are significant in the areas where drainage of excess water takes place. Thus, the measures aiming at keeping excess water within the area are the most relevant (wetlands: 20-40€/kgP/a.).

5. References


1. Introduction (Challenges and characteristics regarding the issue)

Diffuse nutrient inputs are one of the main pressures in the Weser River Basin and have been identified as significant water management issue according to the WFD. The classification of water bodies for the first river basin management has revealed that in about 40% of the river basin area groundwater bodies do not achieve the good chemical status, which is mostly due to nutrient inputs. But not only for groundwater protection the issue of nutrient pressures is important, eutrophication can occur in lakes, regulated streams and, most critically observed, in coastal waters. Therefore, the problem of nutrient inputs has to be dealt with at a river basin wide level to find an overall solution for their reduction. The feasibility and effects of necessary measures, however, need to be tested at regional level.

Nutrient inputs are mostly caused by agriculture which dominates the land use in the Weser River Basin with more than 60%. An adjusted, water preserving agricultural land use is required in order to improve the water quality and meet the objectives of the WFD. The need to assess different ongoing developments in agriculture with their complex interactions and hydro-geological correlations demands tools which integrate all aspects. To analyse the nutrient pressures, their development for the entire river basin and to assess the effects of agricultural and environmental measures, the AGRUM\textsuperscript{14} model project has been carried out from 2005 to 2008.

The LIFE-WAgriCo\textsuperscript{15} project also focused on measures to reduce nutrient inputs and involved project partners from the Federal State of Lower Saxony and the UK. In this regional approach, target areas were identified in which selected measures were applied. Furthermore, an environmental and economic impact assessment and cost effectiveness analyses was carried out at individual farm and federal state level.

2. Approach/solutions and implementations

The AGRUM project analysed in a first step the present situation of nutrients in the entire Weser River Basin based on the reference year 2003. N- and P- balances have decreased in Germany since the end of the 1980ies. The N reduction can basically be assigned to efficient fertilizer application as with raising yields the uptake of nutrients has increased. A further reason is the decreasing livestock density and the consequent reduction of organic fertilizer. However, in the Weser River Basin there are still areas with high livestock densities especially in the northwest of the river basin which cause N surpluses of more than 120 kg/ha and also high P surpluses (Map 1.2.1 and 1.2.2).

\textsuperscript{14} Agricultural and Environmental Policy Measure Analyses in the Field of Agricultural Water Protection in the Weser River Basin against the Background of the EU-WFD

\textsuperscript{15} Water Resources Management in Cooperation with Agriculture
The degradation rate of nitrate in soil which is relevant for the input of nitrogen into groundwater depends on the regional conditions. In the northern lowlands, nearly all the nitrate degrades on its way to the surface water due to the high degradation potential and the slow flow rate of groundwater. This does not apply in areas which are drained. The retention times in groundwater can amount to several decades. Lowest nitrate degradation rates have the podsol soils in the northwest of the river basin where additionally high surpluses and a high exchange rate of seepage water lead to high nitrogen inputs into ground and surface waters. In most areas of the Weser River Basin, nitrate concentration in seepage water exceeds 50 mg NO³/l (Map 1.2.3). Direct run off (interflow and drainages) into surface waters is especially high in the south in areas with bedrock underground and in the artificially drained Lowlands in the west and amounts to 75 % of the entire nitrogen input in the river basin.
With high N- and P- concentrations the set management targets in the Weser River Basin are exceeded at present (Map 1.2.4). The environmental targets for the chemical status of groundwater bodies are specified in the Groundwater Directive (2006/118/EC). For surface water bodies, target values were discussed while the first River Basin Management was drawn up; for N especially with the aim of reducing eutrophication in coastal waters. The concentration of <3mg/l Total N at Hemelingen, which is the sampling station situated closest to the transitional part of the Weser, and for Total P the concentration of 0.1 mg/l in all rivers and streams except for marshland rivers were determined as preliminary target values. In marshland rivers, the P-concentration is naturally higher and here 0.3 mg/l is regarded as an orientation value.

In a second step, a baseline scenario was modelled in the AGRUM project referring to the year 2015 including the effects of the CAP reform, increase of energy plant cultivation, the effects of agri-environmental measures 2007-2013 and additional measures due to current legislation (e.g. Nitrates Directive). The baseline scenario 2015 shows an expected average reduction of nutrient surpluses by 10 to 15 kg N/ha UAA (Map 1.2.5). Agri- and agri-environmental policies generally will lead to a reduction of nutrient inputs. Whereas the prognosed increase of prices induces an increase of production intensity, a decrease of set aside and a rise in energy plant production which presumably will lead to a raise of nutrient surpluses, decoupling of direct payments causes a reduction of livestock densities and consequently a reduction of surpluses. Especially in areas with intensive livestock farming, reduction effects can amount to 50 mg/l NO₃, but with initially high levels, nitrate concentration are still exceeding the target values. In comparison to the year 2003, the baseline scenario assessed a nitrogen reduction of 17%.
Despite anticipated reductions until 2015, the target values in ground- and surface water bodies will not be achieved. Based on the results of the baseline scenario, for potential areas of action in the river basin the N reduction necessary to achieve the objectives was identified (Map 1.2.6). In the north of the river basin with intensive farming, high livestock densities and large quantities of organic fertilizer the need of reduction amounts to 75 kg N/ha/year. 72 % of the entire reduction need can be assigned to that area. Overall, N-balances would have to be reduced by a further 19 % (20,000 t N) to reach the objective for coastal waters.

Therefore, the programme of measures needs to suit the region with its special agri-economic and natural conditions. To develop cost effective combinations of measures all possible measures were systematically recorded by the von-Thünen-Institute (OSTERBURG & RUNGE 2007). For each measure the suitability, the reduction potential, the cost effectiveness and the applicability is described. The most promising combinations of measures with respect to effect, costs and
acceptance were selected through the WAgriCo\textsuperscript{16} project and then applied in the AGRUM model network. In the WAgriCo project (more details in 1.3), the selection of measures was based on a broadly based discussion process between farmers and project partners and, hence, the acceptance had a strong influence (NIEDERSÄCHSISCHER LANDESBETRIEB FÜR WASSERWIRTSCHAFT, KÜSTEN- UND NATURSCHUTZ 2008). Table 1.2.9 shows the measures which have been analysed within the AGRUM and the WAgriCo project.

Table 1.2.9: Selected measures to reduce nitrogen inputs applied in AGRUM

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
<th>Effect N-balance (kg N/ha)</th>
<th>Costs (€/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No application of organic fertilizer after harvest</td>
<td>No application of organic fertilizer after harvesting the main crop</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Catch cropping</td>
<td>Sow legume-free ground cover by beginning of September, ploughing not before 15.01./15.02.</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Turnip rape (Brassica rapa sylvestris) as catch crop</td>
<td>Sow cover crop by 15.08., ploughing not before 10.10., no N-fertilizer</td>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>Increase of extensive crops</td>
<td>Cultivation of crops with low fertilizer need</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>Extensification of grassland</td>
<td>Annual livestock density below 1,4 RVG/ha HFF, no mineral fertilizer</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>Reduced mineral fertilizer in cereal</td>
<td>N-need reduced by 10 to 20 %, no late fertilizer application in cereal</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>Groundwater protecting application techniques for slurry and manure</td>
<td>Exact application by drag hoses, trailing shoes or injection techniques</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Organic farming</td>
<td>Farm management according to the EC council regulation 2092/91</td>
<td>60</td>
<td>170</td>
</tr>
</tbody>
</table>

The AGRUM measures were applied regionally differentiated in the model, aiming at achieving the targets for groundwater in a first step and secondly, for surface water. All AGRUM measures out of Table 1.2.9 were used for this model run, except for “organic farming” as this measure cannot be implemented easily. Therefore, the measure organic farming was only included in areas where the reduction potential of all conventional farmed measures were not sufficient. As the applicability of measures depends largely on the regional conditions, the results of the model show the regional distribution and areas where certain measures are most effective (Map 1.2.7). Overall, measures to achieve the groundwater target would have to be applied on 1.1 Mio. ha UAA including organic farming in 7 % of all local communities. Costs would amount to approx. 74 Mio. per year. The measures “catch cropping” and “reduced mineral fertilizer in cereal” have the largest extent. The measure “no application of organic fertilizer after harvest” is very significant in areas with high livestock densities. After implementing these “groundwater measures”, a further reduction of 5,000 t N is necessary to achieve the targets for surface waters.

\textsuperscript{16} www.wagrico.org
which costs are estimated 20. Mio EUR. (FLUSSGEBIETSGEMEINSCHAFT WESER 2009; KREINS et. al. 2009).

Map 1.2.7: Combination of measures to achieve groundwater objectives

3. Conclusion and recommendations

The use of the AGRUM model network for an entire river basin supported the assessment of overall nutrient pressures and, for that matter, the total discharge in the North Sea and took all hydrological pathways into consideration.

Due to long retention times in groundwater in some areas, nutrient levels in surface water can still rise despite reduction measures.

The effects of changes in agricultural policies and agri-environmental measures were calculated and the need for further measures was assessed.

The groundwater objective and the set targets for surface water will not be achieved in most of the river basin until 2015 and even an extension until 2027 will not be sufficient.

The programme of measures needs to suit the region. A tool has been developed to support the selection and the implementation of measures.

Only with less intensive land use (in the north west of the river basin) efficient protection of waters is possible.
4. References


1.3 Workshop outcomes

Within the third PRB-AGRI workshop entitled “implementation of the WFD – Strategies and approaches”, held in Kirchdorf (Germany, May 2009), the identification of the best measures was discussed by the participants. The strategic approach to identify the most (cost) effective measures was focused on. The selection process itself and the conditions that influence the process were looked at in addition to the workshop in Norwich (UK, May 2008) where several agricultural measures had already been presented.

As described in the article submitted by the Weser RB, the AGRUM Weser project includes the findings from the life- WAgrCo project in terms of combinations of measures with respect to effect, costs and acceptance. The purpose of both projects was to identify suitable measures. The results of the WAgrCo project were used to draw up and implement integrated measures and to come up with Programmes of measures in accordance with the WFD to reduce diffuse inputs caused by the agricultural sector. At the workshop, Hubertus Schültken (Technical coordinator, Lower Saxony Water Management, Coastal Defense and Nature Conservation Agency) explained that farmers played a key role in the field of compilation, testing and evaluation of the measures. Measures were assessed through the following criteria: ecological impact (net farm nitrogen balances and mineralized nitrogen content in soil), economic analysis and acceptance of measures. Acceptance was defined as a key point which should be definitely considered in the identification of the best measures. The inhibiting factors were said to be the lack of flexibility (e.g. 5-year-contract), specific restrictions (e.g. time), the time consuming paper work... On the other hand, the consultancy service plays a crucial role in improving acceptance.

Hans Roust Thysen (Danish Agricultural Advisory Service) presented the results of the Agwaplan project (Agriculture and Waterplan), which main objective was to facilitate the implementation of the WFD and to reduce the contribution of Nitrogen and Phosphorus from the farming to the aquatic environment. A key issue of the project was the cooperation between the agricultural and the environmental sector, as co-operation creates cost effective benefits for the environment. The

17 All presentations are available here: http://prb-water-agri.jrc.ec.europa.eu/Prb-agri/documents/open-section/workshop-documentation
technical approach encompasses establishing the good ecological status, soil mapping and modelling to calculate nitrate leaching at field scale in order to determine the required improvement on farm scale. An integrating advising system was developed including, among other tools, a good-agricultural-practices-manual of about 80 methods for reducing N and P losses, based on information collected from literature. Each method is described (relevance/soil, farm, potential effect) and the effect of the measures can be calculated on farm level using a spreadsheet.

Finally, Håkon Borch (Bioforsk, Norway) presented a model (AGRICAT-P) for soil and phosphorus loss from agricultural areas. By calculation of P and soil loss (surface and drainage), taking into account the crop type effect and the P in the soil, several scenarios of P loss reduction were run. This tool offers decision-support in the WFD implementation strategy.

Based on the inputs from speakers and on the discussions from the roundtable, participants identified the following key points in the selection of best measures:

### Summary of the main challenges and concerns expressed by the participants (Kirchdorf, Germany, May 2009):

- **Consider cost effectiveness (environmental and resource costs, scientific evidence)**
  The cost effectiveness assessment has to be based also on environmental costs (not only consider the farmer’s side in order to implement the best measure for a given place), resource costs and on scientific evidences. Moreover, cost effectiveness should be considered from the society point of view as well (e.g. what are the people ready to pay for reducing leaching?).

- **Models are useful to assess the effects of measures (long residential times)**
  Regarding the identification of the best measures, participants pointed out the usefulness of the models not only to identify measures but also to monitor their effects in the long term.

- **Measures need to find acceptance with farmers**
  Acceptance will also influence the selection of the best measures and the WAgríCo project gives some indications on the criteria affecting the farming community acceptance.

- **Controls are important and are as well a contribution to increase acceptance**
  Controllability also increases acceptance and the crucial role of the advisory system was stressed to reach a win-win situation through an effective dialogue.

- **Evaluation of measures is necessary**

- **Advisory services — win-win situations for farmers and water protection have to be identified**
1.4 Example of field trips organised during the workshops

Each workshop included a field trip whose objective was to learn from local good examples. Most of the visits dealt with assessing the effectiveness of measures, thus some examples are presented in this chapter. The interested reader will find more in the corresponding workshop documentation available on the PRB-AGRI Web Platform.

**WAgriCo model farm (Workshop in Germany)**

One of the of 52 model farms which took part in the Life-WAgriCo project implementing measures to reduce nitrogen inputs was visited. Since the start of the project, catch crops have been cultivated on 50 % of the area (before sugar beets and potatoes). Especially this measure has proven to be successful for the reduction of nitrogen inputs; Nmin (mineral nitrogen concentration available in the soil) in spring could be reduced by 35 kg N/ha in average. Moreover, catch crops improve the capacity of the soil to hold water. Another successful measure that was applied is “reduced soil cultivation”. The evaluation of the results of these measures shows that Overall Nmin was reduced by more than 30 % with the cultivation of catch crops after cereals and by about 65 % in average when the field was not tilled. Slurry is applied with towed umbilical hose in spring and for catch crops also in autumn. Trade of slurry does take place in the area, but it is expensive when purchased and applied after the winter due to the storage costs. On this farm, basic nutrient analyses are carried out every 4 years instead of 6 years according to the fertilizer directive. The quality of drainage water is also tested.

**Research Centre Aarslev: Catch crops as measure for N loss reduction (Workshop in Denmark)**

Senior researcher Kristian Thorup-Kristensen gave an introduction to the root growth of the different catch crops and explained why species with specific root growth, the time of sowing and ploughing, the type of main crop / catch crop / crop rotation are important elements in improving the effectiveness. Catch crops have for several years been a measure in the Danish Environmental Action Plan II and III, and an additional use of catch crops will be part of the supplementary measures in river basin management plans in Denmark.

**Olive Mill Waste – Kokkolis Plant (Workshop in Greece)**

Kokkolis Plant is a LIFE demonstration site near Vassilaki where the wastewater from the Olive Mill goes for subsurface disposal and Phytoremediation treatment by poplar trees. It was the first year of operation and no adverse effects in water quality of the groundwater were observed.
1.4 Main conclusions

Following the objective of reaching the most efficient implementation of the WFD, all the experiences shared have considered cost and effectiveness jointly. This assessment is included in most of the dRBMPs and has turned out to be a mandatory exercise in some cases. However, the cost effectiveness analysis (CEA) is a complex task where the methodology could vary significantly as well as the definition of the variables (e.g. cost). The assessment partially or mainly relies on background documents, experts views or parallel projects (Envifrienndly, AGRUM project, WAgriCo, Agwaplan), often financed by the LIFE instrument. The use of models is widespread first to analyse pressures, second to evaluate the gaps and the best measures to implement (and their combination) in order to reach the good ecological status and, finally to monitor measures effects in the long term. Uncertainty can vary from a measure to another, including on the cost and the effectiveness as stressed in the Guadalquivir paper. Several approaches could be identified to cope with uncertainty, such as using the knowledge from other experiences or from experts or conducting simulations based on existing databases. However, the effects of introducing uncertainty in the analysis need to be further explored as they could have a significant impact in the decision-making.

