

JRC SCIENTIFIC AND POLICY REPORTS

RIVER BASIN NETWORK on Water Framework Directive and Agriculture

PRACTICAL EXPERIENCES AND KNOWLEDGE
EXCHANGE IN SUPPORT OF THE WFD
IMPLEMENTATION (2010-2012)



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EXECUTIVE SUMMARY

Following the entry into force of the Water Framework Directive (WFD, 2000), Member States and the Commission decided in 2001 upon the setting up of a Common Implementation Strategy (CIS), to assist and support Member States in addressing the challenges related to the implementation of the WFD. In this frame, the Pilot River Basin network was established as an independent exercise, with the aim of providing early feedback in the implementation of the Directive. Recognizing agriculture as one of the major priorities to address to achieve the objectives of the WFD, the network was subsequently embedded in the Working Groups structure of the CIS (phase II, 2005-2007, and III, 2008-2010), and has thus continued in its activities throughout the following phases on to the latest one, concluded in December 2013 (phase IV, 2010-2012 mandate) under the renewed denomination of “River Basin Network on WFD and Agriculture” (RBN).

The 2010-2012 mandate of the RBN was endorsed in May 2010 by the Water Directors of the European Union. The overall objective of the exercise would be to provide practical examples or good case practices in the River Basin Management Plan (RBMP) by assessing a list of agricultural measures included in the RBMP and focusing on issues of particular interest for the WFD implementation in the agricultural sector. The RBN would also lend support to the EG in its work by offering technical and from-the-field feed-back. In addition, results from network activities would be disseminated to all other river basin managers, stakeholders and to the EG members. As in the previous phases, activities would be coordinated by the Joint Research Centre of the European Commission (Institute for Environment and Sustainability).

At the core of the mandate of the RBN were: i) the evaluation of measures and enhancement of the catalogue of measures (CAOM); ii) the evaluation of specific issues in the RBMPs. Output from the tasks set in points (i) and (ii) would take the form of the following deliverables, respectively: i) a set of short fact sheets evaluating each of the measure selected for this exercise; ii) a short report for each of the issues selected by the RBN network and dealt with in ad-hoc working groups. The call for participation into the RBN exercise was answered by 21 river basins (RBs), representing 14 Member States. The list of measures selected by the RBs for evaluation was:

1. Buffer strips
2. Establishment and preservation of wetlands
3. Reduce water abstraction
4. Reduce fertilisation
5. Avoiding spreading fertiliser and manure at high risk times and places
6. Plant cover in winter
7. Catch crops
8. Application techniques of manure
9. Capacity of manure storage
10. Erosion-minimising cultivation system

For the compilation of the short reports related to specific issues, working groups were formed, each co-led by a river basin, with the following issues being selected:

- WG1: Indicators to monitor the implementation of the PoM
- WG2: Financing the agricultural measures in the PoM
- WG3: Farmers involvement, strategies and experiences
- WG5: Cost-effectiveness of agricultural measures
- WG6: Comparison of policies and implementation strategies to reduce diffuse agricultural pollution
- WG7: Irrigation related measures

A web platform has been set up and maintained by JRC (<http://rbn-water-agri.jrc.ec.europa.eu/>), with the dual purpose of simplifying network members involvement and communication and granting access to the larger public to selected outputs and products of the activity.

BACKGROUND

Following the entry into force of the Water Framework Directive (WFD, 2000), Member States and the Commission decided in 2001 upon the setting up of a Common Implementation Strategy (CIS), to address the challenges related to the implementation of the WFD in a co-operative and coordinated way. The first outcome of the CIS exercise (phase I, 2002-04) was a series of [Guidance documents](#) covering a number of issues related to implementation. During this phase, a network of Pilot River Basins (PRBs) was established, with the aim of aiding the development and cross-check of the Guidance documents through an early implementation of the WFD, leading to the long-term objective of the development of River Basin Management Plans and preparation of Programs of Measures (see [PRB Report](#) for outcomes of this phase of the exercise).

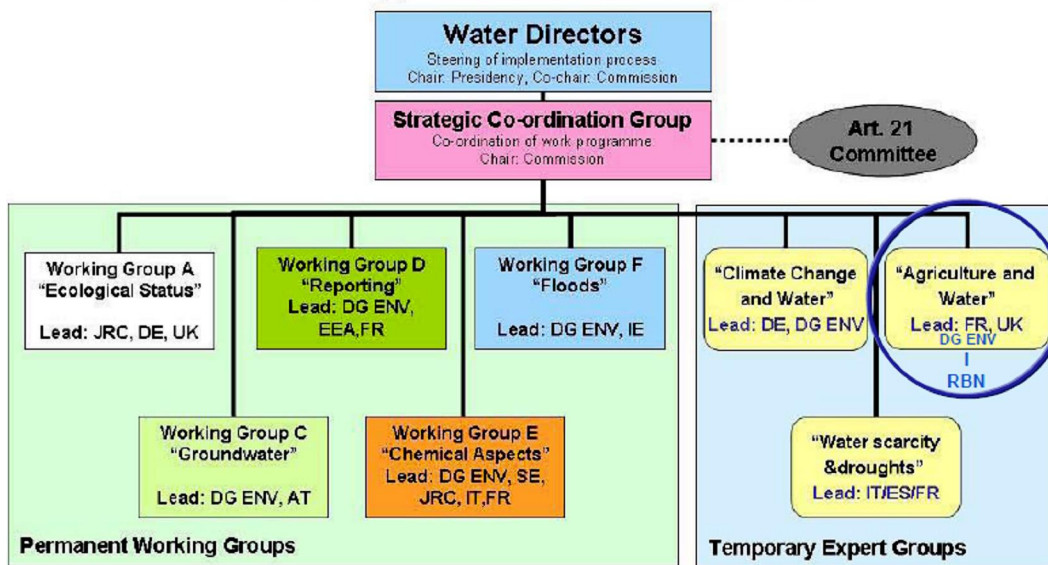
The CIS exercise continued through phase II (2005-2006), with the decision to have the PRB network activities embedded in those of the individual Working Groups (WGs) designated in the CIS work program. PRBs reported on different aspects of the WFD implementation (e.g. chemical pollution, agriculture and river basin management planning), and results from those experiences were collated in a [report](#). 9 PRBs, coordinated by the JRC, worked specifically on the pressures from agriculture on water and related measures, supporting the activities of the newly formed Strategic Steering Group (SSG) on “WFD and agriculture”. At this stage the link between agriculture and water resources had already been identified as one of the highest priorities. Among the main achievements of this phase was the 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 (CAOM) (Cherlet, 2007).

A new phase of the PRB-AGRI was endorsed, covering the period 2008-2009 (phase III), with the mandate of supporting and fostering the exchange of information during the on-going preparation for the River Basin Management Plans (RBMPs), and Program of Measures (PoM), through the development of: Networking activity through a sequence of workshops; refinement of the CAOM through the provision of case studies; development of the PRB-AGRI web platform, to ensure a rapid exchange of information, with an free access section open to the general public.

CIS work programme 2010-2012

The new 2010-2012 work programme for the WFD CIS was endorsed by the Water Directors of the European Union in Malmo (November 2009, see structure in the figure below), confirming agriculture as one of the major priorities to address to achieve the objective of good status of European waters in 2015. The 2010-2012 CIS Work Program listed, among the others, the setting up of an Expert Group on WFD and Agriculture, succeeding the former Strategic Steering Group on this issue. The new EG had the task of: i) have an overview on the implementation of the WFD in the agricultural sector; ii) identify obstacles and constraints related to agricultural issues in the context of the WFD, identifying possible solutions; iii) provide an input to the next CAP reform and; provide a link to farmers' organizations and other interest groups.

CIS Organisation 2010-2012



INTRODUCTION

The 2010-2012 mandate of the Expert Group (EG) on WFD and Agriculture envisaged the possibility to set up a technical network of river basins to support its objectives. In May 2010 (Segovia) the Water Directors of the European Union endorsed the continuation of the PRB-AGRI exercise into phase IV, with a new [mandate](#) drafted jointly by Dg Environment and JRC. It was decided as well that the old “*Pilot River Basins network on agricultural issues*” would now be renamed “*River Basin Network on WFD and Agriculture*”.

The overall objective of the exercise would be to provide practical examples or good case practices in the RBMP by assessing a list of agricultural measures included in the RBMP and focusing on issues of particular interest for the WFD implementation in the agricultural sector. The River Basin network would also lend support to the EG in its work by offering technical and from-the-field feed-back. In addition, results from network activities would be disseminated to all other river basin managers, stakeholders and to the EG members. As in the previous phases, activities would develop under the coordination of the Joint Research Centre of the European Commission (Institute for Environment and Sustainability).

More specifically, the following tasks were set as the core of the mandate:

- (i) Evaluation of measures and enhancement of the CAOM: the network would support the on-going development and improvement of the Catalogue of Measures and, on this basis, the feeding of a more complete database on WFD agricultural measures. The measures to be evaluated would be selected by the network in co-operation with the Expert Group at a common kick-off meeting.
- (ii) Evaluation of specific issues in the RBMPs: cases studies and examples regarding specific issues related to RBMP and/or PoM and agriculture that could be provided by the network.

Output from the tasks set in points (i) and (ii) would take the form of the following deliverables:

- (i) On the evaluation of measures: a set of short fact sheets evaluating each of the measure selected for this exercise, based on the contribution of RBs signing up to contributions for that particular measure, to be distributed among RB administrators, the EG members and entered as direct input to the new Catalogue of Measures.
- (ii) On the evaluation of specific issues in the RBMPs: for each of the issues selected by the RBN network and dealt with in ad-hoc working groups, short articles and information sheets to serve as input for the EG in workshops, assessments or seminars held by the CIS/Commission as well as for distribution among RB managers and stakeholders.

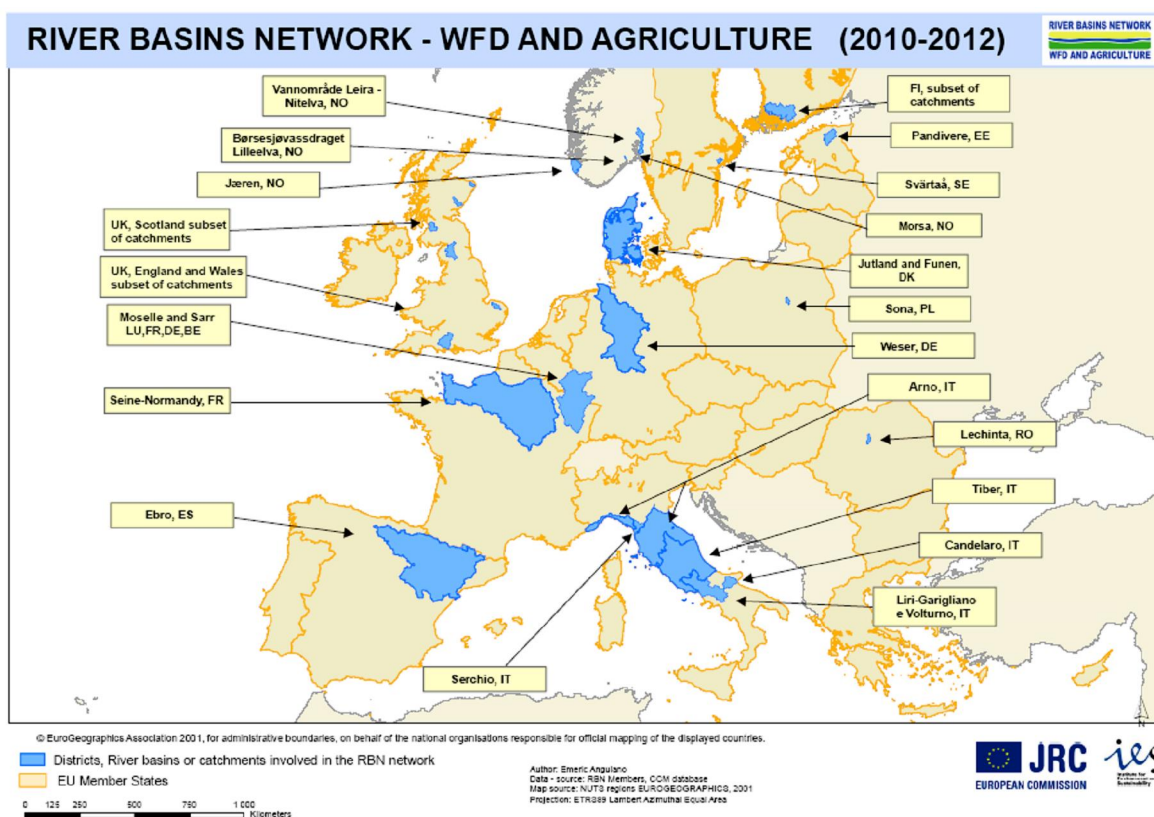
It was decided that the Web platform, created and maintained by JRC during the previous 2008-2009 mandate, would be further developed and used as the main communication tool between the EG and the network (restricted-access section); it would also act as the main instrument for the dissemination of the network's outputs (free-access section). The name and URL would be changed to better reflect the new objective and new denomination of the network (<http://rbn-water-agri.jrc.ec.europa.eu/>).

The 2010-2012 exercise

The “RBN on WFD and Agriculture” exercise was officially launched with invitation letter sent in June 2010. The kick-off meeting was held in September 2010 in Louvain-La-Neuve (BE). The complete list of meeting over the course of the mandate is presented in the table below:

Date	Meeting title	Place	Scope	Notes
27 Sept 2010	Kick-off meeting	Louvain-La-Neuve (BE)	<ul style="list-style-type: none"> - Main outcomes of the previous phase - Presentation of the Expert Group - Presentation of the RBN mandate - Round table on interests and initial proposals for factsheets and specific issues - Factsheets templates approved 	Back-to-back with EG meeting on 28 Sept 2010
26 Jan 2012	Workshop	Zaragoza (ES)	<ul style="list-style-type: none"> - Final endorsement of the list of measures selected for the factsheets and the list of specific issues for the short reports - Presentation of intermediate results 	
12 June 2012	Meeting	Barza (IT)	<ul style="list-style-type: none"> - Presentation of intermediate results - Some country cases discussed 	
11 Oct 2012	Workshop	Edinburgh (UK)	<ul style="list-style-type: none"> - Presentation of final results (draft) - Roadmap to completion of the exercise - Discussion on the way forward (wish list for the next mandate) 	Back-to-back with EG meeting on 10 Oct 2012

The Agenda, list of participants, presentations and minutes of each meeting can be found on the platform under the “Events” tab. By the date of the second meeting the final list of participants to the exercise had been finalized, comprising 21 River Basins representing 14 Member States (see figure below).



The list of measures selected by the RBs for evaluation was:

1. Buffer strips
2. Establishment and preservation of wetlands
3. Reduce water abstraction
4. Reduce fertilisation
5. Avoiding spreading fertiliser and manure at high risk times and places
6. Plant cover in winter
7. Catch crops
8. Application techniques of manure
9. Capacity of manure storage
10. Erosion-minimising cultivation system

Each river basin indicated at the kick-off meeting the factsheet/s to which it could contribute. The list of contributing RBs for each measure is presented in the table below. Factsheet extended summaries are presented in Chapter 1. The individual factsheets are included in Annex 1.

	1	2	3	4	5	6	7	8	9	10
RBN Member	Buffer strips	Wetlands	Water abstraction	Reduced fertilisation	Spreading fertiliser and manure	Plant cover	Catch crops	Application techniques of manure	Manure storage	Reduced tillage (Erosion-minimising cultivation)
IT - ARNO	x		x							
NO - BØRSESJØV-LILLELVA, SKIEN	x					x				
IT - CANDELARO										
ES - EBRO		x	x							
NO - JÆREN	x				x					
DK - JYLLAND and FYN RBD	x	x					x			x
RO - LECHINTA	x							x		
NO - LEIRA . NITELVA	x				x					
IT - LIRI-GARIGLIANO E VOLTURNO	x	x	x	x		x	x			
NO - MORSÅ	x									
LU/FR/DE/BE - MOSELLE AND SARRE	x	x				x				
EE - PANDIVERE GROUND WATER SUB RIVER BASIN						x		x	x	
IT - SERCHIO	x	x	x							
PL - SONA	x									
UK - SCOTLAND (5 CATCHMENTS)	x	x			x			x	x	x
UK - ENGLAND AND WALES (3 CATCHMENTS)	x	x	x	x	x	x			x	x
FI - SOUTHWEST FINLAND	x	x	x		x	x				
SE - SVARTÅÄ	x	x		x	x		x	x	x	
IT - TIBER			x	x						
DE - WESER				x	x	x	x	x		
FR - SEINE-NORMANDY RBD										
ArtWET LIFE project (FR-DE-IT)		x								
French National Authority	x									
NL - Rob van der Veeren					x		x	x		

For the compilation of the short reports on selected specific issues, working groups were formed, each co-led by a river basin, according to the following list:

- WG1: Indicators to monitor the implementation of the PoM
- WG2: Financing the agricultural measures in the PoM
- WG3: Farmers involvement, strategies and experiences
- WG 4: Interplay between the Flood Directive and flood related measures in the PoM
- WG 5: Cost-effectiveness of agricultural measures
- WG 6: Comparison of policies and implementation strategies to reduce diffuse agricultural pollution
- WG 7: Irrigation related measures

The list of contributors and co-leads to each working group are presented in the table below. No co-leadership was identified for WG4, and therefore no report was prepared.

	Working Group 1	Working Group 2	Working Group 3	Working Group 4	Working Group 5	Working Group 6	Working Group 7
Topic	Indicators to monitor the implementation of the PoM	Financing the agricultural measures in the PoM	Farmers involvement, strategies and experiences	Interplay between the Flood Directive and flood related measures in the PoM of WFD	Cost effectiveness of agricultural measures	Comparison of policies and implementation strategies to reduce diffuse agricultural pollution	Irrigation related measures
Ad-Hoc working groups	JYLLAND and FYN SCOTLAND ENGLAND AND WALES SOUTHWEST FINLAND SVARTAÅ MORSA WESER	ARNO ENGLAND AND WALES LIRI-GARIGLIANO MORSA SONA SCOTLAND SOUTHWEST FINLAND SVARTAÅ TIBER Rob van der Veeren NL JYLLAND and FYN EBRO SEINE-NORMANDY	CANDELARO WESER MORSA SEINE-NORMANDY		ARNO JYLLAND and FYN SCOTLAND ENGLAND AND WALES SOUTHWEST FINLAND SVARTAÅ DANUBE Rob van der Veeren NL	ENGLAND AND WALES SCOTLAND SOUTHWEST FINLAND SVARTAÅ WESER SEINE-NORMANDY JYLLAND and FYN	EBRO

During the second half of the mandate (2012), a link was established between the RBN activities and the "Comparative Study of Pressures and Measures in the Major River Basin Management Plans in the EU" (PM Study) commissioned by the European Parliament and overseen by the DG Environment. The Water Framework Directive (WFD) required Member States to report their first River Basin Management Plans (RBMPs) by March 2010. The European Commission has been assessing the compliance of RBMPs against the provisions of the WFD and carrying out a bottom-up assessment of the plans. The PM Study entailed a top-down assessment of the RBMPs on certain topics that merit a deeper analysis. The analysis built on the information available within RBMPs and was complemented by other sources. Ecologic Institute was one of the partners involved in the study, and was responsible for the evaluation of environmental effectiveness of agricultural measures that were most frequently used in RBMPs. This evaluation also fed into the Impact Assessment of the Blueprint. The RBN activities supported the PM Study by contributing to the evaluation of measure effectiveness; while a separate update of CAOM was not made, RBN factsheet contributions were incorporated into an updated catalogue of DG ENV (see <http://www.ecologic.eu/7259>).

The Expert Group on WFD and Agriculture was continuously kept abreast of progresses in both the RBN and the PM activities, and coordination between the two groups was ensured. During the development of the PM Study the Ecologic Institute provided support to the activities of the RBN exercise as well. Partners of the RBN network found the exercise very valuable for sharing experiences, and in the last meeting came up with a wish list of issues to be addressed if a new phase of the RBN exercise is endorsed.

This report is structure in two sections: in the first section extended summaries of the factsheets are presented (the full factsheets are presented in Annex 1). Section 2 contains the full reports on the specific issues selected by the RBN.

SECTION 1

EVALUATION OF SELECTED AGRICULTURAL MEASURES

(EXTENDED SUMMARIES)

1. BUFFER STRIPS

Contributing River Basins: Arno, Liri-Garigliano e Volturno, Serchio (IT); Borsesjo-Leirkup, Jaeren, Leira, Morsa (NO); Jylland and Fyn (DK); Lechinta (RO); various catchments in Scotland, England and Wales (UK); Southwest Finland (FI); Svärtaå (SE); CIPMS/IKSMS - Moselle-Sarre (DE, FR, LUX); Sona (PL); French National Authority (FR).

The measure “Buffer Strips” involves protecting existing (or establishing new) vegetated and unfertilized buffer zones alongside watercourses, in order to i) decrease the movement of nutrients and pesticides into watercourses and ii) reduce soil erosion. Additional positive effects include the creation of ecologic corridors, improvement of soil quality, increase of CO₂ binding in the soil, protection of sensitive field boundaries and improved biodiversity. The establishment of new zones generally requires a change in land use (i.e. no agricultural activities), but specific requirements regarding width and treatment vary by country.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none"> Reduce pollutants and nutrients from entering water through retardation of flow, deposition of sediment and sediment-bound contaminants, interception by vegetation, plant uptake, and infiltration Protect against overland flow from agricultural area and prevent run-off Reduce pesticide loading Vegetative buffers are effective at trapping sediment from runoff and at reducing channel erosion The water vegetation and the area around the base of the river bank offer shelter for many species of macrozoobenthos 	<ul style="list-style-type: none"> Considerable improvement for the whole agricultural ecosystem Positive effects also on biodiversity by creating “ecological corridors” Potential to sequester C in the soil and via tree planting Harvesting biomass from the buffer zone, if carried out without destroying it, could offset the costs of using land for buffers rather than food crops Improvement of soil quality and prevention of soil erosion, soil conservation For riparian woodland, benefits of shade, shelter and C sequestration

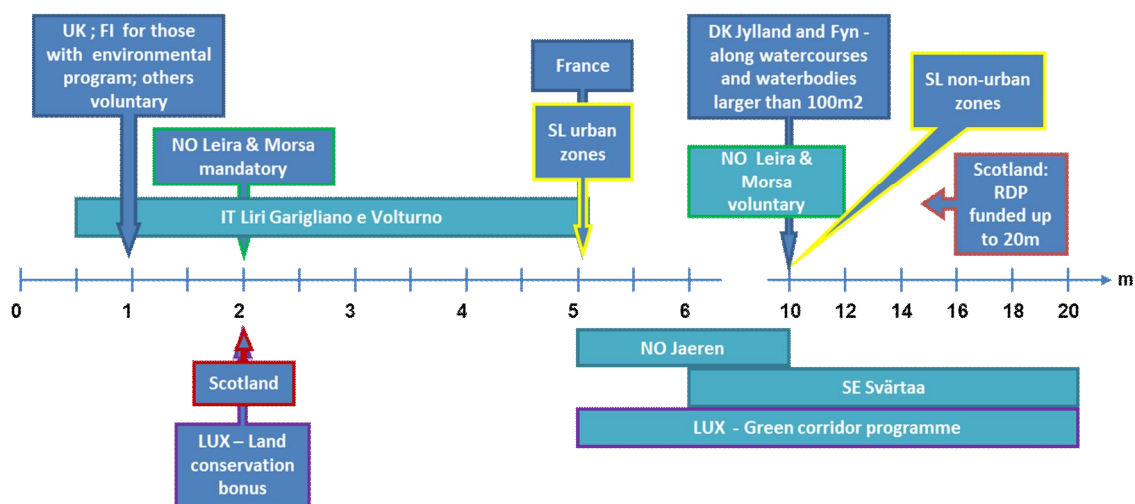
Application of measure

Most RBs have both mandatory measures for a limited width of buffer strips and voluntary measures that expand beyond the mandatory one (NO, RO, UK). Other countries also have both types of measures, but those are differentiated by criteria, such as financial support, the status of the water body, type of crops, or other exceptions (DK, UK, FR). In DE-SL the measure is mandatory, whereas in some river basins it is strictly voluntary (NO, LUX, SE). In most river basins measures apply in the whole river basin area (IT), in others (and in addition to application of measures in the whole RB area) special attention is given to prioritised areas and hotspots where voluntary measures can become mandatory (IT, NO, LUX).

Requirements regarding the width of buffer strips range by country, generally falling between 0.6m and 20m. The majority of countries prohibit entirely the use of fertilizer, pesticide, plant protection products, tillage, ploughing and spraying in these zones (DK, FI, SE, FR, LUX, DE). Some countries also prohibit grazing and agricultural use, cultivation of soil (DK, UK in the 1m no-cultivation-zone, LUX), whereas others allow for some agricultural use or require cutting grass, often with set time limits, i.e. after a certain date in summer (NO, FI, SE). The width requirements by country are provided in the figure below. The graph shows that there is not a single approach to setting buffer strip width and that

even within one river basin, different widths can apply for different areas and vary between compulsory and voluntary.

The graph below uses light blue boxes for ranges and dark blue boxes for a set width. The coloured frames help to find a second indication of width for the same river basin or country (i.e. yellow for DE-SL urban zones and DE-SL non-urban zones or green for NO Leira and Morsa Mandatory and NO Leira and Morsa voluntary).



Legend: dark blue box refers to a specific point. Light blue refers to a range. Coloured borders are used for several limits referring to the same country, i.e. SL – yellow, Scotland – red, NO – green, LUX – violet.

Range of environmental effectiveness

The measure primarily aims to provide guidance for managing riparian vegetation (IT) and keeping fertilization and treatments at a certain distance from watercourses (CIPMS/IKSMS) while contributing to a reduction of nutrients and/or pesticides in surface water and groundwater, eutrophication and spray drift, hydro-geological risk and N₂O emissions.

Reduction of phosphorous and nitrogen are estimated as follows: when buffer strips are 5m wide, reduction of P is estimated 15-20% of total runoff and 10% in meadows (NO). The effect of measure in hilly areas is estimated to be: P 42-96%, N 27-81%, particles 55-97%, organic material 83-90% (NO). If buffer strips covered 5% of the Svärtaå catchment area, load to surface water of P would be reduced by 6-12% and N ca. 2% (SE).

Some limitations concerning effectiveness remain. The UK finds that 1m is unlikely to provide filtering for medium/heavy soils, whereas 6m riparian grass buffer removes sand and silt size particles and can reduce pesticide loading. SE finds that the effect of buffer strips on water eutrophication may be overestimated.

Main issues and social barriers

In DK, farmers do not generally accept the measure, which may be due to the fact that it is mandatory and has strict requirements which impact agricultural production. This also holds true in PL, where buffer strips are not well accepted by farmers on NVZ. They are opposed to the 20m zone width, as it forces too high of opportunity costs (in the form of lost profits). Outside of the NVZ in PL, farmers are

not very interested in the buffer strips measure because of relatively low financing from CAP. Amongst the criticisms was also the lack of flexibility within the measure. In Scotland, while the funded water margin has quite a strong uptake, it is patchy and not necessarily targeted sufficiently to areas where it would be most required. However, the measure is by and large amongst the most accepted measures.

2. ESTABLISHMENT AND PRESERVATION OF WETLANDS

Contributing River Basins: Ebro (ES); Serchio, Liri-Garigliano e Volturno (IT); Southwest Finland (FI); Svärtaå (SE); Jylland and Fyn (DK); Moselle and Sarre (LU/FR/DE/BE - FR only provided the information); stormwater or artificial wetlands and vegetated ditches studied in the LIFE project ArtWET (specifically for this LIFE project FR-DE -IT involved, led by FR); various catchments in Scotland, and various catchments (Wensum, Hampshire Avon, Eden, Kent Rother, Yealm, Yorkshire Ouse, Lugg, Till (Tweed), Cleddau, Teif.i) in England and Wales (UK).

The measure addresses natural, artificial, permanent or temporary wetlands targeting their preservation, restoration or establishment. It is designed to promote water conservation in watercourses and coastal areas with a heavy environmental load from agriculture, to improve the living conditions for birds, to reclaim habitats that were lost when arable areas were drained, and to improve the conditions of brooks that wildlife use as passages. The measure will also promote game husbandry, the fishing and crayfish industries and rural landscape management.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none"> • Reduce non-point-source pollution by intercepting pollutant delivery, providing a buffer zone, and cleaning up polluted water • Denitrification, sedimentation and assimilation processes can serve to reduce nitrogen concentrations in water bodies • Artificial wetlands mitigate phosphorus concentrations and the effect of pesticides from agricultural runoff in ground and surface water • Constructed wetlands disperse and slow down inflowing water and promote the settlement and deposition of suspended particles • Protect/maintain and improve surface and ground water quality, protect soil, and recharge groundwater • Provide barriers for flood control, help to retain and slow down flood flows, and subsequently release the retained water during dry periods 	<ul style="list-style-type: none"> • Increase landscape diversity and benefit biodiversity by providing a habitat for a variety of fish and wildlife species and unique microhabitats for beneficial microorganisms • Act as buffer zones, act as central components of biological life within the adjacent river ecosystem • Increase recreational values of landscapes and provide natural flood control in high risk areas • On a global scale, wetlands play an important role in releasing, sequestering and storing carbon, thus contributing to reducing annual CO₂ emissions

Application of measure

In FI the measure is proposed to all farmers, often times under the condition of commitment to the environment program and registered associations. In SE wetlands are only subsidised within the agro-environmental support scheme in individually evaluated and approved areas (by the County Administration Board). In LU/FR/DE/BE the measure is proposed to all farmers on a voluntary basis, in connection with a project developer 'community'. In the UK, *Constructed Farm Wetlands* are encouraged nationally, but funding is more likely to be available in priority areas; in the case of *Wetlands for biodiversity*, funding is most likely in designated sites, such as SACs. The measure is not proposed to all farmers, but is instead limited to selected areas within the Demonstration Test Catchment (in the flowpath and with pollution to mitigate). Through Higher Level Stewardship (an agri-environment scheme in the UK), the measure is available to all farmers, but relies on a voluntary take-up of agri-environment scheme support.

In some cases, the measure has additional restrictions:

- **FI:** Applicable in areas in which arable areas account for more than 20% of the catchment area of the watercourse or main ditch. The area of a wetland must be at least 0.5 % of the area of the upstream catchment area.
- **DK:** Only river basins that drain directly into fjords and enclosed coastal waters are eligible and it can only be applied downstream of lakes to ensure the cost-effectiveness of the measure (due to the natural nitrogen retention capacity of lakes). In contrast, phosphorus wetlands are dosed according to the need to reduce phosphorus loading of lakes, and can therefore only be established upstream of a lake.
- **SE:** To get agro-environmental support with the aim of N and P retention, wetlands must be established on (or in connection to) agricultural land. A wetland financed by the RDP must be preserved at least for 20 years.

Range of environmental effectiveness

As identified by the majority of river basins, water quality improvement - generally through the capture of P and removal/denitrification of N - is a main intended effect of the measure. In SE, reductions were estimated at 174-217 kg/ha/a N and 2.4-4,9 kg/ha/a P. Results from small constructed wetlands for P sedimentation show retention of almost 23-42% for total P and 3-15% for N. As a comparison, an expected average reduction in DK is 130-135 kg/ha N and 20 kg/ha P. Additional intended effects include: reduction of the flood risk (IT and UK); capture agriculture nutrient-filled run-off and reuse of the accumulated water in the wetlands for irrigation (ES), water storage, groundwater recharge, coastal erosion reduction (IT); increase in the natural value/biodiversity of the site, positive effects on soil (erosion), landscape (ecological connections) and social value (IT).

Main issues and social barriers

In FI the measure is quite well accepted except when affecting normal farming. SE experienced a similar trend, where the measure is relatively well accepted among farmers unless it involves taking arable land out of production; furthermore, the compensation for application of the measure is considered to be too small. In LUX, a significant effort has been made to convince landowners and farmers who consider wetland as fallow land (non-productive) to implement the measure, but the regime of land tax could help.

In UK, CFWs have a very low uptake due to perceived loss of income through land take as a result of the produced guidance, costs of construction and low confidence in effectiveness. Before the guidance was published, uptake of the measure was higher (wetlands were smaller and monitoring has cast doubt about their effectiveness in Scotland). In some locations there has been a bit of a backlash where intensive agriculture is the main land use and landowners feel threatened by proposals to restore an area to fenland (England and Wales).

Ultimately, a voluntary and piecemeal approach has been identified as the greatest barrier to delivering effective conservation and resource/ecosystem service protection through wetland creation, maintenance and restoration. Overall insufficient financing and compensation are crucial for farmer uptake as well as the availability of informational and decision support tools to provide clear information and guidance (not yet available in the UK).

3. CHARGE FOR WATER ABSTRACTION/REDUCE WATER ABSTRACTION

Contributing River Basins: *Ebro (ES); Arno, Serchio, Tiber, Liri-Garigliano e Volturno (IT); Southwest Finland (FI); various catchments in England and Wales (UK).*

‘Reduce water abstraction’ refers to groundwater and surface water abstractions and is relevant in areas with low water supplies and where saline water intrusion and nitrate contamination are high. The measure determines how much water individual farmers can abstract and by how much they have to reduce abstraction, based on historical data. The measure addresses abstraction for public water supply, industrial and agricultural uses.

Charging for ground and surface water abstraction creates an incentive for farmers to reduce water use. In some countries, there is no charge to abstract water (e.g. AT). Such a charge would reduce the amount of water taken out of ground or surface waters, thus reducing the adverse effects of abstraction on the hydrological regime (e.g. aquatic ecology due to changes in flow regimes).

The aim of the measure is thus to improve the quantitative status of the groundwater. The intended effects are to stop the decline of water levels by not allowing new water abstractions in certain areas and to reverse the trends by means of recharging the aquifer (increasing infiltration, building retention weirs in two seasonal streams) and conjunctive use.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none">• Reduction in water extraction• Stabilization of head levels in groundwater bodies/decrease in lowering of piezometric water level trend• Maintenance of minimal flow• Sustainable use of water resources; reduction in water needs	<ul style="list-style-type: none">• Benefits for biodiversity via the protection of minimum vital flow• Improvements in soil quality from positive effects on subsidence• Protection against climate change

Application of measure

In ES an act was passed in 2002 by the Ebro Confederation (Basin Authority) to stop new abstractions of groundwater until the status of aquifers in quantitative risk was assessed. The measure extends its effects to all irrigation land within the area that affects three groundwater bodies. In IT the measures are implemented gradually in different areas on the basis of water availability. Abstraction is forbidden in areas where the water balance shows a critical situation; in other areas, the measure is first implemented where the water availability is out of balance. This means that the measure is sometimes limited to specific river or lake sub-basins.

Monitoring is established in several catchments in ES and IT and is largely compulsory. Where the measure is implemented, there is no time limit until the completion of planned works. No compensation for the measure exists in the two Italian catchments nor for ES-Ebro, but for the actions that are being taken to monitor the groundwater bodies and increase the natural recharge in the aquifer that are carried out by the Confederation.

Range of environmental effectiveness

The goal of these measures is the achievement or protection of water balance in all water bodies via the sustainable use of water resources. As regards aquifers with serious water balance deficit, a decrease in the lowering of the piezometric water level trend has already been observed in IT. Other observed effects include a stabilization of head levels in groundwater bodies (ES), protection against climate change (IT) and the maintenance of minimum environmental flow, which also benefits biodiversity (IT).

Main issues and social barriers

In ES farmers generally agree with the measures addressing the issue of aquifer depletion, as they perceive the latter as a risk to their farming activities in the years to come. The decision taken in 2002 has prevented the over-exploitation of the aquifer and has stabilized its level; as a result, the measures to be taken are neither expensive nor conflictive. The base is to forbid new abstractions in certain areas and optimize the conjunctive use with surface water. A comprehensive hydrogeology study has been developed and during the elaboration of the Ebro River Basin Management Plans there were several meetings with the organisations of farmers in the area. The acceptance of farmers in IT is more difficult. The River Basin Authority is perceived as not having the necessary competencies for awareness rising. These difficulties are echoed by Regional and Provinces representatives.

4. REDUCED FERTILIZATION

Contributing River Basins: *Svårtaå (SE); Liri-Garigliano e Volturno, Tiber (IT); various catchments in England and Wales (UK); Weser (DE).*

This measure aims at reducing nitrogen and phosphorous losses by adapting the amount of mineral fertilizers and manure to the current legislation and lowering application below an economical optimum. The intended effect of the measure is to reduce loads of N and P to surface and ground waters through leaching and run-off, especially in cases when over-dosage is practiced. Reduced fertilization will also reduce the residual nitrate in the soil after harvest and, in the short-term, the amount of soluble phosphorus. In the long-term, decreasing phosphorus fertilization can reduce the amount lost as particulate phosphorus.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none">• Reduction of nitrate pollution from agriculture to surface and groundwater to protect drinking water supplies (in line with Nitrate Directive requirements and WFD Good Status)• Reduction of nitrate and phosphate pollution and the risk of undesirable disturbance to water environments (i.e. eutrophication) and consequently support achievement of WFD objectives (e.g. Good Ecological Status/Potential)	<ul style="list-style-type: none">• Reduction of excess mineral N in the soil, decreasing the emission of nitrous oxide• Encourage better use of resources (inorganic fertilisers and manures) and therefore more sustainable agricultural practices

Application of measure

In SE and UK measures to reduce fertilization are proposed to all farmers. However, the measure primarily targets sensitive areas in the UK and DE with a high leaching rate and where the nutrient surplus has to be reduced. Similarly, part of the measure is limited to nitrate vulnerable zones in SE, resulting in different rules for different areas. In DE the Federal States compensate the income loss of farmers applying this measure (requiring a 5-years minimum commitment).

In IT, the transposition of European Directive into national legislation pertains to the central government; according to Ministerial Decree of the Ministry of Agricultural Policy (MiPAAF) of 19 April 1999, the “Code of good agricultural practices”, which deals with the proper use of nitrogen based fertilizers, has been formalized. Furthermore in 1999, according to Legislative Decree 152/99 (replaced by Legislative Decree 152/06) laying down “Provisions concerning the protection of waters from pollution”, rules have been issued about the use of nitrates in agriculture, in order to reduce or manage the problems related to pollution.

Range of environmental effectiveness

There is an unambiguous relationship between the amount of applied N and leaching. In central SE the reduction in the total N load to water is estimated at 4% when the applied amount of N to winter wheat and spring barley was reduced by 10%. There is also a relationship between the amount of applied fertilizer and leaching for P. In UK, for example, applying half of P fertilizer on horticulture land reduces leaching by 20%. Evidence also indicates a significant variation of N and P applications where over-

dosage is frequent, especially if manure is applied.

Among the expected or observed effects on other environmental priorities is that reduction of excess mineral N in the soil also decreases the emission of nitrous oxide. For accelerated effectiveness, a combination of this measure with other measures like catch crops is recommended.

Main issues and social barriers

The measure is commonly well accepted, but with certain hesitation due to doubts about the impact of the environment and because it may be related to increased costs or other inconveniences. In DE, farmers sometimes do not like to commit to a 5-year contract because of difficulties in estimating the economic effects due to the determined crop rotation and because of additional conditions (i.e. special pesticide application). Additionally, high administrative burdens prevent farmers from applying.

Local implementation can also be challenging, particularly where the initial costs of alternative measures can be more appealing, e.g. improved slurry storage. Additionally, while many farmers have a genuine concern about the impact of the environment related to eutrophication, their perception is that the losses of nutrients related to their own activities are relatively unimportant or difficult to influence.

5. AVOIDING SPREADING FERTILISER AND MANURE AT HIGH RISK TIMES AND PLACES

Contributing River Basins: Southwest Finland (FI); Svärtaå (SE); various catchments from Scotland, England and Wales (UK); Jaeren, Leira-Nitelva (NO); Weser (DE); NL.

Avoiding spreading fertilizer or manure at high risk times and places contributes to (1) reduced nitrate pollution from agriculture to surface and groundwater, and (2) reduced risk of undesirable disturbance in water environments (i.e. eutrophication). The measure also helps to encourage improved efficiency of resource use (inorganic fertilisers and manures).

High risk times relate to the periods of extreme hydric status of the soil (water-logged, flooded, snow-covered, or frozen) or when there is little/no crop uptake of nutrients. These conditions lead to closed period for applications, i.e. prohibiting the use of fertiliser and manure in autumn/winter/spring. *High risk areas* include areas with flushes draining to a nearby watercourse, direct flow paths to water courses, cracked soils over field drains, highly permeable soils, shallow aquifers, highly sloping fields and fields with high phosphorus content. The measure often includes width requirements for application.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none">• Reduced N and P leaching and loss through surface run-off• Prevention of excessive nutrient accumulation in topsoil in erosion and flood risk areas• Protection of drinking water supplies• Reduced eutrophication of rivers and lakes	<ul style="list-style-type: none">• Reduced ammonium-N losses and nitrous oxide in the atmosphere• Reduced phosphorus levels in the soil• Improved resource efficiency, reducing the need for artificial nutrients and creating more sustainable agricultural practices (potentially benefiting farm businesses)

Application of measure

Countries vary between mandatory and voluntary implementation for this measure as well as in the extent of use. The measure is proposed to all farmers in many countries, with additional targeting of farmers in priority areas. Specifically:

- FI: the measures "Spreading of manure during the growing season" and "Incorporation of liquid manure in the soil" are available to livestock farmers with about 1/3 of livestock farmers participating
- UK: the rule is compulsory and there is additional voluntary guidance; implementation and one-to-one advice are targeted to particularly sensitive areas;
- SE: limited to certain areas, with different rules applying (e.g. to nitrate vulnerable zones); voluntary guidance is provided through the environmental extension program;
- NL: measure applies to all farms as a general requirement (Nitrate Directive);
- DE: voluntary since 2007; mainly implemented in water protection areas; requires at least a five year commitment (compensation for income loss is provided by the Federal States); and
- NO: proposed to all farmers; requires a 3-year binding agreement with farmers; financial support available for better storage capacity.

Range of environmental effectiveness

The effect of a ban on application of manure or fertiliser within 2m from water courses or lakes was estimated to 20 ton N and 0.5 ton P for the entire NVZ in Sweden. To reduce N leaching in winter, manure application can be shifted to spring: If 25t/ha are applied in spring, the N leaching reduction could reach 27kg/ha (pig manure) and 13kg/ha (cattle manure). It is estimated if measures are taken up widely in FI, reduction could be around 7% of nutrient load with wide application (P - 30kg/a and N -600 kg/a). P loss reduction in the UK with the application of the measure was found to be 15% on sandy loam and clay loam soil types; N reduction varied between 0 and 15 kg/ha in affected areas.

In general, it is preferential to apply the measure on arable land with light soils. Furthermore, the measure is also likely to become effective more rapidly for N and less for P fertilizers because of the possibility for soil- particle- bound- P to become available for mobilization.

Main issues and social barriers

Farmers generally accept the measure, although some limitations exist. In Norway, 90% of farmers signed environmental agreements, and there is direct involvement of farmers in implementation. The UK offers support by farmer representative groups, which has been successful for the implementation of the measure. Similarly, early involvement and advisory services have contributed to the good acceptance of the measure in Germany.

In other countries and river basins there is more reluctance and discussion about technical details is on-going. In FI, while the provisions set out in the Nitrates Directive are accepted, additional measures are not popular. In some parts of the UK, there is a gap between the acceptance of the measure and its implementation.

The measure can have a negative effect on sod, making it less adapted to application in grassland. Additionally, the level of effectiveness in reducing N-load by reducing run-off is a subject of discussion, as N is not generally lost through surface runoff. A greater concern is pollution swapping between the different forms of nitrogen i.e. balancing losses of nitrate and ammonium via subsurface pathways versus ammonia and nitrous oxide via atmospheric pathways.

6. PLANT COVER IN WINTER

Contributing River Basins: *Liri-Garigliano e Volturno (IT); Borsesjo-Leirkup (NO); various catchments in England, Wales, Scotland (UK); Southwest Finland (FI); Moselle-Sarre (LU/FR/DE/BE); Weser (DE); Pandivere (EE).*

Planting fast growing crops in late summer or fall provides soil cover during the winter months, acting as a physical barrier on fields, slowing down infiltration into soil and reducing water runoff. It can also include leaving the stubbles of the previous crop on the field, without ploughing it under or removing it. The measure reduces nitrate leaching as well as soil erosion and the mobilisation of phosphorous and pesticides. The measure is particularly relevant for areas with excess precipitation and runoff during autumn, winter and early spring. The choice of the crop depends on the time of planting, the purpose of the crop, and the seeding method. The measure is linked to the measure 'catch crops'.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none">• Trapping N and avoidance of N leaching• Improved soil cover and reduced soil erosion• Reduced mobilisation of P and pesticides• Improved water quality	<ul style="list-style-type: none">• Improved soil organic matter• Improved soil quality• Provision of winter food for birds and mammals• Increased nutrient levels• Natural fumigation

Application of measure

In Italy, the measure includes the planting of shrubs in late summer as well as maintenance of native vegetation (forests, reforestation). In NO, the measure covers the maintenance of stubble over winter without ploughing under before 1 March of the next year. In the UK (England), both sowing of crops as well as the maintenance of stubble on fields are covered. Cross-compliance requirements set out post-harvest management rules which include that stubble of the harvested crop remains on the land, put into a cover crop, the next crop sown, a stale seedbed created, or a rough surface created through cultivation. The Entry Level Stewardship Scheme, on the other hand, provides support for more demanding winter cover options. In FI, measure is split into two options. One option involves covering at least 30% of total area eligible for agri-environment payments under vegetation or stubble, or subject to reduced tilling. The second option requires 50% of total area under winter cover. In LU/FR/DE/BE, the measure includes different types of soil cover (grassland or crops). In DE, the measure is an agri-environment measure focusing on water protection areas and crops planted in late summer or fall which can include crops such as green rye or winter turnip rape. In EE, the measure sets a requirement that at least 30% of land area under cultivation is kept. It is a compulsory measure in nitrate-vulnerable zones and a voluntary measure elsewhere.

Range of environmental effectiveness

Plant cover can reduce nitrate leaching by accumulating nitrates in biomass and/or soils. In DE, average rate of reduction that can be achieved is 40kg/ha. In FI, it is estimated that winter plant cover can reduce erosion and nutrient leaching by 10-15%.

The environmental effectiveness of plant cover will depend on the soil conditions and climate properties. The measure can be effective on light to middle light soils, but not on heavy soils. For the measure to be effective, cover crops have to be established early in order to take up sufficient soil nitrate before winter drainage leaches it below the depth of the developing plant roots. Further quantitative results on other parameters (soil erosion, P, pesticides) were not available in RBN contributions.

Main issues and social barriers

The measure tends to be well accepted among farmers as the awareness of the benefits of the measure is relatively high, and the measure contributes to optimised nutrient management on the farm. Many RBs have also already established informational and decision support tools through the farm advisory services. The main issue with acceptance is linked to the level of ambition in terms of the percent of land that needs to be covered by plant winter cover. In FR, for example, achieving 100% coverage in winter is contested in vulnerable zones.

7. CATCH CROPS

Contributing River Basins: Svärtaå (SE); Jylland and Fyn (DK); Liri-Garigliano e Volturno (IT); Weser (DE); NL.

Catch crops are fast-growing crops introduced between two main cash crops. Guidelines are set for the time of establishment of catch crops, ploughing of the crop and types of plants suitable for this use. A catch crop must be followed by a spring-sown main crop.

The measure is used with the objective to lower nitrogen loss from cultivated fields. Catch crops are accordingly included as one of the most important measures in all programs and plans for reducing the eutrophication of coastal areas and the sea. The cultivation of catch crops will ensure nitrogen uptake in autumn where plant available nitrogen is otherwise at risk for being washed out during late autumn and winter. The measure also aims to foster sustainable use and management of agricultural land, in particular by promoting the preservation of water resources, soil conservation, preservation and enhancement of biodiversity and rural landscapes and the improvement of air quality.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none">• Reduction in nitrogen leaching• Reduction in surface run-off and soil erosion• Mitigation of eutrophication in coastal waters and the open sea• Preservation of water resources	<ul style="list-style-type: none">• Preservation and enhancement of biodiversity and rural landscapes• Improvement of air quality• Mitigate release of greenhouse gas emissions from cereal production

Application of measure

In NL all farmers growing maize are required to grow a catch crop. In DE the measure is primarily chosen for arable or vegetable farming and every farmer with plots in sensitive areas can apply. In SE and DK the measure is voluntary. In SE compensation for catch crops from the agro-environmental support scheme is directed to areas with high nitrogen leaching. The total extent of catch crops in Sweden was 120.000 ha in 2010, which corresponds to 10 % of the area with cereals, potato, sugar beets, legumes and oil seed crops, or 5 % of all arable land. Targeted efforts also take place in DK, with emphasis on areas with run-off directly to shallow coastal waters like lagoons or fjords, and with the exclusion of areas with run-off to more open coastal regions like the Waden Sea or the Belts. Within each sub-basin, the number of hectares of catch crops (as with other measures) is calculated based on the need for lowering the nitrogen loading to the marine environment.

Range of effectiveness

The objective of catch crops is to reduce diffuse N loading in rivers, and in turn to coastal waters, lowering their nitrogen concentrations and limiting planktonic algae growth and eutrophication. Fewer algae will make the water clearer and thereby improve growth conditions for Eelgrass (*Zostera marina*). Eelgrass is the main biological quality element in DK coastal waters in first generation RBMPs. The cultivation of catch crops will ensure the uptake of nitrogen (and other nutrients) in autumn, which could otherwise be potentially washed out during autumn and winter.

The effect of catch crops on nitrogen leaching has been found to be high in SE, particularly on sandy soils. The reduction in leaching varies normally between 25 and 50% depending on soil type, when it is ploughed down, plant species used, climate, etc. According to estimates for the year 2005, the nitrogen leaching was reduced of about 1700 tons over a total area of 160 000 ha in Sweden. In DK, the average effect of catch crops in reduced loss of nitrogen from the root zone in RBMPs is 26 kgN/ha/a. Using a N-retention on sub-basin level, the effect on reduced loading to the aquatic environment varies between 11 and 16 kgN/ha/a. The calculated total annual effect from 140 000 ha of targeted catch crops in reduced loading to the aquatic environment is 1950 tonnes of nitrogen, averaging to 13.9 kgN/ha/a.

In addition to limiting N-leaching, catch crops will also mitigate the release of greenhouse gas emissions from cereal production in a changed climate with increasing temperatures, rainfall and CO₂ concentrations.

Main issues and social barriers

The extent of use of catch crops in SE and DE shows that it is a relatively well accepted measure by the farmers, as long as the level of compensation covers the expenditures. In DE acceptance improves with the early involvement of farmers and the availability of appropriate advisory services. This is done in context with the implementation of the agri-environmental programme in different types and on different scales down to intensive personally advisory service to farmers. On the other hand, farmers and farmer organizations in DK and IT are not keen on the adoption of this measure. They argue that the amount (percentage of crop rotation) of catch crops already grown as a basic measure (10-14%, depending on amount of animal manure spread on the field) places already a strong financial burden, as the current scheme does not foresee any compensation to farmers. As a result of such low acceptance, the political decision has been taken to introduce some flexibility into the catch crop measure, in terms of crop alternatives. 2012 is the first year where such alternatives can be used; despite this flexibility, farmers are still not keen on uptaking this measure.

8. APPLICATION TECHNIQUES OF MANURE

Contributing River Basins: *Pandivere (EE); Svärtaå (SE); Lechinta (RO); Scotland (UK); Weser (DE); NL.*

The measure involves promoting the usage of best available technology for manure application to incorporate solid manure into the soil as quickly as possible and directly inject liquid manure into the soil. Rapidly incorporating manure into soil will reduce ammonia losses and will increase the soil mineral N pool that may be lost to water systems by nitrate leaching or to the air as nitrous oxide. The measure also reduces phosphorus losses via surface runoff and macropore flow, by placing manure away from active flow paths and increasing the contact time between manure and soil. In some countries, the measure also requires manure spreading plans or field records with information about the application techniques of manure, type and volume of fertiliser, times of fertilisation and so forth.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none">• Reduces P losses via surface runoff and macropore flow• Reduces the loss of N through emissions into the air and leakages into ground and surface waters	<ul style="list-style-type: none">• Reduced detachment and entrainment of manure particles• Reduces the volatilisation of ammonia by reducing the exposure of manure to the air• Reduce mineral fertilizer by slurry application in spring

Application of measure

This measure is proposed to all farmers in EE and applies to all farmers in the NL. In SE, RO and the UK, the measure is proposed only to some farmers (namely those who keep livestock on slurry-based systems - SE and UK, or are in NVZ - RO). In DE, every farmer whose plots are part of sensitive areas for nutrient reduction can apply; the measure has thus mainly been implemented in water protection areas.

Specific requirements vary by country. In EE, for example, the measure is compulsory for farmers keeping livestock of more than 300 livestock units. In nitrate vulnerable areas in EE, it is also obligatory for farmers to participate in training on environmentally friendly management. It is also compulsory in the NL and RO (for NVZs). The measure is mainly voluntary in DE, UK and SE, but it is possible to prescribe the measure for farms with more than 400 animal units as a requirement for the permit in SE.

Range of environmental effectiveness

The use of best manure application technology is particularly important in case of liquid manure. The loss of ammonium nitrogen into the air is less than 5% in case of direct injection of liquid manure into the soil, as compared to about 50% if the manure is simply spread onto the soil. Here, timing is very important; if applied at the correct time and in correct quantities, more N will be used by crop and lower the risk of leaching.

Field experiments in Estonia show a good correlation between extra yields and used liquid manure application technology. With direct injection technology, the yield of barley was 4.2 t/ha; with manure incorporated into the soil 1 hour after application, the yield was 3.4 t/ha, 24 hours after application was 3.1 t/ha and 48 hour after application was 2.8 t/ha.

Direct injection into the soil also considerably reduces surface runoff, which is particularly important for reducing phosphorus load to surface water bodies. In a recent Danish study with rain simulation on undisturbed clay cores, incorporation of cattle manure reduced the P leaching with up to 50% compared to the cores where the manure was left on the surface. Other studies estimate the measure to reduce the manure component of P baseline losses by 19% on the sandy loam and by 13% on the clay loam soil.

Main issues and social barriers

In general, farmers recognize the importance of proper manure handling, especially in water protection areas. In EE, almost 90% of farmers estimated leakages from manure storages and during manure spreading on fields as the main water pollution problem in agriculture. The uptake of the measure is likely to be increased by emphasizing the economic benefits of better nutrient use. The general public is likely to be in favour of this measure due to reduced odours.

A few risks are connected with the application of this measure. Manure applied in autumn adds N to the soil and increases the risk of loss because there is very little crop uptake at this time. The rapid cultivation can also damage soil structure, which may compromise crop yields and result in applied mineral fertiliser and organic manure N. Utilisation of N is then lower and the risk of leaching over the next winter drainage period increases.

9. PROVIDE CAPACITY OF MANURE STORAGES

Contributing River Basins: Pandivere (EE); various catchments in Scotland, England and Wales (UK); Svärtaå (SE); NL.

The measure addresses on-farm manure storage capacity requirements, on the basis of cattle units and minimum duration of storage. The main aim of this measure is to facilitate the appropriate timing of manure application, i.e. avoid application at high-risk times for losses of nitrogen and phosphorus and maximize crop uptake of N and P from manure. Storage in itself does not reduce pollution loadings, except in ensuring that installations do not leak or burst. However, storage represents good or best practices in manure management.

Storage facilities come in many different types, including earth bank lined and unlined lagoons, above ground slurry stores and below ground shuttered concrete or panelled storage tanks. All storage facilities must be impermeable and built in accordance with specific design criteria.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none"> Reduction in potential run-off and thereby improved water quality Availability of nutrients at crop uptake time Decreased risk of microorganisms contamination from the manure entering water bodies via surface run-off or percolation through the soil to field drains (due to pathogens die-off during storage) Reduced risk of nitrate leaching losses 	<ul style="list-style-type: none"> Minimized risk of impact on the soil structure (reduce the extent of compaction and thus panning, both of which increase the likelihood of pollution) Improved soil structure Aquatic organisms benefit from improved water quality

Application of measure

In UK and SE the measure is proposed to all farmers, but different rules apply within and outside of Nitrate Vulnerable Zones; in EE the measure is obligatory for all farmers; in NL the measure applied to all farms with livestock.

Specific requirements vary by country:

- **Estonia:** if more farm animals than 10 LU are kept in a livestock building, the farm should have a facility with at least an 8-month manure (or liquid manure) storage capacity. Organic and mineral fertilisers may not be spread between 1 December and 31 March, and in any other period when the ground is covered with snow or is frozen.
- **UK:** storage capacity should be 4 months at minimum, and accommodate as well for rainfalls with a 5-year return period. There is no requirement for covers, except if the farm falls under the IPPC regulations for pigs and poultry. Grants are available for these in certain (CSF) catchments. Requirements do not change with location or farm type.
- **Sweden:** there are minimum requirements for adequate capacity for manure storage within and outside NVZs, but additional storage capacity may also be required for some farms to avoid spreading during high-risk periods.
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- **Netherlands:** all livestock farms are required to have a manure storage capacity covering at a minimum the period August 1 – March 1 (7 months). The capacity is equal to the number of animals that the farmer is allowed to have according to the environmental permit, times the amount of manure production by the type of animal, times the minimum 7-month period requirement.

Range of environmental effectiveness

Proper manure management has a significant environmental effect, with liquid manure storage facilities being of particular importance. Investigation of two large farms in Estonia in 2010 showed that where proper manure facilities were available no considerable pollution of groundwater or surface waters could be detected.

Potential negative side effects could include gaseous losses of ammonia and nitrous oxide and immobilisation of N, which will reduce the quantity of mineral-N available for loss by leaching or in surface run-off. Fresh cattle manure typically contains 25% of ammonium-N, compared with 10% in farmyard manure that has been stored for more than 3 months. There is also a reduction in the total N content; typically, 30-50% of the total N in manure is lost during storage. For poultry manure, about 15% of the N is lost during storage but the proportion of readily-available N remains similar to that in the fresh material. The method will have no effect on P losses.

Main issues and social barriers

In general, the measure is relatively well accepted given that farmers recognize the role of proper manure handling in water protection. Almost 90% of farmers in EE, for example, agreed that it is very important to have proper manure storage and avoid leakages from manure storages. Farmers estimated that the support for reconditioning manure storage facilities is the most important water protection measure in agriculture. About 2/3 of farmers agreed that manure storages are not meeting all the standards and 80% were of opinion that there is not enough support schemes to meet the requirements for manure storages. The local population is also putting pressure on farmers to implement manure handling requirements.

In UK the farmers will accept the measure as necessary, but support for the measure is generally mixed and includes discontentment through grudging acceptance (in cases where the business benefits are recognized). Slight discontentment also is raised in EE, where the farmers feel that the cost of the manure storage is higher than the obtainable profit from using manure as fertilizer during the appropriate period.

10. REDUCED TILLAGE / CONSERVATION TILLAGE / EROSION CONTROL MEASURES

Contributing River Basins: *various catchments in Scotland, England and Wales (UK); Jylland and Fyn (DK).*

Using discs or tines to cultivate the soil or direct drill into stubbles (no-till) will maintain organic matter and preserve good soil structure. Results of erosion-minimising cultivation will differ, among other things, depending on the levels of residue cover left on the ground. Minimal cultivation (rather than ploughing) may be the best way to maintain organic matter, preserve good soil structure and break up surface crusts. The resulting soil conditions should improve infiltration and retention of water, thereby reducing loss of P and sediment. Maintaining good structure and promoting infiltration and through-flow also reduces the risk of soil erosion.

Main environmental benefits

Main environmental benefits related to water	Additional environmental benefits
<ul style="list-style-type: none">• Reduced soil erosion risk and surface run-off• Reduced extremes of water logging and drought.• Efficient use of soil nutrients: decrease total P concentrations in surface run-off in the short-term• Decrease of NO₃ leaching through reduced mineralisation of soil organic matter in the autumn	<ul style="list-style-type: none">• Increase in soil organic matter and carbon sequestration if the land is ploughed every few years as a result of compaction

Application of measure

In DK these measures are new and have not been previously applied; they are not targeted to specific areas or sub-basins, but will be targeted to specific fields according to the crop rotation system of the individual farmer.

- **“Prohibition of soil preparation ahead of spring sown crops”** - for clay soils and humus soils the prohibition period is until November 1st and for sandy soils the prohibition period is until February 1st
- **“Prohibition of re-laying fodder grass”** - will mostly target farmers with either dairy cows or beef cattle; the estimated total number of hectares covered by this measure is 15 000.

In the UK, the measure is voluntary and open to all farmers with available guidance, but is not currently actively promoted by SEPA because the focus lies on compliance with basic measures. Additionally, there is a lack of advisory expertise in the area. General compliance is targeted to diffuse pollution priority catchments.

Range of environmental effectiveness

In the UK, the measure was found to decrease leaching by 0-25% compared with ploughing. On arable land with manure the reduction is at the higher end due to the higher labile N where manure is applied; nitrite loss is thought to be similarly affected. Additionally, the Defra project PE0206 (MOPS1) showed

that reduced tillage systems can reduce P and sediment losses by 30-60% on clay soils and by up to 90% on loamy sand.

Effects have been estimated in DK for the prohibition of re-laying fodder grass, indicating a reduction in nitrogen loading to the water environment in the amount of 15.3 kg/ha/a. In total for the measure the reduced wash-out from root zone is 540 tonnes of nitrogen with an effect of 230 tonnes of nitrogen reduced loading. No effect on reduced phosphor loss is calculated for this measure, the estimated effect being too little. For the prohibition of soil preparation ahead of spring sown crops measure, the total reduced nitrogen loading is 739 tonnes of nitrogen equal to about 6.7 kg/ha reduced nitrogen loading. Reduced phosphor loss due to lowered surface loss is estimated in total to be about 1 ton/a.

Main issues and social barriers

The largest barrier to uptake is likely to be the need to purchase new machinery. As such, it is only likely to be adopted on larger, predominantly arable farms. Nevertheless, experience has shown that minimum tillage, no-till, zero till operations are well accepted in most part of the arable sector in the UK and are dependent on soil type, cost and cropping type.

In DK the agricultural sector does not like the restrictions but have raised limited critiques of the measures. One such critique was from the organic farmers association, claiming that the prohibition of re-laying fodder grass will make it even more difficult for organic farmers to grow crops with high N-use (e.g. cultivation of rape-seeds normally sown late August/ beginning of September). This issue was taken into account and registered organic farmers no longer have to comply with the rules of the measures.

Possible negative environmental effects can occur as a result of these measures. While conversion from ploughing to minimum or no-cultivation systems will decrease total P concentrations in surface run-off in the short term, it can increase soluble P in the long term. There is also the possibility that incorporation of large volumes of straw into a small volume of soil under a minimum tillage system may immobilise so much N that it restricts crop growth and creates a need for autumn application of N fertiliser. Minimum tillage may also increase resistant weed populations and therefore increase reliance on chemical control, particularly pesticide use. Finally, there is also the risk that if minimal cultivation is carried out on soils with poor structure, the method may be ineffective at best.

SECTION 2

SPECIFIC ISSUES RELATED TO RIVER BASIN MANAGEMENT PLANS

WG1: INDICATORS TO MONITOR THE IMPLEMENTATION OF PROGRAMME OF MEASURE

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1. Introduction

An important part of the Water Framework Directive (WFD) implementation process is the sharing of information and the development of common methodology and approaches. For this purpose, indicator to monitor the implementation of the Programme of Measure was selected within the River Basin Network as one of the issues for comparison and analysis.

The views and status expressed in the article are those of the individual practitioners and do not necessarily represent the reported status by Member States in December 2012 nor the official views and positions of individual organisations or Members States for which the practitioners work.

2. Objectives

The objective of this work is to see if a more common descriptive way of evaluating the implementation status of the POM is possible using qualitative indicators rather than quantitative indicators.

The WISE reporting ultimo 2012 suggest the use of both predefined quantitative indicator and the possibility to give a qualitative description in case the implementation rate is changed compared to the planned. However there is no requirements to the qualitative description other than a maximum of word in the tick boxes.

This work attempts to set up some descriptive indicators selected by the working group, in order to facilitate a more comparable qualitative description of the status for the implementation of the POM. At the same time, when in some cases obstacles in the implementation have been the case, the same indicators may be used to share and focus information on cause of delay and action taken to overcome the obstacles.