River Basins have presented very interesting cost-effectiveness figures regarding measures on water savings, P-pollutions or N-balance. At the same time, it is well acknowledged that efficiency and feasibility should be tested at local level, even if the overall solution to reduce impact and pressures should be found at river basin scale (like in the AGRUM Weser project). Thus, measures are tested on the field in specific areas (WAgriCo, Envifriendly) or tools are designed to assess directly the effect on the farm (spread sheet from Agwaplan). In most of the cases, the identification of the best measures encompasses a wider range of criteria than cost-effectiveness. Farmers were involved considering that acceptance will also influence the selection of the best measures (WAgriCo, National Centre for Social Research in Evrotas RB). In that sense, increasing controllability is important to enhance acceptance and advisory services should be promoted to reach win-win situations for farmers and water protection and to overcome inhibiting factors. The social objectives should not be minimised in the assessment and the cost effectiveness analysis should take on board environmental and resources costs, farmers’ acceptance, society point of view and be based on scientific evidence.
Chapter 2: Public participation, involvement of farmers

Experience shared by:
Evrotas (GR), Jutland and Funen (DK), UK - Network of catchments, Pandivere (EE), Upper-Tisza (HU), Weser (DE)

2.1 Introduction

The Water Framework Directive encompasses one of the largest participation processes on an European Directive ever launched. Even if Art.14 doesn’t state these words, three forms of public participation are mentioned, with an increased level of involvement:

- Access to background information (information supply)
- Consultation in three steps (on the work programme for the production of the RBMP, on the interim overview of the significant water management issues indentified and on the draft of the RBMP)
- Active involvement of all interested parties

The first two are to be ensured and the latter should be encouraged, according to the Directive and recorded in the Common understanding document with regard to public participation18.

After delivering information and opening consultation on the time table programme and on the overview of significant water management issues in the river basin, Member States should ensure 6 months of public consultation on the draft river basin management plan (dRBMP) that should have been submitted in December 2008. On May 2009, consultation advancement varied significantly between Member States.

The Flash Eurobarometer on water, conducted in January 2009 (randomly-selected citizens), showed that only 14% of EU citizens were aware of the public consultation process in the framework of the RBMP; hardly anyone had already taken part in the scheme (2%). Nevertheless, one in two EU citizens was willing to take part in the scheme. This reflects the situation at national level and the picture could be very different from a river basin district to another.

The former Commissioner for Environment, Stavros Dimas, argued that the involvement of the wider public and all those concerned by water management was absolutely critical. This would ensure an open debate on how to use scarce resources. Most EU Member States started the consultation on the dRBMP and he urged those that had not yet to do so.

The guidance document on public participation in relation to the WFD presents public participation as the mean to allow people to influence the outcome of plans and working processes. Its main purpose is to improve decision-making by ensuring that decisions are soundly based on shared knowledge, experiences and scientific evidence, that decisions are influenced by the views and experience of those affected by them, that innovative and creative options are considered, and that new arrangements are acceptable to the public. Indeed, the process improves awareness, acceptance, transparency and commitment towards plans and at the end a more effective implementation of the WFD. Public participation is a tool to achieve the WFD objectives.

Different methodologies exist for public participation and will be influenced by political, organisational and/or cultural context. PRB-AGRI network members were invited to share experience at local level with the river basin community on how the process had been devised and implemented, with a special focus on the agriculture sector. Conclusions from a PRB-AGRI workshop that tackled the involvement of farmers in the process will close the chapter.
In 2005, a LIFE ENVIRONMENT project entitled “Environmental Friendly Technologies for Rural Development (ENVIFRIENDLY)” sought to assist the implementation of the WFD in the Evrotas River Basin (ERB) with emphasis in the creation of a management plan. The ENVIFRIENDLY project was based: a) on the assumption that water issues cannot be dealt with outside a framework of decentralised management that involves a large variety of interests, stakeholders and management options and b) on the EU demand for active involvement of different stakeholders, such as farmers, industries, local and regional authorities, households and Non-Governmental Organizations (NGOs), in integrated water management. Accordingly, project actions emphasised the promotion of public and stakeholder participation in the elaboration of the ERB management plan and the reaching of the necessary social acceptance for its successful implementation.

1. Public participation (approach - solutions and implementation)

Public participation is essential throughout the preparation, review and updating of the ERB management plan. Different types of participation refer to different levels of involvement of stakeholders and the public. The implementation of the WFD requires the following forms of participation: a) information supply, b) consultation and c) active involvement. It should be stressed that approaches to public participation should be context specific and adapted to the specific institutional, socio-economic and environmental context of the River Basin within which they are pursued.
The ENVIFRIENDLY project organised the public participation process in full consideration of the centralised and hierarchical nature of the Greek state, the limited experience of public and private stakeholders in co-operation and the inexperience of the general public in participatory processes. Thus, the project team closely cooperated with the local authorities (prefectures, municipalities and central state departments) in the preparation of the ERB management plan and approached local stakeholders and the public through the authorities.

Public participation took place at:

1) **the central level**: with the active involvement of the Laconia Prefecture in the elaboration of the ERB management plans (the Land Reclamation Office specialised in the problem of draught and the adoption of preventive practical measures, while the Department of Hygiene specialised on pollution issues in the Evrotas RB and the riparian areas). The regional Office of the General Secretariat for Civil Protection also actively participated in the elaboration of measures against natural disasters.

2) **the local level**: first with the active involvement of the local authorities and the respective local irrigation consortiums (TOEB) that specialise on water management issues and second with the establishment of an informal information network that includes all local stakeholders (NGOs, professional unions, professionals, civil society organizations) and households.

Public participation was organized along the following steps:

1) **Initial step**: upon the starting of the project a timetable and a strategic plan for the project implementation towards the elaboration of the ERB management plan were prepared.

2) **Intermediate step**: the regional peculiarities, the main pollution sources and the related polluting activities were registered and the water management stakeholders at the national, regional and local level were mapped and contacted. The basis for the management plan was set. Some of the proposed measures have been demonstrated in Evrotas basin, during the ENVIFRIENDLY project, such as for example (1) in “Tzinakos olive mill” the wastewater is stored in evaporation ponds and is used during the summer for the irrigation of a corn field and for compost production, (2) the management of drainage canals as a low cost agro-environmental measure.

3) **Final step**: The management plan was presented to the stakeholders and the public in general for open discussion. Different views were presented, comments and suggestions were taken into consideration and the results of the discussion were incorporated in the final version of the management plan.

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22 TOEB are self-governed irrigation consortiums organized locally and administered by local farmers for the management of the state-constructed irrigation networks. The state holds responsibility for the legitimacy of the TOEB decisions and actions.
The analysis of the environmental problems of the ERB indicated the urgency of such problems as the olive mills wastes and drought. These two points were thoroughly addressed by all the participation mechanisms used towards the elaboration of the ERB management plan:

1) **Information provision and awareness rising:** information was provided to all the stakeholders (local and regional) in the ERB in order to raise the awareness of stakeholders and the population in general and give them the necessary know-how to participate in the consultation process at a second stage. More specifically, a) printed and electronic material was widely distributed on a regular basis, b) the results of the socio-economic studies conducted in the region were widely distributed and presented in public thematic events, c) environmental education was pursued with the collaboration of local educational institutions, d) information events and workshops were realised in different municipalities and e) information material was distributed and local stakeholders contacted during local celebrations organised for different reasons in at least six municipalities. With reference to oil mills wastes, a handbook of 10 alternative scenarios for the treatment of wastes was prepared and a series of information and educational events were implemented with the vast participation of olive oil producers. Similar actions were addressed to farmers on water scarcity and the role of wise agricultural practices.

2) **Consultation:** in May 2008 a series of meetings were organised locally in five municipalities in which local authorities (municipal council), large olive oil producers and farmers and their unions, and representatives of the TOEB reviewed and discussed the environmental and socio-economic analyses’ results and the development prospects of their localities. The feedback was then incorporated in the drafting of the preliminary ERB management plan which was presented for open consultation in November (21st) 2008 in Sparta, the capital city of the Laconia Prefecture. The outcome of the consultation process and the written contributions were incorporated in the second draft of the ERB management plan which was presented for open consultation in February (26th) 2009. Both consultation events were organised in a similar way. Participants were invited by the prefectural authorities who issued a press release in the local and prefectural press and the local radio stations – personal e-mails were also sent. Participants included representatives of the local and prefectural authorities and regional administration, representatives of the TOEB, large olive oil producers and farmers and representatives of their professional unions, scientists (agronomists, geologists, hydrologists etc.), civil society, NGO representatives and citizens. Written contributions-responses were then considered in the preparation of the final management plan which focused on the Integrated Water Resources Management of the ERB towards environmental enhancement, social cohesion, economic development and improvement of life quality. The goal of the management plan is the implementation of sustainable agricultural practices and the improvement of the chemical and ecological status of the surface and ground waters of the ERB.
3) **Public acceptance:** Overall, the comparison of the results of the two socio-economic studies (initial and repetitive) conducted throughout the project implementation (interviews with local electives and residents/professionals) demonstrates the fact that to a considerable extent society in the ERB has adopted the philosophy of the ENVIFRIENDLY project, accepted the need to implement the suggested actions in the field of water resources management and prioritised in similar ways the necessary changes. Local society is now aware of the alternative development perspectives of Evrotas and considers the implementation of ENVIFRIENDLY to have set the framework for the sustainable agricultural development of the region and to have paved the road for the implementation of new development projects in the region.

2. Results of participation

Upon the completion of the project, the following results indicate the effectiveness of the public participation tools towards a more active involvement in decision and policy-making:

1) The **institutionalisation** of networking with the establishment of the Observatory for Sustainable Development. The amendment of the regulation of the organisation and operation of the Prefectural Authorities of Laconia was published in the Official Journal of the Government in April 2009 (FEK 725.16.04.2009, B’) establishing the Observatory for Sustainable Development. The Observatory will become operational under the jurisdiction of the Prefectural Authorities and its tasks will include the collection of all information material for the exploitation of the ERB development potential and the collection of feedback from all local stakeholders and citizens, the overall coordination of the development actions and the participation to the resolution of the emerging environmental and broader development problems.

2) Following the meetings with the local olive oil producers it became clear that the majority of them were willing to implement the suggested by the ENVIFRIENDLY group waste treatment measures on the condition that they would receive financial support and guidance by the State. Within this framework, the procedures have started the release of a Local Health Provision with a detailed description of the obligations of the olive oil manufacturers in the ERB.

3) Local farmers acknowledge the scarcity of water problem and the need of the adoption of sustainable agricultural and wise irrigation practices. Thus, they have declared their willingness to proceed with the introduction of drip (or trickle) irrigation if the state provides the required subsidies to cover the extra cost. The Prefecture of Laconia has already commissioned **two studies** with the goal to modernise two of the largest
irrigation networks in the ERB by replacing the existing open channels with irrigation pipes.

3. Conclusions and recommendations

The implementation of the participation procedures planned by the ENVIFRIENDLY project group has verified the assumption that for public participation approaches to be successful (i.e. produce technical knowledge or social capital) they should be tailored-made to the specific institutional, socio-economic and environmental context within which they are pursued:

1) Considering the centralised and hierarchical nature of the Greek state, it is no wonder that the Prefecture of Laconia had to operate as a ‘leader’ in bringing together local stakeholders and the public at large. The inexperience of public and private actors in Greece in participatory procedures necessitated the assumption of a ‘leading’ role by an authoritative public institution. Furthermore, in view of the financial considerations of farmers and olive-oil manufacturers, the most extensive participation of local authorities considerably diminished the reluctance of local stakeholders and society at large to proceed with the required alterations of well-established but not sustainable practices.

2) Local stakeholders and the public have no experience in participatory procedures and often ignore basic environmental facts. Within this framework, before planning and implementing the consultation procedures it is necessary to spend some time to environmentally educate stakeholders and the public and create the required participatory know-how.

3) While implementing the project the environmental conditions underwent dramatic changes with the extreme 2006 draught and the catastrophic 2007 fires. These changes had to be extensively studied by the project team and the results of the relevant studies were introduced in the strategic management plan. The provision of relevant advice to the stakeholders created trust between the project team and the local population and facilitated the participation process in the elaboration of the ERB management plan.

4. References

Tippett L. et al., ‘Social learning in public participation in river basin management – early finding from HarmoniCOP European case studies’ in Environmental Science and Policy, 8(2005):287-299, http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VP6-4G7JY01-1&_user=83472&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&acct=C00005628&version=1&urlVersion=0&userid=83472&md5=875fa083d7a16824d8c8ed60911a0c
Involvement of stakeholders in the water planning process - experiences from a stakeholder role play “Green Fjord”

By Ole Tyrsted Jørgensen & Stig Eggert Pedersen, Environment Centre Odense, Agency for Spatial and Environmental Planning, Danish Ministry of the Environment.

1. Introduction

The Water Framework Directive stipulates the involvement of stakeholders in the river basin management plan process. In Denmark the WFD is brought into effect with the Danish Environmental Objective Act. A range of activities is laid down in the act concerning general involvement of stakeholders, where the public is secured the right to be informed and give comment. These activities are shown in box 1.

Table 2.2.1: The minimum involvement of stakeholders laid down in the Danish Environmental Objective Act.

<table>
<thead>
<tr>
<th>Objective</th>
<th>Time schedule and deadlines</th>
<th>Public hearing/involvement of stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article 5 Analysis</td>
<td>22nd December 2004</td>
<td>-</td>
</tr>
<tr>
<td>Work programme and time schedule</td>
<td>Publication 22nd December 2006</td>
<td>6 months</td>
</tr>
<tr>
<td>Idea phase for preparation of river basin management plans</td>
<td>Initiated 22nd June 2007</td>
<td>6 months</td>
</tr>
<tr>
<td>Draft of river basin management plans</td>
<td>Publication 22nd December 2008</td>
<td>6 months</td>
</tr>
<tr>
<td>Final river basin management plans</td>
<td>Publication 22nd December 2009</td>
<td>-</td>
</tr>
<tr>
<td>Draft municipal actions plans for the implementation</td>
<td>Publication 22nd June 2010</td>
<td>8 weeks</td>
</tr>
<tr>
<td>Final municipal actions plans for the implementation</td>
<td>Publication 22nd December 2010</td>
<td>-</td>
</tr>
<tr>
<td>Program of measures operational and implementation</td>
<td>22nd December 2012</td>
<td>-</td>
</tr>
<tr>
<td>“Good status” achieved for all waters</td>
<td>22nd December 2015</td>
<td>-</td>
</tr>
</tbody>
</table>

In addition to the activities shown in box 1, the Agency for Spatial and Environmental Planning, Ministry of the Environment, which is responsible for the preparation of the Water Management Plans, has decided to form a number of Water and Nature boards for stakeholders in order to secure a more close information flow and dialogue between the river basin management planners and the regional stakeholders during the preparation phase of the Water Management and Nature 2000 plans. These boards meet approximately twice a year within their region.
However, in spite of this structure, the involvement of stakeholders is at times very different and fluctuating. Experience shows that, in order to ensure the involvement of stakeholders in the water planning process, it is essential to bring awareness and acceptance to the complexity of environmental problems involved in achieving good status of all waters, and that is dealt with in a river basin management plan (Rautio et al., 2006). At the same time, knowledge and understanding of the principles of preparing programmes of measures is valuable for the equal dialogue between stakeholders and river basin managers and also stakeholder groups in between.

Acknowledging this, in spring 2008 the Environment Centre of Odense set up a small project with the aim of letting stakeholders themselves work with the preparation of a programme of measures within a specific river basin involving a wide range of different types of waters and Nature 2000 areas and a range of environmental problems to be solved if good status should be met. For this purpose, an artificial river basin “Green Fjord” was designed including a toolbox with 24 different realistic and cost efficient measures and a simple spread sheet for calculating the cost of the selected programme of measure. Representatives from all different groups of stakeholders in the region of Fyn were then invited to a workshop where they were to “play” river basin managers and set up a complete programme of measures for the river basin. The stakeholders were put in groups where all types of stakeholders were represented and by this, all points of view could be present in the discussions and choice of solutions.