Thus, the overall objective is, by using these descriptive indicators, to provide a more comparable basis for exchange of information on the different ways and methods used by different river basin district authorities in differing contexts implementing the same type of measures.

3. Summary and conclusions

The workgroup selected a set of indicators as a starting point for the study and the RBDs were invited to select the indicators they found most usable as well as they were invited to add more indicators if suitable for the description of the status. Not all contributing RBDs used all indicators and no alternative indicators were suggested.

Three types of measures were preselected by the working group for the study: buffer strips, wetlands and changing farmer's behaviour. The feedback on buffer strips however, was too few and poor to conduct further analysis why buffer strips has been omitted in this paper. A summary of the feedback from the RBDs using descriptive indicators is as follows:

Wetlands:

- Being a voluntary measure can make it more difficult to predict if the overall objectives will be met.
- Focus on information to the farmers as well as establishment of a clear and permanent organizational set-up and administration system accepted by farmer is important for reaching a high level of acceptance.
- The adoption of national (or regional) legal notes on criteria's on wetlands and compensation may improve the acceptance among farmers. It is mentioned by one RBD that also the engagement of experiences planners and use of (agricultural) consultants is important during implementation process and for following up.
- All RBDs mention the level (and type) of compensation to the farmers as crucial for the acceptance and the willingness to give up land for construction of wetlands.
- Being a voluntary measure may reduce the cost-efficiency as the areas the farmers bring in play may not be the most suitable for a high-efficiency wetland. GIS based programmes to help point out the most suitable areas as well as perform a pre-investigation of the area before starting the establishment/construction of the wetland may help improve efficiency and thus cost-efficiency. One RBD report that in order to keep a cost-efficiency at times the change of area for placing the wetland has been necessary.
- In spite the measure is well known and use before in most RBDs, a further development of the knowledgebase is suggest by some RBD in order to improve knowledge of reasons for different effects of wetlands and reduce uncertainty of effects. One RBD point out that a focus on design criteria's is important as well.
- Some quantitative indicators are mentions by RBDs, some of which are identical with the ones suggest by the WISE reporting scheme.

Changing farmers' behaviour:

- One – to – one contact between farmer and extension service officers seems to be the prevalent way to handle the approach to changing farmers' behaviour. No RBDs mention general information through internet as important for the success of the measure, indicting the direct contact with the farmers are of uttermost importance for the acceptance and willingness to change in management practice or start using some other environmental friendly measures.
- One important issue of the one – to - one approach is to improve the general understanding of the role of agriculture as contributor to the pollution of water environment and by this motivating the farmers to change behaviour. Besides, also the use of local model farms as a representative control sample of typical farms in design and dimension is mentioned by one RBD as an important approach.
- A clear organizational setup for responsibility and administration is mentioned by RBDs as essential for the implementation independently the measure is voluntary or mandatory for the farmer.
- No direct compensation to the farmers seems to be the case for the measure, however some RBDs mentions the financing as an important indicator. This indicated indirectly the need for a budget to finance the activities of the one – to – one approach and also that there are funds available for the farmers if they, as result of higher awareness, wish to implement other environmental friendly measures.
- Several quantitative indicators to monitor the implantation and participation of the farmers are mentioned by some RBDs. However, at the same time it is stressed that data obtained should undergo spatial analysis in order to obtain local information and thus be able to follow up at local level.

The use of descriptive indicators as method to obtain qualitative information of the status of the implementation of selected measures has been tested in this small study. The study shows that the use of selected descriptive indicators to evaluate the status of implementation of POMs in the RBDs is an interesting way of gathering information across the RBDs.

This study is small practitioners study and as such no evidence of uniformity and common mechanisms that may impede or support the implementation can be produced. However, the study indicate that by using the same qualitative indicators it may be possible to create more comparable descriptions of the reason for the status which again may produce new knowledge that may serve as a source of inspiration for the RBD managers. It is suggested to further examine this way of preparing comparable status reporting in the future.

4. Descriptive indicators of implementation

The indicators preselected and used in the questionnaire (explanation added) were as follows:

Voluntary/mandatory and farmers acceptance: e.g. is the measure voluntary or mandatory for the stakeholders and to which level is the measure accepted by the farmer or riparian owner?

Legislation: e.g. have national and/or regional legislation needed for implementation of measures been prepared and adopted before initiating the implementation of the measure?

Responsibility: e.g. is a clear organizational set-up for the implementation, including responsibility and definition of tasks of each stakeholder/institution clearly defined?

Administrative set-up: e.g. to which extent is an administration model set up and used for controlling quality and economic steering (cost recovery and compensation) as well as monitoring the planned implementation rate?

Cost and/or financing: e.g. to which extent is cost recovery/financing of the implementation of the measure present and is the level of recovery/compensation satisfactory for the different stakeholders involved in the implementation?

Knowledge base: e.g. is the measure well known, where positive and negative side-effects are known? Or is it a new measure where experiences are few and first need to be build up?

Quantitative key figures: e.g. which key figures are developed that may give an indication on the implementation rate (compared to planned implementation rate)?

4.1 Wetlands – feedback from RBDs

General information

Contributors	Sweden (SE)	Morsa, Norway (NO)	Southwest Finland (FI)	England and Wales (UK)	Denmark (DK)
Number of measure planned	13.000 hectares for phosphorus reduction	In the catchment Morsa there are now 73 wetlands, but there is room for more	200 wetland projects (0,5-1,0 % of catchment upstream)	99 wetland project planned	About 8.000 hectares for nitrogen reduction and about 1.500 for phosphorus reduction
Authority in charge of implement.	Swedish board of Agriculture (national planning) County Board Administrations (at local scale)	Land owner, Municipality, County	Local centre for Economic Development, Transport and the Environment.	Environment Agency / Natural England through Catchment Sensitive Farming Project	Nature Agency (national planning) Municipalities (local scale)
Mandatory/voluntary	voluntary	voluntary	voluntary	voluntary	voluntary
Status of implement.	on-going	on-going	on-going	on-going	on-going

Indicator: voluntary/mandatory and farmers acceptance:

In all RBD the measure is implemented on a voluntary basis. In general the RBDs report that the construction of wetlands is a well-known measure already and the acceptance of the measure therefore in general is good.

- However when voluntary for the stakeholder it makes it difficult to know if the planned goals will be achieved. This is a voluntary measure and the consequence is that one of the main obstacles is that if there are a number of land-owners involved (as is the case in many instances) and one is opposing the establishment of a wetland, it will stop the establishment (SE).
- The acceptance of the measure however, is based on more matters than just being a well-known measure. The economic compensation scheme and the possibility to have new arable land as compensation is a major issue (DK).
- The establishment of wetlands is voluntary. The farmers and the land owner must permit and be willing to establish, and he will also be the owner of the dam or wetland (NO).
- The farmer acceptance is being actively addressed through local CSF Officers, local studies/ investigations; tracking change through farmer surveys (which provide evidence of a rising trend of acceptance). A general issue of acceptance is that agriculture is a significant cause of water pollution (UK)
- Acceptance is generally good (FI).

However the acceptance is to a large extent based on other issues as described by the indications below.

Legislation:

- . A national legislation has not been adopted for a more efficient implementation of the measure, as it is a voluntary measure. As consequence one of the main obstacles is that if one is opposing the establishment of a wetland, it will stop the establishment. Another obstacle is the legislation around land drainage. Establishment of a wetland will in many cases can cause altered drainage conditions in conflict with existing permits. This will result in a process of revision of permits that is time-consuming and expensive and may eventually obstruct the wetland establishment (SE).
- . In 2010 a number of legal notes was prepared and passed by the national assembly in order to legalise and support for the implementation efforts. Four main legal acts were adopted: a legal notice on criteria's for selecting municipal wetland projects, a legal notice on cost recovery for municipalities conducting wetland projects, a legal notes on criteria's for farmers for obtaining compensation and a legal note setting criteria's for compensation when farmers make their own private wetland project. No doubt that these legal notes clear the way for the voluntary acceptance of the farmers (DK).

Responsibility:

- A permanent organizational set-up for the implementation, including responsibility and definition of tasks of each stakeholder/institution is clearly defined (SE).
- The responsibility of each part is very clearly defined (see factsheet) (DK).

Administrative set-up:

- A permanent organization is in place for controlling quality and economic steering as well as monitoring the planned implementation rate (SE).

- A clear and consistent organisation set-up for handling the whole implementation process and for monitoring the implementation rate and handle problems arising during the implementation period was made as one of the first operations in the implementations process. At the same time, to improve coordination, a national board with representatives of the partners has been established to monitor the whole process. The board meets twice a year- A slow-down in process after finalizing the pre-investigation and next steep, the application for realization was observed many due to an administrative bottleneck when municipalities applied for approval for realizing a project. Today more desk officer resources have been allocated to the area and it is expected that this will solve the problem (DK).
- The establishing is also highly dependent of good planning and follow-up during the construction. The officers at the local agriculture administration in the municipality as well as private consultants are crucial. A constraint is the lack of experienced planners and consultant at the municipal level. There is a co-operation with the Agricultural advisory service to get more experienced persons to take care of planning of these measures (NO).

Cost and/or financing:

- The voluntarity of the measure will certainly also reduce the cost-effectiveness of the wetlands since the locations will not always be optimal for nutrient reduction.

In the “technical analysis” for the next RDP period (2014 to 2020) presented by the Swedish Board of Agriculture, the proposed budget for establishment of wetlands is close to the needs as estimated in the PoMs. It is proposed that the compensation to the stakeholder (e.g. farmer) could be up to 100% of the actual costs, which is an improvement compared to the current compensation. The proposal also contains other financial improvements to facilitate the establishment of wetlands (SE).

- Without financial support no wetlands will be established. There is a high degree of financing, about 80 % but a constraint is the limited financial resources. We continue to grant funds for wetlands and other measures in the future (NO).
- A total budget for the whole effort expected by wetland projects has been established with both LDP and national means. The paying out is monitored so new projects is only initiated after the financial grant for the specific project is received (DK).
- The cost/financing is most commonly cited barrier to uptake of measures in CSF farmer surveys. CSF Officers are identifying existing funding sources to farmers (e.g. Environmental Stewardship) (UK).

Knowledge base:

- The effect on nutrient reduction from wetlands may be highly variable, and the effect is still uncertain, especially regarding phosphorus (SE).
- Over several years there have been information and communication with the farmers, as well as scientific documentation to convince the farmers that the wetlands are effective and also of benefit for the single farm (NO).
- Suitable places for wetlands are hard to find. Suitable planners are difficult to find. However, at the moment a GIS-based program is developed to help find suitable locations for wetlands (FI).
- To improve the knowledge base a current active research on efficacy and deigns criteria and costs etc. are on-going (UK).
- The measure is well known from previous use in national Action Plans. The administrative and financial set-up where the municipalities are the conducting authority is new.

In some cases flexibility in selecting area for a wetland project has been necessary. In a few cases it has been difficult for the municipalities to find enough suitable areas within a specific sub-basin why an application for establishing a wetland in another sub-basin has been necessary. After a technical

evaluation of the effect on the recipient in the sub-basin pointed out in the management plan, permission has been granted or not by the Nature Agency (DK).

Quantitative key figures:

- In the “technical analysis” for the next RDP period (2014 to 2020) presented by the Swedish Board of Agriculture, the goal in P reduction by wetlands is set to 59 tons, which is close to the requirements described in the PoMs (SE).

- In DK key figures used for monitoring the implementation rate are: a) number of pre-investigations initiated by applications for grants, b) number of realisation of project by applications of grants (after finalized pre-investigation), c) the total sum of nitrogen reduced per year of all the projects under realization, d) the amount of money paid out for projects (counted as hectare wetland or kilo of nitrogen reduced) compared with the budget (DK).

4.2 Changing farmers’ behaviour – feedback from RBDs

Contributors	England and Wales (UK)	Scotland	Sweden (SE)	Weser, Germany (DE)
Range of measure planned	123,387 measures planned through CSF with 55% implementation rate (based on sample of 1,969)	National awareness raising and risk based targeting on farm visits in priority areas	Not specified	9 areas where advisory services are being offered. Overall there are 627 000 ha of agricultural area which are being attended by 5 advisory agencies (4 engineering consultants and the chamber of agriculture Lower Saxony)
Authority in charge of implementation	Environment Agency / Natural England through Catchment Sensitive Farming Project	SEPA supported by stakeholder governance group.	Swedish board of Agriculture and the County Board Administrations	NLWKN as the authorized administration of the ministry of environment, energy and climate protection
Mandatory/voluntary	voluntary	mandatory	voluntary	voluntary
Status of implementation	on-going	on-going	on-going	on-going

Voluntary/mandatory and farmers acceptance:

The measure is voluntary except in Scotland where it is mandatory for the farmers.

- The farmer acceptance is being actively addressed through local CSF Officers, local studies/ investigations; tracking change through farmer surveys (which provide evidence of a rising trend of acceptance). A general issue of acceptance is that agriculture is significant cause of water pollution (UK).

- The farmers’ cooperation is voluntary. Model farms and consultants have regular meetings (so called „GroundWasserCircles“). At first (in 2010) the advisory services had to gain a foothold. Therefore they used multipliers like the chamber of agriculture Lower Saxony and the lower saxonian agricultural folk. Meanwhile the demand for one-to-one nutrient and fertilizer advisory services is quite high and is to be supported by raising the financial means (DE).

Responsibility:

- A permanent organizational set-up for the implementation, including responsibility and definition of tasks of each stakeholder/institution is clearly defined (SE)
- A clear organizational set-up for the implementation, including responsibility and definition of tasks of each stakeholder/institution is clearly defined. Advisory agencies and NLWKN (as the authorized administration) regularly inform the ministry of environment. They have close consultations like in between and final reports and biannual meetings (DE).

Administrative set-up:

- A permanent organization is in place for controlling quality and economic steering as well as monitoring the planned implementation rate (SE).
- A NLWKN group of coordination for the implementation of measures was established to attend to the implementation of measures (especially additional advisory services) in 5 areas in Lower Saxony. Indicators of the effectiveness of the implemented measures are being monitored and evaluated by the NLWKN (Weser, DE).

Cost and/or financing:

- The cost/financing is the most commonly cited barrier to uptake of measures in CSF farmer surveys. CSF Officers are identifying existing funding sources to farmers (e.g. Environmental Stewardship) (UK).
- In the years 2010-2013 the federal state of Lower Saxony provided the financial means by state budget. From 2014 on an ELER-co-financing will be aspired. The funds for 2013 are being raised up to 2.5 million €/year. The financing from 2014 on is to be accomplished by 50% EU-financial means (DE).

Knowledge base:

- Most previous research has focussed on plot scale evidence of measure efficacy - current research is actively focussing on "catchment" scale efficacy response to measures (GB)
- The measure is considered a well-known measure where positive and negative side effects are known. In the lower saxonian model of cooperation on the conservation of drinking water the additional advisory service was implemented in 1992 and has been proven to be very suitable (DE)

Quantitative key figures:

- Number of visits/revisits to farms. SEPA carries out farm visits to give advice on compliance with regulations (the DP GBRs) targeted to impacted areas. Revisits are made when problems are found to check on progress. Up to three revisits are planned before enforcement action is taken. The change in compliance can therefore be monitored to indicate implementation. We also have national inspection data (1-5%) of farmers. Surveys of farmer views, attitude engagement may also be undertaken. Attendance at workshops could also be used. On voluntary measures the number of (successful) applications to the Rural Development Programme would also be very useful. The data should be followed by a spatial analysis of the data. E.g. we know there is low attendance at workshops in the north east and so we need to look at new ways. (Scotland)
- The number of members in the "Focus on Nutrients" environmental extension campaign has increased from 7522 to 9492 (26 %) between the years 2008 and 2011 and the number of one-to-one farm visits increased with 45 % to a total number of 4149 from 2010 to 2011. There has been an increase in the attention to measures related to the WFD during this period, and the area has been extended including additional regions with problems related to eutrophication of inland waters.

The spatial resolution in analysis has not been specifically related to areas with problems, so there is an on-going activity to relate the number of farm visits and the area covered by the “Focus of Nutrients” to the water bodies not achieving good ecological status (SE).

- The indicators mentioned below are being monitored and evaluated. They depict the nutrient flow in model farms. In the area of advisory services these model farms present a representative control sample of typical farms in design and dimension (DE).

- 155 demo farms on which amongst other things diverse nutrient balances (like farm gate balances, field.-barn-balances, aggregated “Schlagbilanzen”) and Nmin values are being taken by an especially written software (DIWA-Shuttle) (DE).

WG2: FINANCING THE AGRICULTURAL MEASURES IN THE PROGRAMME OF MEASURE

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1. Introduction

An important part of the Water Framework Directive (WFD) implementation process is the sharing of information and the development of common methodology and approaches. For this purpose, financing of measures was selected within the River Basin Network as one of the issues for comparison and analysis.

Diffuse and point pollution of especially nitrogen, phosphorus and pesticides from agriculture and water abstraction for irrigation are areas where significant improvements are necessary to reach the objectives with the WFD. Some of the necessary measures can be implemented at no cost or may even save money, however for most measures there is a related cost. For example, construction of wetlands may require a substantial investment and will also result in income loss if the alternative land use is agricultural production. For many measures there will also be a maintenance cost to preserve the function.

The main objective with this analysis is to review how measures in agriculture proposed in the Program of Measures (PoM) for Denmark, Finland, England and Wales, Italy, Norway, Scotland and Sweden will be financed. Financing of agricultural measures is complex, with a variety of different options. When addressing measures and their financing, the WFD calls for the polluter-pays principle and cost-effectiveness analysis and at the same time the Common Agricultural Policy (CAP) allows for compensation through the agro-environmental support scheme. Obviously, financing is closely linked to the policy instrument or delivery mechanism related to the specific measure. In the economic assessment of the WFD, financing is also connected to the analysis of the ability to pay, i.e. affordability. How financing of measures are approached in RBMP, PoM or related documents may also be an indicator of the status of implementation of the measures.

This article summarises the experiences by members of the River Basin Network for Agriculture how the most important measures will be financed within for the first round of Water Framework Directive (WFD) River Basin Management Plans (RBMP), 2009 to 2015. It is intended to help share information among River Basin District (RBD) managers and policy makers to help improve future approaches e.g. second cycle of RBM (2015 to 2021). The views expressed in the article are those of the individual practitioners and do not necessarily represent the official views or positions of individual organisations or Members States for which the practitioners work. These views are shared in good faith to help improve approaches to RBM in the future.

2. River Basin Network Experiences on financing of measures

The following parts of the article have been drawn from responses from the working group with contributions from Denmark, England & Wales, Finland, France, Italy, Norway, Scotland, Spain, Sweden and the Netherlands.

DENMARK

Financing of selected measures

The most costly suggested measure in Denmark is establishment of wetlands for nitrogen reduction to the coastal water bodies. The majority of the wetlands will be established via *municipal projects*, but some wetlands will be realized through minor *private projects*.

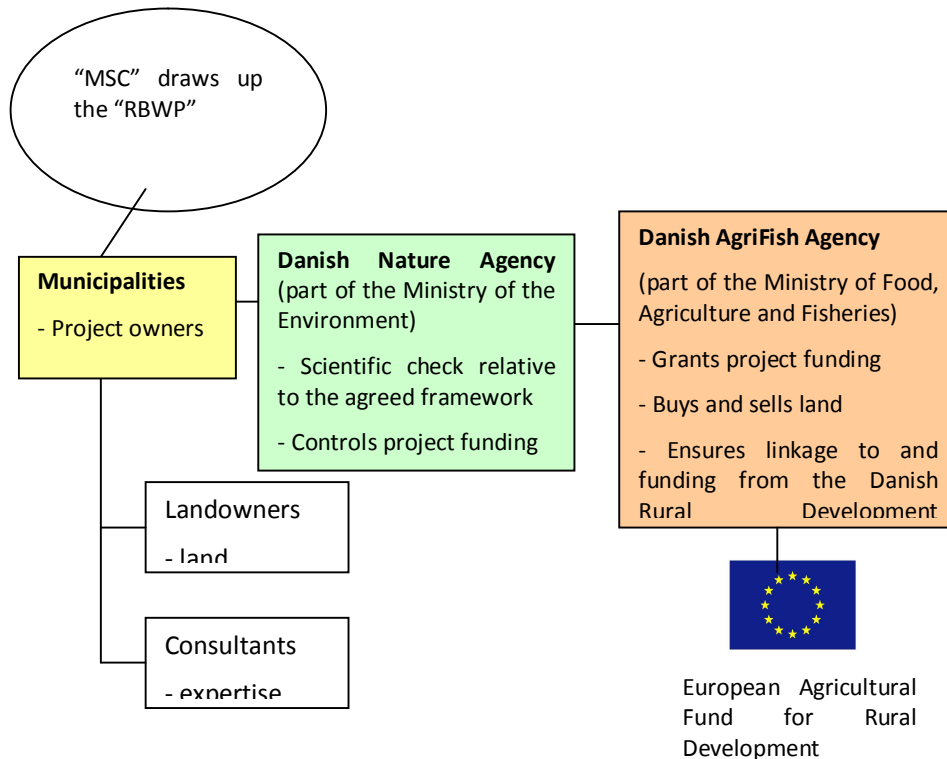
In the municipal wetland project owners of land in potential areas will be asked to let their land be included in a project in return for financial compensation. The most important mechanism for financing implementation of the projects is the purchase and sale of land. When the municipalities have completed the necessary preliminary studies of a potential nitrogen wetland, have received notification that the Danish AgriFish Agency agrees to fund the establishment costs, and the necessary financial framework has been allocated for acquisition of land, the municipality requests the Danish AgriFish Agency to perform the land purchase and land redistribution. The Danish AgriFish Agency is empowered to undertake land purchase within the funding granted for the project. In principle it is up to the landowner whether or not to relinquish land for use in a project. However, expropriation can be employed in special cases where an individual landowner is otherwise hindering implementation of a major project. It is also permissible for a landowner to establish a wetland project as a *private project* instead of entering the municipal nitrogen wetland project. By this the farmer can keep his land, but as a non-arable wetland.

The decision as to whether the land for a project is to be acquired by the purchase and sale of individual land deeds or through land redistribution is made by the Danish AgriFish Agency in the Ministry of Food, Agriculture, and Fisheries. Land redistribution is a useful tool when many trades have to be conducted simultaneously, and when several landowners are both purchasers and sellers. The Danish AgriFish Agency thereby ends up owning all the land within the project area.

Prior to the process of land purchase for a project the Danish AgriFish Agency can use national funds to purchase land outside the project area for use as a land pool for compensating those landowners who relinquish land in the project area. The purchase of land for a land pool is therefore a means of enhancing the interest of landowners in entering into voluntary agreements on the establishment of nitrogen wetlands. Once the project has been implemented, the Danish AgriFish Agency sells off the purchased land within the project area – i.e. the land on which the wetland has been established – through public tender. An individual farmer, a group of farmers or an organisation may then purchase the wetland. Figure 1 illustrates the role of the different partners involved in a municipal wetland project.

In a minor private project, landowners who wish to establish minor wetlands themselves rather than sell the land to the Danish AgriFish Agency as part of a municipal project will be able to apply for a subsidy for private wetlands under the Danish Rural Development Programme. Under this scheme the landowner can apply for the establishment costs and a 20-year subsidy.

In the municipal wetland projects, those landowners who in the preliminary study of the project or later in the planning process express the desire to keep their land may instead establish a private project and instead enter into a 20-year agreement on a subsidy for maintaining the wetland. The agreement between the farmer and the Danish AgriFish Agency provides the municipality with a guarantee that the landowner will make the land available for the project and accept restrictions on right of use of the land in return for compensation over a 20-year period. This ensures that a major municipal project will not be blocked by one or two reluctant farmers not wanting to sell their land. The use of expropriation should with this opportunity be avoided.



Actors involved in implementation of municipal wetland projects. MSC denotes Municipal river basin steering committee (comprised of the municipalities in a river basin), and RBWP stand for River Basin Wetland Plan, which is a catalogue of potential wetland projects.

The establishment of nitrogen wetlands and the restoration of natural hydrology have been employed as a measure for many years in the Danish national action plans for the aquatic environment, both as private wetlands with a 20-year compensation agreement and as major state wetland projects involving nature restoration. The measure is therefore familiar to the agricultural sector and accepted as a well-functioning and cost-effective measure. Land purchase and sale and land redistribution are also familiar methods. The new element in the use of nitrogen wetlands as a measure in river basin management plans is that responsibility for their implementation lies with the municipalities and that these have to undertake large numbers of projects concomitantly within a short period of time. It is often the case that several projects have to be undertaken simultaneously within the same sub-basin.

An overall financial framework of 1050 million DKK has been allocated for nitrogen wetland and phosphorus wetland projects during the period 2010–2015 (up to 10 000 ha nitrogen wetlands and 1500 ha phosphorus wetlands). Much of this money is obtained via the European Agricultural Fund for Rural Development with corresponding national funding. The annual costs (annualised over 50 years) are calculated to be:

- Nitrogen wetlands: 6192 DKK/ha
- Phosphorus wetlands: 3477 DKK/ha

The RDP support is 75% for activities accepted for support (see table in the next page).

Economic conditions for wetlands

			Total costs 2010-2015			
			Million Danish kroner			
Activity	RDP support	RDP-article for support*	Project costs	Administrative costs	Total costs	Responsible institution
Field- and facilitating work	No			9,5	9,5	Ministry of the Environment
Technical pre-investigations	Yes	§ 41	14,7	7,4	22,1	
Pre-investigation of individual farm	Yes	§ 57	13,6	7,2	20,8	
Buying of land for "pool of land" inclusive transaction costs	No		12,0	3,3	15,3	Ministry of Food and Fisheries
Buying and reselling of project soil in a soil distribution process **	Yes	§ 71	563,0			Ministry of the Environment
Buying and reselling of project soil in a soil distribution process including transaction costs and administration	Yes	§ 41	41,3	56,9	98,2	
Installation investments	Yes	§ 41	166,7	8,5	175,5	
20- year subsidy scheme for wetlands (model 2)	Yes	§ 39	88,0	4,4	92,4	Ministry of Food and Fisheries
Expropriation	No		46,7	3,7	50,4	Ministry of the Environment
General administration of the project portfolio	No			11,3		
Total			946,0	112,2	1058,2	

*As the measure is considered voluntary and thus not mandatory the article 38 in the RDP is not in use.

** Buying and reselling of project soil in a soil distribution process: Public registered land surveyor (the Danish AgriFish Agency) buys project soil for the project owner (Ministry of the Environment) and EU reimbursement is received for 75% of the amount. The state provides the 25% of the purchase amount. After establishment of wetland the soil and soil use will be recorded in the deed. When the wetland is established the soil is sold in a public tender and EU will receive 75% of the amount and the state 25%. The sales price will be lower than the purchase amount as the soil is no longer agricultural soil in rotation.

ENGLAND AND WALES

Context of Measures

The agriculture measures in the PoM are set out in 7 river basin management plans, delivered by the Environment Agency and partners. The majority of measures present in the current river basin management plans relate mainly to advice and influencing partnerships and schemes. This is so that action could be taken in areas that we currently know are a priority for water quality, whilst we increase our knowledge of specific failures and solutions through our on-going investigations programme.

From the investigations which are laying our evidence base for action, we will implement more targeted actions to address specific failures in the next river basin management plans. We have also directed our action through the Nitrates Directive, where we have regulated agriculture in accordance with designated 'Nitrate Vulnerable Zones' (NVZs).

Financing of selected measures

What needs to happen to address failing elements, and get water bodies to Good Ecological Status will be identified as part of our investigations programme. This is not available yet. At the end of 2012 we will be at the point of understanding what all failing elements are, and the reasons for those failing elements. The 'pathway to good' will be identified (with costs) between now and 2014 to inform the next river basin management plans which will have targeted actions.

Advice and guidance measures are mainly delivered through the Catchment Sensitive Farming scheme which is financed from central government through the Department for Environment Food and Rural Affairs (Defra) and core activity from the Environment Agency. These schemes encourage behavioural change, and ultimately in some cases investment by the land manager to improve practices.

Direct farm improvements are also funded through the Capital Grants Scheme, which supports land managers in priority catchments in England by providing grant aid towards the improvement or installation of facilities that would benefit water quality by reducing diffuse pollution from agriculture. This scheme is worth €29 million in 2012-13.

Catchment Restoration Fund – Defra has created the Catchment Restoration Fund to support this aim. A £28 million fund, providing between £8 million and £10 million for three years ending in 2015, has been allocated for projects to be delivered in 2012/13, 2013/14 and 2014/15 in England (Wales is not included).

The Environment Agency is administering the Catchment Restoration Fund (CRF) to support third sector groups to bring forward projects that will at a catchment level:

- restore natural features in and around watercourses
- reduce the impact of man-made structures on wildlife in watercourses
- reduce the impact of diffuse pollution that arises from rural and urban land use

By the end of May 2012, we received 131 applications for over £54 million of work during two rounds of bidding this year. A national panel chaired by the Environment Agency, with representatives from Defra and Natural England considered the assessment to recommend grant awards, with the River Restoration Centre acting in an advisory capacity. To date, 42 projects have been approved, with a combined value of £24.5 million. Approval was given to those projects which are of a high priority within their catchment as assessed by liaison panels, and where the technical experts in the Environment Agency, Natural England and the River Restoration Centre had high confidence in delivery. Many of the successful bids embraced partnership funding, collaborative working and in some cases also supported innovation.

WFD measures are also paid for using CAP Rural Development Funds. The current Rural Development Programme for England (2007-2013) budget is £3.7bn, of this £0.8bn is funded from Pillar 2 funds and a further £1.7bn through deductions from farmer's single payment scheme receipts (voluntary and compulsory modulation). Co-financing from Government Treasury is a further £1.2bn. In England, approximately 6.5 million hectares are in an agri-environment scheme, around 70% of the utilisable agricultural area.

For Wales, the current Rural Development Programme (2007-2013) has an overall spend commitment of £795, with an EU contribution of £195 million. Approaching £600 million is provided directly by the Wales Government. CAP Reform is important for Wales as farmers and rural communities in Wales currently receive funding worth £390 million annually.

Approximately 80% of the Welsh RDP budget is currently utilised to enhance the environment and countryside through support for land management and agri-environmental schemes. In Wales over 40% (approximately 750 000 ha) of agricultural land has enrolled in such schemes with the excess of 9000 participating farmers.

FINLAND

Context of Measures

For the implementation of WFD mainland Finland has five national RBDs and 15 Centres for economic development, transport and the environment (ELY-centres) responsible for the planning of RBM in their respective districts. As the natural river basins do not coincide with the RBM authority, for each RBD one ELY-centre is appointed as the competent authority in charge of implementation of the RBMP in close co-operation with relevant interest groups. Southwest Finland is part of Kokemäki River-Archipelago Sea-Bothnian Sea RBD and ELY-centre for Southwest Finland is the responsible authority in that area.

In Finland agricultural measures are financed in general through the Rural Development Programme 2007–2013, and especially common agricultural policies and agri-environment payments (RDP measure 214) and non-productive investments (RDP measure 216)¹. The objective is to grant agri-environment payments to 93% of the farmers covering 98% of arable land, and this objective is mostly fulfilled as for the period 2007-2013 about 90% of Finnish farmers have committed themselves to the scheme (95% of all arable land). Agri-environment payments cover a big part of farmers' income. No other financing is allocated to agricultural measures. Therefore to be able to support the implementation of cost-efficient water protection measures in agriculture the RDPs and their environmental support payments should remain at least on the same level post-2013. Article 38 was not used as a funding mechanism for the support period 2007-2013 though the potential was somewhat explored and should be explored again for the post-2013 support period. Article 38 could be used especially in targeting the measures to heavily polluting parcels.

To achieve the GES in surface waters in region Southwest Finland the following supplementary measures for agriculture (and their extent) are listed in the PoM, in addition to the basic measures (statutory and good agricultural practise):

- increasing the wintertime plant coverage of cultivated fields (54 000 ha)
- increasing the number of constructed wetlands (200)
- enhancing the management of manure (555 000 t/a)
- controlling nutrient releases from agriculture (200 000 ha)
- enhancing the efficient reduction of nutrient load (7300 ha)
- increasing the area of buffer zones (1239 ha)
- increasing the amount of controlled sub-surface drainage systems (1900 ha)
- providing education and counselling (1.015 farms/y)

These measures, all voluntary for farmers, are also listed as additional and special support measures in agri-environmental support scheme. About 40% of the expenses are financed by public expenditures. Responsibility for implementing the measures rests on farm level. Ministry of Forestry and Agriculture and Ministry of Environment are responsible for developing the agri-environmental support scheme and the training and advising is carried out by different advisor organisations.

Financing of selected measures

The two most costly measures suggested in the PoM are wetlands and buffer zones. The establishment of multi-functional wetlands is financed by *RDP measure 216* for non-productive investments and a special contract for wetland management for 5 or 10 years is required. The establishment is funded maximum according to expenditure 11.500 €/ha of wetland. The wetland management is a special

¹ http://www.maaseutu.fi/attachments/newfolder_0/5yNX8hBfo/Rural_Development_Programme_for_Mainland_Finland_280411_EN.pdf

measure in *RDP measure 214* for agri-environmental scheme and the fund is maximum 450 €/ha. Establishment and management of riparian buffer zones is a special measure in agri-environmental support scheme and the funding is maximum 450 €/ha. In Southwest Finland where arable land area is 295 000 ha there is a supplement measure target for 200 wetlands (360 000 €/a) and 1239 ha of riparian buffer zones (558 000 €/a).

Most funding is being allocated to measures aiming at increasing winter time vegetation cover (e.g. wintertime vegetation cover, reduced tilling and catch crops). About 800 000ha of arable land is using some of these measures and 28 M€/a is allocated to that. In Southwest Finland the target is to have 54 000 ha vegetation cover and 2.7 M€/a is allocated for that.

Agri-environmental measures in Finland cover 1.91 Mha of arable land area and the financing is approximately 340 M€/year during the RDP 2007-2013. Almost all the costs (e.g. in 2008 311 M€) is targeted to water protection measures but there is no money ring-fenced or prioritized for the WFD objectives. The cost for supplementary measures is 171 M€/a.

FRANCE

Context of Measures

A national RDP is prepared by the Ministry of Agriculture with the cooperation of the Ministry of Environment. The Water Agencies are consulted by the Ministry of Environment. It is decided which measures are selected, how they are funded and which ceiling apply. Then the national RDP is further specified at regional level (several regions are included in one river basin). In cooperation with the different partners, among whom the Water Agency, the farmers or the regional Council, the local agricultural authority ("Direction Régionale de l'Agriculture et de l'Alimentation et de la Forêt") decides which measures are relevant for the region and how they can be funded and implemented.

Concerning water protection agri-environmental measures are a big deal. There is a dedicated regional committee which meets on a regular basis to follow up and to adapt if necessary. And, finally, each territory (catchment area) proposes to the regional committee a project with local adaptation of those measures.

Financing of selected measures

The conversion to grassland and the purchase of land are considered as costly but effective measures. The purchase of land is the most expensive measure but the result on water protection is ensured. The conversion to grassland is less costly but the result is not always certain at long time (conversion to grassland could be reversed after the 5 years of the measure). For example, conversion to grassland is funded through the RDP with the support of the water agency. The ceiling on the public support is a major constraint as conversion to grass land has to compete with very competitive productions in one of the most productive part of Europe. Support can be up to 600€/ha/year. In most cases in the Seine Normandy river basin, agri-environmental measures with a water protection objective are financed at 100% by the water agency.

The purchase of land (e.g. to restore wetlands) is not supported by the RDP. The Water Agency contributes among other partners. To restore wetland, the water agency brings 80% of the price and Departmental Council ("Conseil Général") up to 20% (for associations and small municipalities). To protect catchment, the water agency supports the municipality with aid and an advance of money which, together, covers 100% of the price of the land (with some limitations of localization and of uses).

ITALY

Context of Measures

Italian River Basin District Authorities do not manage financial resources and measures included in the PoMs are financed by other competent bodies (i.e. Ministries and Regions). The main instrument for financing agricultural measures related to water protection is the Rural Development Program. Another area of measures with importance for financing is improvement of irrigation. The National Irrigation Plan is settled at national level (by Ministry of Agriculture) for improving irrigation infrastructures and enhancing their efficiency.

Financing of selected measures

The national Rural Development Plan (RDP) for 2007-2013 allocates funds between the 20 Regions. Measures related to water quality include:

- adopting of low input agronomic practices (as organic and integrated agriculture)
- maintenance or creation of buffer strips connected with water bodies. Buffer strips is however included in cross-compliance obligations from 2012 under specific criteria: minimum extension of a buffer strip is 5 meters from river body or 3 meters in specific cases related to good environmental status of river bodies; in those areas specific prohibitions and limitations are provided. Financial support for buffer strips (i.e. under agro-environmental payment) is still allowed for practices going beyond cross compliance requirements (such as extra width or vegetation including trees or hedges).
- restoration of wetlands in accordance with Natura 2000 objectives and maintenance of ecological water flow
- other water related measures such as innovation at farm level for water saving and waste water treatment (settled under Axes I)

Then, funds for each measure are given directly by Regions to farmers generally by a public bid under specific criteria and conditions as, for example:

- objectives of measure (i.e. water protection or biodiversity conservation);
- conditions to apply as:
 - o geographical areas eligible (e.g. outside nitrogen vulnerable zones, catchment under specific protection issues etc.);
 - o farm features (e.g. type of farm, size of farms, type of crops or pastures, etc.);
- obligations on how to realize the measure, when and for how long;
- priority criteria (and scores) for selection usually related to achievements of environmental objectives;
- mandatory provisions/plans;
- incompatibility of other measures under RD payment, and
- amount and instalments.

In the eight Italian RBMPs, measures for water quality improvement related to agricultural sector concern improvement in irrigation and introduction of good practices in managing fertilizers and nutrients and in water saving. Here follows some examples from four River Basin Districts.

In the RBMP of *Northern Apennines RBD*, some of the most important measures include:

- establishment of buffer strips along water courses,
- promotion of water saving practices in agriculture through leakage reduction, better water abstractions practices, introduction of new irrigation technologies and practices, advanced monitoring and remote monitoring techniques,
- action plans for vulnerable zones and the introduction of good agricultural practices.

- conversion to grassland or pasture,
- conversion to wetland or wood or for protection of Natura 2000 sites and of drinking water areas.

The total budget for some selected measures in the Emilia Romagna and Liguria regions are:

- 82.5 M€ for promotion of water saving practices in agriculture
- 0.3 M€ for action plans for vulnerable zones and good agricultural practices

In the *Central Apennines RBD* most of the measures are in terms of guidance or orientation and it is up to the responsible organizations to produce specific measures as a consequence of the PoM. There are basic measures concerning water quality in particular regarding reducing of fertilization in the nitrate vulnerable zones. Furthermore, there are supplementary measures that are more detailed in terms of reduction of water abstraction and reduction of fertilization. In any case it's the regional authorities that are responsible at institutional level to organize and monitor the measures. Examples of measures are:

- improved irrigation infrastructure in the watersheds of Tre Ponti and Torre Alfina (3.8 M€), and
- conversion to sustainable agriculture in the Trasimeno Lake area (3 M€).

In the *Northern Eastern Alps RBD*, Region of Veneto, important RD measures related to water are:

- maintenance/improvement of buffer strips including one or more tree lines plus 5 m of grass. Agro-environmental payments are lower if the creation of a buffer strip has been funded by public payments in the past and higher if the creation was voluntary (35 M€);
- reducing organic N use to 2/3 of the Action Program provision quantity (6,5 M€);
- organic agriculture (13 M€);
- maintenance of wetlands in relation to Natura 2000 (2 M€);
- maintenance of grassland and pastures (55 M€);
- conversion to grassland where pesticides and nitrate use is forbidden (2 M€);
- use of micro irrigation or fertirrigation systems at farm level (since January 2012).

For all those measures, funds are given directly by Regions to farmers selected by a public bid and applying specific priority criteria.

In the *Southern Apennines RBD* the most important measure financed within the regional programs include is water saving, e.g. introduction of new irrigation methods, re-use of water, monitoring of the actual volumes used and information about water-saving methods.

THE NETHERLANDS

Financing of selected measures

Water protection measures within the RDP are financed with up to 86 M€/a. This is a preliminary figure though. Provinces and water boards can (and some do) use public money (provincial taxes, water board taxes) for arrangements with farmers to implement agricultural measures. These 'blue-green-services' go beyond cross compliance, e.g.

- " sowing and maintenance of flowery field margins, and
- " maintenance of nature friendly wet banks along smaller rivers and ditches.

However, only a few provinces and water boards actively implement this in practice: the additional costs and lack of administrative support are important limiting factors. Water boards and provinces use their (own) tax income partly on agricultural measures (WFD related water system management). This is supported by governmental investments (period 2009-2015): 125 M€ on water synergy projects (combining water measures with measures for N2000) and research investments 75 M€ on water innovation projects (partly in agriculture).

Other financing exist for 'Nature monuments' (Nature NGO) with lease contracts on nature fields that are (partly) managed by farmers. Water companies have projects in which farmers get payments to reduce emissions on pesticides or nutrients. However, these projects are often temporary and farmers

stop their activities as soon as the projects (funding) are ended. Water companies do not consider it their responsibility to continue these projects on the long run.

NORWAY

Context of Measures

In Norway the agricultural measures are mainly financed by the government as a part of the annual grants to the agriculture. These funds are divided into a central part, which is administrated by the ministry of food and agriculture, a part that is administered by the counties and a part that is administered by the municipalities. The support is linked with the agricultural policy and the various political targets for agriculture and environment. This can result in quite different priorities in the Norwegian regions or counties due to large variations in natural conditions and hence the agricultural production. The agro-environmental policy is described in three levels:

- national environmental program,
- regional environmental program, and
- municipal environmental funds.

In some cases there can also exist additional funds from the county administration, the local municipalities or from the private sector. Measures against water pollution are mainly financed through regional and national environmental programs, and to a minor extent through other funds. However, it has to be mentioned that the farmers themselves finance a part of the costs.

Financing of selected measures

In Norway there are a few regions where most of the agricultural production is concentrated and where agriculture has a dominant influence on the water quality. In regions dominated by animal husbandry the most important measures are related to manure storage and application. Since it is regulated by law these measures are mostly financed by the farmers as part of the ordinary management, but there are some financial support for the conversion to more environmental friendly application methods and for investment in larger and better storages for manure.

In regions with a large extent of grain cultivation, reduced tillage is the most important measure to reduce erosion as well as phosphorus runoff. This measure is financed within the Regional Environmental Program. Other important measures are hydro-technical installations and sedimentation ponds/constructed wetlands. These are financed by the municipal environmental funds. However, this fund does not allow for full financing. The support covers only 30-80% of the cost depending on the particular case and the farmers have to cover the rest.

In some cases we find local water management projects with participation from the other sectors in the municipality. In such cooperative projects there may also be other sources of funding. However, in general, the measures are financed by the above mentioned governmental funds and there is few or no other ear-marked funding from the state for the WFD-measures in the agriculture.

SCOTLAND

Context of Measures

Scotland has two river basin districts. Most of Scotland is covered by the Scotland RBMP. In the south where catchments cross the border with England these are covered by the Solway Tweed RBMP. The Scottish Environment Protection Agency (SEPA) is the lead competent authority. However, many organisations involved in the use and management of Scotland's water were involved in preparing the

RBMPs and are coordinated via a network of advisory groups. There is a specific advisory group for diffuse pollution. There are also a number of Responsible Authorities who must consider RBMPs as they undertake their own activities. Scotland has produced a supplement to the RBMPs, the Rural Diffuse Pollution Plan for Scotland² that describes our PoM.

Basic measures include a statutory baseline of good practice³, guidance and measures funded through the Scotland Rural Development Program⁴. These measures are implemented via a targeted, risk based approach of evidence gathering, awareness raising and one to one visits to land managers. The focus is on achieving a baseline standard of good practice which we believe will provide a cost-effective basis on which to build for the next RBMP.

Basic measures include requirements in relation to cultivation and application of fertilisers, manures and slurries such as minimum distances, avoiding high risk times and locations and nutrient management. Run-off from farm yards should not cause pollution and there are controls over poaching and erosion by livestock. The use of pesticides and sheep dip is also controlled.

Supplementary measures are funded under the RDP. The most important measures are buffer strips, small scale arable reversion to grassland, constructed farm wetlands and biobeds. A number of biodiversity measures such as hedges, beetlebanks and woodland creation are also relevant.

Financing of selected measures

Basic measures (statutory good practice) are funded by the farmer. In general these measures tend to be more about behaviour and land management change rather than capital items and land use change. A detailed analysis is currently being undertaken to estimate costs to farmers for compliance on a per measure and a per farm basis. There are concerns that extrapolating this up to regional and country scale from available data would be too inaccurate to be meaningful.

Supplementary measures, such as buffer strips, wetlands and biobeds, are mainly funded under the RDP. Funds are not ring fenced (although they may need to be in the future) and the scheme is competitive. There is a national target for water quality measures within priority areas which should increase the chance of funding. However, despite this uptake of the water quality measures has been poor for a number of reasons including low awareness, lack of targeting and prioritisation, low payment rates and the complexity of the scheme. Details on spend is published by the Scottish Government⁵. Some work is required to assess the spending on individual options along with mapping and modelling to assess whether there has been an impact of water quality. This work is underway. The next RDP from 2014 aims to overcome many of these issues.

In addition to the RDP, Scottish Water (publically owned national water company) has initiated a catchment management scheme that will operate in Drinking Water Protected Areas. The measures are similar to those in the RDP with the addition of a diffuse pollution risk assessment and again this is a competitive scheme. Other sources of funding are relatively small and include e.g. funding from rivers trusts, other government agencies and research. SEPA also has a Restoration fund⁶ (funded by Scottish Government) and some of the measures will have diffuse pollution benefits. Modelling work is underway to give us our first prediction of how far the measures described above should take us to good status. This includes costs. We are interested in exploring the potential for Article 31 (now 38) to help resolve some of these issues. The finance associated with the approaches taken to help managers achieve compliance with basic measures and to participate in voluntary and funded schemes also needs to be considered. A program of awareness raising, guidance and one to one visits to farmers is

² http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag.aspx

³ Diffuse Pollution General Binding Rules http://www.sepa.org.uk/water/water_regulation.aspx

⁴ <http://www.scotland.gov.uk/Topics/farmingrural/SRDP>

⁵ <http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/RuralPrioritiesStats>

⁶ http://www.sepa.org.uk/water/restoration_fund.aspx

undertaken in Scotland as described in the Rural Diffuse Pollution Plan. The Scottish Government funds SEPA to carry out this work at c. £500k per year.

SPAIN (EBRO BASIN)

Context of Measures

Agricultural measures are financed both by national government and regional governments, although implementation resides vastly on the regions.

Financing of selected measures

Improving the technical efficiency of irrigation is one of the key measures in the RBMP. The financial schema of modernization can be diverse, and is here exemplified with a case from Riegos del Alto Aragón. For an average investment in the primary network of about 12 000 €/ha one third is financed by the farmers, usually by means of a bank credit to be reimbursed in 25 years' time with an interest rate that equals that of Euribor plus 0.8% units. The rest, of the cost is financed by National or Regional Governments to be reimbursed by the farmers from the year 25th to the year 50th without interest rate. The improvement of the plot preparedness is paid by the farmer, usually by means of bank credits to be reimbursed in 30 years.

SWEDEN

Context of Measures

In Sweden, five river basin district authorities (separate competent authorities) are responsible for the implementation of the WFD. The measures in the PoM in Sweden are in the form of 37 'responsibilities' directed to the liable national and regional authorities and municipalities to develop delivery mechanisms that will result in achieving the objectives (i.e. good status). The key measure in the PoM in relation to agriculture is written as:

16. The Swedish Board of Agriculture need to develop regulations and/or other policy instruments with the aim at reducing the impact of agriculture on the water quality, especially in areas not achieving, or at risk at not achieving, good ecological status.

Another example of a measure in the PoM related to agriculture is

32. The municipalities need to, in their operative inspection and enforcement of activities and operators which may have a negative impact on the water environment, prioritize catchments with water bodies not achieving, or at risk at not achieving, good ecological status.

Consequently, mandatory technical measures are not suggested in the PoM, but it is up to the responsible organisations to decide. However, in the consequence analysis of the PoM some of the plausible technical measures has been analysed in terms of effects and costs. The Swedish Board of Agriculture has also presented an evaluation of policy instruments for a number of technical measures as a response to measure No 16. The development of the Rural Development Program (RDP) for the years 2014 to 2020 is a parallel process influencing the outcome of the policy instruments and the resulting financing.

Financing of selected measures

In the consequence analysis of the PoM, four of the technical measures with potential to reduce phosphorus and nitrogen loads substantially that have been singled out from measure *No 16* are:

- cover crops and spring cultivation (93.000 ha)
- permanent grassed buffer zones (28.000 ha)
- larger constructed wetlands (13.000 ha)
- small constructed wetlands for phosphorus retention (800 ha)

This selection was based on cost-efficiency and their potential to reduce the nutrient loads significantly. Financing was not considered in this selection process. Other measures may be more cost-efficient locally, and additional technical measures will also be required to reach the objectives. Measure *No 32* will encompass the enforcement of the nitrate directive and other national legislation. The technical measures that this will result in are for example;

- increased storage and improved management of manure, and
- restrictions (when, where and how much) for application of fertilizer and manure.

The most costly of the potential measures are establishment of constructed wetlands and buffer zones.

1. For wetlands no new financing is planned. Most of the wetlands established on agricultural land today are largely financed via the RDP and a smaller part by the farmer. A suggestion for the next RDP period includes a full compensation to the farmer. However, the funding available for specific measures for the next period is still unclear. For the period 2007 to 2011, c. 540 ha of wetlands was established per year, and the amount spent on construction of wetlands from the RDP was c. 5 M€/a. With this pace it would take 24 years to construct 13.000 ha. However, the proposed budget for establishment of wetlands for the new period, 2014 to 2020, in the RDP is an increase to c. 11 M€/a with a goal of 850 ha/a. Consequently, if the budget for the new RDP will be accepted, it will result in a substantial increase and the suggested goal in the POM of 13.000 ha will be reached to 2029 if the establishment rate is fulfilled and a continuation with the same rate can be realized.
2. Buffer zones are currently financed via the RDP, but it is possible that it will be made obligatory or as a part of the 'greening' requirements for the next CAP. In that case it will be financed by the farmers. Another possibility is that article 31 in CAP will be used to partly compensate farmers. The proposed goal for the next RDP period 2014 to 2020 is 15.000 to 20.000 ha, i.e. 50 to 70 per cent of the proposed extent in the POM.

The nitrate vulnerable zones will be adapted to better match areas with eutrophication problems as defined by the status classification in the WFD. The area will increase from the current 62 % of the arable land to 70 %. In the new nitrate vulnerable zones increased storage capacity for slurry will be required and the restrictions for manure application will be extended. These measures will mainly be financed by the farmers.

3. Summary and conclusions

Considering the significant impact of agricultural activities on eutrophication of surface waters, excessive water abstraction and ground water quality, numerous measures will be required to alleviate these problems and to realise the objectives of the WFD. It is obvious that new financing will be required to meet these needs. Information about financing of measures related to agriculture and the Water Framework Directive was collected from nine different regions and countries from participants in the River Basin Network: Denmark, England & Wales, Finland, France, Italy, Norway, the Netherlands, Scotland, Spain and Sweden. The aim was to get an idea about:

- the dominating financing sources for key measures,
- the status of financing of the measures in the PoMs, and
- to share examples of new or specific financing related to agricultural measures and the WFD.

For most regions/countries it is unclear how much new financing that is directed to measures related to the WFD. However, some examples of new financing are described:

- In Scotland, an extensive campaign is performed in a number of priority catchments to gather farm-specific information used for promoting both supplementary measures financed by agri-environmental payments, but also to inform and ultimately enforce basic measures in accordance with the legislation (statutory baseline of good practice). This campaign is performed by the Environmental Protection Agency and financed by the government.
- In Denmark, the establishment of wetlands has been significantly extended as a response to the WFD. The most important change related to financing is that it has been possible to obtain RDP support for buying the arable land to be transformed to wetland. One demand however, linked to the support is that once the wetland is established and put to the deed, the whole project area must be sold in one aggregate public tender, thereby recovering parts of the financial support. The recovered support can then again be used in new wetland projects and so on. New is also that the establishment of wetland in the extreme case can also be enforced, via expropriation of land if one or few landowners refuse to participate in a wetland project and thereby block the whole project.
- In Sweden, the area of nitrate vulnerable zones will be extended to cover more water bodies with significant pressure from agriculture according to the WFD. This will imply new financing of measures according to the polluters pay principle.
- In Sweden, the WFD has resulted in an increased focus on operative inspection and enforcement of current legislation related to agricultural activities. The administrative costs are partly paid by the tax-payers and partly by the stakeholders (e.g. farmers).
- In England, the governmental agency Defra has created a Catchment Restoration Fund. The fund also allows charities to connect local people and business to improve the environment.
- In the Netherlands, water boards and provinces use their (own) tax income partly on agricultural measures. Additional support to these measures comes from governmental investments.
- In the Netherlands, water companies have projects in which farmers receive compensation to reduce pesticide and nutrient emissions. However, these projects are often temporary and farmers stop their activities as soon as the funding ceases.

An overview of the financing of the most important or most costly measures proposed in the Program of Measures was compiled showing that:

- In Finland most funding is spent on winter time vegetation cover, financed via the agri-environmental payments.
- In Denmark, France and Sweden wetlands is indicated as the most costly measure.
- In Norway, the most important measure is reduced tillage, financed via Regional Environmental Funds (i.e. the government).
- In Italy and Scotland, buffer strips is the most important measure.

It can be concluded that basic measures linked to the Nitrate Directive and other, national legislation is financed by the farmers and the tax-payers due to increased administration, while supplementary measures are generally financed via the Rural Development Program (RDP). New financing of basic measures as a result of the WFD has been mentioned by Scotland and Sweden and is for example identified as a more comprehensive legislation and increased administration to implement current legislation (e.g. information, inspections, controls, enforcement etc.) more effectively.

In Denmark, England & Wales, Finland, France, Italy, the Netherlands, Scotland, Spain and Sweden the agri-environmental payments and non-productive investments in the RDP is the totally dominant financing source for supplementary measures. For some regions/countries it is however unclear how much of the funding in the RDP that is directed to measures resulting in actual improvements of water quality and quantity. Norway is not involved in the RDP but financing of measures comes from the government as part of annual grants to agriculture. Currently, the RDP is crucial for financing of supplementary measures. Since there are no indications that significant new regional or national funding will develop within the coming years, the RDP for the period 2014 to 2020 will continue to play a key role.

WG3: FARMERS INVOLVEMENT, STRATEGIES AND EXPERIENCES

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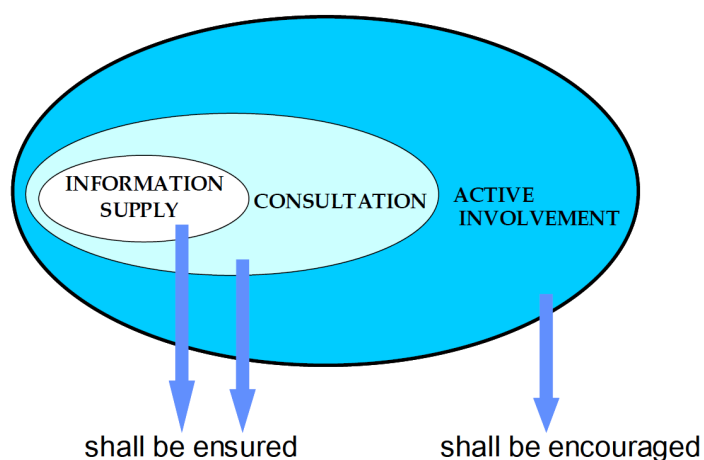
1. Background

This document was developed with the contribution of the members of the River Basin Network (RBN). The network was established in 2010 with the scope of identifying, through the exchange of knowledge and experiences among several European river basin authority representatives, the issues of particular interest for the WFD implementation in the agricultural sector. The overall objective of the network is to provide practical examples/cases of good practice. The crucial issues to be addressed within the RBN were identified in the early stages of RBN development. Among those specific issues, the farmers' involvement in River Basin Management plays a crucial role. The aim of this document is to describe and discuss the experiences concerning farmers involvement carried out in different river basin.

2. Introduction

Today there is an ever increasing interest in enhancing public participation in the water resource management domain, and thus allowing all possible stakeholders, both individuals and organisations, to participate in the decision process and to provide their own knowledge. The role of the participatory process in water management has also been established by the European Community Water Framework, which strongly encourages the active involvement of all the affected parties in resource management.

A European panel of experts has been involved in the development of "Guidance on public participation in relation to the water framework directive". The aim of this document is to provide technical guidance in the implementation of Article 14 of the WFD. The document defines three different level of public involvement, ranging from access to information to the active involvement.



Different level of public participation (Source EU 2002)

There is a clear distinction between stakeholders and the public. Stakeholder is an individual or organization which is effected by the results of the decision process, or which may have an influence on the decision process itself.

The importance given to shared decision processes in water management derives from an awareness of the inadequacy of traditional—i.e. engineering—approaches in dealing with complex and ill-structured problems. Moreover, if the stakeholders are not involved at all in defining and evaluating alternatives, then the decision process outcome could be controversial and the solutions proposed could generate strong opposition, making those solutions unfeasible (Kersten and Concilio, 2002). Unilateral action creates a false efficiency of the decision-making process since although it allows the time, expense and uncertainties associated with a negotiation process to be avoided, implementation problems would almost certainly arise (Susskind and Cruikshank, 1987). There is the hope that participating in decision making will lead people to accept and support those decisions (Raiffa et al., 2002). Several benefits can be expected from a wide participation of stakeholders in water management.

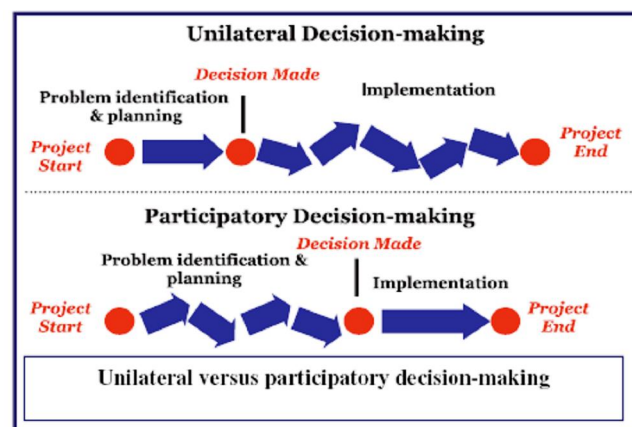
É Better decisions:

- ó Public participation can lead to better decisions. That is, decisions that better meet the needs of more people, decisions that last longer and decisions that have more validity.
- ó By considering the issue as widely as possible, improvements in social conditions, the economy and the environment can occur at the same time.
- ó Involving more people in the process uses a wider range of experiences. It brings in more points of view and uses knowledge about local conditions that might not be widely known. If the decision takes account of this wider range of experience and views, it is more likely to be 'right' since more issues have been considered and more risks evaluated.
- ó The decision making process becomes clear to the participants.

É Stronger democracy:

- ó In the longer term, public participation can improve democracy.
- ó Regular public participation shows people that they are valued and that their views are important. These exercises build trust and confidence in the authority undertaking the exercise and demonstrate to the public that change is possible.
- ó Individuals and community groups can become more active and more responsible for their environment and quality of life.
- ó People can feel more part of a community and authorities can make better relationships with these communities which continue after the decision has been taken.
- ó Participation exercises can build confidence to undertake other initiatives.

It is widely acknowledged that unilateral decision making creates a “virtual” efficiency, because it doesn’t take into account the strong opposition from the community that can emerge during the implementation phase.



Unilateral vs. participatory decision making

Despite the increasing awareness of the direct and indirect benefits, farmers' involvement is still far from being considered the standard in RBM. This is due to several drawbacks, mainly related to the socio-cultural context. The strong hierarchical organizations of environmental management results in scepticism by state officials toward the capabilities of local communities to provide useful knowledge. On the other side, local communities, and particularly farmers, are aware about the top down approach to decision making and, consequently, it is still quite a common opinion that, even if a participatory approach is adopted, the decisions will continue to be taken elsewhere. It is well known that involving the public in the decision process is a difficult task, for many reasons.

É It does not automatically lead to consensus:

- ó public participation does not always lead to everyone agreeing about the decision. With a proper public participation exercise, the problem can be presented and a consensus attempted. Identifying all the people with an interest and consulting them is the best way of trying to get them to agree but it is not always possible;
- ó public participation can also open up disputes that are outside the scope of the decision. It's fundamental to be aware that participants will have different points of view and keep the exercise focused on the decision in question.

É People and public authorities can be cynical about the value of participation:

- ó where public participation is new, even authorities can be unconvinced of the need for public participation;
- ó officials in local authorities may feel threatened by public participation since their decisions will be open to public scrutiny for the first time;
- ó there can also be reservations about decisions informed by the public's opinions since the public's comments are 'unprofessional';
- ó people might be not aware of the value of their knowledge. They perceived the role of the state agency as central and strong, and they did not consider themselves as potential knowledge contributors.

É People may only participate if they think their interests are threatened:

- ó it can be much harder to interest people in plans and programs where there may not be an immediate threat or problem;
- ó to overcome this lack of interest, a variety of techniques can be used to make the participation exercises interesting and relevant to the public.

É It can raise unrealistic expectations of what can be achieved:

- ó public participation can give people the impression that everything will be changed very quickly. When it is not, the public can become frustrated and lose trust in the authority and the process;
- ó to avoid misleading people in this way, it is important to be honest and clear about the nature of the exercise, the possible outcomes and the timescales.

In order to cope with these difficulties, several approaches can be adopted. Firstly, the public should be involved since the beginning of the decision process, that is, since the problem definition phase. This will result in a stronger public's willingness to take part in the process, since their main concerns will be taken into account. Secondly, a strong effort to structure the public knowledge and to integrate it with the scientific knowledge should be carried out. This will increase the decision makers' acceptability.

Starting from these premises, this work aims to support a critical and comparative analysis of the experiences concerning the farmers involvement carried out in the different river basin within the River basin network. The results of this analysis will be used to identify the main barriers hampering the actual involvement of farmers in the decision making process. Moreover, the comparison among the different experiences allows us to identify also the bridges facilitating the transition toward a more participatory approach. At the end of the whole process, guidelines to overcome the barriers and enhances the bridges will be developed.

This contribution is organized as follows. Section 2 describes the framework for the analysis. Section 3 summarizes the narratives collected in the different river basins. Section 4 highlights the main barriers and bridges concerning farmers' involvement in RBM. The draft guidelines to support farmers' involvement are discussed in Section 5.

3. Framework for the analysis

In order to analyse the different experiences under the same perspective, facilitating the synthesis of the results, a common framework for the analysis was developed. The framework was used as basis for the definition of a questionnaire to be sent around to the different RBN partners, within RB networks, in order to collect structured narratives of farmers' involvement experiences.

The framework attempts to analyse three crucial elements of the farmers' involvement:

- The participants taking part in the process;
- The participatory process;
- The impacts of the participatory process.

A set of evaluation criteria was developed for each of these elements, as described in the following.

3.1. Criteria related to the participants.

These criteria aim to assess the level of participation of farmers by taking into account:

1. Percentage of participants;
2. Trend of participants;
3. Diversity among the participants in a process;
4. Representativity of participants;
5. Degree of awareness among participants

The aim of the criteria and how to measure them are described in the following sections.

3.1.1. Percentage of participants

Aim: This criteria aims to evaluate the success of the participatory process in terms of number of participant to the participatory process.

How to evaluate: Number of participants versus reference population

3.1.2. Trend of participants

Aim: This criteria aims to evaluate the continuity of farmers involvement in the different phases of the process.

How to evaluate: Percentage of participants in each phase of the process.

3.1.3. Diversity among the participants in a process

Aim: A participatory process can be considered actually successful if it involves a diversity of interests. In this case, farmers characterized by different attitude towards water management should be involved.

How to evaluate: Profile of the participants (e.g. size of the farm, access to water distribution, kind of crops, etc.).

3.1.4. Representativity of participants

Aim: This criterion can only be applied to those processes that have in account, partially or fully, the participation of organized players (e.g. farming organization). In such cases, a criterion of democratic quality consists in guaranteeing that these representatives really share a common point of view.

How to evaluate: Capacity for information flow between the representatives and the represented.

3.1.5. Degree of awareness among participants

Aim: A successful participatory process requires participants to be informed about the problem at stage, the different phases of the process and the expected results.

How to evaluate: Accessibility to information concerning the participatory process.

3.2. Criteria related to the process.

These criteria allow us to evaluate the participatory process taking into account its most important elements, as described in the following.

3.2.1. Consensus

Aim: A process in which there is wide consensus about its need and methodology has more possibilities of success than a process that can be questioned, both on a political, technical or social scale.

How to evaluate: It can be evaluated considering the political acceptance, the social acceptance and the technical acceptance (i.e. whether the process is accepted by all technicians relevant for the process).

3.2.2. Leadership and initiative

Aim: The initiative could influence the development of a participatory process. In general, processes that arise from citizen initiatives generate more confidence and have more possibilities of succeeding and can have greater levels of participation. In all cases, an initiative must have a political leadership. This condition is mandatory in order to be able to implement the results of the process, and consequently for the process to be efficient.

How to evaluate: Identify which player or players have fostered the development of the participatory process. Identify the presence of specific political leaders who will take care of the process.

3.2.3. Quality of information

Aim: A good participatory process must provide the participants all the information they need to take a decision. Participants must have access to all the information. To achieve this, the information must be plural and have quality as well as being clear and useful. the adequate channels must be used to reach all potential participants.

How to evaluate: Identify the channels that will be used; level of efficiency of the information channels in transmitting information to all potential participants; clarity and utility of information obtained.

3.2.4. Level of participation

Aim: The participatory process can be characterized by different level of involvement, ranging from information sharing to practical involvement. This criterion aims to evaluate the actual level of participation of farmers.

How to evaluate: Perform a qualitative analysis to determine the levels of participation there have been throughout the process.

3.2.5. Involvement methods and techniques

Aim: A successful participatory process should allow all ideas and understandings to be discussed during the debate. The final results should be based on the synthesis of participants' perspectives. The selection of the methods used to support the participation has a strong impact on the results of the process.

How to evaluate: Perform a qualitative analysis to identify the methods used during the different phases of the participatory process.

3.3. Criteria related to the consequences of the process

It's crucial to highlight that the scope of a participatory process is mainly to provoke a shift in the attitude of both farmers and decision-makers toward the more democratic approaches to decision-making. To evaluate the experiences collected in the different basins, the following criteria were defined.

3.3.1. Substantive results

Aim: To be able to legitimize a participatory process, it is fundamental that the process shows results that respond to the needs foreseen when it was being designed

How to evaluate: Type of results obtained at the end of the participatory process; analysis of the impacts on public policies.

3.3.2. Degree of implementation of the results

Aim: The substantive results of a participatory process must be implemented.

How to evaluate: Verify the implementation of tangible results.

3.3.3. Result feedbacks

Aim: A good participatory process should foresee a result feedback at the end of the process. This practice is a fundamental element of transparency to guarantee the legitimacy of the participatory processes and to increase citizen confidence in the institutions.

How to evaluate: Determine whether the process foresees a feedback.

3.3.4. Improvement of relationships among the actors involved in the process

Aim: In order to foster citizen participation, a participatory process not only must look for substantive results, but also strengthen relationships among the participants.

How to evaluate: Analyse the impact the process has on social relationships; Analyse the impact the process has on citizen-administration relationships

3.3.5. Building a political participatory cultural context.

Aim: A participatory process should generate should support the creation of a socio-cultural context favourable to further participatory initiatives.

How to evaluate: Level of participation in other initiatives in the considered areas.

4. Results from the RBN

In order to collect information from the different basins, a questionnaire was developed using the criteria above mentioned. The questionnaire is reported in the box below:

- 1) Is farmers' involvement a usual procedure in your river basin organization?
- 2) If yes, what was the main scope of the farmers' involvement (i.e. establishing a participatory decision process for river basin management, facilitating the knowledge sharing and transfer, raising awareness)?
- 3) In case of participatory decision process, which kinds of decisions are normally taken through farmers' involvement? Which issues are normally addressed through participatory process?

- 4) According to your experience, could you, please, point out the two most significant experiences in your river basin, i.e. a positive experience (to be considered as a successful story) and a negative experience (to be considered as a failure) with respect to involving farmers in the WFD implementation?
- 5) For each of these experiences, could you, please, answer the following questions?
 - a. How were farmers selected? Could you, please, explain whether criteria such as kind of crops, size of farms, etc., were used to select farmers to be involved in the process or not?
 - b. Were farmers the only stakeholder involved in the process? If no, could you, please, list the other categories of stakeholders (e.g. municipalities, environmentalists, etc.)?
 - c. How do you judge the level of participation, considering the number of actual participants compared to the invited ones?
 - d. Did you register a positive or negative trend concerning the number of participants? (if several meetings were organized during the participatory process)
 - e. Were the leaders of farmers' associations involved?
 - f. What were the main factors contributing to the positive experience? (e.g., timing of involvement, format in which farmers were involved, ...).
 - g. Concerning the negative experience, could you briefly explain your opinion about the main reasons of the failure? That is, why did farmers not take part in the process, according to your opinion?
- 6) The following questions are related to both positive and negative experiences:
 - a. Who took the initiative to start the participatory process? Please, explain the role of the initiating institutions.
 - b. Were farmers informed about the objectives of the participatory process prior the start of the process itself?
 - c. Did they have access to understandable information needed to play an active role in the process (e.g. results of previous evaluation studies, modeling results, etc.)?
 - d. Did they seem to be aware of the role of their farming activities in relation to river or estuarine water quality?
 - e. How did participants have access to this information? Which were the information channels used?
 - f. Was the information sharing process facilitated by "translating" scientific knowledge into knowledge easily understandable even by lay people? If yes, was the process of "knowledge translation" led by the initiating institutions? Was a professional moderator involved in this process as "scientific ambassador" (i.e. an expert working to make scientific knowledge understandable for participants)?
 - g. Did the different parties involved in the process, i.e. politicians, technicians, farmers, agree that a participatory process was required to deal with the issue at stage?
 - h. In which of the following stages of the decision process were farmers involved?
 - i. Definition of the issue to be addressed
 - ii. Identification of the main goals to be achieved.
 - iii. Development of the set of feasible alternatives to be implemented.
 - iv. Providing feedbacks and comments to objectives and actions defined by the authorities.
 - i. Could you, please, briefly explain the methods used to support participation (e.g. group model building, participatory GIS, role playing game, round table conference, focus groups, etc.)?
- 7) The following questions are specific for the positive experience:
 - a. How, if, the authorities took the results of the participatory process into account in policy formulation?
 - b. Have the authority already implemented the policy?
 - c. How, if, did the participatory process facilitate the policy implementation (i.e. reduction of potential conflict, speed up the implementation phase, etc.)?
 - d. How, if, did farmers receive feedbacks concerning the results of their involvement?
 - e. How, if, did the participatory process enhance the relationships between authorities and farmers?
 - f. Do you know whether other participatory processes were organized in your river basin after the end of the one previously described? Please explain them briefly. Were they successful?
 - g. Was the degree of satisfaction (involvement/empowerment) of the farmers about the development of the participatory process assessed?

Do you think that the experiences concerning farmers' involvement, both positive and negative, will inspire any changes in the organization of the public participation process in the future?

The filled questionnaires are attached in the appendix. The collected narratives were synthesized and structured according to the criteria described in section 3, in order to facilitate the analysis of the responses and support the discussion.

4.1. Criteria related to the participants

As stated previously, this criteria aims to analyse the level and trend of participation of farmers. Unfortunately, the information concerning these issues is not available at basin level. The quality of participation is also by the heterogeneity of the participants, because differences in problem understanding may lead to creative decision process. According to the narratives collected within the RBN, different stakeholders are normally involved in the processes, facilitating the collection of heterogeneous knowledge and the debate among participants. Nevertheless, since the participation of farmers is mainly on voluntary basis, differences in the features of farmers (e.g. size of the farm, kind of crops, primary source of water for irrigation, etc.) are not taken into account. The farmers' representatives are always involved in the process, facilitating the sharing of the results. The access to understandable and useful information to support the farmers' participation is often neglected.

4.2. Criteria related to the process

These criteria aim to evaluate the quality of the whole process of farmers' involvement. To this aim, the information accessibility, the kind of leadership and the actual level of participation have been taken into account.

According to the collected narratives, farmers' involvement is a usual procedure in most of the collected cases, although farmers were mainly involved to discuss the set of feasible alternatives or to support the implementation. The definition of the issues to be addressed and of the main goals to be achieved was done by the authority. In one of the case – i.e. the Candelaro – farmers were involved basically at the end of the process, in order to collect their feedbacks on the already defined feasible alternatives. This resulted in a low effectiveness of the involvement process.

The accessibility to reliable and understandable information is considered crucial for an effective involvement of farmers. The collected narratives showed the low level of accessibility to information, which reduced their capability to contribute to the process.

In most of the examined cases, a high level of consensus was registered for what concerns the importance of farmers' involvement. In the Candelaro case, on the contrary, the scepticism of decision makers was high. Moreover, farmers adopted a strongly conflicting attitude toward the process.

4.3. Criteria related to the consequences of the process

This set of criteria aims to analyse the actual effects of the participatory process, in terms both of implementation of the selected actions and impacts of the relationships between the involved actors.

On the farmers' side, it is interesting to note that efforts were made by the authorities to incorporate the results of the farmers' involvement process within the policy. This had a positive impact on the farmers' willingness to participate. Moreover, authorities gave feedbacks to farmers concerning the implementation of the selected action. On the authorities' side, the farmers' involvement facilitated the implementation of the selected action. Summarizing, the communication between authorities and farmers was improved by the involvement process. Although is still an on-going process.

5. Discussion: the main barriers and bridges to farmers' involvement.

As stated previously, the main aim of this work is to collect and analyse both successful and failure experiences concerning farmers involvement in water management. The framework of analysis was developed with the scope to identify the main barriers hampering the farmers' involvement and, when existing, the bridges facilitating the process. The results are discussed in this section.

Several barriers can be identified in the three main parts of the analysis. For what concerns the participants, we learned that no assessment of the level of participation and trend of participants were carried out in the selected cases. This does not allow to learn from past experiences and to improve the involvement process

The cases characterized by a clear definition of the issues to be addressed during the process, and in which those issues were based on the main farmers' concerns registered a high level of participation. We can infer that the farmers' willingness to participate strongly depends on the accuracy of conflict analysis. This phase should anticipate the farmers' involvement process in order to provide information concerning who should be involved in the process and which issue should be addresses. In most of the selected cases, the participation to the process is on voluntary basis and the focus of the discussion is defined considering the main objectives of the authorities. Therefore, the absence of a shared definition of the aim process goals represents a strong barrier to participation.

The representativity of the participants is also another barrier hampering the farmers' involvement. As stated in literature, the participation of farmers' representatives facilitates the sharing of the results among the other farmers. Contrarily, due to the participation on voluntary basis the knowledge collected during the participation will not be shared within the farmers' community. This reduces the effectiveness of the involvement process.

Another crucial barrier is the knowledge-gap. In most of the selected cases, farmers did not have access to reliable and understandable information prior the involvement. This resulted in a limited capacity to take part to the process.

Farmers were considered as the final users of the knowledge shared through the involvement, neglecting the importance of their knowledge.

According to the scientific literature, the earlier farmers' involvement is, the more successful is the process. Therefore, farmers should be involved in the early stage, that is, the definition of the goals. In all selected cases, farmers were involved in the late stages of the process, i.e. consensus on the potential actions, implementation of the selected actions. This could be considered as a barrier to the success of farmers' involvement.

Few bridges facilitating the farmers' involvement can be identified from the collected narratives. Among them, the most important one concerns the process results. In most of the selected cases, the knowledge collected was incorporated in the decision. Moreover, feedbacks were provided to the farmers, increasing their willingness to participate. In some cases, this process resulted in an improved relationship between farmers and authority.

6. Concluding remarks: clues from the cases studies

The following lessons can be learnt from the analysis of the case studies:

1. Farmers' involvement should be based on a compromise between the authority requirements and farmers' concerns. The issues to be addressed should be negotiated prior the start of the process.
2. In order to facilitate the knowledge sharing, participants should be selected according to their representativity.
3. The accessibility to understandable information prior the start of the process would result in a more effective involvement process.

4. Farmers' involvement should be considered as a continuous process, powered by the sharing of feedbacks.

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APPENDIX: Questionnaires

Experiences concerning farmers' involvement in water management: Morsa river basin (Norway)

- 1) Is farmers' involvement a usual procedure in your river basin organization?

Yes

- 2) If yes, what was the main scope of the farmers' involvement (i.e. establishing a participatory decision process for river basin management, facilitating the knowledge sharing and transfer, raising awareness)?

Yes, those are the main scopes. There is by tradition a close co-operation between the authorities and the farmers' organizations on the local and regional level

- 3) In case of participatory decision process, which kinds of decisions are normally taken through farmers' involvement? What kind of issue are normally addressed through participatory process?

The farmers are invited to give advice and prepare decisions about subsidy schemes and regulations.

- 4) According to your experience, could you, please, point out the two most significant experiences in your river basin, i.e. a positive experience (to be considered as a successful story) and a negative experience (to be considered as a failure) with respect to involving farmers in the WFD implementation?

Positive: The farmers' involvement create a bottom-up process and a general acceptance among the farmers to the regulations and environmental measures

Negative: The farmers can put "the brakes on" and stop or slow down the decision process. However, we really do not see this is a serious problem, as it is very important to work with the farmers and allow them to spend the time necessary to make their adaptations.

- 5) For each of these experiences, could you, please, answer the following questions?

- How were farmers selected? Could you, please, explain whether criteria such as kind of crops, size of farms, etc., were used to select farmers to be involved in the process or not? The farmers' representatives are appointed by the farmers' organisations
- Were farmers the only stakeholder involved in the process? If no, could you, please, list the other categories of stakeholders (e.g. municipalities, environmentalists, etc.)? There are other stakeholders involved also. In particular other representatives from several departments of the municipalities.
- How do you judge the level of participation, considering the number of actual participants compared to the invited ones? We have found a reasonable balance between the number of participants and the actual involvement.
- Did you register a positive or negative trend concerning the number of participants? (if several meetings were organized during the participatory process). No, this depends on the subject.
- Were the leaders of farmers' associations involved? Yes
- What were the main factors contributing to the positive experience? (e.g., timing of involvement, format in which farmers were involved, ...). The discussion is based on scientific reports and running research projects. This is an important success criteria.
- Concerning the negative experience, could you briefly explain your opinion about the main reasons of the failure? That is, why did farmers not take part in the process, according to your opinion? Too much and unfair blame on the farmers' from the media and the public. This could be the case in the beginning of the project.

- 6) The following questions are related to both positive and negative experiences:

- Who took the initiative to start the participatory process? Please, explain the role of the initiating institutions. The municipalities took the initiative. Important objective to secure drinking water and the recreational value of the lake Vansjø.
- Were farmers informed about the objectives of the participatory process prior the start of the process itself? Yes
- Did they have access to understandable information needed to play an active role in the process (e.g. results of previous evaluation studies, modeling results, etc.)? Yes, there were several scientific reports.
- Did they seem to be aware of the role of their farming activities in relation to river or estuarine water quality? Yes, it was well known that agriculture had a large effect,
- How did participants have access to this information? Which were the information channels used? Information through the media, meetings, conferences, advisory service, information from the municipal agriculture and environmental administrations. The project leader for the Water management district did a very important job in this respect.
- Was the information sharing process facilitated by "translating" scientific knowledge into knowledge easily understandable even by lay people? If yes, was the process of "knowledge translation" leaded by the initiating institutions? Was a professional moderator involved in this process as "scientific ambassador" (i.e.

- an expert working to make scientific knowledge understandable for participants). Yes this was done. The advisory service was very active, as well as scientists and the officials in the County and the municipalities.
- g. Did the different parties involved in the process, i.e. politicians, technicians, farmers, agree that a participatory process was required to deal with the issue at stage? yes
 - h. In which of the following stages of the decision process were farmers involved?
 - i. Definition of the issue to be addressed
 - ii. Identification of the main goals to be achieved.
 - iii. Development of the set of feasible alternatives to be implemented.
 - iv. Providing feedbacks and comments to objectives and actions defined by the authorities. In all these stages
 - i. Could you, please, briefly explain the methods used to support participation (e.g. group model building, participatory GIS, role playing game, round table conference, focus groups, etc.)? Conferences, meetings, information material; the ordinary channels.
- 7) The following questions are specific for the positive experience:
- a. How, if, the authorities took the results of the participatory process into account in policy formulation? It was one of the important inputs to the agri-environmental program in the county
 - b. Have the authority already implemented the policy? yes
 - c. How, if, did the participatory process facilitate the policy implementation (i.e. reduction of potential conflict, speed up the implementation phase, etc.)? yes, as the farmers had a responsibility for the program
 - d. How, if, did farmers receive feedbacks concerning the results of their involvement? Close feedback
 - e. How, if, did the participatory process enhance the relationships between authorities and farmers? We have a partnership and good relations between the two
 - f. Do you know whether other participatory processes were organized in your river basin after the end of the one previously described? Please explain them briefly. Were they successful? The processes are on-going more or less continuously
 - g. Was the degree of satisfaction (involvement/empowerment) of the farmers about the development of the participatory process assessed? Yes, some evaluations have been done
- 8) Do you think that the experiences concerning farmers' involvement, both positive and negative, will inspire any changes in the organization of the public participation process in the future? Yes, this catchment project started in 1999 and it has been a model for many other catchments.

Experiences concerning farmers' involvement in water management: The Seine-Normandy river basin

- 1) Is farmers' involvement a usual procedure in your river basin organization?

The farmers of the Seine-Normandy river basin are involved at different levels:

- the "Comité de Bassin" is the "water parliament" of the river basin: farmers' representatives are members and vote on strategic decisions. It meets on average 3 times a year
- the "Groupe permanent du programme & perspectives" is a sub-group of the Comité de Bassin. It meets 3 times a year (on average, more when they write the RBMP and the PoM) to discuss tactical issues. It addresses agricultural questions among other issues. Farmers' representatives are member of that group.
- local commissions exist in sub-bassins and farmers' representatives are members.
- steering committees for projects at catchment level involve farmers' representatives and also local farmers.

- 2) If yes, which kind of decisions are normally taken through farmers' involvement? Which kind of issue are normally addressed through participatory process?

The farmers' representatives in the Comité de Bassin do vote on any decision submitted to the Comité, even those not directly related to agriculture. The votes are based on the majority.

The decisions can concern the RBMP, the PoM, the budget of the water agency or on the tax put on water ("redevance"), which is framed by law.

- 3) According to your experience, could you, please, point out the two most significant experiences in your river basin, i.e. a positive experience (to be considered as a successful story) and a negative experience (to be considered as a failure)?

Two experiences are on-going:

A positive experience is taking place in the Lasso river basin (Burgundy) concerning a water catchment area. A fruitful co-operation has been initiated with the farmers. A first proposal submitted by the Municipality (through a design office) and prepared with the water agency was submitted to the farmers for discussion. The farmers have then suggested an alternative proposal. After discussion in the steering committee a middle way solution (sufficient for the protection of the catchment and acceptable for farmers) was agreed between the Municipality and the farmers.

But a negative experience is also taking place in another catchment area. Currently a group for the defence of the farmers has been set up to oppose water protection measures. It seems that there has been some confusion between the voluntary measures which were suggested by the Municipality (with the aid of water agency) at watershed level and some regulation update taking place at water catchment level. The farmers don't approve the regulation update, thinking it goes too far (the regulation enforces grassland around the catchment), so they refused any cooperation on the voluntary measures at watershed level. They fear that the voluntary measures will become mandatory. This fear comes, among others reasons, from misunderstanding wrong interpretation of the voluntary approach.

4) Concerning the positive experience, could you, please, answer the following questions?

- a. How do you judge the level of participation, considering the number of actual participants compared to the expected ones?

The information is not known at river basin level. The steering committee may have the information.

- b. Did you register a positive or negative trend concerning the number of participants? (if several meetings were organized during the participatory process)

Same answer.

- c. Were farmers the only stakeholder involved in the process? If no, could you, please, list the other categories of stakeholders (e.g. municipalities, environmentalists, etc.)? Could you, please, explain whether criteria such as kind of crops, size of farms, etc., were used to select farmers to be involved in the process or not?

The Municipality, the water agency and NGO (when present on the area) are usual members of the steering committees. Those stakeholders are also represented in the "Comité de Bassin".

There is no particular criteria used to select the farmers. It is based on a voluntary participation.

- d. Were involved farmers the leaders of farmer associations?

Farmers' representatives as well as local farmers are involved in the steering committee. Farmers' representatives are always involved in the process, this is not always the case for local farmers.

- 5) Concerning the negative experience, could you briefly explain your opinion about the main reasons of the failure? That is, why did farmers not take part in the process, according to your opinion?

There may be political issues interfering with the water protection project.

Moreover some leaders are not open to water protection initiatives.

- 6) The following questions are related to both positive and negative experience:

- a. Who did take the initiative to start the participatory process?

The Municipality with the water agency initiated the participatory process.

- b. Were farmers informed about the objectives of the participatory process prior the start of the process itself?

The information was indirect through the farmers' representatives.

- c. Did they have access to understandable information needed to play an active role in the process (e.g. results of previous evaluation studies, modeling results, etc.)?

The local farmers were not involved in the delimitation of the area or in the assessment of the pressures, but they were informed. Farmers' representatives are involved in each step: delimitation, diagnostic of practices and building of an actions' program.

They were fully associated to the selection of the measures.

- d. How did participants have access to this information? Which were the information channels used?

A design office was employed and contacted the steering committee members and produced communicative sheet.

- e. Did the different parties involved in the process, i.e. politicians, technicians, farmers, agree that a participatory process was required to deal with the issue at stage?

The participatory process was most of the time welcome by the partners.

Two approaches actually exist:

- an approach without a defined preliminary project and which builds on the different members' contributions

- an approach based on an advanced project and then the objective is to convince the different partners.

Both approaches can actually deliver.

- f. In which of the following stages of the decision process were farmers involved?

- i. Definition of the issue to be addressed

The farmers were not significantly involved, their representatives could be informed. However, it's a great recommendation from water agency that the farmers must be involved at a very first stage

- ii. Identification of the main goals to be achieved.

The farmers were not significantly involved, their representatives could be informed.

- iii. Development of the set of feasible alternatives to be implemented.

That's the stage where the farmers were fully involved.

- iv. Providing feedbacks and comments to objectives and actions defined by the authorities.

The farmers give feedbacks concerning the actions. The local moderator supported by the water agency ("animation") is in contact with the farmers.

- g. Could you, please, briefly explain the methods used to support participation (e.g. group model building, participatory GIS, role playing game, round table conference, focus groups, etc.)?

The steering group with ad-hoc working groups play this role. There is no other initiative known.

- 7) The following questions are specific for the positive experience:

- a. Did the authorities take the results of the participatory process into account in policy formulation?

The feedback is taken into consideration. In particular Agri-Environmental Measures build on this feedback.

- b. Did the authority already implement the policy?

The measures are already implemented, with a relative success (10% of the surface covered with actions).

- c. Did the participatory process facilitate the policy implementation (i.e. reduction of potential conflict, speed up the implementation phase, etc.)?

A participatory process is absolutely necessary to reach any achievement in water protection.

It may create conflicts but it remains unavoidable in any water protection project in the agricultural area.

The involvement of the local farmers sometimes shows different ideas than those presented by their representatives. This brings an added value in the project.

- d. Did farmers receive feedbacks concerning the results of their involvement?

Farmers are informed on every step of the project. Feedbacks are given through the steering committee but public meeting open to the farmers also take place.

- e. Did the participatory process enhance the relationships between authorities and farmers?

Not any new particular relationship was set up. The pre-existing co-operation with the farmers through the CAP was just extended to water issues. It enhances the relationships between municipality and farmers.

- f. Do you know whether other participatory process were organized in your river basin after the end of the one previously described? Were they successful?

Different attempts took place in the 90's ("operations fertimieux", "CTE-CAD collectifs") but the achievements in terms of water quality were not always satisfactory.

- g. Do you think that the positive experience will inspire any changes in the organization of the public participation process in the future?

A new approach of the public participation is currently under discussion and should apply to the second cycle of the WFD.

The experience with the farmers in the catchment areas will bring food for thoughts.

Experiences concerning farmers' involvement in water management: Candelaro river basin (Italy)

- 1) Is farmers' involvement a usual procedure in your river basin organization?
Answer: No

- 2) If yes, what was the main scope of the farmers' involvement (i.e. establishing a participatory decision process for river basin management, facilitating the knowledge sharing and transfer, raising awareness)?
Answer: The farmers' involvement is not a usual process. They are normally involvement in knowledge transfer processes.

- 3) In case of participatory decision process, which kinds of decisions are normally taken through farmers' involvement? What kinds of issue are normally addressed through participatory process?
Answer: The only involvement process that has been carried out in the Candelaro river basin concerned the development of the Water Protection Plan. Farmers contributed to identify potential solutions to reduce the impacts of human activities on groundwater.

- 4) According to you experience, could you, please, point out the two most significant experiences in your river basin, i.e. a positive experience (to be considered as a successful story) and a negative experience (to be considered as a failure) with respect to involving farmers in the WFD implementation?
Answer: The only experience was the one for the Water protection Plan development. I'm not sure whether it could be considered as a positive or negative experience.

- 5) For each of these experiences, could you, please, answer the following questions?
- How were farmers selected? Could you, please, explain whether criteria such as kind of crops, size of farms, etc., were used to select farmers to be involved in the process or not?
Answer: Farmers participated to the meetings on voluntary basis. No selection was carried out.
 - Were farmers the only stakeholder involved in the process? If no, could you, please, list the other categories of stakeholders (e.g. municipalities, environmentalists, etc.)?
Answer: Other groups of stakeholders were involved, e.g. municipalities, environmentalists, citizens, etc.
 - How do you judge the level of participation, considering the number of actual participants compared to the invited ones?
Answer: The number of participants was not monitored.
 - Did you register a positive or negative trend concerning the number of participants? (if several meetings were organized during the participatory process)
Answer: The number of participants was not monitored.
 - Were the leaders of farmers' associations involved?
Answer: Yes
 - What were the main factors contributing to the positive experience? (e.g., timing of involvement, format in which farmers were involved, ...).
Answer: We can consider this experience as positive because of the large participation. The main reason for that was the issues to be discussed, which were very close to farmers' main concerns – i.e. water availability for irrigation.
 - Concerning the negative experience, could you briefly explain your opinion about the main reasons of the failure? That is, why did farmers not take part in the process, according to your opinion?
Answer: Other experiences were carried out in the Candelaro. These experiences were research oriented. The lack of a strong commitment from the local politicians provoked the failure of these experiments.
- 6) The following questions are related to both positive and negative experiences:
- Who took the initiative to start the participatory process? Please, explain the role of the initiating institutions.
Answer: The initiative was taken by the Regional Authority, due to the strong conflicts emerged after the first draft of the water protection plan was presented to the public.
 - Were farmers informed about the objectives of the participatory process prior the start of the process itself?
Answer: Yes.
 - Did they have access to understandable information needed to play an active role in the process (e.g. results of previous evaluation studies, modeling results, etc.)?
Answer: No.
 - Did they seem to be aware of the role of their farming activities in relation to river or estuarine water quality?
Answer: No.
 - How did participants have access to this information? Which were the information channels used?
Answer: -.
 - Was the information sharing process facilitated by “translating” scientific knowledge into knowledge easily understandable even by lay people? If yes, was the process of “knowledge translation” led by the initiating institutions? Was a professional moderator involved in this process as “scientific ambassador” (i.e. an expert working to make scientific knowledge understandable for participants)
Answer: No.
 - Did the different parties involved in the process, i.e. politicians, technicians, farmers, agree that a participatory process was required to deal with the issue at stage?
Answer: Yes, although farmers were quite sceptical for what concerns the actual results of this process.
 - In which of the following stages of the decision process were farmers involved?
 - Definition of the issue to be addressed
Answer: No
 - Identification of the main goals to be achieved.
Answer: No
 - Development of the set of feasible alternatives to be implemented.
Answer: No
 - Providing feedbacks and comments to objectives and actions defined by the authorities.
Answer: Yes

- i. Could you, please, briefly explain the methods used to support participation (e.g. group model building, participatory GIS, role playing game, round table conference, focus groups, etc.)?
Answer: During the scientific experiences, cognitive mapping exercises were carried out. The discussion around the Water Protection Plan was conducted without any structured involvement method.
- 7) The following questions are specific for the positive experience:
- a. How, if, the authorities took the results of the participatory process into account in policy formulation?
Answer: The Water Protection Plan was substantially revised according to the comments collected during the process.
 - b. Have the authority already implemented the policy?
Answer: No
 - c. How, if, did the participatory process facilitate the policy implementation (i.e. reduction of potential conflict, speed up the implementation phase, etc.)?
Answer: The strong conflicts between farmers and regional authority were reduced, even if not completely eliminated.
 - d. How, if, did farmers receive feedbacks concerning the results of their involvement?
Answer: No feedbacks were provided to farmers.
 - e. How, if, did the participatory process enhance the relationships between authorities and farmers?
Answer: The strong conflicts between farmers and regional authority were reduced.
 - f. Do you know whether other participatory processes were organized in your river basin after the end of the one previously described? Please explain them briefly. Were they successful?
Answer: No.
 - g. Was the degree of satisfaction (involvement/empowerment) of the farmers about the development of the participatory process assessed?
Answer: No.

Do you think that the experiences concerning farmers' involvement, both positive and negative, will inspire any changes in the organization of the public participation process in the future?

Answer: The experiences raised a certain degree of awareness in the Regional Authority about the importance of farmers' involvement in decision processes.

Experiences concerning farmers' involvement in water management: Weser river basin (Germany)

- 1) Is farmers' involvement a usual procedure in your river basin organization?
Weser: Yes
- 2) If yes, what was the main scope of the farmers' involvement (i.e. establishing a participatory decision process for river basin management, facilitating the knowledge sharing and transfer, raising awareness)?
Weser: Facilitating the knowledge sharing and transfer, raising awareness
- 3) In case of participatory decision process, which kinds of decisions are normally taken through farmers' involvement? What kinds of issue are normally addressed through participatory process?
Weser: Farmers were not involved with the decision making. They were involved with the beginning of the process of the implementation. A farmer may choose which measures are implemented and when. Through the participatory process the farmer is more likely to implement the voluntary measures.
- 4) According to your experience, could you, please, point out the two most significant experiences in your river basin, i.e. a positive experience (to be considered as a successful story) and a negative experience (to be considered as a failure) with respect to involving farmers in the WFD implementation?
Weser: The most significant positive experience we had with the advisory services. It was introduced to increase the communicational process (raising awareness and acceptance). We did not really have a negative experience.
- 5) For each of these experiences, could you, please, answer the following questions?
 - a. How were farmers selected? Could you, please, explain whether criteria such as kind of crops, size of farms, etc., were used to select farmers to be involved in the process or not?
Weser: The advice is concentrated on the reduction of diffused pollution and is more general. It covers mainly all farms in the first step and on the second it concentrates on hot spots.
 - b. Were farmers the only stakeholder involved in the process? If no, could you, please, list the other categories of stakeholders (e.g. municipalities, environmentalists, etc.)?
Weser: Involved were all affected NGO's (depending on the region). These were for example municipalities, environmentalists, water body maintenance services, fisheries, industry, tourism, etc.

- c. How do you judge the level of participation, considering the number of actual participants compared to the invited ones?
Weser: On this we do not have information.
- d. Did you register a positive or negative trend concerning the number of participants? (if several meetings were organized during the participatory process)
Weser: On this we do not have information.
- e. Were the leaders of farmers' associations involved?
Weser: Yes
- f. What were the main factors contributing to the positive experience? (e.g., timing of involvement, format in which farmers were involved ...).
Weser: The main factor was the format in which farmers were involved: to begin with a more general advisory service, then an intensive advisory service on hot spots and last but not least one to one visits.
- g. Concerning the negative experience, could you briefly explain your opinion about the main reasons of the failure? That is, why did farmers not take part in the process, according to your opinion?
Weser: -
- 6) The following questions are related to both positive and negative experiences:
- a. Who took the initiative to start the participatory process? Please, explain the role of the initiating institutions.
Weser: The initiative started with co-operations in water protection zones to ensure save water supply. In water protection zones water suppliers and farmers agreed on groundwater protecting cultivation methods in voluntary agreements i.e. also the implementation of groundwater friendly measures and free advisory service. The implementation of these measures is financed by water abstraction payments.
- b. Were farmers informed about the objectives of the participatory process prior the start of the process itself?
Weser: Yes.
- c. Did they have access to understandable information needed to play an active role in the process (e.g. results of previous evaluation studies, modeling results, etc.)?
Weser: Yes, there are public hearings and public participations.
- d. Did they seem to be aware of the role of their farming activities in relation to river or estuarine water quality?
Weser: Yes.
- e. How did participants have access to this information? Which was the information channels used?
Weser: Professional journals, advisory service (e.g. meetings, one to one visits, various information materials).
- f. Was the information sharing process facilitated by "translating" scientific knowledge into knowledge easily understandable even by lay people? If yes, was the process of "knowledge translation" leaded by the initiating institutions? Was a professional moderator involved in this process as "scientific ambassador" (i.e. an expert working to make scientific knowledge understandable for participants)
Weser: There is an offer of an administrative advisory service.
- g. Did the different parties involved in the process, i.e. politicians, technicians, farmers, agree that a participatory process was required to deal with the issue at stage?
Weser: Yes.
- h. In which of the following stages of the decision process were farmers involved?
- i. Definition of the issue to be addressed
Weser: No
- ii. Identification of the main goals to be achieved.
Weser: No
- iii. Development of the set of feasible alternatives to be implemented.
Weser: Yes
- iv. Providing feedbacks and comments to objectives and actions defined by the authorities.
Weser: Yes
- i. Could you, please, briefly explain the methods used to support participation (e.g. group model building, participatory GIS, role playing game, round table conference, focus groups, etc.)?
Weser: There are round tables, cooperation with farmers and focus groups in hot spots
- 7) The following questions are specific for the positive experience:
- a. How, if, the authorities took the results of the participatory process into account in policy formulation?

Weser: With the Ordinance on fertilisation (national level) based on the Nitrates Directive. The advisory service is a continually process. It is a living process.

- b. Have the authority already implemented the policy?

Weser: Yes

- c. How, if, did the participatory process facilitate the policy implementation (i.e. reduction of potential conflict, speed up the implementation phase, etc.)?

Weser: On this we do not have information.

- d. How, if, did farmers receive feedbacks concerning the results of their involvement?

Weser: They get feedback with the advisory service.

- e. How, if, did the participatory process enhance the relationships between authorities and farmers?

Weser: The advisory service is a living process. This process of communication is getting better.

- f. Do you know whether other participatory processes were organized in your river basin after the end of the one previously described? Please explain them briefly. Were they successful? The advisory service goes on.

- g. Was the degree of satisfaction (involvement/empowerment) of the farmers about the development of the participatory process assessed?

Weser: Yes. It is a developing process.

Do you think that the experiences concerning farmers' involvement, both positive and negative, will inspire any changes in the organization of the public participation process in the future?

Weser: The process will probably be intensified.

WG5: COST EFFECTIVENESS OF AGRICULTURAL MEASURES

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EXECUTIVE SUMMARY

This paper summarises the experiences and approaches used by members of the River Basin Network for Agriculture to undertake cost-effectiveness analysis (CEA) for the first round of Water Framework Directive (WFD) River Basin Management (RBM) Plans. The article is intended to help share information among River Basin District (RBD) managers and Expert Group (for Agriculture) policy makers to improve future approaches.

For the first round of RBM Plans, the majority of countries only applied CEA at the national scale (where it is often seen that a common, consistent approach should be adopted). Most of the methods to undertake CEA involved combinations of qualitative analyses (largely “Expert Judgement”) with some quantitative elements (i.e. nutrient load modelling). The outcomes of specific measures, like the costs, effects, extent of measures (i.e. hectares of land) have generally been deduced using expert judgement.

Data availability and/or consistency were highlighted as a particular concern in nearly all countries. Risk based methods, particularly in relation to data quality are being successfully employed by some countries.

Stakeholder buy-in to proposed measures as well as availability of data on cost effectiveness of measures were identified as key issues. A number of solutions are being implemented, including national databases and improved data transparency. All countries agree on the need for improved stakeholder buy-in. A variety of methods have been identified, but early engagement and simple approaches which can be easily understood are commonly accepted as needed to increase acceptance.

1. Background

The Water Framework Directive (WFD) requires the production of a River Basin Management Plan (RBMP) for each River Basin District (RBD), including the compilation of a cost-effective programme of measures. The document entitled “Guidance for administrations on making WFD agricultural measures clear and transparent at farm level”⁷, approved at the end of May 2011 by the EU Water Directors, mentioned that information on the cost-effectiveness of suggested/required measures was important information to share with farmers. The PRB-AGRI report 2010⁸ highlighted that CEA should be based on environmental costs, resource costs and on scientific evidence. In addition, cost effectiveness should be considered from the social point of view as well.

It is well known that CEA is a complex task where the methodology and the definition of the variables (e.g. cost) could vary significantly. The comparison of relative expenditure (costs) and predicted outcomes (effects) often requires dealing with uncertainties. The net-effect of an individual measure may be complex to estimate even though the direct costs may be relatively easy to quantify. Many approaches could be used to cope with this uncertainty, such as using knowledge/experience from other places, expert judgement, or carrying out sensitivity analysis that makes different assumptions

⁷ www.ec.europa.eu/environment/water/quantity/pdf/guidance_en.pdf

⁸ http://agrienv.jrc.ec.europa.eu/publications/pdfs/EUR_24481_EN_2010.pdf

about the costs & effects of actions. Understanding how different RBDs have tackled this complex work will help identify how they may improve approaches in future.

2. Introduction

This article summarises the experiences and approaches used by members of the European River Basin Network for Agriculture to undertake cost-effectiveness analysis (CEA) for the first round of Water Framework Directive (WFD) River Basin Management (RBM) Plans (2009 to 2015). The article is intended to help share information among River Basin District (RBD) managers and Expert Group (for Agriculture) policy makers to help improve future approaches e.g. second cycle of RBM (2015 to 2021). The views expressed in the article are those of the individual practitioners and do not necessarily represent the official views or positions of individual organisations, competent authorities or Member States for which the practitioners work. These views are shared in good faith to help improve approaches to RBM in the future.

- Why is cost-effectiveness analysis needed?

Article 13 of the WFD sets out requirements for what River Basin Management Plans (RBMPs) should contain. Specific details of what should be included in the plans is given in Annex VII of the directive. Annex VII makes specific reference to Annex III which outlines economic analysis shall contain enough information to make judgements about the most cost-effective combination of measures to be included in the programme of measures. Further specific references to cost-effectiveness are also made in relation to measures to control priority substances (Article 16). Additional guidance has been provided through the EU WFD Common Implementation Strategy (CIS) Working Group 2.6 (WATECO) Guidance Document No. 1 'Economics and the Environment – The implementation challenge of the Water Framework Directive' (October 2003)⁹. In addition to the fact that the WFD requires to undertake CEA, it is incumbent upon organisations tasked with implementing the WFD that the measures required to deliver the objectives of the Directive achieve this in the most cost-efficient way possible.

- Definition of Cost-Effectiveness Analysis

Cost-Effectiveness Analysis (CEA) can be defined as a way of comparing the costs and effects (i.e. environmental improvement) of two or more options to determine the option that will achieve certain (set) targets at least costs.

- How does it differ to Cost-Benefit Analysis?

CEA differs from Cost-Benefit Analysis in that benefits are not included in CEA (i.e. increased value of real estate due to environmental improvement). So there is no assessment of whether benefits outweigh costs, which is needed for example as part of assessing whether a measure is disproportionately costly or not. The RBN Working Group is specifically looking at how Cost-Effectiveness was assessed in the first round of RBM and therefore does not look at CBA or disproportionate cost assessment.

3. River Basin Network Experiences

The following parts of the article have been drawn from responses from the working group.

⁹ Report can be accessed via:

[http://www.google.co.uk/url?sa=t&rct=j&q=the%20implementation%20challenge%20of%20the%20water%20framework%20directive%2E%80%99%20\(october%202003\).&source=web&cd=2&ved=0CCkQFjAB&url=http%3A%2F%2Fcirca.europa.eu%2Fpublic%2Firc%2Fenv%2Fwfd%2Flibrary%3F1%3D%2Fframework_directive%2Fguidance_documents%2Fguidancesnos1seconomicss%2F_EN_1.0_%26a%3Dd&ei=eeFyULeQOqeH0QG0klGQDA&usq=AFQjCNGNI9Gd7tPRKNAKd4EqgC4i5MrE3A](http://www.google.co.uk/url?sa=t&rct=j&q=the%20implementation%20challenge%20of%20the%20water%20framework%20directive%2E%80%99%20(october%202003).&source=web&cd=2&ved=0CCkQFjAB&url=http%3A%2F%2Fcirca.europa.eu%2Fpublic%2Firc%2Fenv%2Fwfd%2Flibrary%3F1%3D%2Fframework_directive%2Fguidance_documents%2Fguidancesnos1seconomicss%2F_EN_1.0_%26a%3Dd&ei=eeFyULeQOqeH0QG0klGQDA&usq=AFQjCNGNI9Gd7tPRKNAKd4EqgC4i5MrE3A)

3.1 Cost-effectiveness analysis - Methods employed by RBN members

The following text is based on survey responses from England & Wales, Scotland, Denmark, International Commission for the Protection of the Danube River (ICPDR), Sweden, Italy (Arno River Basin), Finland (south west) and the Netherlands. Additional information has been sourced from the report on the research project undertaken on cost effectiveness analysis by ACTeon¹⁰.

3.1.1 Overview of Basic method

For the first round of RBM Plans, the majority of methods applied to undertake CEA used combinations of qualitative analyses (largely “Expert Judgement”) with some quantitative elements (i.e. nutrient load modelling). For example, effects of measures have often been expressed quantitatively, like reductions in nutrient loads, to help support decisions, but these were largely underpinned by expert judgement.

The benefits of specific measures, as well as the costs, effects, and the extent of measures (i.e. hectares of land) have in most cases been deduced using expert judgement. Costs typically account for investment, operational and maintenance of the measures. Indirect and environmental costs have been included to a lesser extent. Countries have provided examples of measures and their costs, some with information on the different time periods on which the cost data has been based (but not all). For instance, Sweden has provided an example of a CEA analysis for small constructed wetlands for phosphorus sedimentation based on a 30 year appraisal period, which considers all above costs. The ACTeon report⁴ acknowledges that nearly all CEA across Europe considers investment, operational and maintenance costs, but to differing levels of detail. It also notes that indirect and environmental costs are much less mentioned as part of CEA.

To ensure consistency on costs and effects of individual measures, a number of countries have implemented mechanisms to share this information, such as national databases. A good example of this is the “Knowledgesystem Measures” database used in the Netherlands, which is now being integrated in the WFD Explorer¹¹. This is a central system with details of costs and effects of measures, which has been quality assured by a panel of experts. Similarly, in the Danube River basin, a collection of readily available cost data has been made available. This has been drawn from previous projects within the Danube Basin and from European databases such as RAINS¹².

Quantitative approaches to assess the costs and effects of specific measures have been adopted in some cases (as set out in the table in the next page), particularly in relation to agri-environmental measures at the national level. In the Danube River Basin, the ICPDR (International Commission for the Protection of the Danube River) uses the MONERIS model¹³ to assess nutrient loads and emissions. It is primarily a planning tool which can measure the current situation and run future scenarios. Since the first round of RBM plans this tool has been extended to assess the costs and effects of measures in reducing nutrient emissions, so that it is essentially a form of strategic economic assessment. The ICPDR has since used it to inform additional criteria on cost effectiveness and fairness of measures at the river basin level, essentially to ensure consistency. It is also used to provide an indicative aggregation of the costs and effects of programmes of measures defined at sub-basin level, to give a basin wide picture.

In England and Wales, a quantitative and monetary approach was used at the national scale to assess cost effectiveness of common measures, known as preliminary Cost Effectiveness Analysis (pCEA). A mathematical water quality modelling programme (Simcat) has also been used to model the effects of measures, to help inform expert judgement.

¹⁰ Research project on the use of Cost Effectiveness Analysis in regard to the European Water Framework Directive (2011) ACTeon environment & research consultancy <http://www.fresh-thoughts.eu/projects.php?categoryname=EnvironmentalEconomics&categoryid=7&projectid=37>

¹¹ WFD Explorer can be accessed via <http://www.deltares.nl/en/software/1028369/wfd-explorer> Knowledgesystem measures database can be accessed via: <http://www.helpdeskwater.nl/algemene-onderdelen/serviceblok/english/>

¹² RAINS project database on RAINS project database on the costs of abatement of atmospheric deposition: www.eolss.net/Sample-Chapters/C15/E1-47-15.pdf

¹³ MOdelling Nutrient Emissions into River Systems (MONARIS) <http://www.icpdr.org/main/activities-projects/moneris-modelling-nutrient-emissions-river-systems>

Examples of the quantitative methods applied.

Country	Quantitative Method	Description (where available)
England & Wales	pCEA Simcat	National database used to predict cost of specific measures Mathematical nutrient modelling programme used to predict effects of measures
Danube River Basin	MONERIS CAPRI	Modelling programme used to assess current nutrient emissions and loads – can assess potential of measures to reduce nutrient emissions. Used to predict costs for specific measures and can run scenarios. Shows cost of measures against reduction in load etc. Agricultural sector model system used to assess effects of agricultural policy
Sweden	Nutrient load reductions	Benefits of measures expressed as nutrient load reductions in kg/ha/a using quantitative methodology. Semi quantitative programme of measures with scale (e.g. ++, ++, +, -, --, ---).
Netherlands	Quantitative method applied at national level	Netherlands have performed different CBAs for the WFD ¹⁴ Especially the Strategic CBA performed in 2006 was used to (also) support cost-effectiveness trade-offs (reference in referred paper).
Scotland	Modelling Project	Running modelling project to predict effectiveness & assessing realistic costs of implementation.

Another common approach to identify cost effective measures has been to assume that compliance with statutory good practice is cost effective. Handbooks on best practice measures have been drawn up to contribute to a uniform approach nationally in some countries (for example in the Netherlands, Denmark and Scotland).

When assessing the impacts of measures, there are differences in whether countries have assessed the benefits beyond the objective of a specific measure. It is apparent that there are advantages to a more integrated method, which considers a suite of options to address Good Ecological Status, rather than addressing individual problems in isolation.

A few countries approaches have also considered the effects of measures beyond the waterbody/environment, for example on employment and supplying and processing industries (e.g. Netherlands and England and Wales). In doing this, they have involved stakeholders as a source of information which has served to improve their buy-in to any proposed suite of measures. In the Netherlands, a board of stakeholders supervised CBAs from the early stages, which allowed for early feedback and iterative discussions, improving acceptability of proposed measures.

In the Danube River Basin, it is reported that cultural differences between countries have influenced stakeholder responses to measures. To address this, it is suggested that the EU CAPRI model¹⁵ (agricultural sector model system to assess effects of policy) might be adapted to potentially consider these impacts.

¹⁴ Paper available: <http://www.iwaponline.com/wp/01205/wp012050746.htm>

¹⁵ CAPRI model available via: <http://www.vti.bund.de/en/>

3.2 The geographic scale (level) of analysis

In terms of methodological changes at different scales, the majority of countries only applied CEA at the national scale (where it is often seen that a common, consistent approach should be adopted). Qualitative and some quantitative analyses were used, with many countries focussing on the most commonly applied measures. This is because CEA has been seen as an efficient way to agree cost effectiveness of common measures at the national level. It has, however led to a perception that this is a “top down” approach by some stakeholder groups.

Those that did extend the analysis regionally / locally tended to use qualitative analyses at this level (largely expert judgement), particularly as the measures applied were often more bespoke. Some limited quantitative modelling was used to support this where available. This is the case in both England & Wales and in the Netherlands.

3.3 Data considerations

Data availability and/or consistency were highlighted as a particular concern in nearly all countries. Information gaps on the costs and effectiveness of measures beyond the local scale are an issue. Impacts of diffuse pollution measures are also cited as an issue, as are impacts of measures in “typical conditions” i.e. not laboratory. To address this, a number of countries have developed or are developing central databases on the cost and effectiveness of measures (e.g. the WFD Explorer in The Netherlands). This is intended to improve national consistency and ultimately the reliability of CEA.

For example, England and Wales are building a central database of costs and effectiveness of measures, costs data for the Danube River Basin have been drawn from previous projects undertaken and/ or from European databases (i.e. RAINS project) and the Netherlands has a central database on the costs effects of measures, known as Knowledgesystem Measures. Teams with excellent knowledge of particular measures can share this more easily, thus improving consistency. Quality assurance is provided through workshops and expert review. The Netherlands has also drawn up a handbook¹⁶ on cost effectiveness for WFD to ensure that the methods and details in various regions link up well, and that comparisons can be made. For the same reason the ‘Cost Benefit Water’ instrument was developed in the Netherlands; a tool developed by the regional water management authorities that can easily be applied and adjusted to their individual needs and therefore has a high uptake by the various (other) water managers¹⁷. By disseminating this instrument, more coherent and comparable analyses take place in various regions across the country, thus solving a part of the problem with diffuse data encountered during the analyses for the first RBM.

Sweden and Norway are updating their existing water databases, VISS and Vann-Nett¹⁸ respectively, to include comprehensive information on the costs and effectiveness of measures. This is part of a Nordic co-operation between Norway, Sweden and Finland to share information and build databases of measures.

To mitigate confidence in data, a risk based approach which considers data quality has been applied when implementing measures in England and Wales. For instance, where expensive measures are being required, significant research and investigations have often been undertaken to improve the quality and certainty of the data, to mitigate the risk. Where understanding is relatively poor, lower cost measures and/ or voluntary actions from stakeholders have been implemented. This approach is intended to provide greater certainty in the data so that the number of cost effective measures will increase. All

¹⁶ Dutch handbook on cost effectiveness for WFD:

http://www.google.co.uk/url?sa=t&rct=j&q=in%20pursuit%20of%20optimal%20measure%20packages%20dutch%20handbook%20on%20cost-effectiveness%20analyses%20for%20the%20eu%20water%20framework%20directive%20&source=web&cd=1&ved=0CCAQFiAA&url=http%3A%2F%2Fwww.mra.org.mt%2FDownloads%2FTwining%2520Light%2520Water%2FDutch%2520handbook%2520on%2520cost%2520effectiveness%2520analysis.pdf&ei=e_pyUNdYhvzRBerJgfgG&usq=AFQjCNH1C1nC2QKx3CRpNEDJqltch9YuKg

¹⁷ http://www.helpdeskwater.nl/onderwerpen/water-ruimte/economische_aspecten/kosten-baten-water

¹⁸ Vann-Nett database available via: <http://vann-nett.nve.no/saksbehandler/?language=en>

countries agree that the confidence of any data underpinning CEA must be made clear, so that decisions/ measures can better consider risk.

3.4 Tools to help undertake Cost-Effectiveness Analysis

Where quantitative modelling approaches have been adopted to support CEA, a number of tools have been used to help with this. These include mathematical water quality modelling tools and national databases. Please see Table 1 for more details.

3.5 Communicating the results to support implementation of measures

The approach to stakeholder communication varies. One approach has been to inform stakeholders of the results of the CEA and to inform them of the necessary measures and why. This has had the negative result of reducing stakeholder acceptance of the required measures. However, an alternative approach by some countries acknowledges expert judgement to be dependent on good social engagement. It is agreed that this can be time consuming and resource intensive. There has been a focus on specific sector groups, who are most impacted by measures, particularly in the agricultural sector. Problems experienced include difficulty to get buy in, lack of understanding and criticism of approach.

It has also been noted that some of the countries who adopted a national approach were seen to be implementing measures using a “top down” philosophy, using complicated and difficult to understand methodologies. This significantly reduced transparency and thus stakeholder buy-in. As a lesson learnt from the first round of CEA, early engagement at all levels (particularly participatory) is acknowledged as a necessity, using tools such as workshops and visits by a number of countries. In England and Wales, a series of catchment pilot projects have been initiated to test how best to undertake stakeholder engagement.

3.6 Common difficulties and opportunities/priorities for future action

Common difficulties, as outlined previously centre around stakeholder buy-in to proposed measures as well as availability of data on cost effectiveness of measures. A number of solutions have been proposed, including national databases and improved data transparency.

3.7 ACTeon Report⁴

The aim of the ACTeon report was to “establish evaluation and overview of application of cost effectiveness analysis in implementation of WFD in France and in Europe”. The paper focuses on CEA use, its role in decision making and the main methods used. It suggests that a European NW/ SE division exists, with countries in the NW more advanced in their use of CEA, with more developed databases and methods etc. However, this present survey has suggested that some countries in the SE in fact have reasonably developed methods and databases, for example within the Danube River Basin.

Lack of data for CEA is highlighted as an issue, which is supported by this present survey. The report also proclaims that “CEAs do not often refer to stakeholder participation”. Whilst this is the case for some countries, this present survey has in fact uncovered a reasonable degree of actual stakeholder participation or at least the recognition it will be an important factor for the next round of River Basin Management Plans.

From 48 studies, the ACTeon report suggests that at least 2/3 of CEA is addressed at the agricultural sector. This present survey largely supports the findings of the ACTeon report, but has unearthed an extra level of detail from which we can get a better understanding of different countries’ approaches to WFD CEA.

4. Recommendations

It has been acknowledged that some of the tools developed for local practitioners to use to undertake CEA in the first round of River Basin Plans were too technical and required economic knowledge. For the next CEA, it has been advised that a less detailed and more qualitative approach would be more easily applied at the local level and would improve stakeholder understanding and buy-in.

All countries agree on the need for improved stakeholder buy-in. A variety of methods have been proposed, but early engagement and simple approaches which can be easily understood are commonly accepted as needed to increase acceptance. Risk based analyses are also commonly acknowledged as a worthy solution, particularly in relation to data quality and confidence as outlined previously.

WG6: COMPARISON OF POLICIES AND IMPLEMENTATION STRATEGIES TO REDUCE DIFFUSE AGRICULTURAL POLLUTION (IMPLEMENTATION OF THE POM)

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1. INTRODUCTION

The Water Framework Directive (WFD) requires that a PoM be operational by 2012. Significant attention has been focused on measures, such as buffers and wetlands to help deliver water quality improvements and achieve WFD objectives. However, less consideration has been given to the approach taken (e.g. plans, policies, strategies, awareness raising, workshops, demonstration farms, one to one advice) by MS to getting measures implemented on the ground, which can be as important as the measures themselves.

2. OBJECTIVE – WHAT IS THE WORKING GROUP TRYING TO ACHIEVE?

The MS (Scotland, Finland, France, Germany, England and Wales, Sweden and Denmark) aimed to;

- Compare approaches to implementing the PoM across MS. This information will help with understanding the effectiveness of measures and links closely to both the financing PoM and the cost-effectiveness of measures working groups, and;
- Share information between MS on the most effective approaches used to get measures implemented on the ground to inform the next RDPs and RBMPs.

3. SUMMARY

The main conclusions from the exercise are that:

- There are a large number and a wide variety of plans and campaigns (for examples see section 4 below) in MS addressing diffuse pollution. However, it is unclear how many of these have been specifically driven by the WFD. It would be useful to investigate the role of partner organisations and farmers representatives in these campaigns and what monitoring efforts are in place to assess their effectiveness.
- More information is required on the implementation of basic measures. For some MS this was dealt with by 'state services' and no information was provided and for some MS the information provision was passive e.g. provided via the www. Scotland and Denmark used more pro-active methods. At the RBN meeting it was felt that ensuring compliance with basic measures was important and an area where there may be room for improvement. How effective are these basic measures is also important and links to cost-effectiveness and financing.
- A variety of methods, including booklets sent to all farmers and additional points in priority areas, were used to influence RDP funding. Again an assessment of the most effective would be useful. How can we ensure that measures are targeted to where they are required and with sufficient catchment coverage?
- Most MS do not have a free advisory service for land managers. The main focus of publically funded 'advice' is on inspections and XC. There is a lack of suitably trained advisors identified by many MS.

Several of these issues could be taken forward and further explored under any potential new mandate for the RBN. The detailed responses for each question are given below and provide a useful overview of measures and their implementation across MS.

4. OVERVIEW OF APPROACHES

4.1 Have any MS produced a supplement to the RBMP aimed specifically at reducing diffuse pollution from agriculture?

Scotland	Yes – described in The Rural Diffuse Pollution Plan for Scotland which describes our measures and how they are implemented (essentially via a national awareness campaign and one to one visits in priority areas) http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag.aspx
Southwest Finland	We are making general plans for buffer strips and wetlands to certain river basins. In plans we show the farmers where buffer strips would be most beneficial and where wetlands could be constructed. These plans are done in co-operation with farmers, and they can be used as a preliminary approval for funding.
France (Seine-Normandie)	There is a dedicated part on agricultural diffuse pollution in the programme of measures. Measures are further specified in local programmes.
England and Wales	No, but the Environment Agency does manage all relevant work (see plans and campaigns below) through a Diffuse Pollution Programme Board.
Sweden	No - but a measures catalogue (64 åtgärder inom jordbruket för god vattenstatus) was produced as a complement, including also comments on current policies for the implementation of the specific measures.
Germany (Weser)	Yes – described in agri-environmental programmes which describe our measures and how they are implemented http://www.bmelv.de/SharedDocs/Standardartikel/Landwirtschaft/Klima-und-Umwelt/Agrar-Umweltmassnahmen/AgrarumweltmassnahmeninDeutschland.html
Denmark	The Green Growth plan (see below) could be considered an amendment to the RBMP though the Green Growth plan goes beyond the RBMP and put focus on many other issues related to farming in future and to development of more nature in Denmark.

4.2 Do any MS have specific plans or campaigns (which may include e.g. awareness raising, workshops etc.) aimed at reducing diffuse pollution from agriculture.

Scotland	Yes – a national communications campaign e.g. articles in the farming press and stakeholders communications, as part of the plan described above. These are quite general and focused on good practice but we will move into more targeted messages e.g. key seasonal messages.
Southwest Finland	<p>The Finnish Rural Network have organised different campaigns to educate and raise awareness about environmental matters in agriculture e.g. the theme selected for the year 2010 was 'the environment'. To this end, the network invested heavily in mitigating the effects of agriculture on water and in promoting biodiversity. The theme was also promoted through educational tour comprising 26 different events across the country. http://www.maaseutu.fi/attachments/newfolder_0/67vL2Y3gK/Annual_Report_2010.pdf</p> <p>With RBMPs there are none specific plans or campaigns on national level. There are several projects going on the regions with similar aims.</p> <p>Each municipality (that has farming in its area) has an agricultural advisor, who mostly deals with funding of farming, but also tries to inform farmers about best practices. Information is also spread through media and other communication but also leaflets are produced. Info-events are held to farmers about special issues like buffer strips and wetlands, especially when a general plan for those is made.</p>

France (Seine-Normandie)	<p>This activity is shared between the water agency, the state services (Directions Départementales des territoires, Directions Régionales de l'Agriculture) and the farmers' organisations (chambres d'agriculture, cooperatives agricoles). The farm advisory services (service de conseil agricole) which build on cross compliance information plays an important role.</p> <p>The water agency covers most of the river basin with local moderators to ensure a good level of communication. Articles in newspapers, websites, leaflets, newsletters, meetings with groups of farmers are usual tools to communicate on water protection.</p> <p>The face to face approach through moderators is currently experimented.</p>
England and Wales	<p>Yes.</p> <p>1) The Catchment Based Approach - working with stakeholders to establish a framework for integrated catchment management across England by the end of 2013, to support the 2nd cycle of River Basin Management Plans and deliver Water Framework Directive objectives. The focus is co-ordinated and sustainable management of land and water to balance environmental, economic and social demands at a catchment scale. This holistic approach recognises the many different pressures facing ecosystems and aligns funding and actions within a catchment. http://www.defra.gov.uk/environment/quality/water/legislation/catchment-approach/ or http://www.environment-agency.gov.uk/research/planning/131506.aspx</p> <p>2) Catchment Restoration Fund</p> <p>The Department for Environment, Food and Rural Affairs (Defra) has created the Catchment Restoration Fund to help reduce pollution that comes from the way land is used and improve the landscape through which water flows. A £28 million fund, providing between £8 million and £10 million for three years ending in 2015, has been allocated for projects to be delivered in 2012/13, 2013/14 and 2014/15. The Environment Agency is administering the Catchment Restoration Fund (CRF) to support third sector groups to bring forward projects that will at a catchment level:</p> <ul style="list-style-type: none"> • restore natural features in and around watercourses • reduce the impact of man-made structures on wildlife in watercourses • reduce the impact of diffuse pollution that arises from rural and urban land use <p>http://www.environment-agency.gov.uk/research/planning/136182.aspx</p> <p>3) Catchment Sensitive Farming (CSF) delivers practical solutions and targeted support to enable farmers and land managers to take voluntary action to reduce diffuse water pollution from agriculture to protect water bodies and the environment. It is a joint project between the Environment Agency and Natural England, funded by Defra and the Rural Development Programme for England, working in priority catchments within England. http://www.naturalengland.org.uk/ourwork/farming/csf/default.aspx</p> <p>4) Campaign for the Farmed Environment (CFE) is a voluntary, partnership approach to management of the farmed environment which is supported by organisations from across the agricultural industry in England. The objective is to retain and exceed the environmental benefits that used to be provided by set-aside through voluntary action. The campaign has until the end of 2012 to prove that this approach works and therefore avoid regulation. http://www.cfeonline.org.uk/</p> <p>5) Entry Level Training and Information programme (ETIP) Natural England have identified the Entry Level Scheme (ELS and Uplands ELS) agri-environment options that have the most benefit for the environment. Advisors promote these options to farmers who are about to renew or take up new Entry Level Scheme agreements. There is an accompanying leaflet which promotes options for cleaner water and healthier soils. http://www.naturalengland.org.uk/ourwork/farming/funding/es/agents/elsoptions/waterandsoil.aspx</p> <p>6) Voluntary Initiative (VI) for pesticides. In 2001 the UK Government accepted proposals put forward by the farming and crop protection industry to minimise the environmental impacts from pesticides. The programme was developed as an alternative to a pesticide tax which had been under consideration by the Government. By 2006 the programme had met or exceeded the vast majority of its targets. In the light of this, Ministers accepted that The Voluntary Initiative should continue as a rolling two year programme, and the VI has continued since as a voluntary programme of work promoting responsible pesticide use. http://www.voluntaryinitiative.org.uk/content/water.aspx</p> <p>7) The Soils for Profit Project (S4P) works with farmers to help them improve their soil, manure and nutrient management whilst also signposting to other sources of relevant support. The project aims to help farm businesses become more efficient, and therefore improve profitability, whilst also producing environmental</p>

	<p>benefits. This is achieved by providing advice, training, demonstration and, if relevant, access to other sources of support including other elements of the South West Agricultural Resource Management (SWARM) initiative. S4P is currently available to every farm in the South West region farming in excess of 5ha and it is projected to continue until 2013.</p> <p>http://www.naturalengland.org.uk/regions/south_west/ourwork/soilsforprofitproject/default.aspx</p> <p>8) Metaldehyde Stewardship Group (MSG). 'Get Pelletwise' is the campaign of the Metaldehyde Stewardship Group (MSG) that was set up in 2009 in response to analysis showing traces of metaldehyde, an ingredient of certain slug pellets, being found in catchments used for water abstraction. The MSG is working with the farming industry to prevent the problem recurring.</p> <p>http://www.getpelletwise.co.uk/</p>
Sweden	<p>Yes – especially the campaign “Focus on Nutrients” has been important for awareness rising, with on-farm visits performed by more than 200 advisors. However, since “Focus on Nutrients” is a voluntary approach, currently including c. 33 % of the arable land, it is likely that it attracts the most dedicated farmers and that the big polluters are the ones not enrolling. Since the attention of Focus on Nutrients is on no-cost measures, and the total effect of those will be restricted, “Focus on Nutrients” need to be complemented with other delivery mechanisms to reach the goals with the WFD.</p>
Germany (Weser)	<p>Yes – local free advisory services for farmers include programmes to raise local and regional acceptance and public awareness, etc.</p>
Denmark	<p>In Denmark we have since 1985 adopted three national water action plans for improving the aquatic environment and one action plan for sustainable agriculture aimed at reducing diffuse nutrient pollution from agriculture. A new plan was adopted by the National Assembly in 2010 called “Green Growth”. This plan includes, among others, the nutrient reduction target set by the RBMP's and the measures agreed to be used in order to reach the target. The “Green Growth” is also an agreement on how to finance the implementation of the different measure.</p> <p>See 3.7</p>

4.3 What other approaches are used e.g. co-operatives?

Scotland	
Southwest Finland	<p>In our area there is a project that tries to raise awareness of more environmentally friendly farming practises. TEHO Plus project is also testing “new” farming practices in co-operation with local farmers to find the best ways to reduce impact of farming to water. The focus is on the farm scale. The results, conclusions and experience will be utilized in the preparation of the third Agri-Environmental Program in Finland (2014).</p> <p>http://www.ymparisto.fi/default.asp?contentid=390754&lan=FI&clan=en</p> <p>At the moment we are trying to start a project for purchasing the fields that produce the heaviest nutrient load (steep slopes, flooding fields etc.)</p>
France (Seine-Normandie)	<p>The farmers of the Seine-Normandy river basin are involved at different levels:</p> <ul style="list-style-type: none"> - the "Comité de Bassin" is the "water parliament" of the river basin: farmers' representatives are members and vote on strategic decisions, - the "Groupe permanent programme & prospective" is a sub-group of the Comité de Bassin. It discusses tactical issues. It addresses agricultural questions among other issues. Farmers' representatives are members of that group. - local commissions exist in sub-bassins and farmers' representatives are members. - steering committees for projects at catchment level involve farmers' representatives and also local farmers.
England and Wales	<p>1) Industry-led Certification and assurance schemes e.g. The Red Tractor Scheme which drives good standards (including environmental and animal welfare) in Food & Farming. The Red Tractor logo guarantees that food has been produced to high standards from farm to supermarket. All the major UK supermarkets and a growing number of catering outlets support a range of assured produce.</p>

	<p>http://assurance.redtractor.org.uk/rtassurance/global/home.eb</p> <p>2) LEAF (Linking Environment And Farming) is a national charity that helps farmers improve the way they farm by encouraging them to take up Integrated Farming. LEAF also helps to create a better public understanding of farming through our national network of Demonstration Farms, Innovation Centres and initiatives like Open Farm Sunday. We bring farmers and consumers together to raise awareness of how farmers are working in harmony with nature to produce good food with environmental care, identified in-store by the LEAF Marque logo.</p> <p>http://www.leafuk.org/leaf/home.eb</p> <p>3) The National Environment Programme – steers water companies' five-yearly environmental improvement and asset management programme (AMP). AMP6 (2014-2020) has included investment in Catchment Schemes by some water companies e.g. SW Water's Upstream Thinking , their flagship programme of environmental improvements aimed at improving water quality in river catchments in order to reduce water treatment costs.</p> <p>http://www.southwestwater.co.uk/index.cfm?articleid=8329</p> <p>And United Utilities and RSPB's Sustainable Catchment Management Programme (ScAMP) - to address overgrazing, upland drainage, historical pollution, inappropriate vegetation management and uncontrolled burning, which are thought to contribute to increased raw water colour. SCaMP aims to improve the situation by mitigating these impacts and improving the habitat and water quality, and so reducing the amount of water treatment necessary.</p> <p>http://corporate.unitedutilities.com/scamp-faqs.aspx</p> <p>4) Regulations – Water Resources Act 1991 (including Anti-pollution Works Notices); NVZ regs, GW regs, Sludge regs, SSAFO regs, etc;</p> <p>5) Rural Development funded agri-environment schemes – Environmental Stewardship and the England Woodland Grant Scheme in England.</p> <p>http://www.naturalengland.org.uk/ourwork/farming/funding/es/default.aspx http://www.forestry.gov.uk/ewgs</p> <p>Glastir in Wales, including the Woodland element.</p> <p>http://wales.gov.uk/topics/environmentcountryside/farmingandcountryside/farming/glastirhome/?lang=en</p> <p>6) Other Rural Development grants e.g.:</p> <ul style="list-style-type: none"> • The Farming and Forestry Improvement Scheme which helps farming, forestry and horticultural businesses in England to become more efficient at using resources, making businesses more profitable and resilient whilst reducing the impact of farming on the environment. • The Leader approach, which uses local knowledge to promote an integrated “bottom up”, community-led delivery of RDPE funding. In England it is being implemented by Local Action Groups and is targeted on rural areas with particular needs or priorities; • The Rural Economy Grant (REG) which provides grants to enable a significant ‘game-changing’, transformational performance in farm, forestry, tourism, agri-food businesses and micro businesses in rural areas in England. <p>http://rdpenetwork.defra.gov.uk/funding-sources</p>
Sweden	<p>A special study circle was developed related to the WFD, and many of the 1165 local associations within The Federation of Swedish Farmers (LRF) have performed this activity including river walks and dialogues with other stakeholders. To increase the interest for the WFD-issue and to facilitate participation, the RBD administrations encourage the formation of local catchment-based water councils represented by different types of stake holders.</p>
Germany (Weser)	<p>Co-operations in water protection zones ensure save water supply. In water protection zones water suppliers and farmers agreed on groundwater protecting cultivation methods in voluntary agreements i.e. also the</p>

	implementation of groundwater friendly measures and free advisory service. The implementation of these measures is financed by water abstraction payments.
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4.4 What methods do MS use to make farmers aware of the basic measures under WFD?