By participating in the role play, all groups of stakeholders would acquire the same level of knowledge irrespective of which stakeholder organisation they represented. At the same time, at the workshop, stakeholders would be able to discuss different points of view among each other and not only with the river basin manager. Finally, by working with an artificial river basin, the stakeholders and the water authority would be able to discuss more openly different problems without thinking of sites and in-real situations which may restrain the openness of the discussion.

2. The role play “Green Fjord”

The objective of the play was to prepare an example of a programme of measures related to a water management plan. However, also problems related to Nature 2000 areas should, as far as possible, be integrated into the measures chosen to fulfil the objectives of the water management plan.

For the play, an artificial river basin was designed as shown in Figure 2.2.1.
Figure 2.2.1: The 2500 hectare river basin “Green Fjord” and river valley “Gude Ådal” a Nature 2000-area constructed for the role play. The key figures of the river basin are found in Table 2.2.2

Table 2.2.2: Key figures of the river basin

<table>
<thead>
<tr>
<th>Total catchment</th>
<th>2500 hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Pretty catchment</td>
<td>500 hectare</td>
</tr>
<tr>
<td>Catchment to Green Fjord</td>
<td>2000 hectare</td>
</tr>
<tr>
<td><strong>Lake Pretty Catchment:</strong></td>
<td></td>
</tr>
<tr>
<td>Cultivated area 60%</td>
<td>300 hectare</td>
</tr>
<tr>
<td>- of which 10% is low lying areas</td>
<td>30 hectare</td>
</tr>
<tr>
<td>- of which 90% is higher lying areas</td>
<td>270 hectare</td>
</tr>
<tr>
<td>Sparsely built-up areas</td>
<td>12 households</td>
</tr>
<tr>
<td>Gude river – upper part</td>
<td>1 km</td>
</tr>
<tr>
<td>Angel bog</td>
<td>8 hectare</td>
</tr>
<tr>
<td><strong>Catchment to Green Fjord:</strong></td>
<td></td>
</tr>
<tr>
<td>Cultivated area 70%</td>
<td>1400 hectare</td>
</tr>
<tr>
<td>- of which 10% is low lying areas</td>
<td>200 hectare</td>
</tr>
<tr>
<td>- of which 90% is higher lying areas</td>
<td>1200 hectare</td>
</tr>
<tr>
<td>Sparsely built-up areas</td>
<td>22 households</td>
</tr>
<tr>
<td>Municipal waste water treatment plant</td>
<td>1 WWTP</td>
</tr>
<tr>
<td>Gude river – lower parts</td>
<td>4 km</td>
</tr>
<tr>
<td>• Tributary to Gude River</td>
<td>1.5 km</td>
</tr>
<tr>
<td>Ground water magazine</td>
<td>200 hectare</td>
</tr>
<tr>
<td>• Action area against nitrate pollution</td>
<td>100 hectare</td>
</tr>
<tr>
<td>Hillside common</td>
<td>10 hectare</td>
</tr>
<tr>
<td>The Flower meadow</td>
<td>9 hectare</td>
</tr>
</tbody>
</table>
In the Green Fjord river basin, several types of water and nature areas, where the environmental objectives were not met, were listed. As background information for the players, both the required measures and nutrient and discharge reductions needed for each water and nature area, as well as the pressures, were given beforehand.

The following types of waters and required measures were incorporated:
- Gude river and tributary: reduction of wastewater discharge from scattered settlement with organic and oxygen consumption matters; physical improvement at places; removal of obstruction for fish migration.
- Green Fjord: reduction of nitrogen and phosphorus loss to the fjord.
- Lake Pretty: Reduction of nitrogen and phosphorus to the lake, reduction of waste water discharge from scattered settlements.
- Aquifer Hill Valley common: Reduction of nitrogen loss from agricultural areas.

Concerning the Nature 2000 areas, the areas involved were:
- Alkaline fens
- Semi-natural dry grasslands and scrubland facies on calcareous substrates
- Stonewart algae lake
- Water courses with waterplants
- Bæklampret (Lampetra planeri)
- Gray Goose
- Salt meadows
- Alluvial forests

The needed measures related to the Nature 2000 areas are: more extensive farming of areas of alkaline fens and semi-natural dry grassland on calcareous substrates; establishment of new nature areas; improvement of physical conditions of riverbed; reduction of nutrient loss to lake; improvement of natural hydraulic conditions for salt meadows and reduction of nitrogen deposit on alkaline fens and semi-natural dry grassland on calcareous substrates.

The role play thus not only concentrated on water management solutions but also on nature solutions. The purpose of this was to create a discussion on possibilities of an integrated effort, where the solution of one problem could also help solve other problems and by this, in the end save society money.

3. The toolbox of measures

In order for the groups to produce a realistic play with a final programme of measures, a simple spreadsheet with 24 measures was created. For each measure the pressure against which the measure was relevant, the unit and size of effect, the annual price and price per unit, and finally the total potential was given. Based on this information and on the choice of solutions, a programme of measures should be established. If implementation of a measure in the catchment
of the lake had a nutrient synergy effect on the downstream catchment, the spreadsheet would incorporate it in the calculations as a reduction in the effort required downstream.

The preparation of the programme of measures also resulted in an estimate of the total cost of implementing the programme of measure, and a percentage of total target fulfilment. By this, also some competition among the different groups of participants arose, to see who would produce the most cost efficient programme of measure. This could then in the broad discussion of the follow up be compared with the differences in choice of solutions.

4. The outcomes of the role play “Green Fjord”

In addition to an example of a programme of measures from each group, the outcome of the role play was also a common understanding among the stakeholders. At the end of the day the stakeholders stated, among other things, that:

- It makes good sense to focus on synergy effects.
- Even though the overall cost is high, the solutions chosen are necessary to fulfil the different requirements for obtaining good status.
- We, the stakeholders, have different interests.
- Different opinions on the use of the measures.
- Dialogue with stakeholders and among stakeholders when implementing programmes of measures in real life is essential in order to create good solutions.

Evaluating the process of the role play/workshop the stakeholders said, among other things, that:

- This type of dialogue is better and more productive than just informing the stakeholders.
- It is good to test the principles of the process on “own body”.
- Good to work with an artificial test case and not a real specific area in order to keep the discussion at a principal level.
- It is very positive that the water authority has taken time to create this play and share it with the stakeholders.

From the above, there is no doubt that the stakeholders have felt that this type of “working” dialogue have given them something positive about the planning process to bring home. Also they expressed understanding of the complexity of the problems and acceptance of the different points of view that the different groups of stakeholders represented. Finally, the stakeholders became aware of the great opportunities of gaining synergy effects if an effort is made at the implementation stage.

As such, the objectives of the project were met. However, after the workshop, other positive results have also appeared. First of all, a better direct knowledge of the key people in the water authority office and among the stakeholder groups has made conversation easier. It also seems that among the stakeholders there is a better understanding of why the water authority in the earlier phase of the planning process, due to technical and political reasons, cannot always inform
the stakeholders as fast and accurately as the stakeholders would like. This acceptance of both the process and the technical parts of the water plans is very important for the success of the further steps of implementing the programme of measures.

It is important to follow-up on these findings. It has earlier been found that in the process of implementing the Water Framework Directive in Denmark, the direct link between the planning authority (the state) and the implementing authorities (the municipalities) needs to be strengthened (Agwaplan, 2009). It seems that the dialogue created with the Green Fjord role play, where also the municipal authorities were participating as an equal stakeholder, has functioned well as a method to help strengthen this cooperation and understanding.

5. Since the role play “Green Fjord”

The role play was initially thought to be an activity for the local stakeholders in the Region of the island of Fyn. However, subsequently stakeholders from other parts of the country have inquired if the role play could be introduced to them as well. This also includes national stakeholder organisations and advisors within the field of environmental advising of local authorities.

This interest leaves no doubt that involvement of stakeholders on an equal level in the early planning phase is of great value, and a useful method to help this process has been the role play even though it was based on a theoretical situation on grounds of principles. The fact that the situation was “artificial” made people discussing freely by not focusing on their own “backyard” situation. With this, everybody participated equally in the discussions and the role play. This enables the role play to be used in many different places and with different stakeholders.

6. References:


1. Introduction

The ECSFDI was launched in April 2006 and seeks to raise farmer awareness of the nature of, and problems caused by, diffuse water pollution from agriculture (DWPA). It uses a range of levers including advice and incentives, targeting a number of priority catchments in each River Basin District in England where going beyond good farming practice is essential to deliver the required environmental outcomes. ECSFDI is contributing to the implementation of the Water Framework Directive as an early measure and developing linkages with river basin management planning. ECSFDI advice is targeted to address WFD failures for DWPA (holdings contributing to poor quality of bathing waters, shellfish waters, SSSIs, ground and surface water Drinking Water Protected Areas and river stretches failing Good Ecological Status for N, P and sediment). ECSFDI advice is specified as a measure in the river basin management plans to address these failures. It also contributes towards achieving Natura 2000 objectives and the Site of Special Scientific Interest (SSSI) Public Service Agreement (PSA) target.

Catchment Sensitive Farming Officers (CSFOs) use various methods (e.g. seminars, workshops, demonstration sites, farm walks, newsletters and farm visits) to encourage farmers and other rural land managers to manage land so as to mitigate diffuse pollution.

Engagement with farmers is the main objective of the Initiative delivering an extensive programme of farmer events and farm visits. In its first two years of operation, the ECSFDI delivered advice to over 6000 farmers representing 15% of farm holdings (23% by area) within forty priority catchments. Advice was delivered through more than 500 group events, and over 4700 one-to-one farm visits. More than 14000 farm-specific recommendations were made for measures to tackle diffuse pollution. Over 80% of farmers receiving advice from the ECSFDI confirmed that their knowledge of water pollution had increased and that they had taken, or were intending to take, action to tackle water pollution.

ECSFDI is delivered in partnership by the Environment Agency and Natural England and funded by Defra.

From March 2008 the Initiative expanded to carry out its activities within 50 Priority Catchments (an additional 10 catchments. Appendix 2.2.1). These were identified based on DWPA risk, with emphasis on designated sites. Each Priority Catchment has a CSFO responsible for delivering advice to farmers in that area. A Catchment Appraisal is used to identify holdings contributing to poor quality of bathing waters, shellfish waters, SSSIs, ground and surface water Drinking Water Protected Areas and river stretches failing Good Ecological Status for N, P and sediment. The diagram at Appendix 2.2.2 shows the targeting process.
2. Approach and Implementation

Measures to Control DWPA
The ECSFDI is seeking to achieve reductions in diffuse water pollution from agriculture by encouraging Catchment Sensitive Farming (CSF). This is 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, both in the immediate catchment and further downstream. In terms of farmer behaviours and practices, CSF includes: encouraging best practice in the use of fertilisers, manures and pesticides; promoting good soil structure to maximise infiltration of rainfall and minimise run-off and erosion; protecting watercourses from faecal contamination (e.g. with fencing and livestock crossings) and from sedimentation and pesticides (e.g. with buffer strips); reducing stocking density or grazing intensity; reverting to grassland etc. The DWPA control measures are outlined in ‘An inventory of methods to control Diffuse Water Pollution from Agriculture (DWPA)’\(^\text{23}\), which provides estimates of the effectiveness of each measure in terms of reducing losses of the main DWPA pollutants. These measures have been added to over the course of the Initiative in order to encompass all of the methods CSFOs are promoting. However, the effectiveness of the additional measures has not been quantified.

Engagement with Farmers
Once CSFOs have identified high risk target holdings within their catchments, they approach the farmers/landowners to offer advice on measures to reduce DWPA on their farm. The initial engagement is primarily via telephone or by post, mailing newsletters and flyers. Engagement with farmers at local external stakeholder meetings and workshops is also a valuable method for primary engagement. Each Priority Catchment has a budget allocation for contractor delivered advice, to be used where the CSFO does not have the necessary expertise to deliver specific aspects of advice (e.g. Facts training for Nutrient Management Plans). ECSFDI advice is delivered through workshops, on farm demonstrations, drop in clinics and one to one farm visits covering topics specific to the catchment issues. These include:

Farm visits to:
- Review or assist farmers in producing Soil, Nutrient and Manure Management Plans
- Advise farmers on how to improve farm infrastructure to reduce DWPA, especially on livestock farms
- Carry out soil analysis (N, P, K, Mg and Organic Matter) and give recommendations on nutrient applications
- Carry out organic manure analysis and give recommendations on application rates and methods
- Advice on management of outdoor pig units to reduce DWPA
- Carry out a ‘Whole Farm Appraisal’ to identify the main DWPA sources on the farm and any further specific advice from which the farm could benefit.

Workshops to:
- Introduce ECSFDI and raise awareness of catchment issues by presenting evidence
- Offer advice on good soil management and cultivation techniques
- Offer advice on nutrient budgeting and compliance with Nitrate Vulnerable Zones (NVZ) regulations
- Offer advice on best use of Entry Level Stewardship resource protection measures
- Give information on the ECSFDI Capital Grants Scheme

- Demonstrations of specific topics/technologies including precision farming, cover crops, biobeds, sprayer calibration etc.

CSFOs are encouraged to be innovative in their approaches to advice delivery in order to gain highest possible uptake. It has been recognised over the course of the initiative that different methods for engagement have varying levels of success between geographical areas. For example, workshops have had little success in the Yare catchment where farms are small and farmers generally isolated from one another where as the ‘Bakewell drop in centre’ in the Peak District has had huge success attracting over 2000 farmers/year. One to one advice is generally most effective in bringing about changes in management practices on the ground, however it is more expensive when delivered by contractors.

CSFOs use key messages as ‘hooks’ to engage farmers. Most of these focus on the financial benefits which are most effective in motivating farmers. Examples include:
‘Make voluntary changes now to reduce the risk of increased regulation’
‘ECSFDI helps you to keep up with regulatory requirements and keep one step ahead of future potential requirements’
‘ECSFDI can save you money by reducing running costs (for example, through reduced fertiliser applications)’
‘Expert ECSFDI advice is FREE of charge’
‘You may be eligible for an ECSFDI Capital Grant’

The ECSFDI Capital Grant Scheme was successfully launched in April 2007 providing an important financial incentive for farmers to take action to reduce DWPA. The scheme was oversubscribed receiving 1,150 applications for £8.1 million worth of grants against a budget of £5 million. A scoring system was used to prioritise applications for funding. As a result, grants were only awarded to applications within target areas and with high and/or medium priority items. 740 applications were successful and claims worth £4.645 million were paid. It is worth noting that grants did not exceed 60% of the capital cost, clearly demonstrating that farmers were willing to commit their own money.

At the end of March 2008, the number of farmers (within the 40 priority catchments) receiving advice from the ECSFDI is estimated to be around 6,100. This advice was delivered through:
- 517 group events attended by 3,882 different farmers (6,017 including multiple attendances by the same farmer)
- 147 advice clinics attended by 497 different farmers (660 including multiple attendances by the same farmer)
- 4,736 one-to-one farm advice visits to 3,527 different farm holdings
- More than 14,000 farm-specific recommendations were made for measures to tackle diffuse pollution.

In addition to core farm advice delivery, CSFOs have become 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. CSFOs have worked with numerous agricultural advisory organisations, agronomist groups and agricultural supply groups to promote CSF. CSFOs have also worked closely with a wide range of other organisations, projects and initiatives. This has allowed them to establish themselves in catchments more quickly and use existing communication routes and contact networks to engage farmers more effectively and efficiently.
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 will help 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.

Communications activities include mailing newsletters, holding farmer workshops and ‘piggybacking’ on the communications activities of other farming related organisations to present local and national evidence as to the effects of DWPA.
During the first two years of the ECSFDI, local and national communications significantly increased awareness of the Initiative across the 40 Priority Catchments (evaluation of the level of farmer awareness is carried out through annual farmer telephone surveys).