Scotland	A letter was written to all farmers advising them of requirements. A national communications plan backs up the messages. Workshops, events and one to one visits (by SEPA) in priority areas are also used. A national assessment of compliance with regulatory requirements is also made as part of cross-compliance assessment (<5% of farms). Leaflets have been produced and now (farmer driven) quick check guides on legal requirements are being produced.
Southwest Finland	Information is included in the info material every farmer receives concerning CAP, cross compliance, other supports, agri-environment scheme etc.
France (Seine-Normandie)	This is mainly the role of the State services (Direction Départementale des Territoires) not of the water agency. The farmers' organisations play also an active role (chambres d'agriculture, cooperatives agricoles).
England and Wales	Information is available on the Governments on line resource Business Link www.businesslink.gov.uk/bdotg/action/home/ Defra's Code of Good Agricultural Practice can be found on both the Business Link website and Defra's website. http://www.businesslink.gov.uk/bdotg/action/detail?itemId=1083635198&type=RESOURCES
Sweden	This is mainly the role of the State services (e.g. Swedish Board of Agriculture and the County Board Administrations) and the municipalities, and not of the RBD administrations.
Germany (Weser)	Ordinance on fertilisation (national level) based on the Nitrates Directive.
Denmark	The basic measures are implemented in Denmark by a "fertilizer law" which on an yearly base regulated the maximum use of fertilizer at farm level depending on crop type, rules for utilization of nutrients in organic manure, the extent of catch crops grown in the crop rotation and not least that each farmer once a year must file an fertilizer use form showing the use of fertilizer. The fertilizer use form will be examined by the AgriFish Agency to make sure the rules in the fertilizer law (including the basic measures) are complied with. If not the farmer may receive a fine. Each year a guidance to the fertilizer law and how to fill in the fertiliser use form is published by the AgriFish Agency and the farmer and advisor can download it from the webpage of the AgriFish Agency. From 2012 the fertiliser use form must be reported by internet. However, most farmers (or their advisor) have reported electronically for many years already.

4.5 What methods to MS use to raise awareness of the funding available under the RDPs?

Scotland	Via the RDP www, one to one visits promote potential for funding and existing advisory services are utilised. We have not promoted the measures in our RDP enough. In the next RDP we need to aim for specific campaigns and pro-active advice to encourage collaborative applications.
Southwest Finland	All farmers receive every year guidance booklet of RDP and there is info about funding. Communal advisory services are available to farmers.
France (Seine-Normandie)	This role mainly belongs to the State services (Direction Départementale des Territoires, Direction Régionale de l'Agriculture) but it is also shared with the water agency through its network of local representatives in sub-basins and farmers' organisations (chambres d'agriculture and cooperatives agricoles).

England and Wales	All the campaigns listed in S.3.2 publish sources of funding on their websites and often cross reference to other sources. Natural England are developing a series of leaflets on funding available to specific sectors. The first focuses on lowland beef and sheep farmers: http://publications.naturalengland.org.uk/publication/1583208?category=45001
Sweden	This is mainly performed by the Board of Agriculture and the County Board Administrations. The “ Focus on Nutrients ” campaign also has an important role here.
Germany (Weser)	Professional journals, advisory service (e.g. meetings, one to one visits, various information material)
Denmark	See 4.11

4.6 Do MS have/utilise a free advisory service for land managers?

Scotland	Generally no (apart from cross-compliance). There is some public money available for pollution prevention advice but this is not delivered at a one to one level. This is a gap in our current approach we hope the next RDP will fill.
Southwest Finland	No, but there are lot of projects offering free advisory to farmers and land owners. Before next program period we need to clarify how to utilise support (Art. 38)
France (Seine-Normandie)	Beyond the information on cross compliance requirements, advisory services are not free.
England and Wales	Yes. 1) The new Farming Advice Service (FAS) includes and replaces the former Cross Compliance Advice Programme and provides advice on other subjects to help improve the economic and environmental performance of farmers. FAS provides advice on the following subjects: <ul style="list-style-type: none"> • Cross Compliance • Nutrient Management • Competitiveness • Climate Change Adaptation and Mitigation The main provider is AEA Technology plc but advice from FAS will be delivered in active partnership with industry-related bodies and other stakeholders taking advantage wherever possible of existing activities and engagement with farmers, e.g. those campaigns listed in S.3.2 which also provide free advice or sign post to other sources of advice.
Sweden	Yes - the “ Focus on Nutrients ” campaign is a free environmental advisory with a combination of group activities and on-farm visits. So far more than 10.000 land managers have participated. The county board sometimes also have advisory around specific environmental issues.
Germany (Weser)	Yes, promotion of the implementation of agri-environmental measures
Denmark	No, the advisory service is private and are mostly organised as part of the activities of a regional farmers association. This means that the farmer being a member of an association also “owns” the advisory service. The advisory service, however, functions like a private advisory system, where the farmers are charged for the service. Also farmers not being associated may use the advisory service. Some years ago the advisory service was subsidised by the state, but this do no longer exists (in some cases subsidy may be given to a specific thematic issue within farming, however this subsidy will be given as a pool of money within a defined programme, that the farmers associations may

	<p>seek for as a type of project dealing with the thematic issue).</p> <p>In addition to the advisory service organised by the farmer associations also some private advisory companies exist. However, they are few in numbers and are often one-man companies with just one or to employees.</p>
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4.7 Do inspections just deal with compliance or can advise on other measures and multiple benefits be provided?

Scotland	<p>Guidance is given on solutions to achieve compliance as priority. More emphasis needs to be placed on multiple benefits e.g. reduction in GHG emissions from efficient fertiliser use or benefits to biodiversity from riparian planting.</p>
Southwest Finland	<p>Inspections deal mostly with compliance, and advisory is done by other operator.</p>
France (Seine-Normandie)	<p>Inspections just deal with compliance.</p> <p>It is considered that advice is a different job.</p>
England and Wales	<p>All those listed in sections 3.2 and 3.3 will provide advice on measures and multiple benefits, in so far as the individual advisor is qualified. These are not usually compliance visits.</p> <p>The Environment Agency carries out compliance visits for the regulations for which they are responsible. Some Environment Officers are also qualified to offer advice on diffuse pollution measures and they are all trained to sign post farmers to the correct source of advice and information.</p> <p>The Rural Payments Agency (RPA) in England and the Rural Inspectorate in Wales (RIW) inspect Cross Compliance obligations. The RPA can refer to Natural England for advice on compliance with the Soil Protection Review and to the Environment Agency on the other environmental regulations.</p>
Sweden	<p>Inspections realised to follow regulations are performed by the Municipalities. Depending on the competence by the inspector an inspection can also result in a general discussion of additional measures to reduce the impact on the environment. Cross-compliance inspections for the RDP performed by the county board administrations are not coupled to advice of other measures.</p>
Germany (Weser)	<p>The predominant goal is compliance.</p>
Denmark	<p>Inspection is not to be seen as an advisory service free of charge. However, I believe most inspectors with try to answer a question if asked by the farmer. One most just remember that the inspectors are not trained in knowledge of other measures or in being an advisor.</p>

4.8 Are workshops on specific issues routinely used? If so, on what issues and how often?

Scotland	<p>Yes, mainly on compliance with our statutory code of good practice and nutrient management see http://www.planet4farmers.co.uk/</p>
Southwest Finland	
France (Seine-Normandie)	<p>The local moderators of the water agency organise collective technical seminars for farmers several times a year.</p>
England and Wales	

Sweden	Many county boards work actively together with the local associations within The Federation of Swedish Farmers (LRF) to inform about the water status and discuss measures and financing of measures to achieve GES.
Germany (Weser)	Yes, local advisory services within the framework with offers of the federal states (e.g. round table, workshops, etc.).
Denmark	<p>Workshops for farmers are often arranged on specific issues, e.g. like crop production, fertilization, regulation demands etc., however, such workshops are arranged by the advisory service. Also the farmer associations from time to time arrange meetings for farmers for discussing specific topics e.g. the RBMP and implementation of measures.</p> <p>In the case of River Basin Management Plans, workshops (e.g. on measures and how to implement them) occasionally are arranged by the Ministry of Environment together with other national stakeholder organizations. However the target group is not farmers but advisors, employees from municipalities and people from other relevant stakeholder organisations e.g. green organisations.</p>

4.9 Are demonstration farms or catchments ever or routinely used? If so, on what issues and how often?

Scotland	Yes. We have had a few demo farms but these could be used more widely. They are often cited as being effective by farmers. http://www.sac.ac.uk/news/currentnews/envfocusfarm/
Southwest Finland	Yes. We have demo farms and a few networks of implemented measures on different farms on various issues (traditional biotopes, wetlands, organic production etc.) Not many on other water protection issues. On our catchments (SW Finland) every year 2-3 wetland field trips have been organized (last 10 years) and 2-3 visits on other environmental issues. I guess in other parts of country more or less the same.
France (Seine-Normandie)	<p>There is a national network of demonstration farms for pesticide management ("fermes Déphy"). This is part of the implementation of the Pesticide Framework Directive in France ("Plan Ecophyto 2018"). More information are available on the following website: http://agriculture.gouv.fr/ecophyto</p> <p>The water agency also supports networks of organic farms and integrated agriculture for demonstration.</p>
England and Wales	<p>The Demonstration Test Catchments Programme in England is investigating the impacts of pollution both on ecosystems and on sustainable production and aims to provide information to better predict and control diffuse pollution from agriculture. The programme aims to support policy initiatives, such as the new Defra/EA 'Catchment Based Approach' to environmental management and the delivery of the Water Framework Directive, and policy delivery mechanisms, such as the Catchment Sensitive Farming (CSF) Programme. DTC is helping to provide the sound scientific evidence to underpin the success of these approaches.</p> <p>http://www.lwec.org.uk/activities/demonstration-test-catchments</p> <p>Campaign for the Farmed Environment use case studies and 'Beacon farmers' to publicise their messages.</p> <p>Catchment Sensitive Farming holds demonstration workshops on volunteer farms.</p> <p>LEAF (Linking Environment And Farming) hold Open Farm Sunday, Let Nature Feed Your Senses and year round farm visits to our national network of Demonstration Farms.</p>
Sweden	Yes, within the Baltic Deal project there are 18 demonstration farms in Sweden. Most of these farms are also associated to a pilot farm group, Odling i balans , focused on efficient nutrient and pesticide management but also dealing with energy efficacy, soil compaction etc. In addition, on-going research projects with field- or catchment scale measures (e.g. constructed wetlands, sedimentation ponds, buffer strips, structure liming, river restoration, two-step ditches, erosion

	control etc.) are frequently used as demonstration objects.
Germany (Weser)	Yes. We have representative demo farms which are part of a monitoring system)
Denmark	Demonstration farms are not used by government as such and only research institutions use official demonstration farms for research. However, the agriculture as a sector are involved in many different development project (projects often partly support by RDP money) and in many of these projects individual farmers are engaged in a specific project by letting their farm act like a demonstration farm within the frame of the project.

4.10 Are one to one visits to farmers used to advise on reducing diffuse pollution?

- If so are the visits focused on inspections, advice on RDPs or more general advice?
- Are visits targeted to priority areas?
- Do visits cover all farms in a catchment or is there a risk based approach?
- Who provides the visits and how are they funded?

Scotland	Yes, focused on compliance and targeted at priority areas (WFD protected areas with priority given to areas with potential human health impacts). One to one visits are focused on areas within catchments that are impacted or high risk. Visits are carried out by SEPA and funded by Scottish Government.
Southwest Finland	In TEHO Plus project one to one advice visits are regular. They are targeted to certain areas, but those areas are not necessarily priority areas but areas where farmers are showing more interest. Most of the Southwest Finland is in a way priority area. In those catchment areas almost all the farms are covered. TEHO Plus project is funded by ministry of environment and ministry of agriculture and forestry.
France (Seine-Normandie)	<p>The water agency doesn't organise one to one visits for all the farmers, but :</p> <ul style="list-style-type: none"> - Assessments on point source and diffuse pollutions are done in the catchment area. - One to one visits are organised by the moderators with the voluntary farmers within a collective approach. The water agency is experimenting this approach. <p>And collective meetings take also place and they are targeted to priority areas.</p> <p>Depending on the size of a catchment, all the farmers or just a selection of them will be concerned. If the catchment is large, a risk based approach is implemented taking into consideration erosion or vulnerability.</p> <p>The local moderators of the water agency ensure the contact with the farmers.</p> <p>Besides what the water agency implements, the Farm Advisory Services also provide information but it is not necessarily focused on water protection.</p>
England and Wales	<p>Catchment Sensitive Farming (CSF) uses a combination of one to one visits, workshops, and surgeries to promote their messages. CSF is targeted to priority catchments and visits are targeted to farms in high risk parts of the catchment. CSF officers are employed by Natural England and the work is part funded by RDPE money for capital grants and treasury money pays for the programme management and advisors.</p> <p>Campaign for the Farmed Environment and Voluntary Initiative are Industry funded but run in a similar way to CSF – targeted and priority catchments/farms, using a mixture of approaches to communication.</p> <p>RDP agri-environment schemes - In England resource protection options (for cleaner water and healthier soils) and ETIP advice are also targeted to Protected Areas and water bodies failing or at risk of failing WFD objectives.</p>
Sweden	Farmers visit demonstration farms/objects under different circumstances, e.g. Focus on Nutrient activities, local study circles, meetings arranged by the county boards, advisory groups etc. Hence,

	<p>it is always a voluntary activity. It may be a variety of purposes with the visits covering for example experiences with new technique/measures, advice on a specific issue (e.g. safe storage and handling of pesticides) and it could also be information around regulatory issues.</p> <p>The demonstration facilities are to some extent also used to inform decision makers at different levels, water administrators, and for people working in the advisory to increase the knowledge about new techniques, measures etc.</p>
Germany (Weser)	The advice is concentrated on the reduction of diffused pollution and is more general. It covers mainly all farms in the first step and on the second it concentrates on hot spots. The free advisory service is funded on federal states funds.
Denmark	This is not used by the government in Denmark. This will be the individual farmer decision to arrange one to one visit with his advisory team including which type of advising (crop production, economy, husbandry or environment).

4.11 Do MS have an adequate number of suitably trained advisors? Is there an accreditation scheme associated with advisors?

Scotland	<p>No. We think there is a shortage of advisors to cover needs over and above regulatory compliance e.g. agronomic environmental advice on nutrient management or advice on RDP measures to ensure they are suitable targeted. There are schemes such as http://www.basis-reg.com/facts/default.aspx but we would like to see a more holistic accreditation scheme.</p>
Southwest Finland	<p>No. There is lack of advisers trained to take into account environmental aspects in farms.</p> <p>In The TEHO Plus project education programme for advisors has been compiled as well as farm environment hand book for advisors and farmers. Its purpose is to spread these nationally for education of advisors and maybe create some kind of certification. Nowadays specific education is not demanded for advising.</p> <p>Links to few projects developing advising: http://www.ymparisto.fi/default.asp?contentid=280387&lan=fi&clan=fi (TEHO Plus) http://www.jarki.fi/english (JÄRKI) http://rae.savonia.fi/index.php/in-english (RAE) http://www.ymparisto.fi/default.asp?node=25903&lan=fi (RAVI)</p>
France (Seine-Normandie)	<p>There are around 400 local moderators for the Seine-Normandy river basin an covering all the issues.</p> <p>They are hosted by organisations which are expected to train them and they shall also attend a training session at river basin level once a year. Moreover trainings are available on demand all along the year. They are part of a general package paid by the water agency.</p> <p>More information can be found on the following website: http://www.eau-seine-normandie.fr/index.php?id=4441</p>
England and Wales	<p>The Environment Agency's Environment Officers follow a structured technical development framework. The Chartered Institution of Water and Environment Management (CIWEM) and the Chartered Institution of Wastes Management (CIWM) have endorsed the Technical Development Framework for Regulatory Officers. The title "Practising Environmental Regulator" can be awarded to officers who meet a prescribed level of capability.</p> <p>Independent advisors and Environment Agency Officers can choose to complete BASIS Accredited courses e.g. Soil and Water Management Certificate ; Fertiliser Advisor Certification Training Scheme (FACTs) http://www.basis-reg.com/facts/default.aspx; Certificate in Crop Protection and the BASIS PROMPT Professional Pest Controllers Register, or the Amenity Course.</p> <p>Or, a City & Guilds NPTC PA certificate of competence in applying pesticides and the National Register of Sprayer Operators (NRoSO) to ensure on-going training through Continuing Professional</p>

	<p>Development (CPD).</p> <p>http://www.nroso.org.uk/</p> <p>The Rural Payments Agency train their Officers using the Environment Agency's 'thinksoils' training programme.</p> <p>Catchment Sensitive Farming Officers are currently training local Environment Agency Environment Officers and Natural England agri-environment Advisors in resource protection.</p>
Sweden	<p>No, there have been difficulties to find experienced advisors. One problem is that it has not been as attractive to work with environmental extension as with production advisory. No accreditation scheme for advisors exists.</p>
Germany (Weser)	<p>Yes, there is training for advisors but no audit. The advisors have to have evidence on long term experience in advisory service and an special educational background.</p>
Denmark	<p>The state has no agricultural advisory team and do not provide training. The farmer associations employing the advisors decide for employing new advisors and any training requirement the advisors may need.</p> <p>It is also up to the farmer association and the local/regional advisory services to decide whether they wish to use and implement an acknowledged accreditation scheme or not for the office.</p> <p>In the last few years more and more advisors within the field of environmental advising have been engaged thus indicating that many farmers now are asking for more environmental oriented advising.</p>

4.12 How do MS ensure that applications for measures under RDPs are targeted to where they are required?

Scotland	<p>Additional points in priority areas should increase the chance of funding. But partly because of the lack of proactive advice uptake of measures has been low.</p>
Southwest Finland	<p>As measures are voluntary, we cannot ensure that measures are in the right place. When a farmer is seeking funding for a measure, the situation is evaluated if the measure is suitable to that place or not.</p>
France (Seine-Normandie)	<p>In the RDP the water agency only supports water protection measures in priority areas. The national RDP framework is discussed between the Ministry of Agriculture and the Ministry of Environment which consults the water agency.</p> <p>At regional level the water agency is fully associated to the specification of the regional RDP.</p>
England and Wales	<p>The Environment Agency has provided Natural England with maps showing Protected Areas and water bodies failing, or at risk of failing, WFD objectives. This data needs to be updated in the light of recent investigations. This helps target CSF activities and Agri-environment advice on option choice.</p>
Sweden	<p>On a regional scale this is of minor importance since a majority of the water bodies (80 %) does not reach GES in areas where agricultural land cover more than 5 % of the land use. Consequently, measures are required in more or less all areas with agriculture. For some measures, (e.g. construction of wetlands and sedimentation ponds) each application is evaluated individually and the location is evaluated according to different criterion, where one is nutrient reduction efficacy in areas with waters not achieving GES. For other measures (e.g. buffer zones) there is a lack of targeting resulting in establishment where the effect is negligible.</p>
Germany (Weser)	<p>The targeted implementation of measures in priority areas is ensured by the advisory service.</p>

Denmark	<p>The Danish AgriFish Agency (part of the Ministry of Food, Agriculture and Fisheries) is in charge of preparing a program for the measures agreed to support under the RDP. The programme will describe the frame for applying for support including how the measure is targeted to where it is required (and thereby indicating which farmers comply with the requirements for support and which farmers do not). A legal notice is prepared and is in public hearing for four weeks before final adoption by the minister.</p> <p>After a legal notice is adopted by the minister an administration system is set up within the Centre for Agriculture, part of the Danish AgriFish Agency, handling applications and paying out of RDP money. All programmes/measures are announced at the webpage of the AgriFich Agency.</p> <p>Concerning implementation of wetlands in Denmark a special administrative system has been set-up. Please see factsheet for explication on DK wetlands</p>
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4.13 Do any MS have evidence on the effectiveness of any methods in changing farmer behaviour?

Scotland	We have little info on this and it is important.
Southwest Finland	One to one advice on farm level has been found in the studies to be most effective.
France (Seine-Normandie)	<p>There is no specific study but only horizontal assessments at catchment level.</p> <p>A thesis supported by the water agency is currently addressing innovation in participation.</p>
England and Wales	<p>Catchment Sensitive Farming Evaluation Report includes evidence from the first five years of the initiative on:</p> <ul style="list-style-type: none"> • farmer engagement • farmer awareness and attitude • uptake of measures to control pollution • pollutant losses and water quality <p>http://www.naturalengland.org.uk/ourwork/farming/csf/evaluation.aspx</p>
Sweden	<p>Yes, in the Focus on Nutrients project (voluntary environmental extension) evaluations have been performed on farm-gate balances of N and P and different management factors covering 290.000 ha. Resulting reductions in leaching losses of N has also been estimated (Greppa Näringen, 2012).</p> <p>A study of N concentrations in agricultural dominated areas where Focus on Nutrients have been active shows a declining trend (Fölster et al., 2012).</p>
Germany (Weser)	Evidence is given by different indicators e.g. farm gate balance or the degree / percentage of the implementation of measures (e.g. catch crops).

If possible an indication of the resource used on each of the above approaches would be useful.

Finland: We have problems to make existing advisory services attractive to farmers. We (regional) authorities organize with projects usually every year free advisory lectures, workshops and field trips for farmers and are getting less and less participants (farmers). And still farmers tell us they need more info and more advising. One to one advising could be solution and definitely the most effective, but it is expensive and time consuming, we have no resources for it and private advisory services are quite expensive and used only for production purposes not so much for environmental issues even if these are linked to each other.

The most important thing is to make measures more attractive for farmers and get measures implemented to targeted areas. Advising itself does not improve water quality. Problems with some measures are preventing implementation e.g. buffer zones have to be mowed every year, but there is no use for hay (not many cattle farms around or they do not want it, not biogas plants). We should find solution to these.

WG7: IRRIGATION RELATED MEASURES

Co-leader: R. Galvan (ES)

1. INTRODUCTION

According to the mandate of the River Basins Network on Water Framework Directive & Agriculture, the final objective of the network is "offering feedback from the field "providing practical examples/cases" of good practice. During the kick-off meeting of the network on 27 September 2010 were discussed and proposed several "specific issues" to be evaluated and serve as input to the Expert Group for, CIS / Commission, river basin managers and stakeholders.

The Ebro River Basin member proposed the inclusion of one specific issue on "irrigation related measures," considering the importance of this factor has on the relationship between WFD and Agriculture in many countries in Europe. Unlike other proposed specific issues that have a more transversal dimension, in this case the theme is focused on irrigated agriculture and the different practices and measures to take to comply with the requirements of the WFD.

2. BACKGROUND. WHY IRRIGATION NEEDS A SPECIFIC APPROACH?

In countries like Spain, and elsewhere in Europe, where rain-fed agriculture is highly constrained in productivity and competitiveness by low and erratic rainfall, irrigation takes on a fundamental significance. In many areas of the Mediterranean irrigation is the only viable agricultural production, providing security, quality and diversity of products. It is estimated that one hectare of irrigated agriculture produces six times more than a rain-fed one and creates three times more employment. It's also a tool for rural development and prevention of erosion and desertification.

The association between agriculture, livestock and food industry is one of the main areas of production. This is the case of the Ebro Basin and at the base of the agro-food complex is an irrigated area of about 700.000 hectares. By contrast, it implies a strong irrigation water demand, which in Spain represents 68% of the total consumptive water demand, and in the Ebro basin reaches 93%. Thus, water withdrawals for irrigation are one of the great pressures exerted by agriculture in water scarce areas.

Moreover, the intensification of production which is experienced by irrigated agriculture usually involves a greater use of organic and inorganic fertilizers and pesticides, and the application of water promotes their mobilization, generating diffuse pollution, much of which is collected through drainage networks and ends up in rivers and aquifers. The fact that diffuse pollution is influenced specifically by the practice of irrigation also makes that the approach to the definition of measures to prevent contamination or reverse the trend, can differ from those in other parts of Europe.

On the other hand, it must be taken into account that the water footprint due to the agro-farming activity does not belong exclusively where water is abstracted but where virtual water is consumed. Whereas the Ebro Valley has a population of 3 M inhabitants, it bears the water footprint of additional 6 M inhabitants elsewhere consuming products from the Ebro agro-food -valley. Spain has a virtual water deficit in agriculture of 12 500 Mm³, so the Ebro valley is contributing to lower the virtual water deficit of the whole country, diminishing the external water footprint.

In short, the approach to the effects of agriculture contains differences between the areas with water shortages and large irrigated areas and those with only rain-fed agriculture.

3. ISSUES, PRACTICES AND MEASURES ON IRRIGATION AND WFD

3.1 Water abstractions: monitoring and limiting

3.1.1 Monitoring and control of water withdrawals: water metering.

Given the importance of the volumes of water abstracted for irrigation, adequate monitoring and control of water intake is the first step to take. In the example of the Ebro basin, large consumers of water are controlled, but there are many others who do not have meters installed.

The role of real time monitoring system is of great importance. These real time systems are not only useful for early warning in the case of flood, but are also of great help to monitor and optimize management in water scarcity areas. In the Ebro basin, 516 000 out of 700 000 ha of the irrigated land is fitted with measuring devices connected real time by means of the Automatic Hydrological Information System of the Ebro River Basin Organization. The data is available for the public-through internet (<http://195.55.247.237/saihebro/index.php?url=/data/canales>).

On the other hand, in 2009 a Ministerial Order was approved regulating the obligation to meter water originating from, returned to, or discharging into water bodies. The challenge posed by this order is to control water abstractions by small farms, either surface or groundwater. Currently, this control is carried out in those areas where there is a more intensive use of water. This measure will enable water use to be better managed and more accurately aligned with the conditions established in the licenses and permits, granted by the River Basin Organization. In addition, all new licenses incorporate the requirement to install a water meter and new irrigation communities should implement binomial tariffs (per volume and per hectare) in accordance with the proposal of the Ebro District Management Plan (draft). It is also proposed to extend the concept of beneficiary of water services for a more equitable distribution of costs among all users.

3.1.2 Reviewing and readapting water licenses: limiting grant periods.

Irrigation is an agricultural activity that has its roots in the more distant past. The water licenses and permits for irrigation can be very old. In the Ebro basin, some are dated back to medieval times and half of the irrigated lands obtained their water rights more than 50 years ago. Circumstances may have changed much, so updating the rights recorded in the Water Book Record allows an adequate evaluation and even revision in certain cases.

On the other hand, since the Water Act 1985, the maximum period for granting a water license in Spain is 75 years. The Ebro District Management Plan (draft) proposes to limit the maximum period to 40 years. Limiting the granting period prevents an allocation of water resources for an excessive long term, allowing greater flexibility for future environmental requirements or new water uses. At present, certain actions can be found constrained by water rights granted long ago.

3.1.3 On-farm storage

In general, irrigated crops need their greatest contributions of water in the summer when less flow exist naturally in the rivers. To ensure irrigation, it has been built over the years, large storage and water transport facilities. In the Ebro basin, there is still a need to build or are under construction some of them, but the big challenge is to achieve on-farm storage, to ensure that no water is taken when river flows doesn't meet the minimum ecological flow set and it is granted, to some extent, independence of natural fluctuations.

In accordance to this, the Ebro District Management Plan (draft) proposes to establish the obligation for new licenses for irrigation to incorporate in on-farm storage, setting different requirements on the size

of the storage depending on the circumstances of each sub-basin. This will prevent higher water withdrawals during the dry season, trying to concentrate abstractions only in high waters period. The whole Ebro river basin is divided into several categories, regarding the on-farm storage needed:

1. 10-day storage capacity
2. 20-day storage capacity
3. More than 40-day storage capacity.

It also includes the condition of integration on irrigation communities of new licensees, encouraging collective management and responsibility.

Currently, the actual compulsory reports about compatibility with the River Basin Plan (1998), before releasing a water license, includes a general obligation to build on-farm storage when ecological flow could be compromised by new irrigation schemes.

“(the applicant) should either modify the type of crops....or should build on-farm storage to prevent abstracting water when ecological flow in the river is not met...”

The farmer has to decide what is better in this case: either changing production to a crop with a lower water requirement, or building on-farm storage; in addition, the farmer should take into account the cost and characteristics affordable within the viability of the whole irrigation proposal.

3.1.4 Conditions to use groundwater

To avoid over-exploitation and the preservation of the status of groundwater involves establishing an appropriate zoning and general and specific requirements for the use of groundwater, which is also widely used in agriculture. In the Ebro District Management Plan (draft) are proposed a number of areas which have special restrictions for groundwater abstraction:

- areas without any additional restrictions but those established in the water law,
- areas with priority for urban water supply,
- areas conditioned because of the effects of pollution,
- areas with specific limitations for the preservation or improvement of quantitative status,
- areas with special restrictions for the increase of abstractions,
- unauthorized areas when there is a depletion of groundwater levels.

The restriction to new withdrawals on “unauthorized areas”, before over-exploitation occurs is a key, since reversing a situation of overexploitation later when users have acquired water rights can have a high social and economic cost. A case to illustrate this procedure can be seen in the factsheet about the “Management and recharge of groundwater bodies of “Campo de Cariñena” where groundwater abstraction for irrigation caused a significant depletion of the aquifer and new abstractions were temporary forbidden.

3.2 Irrigation efficiency. Modernization of irrigation

Improving the technical efficiency of irrigation, it is not the only measure to increase water efficiency, but it has a strong impact on the improvement of overall agricultural water use. Technological adaptation and best practices are critical. From a regional and environmental perspective, the determining factor is the reduction of the load of diffuse pollutants exported.

The lack of efficiency has an impact on water quality and associated ecosystems through the removal of excess nutrients, primarily nitrogen, soil leaching of salts and pesticides. Improving irrigation efficiency reduces irrigation return flows contributing to eliminate or at least significantly reduce diffuse pollution.

It is the load of contaminants in the irrigation return flows that determines the concentration of contaminants in the receiving water bodies. Reducing the return flows by means of improving irrigation

techniques tend to increase the concentration of contaminants in irrigation water effluents, but decrease the total load of contaminants exported to water bodies. Hence, diffuse pollution induced by irrigated agriculture should be quantified in terms of irrigation return flows contaminant loads, not in terms of contaminant concentrations. Load is the critical variable for the assessment of irrigation pollution, and it can be reduced highly by means of modernization of irrigation techniques.

Innovation in irrigation offers a wide perspective for improving energy efficiency, quality of production, reduction of pollution and carbon balance. All this is not only compatible with the improvement of the economic and financial efficiency of farms, the water management and the benefits to society, but it contributes effectively to achieving all those goals. During the first decade of the 21st century Spain has made a major effort to modernise its irrigated areas. In the Ebro basin about 30% of all irrigated areas have been modernised and by 2015 around 50% is planned to be modernised. The Spanish National Strategy for the Sustainable Modernisation of Irrigation –Horizon 2015 (draft) set these goals:

- Improving water management and water use efficiency
- Incorporating environmental aspects and biodiversity conservation in irrigation zones (good agricultural practices, GAP)
- Rationalizing energy use
- Using alternative water resources
- Guaranteeing production against climate variability
- Consolidation of the agro-food system
- Increasing the standard of living in rural areas
- Increasing benefits and productivity in irrigating farms
- Employment generation
- Population stabilization
- Farmers training in new technologies

Modernization of irrigation can have several components such as:

- Action in the transport and distribution network
- Pumping and providing pressurized irrigation
- Building ponds (on-farm storage)
- Automated irrigation systems
- Alternative water resources (reuse)

3.3 Water effluents after irrigation

As not all the water used is consumed by the crops (less than 100% efficiency), irrigation generates effluents or returns that result in water flow contribution at certain points of the irrigation district and water bodies. These flows alter the natural regime of water but not necessarily in the negative. There are numerous examples of how irrigation effluents have created and maintain wetlands, ponds or streams of high nature value, dependent, therefore, of irrigation. There are also examples of other water uses where the source of water used wholly or partly is related to irrigation return flows.

However, irrigation return flows are also one of the most relevant diffuse pollution sources. In fact, in the Ebro basin the main sources of diffuse pollution are located around large irrigated areas. Most of the Vulnerable Nitrates Zones are located around irrigation districts. This happens not only because there is more intensive farming and more leaching, but because around these irrigation districts a great number of livestock farms (4,500,000 cattle), especially pork, whose slurry and manure are spread on farmland as fertilizer for digestion and utilization (in fact, irrigation increases the capacity of agricultural land for livestock waste assimilation). Thus, the drainage networks from irrigation districts concentrate a significant load of nitrates and salts (25 709 tonnes N / year exported in the mouth of the Ebro), that discharge into surface and ground water bodies.

In the Ebro basin a special network for the Control of Irrigation Return Water (RECOREBRO) has been set up to add to the existing quality monitoring networks. This network has been established in sub-basins which have a significant predominance of irrigated land in order to control return water flows and their salt and nitrate content on a daily basis. It also enables us to obtain overall data from the irrigation district regarding reported efficiency and the migration of contaminants per hectare.

The network has been set up in close collaboration between users (grouped into irrigation communities), researchers, and government authorities. The collaboration from users is also making it possible to extend the control network on a smaller scale within each irrigation district. This network currently monitors 5 sub-basins representing a total of 215,000 hectares, 22% of the irrigated hectares in the Ebro basin.

3.4 Water reuse

Although the volume of water resources is the same, its successive application allows meeting more uses and, therefore, increase the availability of water resources, while it can contribute to improving quality by replacing natural resources and improve efficiency in the treatment of polluted water. It is essential to have a clear legal framework for the use of reused water. In Spain, the Royal Decree 1620/2007 established the legal framework for reuse of treated water, clarifying the legal framework, the quality of regeneration and the available uses for regenerated waters. Given the inherent cost of regeneration, one of the most appropriate uses of these waters is forestry, where the treatment required is less.

The draft National Wastewater Reuse Plan (MARM, 2010), implementing Royal Decree 1620/2007, calls for water reuse from five wastewater treatment plants of the Ebro basin with a 2015 time frame, with a forecast reuse volume of 11 Mm³. Reuse means the elimination of pollutant masses from water resources with the consequent improvement of water quality, which will have more importance the lesser the flow is in the rivers.

On the other hand, the irrigation return flows, as seen above, contain significant loads of pollutants. Therefore, the reuse of these returns within the irrigation district, guarantees, in addition to an improved efficiency, to minimize the exports of nitrates and salts to the water environment. In some cases these returns could be reused and treated by the creation of artificial wetlands (see factsheet "Water reuse in the irrigation district of" Canal of Aragon and Catalonia").

3.5 Good Farming Practices

Good farming practices and environmental measures to be applied in Vulnerable Zones are not essentially different from those considered for rain-fed agriculture, except in the runoff and leaches control, in line with what was expressed in previous sections. Eco-conditionality and environmental measures are sometimes specially linked to irrigation, like in the Ebro delta.

4. STAKEHOLDER PARTICIPATION AND KEY LEARNING POINTS

In the case of the Ebro basin, there is a long tradition of participation through irrigation communities, which in turn are represented by democratic elections in the participatory bodies of the River Basin Organization. This circumstance facilitates that several aspects, such as the monitoring of water abstraction or irrigation return flows, are understood as something natural. An important part of the measures contained in the Programme of Measures of the Ebro District to this regard, were defined within an extensive and prior participation process, conducted throughout Ebro basin, between the years 2006-2009. 1205 different organizations and entities took part in the process, of which 250 were representatives of irrigation users.

The key is to develop win-win measures, so that the economic cost that the measures have for users, as well result in a greater economic efficiency of farms. To give some examples: the monitoring and metering of water abstraction can be combined with automation of water intakes to allow better management and more comfortable work for the user; the reuse of irrigation return flows, prevents the emission of diffuse pollution load, but also improves efficiency at farm level and good management, optimizing the dosage of fertilizers; the intensification provoked by irrigation also allows a greater assimilation of livestock slurry and manure; the provision of on-farm storage makes less vulnerable the users to drought conditions, and allows sufficient flow in rivers.

5. RECOMMENDATIONS

In many areas of the Mediterranean, irrigation is the only viable agriculture, providing security, quality and diversity of production. In countries and regions with water scarcity and where irrigation is the largest water consumer, a large part of the measures for meeting the water status objectives resides on how to achieve greater efficiency in water use, relieving the pressures on water bodies. The measures most likely to have success and extensive social consensus are those which, while contributing to environmental objectives, do not harm the only truly competitive agriculture in areas of low and erratic rainfall. That is to say, win-win measures, where the cost to users reverts also in greater economic efficiency of farms.

The ideal situation is to make that irrigation users share responsibility for implementing the measures. To this, the joining and participation of administrations, users and researchers in joint projects and participation bodies is very useful. The monitoring and metering, for instance, of effluents from irrigation and the interpretation of results (balance) in a shared way, enable a better coordination for actions. Key measures are:

- Monitoring and control of water withdrawals. Water metering.
- Reviewing and readapting water licenses. Limiting grant periods.
- On-farm storage.
- Conditions to use groundwater
- Modernization of irrigation
- Water effluents after-irrigation
- Water reuse
- Good farming practices

There is also a need to go deeper in a better understanding of the phenomena of irrigation. This focuses on issues such as monitor the effects of the implementation of good practices at large irrigation districts, the ability to capture atmospheric CO₂ by irrigation, the implementation of smart metering and ICT, or the possibilities of the implementation of deficit irrigation.

ANNEX 1: FACTSHEETS (full version)

1. Buffer strips

Contributing River Basins: Arno, Liri-Garigliano e Volturno, Serchio (IT); Børsesjø-Leirkup, Jaeren, Leira, Morsa (NO); Jylland and Fyn (DK); Lechinta (RO); various catchments in Scotland, England and Wales (UK); Southwest Finland (FI); Svärtaå (SE); CIPMS/IKSMS - Moselle-Sarre (DE, FR, LUX); Sona (PL); French National Authority (FR).

1. Definition of measure

CAOM

Establishing vegetated and unfertilized buffer zones alongside watercourses for decreasing the movement of nutrients and pesticides into watercourses and for reducing soil erosion. The establishment of buffer zones usually requires changes in land use (i.e. no agricultural activities).

IT – Arno

The establishment of buffer strips along water courses became compulsory in Italy at the end of 2011 in accordance with the provisions of Decree n. 27417 of the Ministry of Agriculture and Forestry. The Decree foresees the creation of buffer strips and the protection of existing ones. Buffer strips are defined as sown permanent grass strips, or planted tree strips of a width of 5m. The buffer's width is measured by taking the riverbank's edge as a reference point. The 5m width should consider the net surface eventually occupied by streets apart from re-vegetation cases. The buffer's width can be reduced to 3m in case the watercourse is in good or very good status. Buffer strips are compulsory with the exemption of olive groves and permanent pasture land. It is forbidden to use buffer strips for agricultural production. Works to maintain the filtering capacity of the buffer are allowed. Moreover, it is forbidden to use inorganic fertilizers in accordance with the codes of good agricultural practice. The use of manure, nitrogen soil conditioners and organic fertilizers is subject to the strict provisions of Ministerial Decree 7 April 2006.

IT – Liri-Garigliano e Volturno

Buffer strips or "buffer zones" near watercourses aim to filter pollutants from runoff, holding, storing and eliminate a high percentage of nitrogen, phosphorus, pesticides and inorganic toxins, and prevent eutrophication and deoxygenation. In addition, denitrification can permanently remove nitrogen from the "system", but this phenomenon is largely dependent on e.g. the frequency and duration of flooding of riparian zones. The reference for all "buffer zones" is a width ranging from 0.5m to 5m, or there is specific legislation.

From 1 January 2012, the new Ministerial Decree n. 27 417 of 22 December 2011 entered into force involving the CAP. The farmer must observe the following commitments concerning buffer strips: it is forbidden to perform the work, not including preparation for the filtering capacity of the existing strips; it is forbidden to apply inorganic fertilizers, as defined by the Code of Good Agricultural Practice, "Application of fertilizers to land adjacent to waterways," approved by Decree April 19, 1999, within five meters from waterways.

IT – Serchio

Submeasure 1: Description of the objectives of the riparian vegetation.

Submeasure 2: "Code of good practices" aiming at proper management of riparian vegetation.

These measure focus on the protection of native species and addresses pressures such as land erosion, flood water retention and retention of pollutants from agriculture

NO - Børsesjø-Leirkup

Vegetated and unfertilised buffer zone, at least 5m. Between the watercourse and production of potatoes, cornfield, vegetables etc. (the kind of production with little cover, so it is easy for the water to erode).

NO – Jaeren

Unfertilized buffer zones secure year round grass vegetation on areas close to watersheds. The buffer zone can be from 5m up to 10m wide, and are not to be fertilized or exposed to pesticides. The farmers have to harvest the area at least once through the season so the grass doesn't leak nutrients through the autumn/winter; this will also prevent/reduce soil erosion.

NO – Leira

Regulation since 2010. Voluntary agri-environmental measures include 6-12m wide buffer zones. Requirements of voluntary measures: Phosphorus and pesticides are forbidden but a reduced amount of nitrogen (10kg/ha) can be applied. The buffer strips shall be harvested. Tillage is only allowed when reconditioning of the grass cover is necessary.

NO –Morsa

Mandatory: 2m width of natural vegetation along waterways.

Voluntary: extension of grassed buffer strips along waterways 6-12m width. Restrictions: Covered with grass by early autumn. No phosphorus fertilizer and maximum 10kg N/decare. Area has to be harvested. Grazing is allowed if the tramples do not lead to the damages and erosion. Tillage is only allowed when recondition of the grass cover is necessary. Not more frequently than every five years.

DK – Jylland and Fyn

Buffer strips (or buffer zones): 10m wide marginal zone along all watercourses, rivers and lakes larger than 100m², placed in rural zone on arable land. Within the buffer strips no cultivation, spraying or fertilizing is allowed. Clearing obligations (cutting down) of natural emerged and not cultivated perennials exists in order to keep the soil in good agricultural conditions.

RO - Lechinta

Areas of land covered with grass, forest or covered with growing gramineous plants or pulse perennial plants, located near surface waters or near drinking water abstraction areas, on which the use of pesticides and fertilizers is prohibited. The main pressure addressed is the pollution produced by the agriculture. The width of the buffer strips (planted with grass) is between 1m and 3m according the slope of the land. If the slope of the field is higher than 12% the width is 3m. For the drinking water intakes the width of the buffer strips must have at least the minimum width of the sanitary and hydrogeological protection area established by the legislation.

UK – England and Wales

Four types of buffers exist:

- A regulatory requirement for a 1m (from top of bank) no cultivation zone beside all watercourses including field ditches buffer:
- A funded grass buffer in various widths. Additional option for an 'in-field' buffer.
- Voluntary riparian buffer (as part of an industry/government initiative – e.g. Campaign for the Farmed Environment (CFE); Voluntary Initiative - pesticides)
- Unfertilised headlands.

Measures are undertaken under the GAEC, Rural Development agri-environmental schemes and Higher Level Environmental Stewardship Schemes:

Protection of hedgerows and watercourses (GAEC 14) You must not cultivate or apply fertilisers or pesticides to land within 2m of the centre of a hedgerow, watercourse or field ditch; cultivate or apply fertilisers or pesticides to land between the edge of the watercourse or field ditch and 1m on the landward side of the top of the bank

You must:

- take all reasonable steps to maintain a green cover on land within 2 metres of the centre of a hedgerow, watercourse or field ditch;

- take all reasonable steps to maintain a green cover on land between the edge of the watercourse or field ditch and 1 metre on the landward side of the top of the bank.

RD agri-environmental scheme in England, Environmental Stewardship 2m and 4m buffer strips on cultivated land

For these options you must comply with the following:

- Establish or maintain a grassy strip during the first 12 months of your agreement, either by sowing or, ideally, by natural regeneration. Remove any compaction in the topsoil if you need to prepare a seedbed, except on archaeological features. Regular cutting in the first 12–24 months may be needed to control annual weeds and encourage grasses to tiller. Avoid cutting when the soil is moist, to prevent further compaction.
- Do not apply any fertilisers or manure to these strips.
- Only apply herbicides to spot treat or weed wipe for the control of injurious weeds (i.e. creeping and spear thistles, curled and broadleaved docks, or common ragwort) or invasive alien species (e.g. Himalayan balsam, rhododendron or Japanese knotweed).
- After the first 12 months of your agreement, cut buffer strips only to control woody growth, and no more than once in every 2 years.
- Do not use buffer strips for regular vehicular access, turning or storage. There should be no tracks, compacted areas or poaching.

6 m buffer strips on cultivated land

For this option you must follow the management for options EE1/EE2 and in addition comply with the following:

- After the first 12 months of your agreement, cut the 3m next to the crop edge annually after mid-July. Only cut the other 3m to control woody growth, and no more than once every 2 years (where next to woodland, once every 10 years).
- If you wish, you may establish all or part of the margin by sowing a mix of fine-leaved grasses and flowers, such as knapweed, bird's-foot-trefoil, self-heal, oxeye daisy and yarrow. If you decide to do this, it is recommended that you cut each year in August or September and, if excess vegetation threatens to suppress the flowers, cut again the following March or April. This will maintain the flowers in this sward, or others resulting from natural regeneration. You may remove cuttings, which will further benefit flowers.

2m, 4m and 6m buffer strips on intensive grassland

EE4, EE5 & EE6 are only available on improved grassland receiving more than 100 kg/ha of N per year in fertiliser or manures.

For these options you must comply with the following:

- On fields that will be mown, leave an uncut 2m/4m/6m buffer strip around the edge. Graze this buffer strip along with the aftermath, following the final cut.
- Do not allow livestock to poach or overgraze the buffer strip.
- Do not apply any fertilisers or manure to the strips.
- Only apply herbicides to spot-treat or weed-wipe for the control of injurious weeds (i.e. creeping and spear thistles, curled and broad-leaved docks or common ragwort) or invasive alien species (e.g. Himalayan balsam, rhododendron or Japanese knotweed).
- It is not a requirement to fence these buffer strips.
- After the first 12 months of your agreement, cut buffer strips only to control woody growth, and no more than once every 2 years.
- Do not use buffer strips for regular vehicular access, turning or storage. There should be no tracks, compacted areas or poaching.

Buffering in-field ponds in improved permanent grassland and arable land

To maintain their value to wildlife, the water quality of ponds needs to be protected. In areas of improved grassland management and on arable land, the creation of unfertilised grass buffers around in-field ponds will help to protect them from nutrient leaching and run-off and will provide additional habitat for pond wildlife. Buffers will be less effective where field drains discharge directly into the pond. The buffer areas may be designed to link two nearby ponds or to link ponds to copses or other

boundary features. For this option you must comply with the following:

- Buffer areas should be no more than 0.5ha, although areas can be linked where there are several ponds in a field.
- Buffer areas must extend for at least 10m between the pond edge and the intensively managed part of the field within which it lies.
- On arable or rotational land, establish buffer areas by natural regeneration or by sowing.
- Remove any compaction in the topsoil if you need to prepare a seedbed, except on archaeological features. Regular cutting in the first 12–24 months may be needed to control annual weeds and encourage grass to tiller. Avoid cutting when the soil is moist to prevent further compaction.
- After establishment, cut no more than once every 5 years to allow the development of tussocky grass and low scrub. Do not allow scrub to develop on archaeological sites. You may allow some scrub to develop, but this must be around less than half of the pond margin.
- Do not apply fertiliser or manure.
- Only apply herbicides to spot-treat or weed-wipe for the control of injurious weeds (i.e. creeping and spear thistles, curled and broad-leaved docks or common ragwort) or invasive alien species (e.g. Himalayan balsam, rhododendron or Japanese knotweed).
- Where the field is grazed, limit livestock access so that less than half of the pond edge is poached.
- Do not use buffer strips for regular vehicular access, turning or storage. There should be no tracks, compacted areas or poaching.

Higher Level Scheme Buffer strips

Enhanced strips for target species on intensive grassland: this option is used to provide additional habitat for invertebrates, birds and small mammals by managing buffer strips in intensive grass leys. These strips of wildflowers and grasses provide nesting habitat and shelter, as well as a food source for a variety of species including farmland birds, bats and insects such as bumblebees and butterflies. The location of the strip may be rotated within the same field. Management will include sowing and establishing a specified seed mixture of wildflowers and grasses. The strip will need to be protected from grazing and will need to be re-established when the cover of wildflowers decreases. Other management, such as cutting and fertiliser, will be tailored to each site based on the species targeted.

CFE – essential requirements:

Establish or maintain a grassy strip with a minimum width of 6m (including the 1m protection zones under cross compliance) alongside a watercourse.

- Remove any compaction in the topsoil except on archaeological features.
- Do not cultivate the buffer area after the grassy strip has been established.
- Do not apply any fertilisers, organic manures or waste materials (including sewage sludge)
- Do not use the grass area for regular vehicle access, turning or storage. There should be no tracks, wheel ruts, compacted areas or poaching.

Additional management considerations

Use either natural regeneration or sow grass to achieve this (especially if there is not enough green cover from natural regeneration).

- If tussocky grasses like cocksfoot and timothy are included in the seed mix they can provide overwintering habitat for beneficial natural enemies of pests, which can help control infestations in the crop during the summer. However, you should not use more than 10% cocksfoot in the seed mix on ground liable to run-off or erosion as it tends to out-compete other species leading to patches of exposed bare ground to appear.
- If you already have land next to watercourses with a green cover or temporary grass (including former set-aside areas), you may leave these covers in place.
- Including wild flowers in the mixture can also benefit natural enemies such as hoverflies, as well as encouraging crop pollinating insects like bumblebees.
- Regular cutting in the first 12–24 months may be needed to control annual weeds and encourage grasses to tiller. Ideally cuttings should be removed. Avoid cutting when the soil is moist, to prevent

further compaction.

- After the first 12 months, cut the 3m next to the crop edge annually after 31 July. Only cut the other 3m to control woody growth, and no more than once every two years.

VI: Advice on avoiding spray drift: 'Consider leaving a 2m unsprayed strip close to the field margin or sensitive areas (such as watercourses, ponds, gardens and wildlife conservation areas)'. - no cultivation requirements listed

LERAPS: http://www.voluntaryinitiative.org.uk/_Attachments/Resources/1171_S4.pdf generally requires a 5m buffer strip or no spray zone (no cultivation requirements) but there are different width requirements for different Plant Protection Products in different situations.

UK - Scotland

Two types of buffer:

- a regulatory requirement for a 2m no cultivation zone beside all watercourses,
- a funded buffer (water margins) through the Rural Development Programme that needs to be managed and can be up to 20 m wide.

The aim of this option is both to protect water margins from erosion and diffuse pollution, whilst encouraging the development of waterside vegetation that stabilises the banks and enhances biodiversity.

Water margins will comprise either land bordering still water or land bordering a watercourse; and

- for a site bordering still water, the water margin must be between 12m and 24m wide.
- for a site bordering a watercourse with a bed width of less than 1.2m, the water margin must be at least 3m wide on any side and the overall width of the margin at least 5 times the bed width of the watercourse. The maximum width of the water margin is 12m on any one side.
- for a site bordering a watercourse with a bed width equal to or greater than 1.2m, the minimum width of the water margin is 6m on any one side and the maximum width is 12m wide on any one side.

On sites with steep ground or existing semi-natural habitat, the water margin width may be extended to 20m. This will provide an enhanced buffer to intercept run-off and allow you to graze the site more easily.

You will provide a Management Plan which describes the existing vegetation and which outlines your management objectives and how you will achieve them. You may choose to deliver both of the key objectives - to enhance biodiversity and to reduce diffuse pollution or to focus on one of them. The current land use and the type of vegetation on the site will influence your choice. Trees may be planted to enhance the riparian habitat.

Note we are planning to review this guidance with width of buffer based on slope and soil type.

To provide an effective sediment trap in winter, ensure the soil surface in the buffer area is covered with dense plant cover in the winter months. You will control rank, or tussocky growth to maintain a close, even sward, either by light grazing as in Option 1 above, or by mowing to reduce the sward height to between 10 to 15 cm in late Summer/early Autumn. Two cuts may be required to control rank growth. Remove cuttings from the site. Mowing may not control invasive or nuisance species. If they are growing in the buffer area you may need to consider an alternative method of management in the first instance. Where the particular conservation interest of the site would not be met by this approach, an alternative management plan will be agreed with Scottish Ministers.

- you must control grazing to avoid poaching and avoid damage to river and loch banks
- farm livestock must have access to adjacent field(s) whilst grazing the buffer area
- do not apply lime or fertilisers, including slurry or farmyard manure to the water margin
- do not apply pesticides in or near the water margin except for herbicides which may be applied in consultation with SEPA and with prior written agreement of the Scottish Ministers for activities such as spot treatment of injurious weeds or control of invasive non-native species
- do not cultivate the area
- do not clear existing drains or cut new drains

- do not modify or reinforce the river or loch banks
- where farm livestock are prevented from accessing traditional watering places by the water margin Option, you can apply to install water troughs, the cost of which can be supported as a capital item. Alternatively, an access point can be fenced off separately from the water margin, but not through the buffer area
- do not provide supplementary feeding on the buffer area
- where planting small trees to extend or enhance the habitat, use native species, of local origin. Avoid excess shading of the water.

FI – Southwest Finland

1 – 3 m beside main ditches and up to 15-20m beside larger water courses or in sensitive areas based on different kind of agri-environmental agreements. The objective of the measure is to decrease erosion and the movement of nutrients into watercourses from cultivated arable area located adjacent to watercourses which is susceptible to erosion and sloping or is repeatedly flooded, as well as from arable area located in important groundwater areas. The measure is also designed to impoverish the nutrient rate of agricultural parcels in riparian zones, to improve the soil structure, to balance the hydrology of watercourses, to increase biological diversity and promote game husbandry and fishing. Yet another objective of this measure is to decrease carbon dioxide emissions by preventing the consumption of the organic carbon reserves of the soil and promoting the absorption of carbon in the soil. Riparian zones are established and managed in accordance with a specific plan. Riparian zones should preferably be covered by perennial grasses and established with a nurse crop, not be tilled, fertilized or treated with a plant protection product. Pesticide use is prohibited. However agricultural use and grazing is allowed.

The plants of the riparian zone must be mown annually or at intervals specified in the plan. The timing of the mowing must take into account the living conditions of wild birds and mammals, so that mowing shall not start before 1 August, unless it is necessary for the destruction of weeds, plant diseases or vermin, to prevent them from spreading or for similar reasons. The plants mown must be cleared from the riparian zone and can be used in agricultural production. The riparian zone can also be used for grazing provided the biodiversity is not jeopardized and, there are no other related to water protection or other similar reasons. The riparian zones established in flooded areas may not be mown if this is justified from the perspective of water protection.

SE –Svärtaå

Buffer zones are vegetated and unfertilized zones on arable land alongside surface waters. To get agro-environmental support, the buffer zones need to be located alongside a watercourse, lake, sea, or dam, and have a width of 6 to 20m. This applies only to water courses existing in the Swedish topographic map 1:50 000, or those with running water all year round. Hence, almost all field ditches with a length of approximately 93.000km are excluded. A maximum of 10% of the seed for establishment of the buffer zone can be nitrogen fixating ley species, the rest must be ley grass. It is allowed, but not required, to take a harvest from the buffer zone after 15 July, and/or to cut it, and/or to graze it. Application of fertilizer or plant protection products is not allowed. Clearing obligations (cutting down) of natural emerged and not cultivated perennials exists in order to keep the soil in good agricultural conditions. A checklist with 19 points gives information to help comply with all requirements (Jordbruksverket, 2012).

CIPMS/IKSMS - Moselle-Sarre (DE, FR, LUX)

Establishing vegetated and unfertilized buffer zones alongside watercourses decreases the movement of nutrients and pesticides into watercourses. They also reduce soil erosion. As the establishment of buffer zones requires changes in land use (i.e. stopping intensive agricultural use), direct pollution from mineral fertilizers and organic manure will also be reduced. All parties have implemented the measure “buffer strips” in their legislation. Nevertheless, there are regional specificities:

FR: Establishment of non-fertilized buffer strips (covered with grass, shrubs or trees) with a minimum width of 5m alongside watercourses.

LUX: The agri-environmental measure “landscape conservation bonus” (“Landschaftspflegeprämie”) prescribes to establish on arable land 3m wide buffer strips (planted with grass) along rivers with a summer bed width of at least 2m. The agri-environmental measure “green corridor programme” (“Grünstreifenprogramm”) finances buffer strips on grassland and arable land alongside watercourses or ponds. These buffer strips alongside watercourses with a summer bed width of at least 2m, ponds and lakes need to be 5-20 m wide. In all other cases the buffer strips have to be at least 3m and may have a maximum width of 12m. Only the part exceeding the 3m width of the landscape conservation bonus is financed. Ploughing, cultivating the soil, the use of fertilizers (organic and mineral) and overseeding are not allowed on these buffer strips. The use of pesticides is very restricted. The grassed strips may only be moved after the 15th July. Grazing is allowed after the 15th July, but a fence has then to be established at a distance of 1m of the watercourse or lake. The agri-environmental measure “headland program” (“Ackerrandstreifenprogramm”) finances buffer zones of a width of 3 to 9m on arable land alongside watercourses. Not allowed are e.g. the employment of pesticides and fertilizers (organic and mineral), undersowing, mechanical weed protection.

DE-RLP: As part of the “ACTION BLUE” (“AKTION BLAU”), riparian buffer strips are created as a buffer zone for the waters. These are usually secured by a purchase of land or an easement and are subject to conditions (e.g. the riparian buffer strip is left to natural succession). The use of pesticides in these riparian buffer strips is prohibited.

DE-SL: Buffer strips are useful to avoid or minimize the leakage of hazardous substances and the erosion of soils, but also to preserve the ecological features and a natural functioning of watercourse (the good discharge of the floods). In the urban zones the buffer strip is at minimum 5m broad; 10m out of urban zones. No buildings are allowed, except some, including devices for control or managing of water. Such measures are taken into account by the urbanism rules. Buffer strip must be free of construction (no barrier) and free of fertilizer and pesticides; agricultural use is prohibited.

Possibility of growing energy crops:

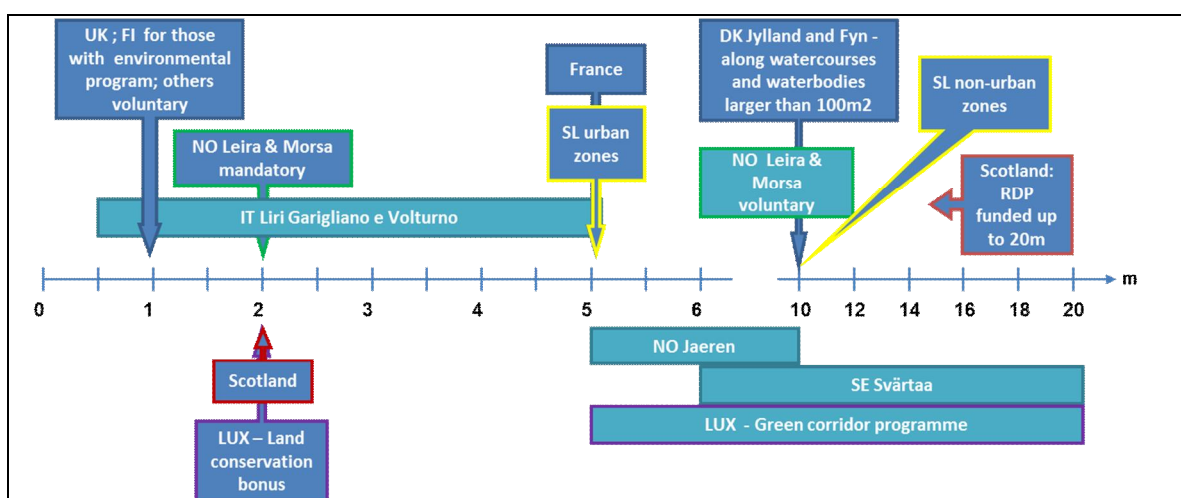
Today this practice isn’t observed. The fact that these buffer strips could also be used for the development of energy crops should be approached with caution so as not to lead to standardization of the medium and slow restoration and renaturation of watercourses. In addition, a number of energy crops (for example Miscanthus) can be invasive. No Party has made a decision on this topic yet. In general, DE-SL prohibited agricultural uses.