Pollutant Losses, Loads and Water Quality
Given the complexities of pollutant mobilisation and transfer and the impact of external factors such as the weather, the measurement of catchment responses to DWPA mitigation requires long-term monitoring. It is therefore too early to detect reductions in DWPA pollutants from the initial results of our water quality monitoring programmes. However, the monitoring we have established should allow us to do so in the future.

Modelling results indicate that, at a local scale, significant reductions in agricultural nutrient, sediment and faecal organisms losses can be expected as a result of ECSFDI activity. At the catchment scale, predicted reductions are generally small (less than 10 per cent), although in some catchments relatively large reductions are predicted (20-40 per cent).

3. Challenges
Increasing Awareness
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. The limited acceptance of the contribution of agriculture to water pollution indicates that the Initiative has not been entirely successful in forming and / or communicating the evidence to farmers, however encouraging acceptance will inevitably be hard to prove within any industry. A notable exception is in the case of pesticides where, on a regular basis, the results of ECSFDI and water company monitoring are provided directly to agronomists working with farmers in the five highest risk catchments. In some other catchments the results of targeted water quality monitoring (for example, of field drains) have also been used to demonstrate the significance of, or impacts from, DWPA.

Implementation of Measures
Across the Priority Catchments, 31 per cent of farmers felt there were obstacles preventing them from taking (more) action to reduce DWPA. Of those indicating there were obstacles, financial constraints were cited by 85 per cent receiving advice and 76 per cent across the Priority Catchments as a whole. The importance of financial incentives for driving change suggest financial constraints become more apparent with increased awareness of the potential scope for change.

ECSFDI has been successful in recommending measures to farmers, however the next step is to audit whether or not these recommendations have been implemented. The CSFOs are doing this
by carrying out repeated ‘follow up visits’ to farms who have already received advice, in order to audit implementation, identify any obstacles to farmers making changes and recommend any additional measures that the farmer could take to reduce DWPA. Once this ‘audit’ is complete we will have a better understanding of the effectiveness of ECSFDI advice.

**Engagement with Farmers**
CSFOs have found that the farmers with the highest risk land or those causing the most DWPA are the most difficult to engage, and some will not engage at all. The best ways for CSFOs to ensure engagement with these farmers is to spend time building relationships with them to gain their trust, by engaging respected ‘champion farmers’ within the catchment who will take the lead and encourage others to take action or by advocating the financial benefits/ Capital Grant Scheme.

**Evaluation of Success**
The complexity by which the ECSFDI translates into changes in agricultural management and hence environmental benefits makes the measurement of success a difficult process. A number of issues should be noted:
- 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 and pollution incidents add further complexity
- the response time lengthens moving through the levels, since each is dependent on a response at previous levels.

At the catchment scale, predicted reductions in in-river phosphorus loads and concentrations were generally less than 5 per cent. Greater reductions were, however, predicted for some catchments or sub-catchments targeted for advice delivery (20%-30%). In isolation, the predicted changes are unlikely to secure significant additional compliance with WFD standards or guideline standards for SAC (Special Areas of Conservation) rivers. In combination with planned and future improvements to sewage treatment works and other pollution sources, it is possible that the predicted reductions to agricultural sources may be more significant in terms of achieving future compliance.

**Funding**
The Programme is constrained by its budget. Budget uncertainties have impacted on recruitment activities, as some good quality candidates have been discouraged from applying because jobs were only offered as an eight-month fixed term contract in the first instance.

4. Conclusions and Recommendations
The ECSFDI is delivering and testing an approach to the Advice element of the WFD policy package selected by Ministers for tackling DWPA. This consists of Advice + Incentive (Agri-Environment Schemes) + Regulation (Water Protection Zones).

In Phase 1 ECSFDI was successful in working with farmers and land managers to raise awareness of diffuse water pollution from agriculture and bring about voluntary mitigation (in priority catchments and elsewhere). Case studies illustrating some of the successes of ECSFDI are available on the Web\(^24\). Evidence of resulting changes in farm practices and farmer behaviours

are a key measure of success for the ECSFDI. These stand proxy for water quality benefits, which will feed through in time.

ECSFDI is important in facilitating synergy and strategic integration - i.e. through linkages with agri-environment schemes, cross compliance, water company actions and other policy drivers such as flood risk management, ecosystems approach, soil strategy, SSSI targets etc.

ECSFDI is currently scheduled to run until March 2011, when the approach to implementing the advice element of the WFD policy package will be reviewed. The development of policy for advice on reducing DWPA beyond this point will build on the successes of ECSFDI and lessons learnt.

5. References
ECSFDI Evaluation Report

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6. Appendices
Appendix 2.2.1: Map of ECSFDI Priority Catchments
Appendix 2.2.2: Targeting process for identifying high risk holdings
Appendix 2.2.1: Map of ECSFDI Priority Catchments
Appendix 2.2.2: Targeting process for identifying high risk holdings

Diagram showing the targeting process for identifying high risk holdings, with various criteria and steps detailed in the text.
1. Introduction

The Pandivere groundwater sub-river basin is one amongst the Estonian’s nine sub-river basins and three river basins designated by the Minister of the Environment Regulation No. 124 of 3 April 2001.

The preparation of the Pandivere groundwater sub-river basin water management plan started in 2001 before EU entrance. The plan was endorsed by the Minister of the Environment on 10 March 2005. Since then, the implementation has depended on economical opportunities. Due to the fast changes in Estonian economy, water management action plans have been continuously reconditioned in co-operation with local governments and other interested organisations.

The preparation of the specification of the Nitrate Vulnerable Zone (NVZ), protection regulations and action plan for the years 2004-2008 were carried out in parallel to the preparation of the Pandivere groundwater sub-river basin water management plan. The action plan for NVZ was endorsed on 30 April 2004. Due to the fact that the entire area of the Pandivere groundwater sub-river basin is located in NVZ, the main goal of the preparation of the NVZ action plan was the harmonisation of its objectives with the water management plan and the rural development plan.

The Water Framework Directive encourages the active involvement of all interested parties (Art.14). This principle and the collaboration at the local scale guided the preparation of the Pandivere groundwater sub-river basin water management plan. More detailed requirements on public consultation are brought in Water Act §38 (RT I 1994, 40, 655).

All preparations of the previously named action plans were carried out as public proceedings and different counterparties were involved since the early phase (2001). In the Pandivere area where agriculture is the most serious impact factor to the aquatic environment, representatives of farmers were among the earliest involved. The main objective of the involvement of public during the preparation of the water management plan was to ensure the protection of the water user interests in planning water management and the protection of the aquatic environment.

2. Public participation, involvement of farmers

Consistent training and availability of relevant information is necessary for the population and farmers to understand the risks in the aquatic environment.

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25 Rivers of four sub-river basins start from the peripheral area of the Pandivere groundwater sub-river basin. The part of groundwater in rivers run-off is very large and the article is focusing on the Pandivere sub-river basin dedicated to groundwater.

The first in-depth and systematic groundwater quality studies in the Pandivere region were performed at the end of 1980s, when water protection scheme was compiled for farmers’ organisations. During that study, hundreds of water samples from both central water networks and private household water intakes were collected and analysed. The results of the study were presented to the local population. That first study can be considered as preliminary work for the preparation of the water management plan and the communication with the public.

Constant groundwater quality observation in the Pandivere groundwater sub-river basin has been performed since 1988. The local government is notified about the results of the observations and they in turn can deliver the information to the local population and farmers.

The first substantial publication on the Pandivere region groundwater conservation was printed in co-operation with Central-Finland environmental colleagues in 1993. A catalogue introducing the Pandivere karst and springs was compiled in 1994 (amended in 2002).

The digital maps of protection, restriction and sensitive areas regarding water were compiled in 2004 (among others: karst and spring locations, regions with unprotected groundwater and slope areas). Regio Ltd. compiled maps where the Pandivere region was divided according to rural municipalities. 120 maps sets were printed and distributed to NVZ’s local governments, the environmental authority, the Estonian Agricultural Registers and Information Board, the Environmental Inspectorate and to the biggest holdings. At the same time maps of NVZ with highlighted and explained restriction zones were disseminated through national and county newspapers. The NVZ web map application is available in Estonian Land Board map server since 2006 (www.maaamet.ee).

The elaboration of the Pandivere groundwater sub-river basin water management plan started in 2001, in co-operation with local governments. Questionnaires were used (following different methods: E-mail, interviews by telephone and face to face interviews) for mapping the main problems. After analysing the results, public discussion involving the local governments, farmers’ organisations and local population was organised. Environmental specialists and experts studied the most problematic issues on site and participated in several village meetings. Many workshops for different target groups (farmers, students and teachers, state and local government specialists and other interested persons) were organised. During the preparation of the water management plan, several information and data forms were compiled: maps with potentially hazardous issues, springs and karst, nature conservation issues and land improvement issues, as well as special package leaflets for farmers introducing the problems in groundwater protection.

The most successful events were conference tables held in 2003-2006. Different organisations were invited such as local governments, land improvement bureaus, the Health Protection Inspectorate, the Environmental Inspectorate, the Ministry of the Environment, the biggest Farmer’s Association, and other interested organisations’ representatives.
Information about the water management plan preparation has been available in our Internet homepage (www.envir.ee/vesikonnad) since 2003.

Introducing the package leaflet about the Pandivere groundwater sub-river basin water management plan had also an important influence (printed in 2005). It was distributed during workshops and to environmental authorities.

**Long-term trainings** for farmers took place in autumn-winter periods during 2005-2006. Trainings covered different environmental topics such as air, soil, water, environmental permits, and environmental supervising. Training on NVZ thematic for farmers lasted 9 days in autumn 2005 and 12 days in 2006. Both years the training program included a field excursion to the holding where potential problems were detected and where solutions were studied. Workshops on water protection issues were held in Järvamaa County and were organised by Järvamaa Environmental Authority. Altogether 190 farmers based in NVZ participated in different workshops, where information and advising materials were distributed to participants.

![Figure 2.2.2: Examples of package leaflets](image)

Workshops have been held according to specific needs such as application of the integrated environmental permit or implementation of the best available techniques.

The goals, actions, expected outcomes and water protection measures of the Pandivere groundwater sub-river basin water management plan were introduced in all trainings hold in Pandivere.

Each year the sub-river management plan’s measure plan is updated and all interested parts can make correction proposals. Information is sent by e-mail, disseminated in newspapers and is available on our web page.

Data about seminars and other public meetings participated by farmers is given in Table 2.2.3.
Table 2.2.3: Seminars and other public meetings about the Pandivere groundwater sub-river basin water management plan participated by farmers or their representatives.

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<th>Meetings held during the preparation of the Pandivere groundwater sub-river basin water management plan</th>
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<th>Meetings held during the endorsement of the Pandivere groundwater sub-river basin water management plan</th>
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<td>30 September 2008</td>
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3. Conclusions and recommendations

Relying on the experience one could conclude that preserving the good status of the environment in the Pandivere groundwater sub-river basin, the development of rural life and the farming system can be only achieved through training and supervising. Although not knowing the regulations does not exempt from the liability of compensation for environmental damage, awareness and knowledge enable farmers and the public to comply with environmental claims.

Environmental education is also an important issue and a spring excursion was organised in 2009 where the local primary school pupils visited farms. During the filed trip the issues of the Pandivere area groundwater conservation were introduced to them. Some of those pupils will become farmers in the future.

Thus, constant information delivery, training of farmers and population linked to water protection and usage should continue. In addition, better co-operation between farmer’s association and agricultural consultants in implementation of PRB management plan is needed.

Thoughts from workshop participants:

Representative of local government Teet Koitjärv: “the Pandivere groundwater sub-river basin water management plan process is the only place where local government specialists have the opportunity to present their viewpoints according to environmental issues and this influences the future water management. That opportunity is important because the Pandivere region is divided between two different counties and numerous local governments which complicate the county
environmental services to be up to date in the fast changing situation. Although the vision in many of the local government level specialists may be still vague, more and more environmental specialists are appointed and are able to co-operate with county environmental officials. Thus specialists in local government level are already able to provide adequate information to persons taking part in the process”.

Aivar Pikkmets (Farmer, Mätliku farm): “It is vastly important to include professional advisers to agricultural process and to participate in different workshops. Professional advice and experience has to be implemented by farmers and additionally more experienced farmer can also rely on his intuitions. In the future I will try to implement knowledge attained from the workshops in my own household.”

Mart Kukk (agricultural consultant): “The main benefit from the trainings and seminars to both the farmers and the consultants is an increase of knowledge and awareness. Before joining the European Union, environmental protection was less discussed and environmental actions were not financed. Now, knowledge and even public interest have risen.”

The compiling of Estonian River Basin Plans is today in final stage and the public display of the River Basin Plans and the public discussion will be performed, as it was performed for sub-river basin plans.

The farmers from Pandivere groundwater sub-river basin area are well informed and today they participate more actively in the elaboration of River Basin Plans.

5. References

- Pandivere põhjavee alamvesikonna veemajanduskava, [http://www.envir.ee/vesikonnad/?op=body&id=71](http://www.envir.ee/vesikonnad/?op=body&id=71)
- Good Agricultural Practice, [http://www.agri.ee/infomaterjalid-juhendid](http://www.agri.ee/infomaterjalid-juhendid)
WFD related public participation in the Upper-Tisza region, Hungary
Case study

By Laurice Ereifej, WWF Hungary and József Gayer, Ministry of Environment and Water, Hungary

1. Introduction

For the successful implementation of the Water Framework Directive (WFD) a close cooperation is necessary among experts and organisations involved or interested in the river basin management planning (RBMP) – in short among all stakeholders. The first WFD compatible public participation (PP) strategy for Hungary was developed in 2006. The strategy points out that river basin management planning must be harmonised with all other development programs effecting water resources management.

The strategy was tested in the Upper-Tisza pilot area during the first half of 2007 with the aim to finalise it by capitalising on the gained experiences. This pilot project was the first in Hungary that fulfilled the WFD PP requirements in the most complex and complete way. The methodology was elaborated by a multi-disciplinary team of hydrologists, economists, ecologists, sociologists, and communication specialists.

To plan and carry out the PP procedure a PP team (including communication experts and sociologists) was established, which closely collaborated with the planning team (including hydrologists, economists, and ecologists) in the course of the project. In addition to drawing on EU guidelines and international experiences, the selection of PP techniques was based on empirical research, and the effectiveness of the tools was continuously monitored.

According to the WFD the planning and public participation process was divided into three stages:
- defining the work plan and schedule,
- identifying the significant water-related issues, i.e., reasons of deviations from the good ecological status,
- defining and evaluating measures for solving the problems.

The methodology implied the involvement of the public in each stage of the above process.

Characteristics of the pilot region

The pilot area in the Upper Tisza region covers 3200 km² with 163,000 inhabitants. The Upper Tisza region (160, predominantly small settlements) is among the poorest areas of Hungary. The rate of unemployment is around 12% compared to the country average of 6% (data valid for 2007). The area is predominantly rural, and in rural settlements the majority of the active population is employed in agriculture. Incomes in this sector are typically small, and agriculture by itself cannot support the local population. Frequent floods of the Tisza River and its tributaries and standing (excess) water have aggravated this situation considerably. On the other hand, the region has a large and underused potential for recreation, tourism, as well as nature conservation. There are pristine, almost untouched areas surrounding the meandering Tisza, and its floodplain is sprinkled with old villages, traditional farms and historic buildings. Water sports have developed intensively; however, infrastructure supporting recreation and tourism remains underdeveloped. Due to inheritance of frequent upstream contamination, there is large uncertainty about the future of tourism in the region.
2. The PP process in the pilot area

Due to the lack of time and resources, the target audience was mainly organisations who were contacted directly via letters, emails, phone calls and invited to comment the consultation documents in writing and/or participate on the fora. The local inhabitants (individuals) were contacted through the media, posters and a short leaflet. They were not invited directly to the fora, but were welcome if they could participate. A project website was set up with all the information needed for the public participation. The most important documents were made available throughout the project.