PL – Sona

Buffer strips are separated areas around the watercourses, water reservoirs and safety areas around water intakes, on which use of manure is forbidden and use of mineral fertilizers is restricted. Width of strips can be different in different cases.

Summary

12 of the river basins that responded give an indication in metres for the width of buffer strips. These range from 0.6m to 20m. Most countries completely prohibit the use of fertilizer, pesticide, plant protection products, tillage, ploughing and spraying (DK – Jylland and Fyn; FI – Southwest Finland; SE – Svärtaå; FR, LUX, DE – CIPMS/IKSMS). Some countries also prohibit grazing and agricultural use, cultivation of soil (UK in the 1m no cultivation zone, Scotland), whereas others allow some agricultural use or require cutting grass, often with set time limits, i.e. after a certain date in summer (NO – Jaeren, DK – Jylland and Fyn, Leira; FI – Southwest Finland; SE – Svärtaå; LUX –CIPMS/IKSMS). Some countries specify that their measures (or part of the measures) are voluntary (NO – Leira, Morsa; SE – Svärtaå; UK – for 1 type of buffer: voluntary riparian buffer).



Legend: dark blue box refers to a specific point. Light blue refers to a range. Coloured borders are used for several limits referring to the same country, i.e. SL – yellow, Scotland – red, NO – green, LUX – violet.

2. Extent of use of measure

IT – Arno

The measure became compulsory at the end of 2011 in accordance with the Decree no. 27417 of the Ministry of Agriculture and Forestry.

IT – Liri-Garigliano e Volturno

These guidelines are already contained in the current legislation, especially in the zoning law and in other fields of legislation (Royal Decree 523/1904, Law 431/85, Legislative Decree 490/99, Law 183/89, Law 37/94, Legislative Decree 152/06). The Liri-Garigliano e Volturno River Basin Authority experimented the implementation of the guidelines through some pilot projects identified in the area of a sub-plan of environmental protection; this sub-plan gives the indications about safeguarding and protection of the environment in the broad sense, in the basin area of competence.

IT – Serchio

The measure is intended for riparian vegetation management and land reconstruction and reformation. The measure involves the whole Serchio River Basin. The measure is mandatory to all farmers in the RB.

NO - Børsesjø-Leirkup, Jaeren

The measure (wider than mandatory 2m) is known among the farmers but the uptake could be better. The uptake is hoped to increase due to publicity and increased economic support (Børsesjø-Leirkup). The measure is supported only in prioritised parts/sub-catchments of RBs but recommended also in the other areas. Some variation in payments and width requirements across RBs. The measure is limited to the Børsesjø-Leirkup area of precipitation, and special along the river Leirkup.

NO - Leira

The measure is both voluntary and mandatory.

1. Voluntary: The extent of use of buffer strips is limited to production areas and must start within 30 meters from the watercourse. The voluntary measure is proposed to all farmers with some variations nationally. The measure is similar for all farmers in Leira – Nitelva.

2. Mandatory: For Leira (part of Leira – Nitelva river basin) there are regulations concerning ploughing in autumn. Farmers are then obliged to leave a 6m buffer strips along the watercourse. This is in addition to the 2m vegetation zone that is mandatory nationally.

NO – Morsa

The 2m width of natural vegetation along waterways is mandatory to all farmers in Norway. The voluntary extension of grassed 6-12m wide buffer strips is proposed to all farmers but with some variation in payment and width. In some sensitive areas it is mandatory but farmers receive compensation.

DK – Jylland and Fyn

The measure is made compulsory by a specific law (legal act) for buffer strips, applying for all farmers having cultivated soils in rural zone next to watercourses, rivers or lakes larger than 100m². Few exceptions, however, exists:

Exceptions for buffer strips including exceptions for the width of the buffer strip:

- In marshland (agricultural land based on salt meadows protected by dikes) watercourses with no existing environmental objective (e.g. silt trenches) are excluded from the law.
- Watercourses with an existing environment objective, already have implemented a two meter wide buffer strip according to regulations in the “law of watercourses”, and therefore shall only increase the buffer strips with 8m to a total of a 10m buffer strip.
- Farmers with a high intensity of watercourses and lakes should not implement buffer zones to a larger extent than the farm land in used for buffer strips do no exceed more the 5% of the farmers arable land. In such cases the farmer may reduce the width of all the buffer strips from 10m to the specific width where the total arable land within his farm converted to buffer strips, is no more that 5% of the total arable land at the disposal for the farmer. The farmer must once for all set the width of the buffer strip together with the controlling authority within the Ministry for Food, Agriculture and Fishery.
- Cultivation and harvest of extensive grass is allowed. No fertilization and spraying are allowed.

RO - Lechinta

In addition to the mandatory requirements (GAEC/ND), wider buffer strips are proposed to all farmers whose land is near a river and it is part of a Nitrates Vulnerable Zone (NVZ). The use of the chemical and organic fertilizers is not permitted. The measure is not compulsory outside of NVZ, but it is contained in GAEC and the farmers have to apply to APIA in order to obtain founding from the National Programme of Rural Development of Romania.

UK – England and Wales

Buffer strip feature in the top 20 options from farmers in Environmental stewardship (Entry level scheme)

- The 2m no-cultivation zone is required nationally as part of cross compliance by all farmers. In the 2m strip it is not allowed to apply fertilisers, dredging, slurry, manures or pesticides to land within 2m of the centre of a hedgerow or watercourse. This rule also applies to all land within 1m of the top of the bank of a watercourse.

- The funded 6m buffer is available nationally through Environmental Stewardship, or 12 m buffer strip next to a water course (new option).

- Unfertilised Headland.

- In field grass areas (new option 2011).

- In Wales, Tir Gofal - all ponds, streams and watercourses were required to be protected by a 1m buffer strip (extended to a width of 10m when using farmyard manure, slurry or other organic manures). Since 2009, this scheme is now closed to new entrants. From 2012, the five existing agri-environment schemes will be replaced by one scheme, Glastir, which is better positioned to meet current and future environmental challenges.

- Under the new Welsh Glastir scheme (to be introduced from Jan 2012) all participating farmers will be required not to plough or cultivate any land within 2m of a watercourse or wetland habitat.

- Voluntary uptake of riparian buffer strips is recommended by the industry led Voluntary Initiative for certain pesticides where runoff is known to be an entry pathway for pesticides to water e.g. grass

buffers between 6m and 20m wide (depending on steepness of slope) are recommended where oil seed rape herbicides are being used.

UK - Scotland

- The 2m no cultivation zone is required nationally by all farmers
- The funded water margin is targeted to priority areas but is available nationally (voluntary uptake)

FI – Southwest Finland

The measure is proposed to all farmers committed to environment program. A so called riparian zone contract may only be concluded (in support areas A and B) for arable areas located alongside a main ditch or a larger watercourse, a pond, lake or the sea and arable areas located in the classified groundwater area. These specific riparian zones contracts require that the zone must be at least 15m wide. The required width is determined on the basis of the terrain and the flood limits. The contract is automatically accepted if need is evaluated in general planning report. In other support areas contracts are restricted for certain areas defined beforehand.

SE – Svärtaå

The measure is voluntary and proposed to all farmers. The whole Svärtaå river basin is a prioritised area and financed within the agro-environmental support scheme. Some areas in the north of Sweden with only local eutrophication problems do not receive financing for this measure. Within the Svärtaå river basin there is 120ha of buffer zones, which corresponds to 1.5% of the arable land. The total extent of buffer zones in Sweden was 10,200ha in 2010 (Miljömålsportalen, 2011), which corresponds to less than 0.4 % of the arable land.

CIPMS/IKSMS - Moselle-Sarre (DE, FR, LUX)

The measure is proposed to all farmers. There are different approaches concerning the limitation of the measure to certain areas:

FR: In 2011 the establishment of the buffer zone has become mandatory for all the farmers seeking for CAP (Common Agricultural Policy) aid. All the other farmers can adhere voluntarily to this measure by an agri-environmental measure which is granted.

LUX: The agri-environmental scheme “landscape conservation bonus” is limited to arable land alongside watercourses with a bed width of 2 m. The rules for the agri-environmental scheme “green corridor” depend on the place of the establishment of the buffer strips. The rules for the agri-environmental scheme “headland program” only apply on arable land alongside watercourses.

DE-SL: Buffer strips are mandatory along all the watercourses. The riverside owners have to implement them.

DE-RLP: Buffer strips are not mandatory (can be implemented on a voluntary basis). However, the law provides the possibility to “issue” buffer strips by ordinance for certain waters which are mandatory in this case. Such an ordinance does not yet exist.

PL – Sona

20m buffer strips are obligatory for all farmers on NVZ zones. For other farmers establishing buffer strips is voluntary. Width of strips up to farmers can range from 2 to 5m zones.

Summary

Most RBs have both mandatory measures for a limited width of buffer strips, and voluntary measures that expand beyond the mandatory one (NO - Leira, Morsa; RO – Lechinta; UK - various RBs in England and Wales, Scotland). Other countries also have both voluntary and mandatory measures, differentiated by other criteria, such as related to financial support, the status of the water body, type of crops, or other exceptions (DK - Jylland and Fyn; UK - various RB in England and Wales; FR - CIPMS / IKSMS). In DE-SL - CIPMS/IKSMS the measure is mandatory, whereas in some river basins it is strictly voluntary (NO – Jaeren; LUX - CIPMS/IKSMS; SE - Svärtaå). In most river basins measures apply in the whole river basin area (IT - Arno, Serchio), in others and in addition to application of measures in the

whole RB area, special attention is given to prioritised areas and hotspots where voluntary measures can become mandatory (IT – Arno; NO - Leira, Morsa; LUX - CIPMS/IKSMS)

FROM PPT:

- “ In most RBs, measures are offered to all farmers/in entire RB
- “ Some RBs focus on specific priority areas:
 - . NO - Børsesjø-Leirkup: limited to the area of precipitation along river
 - . NO – Leira: limited to production areas
 - . NO – Morsa: mandatory in sensitive areas
 - . Scotland and Sweden: funding targeted to priority areas for voluntary measures
- “ RBs focusing on specific areas:
 - . DK – Jylland and Fyn: cultivated soils next to watercourses and waterbodies larger than 100m². Aim: implement about 50.000 hectares new buffer strips on arable land

3. Effects of measure

CAOM

The potential of this measure is dependent on the establishment of buffer stripes along watercourses and the corresponding distance requirement. The efficiency of buffer zones in removing suspended solids and nutrients is affected by the width of the zone, gradient of the drained field, soil type and particularly by the variety and density of zone vegetation. Reported removal efficiencies are highly variable and much of the variation may be related to the many different mechanisms involved (Hickey, et al., 2004). However efficiency of entrapment with particulate pollutants seem generally higher than with soluble. They also act as a shield against overland flow from agricultural area and prevent run-off to reach the watercourse. If a buffer strip is fenced, then it prevents cattle getting directly into waterways.

Further scientific research has shown that vegetative buffers are effective at trapping sediment from runoff and at reducing channel erosion. Buffers, as narrow as 4.6m (15ft) have proven fairly effective in the short term. Although wider buffers provide greater sediment control, especially on steeper slopes. Long-term studies suggest the need for much wider buffers (30m). Further the protection against pesticides and heavy metals is judged to be very positive (Wenger, 1999).

IT – Arno

The measure aims at considerable improvement for the whole agricultural ecosystem. The measure is implemented in the whole RB and has positive effects also on biodiversity by creating “ecological corridors”, improving soil quality and preventing soil erosion. The width, vegetation cover and buffer strip management rules are clearly pre-defined. Monitoring projects on the effects of measures are on-going.

IT – Liri-Garigliano E Volturno

The importance of riparian areas is high in many respects: high ecological productivity, ecological corridors, biodiversity, high rate of utilisation of nutrients, soil conservation, and stability of banks and reduction of sediment transport, soil conservation. Riparian areas show higher productivity than the adjacent terrestrial ecosystems, indicating a high rate of utilization of nutrients. Following the path of bodies of water create a continuous network of ecological corridors through a territory fragmented by human activity thus allowing the movement of fauna present in the riparian and in the few remaining natural areas. The organic matter from riparian ecosystem, consisting mostly of leaves, is the largest source of energy for many river organisms. Riparian areas are also relevant in the river basin planning aimed at soil conservation, optimization of water resources and environmental protection.

IT – Serchio

The aim is to provide guidance for the management of riparian vegetation in order to achieve a compromise between the need to keep the area safe from the hydro-geological risk and to give back

flooded areas to the river. Intended effects are to restore or integrate the riparian areas, also considering the flow reduction. The measure will be verified and number of operations performed will be modified. In addition to direct impacts, the measure has indirect positive effects on biodiversity, soil, landscape and on human health.

NO - Børsesjø-Leirkup

To prevent soil erosion and movement of nutrients into Børsesjø and Leirkup.

NO – Jaeren

Decrease movement of phosphorus into the watercourses and reduce eutrophication of the rivers and lakes. A monitoring program of nutrients is in place since 2004. No clear changes in nutrient contents have been observed so far and they vary from year to year. The detergency of the measure is calculated to be 40-70% phosphorus, in surface runoff (Syversen, 2003). If the surface runoff constitutes about 30% of the total runoff, it would mean a total detergency of about 15-20%. In meadows and grazing areas, a reduction of 10 % of the runoff of phosphorous is estimated. The buffer strips need to be at least 5m wide. (Framstad and Stalleland, 1997)

NO – Leira

To reduce soil erosion and leakage of nutrients and pesticides to watercourses. All supported buffer strips are registered. The municipalities have a 5% control of all applicants for measures that farmers get compensated for, including buffer strips. Voluntary implementation is increasing but varies between municipalities. Effects are still under evaluation and discussed, for instance the most efficient broadness of buffer strips (according to cost- efficiency).

NO – Morsa

Mandatory measures are controlled by the local municipalities at sample controls. Voluntary and supported measures are registered at a yearly basis. The effect in the Morsa region is uncertain. In Hilly areas the effect of this measure could be 42-96% for P, 27-81% for N, 55-97% for particles, 83-90% for organic material. For the pesticides glyfosat, fenpropimorf and propikonazol the effect are respectively 39-48%, 34-71% and 63-85%. Buffer strips contribute to reducing N₂O emissions, and increase CO₂ binding in the soil. Having trees benefits biodiversity both on land and in water.

DK – Jylland and Fyn

Aiming to implement about 50 000 ha new buffer strips on arable land. Expected effects: reduction of approx. 3.1kg P/ha, kg N/ha, improvement of Nature 2000 areas and reduction of damage on flora and fauna from pesticides. WFD/RBMPs main target is the reduction of phosphorous and the main target of the Habitats Directive/Natura 2000 is the creation of new potential sites for nature. Monitoring of the impact is not yet done because implementation will be implemented in 2012-2013. The effects, related especially to phosphorous, are still rather unsure and more monitoring/research is needed.

RO - Lechinta

The reduction of the nutrients or pesticides in surface water and groundwater. Trees, grass or bushes that are planted, also reduce soil erosion, which causes a reduction of losses of P and organic pollution. Surface water quality is monitored and field controls and checks exist. According to the literature, the efficiency of a buffer zone is dependent on the width of the zone, gradient of the drained field, soil type and particularly the variety and density of zone vegetation. A study shows that, buffer zones 10m wide effectively reduce leaching of suspended solids by 50-60%, dissolved phosphorus by 30% and total nitrogen by 50%. Another study shows that by reducing erosion, losses of P, but also of organic pollution are reduced. For grass buffer strips of 6m the effects of COD-losses is around 85% reduction.

UK – England and Wales

The 1m margin aims to protect sensitive field boundaries and their associated habitats. Based on the reviewed literature the current cross compliance 1m wide buffer strip is unlikely to provide any

significant filtering benefit for medium or heavy soils. In addition, the potential habitat within a 1m strip may be of limited value, due to herbicide, sediment, nutrient or spray drift impacts. A 6m riparian grass buffer can provide a filtering mechanism capable of removing the majority of sand and silt size particles carried in runoff water. It is reasonable to expect that such a filter strip would help significantly in reducing the total water-eroded soil leaving a given field to less than 2t/ha/a, especially for light and medium soil types (Cranfield, 2006). Defra Project PS2233 identifies that vegetated buffers can be effective in reducing pesticide loading to watercourses but that these buffers would be more cost effective if located in areas of known run-off (for example, corners of fields) – field scale considerations are important to get maximum benefit from buffers.

NB: Buffer strip have large untapped potential. By some subtle engineering or through use of different crops, it is thought that the effectiveness of a buffer strip could be much enhanced. James Letts (environment-agency)

Buffers need to be well managed. Their efficacy will be reduced when they become saturated and when drainage short circuits through channels.

There is more scope for better placement of buffers so they are targeted in the high risk areas. “Runoff generally exited fields at discrete, consistent locations (e.g. corners) indicating that careful targeting of wider vegetated buffers will be more effective than a strategy based on narrower buffers adjacent to all water bodies” (Defra Project PS2233 on pesticides, Jo Kennedy (EA)).

Demonstration Test Catchments (DTC) project - Results are not yet available but will become available over time. See links to DTC websites and newsletters in reference section below. Newsletter includes an article on buffer strips.

The Tamar Catchment. The work being carried out in the Tamar and linked to Measures component of the Avon DTC is part of the Westcountry River’s Trust and Southwest Water ‘Upstream Thinking’ project. The aim of this project is to improve raw water quality and all ecological aspects of the region’s rivers. A total of £3.26 million over three years across four catchments is being spent on the implementation of measures for water quality improvement through a collaborative approach, which sees landowners informed and assisted in the protection of river catchments as part of an integrated approach to good land management. Tailored one-to-one advice and farm plans are supported by a capital grant scheme. The measures will be widespread and intensive and include establishment of buffer strips, streambank fencing, improved maize management, feeder ring management, separation of clean and dirty water in yards, improving slurry storage facilities and nutrient and manure management strategies. Two sub-catchments situated in the catchment of the River Ottery will be manipulated by implementation of these measures, and a third in the catchment of the River Neet will act as a control. DTC monitoring equipment has been deployed to observe the water quality at the outlets of these three sub-catchments. The Tamar has different underlying geology and soil types to the Avon, and therefore will provide evidence of how widespread, intensive, targeted implementation of a different suite of measures than that implemented in the Avon can affect water quality. It will also provide insight into how different approaches to catchment management and implementation of measures can affect water quality, thereby complementing and bringing added value to the Measures components in all three DTC catchments. Continuing dialogue and involvement in workshops and guidance will take place between the Tamar and Avon allowing input into the national DTC programme.

The Wensum catchment. Results from the monitoring equipment this year have already demonstrated that at sites such as Stinton Hall (E) there can be distinct peaks of sediment, phosphate and nitrate during and following rainfall events. In order to minimise such peaks a combination of measures that reduces sources, intercepts pathways and protects receptors in an integrated ‘treatment train’ is necessary. Such a combination has been identified by starting with a review of relevant reports (e.g. the Defra User Guides from projects ES0203 and WQ0106, Cuttle et al., 2007; Newell Price et al., 2011) and then discussing possibilities with local farmers, agricultural advisers, Catchment Sensitive Farming officers, Environment Agency staff and Wensum consortium members as part of wider knowledge exchange activities within the DTC. This resulted in a subset of measures which were reviewed in more

detail with the farmers (and their advisers) who had expressed interest in participating in the research, particularly with respect to the practicalities of implementation given their current farming system (e.g. crop rotation) and equipment, as well as the cost implications. At this stage, it became apparent that the totality of options was likely to be more expensive than could be directly supported with Defra funding so a multi-track approach has been developed with some key priorities and a number of complementary measures which could be added through funding from other sources. The table below summarises the overall approach, with potential measures categorised according to their role and prospective funding sources.

Possible measures in the Blackwater (Wensum) study area

Source Minimisation	Pathway Interception	Receptor Protection	Funding Source
Reduced cultivation methods (e.g. strip tillage) and use of cover crops	Rural sustainable drainage systems (RSuDS) to act as sediment and nutrient traps		This application
Precision farming (e.g. nutrient mapping, variable rate applications)		Water meadow restoration	Defra CTX 1106 Expression of Interest
	Buffer strips and grass field corners (already in place)		Entry Level Stewardship
	Extended buffer strips (up to 24 m)	Tree planting along selected watercourses	Higher Level Stewardship
Farmyard biobed to treat run off from sprayer spill and washdowns		Fencing and alternative water supplies to prevent livestock poaching of stream banks	Catchment Sensitive Farming Capital Grant

Table summarizing the measures identified, assessment of evidence generated so far, rationale for location of measures and likely success for individual contaminants for the Avon, Wensum and Eden catchments.

Catchment	Measure Identified	Evidence of Success Demonstrated so Far	Evidence Used to Support Location of Measure	Success Criteria: Anticipated Diffuse Pollution Reduction	Likely Policy Delivery/ Windows
Avon (CSF) Eden	Yard Infrastructure	Very little documented evidence.	Local knowledge, Conceptual model	N 30% reduction P 50 - 60 reduction S 50 - 60 reduction	ELS CAP reform
Avon Eden (CSF) Wensum	Integrated manure and fertiliser planning	Individual measures have been examined but little work on integration of measures	Local Knowledge Conceptual model	N 20 % reduction P 20% reduction S 10% reduction	Cross Compliance CAP reform
Avon (CSF) Eden	Farm track re surfacing	Little direct evidence	GIS based analysis Biological and hydrochemical monitoring	N 0 % reduction P 0-10% reduction S 0-10	ELS CAP reform

				reduction	
Avon Eden (CSF) Wensum	Rural suds	Some evidence generated but more needed. Previous work site specific	GIS based analysis Biological and hydrochemical monitoring	N 0% reduction P 6-80% reduction S 50-80% reduction	HLS <i>CAP reform</i> <i>Water com</i> <i>WFD</i>
Avon Wensum	Extension of current buffer strip	Moderate evidence but little known of the impact at the catchment scale. Some work on-going	GIS based analysis Local Knowledge Conceptual model	N 0% reduction P 50 - 60 reduction S 50 - 60 reduction	HLS <i>CAP reform</i>
Wensum Avon	Reduced cultivation	Moderate evidence but little known of the impact at the catchment scale	GIS based analysis Local Knowledge Conceptual model	N 10-80% reduction P 10-80% reduction S 10-80% reduction	Cross Compliance <i>CAP reform</i> <i>Water com</i>
Avon	Stream Bank Re fencing	Some evidence on catchment scale	GIS based analysis Local Knowledge Conceptual model	P 10% N 10% S 30 – 50%	Voluntary HLS <i>CAP reform</i>
Wensum (Stewardship) Eden CSF	Tree Planting watercourses	Little evidence on catchment scale	GIS based analysis Local Knowledge Conceptual model	P 10% N 10% S 30 – 50%	HLS <i>CAP reform</i> <i>WFD</i>
Wensum (CSF) Eden (CSF)	Biobed	Moderate evidence but little known of the impact at the catchment scale	Local Knowledge Conceptual model	N 0% reduction P 6-80% reduction S 50-80% reduction	HLS <i>CAP reform</i>
Wensum (Additional funding sought through Defra CTX 1106)	Water meadow restoration	Some evidence generated but more needed. Previous work site specific	GIS based analysis Biological and hydrochemical monitoring	N 0% reduction P 6-80 % reduction S 50-80% reduction	HLS <i>CAP reform</i> <i>Water com</i> <i>WFD</i>

Catchment measures identified, assessment of evidence generated so far, rationale for location of measure, likely success for individual contaminants Policy drivers and windows. Evidence demonstrated so far and success criteria are based on findings suggested by Cuttle et al 2007.

UK – Scotland

- The aim of the 2m buffer is to establish a baseline level of protection and ensure no deterioration simply by moving the activity away from the watercourse.
- The aim of the funded water margin is to intercept potential pollutants. Other benefits include biodiversity and habitat connectivity.

Monitoring of mandatory buffer through a national compliance assessment (5% of farms) and catchment wide farm visits in priority catchments and voluntary/supported through data provision on spend from Scottish Government. Effects of both measures will be assessed through a combination of inspection results, predictive modelling, monitoring (chemistry and ecology at a range of scales and

with/without flow). The literature quotes a wide range of effects because of site specifics which makes producing guidance, e.g. on buffer widths difficult. Sharing info, guidance and more R&D are required on this. Also a need to look at lifetime and management of this measure e.g. recent studies have shown P leaching – how should buffers be managed to minimise this? Wet riparian buffers are also an important option but what is the impact on N₂O emissions? Ideally buffers should allow the river to move to allow the physical habitat to return to a more natural state. This likely to be important in negating diffuse impacts too. Other countries experience in this would be useful. The use of buffers at a catchment scale and not necessarily next to water e.g. shelter belts is also an issue it would be good to share experience on. Buffers have huge potential to provide other benefits but guidance is required.

FI – Southwest Finland

The effect of the measure is decreasing the movement of nutrients especially phosphorus, and pesticides into watercourses. In addition, increasing biodiversity, reducing soil erosion and adaptation to climate change (soil erosion may increase due to expected increase in precipitation). Regional agriculture authorities monitor the area amount of commitments. The effects are evaluated through water quality and amount of nutrients in the water. Riparian zones can reduce, at best, 20-50% of P and 10-20% of N leaching. (Uusi-Kämpä 2010, Rätty et al. 2010, Uusi-Kämpä 2008). No effects have been observed and measured concerning pesticides. At the moment there are no studies about effects concerning BQE of water course, but there are information about diversity and amount of vascular plant species and of butterflies

SE – Svärtaå

The main aim of the measure is to reduce surface runoff of phosphorus to surface waters to mitigate eutrophication. Other aims are to decrease nitrate leaching, erosion of suspended solids, pesticide runoff and spray drift, and to increase the biodiversity. Research in particular in Norway and Finland (Uusi-Kämpä et al., 2000) under similar agro-environmental conditions reduce total P losses by 0.24 to 0.67 kg/ha (from the area contributing to surface runoff). Considering Svärtaå as a hot spot area with relatively high surface runoff it is assumed efficient with a high establishment of buffer strips. If all streams and ditches have buffer strips, covering ca. 5% of the area (400ha), it would reduce the load to surface waters with between 650 and 1300 kg P (assuming that surface runoff contributes with between 15 and 30% of the P load and 2000 kg of the N load). That would result in a gross P load reduction to the surface waters of between 6 and 12% and N reduction of 2%. Recent results from long-term field experiments in Finland have shown increased losses of dissolved phosphorus from fields with buffer strips (Uusi-Kämpä and Jauhiainen, 2010). The effect on eutrophication of waters may therefore be overestimated. This is a measure in the agro-environmental support scheme and the area of buffer zones is registered annually. In a recent report from the Swedish Board of Agriculture (2011) it is stated that in the investigated buffer strips there were no effects on the abundance of farmland birds, either as a group or individual species. Butterflies were significantly more common on buffer strips than on corresponding farmland with crops only. Bumblebee occurrence was too low to be statistically significant, although it seems as they are more common on buffer strips.

CIPMS/IKSMS - Moselle-Sarre (DE (SL + RLP), FR, LUX)

The establishment of non-fertilized buffer strips alongside watercourses (i) reduces the transfer of nutrients and pesticides in watercourses and (ii) reduces erosion.

The intended effects are to:

- make the achievement of environmental goals possible,
- combat eutrophication / reduce the transfer of nutrients and reduce the transfer of pesticides in watercourses by a) limitation of runoff, b) non-treating and non-fertilization of the buffer strips, c) keeping the treatments at a certain distance of the watercourse
- protect the banks (including stabilization measures by trees or shrubs)
- limit soil erosion
- good status eco-morphology
- Concerning the rate of implementation of the measure, different approaches exist:

FR: Controls on implementation and on the efficiency are made by the *ASP (Agence de Services et de Paiement* = French agency for payment, under the supervision of the *Ministry of Agriculture*).

LUX: The rate of implementation is monitored by the *ASTA (Administration des Services Techniques de l'Agriculture* = agricultural technical support services).

DE-SL: A systematic monitoring program is going to be implemented.

The reduction of inputs (e. a. nutrients and pesticides) is intended. The link between this measure and the reduction should be observed on the long term.

PL – Sona

The aim of this measure is to eliminate surface flushing of nitrates direct to surface water and limit indirect flow of nitrates by creating buffers which will catch nitrogen from surrounding areas. Effect of measure is decrease of concentration of nitrates in surface and ground water especially around water intakes.

Summary

The measure primarily aims to provide guidance for managing riparian vegetation (IT-Serchio) and to keep fertilization and treatments at a certain distance from watercourses (CIPMS/IKSMS). This has the following environmental effects: creation of ecologic corridors, improvement of soil quality, increase of CO₂ binding in the soil, prevention of erosion, protection of sensitive field boundaries improved biodiversity. The measure contributes to reducing: phosphorous and nitrogen (decrease of their movement and quantity), nutrients or pesticides in surface water and groundwater, eutrophication and spray drift, hydro-geological risk, N₂O emissions. Reduction of phosphorous and nitrogen are estimated as follows: When buffer strips are 5m wide, reduction of P is estimated 15-20% of total runoff and 10% in meadows (NO - Jaeren). The effect of measure in hilly areas is estimated to be: P 42-96%, N 27-81%, particles 55-97%, organic material 83-90% (NO - Morsa). If all buffer strips cover 5% of the Svärtaå catchment area, load to surface water of P would be reduced by 6-12% and N ca. 2% (SE Svärtaå).

Some limitations concerning effectiveness and cost-effectiveness remain: the UK finds that 1m is unlikely to provide filtering for medium / heavy soils, whereas 6m riparian grass buffer removes sand and silt size particles and can reduce pesticide loading. Regarding cost-effectiveness, vegetated buffers would be more cost effective if located in areas of known run-off (UK). SE - Svärtaå finds that the effect of buffer strips on water eutrophication may be overestimated.

Monitoring is taking place regularly in some catchments (NO - Børsesjø-Leirkup, Jaeren; RO – Lechinta; FR and LUX - CIPMS/IKSMS). Evaluation is under course in NO - Leira and Saarland - CIPMS/IKSMS. In DK - Jylland and Fyn implementation will take place 2012-2013.

4. Method of implementation of measure

CAOM

Category: Technical measures. Geographical scale: local. Time until implementation: short. Time until effects: short. Adaptability: high. Certainty level: medium.

IT – Arno

The measure is implemented in accordance with the provisions of the River Basin management plan. The measure is compulsory and it is offered to all farmers. Ministerial Decree n. 27417 of 22 December 2011 lays down the provisions as regards to width, cover and management of buffer strips. The Decree lays down targets as regards to the width (3 to 5m), management and use of fertilizers.

IT – Liri-Garigliano E Volturno

Implementation takes place through the Environmental Protection Plan that addresses the planning of a wide area with clear guidance on the methodology used. In addition, the measure was also an integral part of the planning process of the Water Management Plan of the southern Apennines

(2000/60/EC). The Regions are responsible for implementing and monitoring through the Environmental Protection Agencies

IT – Serchio

Issued through binding instructions. Compulsory. The drafting of the guidelines is planned for 2011.

NO - Børsesjø-Leirkup

Part of a plan for the watercourse Børsesjø – Leirkup. Compulsory.

NO – Jaeren

The measure is issued through the regional environmental program, which entitles to apply for compensation. The measure is voluntary and implementation is continuous. Application once per year – deadline 1st October. Compensated by financial grants per year. The grants are depending on the type of crop and on the width of the buffer strip;

- For areas that are used for grass production, the buffer strip has to have a width of at least 5m. (6.25 NOK/m – 0.79 €/m)

- For areas that are used for grain, potatoes or other vegetables, the buffer strip has to have a width of at least 10 meters. (24 NOK/m; 3.05 €/m)

Other conditions for getting grants;

- The area must be drawn on a map (in the environmental plan for the farm, step 1)

- Management of the buffer strip has to be discussed in the environmental plan for the farm, step 2.

- The buffer strip has to be permanent and be at least 50m of length. The buffer strip cannot be fertilized or worked in any way.

- The buffer strip must be harvested by mowing or grazing

NO – Leira

Agro –environmental payment/support scheme. Mandatory zones not compensated. Voluntary measures are. Both are controlled by the municipalities. Mandatory buffer strips are created/maintained when ploughing in autumn (regional regulations 2010).

- Buffer strips 6m in width: 4 NOK/m (0.5 €/m).

- Buffer strips 12m in width: 8 NOK/m (1 €/m).

Controls are under evaluation; guidelines for better control for the municipalities are being developed.

NO – Morsa

Agricultural environment programme. Compulsory buffer strips for all farmers. Wider ones compulsory for some farmers in Morsa, but voluntary for most of the farmers. Implementation over time first. But then a regulation for all farmers in a region.

Compensation: 0.5 €/m for 6m width and 1 €/m for 12m width in vulnerable areas. Local municipalities control the agro-environmental scheme as sample controls. Minimum 5% of the farms are controlled every year.

DK – Jylland and Fyn

A new specific legal act named “the act of buffer strips” under the responsibility of the Ministry of Food, Agriculture and Fisheries (June 2011). The new regulation is expected to be put in practise in the cultivation season 2012-2013 (01/08-2012 to 31/7-2013). Compulsory and compensated by government through the EU-RDP. Where 2m buffer strips already exist these are not compensated. The same ministry is responsible for the control, which is done in connection with the control of land use support including the single farm payment scheme, control of agri-environment measures financed by RDP and control of cross compliance. The prohibition of fertilizing and use of pesticides is controlled by going through the fertilizer plan, the green account (manure and fertilizer), the spraying journal and by physical visits to the field/buffer strip. Compensation is preliminary set at about 160-280 €/ha/a depending on type of crop grown or type of payment scheme established on the field before converting to buffer strip. Together with the single payment scheme which is about 300 €/ha and can be obtained if the soil is kept in good agricultural and environmental conditions and the farmer

complies with the cross-compliance, the total economic support is about 460-580 €/ha. The application for compensation for the buffer strips goes together with the application for single payment and will form the basis information for control (desk control and physical control). Desk control is taking place every year for all farmers and physical controls by random checks on farms.

RO - Lechinta

The Nitrates Directive, Romanian legislation and Action Programs and a Good Agricultural Practices Code, which specifies the establishment of buffer strips, were elaborated. In addition, a national project is on-going ("Integrated Nutrient Pollution Control", 5 year, 60 M€, World Bank, Government, etc.). Vegetative barriers in NVZ are one of the priorities, which are compulsory through the ND and GAEC. GAEC is applicable for all territory. The Action Programme for Craiesti (a village): along the river Lechința the buffer strips will have 5m width and 11.5 km length. In addition for the land that have 5-8% slope, the buffer strips will be created at the base of the slope and for the land that have 8-12% slope, the buffer strips will also be created at the base of the slope and they will have at least 5m width. Forestation is recommended for the strong eroded arable soils (approx. 48 ha). The measure will be implemented during 4 years in the NVZ areas, starting from the approval of the Action Programmes (the Action Programmes were approved in 2010). Compensation from the Rural Development funds according to the National Plan for Rural Development. In addition, the national project already mentioned, covers a part of the Lechința River Basin, and some of the measures will be subsidized by the project funds.

UK – England and Wales

- The 1m no-cultivation zone is a cross compliance condition. An advisory network exists for all compliance advice
- The 6m buffer strip is part of Environmental stewardship. Advice is given through delivery agencies and targeted by catchment officers in priority catchments
- Voluntary buffer advice is given through a network of environmental organisations, the fertiliser industry and trade organisations (e.g. National Farmers Union, Voluntary Initiative)
- Unfertilised headland is delivered through Entry level scheme of environmental stewardship. There are about 400 agreements covering 1 000 ha

UK – Scotland

- 2m no-cultivation zone is compulsory and implemented through awareness raising and advice.
- the water margin is funded by rural development with a range of requirements relating to width and management. Uptake is voluntary so raising awareness is again important. Additional points are given in priority areas.

FI – Southwest Finland

The wider buffer zone is issued through RDP and WFD/POMs. The measure is voluntary but strongly recommended by authorities in certain areas. When applying, a specific plan of the buffer zone must be presented. 5 or 10 years commitment is required and extending the commitment is almost always accepted. Maximum payment is 450 €/ha and support from the common agricultural policy (CAP) and less favoured area (LFA) are available. The buffer zones remain agricultural land and thus CAP eligible. Random controlling by regional agriculture authorities, if implemented and managed according to accepted plan.

SE – Svärtaå

The use of buffer zones is voluntary. Normally they are established with a 5-year commitment in the RDP and compensated with 3 000 SEK/ha (320 €/ha). However, since 2012 the RDP is closed for new enrolments, awaiting the next program period. For certified organic farming 3m buffer zones are required. In the Svärtaå river basin c. 10% of the arable land is receiving compensation from the RDP for organic farming.

CIPMS/IKSMS - Moselle-Sarre (DE (SL + RLP), FR, LUX)

LUX: All 3 measures (landscape conservation bonus, headlands, green corridor) are agri-environmental measures.

FR and DE-SL: Legal act or program

DE-RLP: The establishment of buffer strips is supported through the Rhineland-Palatinate Program *AKTION BLAU* (<http://www.luwg.DE-RLP.de/Projekte/Aktion-Blau/>). This is done in close cooperation with local authorities for land consolidation.

- Voluntary or compulsory

LUX, DE-RLP, DE-SL: Voluntary

FR: Compulsory or voluntary. The establishment of buffer strips is mandatory in the field of GAEC (Good Agricultural and Environmental Conditions) of aid conditionality of the CAP and therefore does not bring financial compensation.

- Implementation time scale (at one time / over a period)

FR: At one time or over a period of 5 years (following mandatory or voluntary implementation)

LUX: Over a period of 5 years

DE-SL: A permanent obligation

DE-RLP: Over a period (according to the WFD deadlines no later than 2027)

- Compensated (How? How much) or not

FR: If mandatory, then no compensation. If voluntary, then the compensation differs depending on the crop, e. a. 158 €/ha for cereals, 450 €/ha for wine grapes or fruit trees.

LUX: Compensated: (i) Buffer strips in the landscape conservation bonus are one of several rules to be followed. (ii) Buffer strips in the headland program: 450 €/ha. (iii) Buffer strips in the green corridor program: 750 €/ha on cutting grassland and arable land ; 1250 €/ha on weeds

DE-RLP: Compensated: Funding up to 90% by the state (Rhineland-Palatinate)

DE-SL: No compensation because it is a mandatory measure in any cases

- Implementation of control requirements

FR: Spot control and survey by water police agents; annual assessment and adjustment of the strategy on-going

LUX: Paper controls and on the spot controls

DE-RLP: No official control. The control respective the reporting of violations is carried out sporadically (not everywhere) by so-called "habitat supervisors" or "river guardians" who are, among other things, entrusted with the monitoring and maintenance of ecologically valuable areas/habitats or watercourses or the advice of farmers for example.

DE-SL: No targeted control.

PL – Sona

For NVZ there are local legal acts within the Program of Measures. The PoM is obligatory for all farmers on NVZ to establish permanent buffer zones. Farmers don't get any compensation.

For other farmers buffer strips are voluntary. They can create buffer strips by taking part in CAP for several years. For each buffer strips farmers get money. Amount is depended on quality of soil – best soils 1580 PLN/ha/a, the worst 1070 PLN/ha/a.

Summary

Measures are voluntary in the following catchments: NO – Jaeren; FI - Southwest Finland; SE – Svärtaå; CIPMS/IKSMS - LUX, DE-RLP. Measures in the following catchments are compulsory: IT – Liri-Garigliano e Volturmo, Serchio; NO - Børsesjø-Leirkup; CIPMS/IKSMS - DE-SL. Some catchments have both, compulsory and voluntary implementation of measures: NO – Leira, Morsa; UK - various catchments and Scotland. Generally, no compensation is given to measures which are mandatory (except for DK - Jylland and Fyn, where measures are compulsory but compensated by 160-280 €/ha/a), whereas voluntary measures are compensated to different extents: compensation ranges from 0.5 €/m to 12.50 €/m, depending on the width of the buffer, vegetation cover, time of commitment (from yearly up to 10 years). Funding often comes from the RDP, the regional or national administration. Implementation is the responsibility of environmental and water plans and their respective authorities at national (DK –

Jylland and Fyn, RO – Lechinta) and regional level (IT – Liri-Garigliano, NO – Jaeren and Leira, FI - Southwest Finland). Management plans at catchment level (NO - Børsesjø-Leirkup), Advisory Groups, voluntary advice and awareness rising is practices in other catchments (UK – England and Wales, Scotland). In some catchments, spot or paper controls are conducted by policy agents or habitat supervisors (CIPMS/IKSMS - LUX, FR) and in some there is no targeted control (CIPMS/IKSMS - DE-SL).

5. Organisation of implementation

IT – Arno

Other Public Administrations than River Basin Authority are responsible for activities both at a technical and financial level, but in cooperation with RB Authority. Regions and local authorities are in charge of other controls (GAEC)

IT – Liri-Garigliano E Volturno

Planning and co-operative approaches are taken among the parties involved (ministries, river basin, River Basin Authorities, regions, provinces, associations), accordingly to the law and regulation. The logic was always to negotiate in the planning phase. According to the law, regulation should be planned at all levels (ministries, river basin, River Basin Authorities, regions, provinces) through participation with representatives of associations and consortiums.

IT – Serchio

Serchio River Pilot Basin Authority

NO - Børsesjø-Leirkup

Administrating the implementation: farmers

Authority for controls: Skien municipality

NO – Jaeren, Leira

The County Governor's Office, Agriculture department and municipality. Controls are carried out by the municipality office of agriculture.

NO – Morsa

Local municipalities

DK – Jylland and Fyn

Ministry of Food, Agriculture and Fisheries is responsible for administrating the implementation. The desk control will be based on information in application form for the single payment scheme. The control is then done by The Danish AgriFish Agency. The physical control will be done in connection to random checks for cross compliance and is handled by the Danish AgriFish Agency. Both agencies are part of the ministry.

RO - Lechinta

Local authorities and farmers, advised by County Offices for Soil Science and Agrochemistry (OSPA) and Authority For Agriculture And Rural Development at county level. There are two competent authorities for control: the Environmental National Guard - NEG and the Authority For Agriculture And Rural Development - DARD at county level. The authorities have duties and responsibilities performed both together and independent based on a control plan.

UK – England and Wales

- For compulsory / paid buffer strips: The Rural Payments agency audit compliance

- Natural England administers environmental stewardship and delivers advice through own staff and through advice contracts

UK – Scotland

- the requirement for the buffer came from Scottish legislation (government) and the implementation and responsible authority is SEPA
 - SEPA is responsible for controls
- For the funded buffer strip Scottish Government fund and control the measure.

FI – Southwest Finland

Responsible authority for administrating is regional environmental and agriculture authorities. Environmental authorities recommend and agriculture authorities accept the application. Responsible authority for controlling is regional agriculture authorities (environmental authorities can help).

SE – Svärtaå

Swedish Board of Agriculture is the responsible authority on a national level, County Board Administrations on a local level and the control is issued by the County Board Administrations.

CIPMS/IKSMS - Moselle-Sarre (DE (SL + RLP), FR, LUX)

FR: The Ministry in charge of Agriculture is responsible for the implementation of cross compliance.

LUX: The responsible authorities are: (i) Administration des Services Techniques de l'Agriculture (ASTA), and (ii) Service d'Économie Rurale (SER = rural economy services),

DE-RLP: The responsible authorities are the "*Flurbereinigungsbehörde*" (land consolidation authority) in cooperation with the "*Obere Wasserbehörde*" (upper water authority)

DE-SL: Ministry in charge of economy and sciences, and regional office for agricultural economy and land management.

- Responsible authority for controls

FR: Agence de Services et de Paiement (see also § 3)

LUX: ASTA/Unité de contrôle (control unit)

DE-RLP: No official control

DE-SL: Environment and working regional departments

PL - Sona

Authority responsible for implementation of actions in NVZ is the Regional Water Management Authorities. Controls according to action plans are carried out by Voivodeship Inspectorates of Environment Protection. Buffer strips are also controlled in cross-compliance by Agency for Restructuring and Modernization of Agriculture. Supporting institutions for all farmers are available especially concerning the training offered by agricultural advisory Centres.

Summary

Several countries implement the measure at national/ministry level (DK - Jylland and Fyn; UK – Scotland; SE-Svärtaå for implementation; CIPMS/IKSMS - FR, LUX). In other catchments implementation and control takes place at regional and local (county and municipality) level (NO - Børresjø-Leirkup, Jaeren, Leira, Morsa; RO – Lechinta; FI - Southwest Finland; SE-Svärtaå for control, CIPMS/IKSMS - DE-RLP, DE-SL). 3 catchments reported to cooperate with the River Basin Authority (IT - Arno, Liri-Garigliano e Volturno, Serchio). In NO - Børresjø-Leirkup the implementation takes place through farmers. In RO - Lechinta, control takes place through the Environmental National Guards. In the UK the Rural Payments agency audit are responsible for compliance and Natural England administers the environmental stewardship.

6. Acceptance of farmers and involvement of stakeholders, social aspects

IT – Arno

Buffer strips measures were adopted after long observation and consultation activities. In particular, agricultural associations (regional and local authorities) produced general observations on the plan,

partly regarding buffer strips that were accepted in accordance with law provisions.

IT – Liri-Garigliano E Volturno

Since stakeholder involvement rules have been incorporated within the Water Management Plan, the process of participation increased through forums, meetings, website sharing etc. To date, the plan is updated and agreements are prepared between the authorities and consortia groups on how to proceed and verify the water quality.

IT – Serchio

Public meetings at local level

NO - Børsesjø-Leirkup

Accepted by farmers, but not very well known yet. The focus is on farmers growing next to the watercourse Børsesjø and Leirkup.

NO – Jaeren

Voluntary measure: fairly well accepted among many farmers, but not all. Many farmers don't like to see that so much area are taken out of production, and don't apply. Information is provided by letters, brochures, arranged meetings and online (County Governors Office, Agriculture dept.). Selection of farms was made by the County Governors Office in cooperation with the County Council, the Rogaland Farmers' Union, the Rogaland Smallholders' Union, the agricultural advisory services, the municipalities. Well accepted by local people.

NO – Leira

Still some farmers are not aware of the new regulations in 2010. Voluntary measures are accepted fairly well, but not by all farmers. Informational and decision support tools used to provide clear information for farmers. Farmers and municipalities have been involved in the process of selecting and implementing measures in the agro- environmental support scheme. Varies from area to area.

NO – Morsa

The measure is well accepted in some areas. In other areas farmers are more sceptical.

A booklet is distributed every year together with the application form; also tools are on the web to help farmers to choose the right measure on their farm, although these tools are probably mostly used by advisers. The farmers are involved and a close dialogue, which becomes active every time there is a change. The involvement is mainly through the farmers' organisation, but there was also an open process where every farmer could contribute.

DK – Jylland and Fyn

The legal act of "Buffer strips" has been in public hearing as a specific law and indirectly as part of RBMPs and POMs. The 10m wide buffer strips implemented as a compulsory measure are not welcome very well by farmers and farmer organisations. On the other hand most green organisation and municipalities welcome the measure.

The main concern of farmers and farmers organizations are:

- " Buffer strips should be placed in a more differentiated way where consideration to the inclination of the fields towards the waterline and to the natural form of the field (to avoid crooked corners) which include the possibility to place buffer strips with different width in order to be more effective and avoid some of the drawbacks
- " The estimated effect of reduction of phosphorus loss is considered not correct estimated but lower, meaning that the buffer strips is not as cost efficient as expected and therefore should not be used so extensively
- " The "new nature" developing will after some years naturally be include in the nature protection act regulating and preventing future possibilities to farm the land
- " When use of fertilizer and manure is not allowed in buffer zones all farmers with animals will lose land for spreading animal manure, which again means that they will lose the right to keep

1,4 AU (pigs) or 1,7 AU (cattle) for each hectare of land converted to buffer strip. This is rather costly for the farmer if no replacement soil can be found.

- “ Many farmers worry about if buffer strips will be open to public access according to regulation by the nature protection act
- “ Many farmers and farmers organization are not comfortable with the compensation promised

RO - Lechinta

The measure is in general well accepted by the farmers and by the local population, especially in the project area. Information, training and assistance to farmers are provided by authorities and institutes. In the NVZ area of the Lechința river basin, the entire Action Programme, including the buffer strips, is dimensioned according to the Action Plan elaborated by farmers and the Village Mayor with the help of the specialists

UK – England and Wales

- The 1m buffer zone is widely adopted by farmers and understanding of the benefits is good.
- Buffer strips in environmental stewardship schemes is also good and is one of the top 20 measures taken up (3rd after Farm environmental record and hedgerow options at 20,500 agreements)

UK – Scotland

- Acceptance of the 2m no-cultivation zone varies enormously. Pictorial evidence base has helped acceptance but there are concerns. Awareness raising activities (leaflets, farmer events) promote the requirement.
- The funded water margin has quite a good uptake but it is patchy and not necessarily targeted sufficiently to where it is required. Because it is funded there is greater acceptance. Guidance is on the rural development www. There is a need for guidance on width according to risk and management for multiple benefits.
- No info on local population, but surveys suggest that people prefer to see a mixed landscape – buffers are part of that.

FI – Southwest Finland

- One of the most accepted measure. Could be more popular, but it is not suitable everywhere and needs some work.
 - General planning report, guidance material, GIS-tool for farmers and advising.
- Farmers can work in cooperation with environmental authorities in general planning process. Farmers are responsible participants in selecting, applying and implementing
- Very much accepted and recommended by local population and the public.

SE – Svärtaå

- Well accepted by those who have established buffer zones, but many farmers don't like to see that so much area are taken out of production, and don't apply.
- Information through diverse channels, e.g. the environmental extension service program “Focus on Nutrients”, information from the County Board Administrations and the Swedish Board of Agriculture.
- The initiative to establish buffer zones and the location is a decision by the farmer.
- Full acceptance by local population.

CIPMS/IKSMS - Moselle-Sarre (DE (SL + RLP), FR, LUX)

- Farmers' opinion on the measures (well accepted or not)

Acceptance varying

FR: Farmers have mostly well accepted the mandatory measure.

LUX: For the landscape conservation bonus, the measure is highly accepted by farmers. For the headland programme and the green corridor programme, there is no rush.

DE-RLP: High acceptance

DE-SL: Weak acceptance

- Informational and decision support tools used to provide clear information for farmers

ALL: Public events, publication, awareness rising by internet and meetings.

- Farmers involvement in the process of selecting and implementing

LS, DE-RLP, FR: Yes. Exchanges between the authorities and professional organisations.

LUX: For the landscape conservation bonus, even if voluntary, the farmer has no real choice. He has to implement the buffer strip. For the other two measures, (headland program and green corridor), it is up to the farmer to decide where to implement a buffer strip.

- Level of acceptance by local population

FR, LUX: No information available

DE-RLP, LS: High acceptance

PL - Sona

Buffer strips are not well accepted by farmers on NVZ. They are arguing against 20m zones width. In their opinion 20m is too much and they lost too many profits. Farmers outside the NVZ are not very interested in buffer strips measure, because of relatively low financing from CAP.

Summary

Generally, the measure seems to be among the more/most accepted measures. Several catchments involve farmers through consultation and dialogue (IT – Arno, Liri-Garigliano; NO – Morsa; RO – Lechinta; FI - Southwest Finland). Informational and decision support tools include forums, meetings, website, letters, brochures, booklet are provided to some extent by most catchments (IT – Liri-Garigliano, Serchio; NO - Jaeren, Leira, Morsa; RO – Lechinta; UK – Scotland; FI; SE – Svääartaå; CIPMS/IKSMS). Some catchments select farms and regions for the implementation (NO - Børsesjø-Leirkup, Leiren). One catchment stated that farmers are not all aware of new regulations (NO - Leira). In DK - Jylland and Fyn, farmers do not accept the measure well, which may be due to the fact that it is mandatory and has high requirements, which impact agricultural production. Also, lack of flexibility is criticised.

7. Financial aspects of the measure

IT – Arno

Measures are partly compensated through European Funds.

IT – Liri-Garigliano E Volturno

Precise data are not yet available. However, programs will potentially be used.

IT – Serchio

Currently unfunded. The costs for the drafting of guidelines includes: costs concerned with the activities of the River Basin Authority and costs due to the production of specific studies, which together amount to approx. 24,000 €.

Yes the economic analysis has been developed in the RB management plan.
http://www.autorita.bacinoserchio.it/files/pianodigestione/formazione/adottato/documenti/8_analisi_economica.pdf.

NO - Børsesjø-Leirkup

2009 was the first year when the farmers could get economical support for this measure 15 NOK/m). In 2010 this was increased to 30 NOK/m (3.9 €).

NO – Jaeren

State funding through the Regional Environmental Program (€ 143 000,-, 2009). The Budget (2009 –

2012) for all types of measures that decreases the movement of nutrients, and pesticides into watercourses 325 000 €/a. The cost-efficiency of buffer-strips for grassland and grazing areas are calculated to:

- between 90 and 130 NOK/kg P (respectively 11.7 and 16.9 €/kg P)
- however, a high variation in the cost-efficiency exists, depending on the type of crops and location.

Implementation based on cost-efficiency evaluation, except for vegetables (carrot, cabbage, etc.). The cost is too high for the farmer to accept agricultural areas set aside for buffer strips.

NO – Leira

State funding

NO – Morsa

State aid funding. Income lost calculated. Very difficult to calculate cost efficiency, but considered in the plans. Synergies in/with biodiversity, access for people for recreational purposes and more stable soil when creeks are flooding.

DK – Jylland and Fyn

Farm level

Compensation is preliminary set at about 160-280€/ha for all types of soils. The compensation level is preliminary as the implementation has not yet taken place and therefore not been recovered by the EU RDP. Also the farmer can receive the single payment scheme which is about 300€/ha if the soil is kept in good agricultural and environmental conditions and the farmer comply with the cross-compliance. Thus the total economic support is about 460-580€/ha of buffer strips. The net income loss from the land taken out of production for buffer strips is calculated to between 0-300€/ha of buffer strip.

In 2009 the average price for lease new farmland was about 525 €/ha, however with many variations according to soil quality. The compensation for the buffer strip therefore equal the net income loss (with marginal consideration however, that there will be no change in costs for machinery- and working capacity) and the total economic support of 460-580€ can enable the farmer to rent new farmland as compensation for the arable land tied to the buffer strips. However for some farmers in areas with high animal density the cost can be much higher if no other land for lease is available and the production of fodder and spreading of manure cannot be moved to new farmland. Special crop production is expected to be able to move within the existing arable land of the individual farm.

Society level

As the main aim of the measure is not only to reduce the nutrient loss from agriculture according to requirement of the RBMP to meet good ecological status, but also to reduce pesticide losses and create “new nature” for the benefit of flora and fauna, thus increasing and improving the living conditions different species, the measure is considered very cost-efficient. However the final cost-efficiency can be weakened if the expected high retention level of phosphorus (3.1kg/ha P buffer strip per year) is not met. The monitoring programme of the coming years will help giving a clearer picture of the effects and cost-efficiency of the measure.

RO - Lechinta

- State aid, municipalities and farmers own contribution?
- In the project area the costs are covered by the project.
- The budget of the Village Hall
- The funds from the Rural Development Fund according to the National Programme of Rural Development of Romania, if the farmers applied for financing.
- No cost-efficiency assessment for this measure, because for the NVZ in the Lechința river basin, this measure is a compulsory measure.

Farmers can obtain payments at around 145 €/ha/a (mean value in Romania for 2008-2009. Exact value for Lechinta not yet available), for maintaining the buffer strips located near surface water, with restrictions on the use of fertilizers (no fertilizers). The farmers must apply to APIA (Agricultural Payment and Intervention Agency) in order to obtain the funding. The contract covers a period of 5

years. The farmers get a yearly rate from APIA if they agree the 5 years contract. According the Mures River Basin Management Plan, the total estimated cost/locality is 1 M€, in the NVZ areas (investment and operation). The estimated cost of the Action Plan for NVZ is 148 M€ for the entire river basin. We do not have the exact cost only for the buffer zones.

In Craiesti, the budget for the implementation of all measures in NVZ is provided only by the project. For the NVZ not included in the project the budget will be provided in general by the farmer or by the Village Hall. For non NVZ areas the buffer strip measure is not compulsory. It became compulsory if the farmer applies for GAEC founding by APIA. In Romania there is a National Action Program for NVZ and Local Action Program for each locality. In the Local Action Programs there are concrete demands for Village halls and/or farmers. At this moment we do not have the information contained in local plans. The funding can come from all mentioned contributors.

UK – England and Wales

- Costs of 1 m no cultivation zone is borne by farmer. An impact assessment was carried out. IA says that farmers were concerned over measurements and cross compliance penalties, and will install wider strips. Farmers didn't see the value of them.
- Payment in the rural development programme based on income foregone and costs incurred. It needs to reflect eco services. Payment is about £30/ha

UK – Scotland

- Costs of 2m no-cultivation zone are borne by farmer. An impact assessment was carried out.
- Payment in the rural development programme based on income foregone and costs incurred. It needs to reflect eco services. It is a 5-year commitment with a payment rate of 286.63 £/ha of land managed per year. Additional payments are available for capital items such as fencing and water troughs.

FI – Southwest Finland

Funding comes from the RD programme. The preparation of the establishment and management plan of the riparian zone, the establishment and management costs and the costs of advisory services have been taken into account as costs incurred by the measure. The establishment costs of the riparian zone consist of the tilling, sowing and seed costs. When calculating the establishment costs of the riparian zone, the 0.6m headland included in cross-compliance and the headland and filter strip included in the basic measure for agri-environment payments have been taken into account as a cost reducing factor. The riparian zone is managed usually by mowing, but grazing is also possible if it is not causing harm for water quality. The benefits of vegetation and the costs of removing the plant mass are equal. The riparian zone will incur losses of income for farmers, because they cannot cultivate crops on riparian zones. Transaction costs are incurred for farmers by the collection of information on riparian zones and contacts with agricultural advisers. It is evaluated that it is cost effective if counted by decreased nutrients but not necessary if counted by area. This is only the case, if they are situated in right areas. There are also synergy effects of the measure if managed together with high biodiversity and nature value areas. The average management cost is about 200-280 €/ha/y and investment cost 100-150/ha (not including fencing and loss of income).

SE – Svärtaå

Buffer zones are currently financed through the RDP. On a Swedish national scale, the proposal for funding of buffer zones for the next RDP period 2014-2020 is close to the requirements indicated by the River Basin Management Plans.

- The cost has been calculated to 310 €/ha and year. The dominating part of this cost is income foregone (297€), and the rest is establishment (sowing) of the buffer zone. The alternative land use cost is variable and the figure 297 €/ha and year have therefore a significant uncertainty.
- Cost-efficiency is calculated between 450 and 1100 € per kg reduced P.
- Synergies with N reduction and biodiversity.

CIPMS/IKSMS - Moselle-Sarre (DE (RLP), FR, LUX)**- Funding sources**

FR: The agri-environmental measures are financially supported by the “*Agence de l’Eau Rhin-Meuse*” (Rhine-Meuse Water Agency) through the use of the European Agricultural Fund for Rural Development (EAGFD).

LUX: The agri-environmental measures are financially supported by the Ministry of Agriculture through the use of the European Agricultural Fund for Rural Development (EAGFD).

DE-RLP: State funds (up to 90% funding rate)

DE-SL: A relevant compensation is currently considered in the context of the agri-environmental measures.

- What costs have been calculated (and how)?

FR, LUX: As agri-environmental measure, the compensation has been calculated on the basis of the loss of income foregone.

DE-RLP: (See grants for water management measures (funding of the Water Management Agency - FÖRiWWV, 2.2.4 and 7.1)) - costs for Planning (i) Land acquisition and compensation, (ii) maintenance of water ways.

- Implementation based on Cost-efficiency evaluation?

No.

- Synergy effects of the measure observed that improve cost efficiency?

No.

PL - Sona

On NVZ there is no special financing buffer strips. For other farmers who are interested there is funding from CAP. The costs are based on area of strips and quality of soil.

Summary

Only one catchment stated, that the measure is currently unfunded (IT – Serchio). In most catchments, the measure is funded through state funding (NO – Jaeren, Leira, Morsa; RO – Lechinta; SE – Svärtaå; CIPMS/IKSMS – DE-RLP). Measures are also supported or paid for by EU funds, especially the European Agricultural Fund for Rural Development (UK – various catchments, RO – Lechinta, FI – Southwest Finland, SE – Svärtaå, CIPMS /IKSMS – FR, LUX). Compensation and payments are mostly based on income lost calculations (DK – Jylland and Fyn, NO – Morsa, UK – several catchments, - CIPMS/IKSMS – FR, LUX). Some catchments also take into account cost efficiency evaluation, but most state that these estimations are difficult to make (NO – Jaeren, DK – Jylland and Fyn, FI – Southwest Finland).

8. Legal aspects**IT – Arno**

There are no relevant legal aspects to be highlighted.

Measures are part of a planning, programming and implementation process that foresees the activity of other local and regional authorities.

IT – Liri-Garigliano E Volturno

None

IT – Serchio

The measure is currently unfunded.

NO - Børsesjø-Leirkup N/A**NO – Jaeren**

It is a voluntary activity, so no legal difficulties.

NO – Leira**NO – Morsa**

We cannot force the farmers to implement buffer strips. Theoretically there is a possibility to buy the land from the farmers, but in practise this is not an issue. What we have chosen is to partly implement it as cross compliance with the general subsidies (remember Norway does not have the CAP, but our system is quite similar), and pay farmers for the voluntary implementation of the broader buffer strips.

RO - Lechinta

No

UK – England and Wales

None

UK – Scotland

Not so far

DK – Jylland and Fyn

As the buffer strips are implemented by a legal act adopted by the Danish Parliament as such no legal obstacles are expected in approaching implementation in 2012-2013

FI – Southwest Finland

No

SE – Svärtaå

No

CIPMS/IKSMS - Moselle-Sarre (DE (SL + RLP), FR, LUX)

LUX: Conflict with single payment scheme for example by fencing alongside watercourses

FR: If mandatory, it has to be done.

DE-SL, DE-RLP: None observed

PL - Sona

The biggest problem is lack of supporting farmers on NVZ from CAP. They can't apply for this money.

Summary

Most catchments have not reported any legal problems with the measure and its implementation. In some catchments, where the measure is voluntary, it is partly implemented as cross compliance to compensate farmers and thus give incentives (NO – Morsa). In Luxembourg, there is a conflict with the single payment scheme for fencing alongside watercourses.

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<http://www.catchmentchange.net/wp-content/uploads/2011/11/The-Demonstration-Test-Catchments-ProjectFinal.pdf>

UK – Scotland

<http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options/WaterMarginsandBufferArea>
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FR:

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DE:

<http://www.luwg.DE-RLP.de/Projekte/Aktion-Blau/Förderrichtlinien> der Wasserwirtschaftsverwaltung - FöRiWWV
www.saarland.de

2. Establishment and preservation of wetlands

Contributing River Basins: Ebro (ES); Serchio, Liri-Garigliano e Volturno (IT); Southwest Finland (FI); Svärtaå (SE); Jylland and Fyn (DK); Moselle and Sarre (LU/FR/DE/BE - FR only provided the information); stormwater or artificial wetlands and vegetated ditches studied in the LIFE project ArtWET (specifically for this LIFE project FR-DE -IT involved, led by FR); various catchments in Scotland, and various catchments (Wensum, Hampshire Avon, Eden, Kent *Rother*, *Yealm*, *Yorkshire Ouse*, *Lugg*, *Till (Tweed)*, *Cleddau*, *Teif.i*) in England and Wales (UK).

1. Definition of measure

Establishment of wetlands

Constructed or established wetlands can help to capture nutrients and pesticides from agricultural run-off or subsurface drainage before entering water bodies. Wetlands can be natural, artificial, permanent or temporary.

Preservation of wetlands

Where natural wetlands are trampled by cattle, their water quality value, e.g. through denitrification, can become very much diminished. Therefore, existing wetlands should be considered in the implementation of the Directive either as integral water body components (e.g. river or lake marginal wetlands), as systems in direct contact with groundwater resources (i.e. groundwater fed wetlands) or as functionally linked entities influencing water body status (e.g. slope buffer zones).