At the beginning of the process a stakeholder list was elaborated with all the potentially interested organisations (regional governments, local municipalities, scientific institutions, professional bodies, civil society organisations, main water suppliers, water associations, business organisations: agriculture, forestry, fishery, tourism, industry), and regional development agencies. In total, a list of approximately 450 organisations was compiled.

Public consultation of the timetable and work programme of the RBMP

Method
The first round of the public participation process was organised between February and March 2007. The PP team published the first consultation document, which contained a short summary about the goals of the WFD, the phases of the pilot area planning, as well as the possibilities for obtaining information and providing feedback on behalf of the stakeholders and the general public. A small local media campaign called the attention to the consultations, the accessibility of the consultation document, and possibilities for commenting on. Posters containing similar information were placed in local government offices and other public institutions, and leaflets were delivered to each household in the pilot area. The consultation document was placed on the website of the project. In addition, it was posted to the selected local/regional stakeholder organisations, which were requested to provide their opinion.

Results
Approximately 50 comments or filled questionnaires were received in the first round. The most interesting outcome was the proposal to organise fora not only for the representatives of stakeholder organisations but also for local inhabitants, providing thereby the possibilities of personal meeting with the planning team for the citizens showing interest. The PP team were unable to completely fulfil this proposal during the pilot project – in the lack of time and
resources – but it was built into the PP methodology recommended for the national river basin management planning.

**Discussing the most significant water management problems**

**Method**

The second round of the PP process took place in April–May 2007. It started with the elaboration of the second consultation document. It provided a short description of the most significant water management problems, together with explanation of their main causes, for five sub-regions within the pilot area. Comments were invited from the public regarding both the problems and the causes, and they were also asked to comment on the importance of the individual problems for the given sub-region. The report was displayed in the municipalities and was put on the website. Publication of the report was followed by a second, smaller media campaign and the repeated display of posters. In this round, fora were also organised for the representatives of local and regional stakeholder organisations, where participants had the opportunity of having a direct dialogue with the planners. Stakeholder fora were held at three locations, where approximately 130 persons took part altogether.

**Results**

Some important observations regarding water-related problems, which surfaced at the fora and have agricultural aspects:

1. The first group of the problems was related to the narrow floodway as a result of the former regulation of the Tisza River and its tributaries, the deterioration of the connections between the main riverbed, the floodplain, the side arms and the oxbows. The aims of the river regulations performed about 150 years ago were predominantly flood protection and gaining additional agricultural areas. This, however, resulted in the deterioration of the ecological status of the floodplain while the oxbows in the flood-protected areas have been threatened by quick filling-up in lack of fresh water supply. A related problem is the excessive draining of stagnant waters for the sake of agricultural production, which results in tapping the groundwaters and jeopardising the aquatic habitats.

   • Ecological perspective (represented primarily by environmentalists, but it is close to the spirit of the WFD, as well): The rivers should get back their floodplain, and the connections between the river, its side arms, oxbows and the floodplain should be restored. This would decrease ecological vulnerability of the area, while re-naturalisation may bring significant advantages for tourism, as well. Waters should be retained preferably in the deeper areas (oxbows, lakes) in a semi-natural way. Instead of the quick drainage of flood waves and standing waters, cultivation methods are to be implemented adjusting to the possibilities provided by nature, i.e., extensive farming (fruit growing, animal keeping, fishery, forestry) should be preferred instead of seed-growing.

   • Farming perspective (represented predominantly by stakeholders involved in agricultural production): There is not much industry in this region; the majority of people live on agriculture. Floods and stagnant waters cause problems in spring and autumn, and drought is a serious issue in summer. The present (predominantly arable) farming requires draining the waters off the lands as quickly as possible in wet seasons, however, irrigation would be required during drought. In case people are to adopt another type of farming because their lands are requested for emergency flood reservoirs or water retention, they should get adequate compensation. In case people see their living secured, they will be willing to change.
2. The next group of problems covered water contamination of domestic origin. The planners identified the main household- and agricultural pollution sources in the region, as well as typical contamination events of foreign origin. With regard to household pollution, some participants emphasised that no financing will be provided at governmental level for the wastewater sewerage of settlements below 2000 inhabitants until 2015–2020. This is seen as a serious problem because municipalities are unable to solve it out of own resources. Participants expressed less negative views on the contamination of agricultural origin, since it is associated with income-gaining activity. They called the attention that additional burdens imposed on farmers by more stringent rules may be detrimental for certain sectors, for example animal husbandry.

Public consultation of potential measures

At this round, first an informal meeting was organised where planners discussed potential measures with a small group of stakeholders (e.g., environmentalists, representatives of forestry and the regional agricultural authority), who had indicated in the previous round that they would like to put forth their own proposals for consideration. Planners incorporated some of these ideas in the set of the potential measures. Next, measures were analysed in terms of costs and expected impacts.

The final round of PP started with the publication of the third consultation document summarising the analysis of potential measures in July 2007. Publication of the document was followed by a third, smaller media campaign and the repeated display of posters. Again, it could be commented on in writing, and three stakeholder fora were organised. There were altogether 120 participants in the three fora.

At the end of the fora organisers asked the participants to evaluate each of the proposed measures in terms of environmental/health risks, soundness of financing and overall support for the given measure. Based on the discussions the planning team selected a set of interventions for reaching the good ecological state.

Results

Some important observations which surfaced at the fora and have agricultural aspects:

Discussions at the related forum indicated that participants unambiguously supported most of the proposed measures. However, measures coupled with changing the land use represented an exception. These would be accepted by farmers only if lost incomes would be compensated. Stakeholders responsible for the maintenance of stagnant water drainage canals (water associations, water directorates) are also counter-interested, since in case of land use change there would be less need for their services.

It was also concluded that the level of support for the measures is high, although participants have forecasted rather high environmental/health risks and financial uncertainties with some measures. With measure “revitalisation of the side arms” the participants appear to regard gentle (controlled) inundation as the best solution, although representatives of water associations and water directorates rated this solution lower than other variants. The measure “land use change” would be least supported by those (farmers, agricultural authority) who would (at least partially) bear its costs.
Lessons learned at stakeholder fora

The involvement of some type of stakeholders was a challenge. One is the representatives of the agriculture sector. Despite that different agriculture organisations (official bodies, chambers, alliances, research and education institutes) were directly informed and invited to the consultations, their participation was poor. This also shows that the need of highlighting the relation between WFD (the status of waters) and the agriculture is essential. The Water Framework Directive is not only about water. All the human activities that affect the natural waters will be modified by the WFD.

At all meetings, planners and stakeholders repeatedly raised the uncertainties concerning the future of the WFD. The most important uncertainty is related to the question of how the solution of the water-related problems will be financed.

A part of the comments referred to recent initiatives associated with flood protection, which – in spite of the vivid local campaigns and PP – had limited specific results on the ground. It seems that trust in policy makers has shrunk significantly in the region. For that very reason participants welcomed the openness of the planners and the fact that they were taken by planners as partners. However, they indicated that confidence can be restored only if the proposed – and apparently supported – measures will be implemented indeed.

At the end of the meetings participants filled out a questionnaire to evaluate the fora (e.g., timing, organisation, structure) and supporting documents (e.g., clarity, sufficiency of commenting period). The evaluations were positive as a rule. Some examples on what was considered as the most useful part of the fora: ‘the joint thinking’ ‘the mutual sincerity and comments.’ ‘The forum itself, in other words presenting and clashing the views.’ ‘The debate – it was colourful and exciting.’ ‘I liked the all-round professionalism and the lack of partisan approaches’.

As for the critics, most of the objections were given to the structure of the meetings. Since several sub-regions were covered during each forum, and there was overlapping between the problems of the various sub-regions, cross-regional problems came to the surface unavoidably. This made presentations sometimes too complex and lengthy. It was also criticised by several people that the fora lasted too long. These problems can be handled by assigning a separate forum for each sub-region.

An interesting phenomenon was the willingness to compromise on behalf of most participants. Several people indicated: they were aware that an optimum solution from the viewpoint of the stakeholder organisation they represented was fairly unlikely; therefore they were ready to agree on a mutually acceptable solution.

An important result of the dialogue was that locals provided information for the planning process that was new even for the planners. The latter obtained knowledge of a number of local development ideas, or projects already in progress. On the other hand, some participants emphasised that they had obtained a lot of useful information during the discussions, to think on further.

The carrying out of the pilot project coincided with the first round of the Article 14 consultations on the river basin management planning work programme and time schedule in the country, therefore the final version of the Hungarian PP strategy can be considered as the result of the two processes.

3. Acknowledgement

The authors are thankful for the professional support of Anna Vári of the Institute of Sociology, Hungarian Academy of Sciences.
1. Introduction (Challenges and characteristics regarding the issue)

The public participation process is one of the main elements of the WFD. To fulfil its different functions it needs to be carried out at different spatial scales. In general, three forms of participation have to be implemented: information, consultation and active involvement. In the Weser River Basin the general public is informed especially at the levels of the river basin district and the sub basins. For the official consultation process the river basin institutions are responsible. The active involvement of stakeholders takes places at all scales, from the river basin level at the top scale to the sub unit and its management units at the bottom scale. Sub units in the Weser River Basin are defined by hydrological borders and their size varies between 1.700 and 9.200 km². This structure of public participation at different scales serves a procedure in which top-down the framework for major specific issues are developed and bottom-up the interests of local and regional stakeholders are taken into consideration. Consequently, the main tasks at river basin level are the coordination of the process and the development of overall strategies, whereas at the level of the sub-unit and below the strong identification of the people with rivers and streams in their area supplies concrete input into the management of water bodies.

In the Weser River Basin round tables have been set up at sub unit level and management units below to ensure the active involvement of stakeholders. Moreover, at river basin or sub basin level advisory boards have been established to find solutions with stakeholders at larger scale which have to be considered in the top-down process. In the following the example of Lower Saxony and its area co-operations is described to present a regional public participation process.

Public participation has been taken further in some co-operation projects that have been carried out for years to ensure the implementation of measures to improve the quality of drinking water in protected areas. This co-operation process can serve as an example for the implementation of measures according to the WFD in other areas and for the involvement of stakeholders, especially
of farmers. In 2.3, the co-operation with farmers in drinking water protection areas in Lower Saxony is described in more detail.

2. Approach, solutions and implementations

In Lower Saxony, which covers 60 % of the Weser basin area, the active involvement at regional level takes place in 28 round table working groups, the so called area co-operations of which 17 are situated in the Weser River Basin. These are composed of about 15 members who represent different regional organisations including water management, agriculture, nature conservation, municipalities and water suppliers. The round tables were set-up in 2005 as long-term institutions by the Ministry of Environment of Lower Saxony and the water management authorities as a regional and direct form of active involvement (Niedersächsisches Umweltministerium 2005). These cover each a “working area” of 1,500 to 2,500 km². They are assigned to sub-catchments of the river basin and have the task to contribute to the implementation of the WFD regarding surface waters. Even though the official consultation process is carried out at the level of the river basin district, which can also influence the implementation of the WFD, important discussions and weighing of interests are expected to take place at these round tables (Kastens & Newig 2008). With the knowledge of local and regional stakeholders and experts, the co-operations are supporting the development of specific and innovative measures for their region. With this intention the area co-operation can be regarded as the most important instrument of stakeholder involvement in Lower Saxony (Matthies 2007).

In the special case of the agricultural sector, representatives are the Chamber of Agriculture and as NGO the farmers’ association “Landvolk”. The Chamber of Agriculture does both, representing the interests of agriculture and acting as an official authority with controlling and administrative tasks. The water maintenance boards are responsible for maintaining the structures and permanent flow and therefore connect water management and agriculture. Water suppliers are important stakeholders with respects to agricultural pressures as they are responsible for providing clean drinking water which in Lower Saxony is mostly taken from groundwater. Especially with the regionally well organised Landvolk association local farmers’ interests are well represented.

As groundwater protection has been carried out and funded intensively in so called drinking water co-operations since 1992, the public participation process of the WFD could be based on good experiences of agricultural and water supply stakeholders and water management authorities. However, experience, trust and knowledge gained in these co-operations predominantly refers to the aspect of nitrate pollution in groundwater (Newig et. al. 2007), was limited to the drinking water protection areas and the funding of compensation payments to farmers was secured with money from water abstraction fees. When implementing the WFD, the challenge was and still is to ensure a participation process covering the entire area, all concerned stakeholder and various pressures.

The variety of pressures implies that specific topics have to be dealt with which normally the representatives cannot cover entirely with their knowledge. Consequently, on the one hand capacity building needs to take place to ensure a discussion at eye level. On the other hand, it could be a support to prepare and accompany round tables with the contribution from regional stakeholder conferences. This way, every interested and competent person would have the chance to discuss certain issues and give an input to the round tables on specific topics.

The active involvement not only concerns the development of measures but also the identification of regionally specific significant water management issues, regional and local objectives, the
designation of Heavily Modified Water Bodies (HMWB) and Artificial Water Bodies (AWB). Furthermore, the round tables accompanied the elaboration of monitoring concepts. Decisions of these round tables are regarded as recommendation and the final deciding authority is the Ministry of Environment. But with their tasks and their role, the area co-operations are involved in the decision-making process and with that they are able to give the implementation of the WFD a strong impetus in their area.

During the first WFD management period, predominantly measures to improve hydromorphological conditions have been identified and decided upon. Pressures on groundwater and nutrient inputs were not dealt with in the area co-operations with the purpose of identifying consequent measures. For groundwater bodies, technical measures have been identified by experts from different institutions. The application of these measures is connected to the establishment and implementation of agri-environmental funding schemes and, therefore, relies on the willingness of farmers.

As far as measures to improve hydromorphology and river continuity in surface waters are concerned, the present programme of measures in Lower Saxony is based on the suggestions of the area co-operations. The programme provides summarised information on the measure type, the availability in each sub unit and the possibility of implementation until 2015.

An evaluation of the round tables in Lower Saxony carried out in 2007 came to the conclusion that the stakeholders themselves regarded round tables as an effective mean for active participation and, according to the analyses, there are signs that successful social learning took place. However, regarding the selection of right measures to achieve the goals of the WFD potential conflicts due to different interests can be expected especially if the financing is unclear (Borowski et. al 2008).

3. Conclusions and recommendations

Round tables are an important instrument for successful public participation in line with the stipulations of the WFD and its principles of subsidiarity and active involvement. However, the WFD’s request to encourage active involvement is new in respect of implementing directives and the demands on the involved people are very high. The quality of the involvement in such a bottom up process depends largely on the professional background, the capacity building skills but also on the personal engagement of local and regional people.

The CIS guideline for the participation process contributes to a common understanding. (CIS Guidance No. 8 on Public Participation in Relation to the Water Framework Directive 2003). Other guidelines provide support with the technical implementation of the process (e.g. a guideline for local communities implementing the WFD published by the DWA 2008).

From the actual WFD participation process in the area co-operations some recommendations and conclusions can be drawn (inter alia Ridder et. al. 2007; I-Five project – first results27):

• Comprehensive information is necessary to enable stakeholders to learn and to make decisions (e.g. maps, description of deficits and their cause) and is more important than distributing plentiful of information.

27 I-Five project: Innovative Instruments and Institutions in Implementing the WFD, http://www.i-five.eu
Accordingly, information before and after each meeting, including a documentation of the meeting itself, has to be made available in time and with easy access.

It is recommended to limit the number of participants to about 10 permanent representatives. Otherwise the round table could become too big to achieve a working group atmosphere and consequent results.

As professionals and volunteers are involved, there might be a difference in background knowledge and consequently an imbalanced representation of interests. The round table representatives need to be enabled to discuss at eye level.

“Open” regional conferences would enable all concerned stakeholders to discuss specific topics as preparation and support of the round tables.

Information on the (possible) financing of measures needs to be provided.

It has to be taken good care that all concerned interests are represented (e.g. if nature conservation cannot be represented by a local NGO, a municipal or state authority could be in charge).

Transparency is important as to how the input of the round table has been dealt with, what decisions are finally made and how the measures will be implemented.

Good and regular information of the general public can have a positive effect on people’s awareness of water protection issues but is also important to gain people’s acceptance for expensive measures. Additionally, public relation work can facilitate the implementation process by achieving the support of political decision makers.

4. References


2.3 Workshop outcomes\textsuperscript{28}

The third workshop entitled “Implementation of the WFD – Strategies and approaches”, held in Kirchdorf (Germany, May 2009), addressed amongst others the question of the involvement of the agricultural sector in the participation process. Indeed, the success of the measures largely depends on farmer’s involvement. Some experiences (DK, HU) described in the articles were presented and discussed.

Christina Aue, from the Water Board of Oldenburg and East Frisia (Germany), completed the session by presenting their experience in cooperation and voluntary agreements in drinking water protection areas. They started to establish this concept in 1989 and it was financed by a fee paid by water users. After an amendment to the federal lower-saxonian act in 1992, a decree was released in 1994 to enhance cooperation between agriculture and water management with the aim to prevent pollution of drinking water and avoid cleaning procedures. In 1995, a water protection degree completed the legislative package.

The water suppliers as public bodies were the drivers of the process, backed by the public opinion in the late 80ies of the last century. Contamination of groundwater was not acceptable and therefore treatment of water was not seen as a favoured solution. A public discussion (press articles, panel discussions) and involvement of all stakeholders groups was necessary and rising awareness is still important. In the beginning, the authorities were very important as moderators between water suppliers and farmers. A lot of data were necessary to demonstrate and illustrate the issue. The status of water protection areas also underlined the high value of the scheme. It was also of high importance that the farmers were not seen by the public as “the bad guys”, but as the ones who are contributing to the scheme successfully. They are working on the plots. Without their co-operation no success would have been achieved. Finally, the release of the “water-penny” fee created the basis for the programme. Without funding, collaboration would not have been realised. On the way, farmers learnt to appreciate the money they get from participation in the scheme as secure income especially in either hot or dry years, when there was a decline in yield. The long term aspect of the scheme and also the personality of the adviser and his long-lasting presence are very important. The scheme should also be a long-lasting option, because it takes time until farmers are convinced to contribute. It is also important to have a bunch of measures, because flexibility is necessary as well as the aspect of voluntariness from the farmers’ perspective.

\textsuperscript{28} All presentations are available here: http://prb-water-agri.jrc.ec.europa.eu/Prb-agri/documents/open-section/workshop-documentation
Participants drafted altogether the conclusions of the round table session. The main points on how to get the agricultural sector involved are listed hereafter.

Summary of the main challenges and concerns expressed by the participants (Kirchdorf, Germany, May 2009):

- **Time is needed for the involvement of farmers /for change**
- **Dialogue with all farmers (education) is necessary**
- **Innovative approach to engage stakeholders**
  Innovative approach (as the role play presented by DK) can help in giving impetus to participation, dialogue and involvement.
- **Effective co-operation between the administration for water resource management and agriculture at all levels** is needed (i.e. Lower Saxony).
- **More interdisciplinarity in developing the strategies and the discussion process**
  Farmers have to trust authorities to get involved and an interdisciplinary team is needed to develop the strategy and the discussion process (involving sociologists, communication experts, agronomists…).
- **Feedback from decision makers to farmers and the other way round**
  If decisions makers ask farmers for feedback (eg: on measures) then decision makers should inform farmers on how the consultation results have been taken on board.
- **Hook: money, business interests, to prevent stricter regulations…**
  To arouse farmers’ interest, messages (or hook: acting now to prevent stricter regulation, save money by reducing running costs, eligibility to a grant system...) and strategies (one or two farmers acting as ice breakers) have to be tailored to them.
2.4 Main conclusions

As main pressures against the achievement of the WFD come from agriculture, it is therefore clear that an early involvement of the sector at all scales and its commitments towards plans will heavily facilitate the Directive implementation and the goals achievement. Experiences that are shared in this chapter present different participation strategies and their implementation. All in all, they give a picture on how the public participation and farmers involvement is working on the ground and the challenge involved.

The approach to public participation should be context specific and adapted to the institutional, socioeconomic and environmental context of the river basin. However, common rules or guidelines do not exist. Even at a river basin scale, the level of success of a given method can vary between geographical zones. In the examples shared, public participation process have sometimes led to the creation of more permanent participation organisations, as the establishment of the Observatory for Sustainable Development under the Prefectural Authorities (Greece) or the round table set-up in 2005 as long-term institutions by the Ministry of Environment of Lower Saxony and the water management authorities (Germany). Pilots projects were carried-out to explore the more appropriate paths (Hungary), a Life project has supported the participation process (Envifriendly, Evrotas) or early measures were implemented to prevent the failure of WFD objectives and develop linkages with river basin management planning, as in the case of the England Catchment Sensitive Farming Delivery Initiative, where advice is delivered to farmers in priority areas. Planners are working hard on the public participation issue as it is a tool to achieve the environmental objectives of the WFD. A good understanding, knowledge and commitment from stakeholders will ensure an efficient implementation.

More generally, to reach this objective and create the required participatory know-how, combination of passive (website, leaflet, posters, press release, radio…) and active tools (meetings, demonstration, role play…) is seen as necessary. Due to the inexperience in participatory procedures and/or because of the large scope of potential stakeholders, the solution of setting-up multidisciplinary teams was often chosen (putting together sociologists, communications experts, hydrologists, agronomists, ecologists…). Innovative approaches, like the role play carried out in a virtual catchment to avoid focussing on potential local conflicts, show good results in common understanding among the stakeholders. In order to get an effective and continuous process attention should be paid to legitimacy (make the process representative of all interests), transparency and feed-back information (on progress and how comments are taken on board).

Frequently, the main challenge is about rebuilding trust to enhance participation – perhaps more than interest- between planners, farmers and local population. As it has been said, it is of high importance that the farmers are not seen by the public as the “bad guys”, but as the ones who are contributing to the scheme successfully. At the same time, farmers should understand and be conscious that they have a key role to play in the WFD. Nevertheless, involvement of the agricultural sector is often a challenge. At the PRB-AGRI workshop, it was said that the long term aspect of the scheme, the personality of the adviser and his long-lasting presence are very important. Time is needed for the involvement of farmers. It is also crucial to have a bunch of measures to ensure flexibility and an adapted funding system should be proposed. The dialogue should include all farmers and strategies and messages have to be tailored to them. Only by involving farmers, changes will be facilitated.
Chapter 3: Monitoring and evaluation of measures

Experience shared by:
Pandivere (EE) and the UK – Network of catchments

3.1 Introduction

The Water Framework Directive (WFD) requires the implementation of operational monitoring programmes to ensure a comprehensive overview of water status within each river basin district (surveillance, operational and investigative monitoring). In place since end 2006, these systems will allow to evaluate the effects of the programme of measures (PoM). Members were invited to share their experience both on monitoring the implementation of the PoM and the evaluation of its effect on the environment. With the WFD implementation, a dynamic process has started where RBMP will be reviewed and updated every six years. On the one hand, evaluation and monitoring should ensure that the implemented plan is in line with the objectives and effective and, on the other hand, it should consider that pressures or response to pressures could change (new measures could be added to the programme of measures, other inefficient measures taken on board by farmers could be removed …).
3.2 Articles from PRB-AGRI network members

Pandivere (EE)

Monitoring and assessment of agri-environmental measures in Pandivere groundwater sub-district

By Milvi Aun, Environmental Board, Coordinator of water management,
Tiiu Valdmaa, water management expert, Maves Ltd

1. Groundwater and surface water monitoring

According to the Water Framework Directive, the monitoring programmes should provide a coherent and comprehensive overview of the water status. Monitoring results must afford to distinguish long-term trends of surface and groundwater bodies in natural conditions (monitoring of reference water bodies) and in regions with intensive human impact.

The Pandivere groundwater sub-district constitutes about ¼ of the Pandivere and Adavere-Põltsamaa nitrate vulnerable zone (NVZ). According to the EU Nitrates Directive requirements, the monitoring results shall give a possibility to assess the effectiveness of the NVZ action programme and to examine the impact of changes in agricultural activities on nitrate runoff into surface water and groundwater at river basin, sub-basin and field level.

The monitoring programme for the Pandivere groundwater sub-district is compiled in the way to enable the assessment of the effectiveness of both the measures of the water management plan and the NVZ action programme in their common goal – achieving good status of all waters.

The main distinctive feature of the Pandivere region is widespread karst and scarcity of surface water bodies. Rivers in Pandivere begin usually from karst springs and get its water from groundwater in summer and during winter low-water period.

In the present overview, the main focus is given to the monitoring of surface and groundwater bodies with significant agricultural impact. The water abstraction from groundwater or surface water bodies for agricultural needs is not significant in the Pandivere region and has no considerable impact on water quality.

Groundwater monitoring gives the initial data for planning sustainable groundwater use and assessing the quality of groundwater and its suitability for drinking water supply. The monitoring data obtained from hydrological and hydrochemical monitoring of inland water bodies enable to assess the physicochemical status of rivers, indicate and predict possible trends and analyse the relationship of those with human activities and natural changes.

Explorations carried out in the frame of monitoring programmes give also a possibility to identify pollution sources, assess the status of groundwater in polluted and risky regions in order to design water protection measures.
Groundwater monitoring

When selecting groundwater monitoring stations in the Pandivere groundwater sub-district, the peculiarities of the region were taken into account. Karst springs, which open in border areas of Pandivere upland, characterise quite well the groundwater nitrate content. In the central part of the region, where there are no springs, drilled wells are used for monitoring purposes. The water quality of a single well describes the status of groundwater on a much smaller scale than karst springs do. Water quality of the well depends also on the well construction and water abstraction and is more easily impacted by local pollution sources. In the selection of monitoring wells, it was taken into account that nitrate content from upper layers of groundwater depends on the nitrate content of precipitation. Monitoring results from Lavi spring, getting its water from forested area, particularly describe well the above mentioned situation. The majority of monitoring stations reflect the impact of agricultural diffuse pollution.

The monitoring frequency in the Pandivere region is 4 times per year for 25 sampling sites, once a year for other 50 sampling points completed by 30 sampling sites to get additional information on water quality of upper layers of groundwater. The number of monitoring stations, where samples are taken 4 times per year, will be increased up to 40-45 by 2012. The indicators determined in groundwater samples are: pH, electrical conductivity, O₂, NO₃, NO₂, NH₄, Cl and SO₄.

Surface water monitoring

The network of water courses in the region is sparse due to the widespread karst formations. The water quality of upper courses of river, which begin from karst springs, is monitored. These sampling sites give information about agricultural impact on water quality, primarily for summer and winter low-water periods. Sometimes there can be problems to collect a representative sample due to the shortage of water.

The surface water monitoring programme is presented in Table 3.2.1. The following parameters are measured: temperature, suspended solids, pH, O₂, O₂%, BOD₅, CODMn, NH₄, NO₂, NO₃, N_total, PO₄, P_total, Fe, Si, SO₄, Cl, Ca, Mg, Na, K, HCO₃, electrical conductivity and colour.

Table 3.2.1: Surface water monitoring programme in Pandivere groundwater sub-river basin

<table>
<thead>
<tr>
<th>Sampling site</th>
<th>Water body</th>
<th>Monitoring frequency per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varangu</td>
<td>Preedi River</td>
<td>12</td>
</tr>
<tr>
<td>Lavi</td>
<td>Kunda V</td>
<td>12</td>
</tr>
<tr>
<td>Porkuni</td>
<td>Valgejõgi River</td>
<td>6</td>
</tr>
<tr>
<td>Vodja</td>
<td>Vodja River</td>
<td>6</td>
</tr>
<tr>
<td>Jäneda</td>
<td>Jänijõgi River</td>
<td>12(24)</td>
</tr>
<tr>
<td>Oostriku</td>
<td>Oostriku River</td>
<td>12</td>
</tr>
</tbody>
</table>

Surface water samples are collected during every hydrological period. The investigations have proven that the variation of nutrient content in water courses with agricultural catchment areas has been quite small in Estonia. Therefore, the sampling frequency 6-12 times per year (24 times in automatic station) is sufficient to describe the water quality and the trends. For more exact determination of agricultural load the sampling frequency during flood periods should be increased up to 24 in some sampling stations.

Drain water and soil sampling was started in 2007. These investigations are integrated with groundwater and surface water monitoring programmes. For monitoring drain water quality, two fields have been chosen. The samples, from which the content of NO₃⁻, NH₄⁺, K, P, SO₄²⁻ is
determined, are collected every two weeks, the flow rate is measured on a weekly basis. Based on drain water analyses and flow rate measurements, the leaching of nutrients is calculated. Soil samples to determine the concentration of ions available for plants are collected yearly. The analysis of field records and leaching data indicate how different fertilising and crop rotation impact the environment in long-term perspective.

The aim of soil monitoring is to identify the dynamics of mobile forms of nitrogen (nitrate, ammoniacal nitrogen) in the soil, depending on soil temperature and soil moisture, in order to examine the leaching risk by different land uses and under different weather conditions. There are 3 sampling sites in the Pandivere region. Their selection takes into account the location of groundwater drain water monitoring sites, which enable to monitor nitrate content and dynamics in the soil, groundwater and surface water simultaneously. The data about dynamics of soil characteristics is important to forecast the nitrate leaching risk by different land use.

Soil samples for determination of background values are taken twice a year – before sowing in spring and after harvesting in autumn. From these samples the pesticides and polycyclic aromatic hydrocarbons (PAH) content is also measured. The soil samples are collected near groundwater sampling sites. Pesticides and PAH residuals are measured simultaneously.

Monitoring results give a possibility to describe the dynamics of nitrogen compounds and SO$_4$ in the soil during the year, depending on crop rotation. They give also the possibility to assess the risk of potential leaching, which gives important information for elaboration of environmental measures. In addition, data about pesticides content and PAH-s in the soils of nitrate vulnerable area is obtained and the risk of soil contamination is assessed.

**Map3.2.1: Location of sampling sites in Pandivere groundwater sub-district**
2. Monitoring and assessment of the programme of measures

The programme of measures of the Pandivere groundwater sub-district water management plan consists of basic and supplementary measures. Supplementary measures are taken in cases when requirements of legal acts are insufficient to reach a good status of waters and provide population with drinking water of needed quality. The measures for handling pollution sources are the same for groundwater and surface water bodies. Construction and renovation of manure and silage storages have a great importance in point pollution reduction. To address diffuse pollution, the main attention should be given to the handling of pesticides, manure and fertilisers.

**Basic measure: Manure handling of animal farms.** The use and storage of manure and silage has to meet the requirements of the Nitrate Directive and relevant Estonian legal acts. Wastewater treatment in the farms also needs improvement. Manure storages and management in the nitrate vulnerable zone had to fulfil the requirements of Estonian Water Act by 31.12.2008. Large animal farms (>300 animal units) and piggeries (>2000 pigs) were obliged to implement the best available techniques by November 2007. The capacity of manure storages has to be at least 8 months.

In the Pandivere groundwater sub-district there are 206 farms which exceed 10 animal units. The surveillance of manure storages and handling of those farms started in autumn 2009. About 58% of farms got subsidies for renovation works in the frame of Rural Development Plan 2004-2006. How many manure storages actually meet the requirements will be known by May 2010. The potential water pollution risk from manure storages is also assessed during the surveillance.

Implementation of supplementary measures (construction of larger storages for liquid manure and additional restrictions for manure application) and the scope thereof will be identified after the implementation of basic measures, inventory of farms and assessment of the status of water bodies concerned by the issue. The need for supplementary measures to preserve or reach a good status of surface and groundwater bodies will be decided afterwards.

**Basic measure: Action Plan 2004-2008 for Nitrate Vulnerable Zone** is implemented to date. The aim of the action plan is to prevent the negative impact of agricultural activities to the surface and groundwater bodies in the region.

The main measures are:

- The period when application of fertilizers is prohibited: from the 1st December to 31st March
- The period when fertilizing on the steep slopes (5-10%) is prohibited: from the 1st November to 15th April.
- Maximum amount of fertilizers use: in the NVZ the average amount of the nitrogen per hectare allowed is up to 170 kg a year (organic and mineral fertilizers).
• In unprotected groundwater areas (vulnerable zone) the amount of nitrogen from mineral fertilizers could not exceed 120 kg per hectare a year and the livestock number cannot exceed 1.5 animal units per hectare of UAA.