ES – Ebro

Measures: Establishment of wetlands and modernisation of irrigation systems. These wetlands can capture nutrients from the agriculture run-off and be reused in dry years pumping the water for irrigation. The water will be of lower quality with higher conductivity, so it will require mixing those waters with higher quality ones to use them in irrigation. Natural wetlands in all these areas were temporary wetlands that used to dry up completely in summer. Nevertheless, environmental requirements for water use are supposed to be established in the construction project and by the regional environmental authorities (authorisation needed).

IT – Serchio

Divided into three sub-measures: preservation of wetlands, restoration of degraded wetlands and establishment of wetlands. The measure is intended to help the selection of areas adjacent to surface water bodies that should be focused on to promote redevelopment and re-naturalization of the river environments. This should be done through appropriate management and should be consistent with the predictions of the Hydrogeological Plan to regulate the types of intervention and the methodology for their execution. The measure involves both public and private areas. Information about the measure has been published under:

http://www.autorita.bacinoserchio.it/files/pianodigestione/formazione/adottato/allegati/allegato_9C.pdf.

IT - Liri-Garigliano e Volturno

Establishment and conservation of wetlands.

The term "wetlands" includes and summarizes a series of special habitats (morasses, swamps, ponds, alluvial plains and grazing land in the rainy season, estuaries, etc.). They represent an important ecological and economic value, linked with cultural values, scientific and recreational activities; they are also regulators of water resources and habitat for flora and fauna. In some project wetlands have already shown a close connection to the herbal purification for the sewage disposal from small villages. In this case, we speak of 'natural' cleaning technologies (wetlands and lagoons) as defined by Legislative Decree 152 of May 1999 - abrogated and replaced by Legislative Decree 152/06. The rural development

plans (PSR) are the means to get funding for the wetlands implementation and realization; for example a specific measure for the creation of high nature value areas - called "conservation of ecosystems and natural value"- has allowed to obtain the creation of a buffer zone along rivers and the restoration of idle wetlands, for the creation or the recycling of small tanks and fountains.

FI – Southwest Finland

Establishment of multifunctional wetlands

The measures are designed to promote water conservation in watercourses and coastal areas with a heavy environmental load from agriculture, to improve the living conditions for birds, to reclaim habitats that were lost when arable areas were drained, and to improve the conditions of brooks that organisms use as passages. The measures will also promote game husbandry, the fishing and crayfish industries and rural landscape management. Multifunctional wetlands are areas that are permanently or from time to time covered by water and retain solid matter and nutrients, provide a nesting and feeding environment for birds, for instance, and diversify the agricultural landscape. Flooded areas and extensive wetland areas alleviate harmful flooding downstream and increase low flows. Multifunctional wetlands can be used as storage for irrigation water, as places where fish and crayfish are grown on the basis of natural feed, and for recreation. Channels that wind naturally slow down water flows and increase the biodiversity and landscape diversity of the arable environment. The measure may have a significant local impact, as it will reduce the environmental load from agriculture and enhance biodiversity.

Management (preservation) of wetlands

Sedimentation ponds, wetlands and water meadows must be managed in accordance with a specific plan. Annual management measures include the removal of slurry, dam management and the mowing and removal of plants in the wetland and its edges.

SE –Svärtaå

In the RDP, four different wetland measures are defined:

1. Establishment and restoration of wetlands. A wetland is an area covered with vegetation where the water surface is close to or above the soil surface under most part of the year, and where the water level is allowed to vary according to natural seasonal variations. To get agro-environmental support for wetlands with the aim of N and P retention, it must be established on or in connection to agricultural land. A wetland financed by the RDP must be preserved at least for 20 years.
2. Rinsing of an existing wetland that has been constructed or restored according to point 1 to prolong the life-span.
3. Management of wetlands. Banks, drains and other equipment need to be maintained, and undesirable vegetation must be mowed. It is not allowed to apply fertilizer, lime or plant protection products. Commonly there are also restrictions for keeping fish, crayfish and to feed fish, crayfish, ducks or other animals in the wetland.
4. Establishment of small constructed wetlands with the aim of phosphorus trapping. This type of wetland should collect water from a small agricultural dominated catchment area (c. 20-100 ha), and have a size of c. 0.1 to 0.5% of the catchment but with a minimum size of 0.1ha (Jordbruksverket, 2010). A small constructed wetland financed by the RDP must be preserved for at least 10 years and managed on order to preserve the function.

DK - Jylland and Fyn

The measure: wetlands for N or P removal.

One of the measures specified in the Danish river basin management plans is the establishment of wetlands. Two types are involved:

- Nitrogen wetlands aimed primarily at reducing nitrogen loading of the aquatic environment through enhanced denitrification of nitrogen in the water
- Phosphorus wetlands aimed primarily at reducing phosphorus loading of the aquatic environment through enhanced deposition of particle-bound phosphorus on periodically

flooded riparian areas.

With both types of measure, implementation is based on the withdrawal of farmland from crop rotation. When the water level is raised, the land will become wetter and will flood more frequently.

LU/FR/DE/BE – Moselle and Sarre (FR only provided the information)

At the beginning of the process, "establishment wetlands" (i. e. artificial wetlands.) and "preservation wetlands" (i.e. natural wetlands.) were 2 separate topics, and the ICPMS had opted for "natural wetlands". Later, these 2 topics were merged. That led to confusion, and partners were reluctant to complete the factsheet mixing 2 very different concepts.

DE-SL highlighted the ambiguity of the question and briefly stated: "the wetlands policy concerns nature conservation policy and is not part of the agricultural practices."

FR alone provided input, namely: the measure - Establishment and preservation of wetlands (M2). (ii) Preservation and proper management of wetlands; (ii) establishment of wetlands at the lowest point of the watershed (runoff) and at the outlet of the soil draining network.

FR – Stormwater or Artificial Wetland and vegetated ditches (specifically for this LIFE project FR-DE -IT involved, led by FR)

The measure: demonstrate and improve the potentialities of vegetated prototype treatment systems, such as vegetated ditches, detention ponds, artificial wetlands or forested wetlands, in order to mitigate the pesticides load at the outlet of agro-systems (by run-off or agricultural drainage).

Demonstration sites (Full scale)

- Detention pond - Eichstetten, Germany
- Storm basin - Rouffach, France
- Artificial wetland – Loches and Rampillon, France
- Detention pond - Landau, Germany
- Vegetated ditch - Landau, Germany
- Forest plot - Loches, France

In addition to the studies on the demonstration sites, experiments under controlled conditions are carried out, making it possible to test the various methods to be adopted more quickly and easily in field. For more details, see:

- http://coursenligne.u-strasbg.fr/depotcel/DepotCel/592/documents%20a%20telecharger/Artwet_technical_guide.pdf
- http://coursenligne.u-strasbg.fr/depotcel/DepotCel/592/documents%20a%20telecharger/Artwet_non_technical_guide.pdf

UK – various catchments in Scotland

The measure: Establishment and preservation of wetlands.

CAOM definition:

In Scotland there are two main wetland types distinguished:

1. Constructed Farm Wetlands (CFWs) – to help reduce the risk of pollution from farm yards. It is defined as: "CFWs can collect, store and treat lightly contaminated run-off from roofs, roads and yards and so reduce inputs of diffuse pollutants to the water environment. CFWs may also intercept emergency leaks or spillages, control storm water run-off, and provide habitat and biodiversity benefits. Constructed wetlands can trap sediment and, through the retention of run-off and biological action, reduce Nitrogen, Phosphorus (soluble and particulate) and faecal indicator organism (FIO) loads to watercourses. A CFW may be an effective option on farms to deal with lightly contaminated surface water run-off (there is a definition in the regulations controlling slurry as to what areas of a farmyard can drain to wetlands and what areas must go to a slurry store). CFWs

should be designed in accordance with the SEPA CFWs Design Manual. It should be noted that natural wetlands should not be used for this purpose.” For more details, see: <http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options/ConstructionofWetlands>

2. Wetlands for biodiversity. “The aim of the option “Management of Wetlands” is to support the management of in-bye wetland areas for the benefit of plants, birds and invertebrates. These areas provide a food source for livestock (grazing) and benefit associated insects, mammals and birds. They can also act as flood storage zones and help to reduce the impacts of flooding downstream.” For the management of these areas, specific requirements have to be followed e.g. “Land receiving payments for similar management under other agri-environment schemes is not eligible under this Option. For more details, see: <http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options/ManagementofWetlands>. (other options include: “Create, Restore and Manage Wetland”, for more details see: <http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options/CreateRestoreWetlands>, and the option “Management of Flood Plains”, for more details see: <http://www.scotland.gov.uk/Topics/farmingrural/SRDP/RuralPriorities/Options/ManagementofFloodPlain>).

UK – England and Wales

The measure: establishment and preservation of wetlands.

Constructed wetlands: artificial features (swales, in-ditch features, temporary water bodies etc.), specifically constructed to intercept and treat run-off from agricultural land/ farmyards (e.g. new measures under ELS, in-ditch features Natural England (NE) Technical Information Notes).

Semi-natural wetlands: either existing wetlands (where the measure would be to restore or manage habitats such as reedbeds, fen, water meadows, wet woodland, floodplain or coastal grazing marsh/grassland, moorland and raised bog etc.) or newly created habitats such as reedbed, saltmarsh, wet grassland and wet woodland, specifically created for managing flood risk or helping to reduce diffuse pollution.

Wetland functions would/could include: aquifer recharge/protecting or enhancing hydrological regime and thereby fluvial geomorphology, storing sediment and processing nutrients (N&P), storing floodwater and carbon etc. Some of these functions would undoubtedly be diminished or altered by compaction or drainage. Some will depend on geology/soils and prevailing temperature, size and position within catchment etc. Treatment of selected farm pollutants e.g. lightly contaminated drainage off extended yard areas, where containment would overload otherwise correctly sized slurry management systems, in particular to reduce ammonia and pathogens.

Summary:

Three sub-measures:

- 6 RBs - preservation of wetlands (IT – Serchio, IT - Liri-Garigliano e Volturno, FI – Southwest Finland), (preservation and proper management) in LU/FR/DE/BE – Moselle and Sarre (FR only provided the information), (by CFWs) in UK – various catchments in Scotland, and UK - various catchments in England and Wales;
- 1 RB - restoration of degraded wetlands (IT – Serchio); and
- 7 RBs establishment of wetlands (IT – Serchio, IT - Liri-Garigliano e Volturno, FI – Southwest Finland, DK - Jylland and Fyn RBD, LU/FR/DE/BE – Moselle and Sarre (FR only provided the information), UK – various catchments in Scotland, and UK - various catchments in England and Wales).

River basins use different definitions of “wetlands”: some river basins provide definition of: “wetlands” (IT - Liri-Garigliano e Volturno, SE –Svartaå), of “multifunctional wetlands” (FI – Southwest Finland), of

“nitrogen wetlands” and “phosphorus wetlands” (DK - Jylland and Fyn RBD), of “constructed farm wetlands (CFWs)” and “wetlands for biodiversity” (UK – various catchments in Scotland), of “constructed wetlands” and “semi-natural wetlands” (UK - various catchments in England and Wales).

Some river basins identify various functions of the measure (wetlands), focusing mainly on the following:

- (1) To reduce diffuse pollution from agriculture - promotes wastewater treatment by artificial wetlands (IT - Liri-Garigliano e Volturno); reduces the environmental load from agriculture by multifunctional wetlands (FI – Southwest Finland), may be used, in connection to agricultural land, for N and P retention (SE –Svärtaå), reduces nitrogen and phosphorus loading of the aquatic environment (DK - Jylland and Fyn RBD), helps to reduce the risk of diffuse pollution from farm yards (CFWs in UK – various catchments in Scotland), helps to capture nutrients from agriculture run-off before entering water bodies by “constructed wetlands” and helps to reduce diffuse pollution by “semi-natural wetlands” (UK - various catchments in England and Wales).
- (2) To enhance biodiversity - enhances biodiversity (FI – Southwest Finland, IT - Liri-Garigliano e Volturno), provides habitat and biodiversity benefits in “constructed farm wetlands”, and supports benefits of plants, birds and invertebrates in “wetlands for biodiversity” (UK – various catchments in Scotland).
- (3) To store water for irrigation - it is identified that (multifunctional) wetlands can be used as storage for irrigation water (FI – Southwest Finland).
- (4) To provide food for livestock (grazing) - “wetlands for biodiversity” areas provide a food source for livestock (grazing) (UK – various catchments in Scotland).
- (5) To reduce the impacts of flooding - “wetlands for biodiversity” areas can also act as flood storage zones and help to reduce the impacts of flooding downstream (UK – various catchments in Scotland), and to reducing and managing flood risk (“semi-natural wetlands” in UK - various catchments in England and Wales).

In one river basin (DK - Jylland and Fyn RBD), the measure is based on the withdrawal of farmland from crop rotation.

2. Extent of use of measure

ES – Ebro

The measure extends its effects to the whole irrigation district of “Canal de Aragón y Cataluña” (98 000 ha). However, it’s the area that drains to the main drainage channel that will be the more affected (55 517 ha). The main drainage channel is a temporary stream classified as heavily modified water body (166 Clamor Amarga).

IT – Serchio

The measure is intended for the individuation of areas adjacent to surface water bodies in which to promote redevelopment and re-naturalization of the river environments through an enactment of the appropriate discipline. The measure involves both public and private areas and has been published.

IT - Liri-Garigliano e Volturno

Within the Basin Plan, the extract was prepared with the theme Excerpt Environmental Protection Plan (PSTA). The development plan is made explicit through the testing of projects for the conservation of resources and environmental restoration. One of the experiments is the "Project - Wetlands Conservation - The Mortine Pilot Area" in the basin of Volturno. This project, based on the value and vulnerability of wetland habitats and the river, has finalized the planning and programming of actions to safeguard the recovery and reconstitution of these key areas to the entire river system, as well as the enhancement of the surrounding areas. Such testing has been implemented in all areas by the planners of the Regions, Provinces and Municipalities.

FI – Southwest Finland

The measure *Establishment of multifunctional wetlands* is proposed to all farmers committed to the environment program. The Leader approach provides registered associations with the opportunity to establish wetlands that individual farmers are not able to establish. The measure may be implemented only in the catchment areas of rivers running into the Gulf of Finland, the Archipelago Sea, the Bothnian Sea, the Kvarken and in the catchment areas of lakes for which the measure can considerably decrease the load to the watercourse from agriculture. Should it be considered necessary in the general plan, wetlands may also be established in other locations that are naturally suitable and appropriate from the perspective of environmental management. The measure can also be implemented for projects in which these measures are used for handling drainage waters from arable land in one or more wetlands.

The measure may be implemented only in areas in which arable areas account for more than 20% of the catchment area of the watercourse or main ditch. The area of a wetland must be at least 0.5 % of the area of the upstream catchment area. Further target areas include the catchment areas of rivers running into the Gulf of Finland, the Archipelago Sea, the Bothnian Sea and in the lakes of catchment areas with agriculture as the main land user. In addition wetlands may also be established in other areas if the locations are defined in general plans as suitable sites. The investment support can be granted if a special contract for wetland management is concluded for 5 or 10 years after the wetland is completed. The measures must be implemented in accordance with a specific plan. The implementation of the measures must not have an adverse impact on the drainage situation of arable land cultivated outside the area covered by the measure.

The target in whole Finland was to reach 1626 new wetlands by the end of the period, but only about 60-70 farmers had received non-productive investment support for the construction of wetland by 2011. There were 291 special support contracts for management of multifunctional wetlands in 2010 covering 226 hectares. Only 38% of the area target has been met so far.

SE –Svärtaå

The measure is proposed to all farmers but each case is evaluated individually by the County Administration Board before support is granted. The measure is not limited to certain areas. Svärtaå river basin is a “hot spot area” and wetlands are financed within the agro-environmental support scheme. Within the Svärtaå river basin there is 72ha of wetlands receiving the compensation from the RDP according to the “Management of wetlands” measure, which corresponds to 0.9% of the arable land. The wetlands are mostly located in upstream areas and it was estimated that drainage from 250 ha of arable land is flowing thorough the constructed wetlands, corresponding to only c. 3% of the arable land. The total area of constructed wetlands in Sweden receiving “Management of wetlands” compensation was 7159 ha in 2011, which corresponds to less than 0.3% of the arable land.

DK - Jylland and Fyn RBD

Approximately 66% of the Danish landmass drains directly into fjords and enclosed coastal waters, while the remaining 34% of the landmass drains directly into more open marine waters. The measure is therefore only applicable in 2/3 of the river basin area.

LU/FR/DE/BE – Moselle and Sarre

The measure is proposed to all the farmers on a voluntary basis, in connection with a project developer “community”. The Water Agency is able to financially support such initiatives.

LIFE project “ARTWET” FR-IT-DE; lead by FR - Stormwater or artificial wetlands and vegetated ditches

The measure is proposed for all farmers by some water agencies such as Loire Bretagne in their program. For new drainage projects, the water law requests to propose a remediation zone.

Demonstration sites (Full scale)

- Detention pond - Eichstetten, Germany
- Storm basin - Rouffach, France

- Artificial wetland - Loches, France
- Detention pond - Landau, Germany
- Vegetated ditch - Landau, Germany
- Forest plot - Loches, France

All the types of artificial wetlands are detailed in:

<http://www.artwet.fr/pages.jsp?idRub=1413&idsite=630>

UK - Various catchments in Scotland

Two types of wetland areas. *Constructed Farm Wetlands (CFWs)* are encouraged nationally where there is a risk. The measure is funded through rural development programme (SRDP) and is more likely to be funded in priority areas. For the *Wetlands for biodiversity* all managers can apply for the wetland options in the SRDP, although funding is more likely in designated site such as SACs (Special Areas of Conservation).

UK - various catchments in England and Wales

The measure is not proposed to all farmers, but instead only in the Demonstration Test Catchment (DTC) project to those which are appropriate (in the flowpath and with pollution to mitigate) and/or accepting. Thus the measure is limited to certain areas. There are active areas and control areas where no measures are being proposed. (ADAS User Manual: [Mitigation Methods - User Guide August 2011, Method 81 – Establish and maintain artificial wetlands](#)). Link:

http://archive.defra.gov.uk/foodfarm/landmanage/water/csf/documents/UserManual_Jan07.pdf

The measures are available to all farmers through HLS, but rely on a voluntary take-up of agri-environment scheme support, which has been somewhat low because a) the amount of money available across E&W is low and b) the incentive level of the payments is not great compared to the returns from other land use and crops. There is also an urgent need to encourage collaborative action to increase effectiveness, as these measures need to be applied on a relatively large, landscape scale.

The Westcountry Rivers Trust are developing a mosaic approach using stacked GIS layers, determining 'hotspots' of ecosystem service production and overlaying that on maps of currently farmed land to see where subsidies or, on the other hand, continued intensification could be targeted most sympathetically.

Summary

The measure is proposed to all farmers but normally under certain conditions, such as they have to be committed to the environment program and registered associations (FI – Southwest Finland). In Svärtaå (SE) the measure is not limited to certain areas; however, wetlands are financed within the agro-environmental support scheme only in areas which have to be evaluated individually by the County Administration Board in order to receive financial support. In LU/FR/DE/BE, the measure is proposed to all farmers on a voluntary basis, in connection with a project developer 'community'. In Scotland, *Constructed Farm Wetlands* are encouraged nationally, but funding is more likely in priority areas; for *Wetlands for biodiversity*, funding is most likely in designated sites, such as SACs. In the UK, the measure is not proposed to all farmers, but is instead limited to certain areas in the Demonstration Test Catchment. Through HLS, the measures are available to all farmers, but rely on a voluntary take-up of agri-environment scheme support.

In some cases, the measure is limited to certain areas, namely:

- Areas in which arable areas account for more than 20% of the catchment area of the watercourse or main ditch. The area of a wetland must be at least 0.5% of the area of the upstream catchment area (FI).
- The 2/3 of the river basin that drain directly into fjords and enclosed coastal waters (as opposed to more open marine waters) and is only applied downstream of lakes to ensure the cost-effectiveness of the measure (due to the natural nitrogen retention capacity of lakes). In contrast, phosphorus wetlands are dosed according to the need to reduce phosphorus loading

- of lakes, and are therefore established upstream of a lake (DK)
- The whole irrigation district (ES – Ebro).
- Areas inside the Demonstration Test Catchment which are appropriate (in the flowpath and with pollution to mitigate) (UK)

The Leader approach provides registered associations with the opportunity to establish wetlands that individual farmers are not able to establish (FI – Southwest Finland). The measure is proposed to farmers on a voluntary basis (LU/FR/DE/BE – Moselle and Sarre).

3. Effects of measure

CAOM

Wetlands increase landscape diversity by providing habitat for a variety of fish and wildlife species. They also protect/maintain and improve surface and ground water quality, control soil erosion and provide barriers for flood control. Wetlands can reduce nitrogen concentrations in water bodies through denitrification and phosphorus concentrations through sedimentation of particles. Wetlands can increase biodiversity and recreational values of landscapes. In addition, wetlands provide natural flood control in areas that are sensitive to erosion or drought.

ES – Ebro

The aim of the measure is to reduce the quantity of water effluents and agrarian pollutants. The wetlands will increase the permanence of polluted water and intensify the natural depurative process. Thus, it is expected to improve the heavily modified water body 166, Clamor Amarga, and contribute to a better water status downstream, especially in the water body 441, Cinca river. It will also allow the use of the water accumulated in the wetlands for irrigation in dry years; 4672 ha could benefit from this. So, effluents in irrigation will be reused, limiting the amount of polluted waters discharging in Cinca river. The expected reduction in pollutants is:

PARAMETER	REDUCTION
BOD	65-80 %
COD	55-75 %
Nitrogen	25-40 %
Phosphorus	20-30 %
Suspension solids	60-70 %

FI – Southwest Finland

Annually, 400 farms and other land users receive payments for the management of multifunctional wetlands. 600 ha/y of physical area eligible for payments for management of multifunctional wetlands. The amount of payments for management of multifunctional wetlands is 180 000 €/y. The National agricultural authority monitors implementation. Experts estimate that on a catchment scale, wetlands can trap anything from 5 to 30% of nutrients and on some actively monitored wetlands nutrient retention can be up to 50%. But in some cases, wetland can be a source of nutrients (P).

Information on potential impacts through monitoring data exists only for 2 or 3 ideally constructed and much larger wetlands (wetland size/catchment size) than average wetlands and so their reduction rates are better than average.

- Reduction in nitrogen load (kg/ha, or percentage) up to 60%
- Reduction in phosphorous load (kg/ha, or percentage) up to 60%
- Reduction in pesticide load: not monitored: In Finland pesticides are used so little that it is not considered a main problem
- Soil erosion rates reduced or avoided: 0-74%
- Impacts on biological quality elements: no data
- Impact with regards to flooding reduction (peak flow reduction: the best wetland reduces flow from inflow max 25 l/s to outflow max 7 l/s)

- Biodiversity several wetland bird surveys are carried out, as well as some studies about dragonflies and amphibians and they all indicate benefits of wetlands

In some cases, wetlands can be a source of nutrients (P). This can happen when P-rate in the bottom soil is high, the wetland is too deep and there is not oxygen (usually during wintertime) in the bottom water layer. In such cases, P starts dissolving into water from bottom and then, if wetland is too small, in high flow situations sediment (and PP) settled on the bottom is carried out by flow.

SE –Svärtaå

The main aim is to reduce the load of nitrogen and phosphorus from agricultural land to water bodies, and another aim is to increase the biodiversity. Constructed wetlands can help to capture phosphorus and remove N by denitrification (Kronvang et al., 2008). In Sweden two types of constructed wetlands are distinguished; larger wetlands with the main purpose of N-denitrification, and small wetlands designed for P-sedimentation and trapping. A recent review of 68 constructed wetlands in Sweden by Weisner and Thiere (2010) showed an average N-retention between 53 and 97 kg per ha of wetland and year. The correspondent figures for P was 1.4 to 4.3 kg/ha. The range is explained by different models and assumptions. If 16 wetlands with the aim of reducing nutrients were selected, the N reduction was estimated to between 170 and 220 kg and the P reduction to between 2.4 and 4.9 kg/ha of wetland and year.

Results from small constructed wetlands for P sedimentation show a retention of 23-42% for total P and 3-15% for N (Jordbruksverket, 2010).

In an estimation of the effect of all constructed wetlands established in Sweden until 2006, the nitrogen and phosphorus retention was calculated to 140 ton/a and 12 ton/a, respectively (Brandt et al., 2009). The total transport from land to the sea from south of Sweden was reduced by < 0.2% for N and 0.5% for P as an effect of the constructed wetlands.

DK - Jylland and Fyn RBD

In connection with preparation of the programme of measures under the river basin management plans, the Danish government has decided that the measure “nitrogen wetlands” should reduce nitrogen loading of coastal waters by a total of 1130 tonnes N during the first plan period. The river basin management plans assume a nitrogen reduction capacity of 113 kg N/ha wetland. Thus a total reduction of 1130 tonnes N requires the establishment of up to 10 000 ha of nitrogen wetland. As regards phosphorus wetlands, the goal is to reduce phosphorus loading of the aquatic environment by 30 tonnes P. As the river basin management plans operate with a phosphorus reduction capacity of 20 kg P/ha wetland, attainment of the goal requires the establishment of approximately 1500 ha of phosphorus wetland. With both measures the dose is to be carefully matched to the needs of the individual water bodies in the individual river basin management plans. No use of pesticides is allowed after the (semi natural) wetland is constructed.

The nitrogen wetlands are normally dosed according to the need to reduce nitrogen loading of coastal waters. In order to maximise the effect of a nitrogen wetland the measure is solely applied in basins draining directly into fjords and enclosed coastal waters. Moreover, the measure is only applied downstream of lakes as the natural nitrogen retention capacity of a lake will otherwise reduce the cost-effectiveness of a nitrogen wetland placed upstream of a lake. Phosphorus wetlands are dosed according to the need to reduce phosphorus loading of lakes, and are therefore established upstream of a lake.

The nitrogen reduction capacity assumed for nitrogen wetlands in the river basin management plans (113 kg N/ha) is based on experience from earlier wetland projects established under Danish national action plans for the aquatic environment. Experience from state nature management projects shows, however, that with very selective placement of the wetlands a nitrogen reduction capacity as high as 177 kg N/ha can be achieved. In this case fewer hectares of farmland will be needed to achieve the reduction target in the river basin management plans.

Establishment of the nitrogen wetlands pursuant to the river basin management plans began in 2010 and is now well underway. The projects registered so far are expected to yield an average reduction in nitrogen loading of 130–135 kg N/ha. It is therefore expected that it will be possible to achieve the

reduction target of 1130 tonnes nitrogen through the establishment of 8000–8500 ha nitrogen wetland, of which approx. 7% will be individual private wetlands and approx. 93% will be municipal wetlands.

Regarding phosphorus, the reduction capacity is expected to be 20 kg P/ha, and a total reduction of 30 tonnes phosphorus will require the establishment of approx. 1500 ha phosphorus wetland. Efforts to establish phosphorus wetlands are expected to begin in 2012.

No information on reduced soil erosion rates is available. However, there are recommendations on how to reduce brink erosion in general in new reconstructed river profiles e.g. in connection with establishment of a wetland.

Concerning biological quality elements, the goal of N-wetlands is to reduce N loading in the rivers in order to reduce N loading to coastal water, thereby lowering the nitrogen concentration in the coastal water and limit planktonic algae growth. Fewer algae will make the water more clear and hereby improve growth conditions for Eelgrass. Eelgrass is the main biological quality element in Danish coastal waters.

For P-Wetlands the goal is to reduce phosphorus loading to lakes downstream. By this the phosphorus concentration (measured as chlorophyll a) in the lake will fall and limit the growth of phytoplankton. Phytoplankton is one biological quality element in lakes and very often the level is too high and thereby influence negatively on the composition of phytoplankton species and reducing living conditions for other biological quality elements (plants).

Many of the wetlands are based on being flooded with river water from upstream. This will reduce peak flows, but no wetlands are constructed with the prime purpose of flood control - no such information available. Some wetlands also aim to improve nature and biodiversity. In order to secure the right development of the nature in these cases normally a specific plan for regulated farming (hay cutting and grassing) and tendering of the areas is made.

Critical features of the wetland design for environmental effectiveness are to re-establish and secure the natural hydrological processes to function with high efficiency without assistance of larger technical measures. This means that the water on the areas must be able to run freely after the natural conditions, depending on type of water (groundwater or surface water) and source of water (drainage water or water from the river); thus, the wetland may develop according to the given natural processes. Without human intervention with technically installations needing maintenance, the development of the wetland doesn't create extra costs (beside the initial construction) and a more natural development in flora and fauna is the result.

IT – Serchio

The aim of the measure is to establish and preserve wetlands adjacent to surface water bodies, in which to promote redevelopment and re-naturalization of the river environments. The implementation of the measure in the first phase will cover the verification of the production of regulation. The effects of the measure will be monitored/evaluated by redevelopment and re-naturalization of the river environments. The expected effects are that the measure has direct positive effects on biodiversity (the measure has positive effects on habitats, plant and animal species and ecological dynamics), on soil (positive effects on erosion and the restoration of fluvial dynamics), on water quality (wetlands can help to capture nutrients from agriculture runoff before entering water bodies), landscape (positive effects on natural aspects, and ecological connections) and on human health (positive effect on water component).

IT - Liri-Garigliano e Volturno

The wetlands are aimed at soil protection, optimization of water resources and environmental protection. These objectives are achieved by balancing the natural functions they perform (Article 3 of Law 183 / '89, points b and c, Art. 17). The wetlands, in addition to the protection of the various biotic communities, perform important functions such as:

- improving water quality through processes of assimilation and transformation of nutrients and other pollutants; containment of toxic substances (through self-purification function improve water quality by acting as catchment areas where sediments are deposited and toxic substances);

- the attenuation of flood peaks and store water;
- groundwater recharge;
- reducing coastal erosion;
- increase the natural value of the site through:
 - Photosynthetic production
 - The production of animal life
 - The increase in biodiversity
 - Export to adjacent ecosystems;
- work with social value:
 - Sustainable development through the identification of opportunities to play a nature-based tourism through the organization of spaces for recreation, hiking, bird watching, nature photography, fishing controlled.

The aspects analysed become the objectives to be pursued with the reconstruction of wetlands, and these can also be achieved simultaneously. It is necessary, in fact, at the planning stage to clearly define the objectives to be achieved with the reconstruction of the wetland and to adjust the planning functions to them.

LU/FR/DE/BE – Moselle and Sarre

The purpose of the establishment wetlands is (i) protection of the resource (groundwater and surface water): lowering the nitrate flux (proven effectiveness) and pesticides (on-going assessment of effectiveness on the experimental sites, granted by Water Agency). (ii) Management of the run flows within the watershed (mitigation of floods).

The purpose of the restoration and conservation of wetlands is (i) maintain of the natural capacity to control the risk of inundation, (ii) biodiversity conservation (Natura 2000), (iii) carbon sink. Monitoring leads to verify the ecological performances on the basis of an "objective paper".

LIFE project “ARTWET” FR-IT-DE ; lead by FR - Stormwater wetlands and vegetated ditches

Hydraulic performances of the test sites:

- It is necessary to optimize the contact time between water/sediment and micro-organisms.
- Water recirculation (e.g. in biomass beds) is 99.8% efficient for pesticide mitigation even with strong concentrations of active ingredients widely used in vineyards such as metalaxyl, penconazole and chlorpaifos. The efficiency of mitigation was also tested for several herbicides used on maize, wheat and tomato crops.
- Tracers used as a surrogate for contaminants showed that shallow water (30 to 40 cm) depths and dense vegetation significantly increase pesticide retention.

Wetland adapted from storm basin in France (Rouffach, France – LHYGES Strasbourg):

- At least one year after system implementation is required to establish efficient pesticide mitigation.
- It is possible to treat > 90% of the rainfall-runoff events for which 100% of the surface runoff water reaches the storm basin. 90 % of the suspended solid mater is retained in the system.
- During the agricultural season (April-September), a mean mitigation efficiency of $76 \pm 19\%$ (total concentrations) and $73 \pm 19\%$ (total load estimates) can be achieved (calculation based on 28 rainfall-runoff events occurring from April 06 to September 29, 2009 and encompassing 18 pesticides).
- A well-oxygenated system is more effective.

Wetland collecting drainage (Loches, France – IRSTEA Antony)

- The specific hydrology of a drained subsurface area requires a new strategy aimed at trapping maximum pesticide loads in minimum drained water flows.
- So, by implementing an artificial wetland in parallel of an arterial ditch, with a manually operated open-close device (requires farmer's involvement), most pesticide fluxes are stored and degraded in the system.
- Efficiency is strongly linked to pesticide properties: mobile pesticides are dissipated less (20

%) than sorptive ones (80 %).

Vegetation wetland systems

- Short vegetated ditches with hydraulic retention times of less than 1 hour reduce peak concentrations during runoff by a mean of 52% after storm events of 3-20 mm.
- The detention pond with hydraulic retention times of more than 8 hours reduces peak concentrations during runoff by a mean of 87% after a very heavy storm event of 30 mm.
- Studies in experimental wetland cells and experimental vegetated ditches confirmed the efficiency of vegetated wetland systems.

sorbent mixture like support for artificial wetland

- The sand-sediment mixture (80:20) used as sorbent in microcosms proved to be efficient. Retention efficiency reached 91% for glyphosate, 87% for 3,4-DCA and 64% for diuron after 6-hours storage time.
- Copper sorption was 20% higher when sugar beet pulp was located at the microcosm outlet, and not mixed with the sand-sediment mixture; this yielded a mitigation rate of 95%.
- Dissipation performances were satisfactory. 99% glyphosate, 84% 3,4-DCA and 65% diuron were dissipated after retention and five weeks of treatment.
- Copper extraction in aerial parts of *P. australis* has been improved by a factor of 1.7 with bioaugmentation (2% of applied copper extracted in 7 weeks).

Artificial wetlands implementation is recommended at strategic interfaces:

- Foothills/plains
- Rural/urban
- Production/storage
- Dryland/wetland
- Nonpoint source/concentrated pollution

It is clear that artificial wetlands are not "the miracle solution". Artificial wetlands are not a license to pollute but have to be implemented in addition to local action such as a pesticide reduction plan. Together all these undertakings should help target "good chemical status".

UK – Scotland

1. The aim of CFWs is to treat lightly contaminated run-off from farm yards (areas are specified in guidance and regulation) to help reduce diffuse pollution from agricultural sources. CFWs can also capture spills and benefit biodiversity. The design was based on published studies, however; we have limited monitoring of the effectiveness of CFWs built according to the design guidance. We do have monitored data on other designs. *This is a gap and we would like to share info on this.* See work by Rory Harrington in Ireland who pioneered this concept e.g.

http://www.dublincity.ie/WaterWasteEnvironment/WasteWater/Documents/ICW_Concept_Design_Site_Evaluation_and_Performance.pdf. Implementation will be monitored as part of SRDP. There is potentially a very effective measure but since the guidance has been produced uptake has slowed – due to land area required.

2. The wetland options for biodiversity are monitored if on a designated site. They are included in this factsheet because they have potential to benefit water quality and need in the future to be used in this way. *We would like to learn from other MS about the use and effectiveness of wetlands in the landscape to treat field issues.*

UK – England and Wales

The aim of the measure - in the Eden Demonstration Test Catchment (DTC) – is to slow the water flow and trap sediment/nutrient. The intended effects are to reduce pollution and flood risk. Monitoring of rate of implementation is in the hands of the research consortium who are liaising closely with the farmers; monitoring of the effectiveness is being carried out using highly intensive in-situ monitoring kit remotely telemetering data back for analysis together with more traditional sampling techniques. As regards the expected or observed effects on other environmental priorities, we expect to see: reduction of siltation; less flashy flows in river; wetland habitat creation and associated biodiversity increase; less

phosphate in the river.

Evidence that storing water on land can reduce and slow down the time to peak flows. Flood risk in Belford (Northumberland) mitigated by storing and attenuating high flows through Sustainable Drainage Systems (SuDS) on farmland with a minimal impact on farm economics¹⁹. It (SuDS) extends and reduces the flood peak in Belford (from 20-40 mins) also helps to reduce the amount of silt being washed off and delivers wildlife benefits. It has been shown to be effective at both large and micro-scale within catchments. Holding the water back in the landscape could be particularly relevant to the Uplands, where the returns from farming are less.

In Pickering, West Yorkshire, a 2 a pilot project looking to demonstrate that land use change through targeted use of woodland and SuDS can reduce run-off, increase the water holding capacity of a catchment and thus reduce the risk of flooding. Attempted to evaluate ecosystem services provided by woodland measures, the most significant considered to be flood regulation, erosion, habitat provision, social relations, and education and knowledge. Benefit for climate regulation in terms of carbon sequestration, and on the deficit side, the loss in agricultural income resulting from land use change, were also assessed. Combined values for all services gave an estimated mean annual gain of £203,687²⁰.

In Wales, farmers in the Pontbren river catchment observed that overland water flow was reduced by strips of trees planted to shelter livestock. Research has shown that infiltration rates in these shelterbelts can be up to 60 times higher than in pasture²¹ and reduce peak flows by 20%. Those areas subject to agricultural intensification have a lower base flow and higher peak flows compared to more naturally managed areas within the catchment²².

Whitfield Moor in the North Pennines, grip blocking used to achieve flood risk, water quality and nature conservation benefits as part of the 'Peatscapes' (<http://www.nwl.co.uk/PeatscapesProject.aspx>) initiative. It cost £120k to block 120 km of grips and restore the hydrological integrity of 480 ha of peat on the moor. Monitoring shows that blocked grips reduce the amount of, and rate at which, water flows from the moorland. The peatland system is recovering and the hydrological regime has changed from rapid drainage to storage²³.

Dartmoor <http://www.dartmoor-npa.gov.uk/lookingafter/laf-naturalenv/dartmoormiresproject>

Exmoor Mires projects <http://www.exmoor-nationalpark.gov.uk/environment/moorland/mire-project>

Integrated constructed wetland (ICWs) have also been in place in the Anne Valley and elsewhere in Co Waterford, Ireland since 1988 as a multi-benefit approach addressing ecosystem services in an integrated way. ICWs should only be used for some pollutants, e.g. 'lightly contaminated yard effluent', where complete containment of which will overwhelm even the better slurry etc. systems - in weather like we are currently experiencing. Not to use as an alternative to 'store and spread, to utilise nutrients in slurry', as in current good practice and certainly not to treat 'neat slurry/ silage effluent'- as sometimes the case in Ireland- as this can then represent a substantial loss of nutrients out of the farming system and to some extent at least into the discharge. There are also bio-diversity issues to consider - that ICWs do not compromise existing wetland habitats.

Certain caveats apply:

- a) basic good practice is always essential as a first requirement – e.g. good yard management;
- b) CONSTRUCTED artificial wetlands are the only ones to use, as they can be suitably located and adequately sized to deal with whatever pollutant and volumes are likely;
- c) natural existing wetlands of (any) conservation value should NEVER be used as they are now pretty rare (even in Ireland!) and the sediment/pesticide/nutrients etc. will have an adverse effect on their

¹⁹ Wilkinson, M.E.1, Quinn, P.F.1 and Welton, Belford catchment proactive flood solutions: storing and attenuating runoff on farms.

²⁰ Defra PROJECT RMP5455: SLOWING THE FLOW AT PICKERING

²¹ Land Use Policy Group (2009) – Adapting agricultural policy to increased flood risk Land Use Consultants 14 May 2009, piv.

²² Pontbren project homepage http://www.pontbrenfarmers.co.uk/project_background.html

²³ Peatscapes monitoring programme <http://www.nwl.co.uk/PeatscapesProject.aspx>

biological value.

The aim of the measure (see below) usually to reduce diffuse pollution and secure other benefits such as reduction of flood risk, aquifer recharge etc. Intended effects: the conservation, restoration and re-creation of wetlands within a catchment would aim to deliver the following: protection and/or restoration of hydrological regime (aquifer re-charge, attenuation and storage, delaying flood peaks), storing/managing sediments and take up of nutrients (N&P); clean drinking water; reducing faecal pathogens fisheries and biodiversity benefits. Coastal salt marsh: energy abatement, storage of carbon and nutrients, benefits to overall biodiversity and specifically to fish populations. Incidental benefits would be to cultural heritage/wetland archaeology, more sustainable agriculture, recreation and tourism, health (mental and physical) benefits to local people, inspiration and education (research at various levels) etc.

As regards monitoring/evaluation of a) the rate of implementation and b) the effects of the measure, NB we can probably provide figures on extent of uptake for the different options within CSFDI catchments, and maybe begin to make some tentative general statements about effectiveness in terms of reduced N&P, but a) there would be a time lag before any beneficial effects would be observed and b) monitoring costs money and I am not sure much gets done ... also there has not yet been much wetland creation etc. on a landscape scale (though see work listed below).

With wetland habitat creation or restoration, one is in for the long haul, i.e. there won't be discernible effects over short timescales and without monitoring ... but are setting up projects such as SuDS for schools which will begin to look at the effectiveness of urban SUDS in reducing diffuse pollution.

The following examples would be good to look at:

- [Broads Flood Alleviation project](http://www.bfap.org) (BFAP) www.bfap.org
- [Penny Johnes work at Reading University](#) on floodplain grasslands
- Constructed wetlands in the [Anne catchment in Ireland](#) (Mark Everard has done a note re this)
- [UU SCAMP project](#)
- [UK NEA: Chapter 9 on freshwaters](#) and wetlands...quantified the benefits, lots of references
- SW Water Upstream Thinking
- CSFDI work to monitor and demonstrate effect, usually reduced sediment loads in lakes and rivers (and other waterbodies) and reduced nutrient load especially N&P.

Denmark: work using wetlands in catchments to reduce nitrate loads into lakes and estuaries

Sweden: evidence work on buffer strips

Vienna: work on use of floodplain to protect city from flooding

NW Germany (Lower Saxony): use of floodplain

Integrated constructed wetlands are also used in Ireland and Scotland- where SSAFo regs have been altered to allow for ICWs.

Summary

Aim of the measure:

The majority of the river basins (5 - ES – Ebro, SE –Svårtaå, LU/FR/DE/BE – Moselle and Sarre, UK – Scotland, and UK - England and Wales) that responded indicate the reduction of the load of the agrarian pollutants (mainly nitrogen and phosphorus) to the water bodies as the main aim of the measure. One river basin (LU/FR/DE/BE – Moselle and Sarre) indicated, in addition to nitrate flux, reduction of pesticides in groundwater and surface water. Biodiversity conservation/increase is another frequently identified aim (by three river basins - SE –Svårtaå, LU/FR/DE/BE – Moselle and Sarre, and UK –Scotland). Furthermore, other aims of the measure include: floods mitigation (2 - LU/FR/DE/BE – Moselle and Sarre and UK - England and Wales), soil protection (IT - Liri-Garigliano e Volturno) and carbon sequestration (LU/FR/DE/BE – Moselle and Sarre).

As identified by the majority of river basins (5 - ES – Ebro, SE –Svårtaå, DK - Jylland and Fyn RBD, IT – Serchio, UK - England and Wales), water quality improvement, in general through capture of phosphorus

and removal/denitrification of nitrogen, is an intended effect of the measure. For example in Sweden, the N reduction was estimated between 170-220 kg N/ha and the P reduction between 2.4-4.9 kg P/ha of wetland and year. Results from small constructed wetlands for P sedimentation show retention of almost 23-42% for total P and 3-15% for N. As a comparison, in Jylland and Fyn RBD (DK) an expected average reduction in nitrogen loading is 130-135 kg N/ha, and the reduction capacity of phosphorus is expected to be 20 kg P/ha.

Another identified intended effect was the reduction of the flood risk (IT - Liri-Garigliano e Volturno and UK - various catchments in England and Wales). One river basin (ES – Ebro) identified use of the accumulated water in the wetlands for irrigation. Other identified effects: store water, recharge groundwater, reduce coastal erosion (IT - Liri-Garigliano e Volturno), increase the natural value of the site/biodiversity - positive effects on habitats, plant and animal species (IT - Liri-Garigliano e Volturno, IT – Serchio); positive effects on soil (erosion) and landscape (ecological connections) (IT – Serchio), and social value: development of a nature-based tourism through: recreation, hiking, bird watching, nature photography, controlled fishing (IT - Liri-Garigliano e Volturno).

Monitoring/evaluation of:

(a) the rate of implementation is monitored through number of farms receiving payments for wetlands management (A-E scheme); the area eligible for this payment and the amounts of payments (FI – Southwest Finland, SE –Svärtaå, UK –Scotland); the wetland for biodiversity are monitored if on a designated site (UK –Scotland).

(b) Only one river basin (UK - England and Wales) identifies that monitoring of the effectiveness is being carried out, however the results were not provided (UK - England and Wales). Other river basin (IT – Serchio) identifies that the effects of the measure will be/are planned to be monitored.

Expected or observed effects on other environmental priorities (such as climate change, soil and biodiversity) were identified just by one river basin (UK - various catchments in England and Wales) It identified: reduction of siltation, less flashy flows in river, wetland habitat creation and associated biodiversity increase as expected effects; and an evidence that storing water on land can reduce and slow down the time to peak flows.

4. Method of implementation of measure

CAOM

Category: Technical measures, Geographical scale: local, Time until implementation: long-term, Time until effects: medium/term. Adaptability: high, Certainty level: high.

ES – Ebro

The measure is implemented by the Government. Maintenance is done by the farmers (Community of Users). The measure has not been implemented yet.

FI – Southwest Finland

Common EU indicators and national indicators

Measures are issued as programme plan on a voluntary basis. Establishment is once in a period, but it must be implemented within 2 years from acceptance. Management is 5 or 10 years. Establishment up to 11 500 €/ha of wetland, but only according to costs. 3 226 €/sites, fixed payment for small sites, when the area of the wetland is 0.3-0.5 ha. Management up to 450 €/ha according to costs. There is also random controlling by agriculture authorities, if implemented and managed according to accepted plan.

SE –Svärtaå

Establishment of constructed wetlands is voluntary and a part of the national implementation plan for

the Baltic Sea Action Plan (Naturvårdsverket, 2009a), with the goal to establish 500 ha of small P-sedimentation wetlands and at least 6000 ha of larger wetlands. In the Rural development Plan (Regeringskansliet, 2010), the goal for large wetlands is at least 6000 ha, and support to management of constructed wetlands for 2013 is set to 11 300 ha. The goal for small P-sedimentation wetlands is 200 ha to 2013.

The RDP can finance up to 90 % of the actual costs, with a threshold of 200 000 SEK/ha (ca. 21 000 €) in the counties of Kalmar, Gotland, Blekinge, Skåne, Halland and Västra Götaland and 100 000 SEK/ha in the rest of the country. The compensation for management and income loss is between 3 000 (ca. 320 €) and 4000 SEK per hectare and year for wetlands on arable land and 1500 SEK for other land uses. The compensation for constructing small P-sedimentation wetlands is set to a maximum of 300 000 SEK per hectare, and up to 90 % of the actual cost.

DK - Jylland and Fyn

Both types of wetland are being established pursuant to an agreement between the Danish Ministry of the Environment and Local Government Denmark whereby the municipalities are responsible for the implementation of the measure as specified in the state river basin management plans for the individual river basins. The organisation is illustrated in the figure in Section 5.

Nitrogen wetlands

It is anticipated that the nitrogen wetlands will be established via two models:

1) Major municipal projects, which will account for by far the greatest proportion of the reduction in nitrogen loading

Owners of land in potential project areas will be asked to let their land be included in a nitrogen wetland project in return for financial compensation. The most important mechanism for financing implementation of the projects is the purchase and sale of land. When the municipalities have completed the necessary preliminary studies of a potential nitrogen wetland, have received notification that the Danish AgriFish Agency agrees to fund the establishment costs, and the necessary financial framework has been allocated for acquisition of land, the municipality requests the Danish AgriFish Agency to perform the land purchase and land redistribution. The Danish AgriFish Agency is empowered to undertake land purchase within the funding granted for the project.

In principle it is up to the landowner whether or not to relinquish land for use in a project. Expropriation can only be employed in special cases where an individual landowner is otherwise hindering implementation of a major project. It is permissible for a landowner to establish part of a municipal nitrogen wetland project as a private project – see model 2.

The decision as to whether the land for a project is to be acquired by the purchase and sale of individual land deeds or through land redistribution is made by the Danish AgriFish Agency in the Ministry of Food, Agriculture, and Fisheries. Land redistribution is a useful tool when many trades have to be conducted simultaneously, and when several landowners are both purchasers and sellers. The Danish AgriFish Agency thereby ends up owning all the land within the project area.

Prior to the process of land purchase for a project the Danish AgriFish Agency can use national funds to purchase land outside the project area for use as a land pool for compensating those landowners who relinquish land in the project area. The purchase of land for a land pool is therefore a means of enhancing the interest of landowners in entering into voluntary agreements on the establishment of nitrogen wetlands.

Once the project has been implemented, the Danish AgriFood Agency sells off the purchased land within the project area – i.e. the land on which the wetland has been established – through public tender. An individual farmer, a group of farmers or an organisation may then purchase the wetland.

2) Minor private projects with a subsidy scheme

Landowners who wish to establish minor wetlands themselves rather than sell the land to the Danish AgriFood Agency as part of a municipal project will be able to apply for a subsidy for private wetlands under the Danish Rural Development Programme. Under this scheme the landowner can apply for the establishment costs and a 20-year subsidy.

In the municipal wetland projects, the municipality enters into an agreement with those landowners

who in the preliminary study of the project or later in the planning process express the desire to keep their land and instead enter into a 20-year agreement on a subsidy for maintaining the wetland. The agreement provides the municipality with a guarantee that the landowner will make the land available for the project and accept restrictions on right of use of the land in return for compensation over a 20-year period.

This ensures that a major municipal project will not be blocked by one or two reluctant farmers not wanting to sell their land. The use of expropriation should be avoided.

Timetable for implementation of nitrogen wetlands: Implementation of the measure began in 2010 with the establishment of municipal river basin steering committees (MSCs – see Section 5), and physical implementation of the first projects will take place in 2011.

Phosphorus wetlands

Implementation of the phosphorus wetlands will focus on the reduction of phosphorus loading in lakes identified in the river basin management plans as requiring a reduction in phosphorus loading. Implementation of the measure will be initiated in 2012.

IT - Serchio

The measure is issued as binding instructions on a compulsory basis. The drafting of the regulation is planned for 2011/2012. Currently there is no compensation.

IT - Liri-Garigliano e Volturno

To date, as stated, there is the Protection Plan Excerpt Ambientale that addresses the planning of a wide area with clear guidance on the methodology used for the planning. Such signs were also an integral part of the planning process of the Water Management Plan of the southern Apennines (2000/60/EC).

LU/FR/DE/BE – Moselle and Sarre

- Water Act (Loi n°2006-1772 du 30 décembre 2006) that frames the drainage of wetlands (if < 20 ha);
- Establishment and restoration of wetlands on a voluntary basis, with financial compensation and granting the AEM;
- Financial compensation of lost income, acquisition of land by community with objective of proper management.

LIFE project “ARTWET” FR-IT-DE ; lead by FR - Stormwater wetlands and vegetated ditches

The methods of implementation of measure were detailed site by site in:

<http://www.artwet.fr/pages.jsp?idTheme=4251&idsite=630&idRub=1414&rubSel=1414>

On a voluntary basis, financial compensation with MAET (agro-environmental and territorial measure) such as management of pond (150 € for 4 years), with PVE (vegetal environment plan). For artificial humid buffer zone, agricultural hydraulic subsidies could be requested depending to local authorities (department council).

Concerning natural wetland, financial subsidies for land acquisition (by Water Agency).

UK - Scotland

CFWs are part of PoM but uptake is voluntary and only part funded by SRDP. Awareness is raised mainly via one to one visits to land managers. Uptake is low. If funded CFWs must comply with requirements in guidance referenced above.

UK - England and Wales

- Issued as a legal act, programme, plan – The Eden DTC is part of a research programme
- Voluntary or compulsory - voluntary
- Implementation time scale (at one time / over a period) – 5 years initially
- Compensated (how? How much) or not - no
- Implementation of control requirements – N/A

Voluntary measure supported by limited agri-environment scheme funds.

Takes time to restore or create new functioning wetland habitats. E.g. restored fens initially give off

ammonia, but eventually store carbon.

Farmers encouraged to take up these options where there are catchment officers promoting and advising (this is vital to success, persuading farmers of the best possible options for their particular circumstances/farm/fields etc.). A-e scheme payments encourage landowners (but £ insufficient).

In England, Environmental Stewardship Higher Level Scheme payments are available for Wetlands options and Capital expenditure on Rural SuDs (sustainable drainage systems), www.naturalengland.org.uk.

Capital works include:

Upland management

Grip-blocking drainage channels GBC block

Items associated with wetlands

Creation of ditches – rhines and dykes WDC m2

Creation of gutters WGC m2

Soil bund S1 each

Culvert C each

Timber sluice S2 each

Brick, stone or concrete sluice S3 each

Scrape creation – first 100 m2 SCR m2

Scrape creation – over 100 m2 SCP m2

Silt trap provision STP

Wind pumps for water-level measures WWP

Drove improvement WDI

Ligger and bridge provision WLB each

Construction of water-penning structures WPS

Wetland options include:

HLS Wetland options Code Page

Ponds

Maintenance of ponds of high wildlife value (less than 100 m2) HQ1 41

Maintenance of ponds of high wildlife value (more than 100 m2) HQ2 41

Reedbeds

Maintenance of reedbeds HQ3 42

Restoration of reedbeds HQ4 42

Creation of reedbeds HQ5 42

Fens

Maintenance of fen HQ6 43

Restoration of fen HQ7 43

Creation of fen HQ8 43

Lowland raised bogs

Maintenance of lowland raised bog HQ9 43

Restoration of lowland raised bog HQ10 43

Supplements

Wetland cutting supplement HQ11 44

Wetland grazing supplement HQ12

- The Higher Level Scheme (HLS) Handbook can be found on the Natural England website at:

http://webarchive.nationalarchives.gov.uk/20100429120916/http://www.naturalengland.org.uk/images/NE%20ES%20HLS%20Part%20C_tcm6-6451.pdf

- Glastir (the new agri-environment scheme for Wales) will cover substantial wetland creation under the targeted element (TE):

<http://wales.gov.uk/topics/environmentcountryside/farmingandcountryside/farming/glastirhome/?lang=en>

It is a voluntary scheme and, as with the lower tier of the Countryside Stewardship Scheme in England, the All Wales Scheme (AWE) is open to all farmers provided they select sufficient options to qualify, whilst as with the Higher Level Scheme (HLS) in England, the targeted element (TE) is only available to those farmers who can deliver against Government priorities (the difference in Wales being that these priorities are identified via a system of GIS layers, whilst in England the I understand that the priorities are defined by lines on maps). The first Glastir AWE contracts only took effect on 1/1/12, whilst the first targeted element (TE) contracts aren't due to start until 1/1/13.

Relevant AWE options in terms of wetland creation will include the establishment of streamside corridors (options 8 and 9) and rough grass margins (option 26) but you may regard these as being covered already under the factsheet on buffer strips.

Farms participating in the TE will be obliged to adopt at least one measure in relation to each of the TE priorities for which they have been selected. This may involve them in undertaking additional AWE options and /or additional prescriptions only available under the TE - the details of these are still to be approved by the European Commission. In the meantime, existing agri-environment agreements under both the Tir Cynnal (equivalent to entry-level) and Tir Gofal (equivalent to higher-level) schemes will continue to run until 31/12/13. A small number of Tir Cynnal agreements involve habitat creation; It appears no wetlands have been created under the scheme. Similarly whilst Tir Gofal provides for wetland habitat creation, the areas so far created are very small indeed (although if you included the vegetation within fenced buffer strips, you could be talking about c 300ha).

In terms of reduced fertilizer inputs and plant cover in winter, this would only take place under Tir Cynnal if the farmer had to create new habitats (which only took place on a small number of agreements), but there would have been substantially more work of this type under Tir Gofal since most of the habitat options (which were mandatory if the relevant habitat was present on the farm) involved restrictions on fertilizers and a number of habitat creation options (winter stubbles, conversion of arable land to grassland) involved the provision of plant cover in winter.

Summary

The majority of river basins issue the measure as a plan (3 river basins) – programme plan (FI – Southwest Finland); the protection plan (IT - Liri-Garigliano e Volturno); national implementation plan for the Baltic Sea and the RD plan (SE –Svårtaå); or as a research programme (UK - various catchments in England and Wales); on a voluntary basis. One river basin (DK - Jylland and Fyn RBD) identifies an agreement between the Ministry of the Environment and municipalities/financed under the RDP. One river basin (in FR - LU/FR/DE/BE – Moselle and Sarre) indicated a legal (Water) Act, and in (IT – Serchio) as binding instructions on a compulsory basis.

The majority of river basins (4) issue the measure on a voluntary basis supported mainly by agri-environment scheme funds (FI – Southwest Finland, SE –Svårtaå, UK – various catchments in Scotland, UK - various catchments in England and Wales); one RB – on a compulsory (IT – Serchio), and on both in one RB (in FR - LU/FR/DE/BE – Moselle and Sarre).

Implementation time scale is indicated mainly over a period: once in a period but it must be implemented within 2 years from acceptance, management is 5 or 10 years (FI – Southwest Finland); implementation is done over a period (SE –Svårtaå); and 5 years (UK - various catchments in England and Wales).

As regards compensation:

- Establishment up to 11 500 €/ha of wetland, and management up to 450 €/ha (FI – Southwest Finland);
- RDP can finance up to 90 % of the actual costs, with a threshold of 200 000 SEK/ha (ca. 21 000 €) in a part of the country and 100 000 SEK/ha in the rest of the country. The compensation for management and income loss is between 3000 (320 €) and 4000 SEK per hectare and year for wetlands on arable land and 1500 SEK for other land uses. The compensation for constructing small P-sedimentation wetlands is set to a maximum of 300 000 SEK per hectare, and up to 90 % of the actual cost (SE –Svårtaå).

- Establishment and restoration of wetlands with financial compensation and granting the AEM, and financial compensation of lost income, acquisition of land by community with objective of proper management (in FR - LU/FR/DE/BE – Moselle and Sarre).
- Funded by RDP (UK – various catchments in Scotland (only part) and DK - Jylland and Fyn RBD).
- No compensation was indicated in two river basins (UK - various catchments in England and Wales and IT – Serchio).

One river basin identified random controlling by agriculture authorities, if implemented and managed according to accepted plan (FI – Southwest Finland).

5. Organisation of implementation

ES – Ebro

Ministry for Environment and Rural and Marine Affairs is responsible for the investment. Ebro River Basin Confederation carries out the implementation and monitors results. Autonomous Communities of Aragon and Catalonia control the environmental permits. Community of users (farmers) of “Canal de Aragón y Cataluña” are responsible for new investment and maintenance.

FI – Southwest Finland

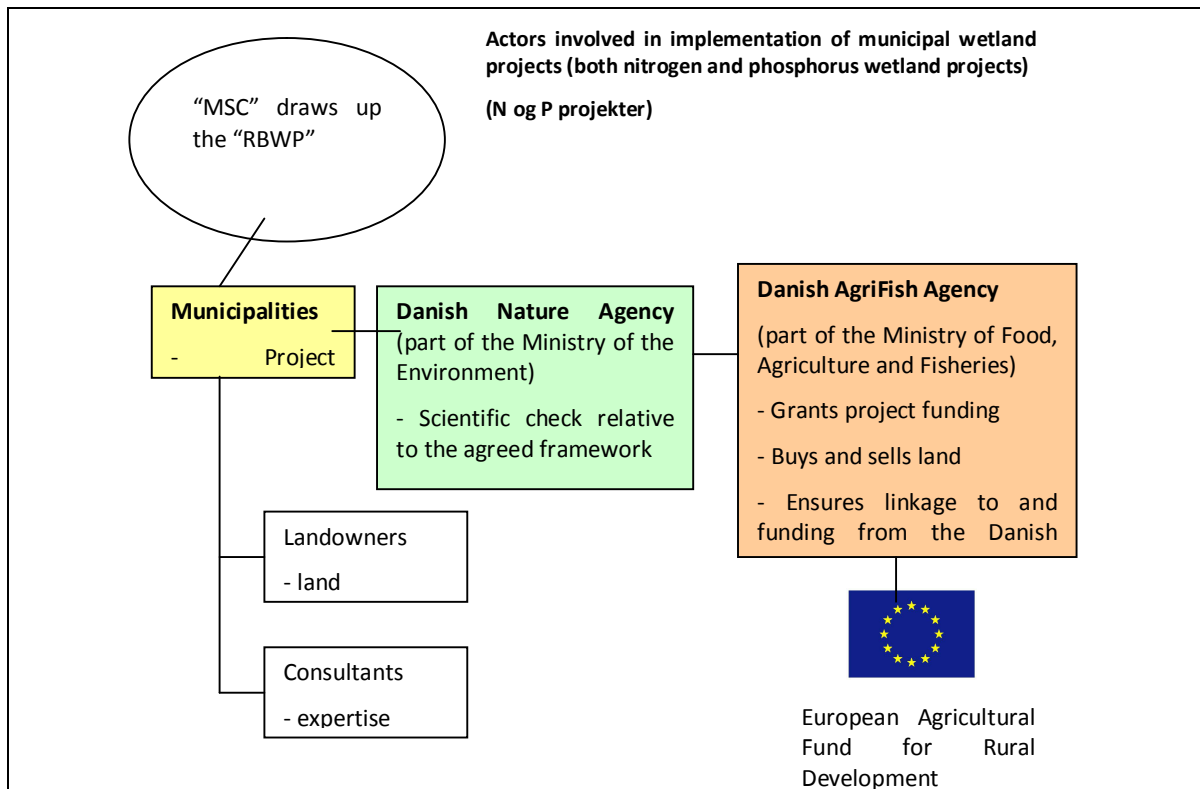
Responsible authority for administrating the implementation is regional environmental and agriculture authorities. Responsible authority for controls is regional agricultural authority. Local municipality environment authority administers construction.

SE –Svärtaå

The responsible authority for administrating the implementation is Swedish Board of Agriculture on a national level and County Board Administrations on a local level. The responsible authorities for controls are County Board Administrations.

DK - Jylland and Fyn RBD

Organisation of the nitrogen wetland and phosphorus wetland measures in the river basin management plans is outlined in the figure below:



MSC = Municipal river basin steering committee (steering committee comprised of the municipalities in a river basin)

RBWP = River basin wetland plan (a kind of a project catalogue of potential wetland projects)

The municipalities carry out the projects. All river basins are naturally subdivided into a number of sub-basins. Within each sub-basin the municipalities involved are required to describe and investigate the possibility for undertaking specific wetland projects. This is done on the basis of the municipalities' prior knowledge of potential project sites and on the basis of contact with landowners. The municipalities are responsible for ensuring that the reduction targets for nitrogen and phosphorus loading specified in the programme of measures under the river basin management plan are achieved within the overall financial framework allocated for the river basin.

The municipal river basin steering committee for the river basin in question receives the specific project proposals from the individual municipalities, prioritises among them and draws up the overall river basin wetland plan, which is basically a catalogue of potential wetland projects within each river basin. In this connection a single municipality is assigned responsibility for each project. The municipality in charge for each project can then apply for state funding for practical implementation of the project.

The Ministry of the Environment controls project funding. The river basin wetland plans (project catalogues) are sent to the Danish Nature Agency in the Ministry of the Environment. Among other things the Danish Nature Agency uses them to determine whether a proposed project is entitled to funding. In order to be entitled to funding the project has to be included in the river basin wetland plan for the river basin in question and has to be cost-effective as assessed from the cost per kilogramme reduction in nitrogen or phosphorus loading.

Large projects that entail large reductions in nutrient loading are accorded higher priority than minor projects.

The Danish Nature Agency also serves at the secretariat for the national steering committee.

The Ministry of Food, Agriculture and Fisheries grants the funding and is responsible for the purchase and sale of land. Once a project has been approved by the Danish Nature Agency in the Ministry of the Environment it is forwarded to the Danish AgriFish Agency in the Ministry of Food, Agriculture and Fisheries, which grants the funding. Funding for preliminary investigations and implementation of the

projects, including administration of the projects, is allocated in the form of a grant from a special scheme under the Danish Rural Development Programme

Landowners are very important project participants. Owners of land in potential project areas will be asked to let their land be included in a nitrogen or phosphorus wetland project in return for financial compensation. Landowners who wish to establish minor wetlands themselves will be able to apply for a subsidy for private wetlands under the Danish Rural Development Programme.