• Around the karst springs and karst holes it is prohibited to use fertilizers and pesticides (the radius of the protection zone varies between 10 and 50 meters).

**Supplementary measures:** Implementation of good agricultural practice, raise of awareness of farmers, increase of extensive land use etc.

The monitoring of the effectiveness of the second basic measure (to reduce the leaching of nutrients) is carried out in the frame of the groundwater and surface water monitoring programme. In 2007, soil and drain water monitoring also started.

**Groundwater quality**

In unprotected groundwater areas dug wells and shallow drilled wells, which feed from upper groundwater layers, are primarily threatened by nitrate pollution. The yearly average nitrate content in wells and springs has risen rapidly since 2006 and in last years it has exceeded the highest values observed in the early 1990ies. The average nitrate content in all sampling sites (wells, springs, karst water) was 27.4 mg/l in 2008. The average nitrate content in 2008 in springs was 29 mg/l, in wells it was 32.3 mg/l.

In 2008, 10 samples for measuring pesticides residuals were taken. Content of 10 different pesticides was investigated and in all cases the results were under the detection limit.

![Figure 3.2.1: Dynamics of nitrates in Pandivere groundwater sub-river basin](image)

**Surface water quality**

Taking into account the trends and the current level of the nitrate concentration as well as the changes in the agricultural intensity, it could be said that, in the foreseeable future, the average nitrate concentration will not exceed 25 mg/l in surface water bodies in Pandivere region.

Five water courses - Preedi, Põltsamaa, Oostriku, Vodja and Jänijõgi rivers - are protected as salmonids habitats, where the content of total nitrogen can not exceed 3 mgN/l. This requirement can be an unachievable goal in upper courses of Pandivere rivers. Monitoring results from 2004-2008 indicate nitrates concentration exceeding the permitted level in all samples from Preedi, Oostriku and Jänijõgi rivers.
Results of drain water monitoring

Drain water monitoring has only started in 2007 and therefore no general conclusions can be made. On the monitoring field N1 (Figure 3 and 4) the barley was cultivated and on the field N2 barley with fieldgrass sow was grown. In the filed N2, the nitrate concentration in drain water exceeded the permitted level during the whole autumn-winter period 2007-2008. That was probably caused by the fact that in spring 2007 the sowing failed after nitrogen fertilizing and the filed was not cultivated any more. Applied nitrogen was not used due to low coverage of weed and in late autumn part of the nitrogen was leached. In the filed N1, field grass was grown in 2007. Grass rind plow did not increase nitrate content in drain water in autumn 2007.

![Figure 3.2.2: Nitrates content in drain water](image)

Although a phosphorus balance was negative, the content of phosphorus exceeded the level of surface water moderate class boundary in two cases. During the rest of the monitoring period, the content and leaching of phosphorus was very low.

![Figure 3.2.3: Phosphorus content in drain water](image)
3. Conclusions and recommendations

The groundwater bodies of the Pandivere sub-district are mostly in good qualitative and quantitative status. At the same time, there is a risk for all groundwater bodies to lose this good status if the pollution prevention and sustainable use principles are not followed in the future. Upper layers of groundwater are under the risk in densely populated areas and regions of intensive agriculture. In the fields, where the groundwater is unprotected, there is also a risk of pesticides pollution.

Agricultural diffuse pollution can only be effectively reduced by decreasing the potential pollution (by reducing the amount of used manure and mineral fertilizers). However, in some cases strict restrictions on fertilizing can harm the competitiveness of farms (compared with regions with lower requirements).

The implementation of agricultural diffuse pollution reduction measures is a long-term process and usually demands a change in awareness of farmers (which is sometimes contrary to local official agricultural policy) and considerable investments.

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- Pandivere and Adavere-Põltsamaa NVZ, AS Maves 2006.
- The groundwater monitoring of groundwater in Pandivere sub-river basin 2000-2008. KUK, AS Maves
Evaluation of the England Catchment Sensitive Farming Delivery Initiative (ECSFDI)

By Phil Smith, CSF Monitoring Policy Manager, Environment Agency.

1. Introduction

The England Catchment Sensitive Farming Delivery Initiative (ECSFDI)\(^{29}\) is subject to ongoing and comprehensive evaluation. This is essential (i) for effective management of the Initiative and (ii) to assess the outcomes delivered through the Initiative, which will inform future policy and delivery for Water Framework Directive Programmes of Measures.

Evaluation is considered in terms of the primary objectives of the ECSFDI to:

- increase awareness amongst farmers 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 article summarises the approach adopted for evaluation of the ECSFDI and presents an assessment of the results during the fourth year of the five year initiative.

2. Approach and implementation

The main approaches used to evaluate the Initiative are:

- detailed recording of farmer engagement and advice delivery
- research surveys to measure changes in the awareness and attitudes of farmers
- farm visits to assess implementation of advice
- environmental monitoring and modelling to assess DWPA reductions resulting from implementation of advice

**Farmer engagement and advice delivery**

Details of all engagement and advice delivery are recorded in a purpose built database. The *CSF Reporter* records information on farmers and other stakeholders; the advice they receive; and the land to which that advice relates. All advice is recorded in the form of recommendations for changes to farming practices to reduce DWPA (based on the control methods outlined in Cuttle *et al.*, 2006).

The CSF Reporter is a replicated database which allows catchment officers to enter information off-line with the data stored locally on their laptop. On a regular basis, officers synchronise data

The master database is used to produce a range of management reports summarising farmer engagement and advice delivery for each Priority Catchment and across the Initiative as a whole. These include:

- numbers of group events, clinics and one-to-one farm visits
- numbers of farmers and other stakeholders engaged
- area of land receiving targeted advice
- a breakdown of advice delivered by advice category (land use; soil management; livestock management; fertiliser management; manure management and farm infrastructure)

**Farmer awareness and attitudes**

Farmer awareness of DWPA and attitudes to the support available through the ECSFDI are assessed through telephone surveys of a random selection of farmers across the priority catchments and farmer case studies. Surveys are conducted annually by an independent market research company. They assess:

The process of engagement with farmers:
- the type and range of engagement with farmers
- the perceived relevance of ECSFDI activities and farmers’ satisfaction with them

Farmer awareness and attitudes:
- awareness of DWPA as an issue in general and as an issue that affects them
- awareness that DWPA is caused by the activities of farmers
- awareness that help is available through the ECSFDI to assist them to reduce DWPA
- attitude to the help available through ECSFDI
- confidence they can take action to reduce DWPA
- understanding of action they could take to reduce DWPA
- disposition to take action to reduce DWPA
- awareness of available grants and attitudes to take-up

Changes in farmer behaviour:
- intended actions to address DWPA
- actions taken to address DWPA
- attribution of actions to the ECSFDI

Responses are compared between (i) recipients of one-to-one visits from ECSFDI advisors; (ii) attendees at ECSFDI advice events (workshops, seminars, etc); and (iii) non-users within the ECSFDI catchments.

**Implementation of ECSFDI advice**

To assess the uptake of ECSFDI advice, catchment officers re-visit selected farms to determine whether recommended changes to farming practices have been implemented. The farm sampling procedure, designed by WRc (2008a), provides reliable estimates of the proportion of farms that have substantially implemented recommendations. The procedure will also allow us to assess:
• any differential uptake of the different categories of measure (land use; soil management; etc)
• any differential uptake of measures that are cost-negative, cost-positive and cost-neutral to farmers
• the influence of incentives and other schemes (e.g. ECSFDI Capital Grant Scheme and Environmental Stewardship)
• the expected beneficial influence of catchment officers’ continued engagement with farmers (i.e. to what extent does continued contact increase implementation?).
• any decline in implementation over time (i.e. how permanent are any changes?)

**Environmental monitoring and modelling**

Environmental assessment is undertaken at two levels:

• high level assessment of the indicative reduction in agricultural loadings of pollutants resulting from changes to farming practices
• water quality modelling and monitoring of within-river reductions in pollutant loads and concentrations

The high level assessment uses a specifically designed tool, the Catchment Change Matrix (CCM). The CCM starts from a modelled baseline of agricultural pollutant loads, looks up the relevant reductions (as defined by Cuttle *et al.*, 2006) from the implemented DWPA control methods and then calculates the cumulative reduction for all control methods applied.

Water quality models, calibrated using monitoring data, are used to predict reductions of in-river pollutant loads and concentrations from the estimated reductions in agricultural loadings. The water quality models take account of the contribution of point sources (e.g. sewage treatment works) as well as the amount of removal (or ‘decay’) within the river. For pesticides, we use a simpler ‘reduction model’, based on expert judgement and previous experience of the effectiveness of voluntary uptake of pesticide best practice.

The Initiative is also supported by a dedicated water quality monitoring programme. This comprises 90 sites across 14 catchments. Samples are collected routinely on a weekly (or twice-weekly) basis, with additional storm event sampling at key sites. The primary purpose of the monitoring programme is to support the water quality modelling. However, we are also developing data analysis techniques to identify early indications of water quality improvements from the monitoring data. In addition to the dedicated water quality monitoring programme, an existing monitoring programme on the River Frome within the River Piddle, River Frome and Fleet Lagoon Priority Catchment, established in 2003 as part of the NERC LOCAR (LOwland CAthchment Research) community research programme, is being extended through the ECSFDI. This will permit a comparison with pre-ECSFDI data, to assess any initial response of this catchment to diffuse pollution mitigation.

**Interim evaluation of the ECSFDI**

At the end of June 2009 the ECSFDI had delivered advice to 7,400 farmers and other stakeholders. This advice was delivered through 6,700 one-to-one farm advice visits; 815 group events and 230 advice clinics. In many cases, stakeholders received advice through more than one contact with the ECSFDI, reflecting the fact that behavioural change can take time. Typically a
farmer attends an introductory event on Catchment Sensitive Farming (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.

Overall, advice had been delivered to 6,470 holdings covering an area of 804,850 hectares. This equates to 27% of targeted farm holdings (and 40% of the total area occupied by targeted holdings) and 12% of all holdings located within the 50 priority catchments (and 23% of the total area occupied by holdings within priority catchments). The higher percentages for holding area reflect the fact that in many catchments, and particularly those with large numbers of holdings, catchment officers have prioritised advice to larger holdings to maximise the land area adopting CSF.

A detailed assessment of the results of the most recent farmer awareness and attitude survey (November 2008) is provided in Ipsos MORI (2009). Overall, farmers and other stakeholders that have engaged with the ECSFDI are more aware of the support the Initiative offers and also that available elsewhere. Those that have engaged are positive about the impact the Initiative has had. Over 80% confirm their knowledge has increased and that they have taken, or intend taking, action to reduce water pollution.

Despite an increased awareness and understanding there remains only limited acceptance from farmers that agriculture makes a significant contribution to water pollution. Catchment officers have 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

The financial incentives of free advice, reduced running costs (for example, through reduced fertiliser applications) and capital grants have been key drivers of change, although financial constraints are still cited as the main obstacle discouraging farmers from doing more.

As of August 2009, action had been taken to make a significant contribution to mitigating diffuse pollution (i.e. at least half of the farm-specific recommendations had been implemented) at 65% of farm holdings receiving one-to-one advice in the first two years of the Initiative. For 79% of the implemented practices, implementation resulted solely from ECSFDI advice. For 21%, implementation was also influenced by one or more incentives, other schemes or initiatives. The single most important influence was the ECSFDI Capital Grant Scheme (8%).

An initial assessment of environmental outcomes indicates that by 2011 the ECSFDI could reduce average agricultural loadings of key pollutants (across the original 40 priority catchments) by around 5 to 10%. At a local scale, and within sensitive sub-catchments, greater reductions could be expected; for example, up to around 20% for phosphorus. A more detailed summary of our initial environmental assessment is provided in ECSFDI (2008) and Collins (2008) provides an interim summary of the River Frome monitoring programme.
**Further planned developments**

Over the remainder of the current phase of the ECSFDI (which ends in March 2011), we will continue to develop and refine our evaluation approach, in particular for the assessment of environmental outcomes.

We are working with WRc to develop statistical methods for detecting improvements in water quality resulting from ECSFDI activity. Simulation models have shown that the ability to detect relatively small reductions in pollutant loads on a site by site basis is low due to the high temporal variability, magnitude of change and quantity of monitoring data available (WRc, 2008b). We are therefore developing analyses that will (i) test for an overall reduction across sites located within sub-catchments targeted for advice delivery and (ii) compare monitoring sites downstream of advice target areas with paired ‘control’ sites downstream of non-target areas (the latter will allow us to factor out broad, catchment-scale changes in flow and land use).

We will underpin our environmental modelling with data on the actual uptake of DWPA control methods (existing modelling is based on estimated uptake rates); develop improved methods for assessing the impact of control methods when applied in combination; and expand the range of modelled pollutants. Modelling approaches will also be broadened to assess the environmental benefits of CSF under a range of scenarios (i.e. different durations and spatial coverage) and to identify locations where CSF approaches will be most effective (to support future targeting of resources). We will also undertake further work to place the predicted environmental improvements in the context of likely improvements required by the Water Framework Directive.

### 3. Conclusions and recommendations

For an advisory initiative, such as the ECSFDI, to provide a comprehensive evaluation of its performance is unique. The Evaluation Framework that has been developed has proven to be highly effective in providing key information to support effective management of the Initiative and for assessing current and future predicted outcomes.

We will continue to evaluate the ECSFDI during the current phase of the Initiative and report the results. We will also develop our approaches for assessing environmental outcomes to inform both the evaluation of ECSFDI and future policy and delivery for WFD Programmes of Measures.

### 4. References


90
3.3 Workshop outcomes

The fourth workshop of the PRB-AGRI network, held in Odense (DK, October 2009), invited the participants to exchange on how they plan to monitor and evaluate the implementation of the programme of measures and its specific measures, as well as how to monitor the effect of the implemented programme of measures³⁰.

In addition to the presentation of the UK experience (see article), Harley Bundgaard Madsen (Head of Water and Nature Division of the Environmental Centre Odense) explained that the Danish national monitoring programme of the aquatic environment was under revision. The main priority of the monitoring strategy was to support the management of water and nature according to the Water Framework Directive and the Habitat Directive. In that connection, the future monitoring programme should supply national and local demands for monitoring the state of the environment and evaluate the effects of the programmes of measures on the quality of surface and groundwater. This includes a careful balance between geographical coverage and frequency of monitoring.

Line Meinert Rød (Norwegian Institute for agricultural and Environmental Research, Soil and Environment Division) presented the agricultural environmental monitoring programme in Norway (JOVA). The system is based on eight catchments - representative for the regions- that have continuous discharge measurement and water sampling and where farmers provide detailed information on their farming practices. Pesticides are monitored in two additional and larger catchments. The aim is to document the occurrence of nutrients, particles and pesticides in water and changes during time; water quality into streams; effects of the measures taken; knowledge of the pathways for nutrient and pesticide transport; gathering data for modelling nutrient and pesticide use.

³⁰ All presentation and Workshops documentation are available here: http://prb-water-agri.jrc.ec.europa.eu/Prb-agri/documents/open-section
Summary of the main challenges and concerns expressed by the participants (Odense, Denmark, October 2009):

**Monitoring the implementation of the PoM:**

- Important to monitor the implementation of PoM (need for an effective system), although it is a complex task.
- Different levels of authorities involved and needs for collaborations between levels (e.g. data, accessibility, dissemination).
- Some measures are more difficult to monitor than others e.g. lag-time, status of measure (compulsory vs. voluntary) and financing play a role.
- Involvement of stakeholders: farm level, farmers’ organisation, NGOs, local politicians. Involvement takes time. Awareness is a prerequisite for involvement.

**Monitoring the environmental effects of the PoM**

- It is the task of the surveillance and operational monitoring programme to find out how effective the measures have been.
- Measuring environmental effect is also important at single measures level (value for money)
- Dissemination of monitoring results to the public (need to reach the public) – important to obtain the right picture of effects (take the time-lag into consideration).
- Monitoring systems may be new, redesigned or rebuilt on existing systems.
- A good monitoring system serves modelling (sampling, reliable data).
- Origin (and amount) of resources should be well defined.
3.4 Main conclusions

The purpose of the chapter was to bring together insights and experiences on the monitoring and evaluation of the implementation of the programme of measures and its effects on the environment. The latter is commonly associated to surveillance and operational monitoring programmes as the figures they give should state out how effective the measures have been.

Following this scheme, the Pandivere RB offered a detailed overview of its system which should give the opportunity to assess the effectiveness of the PoM. It should as well lead to a better understanding of the pollution sources and their dynamics (e.g. through soil monitoring). In the case of Norway, a special focus is put on the pathway for nutrient and pesticide transport. These findings will undoubtedly be of the utmost importance for the second generation of the RBMPs. Additionally, data collected will be crucial in feeding models (see examples from the UK and Norway) to assess the effectiveness and the impacts of the programmes of measures on the long term (see chapter 1), as well as the value for money. It is important to obtain the right picture for all stakeholders involved in the process as well as the public.

While monitoring the implementation of the PoM remains complex, it is an essential task. Members of the network stressed for instance the need for collaboration between administration levels and that difficulties in monitoring could vary depending on lag-time, status of the measure (compulsory vs. voluntary) and financing. It was also pointed out that stakeholders must be involved in the exercise although the process takes time. On that point, the evaluation of the England Catchment Sensitive Farming Delivery Initiative, presented by the UK, is an interesting example on how to monitor, in a comprehensive way, an official tool to reach the WFD objectives. The evaluation strategy is based on five elements: farmer engagement, farmer awareness and attitude; farming practices; diffuse water pollution from agriculture loads and water quality improvement. Depending on the element, the evaluation can be based on reporting results (database), audit of advice uptake, telephone survey (awareness), environmental monitoring and modelling (reduction of DWPA and water quality).
Chapter 4: Impact of climate change on RBMPs

Experience shared by:
Denmark (Jutland and Funen)

4.1 Introduction

Even if the Water Framework Directive does not explicitly address climate change, the phenomenon was mentioned in some of the Significant Water Management Issues documents as a key pressure. European Water Managers recognise that climate change may interfere with river basin planning under the WFD, and also that the WFD provides scope and tools for integrating climate change adaptation. From their side, the Water Directors have agreed that it is necessary to integrate climate change into the WFD implementation. In June 2008, they stressed that “it is important that river basin management plans take account of the medium and long-term implications of climate change, as there is a large potential for synergies between WFD objectives and adaptation aims. On the other hand, it needs to be ensured that measures do not run counter to adaptation objectives, and that they are flexible and robust enough to be viable under changing climate conditions.”

The strategic steering group on WFD & climate change developed recommendations on how to include climate change in the first RBMPs. In addition, the white paper on Adaptation to Climate Change (April 2009) mentions that “the river basin management plans due in 2009 under the Directive will take into account the impacts of climate change and the next generation of plans, due in 2015, should be fully climate-proofed”. PRBs were invited to discuss and share their approach to climate change issues in the RBMPs.

31 Common Implementation Strategy for the WFD, Policy paper on Climate change and water, June 2008, 8pp.
4.2 Articles from PRB-AGRI network members

Denmark (Jutland and Funen)

Impact of climate change on the water environment and implications for monitoring programs and the river basin management planning in Denmark
Results from the IGLOO project

By Jens Würgler Hansen33 and Mads Nedergaard33

1. Background

Denmark has time series up to 90 years long of high quality monitoring data. These data provide an opportunity to study environmental change caused by anthropogenic pressure.

Effects and indicators of climate change in the Danish nature were studied in the IGLOO project (Indicators for global climate changes in monitoring data) within terrestrial systems, streams, lakes and marine waters.

The objectives were to demonstrate effects and to identify indicators of climate change based on analysis of time series of monitoring data. Furthermore, the project should provide recommendations for optimising the national monitoring programme for indication of ecological consequences of climate change.

The results from the project of present change in nature should be evaluated in perspective of an expected future (2070-2100) increase in temperature of 3-4ºC, combined with more rain in winter and less in summer and a general higher frequency of extreme weather.

2. Results

The results from IGLOO provide the first general documentation of present-day effects of climate change in the Danish nature, and demonstrate the usefulness of long-term time series of monitoring data.

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**Water temperature**

Figure 4.2.1: Lakes – seasonal variability of temperature

Changes in surface water temperature at different seasons: data are based on measurements within 20 lakes throughout the country, which have been intensively monitored since 1989. Data represent annual means with 25% percentiles (lower of vertical line) and 75% percentiles (upper of vertical line) and a linear trend line added for each season.

Temperature has increased with up to 2°C, but the change in surface water temperature demonstrated large seasonal differences. The increase was highest during summer and autumn, whereas the temperature has slightly decreased during winter. The surprising result for winter could be explained by a lowering of the winter NAO-index (North Atlantic Oscillation) indicating influence of colder continental winds since the beginning of the 1990’s.

Similar trends for changes in water temperature as for lakes were found for streams and marine waters.

**Discharges in streams – regional variability**

Trends in Figure 4.2.2 are based on monitoring data from 18 streams comparing annual runoff from the period 1950-1977 with the period 1978-2006. An increasing (+) or decreasing (-) trend is indicated for each stream as well as statistical significance (*). Clusters of similar trends are encircled by dashed red lines.

The left panel shows the trend of maximum discharge and the right panel the trend for minimum discharge. Large regional differences are evident for both maximum and minimum discharge, with statistical significant trends for several streams. The regional variations and trends are in accordance with modeled future scenarios for discharge.
Figure 4.2.2: Streams – trends of minimum and maximum discharge

Impact of climate change on RBMPs
Marine areas – multiple press factors illustrated by trend in oxygen concentration.

Figure 4.2.3: Marine areas – change in oxygen concentration

The figure shows the change in oxygen concentration in bottom water in Belt Sea in Denmark. Data represent monthly means for September (main season for oxygen deficiency) based on measurements at 4 stations monitored since 1977. The blue trend line is found by a smoothing function.

The oxygen concentration decreased from 1977 till 1990 to critically low levels despite a relatively stable load and concentration of nitrogen. The increase in water temperature during the same period can explain most of the reduction in oxygen concentration. The temperature continued to increase after 1990, but the oxygen concentration seemed to stabilise. This is most likely the combined effect of increased temperature and reduced nitrogen load during that period. In conclusion, climate change has hampered the positive effect from the reduction in nitrogen load.

Anthropogenic pressure (mostly eutrophication) has lowered the environmental status of many ecosystems. According to the Water Framework Directive (and the Habitat Directive) the environment should have a good ecological status in 2015 and if necessary, actions (oligotrophication) should be implemented to ensure this.

Ecological status

Figure 4.2.4: Ecological status and management – Water Framework Directive and Habitat Directive
A good ecological status is defined relative to a reference condition (I). If the needed action (I) is quantified without considering the influence of climate change it may increase the risk that the action will not improve the ecological status (dashed green line) enough to cross the borderline between good and moderate status (gray dashed line). In that case there are two possible solutions:

1) The action is increased (II) to improve the ecological status (full green line) enough to cross the borderline between good and moderate status (dashed gray line).

2) The reference condition is redefined (II) taking climate change into account and thereby lowering the restoration target (dashed and dotted grey line) to a level that can be fulfilled with the smaller action (action I and dashed green line). Restoration target could also be lowered more directly by compensating for the climate change when defining the borderline between good and moderate status.

3. Conclusions

Long-term time series of relevant indicators are extremely valuable to document and study ecological consequences of climate change.

The IGLOO project shows that ecological effects of climate change in nature are not only a matter of future concern, as climate change has already caused significant changes in the Danish environment.

The analysed data illustrate a high seasonal and regional variability of ecological response to climate change (Figures 4.2.1 & 4.2.2). Therefore, the sensitivity of data analysis is often increased by studying time series of seasonal or regional data, whereas a lot of information is lost when only focusing on annual or national averages. Together with coping with seasonal and geographical variation monitoring programs optimised for documentation of climate change should include biological indicators at species level.

Nature is simultaneously influenced by many anthropogenic activities and natural variability. Therefore, it is difficult to single out the causes of change (Figure 4.2.3). High quality of monitoring data is necessary to understand ecological interactions and to demonstrate changes at an early stage. Consequently, monitoring of indicators of climate change is important in order to show present changes and to improve the predictions of future changes in our environment. Monitoring indicators will enhance the possibilities for successful preventive and adaptive actions.

The impact of climate changes adds pressure to most ecosystems (Figure 4.2.4). Therefore, actions necessary to reach good ecological status, as demanded by the Water Framework Directive and the Habitat Directive, either needs to compensate for impacts of climate change or the framework for defining reference condition or borderline between good and moderate status has to include a changed climate.
4.3 Workshop outcomes

The fourth workshop of the PRB-AGRI network on Agricultural issues, held in Odense (Denmark) in October 2009, dedicated one of its sessions to climate change and RBMP. The objectives were to learn about and discuss when and how climate change will influence the water planning and how Member States plan to incorporate climate change in the next RBMP generation.

Besides the presentation of Jens Wurgler Hansen based on the results laid out in the article hereinbefore, Simon Henneberg (Director of the River Basin Commission, Weser) stressed that integrating climate change and its impacts into the RBMP meant to deal with uncertain predictions of different scenarios and models which have been installed at different levels. However, some issues can be already considered (despite uncertainty about the extent of their occurrence) in the Weser catchment, as for instance: higher irrigation needs versus reduced water quantity, reduced runoff and increase of nutrient concentration in inland water…

The climate change was said to concern more the second generation of RBMP (after 2015). Plans for extreme situation should be developed; the changes in socio-economic development must be taken into consideration as well as new strategies and possible new targets. Objectives and measures must be checked considering their long term impact. Following this line and regarding the catalogue of measures, Simon Henneberg proposed to assess the impact of climate change on measure benefit.

Rania Tzoraki (Evrotas, Greece) presented the risk management of drought and floods in the Evrotas RB (to be included in the RBMP). Basically, regarding precipitations, she explained that the standard deviation has changed, not the mean of the years. Flood risk sources have been identified (flash flood hazards…) as well as pathways (morphological changes…) and vulnerability (flood damage, risk perception). Measures to prevent and manage these extreme events are proposed.

Summary of the main challenges and concerns expressed by the participants (Odense, Denmark, October 2009):

1. How climate change will influence water planning processes?

- High level of uncertainty makes it difficult.
- Interlinkages between the different extreme weather conditions should be considered.
- There is a need for more scientific knowledge for making the picture clearer for political decisions and to be integrated in the 2nd generation RBMPs.
- Climate change makes the picture more complex to disseminate to stakeholders.
- To integrate climate change in water planning processes and settle the strategy for the future, monitoring systems should help in detecting CC effects (long term data series are needed).
- It is difficult to foresee whether changes in stakeholders’ involvement is needed

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34 All presentations are available here: http://prb-water-agri.jrc.ec.europa.eu/Prb-agri/documents/open-section/workshop-documentation
2. How climate change is taken into account in RBMPs?

- Not in the 1st generation, unless in Evrotas (drought and flood protection), Weser (climate check of the measures) and the network of RB from the UK (climate changes measures).
- Ensure interlinkages between policies, mainly – agricultural and water policy.
- Are the measures climate-proofed (positive or negative response to climate change)?
- CAP Health Check identified climate change as a new challenge and redistribution between pillar 1 and 2 should give more opportunities to finance climate change measures.

4.4 Main conclusions

The main difficulty in dealing with climate change in RBMPs relates to its involved uncertainties. Even if some PRB members have demonstrated that they have already considered the phenomenon (Evrotas, UK and Weser) in their first RBMP, it is generally acknowledged that climate change will concern more the next generation of the plans. Nevertheless, ways, needs and actions must be planned now in order to make it possible.

Scientific knowledge is the prerequisite for a clearer picture of the ongoing processes and the likely impacts of a changed climate. At the same time, research need to be fed with suitable data. Besides the need of long term data series, and as stressed in the article from Denmark, an optimised monitoring system must be designed, coping with seasonal and geographical variation. High quality monitoring data will enhance the detection of climate change effects and, thus, the possibility for successful preventive and adaptive actions. Following that idea, programmes of measures must be climate change checked in order to not implement counterproductive actions both in terms of cost and effectiveness. In other words, actions must be robust and flexible.

The Catalogue of Measures proposed by DG Environment (European Commission) and updated by the PRB-AGRI network could also be checked, ranking the measures according to their robustness to climate change conditions. However, it should be stressed that a special attention must be paid to keep messages as clear as possible when disseminated to stakeholders. Climate change will influence socio-economic development and could lead to the redefinition of targets or reference conditions for water bodies if actions are not increased enough to reach the WFD goals. Climate change was defined as a new challenge in the Common Agriculture Policy Health Check which should give more financing opportunities. In end November 2009, the list of guidance documents offering a common reference to stakeholders in the WFD implementation was completed to illustrate ways to take climate change into account within the second and third RBMP cycles, including provision for floods and droughts. Most of the views expressed by the PRB-AGRI network are covered and detailed in this document. Undoubtedly, climate change is an unavoidable issue in reaching the WFD objectives and will be one of the main challenges in the next RBMP generation.
Abstract

In January 2008, the Pilot River Basins (PRB) network on agricultural issues entered into a new phase. The main purpose was the exchange of information during the ongoing preparation of the river basin management plans (RBMP) and programme of measures (PoM). In early 2009, members of the PRB-AGRI network decided to go beyond the mandate and share better their experience on four specific topics: (i) Effectiveness and acceptance of measures; (ii) Public Participation, involvement of farmers; (iii) Monitoring and evaluation of measures and (iv) Impact of climate change on RBMP.

This document gathers articles from PRBs and the conclusions from PRB-AGRI workshops related to the topics mentioned above. As main conclusions, it could be highlighted that cost effectiveness analysis of measures should include environmental and resources costs, farmers’ acceptance and the societal point of view and be based on scientific evidence. It was well agreed that measures efficiency and feasibility should be tested at local level, even if the overall solution to reduce impact and pressures should be found at river basin scale, and that surveillance and operational monitoring programmes should state out how effective the measures have been and lead to a better understanding of the pollution sources and their dynamics. While monitoring the implementation of the PoM remains complex, it is an essential task and PRBs have stressed as well that the need for collaboration between administration levels and that difficulties in monitoring could vary depending on lag-time, status of the measure (compulsory vs. voluntary) and financing. An early involvement of the agricultural sector at all scales and its commitments towards plans is a factor for success. More generally, the approach to public participation should be adapted to the institutional, socioeconomic and environmental context of the river basin. PRBs have showed how that was working on the ground, based on pilot projects, innovative approaches, multidisciplinary teams or more permanent participation organisations. The main challenge was often said to be rebuilding trust - perhaps more than interest - to enhance participation between planners, farmers and local population. It is often a challenge to involve farmers and dialogue should include all of them. Strategies and messages have to be tailored and it is also crucial to have a bunch of measures to ensure flexibility and to propose an adapted funding system. All in all, it should not be ignored that stakeholders’ involvement takes time.

The use of models as decision-support tool is widely widespread amongst PRBs. First, they make possible to analyse pressures and evaluate the gaps and are helpful in the selection of best measures to implement. Second, they help to monitor the effect of the measures on the long term as well as the value for money, and propose climate change scenarios. In order to obtain the right picture, these tools need to be fed by robust data, long time data series and feedbacks from the field. Monitoring systems are a crucial piece of the puzzle and must be appropriately designed to provide useful data, and help water planners in their approach to cope with uncertainties which could have a significant impact in the decision-making.

Regarding the climate change issue, even if some PRBs have demonstrated that they have already considered the phenomenon in their RBMP, it is generally acknowledged that it will concern more the next generation of the plans. Scientific knowledge is the prerequisite to understand the ongoing processes and the likely impacts of a changed climate. Climate change will influence socio-economic development and could lead to the redefinition of targets or reference conditions for water bodies if appropriate actions are not implemented. Programmes of measures must be climate checked in order to not run counterproductive actions both in terms of cost and effectiveness.
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