The national steering committee monitors and supports the progress of implementing the wetland measures at national level. The national steering committee is comprised of representatives of the state (Ministry of the Environment) and the municipalities (Local Government Denmark). The state serves as chairman. The Ministry of Food, Agriculture and Fisheries assists the national steering committee.

IT – Serchio

The responsible authority for administering the implementation is Serchio River Pilot Basin Authority.

IT - Liri-Garigliano e Volturno

The logic has always been planning to negotiate, so according to law, regulation by all planning levels (ministries, river basin, river basin authorities, regions, provinces) through participation in negotiations with representatives of environmental associations and protection areas, also to the subsequent management.

LU/FR/DE/BE – Moselle and Sarre

If constraint exists, checked by water police bodies.

LIFE project “ARTWET” FR-IT-DE ; lead by FR - Stormwater or artificial wetlands and vegetated ditches

To promote the ArtWET LIFE ENVIRONMENT project, 2 projects were carried out typically in this aim:

- PhytoRET INTERREG IV (2010-2014): Characterization of the functioning and potential of treatment of the artificial wetlands (Upper Rhine Valley)
- ENRHY (2010-2013)- national project funded by ONEMA (LHYGES Strasbourg): Transposition at the national level for wetland adapted from storm basin in runoff context (France)
- Project funded by ONEMA (lead IRSTEA Antony) to develop an implementation guidance for artificial wetland in drainage context

These projects are on-going.

National guidance by ONEMA (technical group about buffer tools to manage catchment) on going, but local dissemination by local stakeholders such as department office of the environment ministry, department council, agriculture council and watershed association (catchment syndicate).

UK – various catchments in Scotland

Scottish Government is responsible for implementation and control via the SRDP. For CFWs SEPA guidance must be followed to qualify for funding (see CFW Design Manual, http://www.sepa.org.uk/land/land_publications.aspx). Implementation is encouraged via Rural Diffuse Pollution Plan for Scotland (supplement to RBMP) and stakeholder group (http://www.sepa.org.uk/water/river_basin_planning/diffuse_pollution_mag.aspx)

UK - various catchments in England and Wales

Responsible authority for administering the implementation – research consortium contracted to Defra. The responsible authority for controls – the Environment Agency (EA)/Natural England (NE) (CSF).

Natural England (NE) administers the Agri-environment schemes in England, e.g. Environmental Stewardship. The Environment Agency (EA) suggests where such measures might work; NE advisors try to encourage suitable landholdings to take up the HLS option(s) that is/are most relevant for them.

[Wetland Vision](#) maps could/should be used to help decide what wetlands can and should be created where.

Summary

Ministries (national level) are indicated in majority (5) river basins as a responsible authority for administrating the implementation of the measure (Swedish Board of Agriculture on a national level, but the County Board Administrations on a local level in SE –Svärtaå; Ministry for Environment - responsible for the investment in ES – Ebro; the Ministry of the Environment controls project funding and the Ministry of Food, Agriculture and Fisheries grants the funding, while the municipalities carry out the projects in DK - Jylland and Fyn RBD; Scottish Government via the SRDP in UK – various catchments in Scotland; and research consortium contracted to Defra in UK - various catchments in England and Wales).

Regional authorities are indicated in 3 river basins as: River Basin Authority in IT – Serchio; regional environmental and agriculture authorities in FI – Southwest Finland, while Local environment authority administers construction; River Basin Confederation carries out the implementation and monitors results in ES – Ebro.

On a local level, municipalities are responsible to carry out the projects in DK - Jylland and Fyn RBD; community of users (farmers) - for new investment and maintenance in ES – Ebro; the County Board Administrations on a local level is responsible for administrating the implementation in SE –Svärtaå.

In two river basins (both within one country), a national authority was indicated as responsible for controls, i.e. Scottish Government via the SRDP in UK – various catchments in Scotland and the Environment Agency/Natural England in UK - various catchments in England and Wales. One RB - in DK - Jylland and Fyn RBD - the national steering committee (comprised of representatives of the Ministry of the Environment and the municipalities, the Ministry of Food, Agriculture and Fisheries assists the national steering committee) is responsible to monitor and supports the progress of implementing the wetland measures at national level. More river basins (3) indicated a regional level authority as responsible for controls, i.e. the regional agricultural authority in FI – Southwest Finland; the County Board Administrations in SE – Svärtaå; and the Autonomous Communities that control the environmental permits in ES – Ebro. One river basin identified a local level authority - water police bodies in FR - LU/FR/DE/BE – Moselle and Sarre.

6. Acceptance of farmers and involvement of stakeholders, social aspects

ES – Ebro

It's a proposal made by the farmers themselves willing to increase irrigation efficiency and control diffuse pollution to comply with standards. The double effect of the measure contributes to acceptance and it's also important to have the support of the Government in the investment.

FI – Southwest Finland

Not accepted if affects normal farming, but is otherwise quite well accepted. Informational tools for farmers have been general planning reports, guidance material, GIS-tool and advising. Environmental authorities offer pre-planning before actual planning process and application. Farmers can work in cooperation with environmental authorities in general planning process. Farmers are responsible participants in selecting, applying and implementing. Very much accepted and recommended by the local population and the public.

SE –Svärtaå

The measure is not quite accepted among farmers since the compensation is considered to be too small and many farmers don't like to take arable land out of production. Informational and decision support tools used are information from the County Board Administrations and the Swedish Board of Agriculture. The initiative to establishing wetlands and the location is a decision made by the farmer.

The measure is well accepted by the local population.

DK - Jylland and Fyn RBD

The establishment of nitrogen wetlands and the restoration of natural hydrology have been employed as a measure for many years in the Danish national action plans for the aquatic environment, both as private wetlands with a 20-year compensation agreement and as major state wetland projects involving nature restoration. The measure is therefore familiar to the agricultural sector and accepted as a well-functioning and cost-effective measure. Land purchase and sale and land redistribution are also familiar methods.

The new element in the use of nitrogen wetlands as a measure in river basin management plans is that responsibility for their implementation lies with the municipalities and that these have to undertake large numbers of projects concomitantly within a short period of time. It is often the case that several projects have to be undertaken simultaneously within the same sub-basin.

The establishment of phosphorus wetlands to reduce phosphorus loading of the aquatic environment is a new measure. Responsibility for their implementation will also lie with the municipalities.

IT – Serchio

Public meeting for the local involved population and public administrations are arranged for providing information and supporting decisions.

IT - Liri-Garigliano e Volturno

Water Management Plan, the process of participation in dense built and programmed to bring the knowledge of it, has gone through forums, meetings, website sharing the hill associations. To date, in the process of updating the plan, are under stipulations of agreements between the authorities arrived Basin and consortia groups to experience the creations of the sample and verify the quality and the fallout on the water.

LU/FR/DE/BE – Moselle and Sarre

A significant effort has to been made to convince landowners and farmers who consider wetland as fallow land (non-productive) to implement the measure. The regime of land tax could help.

UK – various catchments in Scotland

CFWs have a very low uptake due to perceived loss of income through land take as a result of guidance, cost of construction and confidence in effectiveness. Before the guidance publication uptake was higher (wetlands were smaller and monitoring has cast doubt about their effectiveness). Guidance is given both on the SRDP Internet website and in guidance referenced above, but the recommendation is that specialist advice is required. Farmers are involved in this process. No info on local population acceptance.

LIFE project “ARTWET” FR-IT-DE ; lead by FR - Stormwater wetlands and vegetated ditches

Artificial wetlands can have other functions than the only phytoremediation. If the benefit of artificial wetlands for whole society exceeds the cost of implementing them, then the socioeconomic return is positive. Indeed, some of those externalities were already noted by farmers on the ArtWET devices: improvement of the agriculture image, income linked to the production of biomass, improvement of the agronomic potential of lands.

To conclude, it is important to specify that the artificial wetlands have no negative impact on the quality of the water. Monitoring measures showed that their discharges do not pollute downstream and that they assure thus their role of water treatment. Implementation of artificial wetlands has an impact on the expenses linked to water pollution fighting as they aim at optimizing the treatment of pesticides contained in runoff or drainage water.

There is a lack of incentive to convince farmers or even volunteers. Several local actions should be supported by authorities. The sociological aspect of acceptance will be studied in order to support development of action managed by farmers themselves (see Tournebize et al., 2011 and 2012).

UK - various catchments in England and Wales

The measures are well accepted by farmers, once trust is established and reasons are given and if there are no additional costs to the farmer. However, there are no informational and decision support tools used to provide clear information for farmers yet. Farmers' involvement in the process of selecting and implementing the measure is essential. But the level of acceptance by local population is not at a sufficient scale to raise interest as yet.

It is difficult to generalize. In some catchments where flooding is common, there has been an improved understanding of the value of the wetland resource and their function in terms of helping to protect property from flooding, e.g. the Parrett catchment in Somerset or the role that uplands play in helping to recharge aquifers and improve the water quality of drinking water (e.g. SW Water Upstream Thinking, United Utilities SCAMP project). In other places, there has been a bit of a backlash, e.g. in the Fens where intensive agriculture is the main land use and landowners feel threatened by proposals to restore an area to fenland (for multiple benefits).

A voluntary and piecemeal approach are the greatest barriers to delivering effective conservation/resource protection/ecosystem services through wetland creation/restoration; insufficient finance overall and insufficient per ha rate is biggest disincentive to farmers/uptake (uptake low as not financially worthwhile for farmers).

Also need to encourage collaborative/collective action by farmers (i.e. farmers within a catchment/hydrological unit working together). Use of agri-environment schemes needs to be carefully targeted, with good advisors and preferably non-voluntary to be most effective.

Summary

The measure is quite well accepted in majority of river basins, e.g. since the farmers themselves make a proposal for measures to comply with standards (ES – Ebro); but not accepted if affects normal farming (FI – Southwest Finland); but some complain about low compensation (SE – Svärtaå); since the measure is familiar to the agricultural sector since many years as a well-functioning and cost-effective measure (DK – Jylland and Fyn RBD); once trust established and reasons given and if at no cost to farmer, there is high acceptance (UK – various catchments in England and Wales). Two river basins identify low acceptance due to income foregone, e.g. in LU/FR/DE/BE – Moselle and Sarre, they suggest the land tax regime; or in UK – various catchments in Scotland, cost of construction and confidence in effectiveness are also mentioned as reasons for a lack of acceptance.

Information and decision support tools used to provide clear information for farmers comprise: general planning reports, guidance material, GIS-tool and advising (FI – Southwest Finland); information from the responsible authorities (SE – Svärtaå); public meeting for the local involved population and public administrations (IT – Serchio); participatory approach in the development of the Water Management Plan such as forums, meetings, website sharing (IT - Liri-Garigliano e Volturno).

Farmers' involvement in the process of selecting and implementing comprise: making proposals of measures by the farmers themselves to comply with standards (ES – Ebro); farmers work in cooperation with environmental authorities in general planning process (farmers are responsible in selecting, applying and implementing) (FI – Southwest Finland); and farmer initiate and decide for the location (SE – Svärtaå).

Only two river basins indicated high acceptance by local population and the public (FI – Southwest Finland, SE – Svärtaå). One river basin (UK – various catchments in England and Wales) indicated that there hasn't been a sufficient scale to raise interest.

7. Financial aspects of the measure

ES – Ebro

Investment: 52.75 M€ (538 €/ha). Tentative financial scheme: Ministry 80%, Farmers 20% (in 25 years)

Maintenance: 11 726 €/year (50 years). Farmers

Energy costs (pumping): 8504 €/year. Farmers

IT – Serchio

The measure is currently unfunded. The costs for the drafting of regulation: costs concerned with the activities of the River Basin Authority and costs due to the production of specific studies have been calculated. The total of costs is about 17 000 €.

FI – Southwest Finland

Measures are funded via the Finland Rural Development Programme. The preparation of the wetland management plan, the costs of advisory services and the labour costs of keeping a management log have been taken into account as costs incurred by the measure. Monitoring the condition of the structures, controlling the level of accumulated sludge and removing and transporting the sludge, and mowing the vegetation of the wetland and the adjacent uncultivated management area are major cost items. The benefits of the vegetation of the wetland and its edges and the costs of removing the plant mass are estimated to be equal. Transaction costs are incurred for farmers by the collection of information on wetlands and contacts with agricultural advisers. The payment for the measure is 450 €/ha. The amount of the payment depends on the costs incurred and the income foregone resulting from the management measures.

Total funding earmarked for 2007 – 2013 is 180 000 €/y, only for management. 10 M€ is earmarked for non-productive investments (wetlands and traditional biotopes) for programming period and only 5% is tied at the moment. The measures are tied to the WFD, regional environment strategy.

SE –Svärtaå

Measures are funded currently through RDP. On a Swedish national scale, the proposed funding for the next RDP period 2014-2020 is enough to cover about half of the extent indicated by the River Basin Management Plans, so if funding will continue at the same level after 2020, the goals will be possible to meet to 2027.

The total yearly cost is for management and income loss of wetlands is calculated to 4 489 SEK (c. 490 €) for 2010. The different parts are in SEK and (€):

390 (42): 10 h with excavator in 20 years, 780 SEK/h

316 (34): 20 h with tractor and trailer in 20 as, 316 SEK/h

108 (12): chainsaw or brushcutter

300 (32): material (e.g. pipes, water level control device)

559 (60): work

231 (25): reed cutting (once every 20 as)

1 212 (130): loss of direct payment (60 % of area)

-688 (-74): gain due to less maintenance for direct payment (60 % of area)

2 061 (220): deterioration of land

Implementation cost based on cost-efficiency evaluation is calculated to 80 (38 to 380) € per kg reduced P for the small wetlands, and 700 (180 to 1200) per kg reduced P for the bigger wetlands (Länsstaelsen, 2009). The average cost for N reduction has been estimated to 7 € per kg reduced N to the sea (Naturvårdsverket, 2009b). Biodiversity is observed as synergy effects of the measure to improve cost efficiency (Holstein, 2011).

DK - Jylland and Fyn RBD

An overall financial framework of 1050 MDKK has been allocated for nitrogen wetland and phosphorus

wetland projects during the period 2010–2015. Much of this money is obtained via the European Agricultural Fund for Rural Development with corresponding national funding.

The annual costs (annualised over 50 years) are calculated to be:

- Nitrogen wetlands: 6192 DKK/ha
- Phosphorus wetlands: 3477 DKK/ha

IT - Liri-Garigliano e Volturno

Precise data are not yet available. However, it is expected to be able to use programs. Out of the amount of funding appropriated for the 2007 - 2013 more than 60% has not yet been used.

LU/FR/DE/BE – Moselle and Sarre

Evaluator: No information provided.

LIFE project “ARTWET” FR-IT-DE ; lead by FR - Stormwater wetlands and vegetated ditches

Implementation of artificial wetland has a cost from their conception to their maintenance. It is possible to distinguish three types of expenses:

- preliminary studies: include design, feasibility and possible necessary statutory files (between 5000 and 10 000 € for the totality)
- implementation costs, consisting most of the time of earthworks, vegetalisation, or hydraulic arrangements; for example, for a watershed of 50ha, the cost of the adjustment of a storm basin or a humid artificial buffer zone will be about 10 000€, that of a vegetated ditch or a forest plot from 1000 to 2000 €.
- maintenance of the device: generally very simple (clearing out) and thus quite cheap.

In parallel of these expenses, certain ones can be added during the conception or the implementation. First of all, expenses can be connected to the location of the device. If this one is not property of the project initiator, two solutions exist:

- purchase of the land: add the cost of the land to the price of the device (on average: 5000 €/ha but can reach more than 100 000 € / ha for vineyard),
- dialogue with the owner or local animation in case of multiple projects: additional costs can be thus engendered.

Losses of harvest (income) for the farmers owning the land on which the device is implanted must be considered. Even if they cannot, strictly speaking, be considered as expenses and that they are in general not high, these losses can however be avoided by a sensible choice of location, for example less productive or less advantageous zones.

Finally, monitoring of the water quality can be installed and engendered expenses, essentially linked to the cost of pesticides analyses which can reach some hundreds of Euros.

These various costs can be compensated by requests of subsidies of diverse origins. Farmers are helped within the framework of the CAP, and its transposition by every state member, but also locally by governmental structures or local authorities.

The local authorities can count on some local aids, declined according to countries and regions.

In MAET, financial subsidies for pond management is about 150€ for 4 years. Some subsidies could be grant from PVE (vegetal environment plan). Financial support could be attributed by Water Agency for land acquisition in the case of natural wetland.

More details in: http://coursenligne.u-strasbg.fr/depotcel/DepotCel/592/documents%20a%20telecharger/Artwet_non_technical_guide.pdf

UK – various catchments in Scotland

Measures are funded via the Scotland Rural Development Programme. Payment is based on income foregone (cost of loss of production capacity) and costs incurred (through establishment and construction). Costs may be claimed for: primary treatment of bracken, manual eradication of rhododendron, eradication of scrub/woody vegetation (various), fencing, gates and fence removal - as

appropriate, underdrain (or culvert breaking). A comprehensive list of Capital Items is provided. This is a 5-year commitment. It will be paid £90 per hectare of land managed under this Option per year at the end of each year.”

UK - various catchments in England and Wales

Funding sources include the DTC research budget supplemented by funding from Environmental Stewardship and any projects relevant in the area. Costs have been calculated based on best judgement and experience of researchers in building ponds, wetlands and suchlike (c. £200K).

Implementation is not formally based on Cost-efficiency evaluation. Cost efficiency will be assessed as part of the evaluation.

SW Water has estimated that for every £1 spent on land management agreements to reduce fertiliser use in catchment headwaters they save a **massive £65** in downstream water treatment costs. There is a need to consider financial side of ‘discharge consents/ permits and subsistence charging.

8. Legal aspects

IT – Serchio

The measure is currently unfunded.

FI – Southwest Finland

Water act and dam safety act regulate wetland construction. Environmental authorities check before possible need for environmental permit and acceptance of application. Large wetlands may trigger a need for water / environmental permit. Financial regulations are described in the Rural Development Programme and legal follow-up of it (acts and decrees).

SE –Svärtaå

There is often a need to get a new permit for altered ‘water operations’ (Chapter 11 in the Environmental code; Ministry of Environment, 2000). This can be both time consuming and expensive. If more than one land owner is affected, which is the normal case, the different landowners need to come to an agreement about the new terms for the permit of the water operation. In many cases this is not possible. So far, this obstacle has not been tackled and this hampers the establishment of new wetlands. There may also be an obstacle establishing small P-sedimentation wetlands in existing streams and ditches since the habitats in these elements fall under nature protection regulation. In some cases there is also a conflict with cultural protection legislation.

DK - Jylland and Fyn RBD

The legal basis for implementation of the measures is contained in two statutory orders adopted by Parliament:

- Statutory Order on criteria for assessing municipal wetland projects (*Bekendtgørelse om kriterier for vurdering af kommunale vådområdeprojekter*)
- Statutory Order on subsidies for municipal wetland projects (*Bekendtgørelse om tilskud til kommunale vådområdeprojekter*)

IT - Liri-Garigliano e Volturno

None.

LU/FR/DE/BE – Moselle and Sarre

Evaluator: No information provided.

LIFE project “ARTWET” FR-IT-DE ; lead by FR - Stormwater wetlands and vegetated ditches studied

Regulatory framework: The legal framework linked to the realization of artificial wetlands is variable by

countries. In France, the transposition of the Water Framework Directives gave results in several articles distributed in so called “codes”: Environment code, Rural code, Urbanism code. According to the nature of the device, these can be subject to declaration or authorization and thus accompanied by an incidence study or an impact study. More details in:

[http://coursenligne.u-](http://coursenligne.u-strasbg.fr/depotcel/DepotCel/592/documents%20a%20telecharger/Artwet_non_technical_guide.pdf)

[strasbg.fr/depotcel/DepotCel/592/documents%20a%20telecharger/Artwet_non_technical_guide.pdf](http://coursenligne.u-strasbg.fr/depotcel/DepotCel/592/documents%20a%20telecharger/Artwet_non_technical_guide.pdf)

For new drainage projects, the French water law (via DDT water law service and ONEMA) recommends to propose mitigation measure to prevent water quality from degrading, such as humid artificial buffer zone at drainage collector outlet.

UK – various catchments in Scotland

Planning permission may be an issue in some areas. The Control of Pollution (Silage, slurry and Agricultural Fuel Oil) (Scotland) Regulations 2003 define slurry. The Water Environment (Controlled Activities) (Scotland) Regulations 2011 also need to be complied with.

UK - various catchments in England and Wales

Legal obstacles observed during implementation include: land access; negotiated with farmers. There is a need for ‘discharge consents/ permits’ and a standard of construction and maintenance.

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UK - various catchments in England and Wales

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Denmark: work using wetlands in catchments to reduce nitrate loads into lakes and estuaries

Sweden: evidence work on buffer strips

Vienna: work on use of floodplain to protect city from flooding

NW Germany (Lower Saxony): use of floodplain

Integrated constructed wetlands are also used in Ireland and Scotland- where SSAFo regs have been altered to allow for ICWs

3. Charge for water abstraction / reduce water abstraction

Contributing River Basins: Ebro (ES); Arno, Serchio, Tiber, Liri-Garigliano e Volturno (IT); Southwest Finland (FI); various catchments in England and Wales (UK).

1. Definition of measure

CAOM

Charge for water abstraction

Charging for ground and surface water abstraction creates an incentive for farmers to reduce water use. In some countries, there is no charge to abstract water (e.g. Austria). Such a charge would reduce the amount of water taken out of ground or surface waters, thus reducing the adverse effects of abstraction on the hydrological regime (e.g. aquatic ecology due to changes in flow regimes) (Ecologic et al, 2007).

Reduce water abstraction

Reduce water extraction is relevant in areas with low water supplies and where saline water intrusion and nitrate contamination are high.

ES – Ebro

This measure is the final stage of a process to alleviate the impact of water abstraction on the groundwater bodies “campo de Cariñena (075)”, “Pliocuatenario de Alfamén (076) and “Mioceno de Alfamén (077)”. Actions started in 2002 and have covered several aspects chronologically:

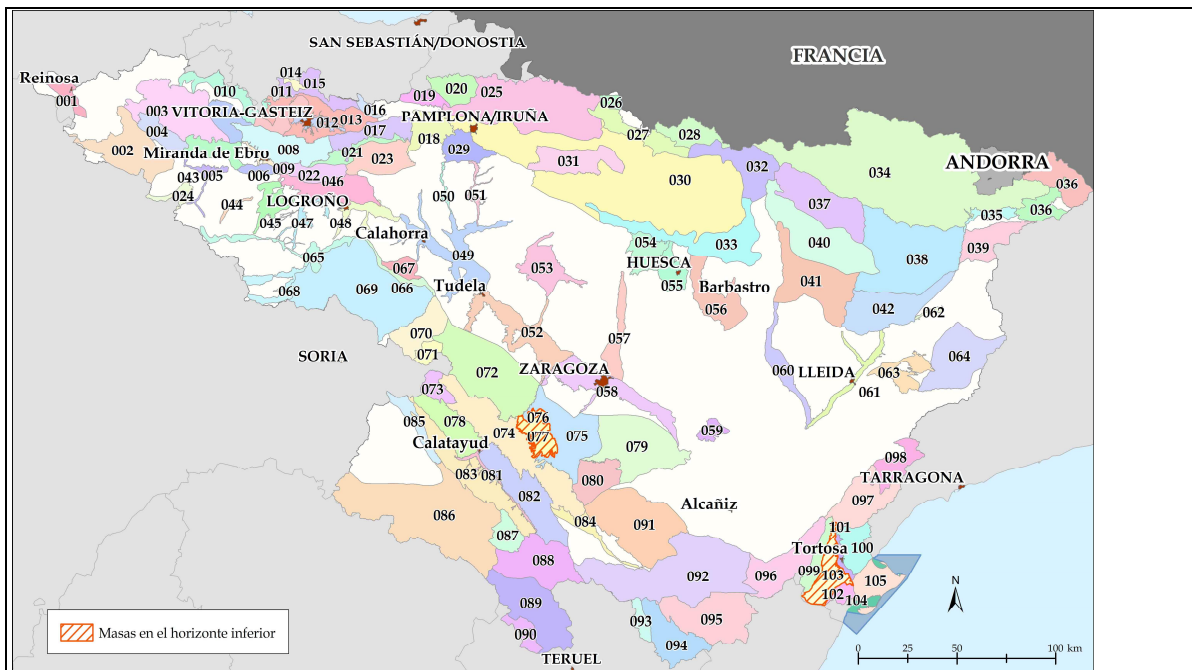
- 1) Monitoring of headwater levels (before 2002 and on-going)
- 2) All new abstractions were forbidden, due to the depletion detected in aquifers, until a whole assessment of the aquifer situation was carried out (decision taken by the Ebro River Basin Confederation in 2002)
- 3) Implementation of counters in all wells and intensive monitoring of abstraction and headwater levels (already done)
- 4) In depth hydrogeology study to assess the situation thoroughly (already done).
- 5) As a result, a proposal of rules and zones limiting new abstractions in the area has been made, and it has been incorporated in the Basin Management Plan (waiting for its approval; in the meantime step 2 is being put in place).
- 6) Aquifer recharge: Building retention weirs in two seasonal torrential streams to increase infiltration into the aquifer (on-going).
- 7) Follow-up monitoring (on-going)
- 8) Conjunctive use of surface and groundwater in the whole sub-basin in the future (Mularroya dam under construction and pumping from Canal Imperial)

IT – Arno

The measure “*Reduce Water Abstractions*” refers to groundwater and surface water abstractions. How much water a farmer can abstract (and by how much he has to reduce abstraction) is defined in the Water Balance Plan (drafted on the basis of historical data). The plan assesses the balance between water resource availability and abstractions. On the basis of this, the Plan sets abstraction restrictions during the summer months for surface water abstraction. Groundwater abstraction when the water balance is negative is prohibited. The measure addresses abstraction for public water supply, industrial and agricultural uses.

IT – Liri-Garigliano e Volturno

Limits are imposed for the amount of water taken; sometimes the time of abstraction and the water levels are monitored. Limits exist primarily for irrigation and drinking water in specific times. Water abstraction is prohibited in water stress areas. The measure addresses the problem of unregulated water withdrawals, lack of monitoring and control, and a large number of wells.



Location of groundwater bodies (Ebro - ES)

The ascent of the salt wedge is due in part to fluctuations of the interface between the freshwater aquifer and the underlying sea water due to excessive exploitation of the resource, and partly to the reduction of water flow rate value of the watercourses. This, in turn, is caused by changing climatic conditions and by human intervention and increasing pressure on the physical system.

All of these factors cause serious environmental problems, such as groundwater dependent ecosystems and – indirectly - deterioration of the soil quality. Since water is used primarily for agricultural purposes the soils undergo a significant chemical deterioration due to the accumulation of salts in the soil, resulting in increased aridity. Such degradation is proven by the fact that the soils of large areas of the coast are no longer usable for agriculture and in other areas farmers cannot use wells for irrigation anymore.

In addition, the degradation of fertile soils can be attributed to the lack of planning, both in terms of urban sprawl and in terms of the absence of a policy strategy for choosing adequate types of crops to be produced on the territory.

IT – Serchio

Submeasure #1: set of rules for surface water exploitation For surface water: new licenses are forbidden.

Submeasure #2: set of rules for groundwater exploitation. For groundwater exploitation new licenses are forbidden. Home use is permitted within 0,1l/sec. Exemptions exist

Submeasure #3: set of rules for water supply.

During drought years, licenses of abstraction from surface water body have restrictions from 15 July to 30 September.

IT – Tiber

Safeguard of aquifers and base flow

New water abstractions are forbidden in critical areas. In areas that are not critical, specific guide parameters should be followed in terms of cubic meters of water per hectare per year.

A specific study has been made to collect data and calculate the evapotranspiration and the specific needs of water for irrigation of crops cultivated in volcanic areas (i.e. the guide parameter is 1800 m³/a/ha in a specific hydrogeological basin).

FI – Finland

In Finland, there is currently no problem of lacking water; only 2% of natural water is used altogether. But during very dry summers, some areas have a shortage of water for agricultural use. Only greenhouses and some special horticultural crops need irrigation in Finland. Only 6% of fields in Southwest Finland are occasionally irrigated. At the moment, there is no need for measures to reduce water abstraction, but there might be some risks in the future. Nitrate contamination of groundwater as well as lack of water might be possible in some areas. Climate change is supposed to diminish precipitation during the growing season. Due to geographical reasons, Southwest Finland is the most likely area in Finland to suffer from climate change.

UK – various catchments

Reduce water abstraction in areas with low water supplies and where saline water intrusion and nitrate contamination are high.

Summary

Targets: both surface and groundwater bodies (IT – Arno, ES – Ebro)

Problems: some countries report no lack of water problems (FI – Southwest Finland). Problems in other catchments include: excessive exploitation of aquifers, salt water intrusion and salt wedge, reduction of flow rate, changing climatic conditions, chemical deterioration of soils causing aridity (loss of agricultural land), absence of adequate strategic policy (agricultural, urban, etc.) (IT – Liri-Garigliano E Volturno), and nitrate contamination (UK – several catchments).

Actions: water abstraction forbidden in critical areas (IT-Tiber, ES - Ebro), specific guide parameters in m³/ha/year (IT-Tiber), monitoring of headwater levels and follow-up monitoring, implementation of counters in wells, hydrogeology study, proposal of rules and zones limiting new abstraction and incorporation in RBMP, aquifer recharge (retention weirs) (ES - Ebro)

2. Extent of use of measure

ES – Ebro

The measure extends its effects to all irrigation land within the area that affects groundwater bodies. Around 10 000 ha are highly productive.

IT – Arno

The described measures are implemented gradually in different areas on the basis of water availability. The measure applies to the entire catchment. This means that abstraction is forbidden in areas where the water balance shows a critical situation. In other areas, abstractions are monitored according to water availability. The measure is implemented first in areas where the water availability is out of balance.

IT – Liri-Garigliano e Volturno

This measure could be problematic for the analysis phase especially the use of a common methodology for determining the areas to be investigated. An air pilot study may allow for adjusting the measure as it is developing. The Water Management Plan prepared already contains a series of measures that could be applied in areas of proven problematic samples.

IT – Serchio

The measure is proposed for all the water uses and is limited to the Massaciuccoli Lake sub-basin.

IT – Tiber

At the moment, the measure is limited to volcanic aquifer and Tarhenian coastal areas. In the future, the measure could become compulsory for these regions and voluntary for others. This development is, however, not currently scheduled.

UK – various catchments

The Environment Agency works with abstractors to develop and promote water efficiency for agriculture, i.e. to improve resilience to climate change, including promotion of winter storage reservoirs; grants; water efficient irrigation and farm housekeeping; and water audits. A number of publications have been produced to promote water efficiency in agriculture, as well as generally in businesses.

Water conservation publications

<http://www.environment-agency.gov.uk/research/library/publications/33993.aspx>).

The publication **Resources on water efficiency in agriculture** lists resources useful for farmers seeking to improve their water management, and specifically, their water efficiency. It is due to be published externally on our website. **Be Waterwise** information sheets: These documents give practical advice to abstractors on how they can save money and energy by using less water; improving the reliability of their abstractions through storage; and using rain and grey water as alternative options. These are due to be published externally on our website.

Summary

In the Ebro catchment, the measure targets all irrigation land in the area that affects groundwater bodies (ES – Ebro). Sometimes the measure is limited to the specific river / lake sub-basin (IT-Serchio, IT – Tiber). Some catchments do not seem to have started implementation yet, but measures are included in the RBMP (IT – Liri-Garigliano E Volturno).

3. Effects of measure

CAOM

Reduce water abstraction primary effect: reduce the water needs.

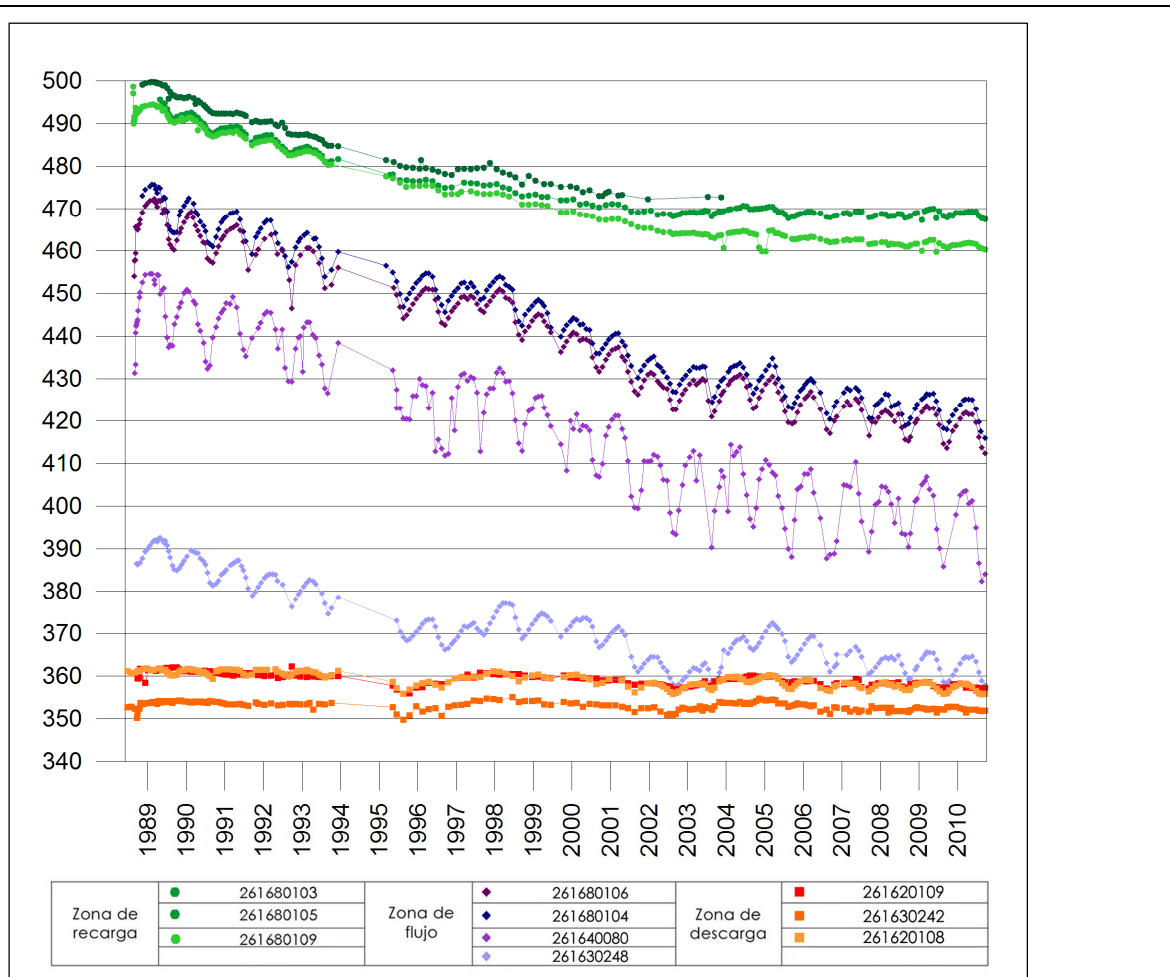
Water related side effect: reduce water extraction.

ES – Ebro

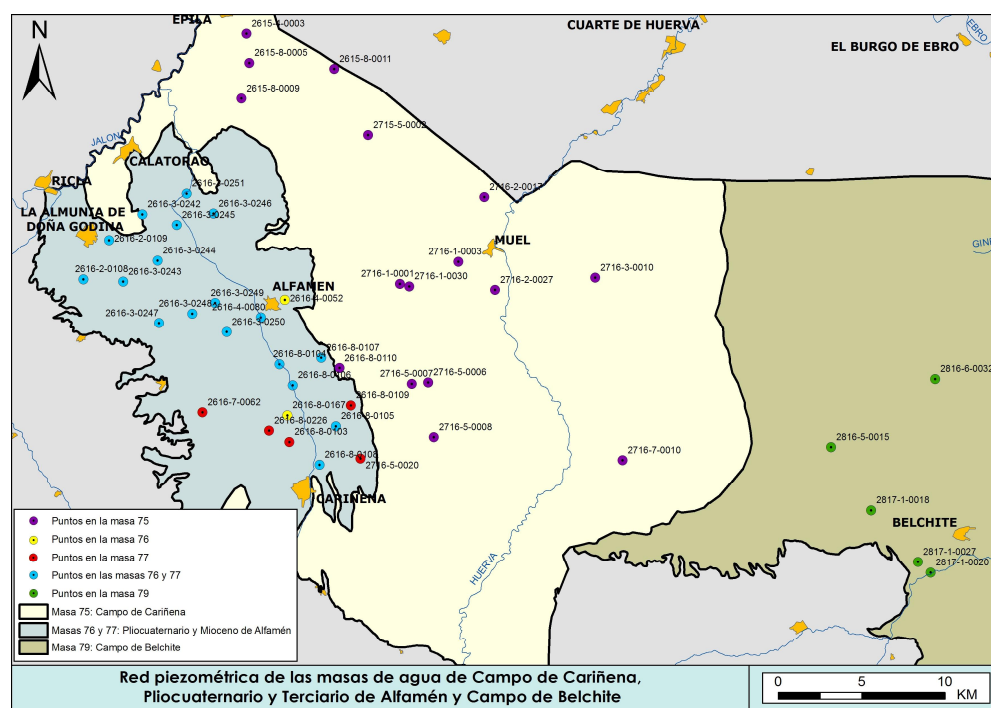
The aim of the measure is to improve the quantitative status of the groundwater. The intended effects are to stop the decline of water levels by not allowing new water abstractions in certain areas and to reverse the trends by means of recharging the aquifer (increasing infiltration, building retention weirs in two seasonal streams) and conjunctive use. It's expected to diminish the exploitation index below 0.8 (this index is a ratio between water abstraction and the available resources). As a side-effect, the retention weirs will prevent flash floods in the village La Almunia de Doña Godina. It may also help in the improvement of chemical status (it's also a vulnerable zone). There has been intensive monitoring. A high density network of piezometers in the affected areas and water counters in wells has been implemented. New piezometers have been recently set to monitor the effects of aquifer recharge. At present, it seems that there is a stabilization of head levels in the groundwater bodies. Once the aquifer recharge and conjunctive use are in place, the trend is expected to reverse somewhat.

The effectiveness indicator is the evolution of head water level in the groundwater bodies, although it's an indicator that reflects the widespread measures taken and not only the implementation of water counters.

The following graph shows how water levels tend to stabilize since first measures were implemented in 2002.



Piezometers in groundwater bodies of the area of Campo de Cariñena. Evolution of piezometric levels.



Piezometers network.

IT – Arno

The goal of these measures is the achievement or protection of water balance in all water bodies. The expected effect is the sustainable use of water resources. Measures are being applied on the whole territory of the River Arno Catchment since April 2008. As regards aquifers with serious water balance deficit, a decrease in the lowering of the piezometric water level trend has already been observed. There are measures that establish quantitative limits and piezometric water levels for withdrawal prohibition.

Although no climate change model has been applied, datasets on pluviometric, piezometric and hydrometric information from the last 15 years that take climate change scenarios into account were considered. The protection of the minimum vital flow has positive effects on biodiversity. Regarding the management of groundwater bodies, there will be positive effects on subsidence and therefore on soil quality. The effectiveness of implemented measures is checked by testing groundwater piezometric levels, surface water minimum vital flow for longer periods, decrease in yearly abstractions and decrease of WEI index values during summer months.

IT – Liri-Garigliano e Volturno

The Water Management Plan has made an estimate of volumes that pass through the surface and the allocation of underground water (underground aquifers) that are in the district. First, the areas where there is an on-going process of desertification or high potential risk of desertification should be identified (where desertification means the set of processes of different nature and origin can lead to irreversible degradation of the ability of soils to sustain ecosystems, regulate the hydrological cycle and to provide goods and services). Particular reference to the processes of salinisation of groundwater and soil and triggering causes should be made. The study, on which measures concerning water abstraction will be based, will provide support for planning activities in the field of forestry, protection of water resources and soil resources, protection of landscape, habitat and biodiversity; it will also promote the production of tools and aids for training, dissemination and education on environmental issues concerning the conservation and sustainable management of soil resources and water resources of surface and groundwater. The increase of knowledge about these phenomena will lead to the definition of guidelines for the proper use of water resources and specific actions aimed at mitigating the phenomena in question.

IT – Serchio

The measure is aimed to water abstraction reduction in the Massaciuccoli lake area. The Massaciuccoli lake area is a sensitive area and vulnerable zone to pollution caused by nitrates from agricultural sources. The measure is intended to avoid the deterioration of water deficit. One of the possible indicators for assessing the degree of implementation of the measure is "number of abstraction licenses and granted concessions for the abstraction". The effect of the measure is intended to avoid the further decline of the water deficit. There are indirect positive effects of the measure on human health (positive effects on the water component), and on sustainable use of natural resources (positive effect on water saving). The implementation of the measure, leading to a temporary limitation on the availability of water in the Massaciuccoli lake area, produces a reduction in terms of the capability of the building section, resulting in a lower income (urbanization costs) for municipalities.

IT – Tiber

The intended effects are to re-equilibrate the water balance in all the aquifers. The first expected result is the increased level of awareness on water availability and that water is not always available. Acceptance of the water users is an obstacle.

Summary

Effects: stabilization of head levels in groundwater bodies (ES – Ebro), decrease in lowering of piezometric water level trend (IT – Arno, IT – Tiber), protection against climate change (IT – Arno), maintenance of minimum flow (IT – Arno).

Goal: Diminish exploitation index below 0.8, improve quantitative status of groundwater, stop decline of water levels, reverse trends by recharging aquifer and conjunctive use (ES – Ebro), achievement of water balance in all water bodies (IT – Arno), avoid deterioration of water deficit (IT – Serchio), increase in the level of awareness on water availability (IT – Tiber). Some catchments have not reported on effects (FI, UK).

4. Method of implementation of measure

ES – Ebro

In 2002, the Governing Board of the Ebro River Basin Confederation issued an Act to stop new abstractions of groundwater until a whole assessment of the aquifer situation was carried out. The Ebro Confederation has established the monitoring network. The farmers had to implement water counters in their wells and facilitate the monitoring. The actions and the cost to recharge the aquifer are implemented by the Ebro Confederation.

IT – Arno

Management is implemented with safeguard measures detailed in a specific “Water Resources Balance Plan” which is part of a wider Basin Plan. Measures are compulsory, have no time limit and are not compensated; their effects are monitored with hydrometric and piezometric monitoring systems.

IT – Liri-Garigliano e Volturno

In Italy, some indications are available through “good agricultural practices”. In this sense, there was a push by the Water Management Plan drawn up which already contains measures related to the topic.

IT – Serchio

- Issued as a legal act.

- Implementation of control requirements is already established by law.

Issued as a legal act on a compulsory basis. The measure will apply until the completion of the works concerned with the water derivation from the Serchio river toward the Massaciuccoli lake. Compensation is not required.

IT – Tiber

Issued as a plan rather than as a legal act. Therefore, it is a compulsory measure for farmers who are in the areas mentioned before. It is a compulsory measure for farmers in need of new water abstractions. There is no deadline, the measure is effective since the Plan has been adopted and the Regions and Provinces are the responsible authorities for implementation. Implementation of control requirements is already established by law.

Summary

In the Ebro basin, there was a special act to stop new abstractions of groundwater until the situation of aquifers was assessed. Other catchments have plans (IT – Arno, IT – Tiber) and legal Acts (ES – Ebro, IT – Serchio). In Italy, the Regions are responsible for implementation through Provinces. Monitoring is established in several catchments (ES – Ebro, IT – Arno, IT – Serchio, IT – Tiber). Measures are compulsory (ES – Ebro, IT – Arno, IT – Serchio, IT – Tiber), except for the Liri-Garigliano e Volturno basin, where measures are not implemented yet but the GAEC guidelines are considered. Where the measure is implemented, no time limit exists (IT – Arno, IT – Tiber), at least not until the completion of planned works (IT – Serchio). No compensation exists in two catchments (IT – Arno, IT – Serchio), nor in ES– Ebro, but for the actions to monitor and to increase aquifer recharge.

5. Organisation of implementation

ES – Ebro

The Authority responsible for the implementation is the Ebro River Basin Confederation.

IT – Arno

The Authority responsible for the implementation of the above described measures is the River Arno Basin Authority together with Provinces (local Authorities) that are in charge of issuing water abstractions licenses. Issuing the licenses is part of the measure and a certain decrease in number of licenses can be observed since the implementation of the measure.

IT – Liri-Garigliano e Volturno

Regulation is developed at the following levels: ministries, river basin, river basin authorities, regions, provinces. This is done through participation in negotiations with representatives of environmental associations and protection areas.

IT – Serchio

Responsible authority for administrating the implementation: Serchio River Pilot Basin Authority and provincial administration.

IT – Tiber

The Regions are the responsible authorities that administrate the implementation through the Provinces.

FI – Southwest Finland

N/A

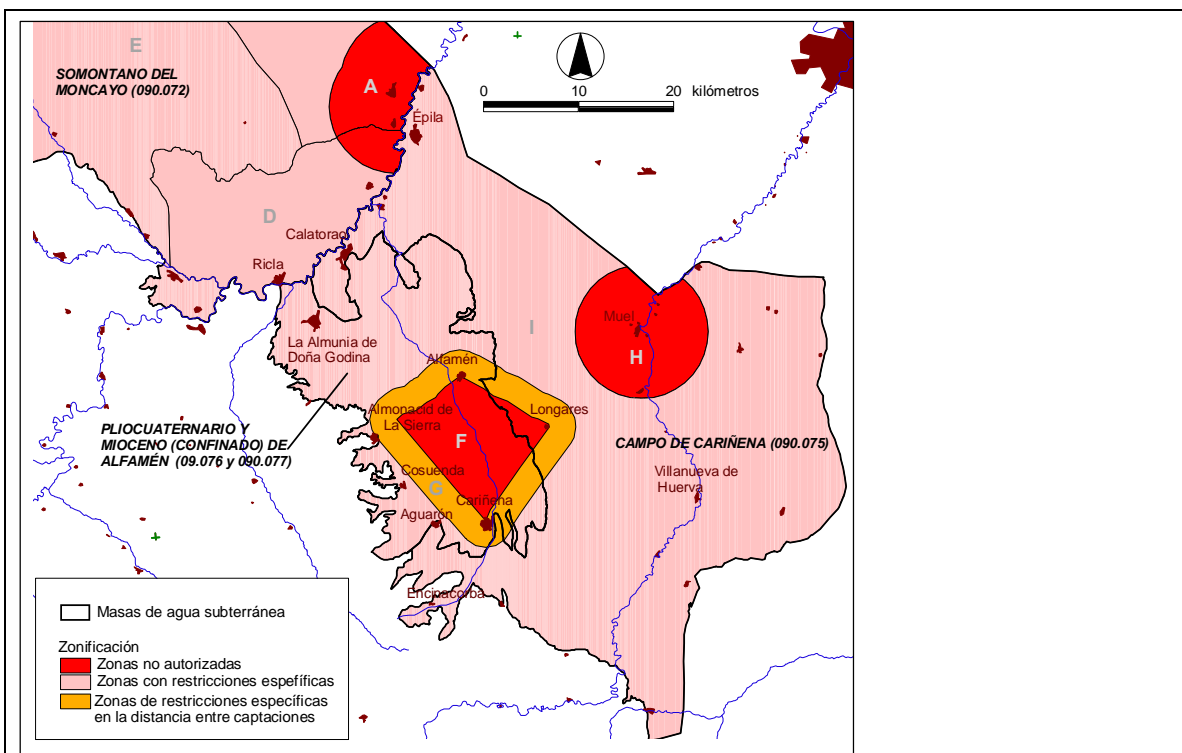
Summary

The regions and provinces or the specific organisation of the river basin in question are the responsible authorities for implementation.

6. Acceptance of farmers and involvement of stakeholders, social aspects

ES – Ebro

In general, farmers and irrigators agreed with the measures to control the depletion of the aquifer since they perceived the risk for their farms in the years to come. The implementation of water counters was made along with prohibiting new water licenses in the area. The early decision taken in 2002 has prevented the over exploitation of the aquifer and stabilized levels; as a result, the measures to be taken are neither expensive nor conflictive. The base is not to allow new abstractions in certain areas and optimize the conjunctive use with surface water. A comprehensive hydrogeology study has been developed and during the elaboration of the Ebro River Basin Management Plans there were several meetings with the organisations of farmers in the area.



Proposal of zones (in red, zones where new abstractions are not allowed) (EBSO, ES).

IT – Arno

Measures do not only refer to agriculture but to all water uses and have been adopted after long observation and consultation activities carried out by all users. In particular agricultural associations submitted observations from "Confagricoltori-CIA" against the reduction of abstraction that were accepted in accordance with law provisions.

IT – Liri-Garigliano e Volturno

The Water Management Plan outlines the process of participation in densely built areas and has been programmed to gather knowledge through forums, meetings, website sharing. To date, in the process of updating the plan, agreements between the Basin authorities and consortia groups to experience the creations of the sample and verify the water quality are under stipulation.

IT – Serchio

Informational and decision support tools used to provide clear information for farmers: public meeting for the local involved population.

IT – Tiber

The acceptance from the farmers is difficult. The River basin Authority doesn't have competence for awareness rising. When having relations with Regions and Provinces sometimes we are informed about the difficulty of acceptance by the farmers.

7. Financial aspects of the measure

ES – Ebro

Financed by:

State (through the Ebro River Basin Authority):

The cost of the actions to recharge the aquifer has been evaluated in 800 000 €.

The special piezometric monitoring can be estimated in 25 000 €/year

The hydrogeology study cost 400 000 €

Farmers:

The farmers implemented counters in wells (1000 – 1200 € per well – around 350 wells). Farmers (investment made to improve their efficiency as a whole, notwithstanding the implementation of measures). The farmers are using efficient irrigation techniques at their own cost.

IT – Arno

Not yet available

IT – Liri-Garigliano e Volturno

Precise data are not yet available. However, we expect to be able to use funding programs.

IT – Serchio

Funding sources: unnecessary

IT – Tiber

No

8. Legal aspects

ES – Ebro

The Governing Board of the Ebro River Basin Confederation issued in 2002 an act to stop new abstractions of groundwater until a whole assessment of the aquifer situation was carried out.

IT – Arno

Difficulties encountered in transposing water resources planning tools are the main legal aspects linked to the implementation of the measures. These difficulties stem from the necessity to ensure the integration of the different plans (plans drafted by the provinces or territorial management plans and the basin plan with the aim of water resources and environmental protection).

The SEA (Strategic Environmental Assessment) and public consultation, which are at the basis of planning procedures, are fundamental to tackle the above mentioned difficulties. Measures are based on and justified by the Basin Plan that contains data on the availability of the water resources. The opinion that the Authority releases on single water abstraction licenses is based on the Basin Plan. During administrative proceedings, the competent body can, and in certain cases must acquire the opinion of another body to decide properly. The competent body must ask for the opinion of another body and decide in compliance with that expressed opinion. It is a mandatory opinion, fundamental to the Provinces' abstractions licensing activity.

IT – Liri-Garigliano e Volturno

None

IT – Serchio

No legal obstacles observed during implementation

IT – Tiber

The legal act as mentioned above is the adoption of the Plan containing the measure.

9. References

ES – Ebro

<http://iber.chebro.es/participacion/>

IT – Tiber

Central Apennines River Basins Management Plan

UK – various catchments

Restoring Sustainable Abstraction (RSA) link for external audiences:

<http://www.environment-agency.gov.uk/business/topics/water/32026.aspx>

EA water conservation publications:

<http://www.environment-agency.gov.uk/research/library/publications/33993.aspx>

Following three documents in attached Abstraction Papers folder:

- Environment Agency 'Be waterwise for farmers'
- Environment Agency 'Be waterwise: spray irrigators'
- Environment Agency 'Resources on water efficiency in agriculture'. This document lists resources that will be useful for farmers seeking to improve their water management and, specifically, their water efficiency.

4. Reduced fertilization

Contributing River Basins: Svärtaå (SE); Liri-Garigliano e Volturno, Tiber (IT); various catchments in England and Wales (UK); Weser (DE).

1. Definition of measure

CAOM

Reducing the amounts of nitrogen and phosphorus fertilizers by a certain percentage below the economic optimum will reduce the residual nitrate in the soil after harvest and - in the short term - the amount of soluble phosphorus. In the long term, reducing phosphorus fertilizers can reduce the amount lost as particulate phosphorus.

SE – Svärtaå

This measure can be divided into three sub-measures *a*, *b*, and *c*:

- a) Fertilisation following the Swedish Environmental code, which mandates that manure and fertiliser should be applied so that as much as possible of the applied nutrients could be consumed by the crop. This implies:
 - On average, in a five year period, it is not allowed to apply more than 22 kg/ha/a of phosphorus.
 - In Nitrate Vulnerable Zones (NVZ), the maximum applied amount of manure corresponds to 170 kg/ha/a of nitrogen.
 - In NVZ, it is allowed to apply a maximum of 60 kg of available nitrogen per hectare in autumn before cultivation of winter rape seed, for other winter crops, it is allowed to apply a maximum of 40 kg nitrogen. The amount of nitrogen applied in the autumn should be adjusted so it corresponds to the actual crop requirement in the autumn.
- b) Fertilisation according to the official recommendations by the Swedish Board of Agriculture (Albertsson, 2011).
- c) Fertilisation of N below economical optimum.

IT - Liri-Garigliano e Volturno

Mineral fertilizers and nitrogen-based fertilizers are the prevailing types used. The distribution of fertilizers is conditioned by the specific environmental conditions and the characteristics of agricultural land.

The Nitrates Directive introduces specific measures for the land application of nitrogen fertilizer, with limits per hectare in the distribution of manure and concentration of nitrates in water. Limits concerning the application of livestock manure in an amount equal to 170 kg/ha/a of N. The maximum permissible concentration of nitrates in water is 50 mg/l. Also, limitations to the use of fertiliser are part of the good agricultural practice.

English Agri-environment schemes (ELS scheme handbook, Natural England)

Entry Level Scheme options for Permanent grassland with low inputs:

“Do not apply more than 50 kg/ha nitrogen per year as inorganic fertiliser. Where animal manures are applied, either alone or in addition to inorganic fertiliser, the total rate of nitrogen must not exceed 100 kg/ha N per year. Only apply during the growing season, provided no birds are nesting in the field, and ground conditions are dry enough to prevent soil compaction. If your current manure and fertiliser application rates are less than this, you must not increase applications. You may find it useful to refer to the table in appendix 2 of the ELS handbook showing average total N supplied by various manures.”

ELS Permanent grassland with very low inputs

“You may apply up to 12.5 tonnes/ha (5 tonnes/acre) of FYM a year, but only where the grassland is regularly cut. Only apply FYM during the growing season, provided no birds are nesting in the field, and ground conditions are dry enough to prevent soil compaction. No other type of fertiliser or manure

may be applied. If your current manure and fertiliser regime is less than this, you must not increase applications. You may find it useful to refer to the table in appendix 2 showing average total N supplied by various manures.”

Management of rush pastures

“You may apply up to 12.5 tonnes/ha (5 tonnes/acre) of FYM a year, but only where the grassland is regularly cut. Only apply FYM during the growing season, provided no birds are nesting in the field, and ground conditions are dry enough to prevent soil compaction. No other type of fertiliser or manure may be applied. If your current manure and fertiliser regime is less than this, you must not increase applications. You may find it useful to refer to the table in appendix 2 showing average total N supplied by various manures.”

Welsh Agri-environment schemes

Glastir Land Management Scheme.

Glastir (the new agri-environment scheme for Wales) Reduced fertilizer inputs options are available under both the All Wales Element (AWE) and the Targeted Element (TE). Relevant AWE options as regards reduced fertilizer usage will include all of the habitat management options (15-21) and many of the arable options (26-34)

<http://wales.gov.uk/topics/environmentcountryside/farmingandcountryside/farming/glastirhome/?lang=en>

The first Glastir AWE contracts only took effect on 1/1/12, whilst the first TE contracts aren't due to start until 1/1/13. Farms participating in the TE will be obliged to adopt at least one measure in relation to each of the TE priorities for which they have been selected. This may involve them in undertaking additional AWE options and /or additional prescriptions only available under the TE - the details of these are still to be approved by the European Commission. In the meantime, existing agri-environment agreements under both the Tir Cynnal (equivalent to entry-level) and Tir Gofal (equivalent to higher-level) schemes will continue to run until 31/12/13. Reduced fertilizer inputs would only take place under Tir Cynnal if the farmer had to create new habitats (which only took place on a small number of agreements), but there would have been substantially more work of this type under Tir Gofal since most of the habitat options (which were mandatory if the relevant habitat was present on the farm) involved restrictions on fertilizers.

Glastir is a 5-year whole farm sustainable land management scheme available to farmers and land managers across Wales. From 2012, Glastir will replace the existing agri-environment schemes, ensuring that future environmental challenges can be met. Glastir pays for the delivery of specific environmental goods and services. It is designed to deliver measurable outcomes at a farm and landscape level in a cost effective way.

Glastir consists of three elements:

- All-Wales Element (AWE) - a whole farm land management scheme which is open to application from all farmers and land managers throughout Wales. It is designed to provide support for the delivery of environmental benefits that meet today's challenges and priorities. Successful applicants will make a commitment to deliver environmental goods for five years under a legally binding contract. An additional funding source for an Agricultural Carbon Reduction and Efficiency Scheme (ACRES) is available to farmers who have a contract under the All-Wales Element.
- Targeted Element (TE) – a part farm scheme intended to deliver significant improvements to the environmental status of a range of habitats, species, soils and water that might also require changes to current agricultural practices. In order to achieve these specific improvements and outcomes, financial support from the Welsh Government will be targeted at locations where action will lead to the required result.
- Common Land Element - designed to provide support for the delivery of environmental benefits on common land.

Rules applicable to all land in the Glastir AWE: Maintain field records of all applications of farmyard manures, slurry, inorganic fertiliser, organic fertiliser, calcified seaweed, lime, sewage sludge, waste paper sludge, other off and on-farm wastes, pesticides and herbicides. Land Managers must keep an

up to date paper or electronic record of all these applications on a parcel by parcel basis for all the land in your AWE contract covering the full period of the contract. All records must be retained for six full years after the end of the contract.

Options 14: Commit to slurry injection is an option available to enterprises with a minimum slurry storage capacity of 100000Litres. The aim is to help to improve the quality of the water by reducing runoff from farmland and to ensure that nutrient from slurry is fully used so that less chemical fertilisers will need to be bought in, reducing costs and greenhouse gas emissions to the atmosphere. All slurry used on the holding must be applied using an injector or trailing shoe system for the duration of the agreement.

The Glastir Targeted Element (TE) also contains the following prescriptions to reduce fertiliser usage;

- Promoting arable management without inorganic fertiliser,
- Unsprayed spring sown cereal and linseed crops with the retention of winter stubbles - conversion from improved grassland.
- Improve nutrient management through planning and soil sampling.
- Grassland managed with no inputs between 15 October and 31 January.

DE - Weser

Reducing the amounts of nitrogen and phosphorus fertilizers by a certain percentage below the economic optimum will reduce the residual nitrate in the soil after harvest and - in the short term - the amount of soluble phosphorus. In the long term, reducing phosphorus fertilizers can reduce the amount lost as particulate phosphorus.

By reducing the nitrogen fertilisation, the N-surpluses are sometimes decreasing to a negative balance. This effect can be increased by avoiding the late fertilisation in autumn after harvesting.

2. Extent of use of measure

SE – Svärtaå

According to the Swedish Environmental Code and the official recommendations by the Swedish Board of Agriculture (*a* and *b* under point 1), measures to reduce fertilization are proposed to all farmers.

Under the Swedish Environmental Code, part of the measure is limited to NVZ. In the Svärtaå river basin 44% of the area (52% of the arable land) is designated as nitrate vulnerable zone, and as a consequence different rules apply to different areas.

IT - Liri-Garigliano e Volturno

The Italian legislation being developed to transpose European standards at national level. Good agricultural practices in regional plans for water protection and water management plans should be used.

UK - various catchments in England and Wales

The measure is proposed to all farmers. These measures are implemented in a more targeted way in particularly sensitive areas. NVZ Action Programmes in England and Wales do not act to reduce fertilisation rates.

Farmers are encouraged to reduce fertiliser use on a voluntary basis in England and Wales, through several schemes, such as the **Environmental Stewardship**, which is a targeted scheme.

- About 66% of agricultural land in England is in some form of Government funded agri-environment scheme, many of which support improved nutrient management (e.g. low input grassland). There has been a wide uptake of various environmental stewardship schemes – in England. They cover ca. 6.5 Mha.
- About 40% of the agricultural land in England (50 priority catchments) has been identified as priorities for additional government funded advice (including nutrient management) through the Catchment Sensitive Farming initiative. ([Method 24 – Reduce manufactured fertiliser](#))

DE - Weser

This measure is primarily chosen in sensitive areas with a high leaching rate and where the nutrients surplus has to be reduced. Every farmer with plots in these sensitive areas can apply. In the River Basin Weser this measure is recommended for more than 200 000 ha which is 15% of the arable land of concern.

3. Effects of measure

SE – Svärtaå

The aim of measure *a* and *b* under point 1 is to reduce N and P losses by adopting the amount of mineral fertilisers and manure to the current legislation and to an economical optimum. Measure *c*, fertilisation of N below economical optimum, aims at reducing N leaching losses by decreasing the amount of N applied below present economic optimum.

The intended effect is to reduce N and P losses to water by reducing fertilization, in particular in cases when over-dosage is practiced.

There is an unambiguous relationship between the amount of applied N and leaching (e.g. Bergström and Brink, 1986; Harmel et al., 2006). In central Sweden, where the Svärtaå river basin is situated, Johnsson et al. (2005) estimated a reduction in the total N load to water of 4 % when the applied amount of N to winter wheat and spring barley was reduced with 10 %. Also for P there is a relationship between the amount of applied fertilizer and leaching (e.g. Hart et al., 2004; Gessell et al., 2004; Ulén and Mattsson, 2003; Tarkalson and Mikkelsen 2004). According to a recent compilation by Djodjic and Kyllmar (2011), there is a significant variation of N and P applications where over-dosage is frequent, especially if manure is applied.

The rate of implementation can be evaluated through the national official statistics on how much manure and fertilizer that is applied in different regions in Sweden (Swedish Statistics, 2010). For those farmers participating in the environmental extension program “Focus on Nutrients”, farm gate balances are performed and evaluated, which is an approximate indicator of the implementation.

Among the expected or observed effects on other environmental priorities is the reduction of excess mineral N in the soil also decreases the emission of nitrous oxide (e.g. McSwiney and Robertson, 2005; Millar et al., 2010).

IT - Liri-Garigliano e Volturno

There is constant monitoring by the regions through regional agencies for environmental protection (ARPA).

UK - various catchments in England and Wales

The aim of this measure is twofold:

- Reduce nitrate pollution from agriculture to surface and groundwater to protect drinking water supplies (in line with Nitrate Directive requirements and WFD Good Status and DrWPA)
- Reduce nitrate and phosphate pollution and the risk of undesirable disturbance to water environments (i.e. eutrophication) and consequently support delivery of WFD objectives (e.g. Good Ecological Status/Potential)

The measures also help encourage better use of resources (inorganic fertilisers and manures) and therefore more sustainable agricultural practices.

The intended effects of the measure are to reduce loads of nitrate and phosphate to surface and ground waters through leaching and run-off. Specific information on the relative cost-effectiveness of these measures at the site scale can be found in pages 41 to 77 of:

http://archive.defra.gov.uk/foodfarm/landmanage/water/csf/documents/UserManual_Jan07.pdf

Monitoring/Evaluation is being conducted for the rate of implementation and the effects of the measure

Reducing the amounts of nitrogen and phosphorus fertilizers by a certain percentage below the economic optimum will reduce the residual nitrate in the soil after harvest and in the short term the amount of soluble phosphorus. In the long term reducing phosphorus fertilizers can reduce the amount lost as particulate phosphorus.

Effects of the measure include:

Livestock Management: Reducing animal feed N with primary regard for animal health animal health can still reduce the concentration of N in animal urine by up to 30%.

A reduction in stocking density is the most effective measure to reduce N loading, although, costly. Stocking density is proportional to N loading per hectare. Reducing herd size, spreading the livestock out or reducing grazing time will reduce the N loading. Although beef and sheep are less intensive than dairy the costs in reducing nitrate loading are similar. *Reported effectiveness:* 30% reduction in urine N content. *Reduced stocking density:* 2.9 and 14.6 kg N ha⁻¹ (9-33%).

Agri-environment techniques: i) Fertiliser application rates have dropped – in the case of nitrogen in England and Wales from around 150 kg/ha in 1987 to just under 100 kg/ha in 2009, contributing to improvements in water quality in both marine and freshwater ecosystems. This could be as a result of greater awareness of efficient fertiliser use, coupled with the increasing costs of fertiliser. ii) Managing farmland more sympathetically led to a 25% improvement in biological condition of streams and small rivers between 1990 and 1998 with only 2% of sites deteriorating.

Monitoring: Within the Glastir TE water priority areas, Environment Agency Wales undertake soil samples on improved land to assess nutrient levels. A Nutrient Management Plan (NMP) is then generated for the farm holding to implement. Furthermore Water Management Plan (WMP) and storage reports are also produced to support any current or future ACRES applications under the ACRES Manure and Slurry Management themes. Glastir is a voluntary scheme - and as with the lower tier of the Environmental Stewardship Scheme in England, the AWE is open to all farmers provided they select sufficient options to qualify, whilst as with the HLS in England, the TE is only available to those farmers who can deliver against Government priorities (the difference in Wales being that these priorities are identified via a system of GIS layers, whilst in England the priorities are defined by lines on maps).

DE - Weser

The impacts that can be monitored immediately are savings in expenditure for fertilisers and a reduction in the farms gate analysis. Usually income loss is linked. The impact to the water bodies especially in seepage water or in groundwater can usually be monitored later due to the partially long retention times. For a faster success a combination with other measures like catch crops is recommended.

Guidelines for fertiliser demands, coming from a huge set of surveys in test-areas, are accessible through the chambers of agriculture. This measure is recommended as being very appropriate and independent of soil and climate. The amount of implemented measures can be estimated by the registered applications and is estimated between 30 – 50 kgN/ha N-Saldo.

Summary

	Nitrogen load	Phosphorus load
Svärtaå, Sweden	A reduction of nitrogen application by 10% on winter wheat and spring barley result in a 4% reduction in the total N load to water	Reduces P leaching into water courses

United Kingdom	Arable land: 5-10 kg N/ha reduction in leaching per year from a 20% reduction in N application below fertiliser recommendation. A 50% reduction in N application reduced leaching by 10-15 kg N/ha	Applying ½ P fertilizer on horticulture land reduces leaching by 20%
Weser, Germany	Mentioned a reduction in leaching based on farm gate analyses	

4. Method of implementation of measure

SE – Svärtaå

Issued as a legal act, programme, plan

a) The Swedish Environmental Code is issued as a legal act. The Swedish Board of Agriculture is currently performing a capacity building project together with the municipalities to increase the efficiency of the enforcement (Jordbruksverket, 2012).

b) The official recommendations by the Swedish Board of Agriculture are part of the environmental extension campaign 'Focus on Nutrients' and therefore voluntary.

The Swedish Board of Agriculture also publishes a report every year with a calculating scheme and instructions for how to calculate the fertilization to optimize the profit updated with information on prices on fertilizer and expected crop value (Albertsson, 2012). Schematic tables are presented as well as more sophisticated calculation schemes making it possible to adjust for local conditions. The calculating scheme includes a recommendation based on crop type (26 crop types to choose from), and expected yield. The recommended fertilization of mineral N is then reducing considering the:

- long term effect of manure applications,
- preceding crop,
- soil organic matter content and
- applied amount of manure for the crop.

Besides price for the yield and fertilizer costs, the P-fertilization recommendation is based on crop type (10 crop types to choose from), expected yield and soil P status.

c) Fertilisation of N below economical optimum is included as a potential measure in the Baltic Sea Action Plan, as a part of the Swedish commitment to HELCOM, to reduce the N load to the Baltic Sea (Naturvårdsverket, 2009). This measure is voluntary and not yet implemented.

No compensation is provided for these measures.

IT - Liri-Garigliano e Volturno

According to Ministerial Decree of the Ministry of Agricultural Policy (MiPAAF) of 19 April 1999, the "Good agricultural practices Code", which deals with the proper use of nitrogenous fertilizers, has been formalized. Furthermore in 1999, according to Legislative Decree 152/99 (abrogated and replaced by Legislative Decree 152/06) laying down "Provisions concerning the protection of waters from pollution", the rules about the employ of nitrates in agriculture have been issued, in order to reduce or manage the problems related to pollution.

UK - various catchments in England and Wales

1) implementing Codes of Good Agricultural Practice

All farmers are encouraged by government (such as the Code of Good Agricultural Practice) and national partnerships (including agricultural sector led e.g. 'Tried and Tested') to adopt good nutrient management practices on a voluntary basis in all parts of England and Wales. This is because the measures not only benefit the environment, they also benefit farm businesses through waste minimization of inorganic fertilisers, and good re-use of manures (DEFRA, 2009).

2) There are Government funded agri-environment schemes to provide farmers with targeted advice and incentives to help support up-take of improved nutrient management on a voluntary basis. These provide advice and CAP funded (pillar 2) incentives to adopt a variety of low input (reduced fertiliser) agricultural practices.

In England these are:

- Entry Level Stewardship (ELS):
<http://www.naturalengland.org.uk/ourwork/farming/funding/es/els/default.aspx>
- Organic Entry Level Stewardship (OELS):
<http://www.naturalengland.org.uk/ourwork/farming/funding/es/oels/default.aspx>
- Higher Level Stewardship (HLS) scheme:
<http://www.naturalengland.org.uk/ourwork/farming/funding/es/hls/default.aspx>
- In Wales this is Glastir:
<http://wales.gov.uk/topics/environmentcountryside/farmingandcountryside/farming/glastirhome/?lang=en>

DE - Weser

This measure is voluntary and offered since 2007. The Federal States compensate the income loss of farmers who have applied. The farmers have to apply for at least 5 years. The control is part of the contract and has to be reported as fertiliser amount and N-min-concentration in soil at determined times.

5. Organisation of implementation

SE – Svärtaå

Responsible authority for administrating the implementation:

- a) The municipalities are responsible for the operational implementation of the legislation at the farms while the responsibility for inspection- and enforcement-guiding rests at national (Swedish Board of Agriculture) and regional level (County Board administration). The guiding responsibility includes supporting, advising and evaluating inspection and enforcement work.
- b) Through the environmental extension service campaign “Focus on Nutrients”. Information is also given from the County Board Administrations, the Swedish Board of Agriculture and the municipalities.
- c) Swedish Agency for Marine and Water Management and the Swedish Board of Agriculture.

Responsible authority for controls: Inspection and enforcement of the requirements that follows under the Environmental code is performed by the municipalities. The requirement that follows under Cross-compliance is performed by the county board administrations.

IT - Liri-Garigliano e Volturno

UK - various catchments in England and Wales

Responsible authority for administrating the implementation

- The Single Farm Payment in England = Rural Payments Agency
<http://rpa.defra.gov.uk/rpa/index.nsf/home>
- The Single Farm Payment and RDP (including agri-environment) in Wales = Rural Inspectorate for Wales which is part of the Welsh Government <http://wales.gov.uk/?lang=en>
- RDP Agri-environment in England = Natural England www.naturalengland.org.uk

Responsible authority for controls

- Developing controls and policy in England =Department of Environment, Food and Rural Affairs
<http://www.defra.gov.uk/>
- Developing controls and policy in Wales = Welsh Government <http://wales.gov.uk/?lang=en>

Representing farmers, land managers and agricultural professionals: many farming organisations

support delivery of measures, some of the main ones are:

- National Farmers Union - <http://www.nfuonline.com/>
- Country Landowner and Business Association - <http://www.cla.org.uk/>

DE - Weser

Agri-environmental programme: Sponsor and approving organisation are the Ministries for Agriculture of the Federal States or the chambers of agriculture, which are controlling the farmers' reports as basis for the compensation payment and have additional controls by spot tests on the plots.

Co-operation: In the drinking water co-operations, money for the water abstraction is paid and can be used for sensitive farming and eventually included income losses. The controls are similar to those of the agri-environmental programme. Seepage water and raw drinking water monitoring results are used additionally. Farmers have to apply to both systems.

6. Acceptance of farmers and involvement of stakeholders, social aspects

SE – Svärtaå

Farmers' opinion on the measures (as defined under point 1):

- a) Commonly well accepted, but with certain hesitation due to doubts about the impact of the environment and because it may be related to increased costs or other inconveniences. Many farmers have a genuine concern on the impact of the environment related to eutrophication, but their perception is that the losses of nutrients related to their own activities are relatively unimportant or difficult to influence.
- b) Commonly well accepted, especially when it will result in cost saving for the farmers; some scepticism exists due to established traditions, or based on own experiences and information from extension services that are not always in agreement with the recommendations from the Board of Agriculture.
- c) Not introduced yet, but the acceptance will partly relate to the strategy for implementation, i.e. the choice of policy instrument.

Informational and decision support tools used to provide clear information for farmers:

The Swedish Environmental Code and for measure *b*) information through diverse channels, e.g. the environmental extension service program "Focus on Nutrients", information from the County Board Administrations, the Swedish Board of Agriculture and municipalities. For calculation of nitrogen fertilisation according to the official recommendations, there is a decision support tool available through the [Focus on Nutrient web site](#).

Farmers involvement in the process of selecting and implementing

- a) There is no direct involvement of farmers in the process of selecting and implementing mandatory measures.
- b) Fertilization according to the official recommendations is a voluntary measure promoted by the environmental extension and the implementation is therefore a decision by the farmer.

IT - Liri-Garigliano e Volturno

The measure is generally well accepted. The participation process is an integral part of the Water Management Plan in order to gather knowledge through forums, meetings and websites to share information.

Concerning monitoring: To date, in the process of updating the plan, agreements between the RB Authorities and consortia groups are underway to conduct water sampling and verify the quality of the water.

UK - various catchments in England and Wales

The measure is well accepted and supported by farmer representative groups, as indicated by their involvement in national and local partnerships to implement measures voluntarily.

Farmers involvement in the process of selecting and implementing:

- For national partnership measures farmer groups are instrumental in measures development.
- For local implementation farmers are involved to varying degrees in development of partnership measures.

Various modelling tools have been, or are being used including:

- River Basin Management Plan Risk Assessment models
- NITCAT, NCYCLE and MANNER models for nitrate:
<http://www.adas.co.uk/MANNER/tabid/270/Default.aspx>
- PSYCHIC model for P: <http://www.sciencedirect.com/science/article/pii/S0022169407006233>

FARMSCOPER <http://www.avondtc.org.uk/Mitigation.aspx>

DE - Weser

Saving fertilisers is a direct advantage for the farmers. The acceptance of the farmers couldn't be assessed yet, but is estimated to be rather low, especially in comparison with catch crops.

7. Financial aspects of the measure

SE – Svärtaå

Funding sources

- a) Costs resulting from complying with the law are covered by the farmer. Farmers are also charged for inspections and controls performed by the municipalities, however full cost recovery is not accomplished, so part of the controls are financed via the budgets of the municipalities (i.e. tax payers).
- b) Environmental extension is funded through the rural development program, and the measure is generally cost saving for the farmer.

What costs have been calculated (and how)?

- a.) Costs for increased frequency of inspection and enforcement has been calculated to 380 000 €/a for the RBD. This is based on an assumption that ca. 3% of the farmers are controlled every year and a cost per issue of 1050 €. For the Svärtaå river basin this would correspond to a yearly cost of approximately 3000 €. However, since the inspection covers more measures than only this it can be motivated to divide this cost on different measures (e.g. avoid spreading fertilizer and manure in high risk areas and at high risk times).
- b.) Financing of environmental extension services to realise fertilisation according to the official recommendations has been estimated to a yearly cost of 30-40 MSEK for whole Sweden (Jordbruksverket, 2010). If 100 000 ha is covered by this extension per year, this would correspond to a cost of c. 35 €/ha.
- c.) The increased costs are related to income forgone and are primarily related to expected yield reductions and loss of income, but also other things such as increased costs for storing and spreading manure.

Implementation based on Cost-efficiency evaluation?

- a.) No. This is a basic measure according to the WFD and has to be implemented regardless of cost-efficiency. However, the cost-efficiency for avoiding over dosage of N to autumn sown crops is estimated to 7-16 €/kg reduced N, calculated from the yearly cost to increase the storage capacity for manure (Naturvårdsverket, 2009).
- b.) Yes, according to Swedish Environmental Protection Agency (Naturvårdsverket), the cost for environmental extension (e.g. Focus on Nutrients) would be between 150 and 300 € per kg reduced P and 3-6 €/kg reduced N.
- c.) Yes. If N doses 30 % lower than recommended are used for 800 000 ha of cereals, it would reduce the load with 1900 ton to an average cost of c. 5 €/kg reduced N (Naturvårdsverket, 2009).

Synergy effects of the measure observed that improve cost efficiency?

Yes, reduction in the emission of nitrous oxide.

IT - Liri-Garigliano e Volturno

This measure, in Italy, provides for the application of a maximum proportion of animal origin nitrogen equal to 170 kg/ha. Although the existence of some exclusion factors, it is possible to comply with European funds.

UK - various catchments in England and Wales**Funding sources**

Measures are funded through different implementation methods including CAP Axis 1 and 2, U.K. Government funding (Grant in Aid), as well as water industry and agricultural sector private funding.

What costs have been calculated (and how)?

Typical cost estimates for individual site measures are given in http://archive.defra.gov.uk/foodfarm/landmanage/water/csf/documents/UserManual_Jan07.pdf

And also in <http://www.environment-agency.gov.uk/business/sectors/bestfarmingpractices.aspx>

Much of this has been built into the FARMSOPER modelling tool to help farmers and farm advisers understand the costs and benefits of various agricultural measures at individual farm level. This has not yet been rolled out for routine use. It is extremely difficult to scale-up this farm/field cost information to the catchment scale. In addition there is also the Catchment Sensitive Farming initiative which primarily provides advice and some funding: <http://www.naturalengland.org.uk/ourwork/farming/csf/default.aspx>

National estimates of cost are given in relevant Impact Assessments for various regulations (including the Water Framework Directive)

Implementation based on Cost-efficiency evaluation?

Implementation is based on cost-effectiveness in so much as many of these measures are seen as cost-effective for farm business as well as the environment. The exception is the relative high initial outlay for new storage facilities, relative to the long pay-back period to the farmer for implementing this measure.

Synergy effects of the measure observed that improve cost efficiency?

In considering the costs and benefits of these measures, synergetic impacts to other agriculture pressures (e.g. soil erosion, sediment pollution and climate change) have also been considered.

Environmental Stewardship in England – Entry Level Scheme -

EF9 Unfertilised cereal headlands 100 points per ha

EL2 Permanent grassland and Moorland with low inputs in SDAs 35 points per Ha

EL3 Permanent grassland and Moorland with very low inputs in SDAs 60 points per Ha

EK2 Permanent grassland with low inputs 85 points per ha

EK3 Permanent grassland with very low inputs 150 points per Ha

Environmental Stewardship Higher Level Scheme:

HJ3 Arable reversion to unfertilised grassland to prevent erosion or run-off: £280 per ha

HJ4 Arable reversion to grassland with low fertiliser input to prevent erosion or run-off: £210 per ha

HJ8 Nil fertiliser supplement £55/ha

HD7 Arable reversion by natural regeneration £500 per ha

HF14 Unharvested, fertiliser-free conservation headland £440 per ha

Defra estimated that the costs to the agricultural sector of complying with the 2008 revised NVZ rules will be between £44 million and £65 million per annum.

The most effective measures (in terms of cost and N leaching reduction) are:

- É Having a nutrient plan and knowing the N content of manures, composts and slurries
- É Calibrating fertiliser spreaders (predicted 8% reduction in leaching);
- É Reducing stocking density (it is the most effective measure to reduce N loading from livestock, but costly).
- É Spreading farmyard manure rather than slurry (as this has less readily available N)

DE – Weser

Current surveys show that compensation payments of 45-70 €/ha are paid.

The cost effectiveness of the measure can be calculated by the ratio of the compensation payment in comparison with the decrease of the autumn N-min. which is in average 9-14 €/kgN.

Summary

	Financial costs associated with measure
Svärtaå, Sweden	<p>“ Inspection and enforcement costs is estimated to 1050 € per visit. Cost is spread over inspection of multiple measures.</p> <p>“ The cost for environmental extension (e.g. Focus on Nutrients) would be 150-300 €/kg reduced P and 3-6 €/kg reduced N.</p> <p>“ Savings: If N doses 30% lower than recommended are used for 800 000 ha of cereals, it would reduce the load with 1900 ton to an average cost of c. 5 €/kg reduced N (Naturvårdsverket, 2009).</p>
Weser, Germany	<p>“ Compensation ranges between 45-70 €/ha</p> <p>“ The cost effectiveness of the measure can be calculated by the ratio of the compensation payment in comparison with the decrease of the autumn N-min: 9-14 €/kg N.</p>
Liri-Garigliano e Volturno, Italy	<ul style="list-style-type: none">• Precise data are not yet available. However, it is expected to be able to use programs.

8. Legal aspects

IT - Liri-Garigliano e Volturno

UK - various catchments in England and Wales

No legal obstacles observed during implementation.

DE – Weser

The farmers don't like to commit to such a contract for at least 5 years, because the economic effects can hardly be estimated due to the determined crop rotation and because of additional conditions that to be regarded (i.e. special pesticide application). Additionally, high administrative burdens prevent farmers from applying.

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Links to DTC websites at:

<http://www.edendtc.org.uk/>

<http://www.wensumalliance.org.uk/>

<http://www.avondtc.org.uk/>

Natural England Environmental Stewardship pages:

<http://www.naturalengland.org.uk/ourwork/farming/funding/es/default.aspx>

5. Avoiding spreading fertiliser and manure at high risk times and places

Contributing River Basins: Southwest Finland (FI); Svärtaå (SE); various catchments from Scotland, England and Wales (UK); Jaeren, Leira-Nitelva (NO); Weser (DE); NL.

1. Definition of measure

High risk times can be linked to frozen or snow-covered soils, or when fertilizer application is followed by heavy rains with excessive runoff, extreme hydric conditions (e.g. water-logged, flooded conditions) or when there is little or no crop uptake. These conditions serve as the basis for closed period for applications. The measure requires adequate collection and storage facilities. The latter will be assessed in another factsheet.

High risk areas can include areas with flushes draining to a nearby watercourse, cracked soils over field drains, highly sloping fields and field with high phosphorus content. The measure implies for instance width requirements for application.

FI - Southwest Finland

Mandatory measures:

Nitrate is regulated by a legal act according to the nitrate directive all over Finland. The nitrate directive is stricter depending on the slope of the field. According to the act, manure may not be applied on frozen, snow covered or water-saturated ground. Manure may not be spread between 15 October and 15 April. Organic fertilizer applied in the autumn must always immediately, and within 24 hours at the latest, be incorporated, or arable land must be ploughed. Nitrogen fertilization, among others, is prohibited on land that is located closer than 5 m from the watercourse. The surface application of nitrogen fertilizers is prohibited located closer than 10 m from the watercourse if the slope of the arable area exceeds 2%.

Additional and special measures:

"Spreading of manure during the growing season". The measure can only be chosen by a livestock farm within agri-environment payments. Manure may be spread in the spring no earlier than 15 April and is allowed until 15 August. Sometimes earlier or later spreading is allowed depending on crop or on weather conditions.

"More efficient reduction of nutrient load". The measure is available for cultivated parcels in the fertility class "high" or "possibly excessive" for phosphorus. The measure may also be available for cultivated parcels where the fertility class for phosphorus is at least "good" if the parcel is located alongside main ditches and bigger water bodies. With the measure farmer is committed to reduce phosphorus fertilization to reduce content of P in soil and is supposed to monitor P-status in soil by soil analyses every three year.

In addition the special measures: "Incorporation of liquid manure in the soil" is also designed to avoid spreading manure and fertilizers at high risk areas. See part no. 9.

In the **Svartaå RB**, in Nitrate Vulnerable Zones (NVZ) it is prohibited to apply manure or fertilizer between 1st November and 28th February. For the period 1st August to 31st October, it is only allowed to apply manure and organic fertilizers to a growing crop, or before autumn sowing. However, solid manure (except poultry manure) can be applied to growing crops and to bare soil between 1st and 31st of October. Application of fertilizer and manure to cover crops is not allowed.

Outside NVZ, manure and fertilizer should not be applied if soil or land is snow-covered, or if soil or land is frozen and it can be a reason to think that fertilizer or manure can be lost via surface runoff or via leaching through cracks.

Regarding the high risk areas, manure and fertilizer should not be applied to soil or land if it can be a reason to think that it can be flushed to adjacent surface waters or if it can contaminate ground waters. In areas with fluctuating water levels, application of fertilizer and manure should be avoided if there is a risk for losses by flooding or water logging. It is prohibited to apply manure or fertilizer within

2m from water courses or lakes, and in NVZs also if the soil slope adjacent to the water course or lake exceeds 10%.

There are also official national fertilizer recommendations, where it is stated at what soil P levels fertilization should be avoided for different crop types.

NL

According to the Dutch Fertiliser Act, all livestock farms are required to have manure storage facilities, which are large enough for the storage of manure of their animals for the period August 1 – March 1 (7 months). This is (roughly) the period in which manure application is prohibited. There are different periods for manure application for manure, depending on the type of manure, soil type and whether there is grassland or arable land.

Grassland

- The application of slurry is allowed from February 16th to September 1st (all soil types).
- The spreading of solid manure is allowed from February 1st to September 1st on sand and loess soil. On clay and peat soil spreading of solid manure is allowed from February 1st to September 16th.

Arable land

- The application of slurry on arable land (all soils) is allowed from February 1st to August 1st. Spreading to September 1st is allowed if winter rape or a green manure crop is planted before August 31st of that year or bulbs are planted in the fall.
- Spreading of solid manure on arable land on sand and loess soil is allowed from February 1st till September 1st. Solid manure can be applied all year directly before the planting of fruit trees and park on sand and loess soils.
- On clay and peat soils solid manure can be spread all year.

It is not allowed to apply manure if the soil is frozen, covered with snow or water saturated, nor can manure be applied when the soil is irrigated or infiltrated.

Manure application is not allowed on steep slopes

Although the Netherlands is largely a flat country, there are some slopes. Steep slope refers to land with a slope of 7% or more. Different rules apply for different gradients:

Slope of 7% or more

- Manure application is not allowed on steep slopes if there is gully erosion, or when the land is cultivated.
- Manure application is not allowed on uncultivated land with a slope of 7% or more, except if sown within eight days (with again exceptions; see <http://www.hetInVloket.nl/onderwerpen/mest/dossiers/dossier/gebruik-en-uitrijden-meststoffen/dierlijke-mest/uitrijdregels>).

Slope of more than 18%

Manure application is not allowed on arable land with a slope of 18% or more.

‘Emission poor application’

Manure should be applied in such a way that emissions are reduced as much as possible (‘emission poor application’). There are different conditions for arable land and grassland.

Arable land

On arable land ‘Emission poor application’ is required. Arable land refers to land on which at least part of the year a crop is grown other than grassland. Uncultivated land is land which does not show that it

is evenly covered with a crop.

Liquid manure

With respect to the application of liquid animal manure on arable land, the following rules apply:

- On cultivated arable land the manure needs to be put immediately in slots in the floor. The slots should not be wider than 5 cm.
- On cultivated arable land the manure needs to be put immediately in slots in the floor. The slots should not be wider than 5 cm and less than 5 cm deep.
- Or the manure should be applied on the surface and simultaneously be incorporated in one pass with one machine, so that the manure is ploughed under or mixed thoroughly with the soil immediately after application. The manure is then no longer visible on the soil surface.

Solid manure

With respect to the application of solid manure, the manure should be applied on the surface and incorporated in maximal two directly consecutive swaths, so that the manure is ploughed under or mixed thoroughly with the soil immediately after application. The manure is then no longer visible on the soil surface.

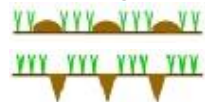
Grassland

Liquid manure

On pastures 'Emission poor application' is required. In 2011, manure application on grassland on sand and loess soils was allowed directly on or in the ground. However, as of January 1st 2012, manure application on sandy and loess soils is only allowed if manure is applied directly into the soil (no drag feet allowed anymore).

On grassland on clay and peat soils manure must be applied immediately on or in the soil. Here's how you can use emission:

On the ground means: in strips between the grass, where the grass is tilted or laterally pushed. The strips are up to 5 cm wide and are at least 15 cm apart.



In the ground means in slots with a maximum width of 5 cm.

Solid manure

The application of solid manure on pasture does not have to be 'emission poor'.

Exceptions

In the following situations, 'emission poor' manure application is not required:

- On arable land on the island of Texel.
- On soils used solely for the cultivation of grass or fruits, the application of solid manure. Unless this land has a slope of 7% or more.

UK - Scotland

This measure is a regulatory requirement (General Binding Rule <http://www.legislation.gov.uk/ssi/2011/209/>) covering storage and application of fertilisers see http://www.sepa.org.uk/land/land_publications.aspx for a description of width requirements for application and timing requirements for snow etc. It is recommended that a Risk Assessment for Manures and Slurries (RAMS) is carried out to help ensure compliance. Guidance on this is given in the Four Point Plan for livestock farmers) <http://www.sac.ac.uk/consulting/services/f-h/fbs/publications/fourpointplan/>. Nutrient management is also required.

NO – Jaeren

By avoiding the spreading of mineral fertilizers or manure at high risk times, the nitrate leaching and

loss of nitrogen through surface run off is diminished. High risk times include when there is a high risk of surface flow, rapid movement to field drains from wet soils or when there is little or no crop uptake. The measure requires adequate collection and storage facilities. Avoiding applying mineral fertilizers and manure to high risk areas help to prevent run-off of nitrate and phosphorus in the watercourses. Risk areas include areas with flushes draining to a nearby watercourse, cracked soils over field drain or fields with high phosphorus number (Helsinki Commission, 2007). To determine Phosphorus risk areas, a risk index or specific risk factors can be used.

Important part of the measure (project in Jæren RB); Right use and even distribution of the manure

NO - Leira-Nitelva

Avoiding spreading fertiliser and manure at high risk times and places. (See NO-Jaeren)

Mandatory measures: Manure shall only be spread between 15Feb and 01Nov. It is not allowed to spread on snow covered or frozen fields. Storage capacity shall be at least 8 months.

Storage of manure must not be placed in flood prone areas or close to wells/waterways if it presents a risk of pollution/contamination.

(There are also voluntary measures of not spreading mineral fertilizers (phosphorus), for example on buffer strips).

UK - England and Wales (various catchments)

The definition for this measure given in the EU RBN Spreadsheet of Measures for evaluation is ...

By avoiding the spreading of mineral fertilizers or manure at high risk times, the nitrate leaching and loss of nitrogen through surface run off is diminished.... (see definition at the top of the FS)

In England and Wales this measure is generally broken down into controlling and/or encouraging good practice on:

- storage of organic manures which may include:
 - Adhere to minimum basic requirements for storage
 - Increase the capacity of slurry stores or minimise dirty water inputs
 - Adopting batch storage for solid manure
 - Positioning of field manure heaps
- use of inorganic fertilisers and organic manures from on and off the farm (including nutrient management planning, closed periods, soil testing, farm risk maps, spreading risk assessments, recording and calibration/maintenance of machinery used in applying fertilisers). This is often achieved by encouraging changes in land use to low input practices in high risk areas including use of buffer strips, conservation headlands or grassland.
 - Use a fertiliser recommendation system
 - Integrate inorganic fertiliser and manure nutrient supply to match crop requirement for quantity and timing, taking account of SNS
 - Closed periods for fertiliser applications
 - Reduce fertiliser application rates
 - Produce and follow a farm risk map identifying areas for limited or no spreading, related to slope, under-drainage, etc.
 - No organic manure to be spread within 10m of a watercourse, or within 50m of a well, borehole or spring. No inorganic manure within 2m of a watercourse
 - Avoid spreading fertiliser, manures and slurry to fields at high-risk times
 - Transport excess manure to neighbouring farms or reduce stocking

These measures are implemented through a combination of advice, incentive and regulation (see section 4 below).

DE - Weser

Application techniques of manure (CAOM 2): This measure involves cutting slots in the soils, injecting the slurry and then closing these slots after application. Injecting slurry as opposed to applying it to topsoil makes it possible to directly reach the active soil layer in order to reduce nutrient leaching. In

addition, direct ground injection systems directly inject pressurized slurry into the ground. Furthermore this measure helps to reduce mineral fertiliser by slurry application in spring.

Summary table

	Time	Area	Soil condition	Soil slope
FI - Southwest Finland	No Spread: 15 Oct - 15 April. Organic fert. in autumn must be ploughed within 24h.	No N fert. 5m from watercourse	No application on frozen, snow covered, water-saturated ground	No N fert. 10m from watercourse, if slope exceeds 2%
SE –Svärtaå	NVZ: fert. app prohibited 1Nov-28Feb. 1Aug-31Oct only organic fert./manure to growing crop or before autumn sowing. Solid manure to growing crops and bare soil 1-31 Oct	Fertilizer/manure prohibited 2m from watercourses. Spreading of P prohibited to fields with high P concentration for some holdings with many animals.	No app. frozen, snow covered, possibility that fert./manure is lost via surface runoff of leaching through cracks.	Risk areas in NVZ: No fert./manure if soil slope adjacent to water exceeds 10%
Scotland		Distance from: 1) drainage ditch=2m. 2) Surface water/wetland=:5m. Good practice for 1)+2)=10m	No app. on snow-covered, waterlogged ground, land with soil depth less than 30cm or overlying gravel/fissured rock.	No application on slope exceeding 15°
NO - Jaeren				
NO – Leira Nitelva	Manure spread 15.Feb - 1. Nov.		No spread on snow covered, frozen fields	
UK - England and Wales	Encouraging good practice on: storage of organic manure, use of inorganic fert./manure			
DE - Weser				

2. Extent of use of measure

FI - Southwest Finland

The nitrate directive is mandatory to all farmers.

The measures "Spreading of manure during the growing season" and "Incorporation of liquid manure in the soil" are available to livestock farmers and about 1/3 of them are committed. Less than 1% farmers are committed to the measures available to all "More efficient reduction of nutrient load" and "Arable farming in groundwater areas".

If the farmer, excluding livestock farmers, is committed to agri-environment scheme, then spreading of phosphorus (mineral or manure) is prohibited to the fields with high or possibly excessive phosphorus concentration. Soil testing is mandatory every 5 years. The measure "More efficient reduction of nutrient load" is available in A and B support areas.

SE - Svärtaå

The measure is limited to certain areas: 44% of the Svärtaå catchment area (52% of the arable land) is designated as nitrate vulnerable zone, and as a consequence different rules apply to different areas.

NL

Applies to all farms.

UK - Scotland

The measure is a national requirement but implementation i.e. inspections and one to one advice are targeted to priority areas.

NO – Jaeren

The measure is proposed to all farmers within the selected area.

The measure is limited to agricultural areas within the catchment of Skas-Heigre.

NO - Leira-Nitelva

The measure for spreading of manure is proposed to all farmers

The measures for spreading manure in Leira – Nitelva are the same as the national measures: the municipalities are allowed to adjust the measure/regulations to local condition within certain limits.

UK - England and Wales (various catchments)

These measures are widely used with a range of different delivery mechanisms (refer to Section 4 below for a list of implementation methods).

The measure is proposed to all farmers. Controls on storage of manures (particularly slurry) apply everywhere in England and Wales (see below for details of relevant regulations).

All farmers are encouraged by government (such as the Code of Good Agricultural Practice) and national partnerships (including agricultural sector led e.g. 'Tried and Tested') to adopt good nutrient management practices on a voluntary basis in all parts of England and Wales. This is because the measures not only benefit the environment, they also benefit farm businesses through waste minimization of inorganic fertilisers, and good re-use of manures.

These measures are also implemented in a more targeted way in particularly sensitive areas:

- Currently 62% of the agricultural land in England and 3% of the agricultural land in Wales is designated as Nitrate Vulnerable Zone under the Nitrates Directive. Mandatory controls apply in NVZ on use of inorganic N fertilisers and manures in high risk areas and/or times, and requiring significant storage capacity for livestock slurry.
- About 66% of agricultural land in England is in some form of Government funded agri-environment scheme, many of which support improved nutrient management (e.g. low input grassland).
- About 40% of the agricultural land in England (50 priority catchments) has been identified as priorities for additional government funded advice (including nutrient management) through the Catchment Sensitive Farming initiative.

DE – Weser

This measure has been implemented in the past mainly in water protection areas. Here good experiences have been made with this measure, wherefore the measure is part of the agri-environmental programme since 2007 in arable and grassland areas with higher livestock farming. Test surveys promote these results.

Every farmer whose plots are part of sensitive areas for nutrients reduction can apply.

In the strategic investigation AGRUM Weser this measure was recommended for nearly 9% of the areas of concern.

Summary

- “ Proposed to all farmers:
 - . SE –Svårtaå: 44% of catchment area (52% of arable land) designated as NVZ
 - . NO – Leira Nitelva: Municipalities can adjust national measures to local conditions
 - . UK - England and Wales: Widely used, different delivery mechanisms. NVZ: 62% of agricultural land in England, 3% Wales
- ” Proposed to farmers in specific areas:
 - . Scotland: targeted to priority areas
 - . NO – Jaeren: in agricultural areas within Skas-Heigre catchment
 - . DE – Weser: in sensitive areas for nutrient reduction.

3. Effects of measure

The aim of the measure itself is to reduce nutrient leaching to groundwater and prevent direct surface runoff of manure and excessive amounts of nutrient in the topsoil which will increase the risk for losses to surface waters. The measure also helps encourage better use of resources (inorganic fertilisers and manures) and therefore more sustainable agricultural practices. They have the potential to benefit the farm business.

The effect of a ban on application of manure or fertiliser within 2m from water courses or lakes was estimated to 20 ton N and 0,5 ton P for the entire NVZ in Sweden (Naturvårdsverket, 2009). An approximation for the **Svårtaå River basin** would generate a reduction of 200kg N and 5kg of P, corresponding to c. 0.3% and <0.1% of the N and P load from agriculture, respectively .

The relation between the amount plant available P in the top soil and the leaching of phosphorus has been shown in various studies (e.g. Heckrath et al., 1995, Johansson, 2009).

However this measure has not been quantified.

At the site scale, the inventory of Methods to Control Diffuse Water Pollution from Agriculture – User Manual offers specific information on the relative cost-effectiveness of these measures. However, it is often uncertain how these site estimates scale up the catchment or River Basin District scale. This depends upon the relative cost-effectiveness of the delivery mechanism that is used to implement the site specific measures. The rate of measure implementation (uptake by farmers) is difficult to assess and varies from methods of implementation.

Generally, the effect of the measures are monitored globally and not at individual measure level. It could include a combination drawn from inspection results, predictive modelling, monitoring (chemistry and ecology at a range of scales and with/without flow), farmer attitudes/behaviour, uptake surveys and other relevant information (e.g. statistics on fertiliser use and pollution incident data). One of the main evaluation methods for measures will be the Significant Water Management Issues reports for the second round of River Basin Management, which should allow each RB to assess whether the first programme of measures is being effective.

FI - Southwest Finland

- The aim is to reduce nutrient leaching during wintertime. Also to prevent excessive amounts of nutrients in the topsoil on erosion and flood risk areas.
- Agriculture authorities monitor the area amount of commitments. On the general level the amounts of fertilizers are monitored, but on the field level use of fertilizers is monitored by compulsory sample.
- The effects are evaluated through water quality and amount of nutrients in the water. It is estimated if measures are taken up widely, reduction could be around 7% of nutrient load. (P - 30 kg/a and N - 600 kg/a).

SE – Svärtaå***Aim of the measure***

The measure reduces nitrogen and phosphorus leaching and loss through surface run off. High risk times include when there is a high risk of surface flow, rapid movement to field drains from partly frozen or wet soils or when there is little or no crop uptake.

Intended effects

Risk for nutrient losses via leaching through macropores and surface runoff is greatest when rain falls on saturated, frozen or snow covered soils (e.g. Uhlen, 1978; Ulén, 2002). For nitrogen there is a high risk for losses during winter when there is no crop uptake (e.g. Torstensson, 1999). High losses of nutrients through the soil can also occur on drained soils when they are wet and rainfall follows soon after applying fertilizers (e.g. McGechan, 2003). As a consequence, by avoiding application at these circumstances the losses of nutrients will be reduced.

A way to reduce nitrogen leaching in the winter when there is no crop uptake is to shift manure application from autumn to spring. For an amount of 25 ton/ha of liquid pig manure a shift from autumn to spring application has been estimated to reduce N leaching with 27kg/ha (Strandmark and Albertsson, 2003). This would correspond to a cost of 7€ per reduced kg of nitrogen. For liquid cattle manure, the corresponding effect is estimated to 13 kg N per hectare, and the cost to 14€ per reduced kg of nitrogen. For phosphorus there is on-going research, but no results are available so far.

The rate of implementation has not been monitored/evaluated. Data collection with a resolution to follow up of these issues are lacking.

NL

The manure policy in the Netherlands is based on the Nitrate Directive. This directive includes agreements on the amount of nitrate that is allowed in ground and surface water. In order to achieve the objective of the Nitrates Directive, measures are taken with respect to fertilization.

The main components of the manure policy are:

Application standards for nitrogen and phosphate from all sources of fertilizers that are allowed to be used in the cultivation of crops. This provides each crop with exactly that amount of fertilizer it needs.

Instructions for how manure is used and the periods in which this is applied. The manure is applied at the right time and in the most efficient way to the crop. This reduces losses to the environment.

A system of animal permits which sets limits to the number of animals for production that may be kept. This ensures that no more manure is produced than can be used in the cultivation of crops.

Rules for the removal of manure from livestock farms. So that it is always known where the manure comes and goes.

UK - Scotland

The measure aims to reduce nutrient pollution and resource use and has potential to benefit the farm business. Rate of implementation is difficult to assess but inspections and e.g. fertiliser usage rates will help. Effects will be assessed through a combination of inspection results, predictive modelling, monitoring (chemistry and ecology at a range of scales and with/without flow). There are many issues associated with this- would be good to share experience.

NO – Jaeren

The aim of the measure is to decrease movement of phosphorus into the watercourses.

The intended effects: reduce the eutrophication of the rivers and lakes; and optimize the utilization of manure in the growing season.

The effects of the measure are being monitored, by taking continuously water samples throughout the year at a water station, and analyse the content of nutrients (phosphor and nitrogen). Monitoring program of rivers and lakes at Jæren since 2004, combined with the JOVA program, a detailed monitoring project held by Bioforsk. Too soon for evaluating the effects of the measure, since the

measure was implemented last year.

The expected or observed effects on other environmental priorities such as climate change, soil or biodiversity include: reduced nutrient run off to the catchment, so the goals of the water frame directive can be reached. One of the goals is to reduce the phosphor level in the soil, and a better use of the manure in the area, which also will reduce the need of artificial nutrients in the area.

NO - Leira-Nitelva

The aim of the measure and intended effects: reduced runoff to watercourses from spreading manure. Control is performed by the municipalities.

UK - England and Wales (various catchments)

The aim of this measure is twofold:

- Reduce nitrate pollution from agriculture to surface and groundwaters to protect drinking water supplies (in line with Nitrate Directive requirements and WFD Good Status and DrWPA)
- Reduce nitrate and phosphate pollution and the risk of undesirable disturbance to water environments (i.e. eutrophication) and consequently support delivery of WFD objectives (e.g. Good Ecological Status/Potential)

The measures also help encourage better use of resources (inorganic fertilisers and manures) and therefore more sustainable agricultural practices.

The intended effects: Reduce loads of nitrate and phosphate to surface and ground waters through leaching, run-off and point sources (e.g. leaking slurry stores). Specific information on the relative cost-effectiveness of these measures at the site scale can be found in pages 41 to 77 of: http://archive.defra.gov.uk/foodfarm/landmanage/water/csf/documents/UserManual_Jan07.pdf

In relation to Fertiliser/manure use measures:

- Adopt phase feeding of livestock (page 39)
- Use a fertiliser recommendation system (page 41)
- Integrate fertiliser and manure nutrient supply (page 43)
- Reduce fertiliser application rates (page 45)
- Do not apply P fertilisers to high P Index soils (page 47)
- Do not apply fertiliser to high-risk areas (page 49)
- Avoid spreading fertiliser to fields at high-risk times (page 50)
- Do not apply manure to high-risk areas (Page 67)
- Do not spread farmyard manure to fields at high-risk times (page 69)
- Do not spread slurry or poultry manure to fields at high-risk times (page 71)

However, it is often uncertain how these site estimates of cost-effectiveness scale up to the catchment or River Basin District scale. This depends upon the relative cost-effectiveness of the delivery mechanism that is used to implement the site specific measures.

Monitoring/Evaluation

a) the rate of implementation (we assume this relates to uptake by farmers):

Rate of implementation is difficult to assess and varies markedly for different methods of implementation (i.e. delivery mechanisms - see section 4 below). Most of the implementation methods in England and Wales have their own progress reporting systems at the national level but these are not easy to breakdown to provide uptake figures across the relevant RBN catchments.

b) the effects of the measures:

Most of the implementation methods have their own monitoring and evaluation usually incorporating a combination drawn from inspection results, predictive modelling, monitoring (chemistry and ecology at a range of scales and with/without flow), farmer attitudes/behaviour, uptake surveys and other relevant information (e.g. statistics on fertiliser use and pollution incident data). One of the main evaluation methods for measures will be the Significant Water Management Issues reports for the second round of River Basin Management, which should allow us to assess whether our first programme of measures is being effective.

The expected or observed effects on other environmental priorities:

It is anticipated that the combined impact of all the various measures should prevent deterioration of surface water bodies and improve many. Within groundwater this would also be a longer term expectation, but some bodies are expected to continue deteriorating while historic pollution moves through the water table.

We are therefore uncertain whether additional measures are required, and if they are, whether they are disproportionately costly. We have therefore instigated a range of investigations (including with local stakeholders) to understand the scale and causes of any nutrient problems and help to identify how to tackle them.

DE – Weser

This measure increases the efficient of nitrogen balance and reduces the deposition losses and nutrient leaching in soil. It's preferential choosing in arable land with light soils. Because of bad effects to sod is less adapted in grassland.

The implementation rate can only be monitored by the existing applications. Numbers are currently not available due to the first funding period. Additional indicators are the autumn N-min or nitrate concentration in leakage water. Experiences show autumn N-min-reduction up to 10 kgN/ha.

Summary table

	P load	N load
FI - Southwest Finland	P=30kg/a, (7% nutrient load reduction with wide application)	N=600kg/a (7% nutrient load reduction with wide application)
SE –Svärtaå	Effect of ban on application of fert./manure 2m from water course <ul style="list-style-type: none"> - for entire NVZ in Sweden: P red.=0,5t - For Svärtaå: P red.=5kg 	Effect of ban on application of fert./manure 2m from water course: <ul style="list-style-type: none"> - for entire NVZ: N red.=20t - For Svärtaå: N red.=200kg To reduce N leaching in winter, manure application can be shifted to spring: if 25t/ha are applied in spring, N leaching reduction= 27kg/ha (pig manure) and 13kg/ha (cattle manure).
NO – Jaeren	Measure implemented last year - no results. Synergies with measures for climate change and biodiversity.	
NO – Leira Nitelva		
UK - England and Wales	P loss reduction= 15% on the sandy loam and clay loam soil types	0-15 kg/ha N reduction in affected areas
DE - Weser	Results unavailable due to first funding period.	Autumn N-min-reduction= up to 10kg/ha

4. Method of implementation of measure

Compulsory, not compensated

Firstly, the measure is intimately related to the Nitrates Directives which imply legal acts and mandatory measures which are not compensated in NVZ.

Nitrate directive: cross compliance

One time implementation- valid all the time.

Voluntary and compensated

- Then, additional measures, issues from rural development programmes (CAP, pillar 2) are proposed

to the farmers and some are linked to manure and fertiliser management. Commitment to agri-environmental scheme is voluntary and committed farmers are compensated. For instance, in Southwest of Finland, spreading manure during the growing season is compensated by 27€/ha/a; “more efficient reduction of nutrient load up to 347€/ha/a.

Implementation over a programme period

- Regional environmental programme (ex NO)

Free Advice, service to farmers

No compensated: e.g. Sweden: fertilizer recommendations.

PLANET and ENCASH are nutrient management software tools that are freely available for use by farmers and their advisers in England, Wales and Scotland.

Other programmes: e.g. UK

Incentives are used to encourage farmers to adopt a variety of measure

FI - Southwest Finland

- Mandatory measures are legal acts. Additional measures are issued as a rural development programme. Also water framework directives programme of measures includes additional measures.

- Nitrate directive is compulsory but commitment to agri-environment scheme is voluntary (about 95% farmers are committed)

- Implementation time scale is over a programme period except nitrate directive which is valid all the time.

- Nitrate directive is part of cross compliance related to CAP. Other measures are compensated by Agri-environmental payments.

SE – Svärtaå

In addition to the measures following the regulation, there is voluntary guidance through the environmental extension program Focus on Nutrients. Farms with more than 400 livestock units require a permit. In the licensing for this permit it is sometimes stated that phosphorus application is prohibited on soils with high phosphorus levels. A prevalent limit for prohibition of P-application is a content of 16 mg P-AL/100 g soil.

NL

General requirement (Nitrate Directive).

UK - Scotland

The rule is compulsory and there is additional voluntary guidance. The rule came into force in April 2008 and is being implemented via a programme of guidance, training, awareness raising and one to one visits. Farmers should save money through the nutrient management requirement.

NO – Jaeren

The measure is issued as a Regional environmental program.

The scheme requires binding agreements between the farmers and The County Governors Office. The agreement is binding for 3 years at a time (first period is 2010-2012). The measure is initiated through a project in Jaeren RB; “Voluntary measures in agriculture”.

It's voluntary.

Implementation from 2010 – 2012 (pilot).

Conditions for the agreement;

- a map that shows which areas are included (environmental plan, step 1)
- measures must be described (environmental plan, step 2)
- amount of manure must be adapted to the nutritional needs of the plants
- fertilization plan and fertilization journal for all the areas
- fertilizer trial must be taken in spring-time before the growing period every year

The project managers have an important role in following up the practical aspects of the project, with direct dialog with the farmers.

NO - Leira-Nitelva

The measure is issued as a national regulation and is therefore compulsory. Financial support for better storage capacity can be applied for it. The measure is difficult to control.

UK - England and Wales (various catchments)

1) Controls on storage of manures (particularly slurry) apply through the Water Resources (Silage, Slurry and Agricultural Fuel Oil) Regulations 2010 (SSAFO) and parallel Welsh regulations. These prescribe minimum design, building and maintenance requirements (including storage capacity) for storage infrastructure when it is enlarged or reconstructed. Having the correct storage in place can reduce the danger of having stores that need emptying during high risk spreading periods. <http://archive.defra.gov.uk/environment/quality/water/waterquality/diffuse/nitrate/documents/201009ssafo-england.pdf> Also parallel Welsh guidance

Given good nutrient management can benefit the farm business (through waste minimization of inorganic fertilisers, and good re-use of manures) all farmers are encouraged to adopt good nutrient management practice on a voluntary basis in all parts of England and Wales through:

2) implementing Codes of Good Agricultural Practice <http://archive.defra.gov.uk/foodfarm/landmanage/cogap/documents/cogap090202.pdf>

Also parallel Welsh code

3) following government funded advice on nutrient planning such as PLANET

<http://www.planet4farmers.co.uk/>

4) getting involved in National Partnerships between government, regulators, and farming industry such as the 'Tried and Tested' Partnership <http://www.nutrientmanagement.org/> or the Campaign for the Farmed Environment <http://www.cfeonline.org.uk/>

5) Mandatory controls on use of inorganic fertilisers and manures in high risk areas and times through implementation of the Nitrates Directive. In England this is implemented via the Nitrate Pollution Prevention Regulations 2008 (as amended). <http://www.defra.gov.uk/food-farm/land-manage/nitrates-watercourses/nitrates/>. In Wales this is implemented via the Nitrate Pollution Prevention (Wales) Regulations (2008) (as amended)

<http://new.wales.gov.uk/topics/environmentcountryside/epg/waterflooding/nitratezones/?lang=en> Compliance and inspection with these regulations is linked to CAP Single Farm Payment through Cross-compliance

<http://rpa.defra.gov.uk/rpa/index.nsf/vDocView/FFDD11D4803F7D580256F72003DD33D?OpenDocument>, and the Rural Inspectorate in Wales (part of the Welsh Government).

6) In addition to the measures above there are also Government funded agri-environment schemes to provide farmers targeted advice and incentive to help support up-take of improved nutrient management on a voluntary basis. In England these are:

Entry Level Stewardship (ELS)

<http://www.naturalengland.org.uk/ourwork/farming/funding/es/els/default.aspx>

Organic Entry Level Stewardship (OELS)

<http://www.naturalengland.org.uk/ourwork/farming/funding/es/oels/default.aspx>

Higher Level Stewardship (HLS) scheme:

<http://www.naturalengland.org.uk/ourwork/farming/funding/es/hls/default.aspx>

In Wales these are: Tir Gofal

<http://new.wales.gov.uk/topics/environmentcountryside/farmingandcountryside/farming/agrienvironschemes/tirgofal/?lang=en>

Tir Cynnal

<http://new.wales.gov.uk/topics/environmentcountryside/farmingandcountryside/farming/agrienvironschemes/tircynnal/?lang=en>

These provide advice and CAP funded (pillar 2) incentive to adopt a variety of low input (reduced fertiliser) agricultural practices.

7) In addition there is also the Catchment Sensitive Farming initiative which primarily provides advice and some funding: <http://www.naturalengland.org.uk/ourwork/farming/csf/default.aspx>

8) In some areas additional local partnership projects have been implemented through Water Framework Directive River Basin Management Planning to help support farmers implement more effective nutrient management (e.g. Anglian Region Phosphate study with the National Farmers Union), or undertake enhanced pollution prevention and enforcement activity to ensure farmers are not causing pollution.

DE - Weser

This measure is voluntary and offered since 2007. The Federal States compensate the income loss of farmers who have applied. The farmers have to apply at least for 5 years. The control is part of the contract and has to be reported as fertiliser amount and N-min-concentration in soil at determined times.

5. Organisation of implementation

FI - Southwest Finland

- Responsible authority for administrating are environmental and agriculture authorities. Environmental authorities recommend and agriculture authorities accept.
- Responsible authority for controlling is agriculture authorities (environmental authorities can help)
- Nitrate directive is monitored also by municipality authorities.

SE – Svärtaå

Responsible authority for administrating the implementation- Inspection and enforcement guiding responsibility rests at national (Swedish Board of Agriculture) and regional level (County Board administration). The guiding responsibility includes supporting, advising and evaluating inspection and enforcement work.

Responsible authority for controls - Inspection and enforcement of the requirements that follows under the Environmental code is performed by the municipalities. The requirement that follows under Cross-compliance is performed by the county board administrations.

NL

Controls are performed by nVWA (physical controls) and DR (administrative controls). nVWA may also check on animal health and food security. DR is responsible for agricultural payments.

UK - Scotland

SEPA and Scottish Government.

NO – Jaeren

The responsible authority for administrating the implementation: the County Governors Office, Agriculture department; The responsible authority for controls: the municipality office of agriculture.

NO - Leira-Nitelva

Responsible authority for administrating the implementation:

- a) Ministry of Agriculture and Food
- b) Ministry of the Environment
- c) The Ministry of Health and Care Services

Responsible authority for controls: The municipalities

UK - England and Wales (various catchments)

Responsible authority for administrating the implementation:

- Water Framework Directive, SSAFO and water pollution control = Environment Agency
<http://www.environment-agency.gov.uk/>
- The Single Farm Payment in England = Rural Payments Agency

<http://rpa.defra.gov.uk/rpa/index.nsf/home>

- The Single Farm Payment and RDP (including agri-environment) in Wales = Rural Inspectorate for Wales which is part of the Welsh Government <http://wales.gov.uk/?lang=en>
- RDP Agri-environment in England = Natural England www.naturalengland.org.uk

Responsible authority for controls:

- Developing controls and policy in England = Department of Environment, Food and Rural Affairs <http://www.defra.gov.uk/>
- Developing controls and policy in Wales = Welsh Government <http://wales.gov.uk/?lang=en>

Representing farmers, land managers and agricultural professionals:

Many farming organisations support delivery of measures, these include:

- National Farmers Union - <http://www.nfuonline.com/>
- Country Landowner and Business Association - <http://www.cla.org.uk/>

Tried and Tested - <http://www.nutrientmanagement.org/>

DE – Weser

Sponsor and approving organisation are the Ministries for Agriculture of the Federal States or the chambers of agriculture, which are controlling the farmer reports as basis for the compensation payment and have additional controls by spot tests on the plots.

Farmers have to apply.

6. Acceptance of farmers and involvement of stakeholders, social aspects

FI - Southwest Finland

- Nitrate directive is accepted. Additional measures are not very popular among farmers.
- General agri-environmental guidance material. Measures are not well known. Every year agri-environmental advising is given to farmers, but it usually deals with changes and not every measure is dealt.
- Additional measures can be chosen freely.
- Nobody outside agriculture knows if these measures even exist or are implemented.

SE – Svärtaå

It is relatively well accepted not to apply manure on snow covered fields, but the acceptance for other measures may be variable due to hesitation on the impact of the environment and because it may be related to other inconveniences such as high costs or soil compaction.

Information of these measures to the farmers has been given through diverse channels, e.g. the environmental extension service program “Focus on Nutrients”, information from the County Board Administrations, the Swedish Board of Agriculture and municipalities.

No direct involvement of farmers in the process of selecting and implementing.

The measure is well accepted by local population if they are aware.

NL

General requirement.

Additional measures are not very popular among farmers, unless tailor made.

UK - Scotland

Fairly well accepted but not necessarily adhered to!

See RAMS link above and also Planet Scotland for nutrient management.

NO – Jaeren

The Farmers’ opinion on the measures: Well accepted. About 90% of the farmers within the catchment have signed environmental agreements.

Information to the farmers has been given in letters, brochures and in arranged meetings. Information

about the measures included in the regional environmental program is available at the homepage of the County Governors Office, Agriculture dept.

The project "Voluntary measures in agriculture" have two Project Managers, who provides practical and clear information to the farmers. The Project Managers, who are farmers themselves, are essential for good results in the voluntary agricultural project.

Measure selection was made by the County Governors Office in cooperation with:

- the County Council
- the Rogaland Farmers' Union and
- the Rogaland Smallholders' Union
- the agricultural advisory services, and
- the municipalities

The measure is well accepted by local population.

NO - Leira-Nitelva

The measure is generally well accepted by the farmers, but the date for last spreading of manure is under some debate.

Information to framers is provided by the municipalities and County Governors.

Farmers involvement in the process of selecting and implementing: the regulation for manure is supposed to be revised in the near future and there are expected adjustments and a hearing.

The measure is accepted, but not always commonly known among local population. Several factors come into account here.

UK - England and Wales

The measure is well accepted and supported by farmer representative groups, as indicated by their involvement in national and local partnerships to implement measures voluntarily. Local implementation can be more challenging, particularly where initial costs of measures can be more cost-effective e.g. improved slurry storage – there are limited capital grants to fund improvements to infrastructure. Many farmers locally will not accept publicly that agriculture makes a significant contribution to diffuse pollution.

Farmers involvement in the process of selecting and implementing:

- For national regulatory measures farmer groups are involved in consultation processes.
- For national partnership measures farmer groups are instrumental in measures development.
- For local implementation farmers are involved to varying degrees in development of partnership measures.

Informational and decision support tools used to provide clear information for farmers. Various modelling tools have been, or are being used including:

- River Basin Management Plan Risk Assessment models
- NITCAT, NCYCLE and MANNER models for nitrate
<http://www.adas.co.uk/MANNER/tabid/270/Default.aspx>
- PSYCHIC model for P <http://www.sciencedirect.com/science/article/pii/S0022169407006233>

FARMSCOPER <http://www.avondtc.org.uk/Mitigation.aspx>

DE – Weser

The measure optimises the fertiliser potential in soil and helps the farmer to save fertiliser and money. Farmer communities for the required equipment can also help to reduce the costs for this measure. The experiences show that the acceptance of farmers is very good, which is underlined by the life project WAgriCo as well.

Important issue regarding acceptance is the early involvement of farmers and the offer of appropriate

advisory services. This is done in context with the implementation of the agri-environmental programme in different types and on different scales down to intensive personally advisory service to farmers.

7. Financial aspects of the measure

FI - Southwest Finland

- Funding from Finland's rural development programme except nitrate directive which is not funded.
- Estimated crop loss.
- No cost-efficiency calculations have been evaluated.
- Reduced fertilization reduces costs.

Spreading of manure during the growing season 27 €/ha/a. More efficient reduction of nutrient load up to 347 €/ha/a.

SE – Svärtaå

In the PoM costs for increased frequency of inspection and enforcement has been calculated to 380.000 €/a for the RBD. This is based on an assumption that ca. 3 % of the farmers are controlled every year and a cost per issue of 1050 €.

No cost-efficiency evaluation was performed since this is a basic measure according to the WFD and has to be implemented regardless.

NL

Regulatory requirement, so no funding.

UK - Scotland

Regulatory requirement so no funding. Impact assessment carried out for the RBMP.

NO – Jaeren

Funding sources: State funding through the Regional Environmental Program. Budget (2009 – 2012) for all types of measures that decreases the movement of nutrients, and pesticides into watercourses; NOK 2,5 mill per year / Euro 325 000.

The measure is compensated:

- Cultivated land; NOK 100,- per acre
- Grazing land; NOK 60,- per acre
- Fertilizer trial: NOK 1000,- per year

Cost-efficiency of this measure has not been estimated.

For some farmers implementation of the measure will mean high costs, while for other farmers it could mean no costs. The reason for that are potential structural changes caused by implementation of the measure. E.g.; need for transportation of surplus manure to other areas or need for construction of more storage for manure (more than the obligatory 8 months storage capacity).

Implementation is not based on Cost-efficiency evaluation.

NO - Leira-Nitelva

For storage capacity it is possible to receive financial support by application to the municipalities.

UK - England and Wales

Measures are funded through different implementation methods including CAP Axis 1 and 2, U.K. Government funding (Grant in Aid), as well as water industry and agricultural sector private funding.

Typical cost estimates for individual site measures are given in http://archive.defra.gov.uk/foodfarm/landmanage/water/csf/documents/UserManual_Jan07.pdf

And also in <http://www.environment-agency.gov.uk/business/sectors/bestfarmingpractices.aspx>

Much of this has been built into the FARMSCOOPER modelling tool to help farmers and farm advisers understand the costs and benefits of various agricultural measures at individual farm level. This has

not yet been rolled out for routine use.

It is extremely difficult to scale-up this farm/field cost information to the catchment scale. National estimates of cost are given in relevant Impact Assessments for various regulations (including the Water Framework Directive)

Implementation is based on cost-effectiveness in so much as many of these measures are seen as cost-effective for farm business as well as the environment. The exception is the relative high initial outlay for new storage facilities, relative to the long pay-back period to the farmer for implementing this measure.

Synergy effects of the measure observed that improve cost efficiency?: In considering the costs and benefits of these measures, synergetic impacts to other agriculture pressures (e.g. soil erosion, sediment pollution and climate change) have also been considered.

DE – Weser

Compensation payments of 30 €/ha are paid by the Programmes of the Federal States. The cost effectiveness of the measure can be calculated by the ratio of the compensation payment in comparison with the decrease of the autumn N-min. It's in average 3 €/kgN.

Summary table

	Voluntary or mandatory	Funding
FI - Southwest Finland	ND mandatory. Other measures voluntary 'Spreading of manure during growing season' 1/3 are committed.	No compensation in NVZ. Compensated AES=95% farmer commitment. " Spreading manure in growing season=27 €/ha/a, " 'More efficient reduction of nutrient load'=347 €/ha/a.
SE –Svärtaå	Regulatory requirement + voluntary guidance	No compensation. Cost for inspection and enforcement = 380 000 €/a for RBD
Scotland	Regulatory requirement + voluntary guidance	Nutrient management should save money
NO – Jaeren	Voluntary	Compensated: cultivated land=100 NOK/acre, grazing land=60 NOK/acre, Fertilizer trial=1000 NOK/acre
NO – Leira Nitelva	Compulsory	Financial support from municipality & better storage capacity
UK - England and Wales	Voluntary. Beneficial for farmers	<ul style="list-style-type: none"> • Nutrient management supported by AES in 66% agri. land • Add. Gov. Funding in priority catchments=40% agri. land. • No compensation: Code of Good Agric. Practice, ND. • Funding available: Government, national partnerships, CAP, ELS and Tir Gofal.
DE - Weser	Voluntary	Compensation of income loss by Federal State 30€/ha

8. Legal aspects

FI - Southwest Finland
No

SE – Svärtaå

No

UK - Scotland

Not yet.

NO – Jaeren

It is a voluntary activity, so no legal difficulties.

NO - Leira-Nitelva

Evaluator: No information is provided.

UK - England and Wales

Measures for Nitrates Directive and Water Framework Directive have been developed in line with relevant U.K. Government Policy, Guidelines and legal requirements.

DE - Weser

The farmers don't like very much to commit to such a contract for at least 5 years, because the economic effects can be estimated hardly due to the determined crop rotation and additional conditions (i.e. special pesticide application) have to be regarded. Over that high administrative burden prevent farmers to apply.

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NL

<http://www.hetinvloket.nl/onderwerpen/mest>

UK - Scotland

See above.

NO – Jaeren

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NO - Leira-Nitelva

No information is provided.

UK - England and Wales (various catchments)

Provided throughout the text (including the hyperlink to the documents).

6. Plant cover in winter

Contributing River Basins: Liri-Garigliano e Volturno (IT); Børsesjø-Leirkup (NO); various catchments in England, Wales, Scotland (UK); Southwest Finland (FI); Moselle-Sarre (LU/FR/DE/BE); Weser (DE); Pandivere (EE).

1. Definition of measure

CAOM

Planting a winter cover crop in late summer or fall to provide soil cover during the winter. This leaves less nitrate available for leaching over winter and helps to reduce soil erosion and the mobilization of pollutants. As a primary effect plant cover in winter can reduce nitrate leaching resulting from excess winter rainfall, as well as phosphorus leaching, this occurs through sediment transport in surface run-off. Plant cover in winter protects the topsoil of the fields against the erosive forces of rain, melt and runoff waters during winters. This also reduces soil erosion into waters. This measure can improve soil structure by increasing the amount of organic matter in the topsoil of the fields, which decreases the topsoil's susceptibility to silting. Further, cover crops can improve soil fertility. Implementation of this measure is easy and costs depend on the plant in question, area and whether the farm has its own machinery or contractor.

IT – Liri-Garigliano e Volturno

The measure concerns the planting of shrubs in late summer in order to assure adequate soil cover during winter. Also, the preservation and maintenance of existing forests, reforestation with native vegetation to help the naturalization process, defining an upper limit cutting of the forest are important aspects. In Italy the management of the catchment in mountainous and hilly areas occurs according to the law on soil protection (L.183/89). Farmers are not obliged to cover the soil, except if specific measures apply to their farm to limit the hydrogeological effects established in the CAP.

NO - Børsesjø-Leirkup

The measure consists of areas which are not ploughed until 1. March of the next year, after you have had crops with grain, rape, peas etc. Although no new crops are planted in late summer/fall, this technique will provide a plant cover during winter.

UK – England and Wales

A winter cover crop is planted in late summer or autumn to provide soil cover during the winter. This leaves less nitrate available for leaching over winter and helps to reduce soil erosion and the mobilisation of pollutants.

- 1) Winter sown crops are sown after a summer / autumn harvest if soil conditions permit and market forces are favourable;
- 2) Winter cover crop or green manure such as mustard that is ploughed back into the topsoil in the early spring.

For this option, farmers must comply with the following:

- Establish a cover crop by 15 September.
- Drill or broadcast a quick-growing cover crop. The cover crop can be a mixture of seeds. Suitable species to include are rye, vetch, phacelia, barley and mustard. The choice of cover crop will be dependent upon herbicide choice and rates of application in the previous crop.
- Sow at a seed rate that will provide a dense cover and protect from soil erosion.
- Do not apply any fertilisers or manures.
- Destroy the cover crop by cultivation in late January or early February, immediately before establishing the following spring crop, to minimise any nitrate losses. When weather conditions delay establishment of a spring crop, the cover crop can be left until mid-March.

Winter cover crops are no longer an option in Glastir AWE
<http://wales.gov.uk/docs/drah/publications/110907gaecafactsheeten.pdf>

OPTION 28 RETAIN WINTER STUBBLES

Aims to allow natural regeneration of grasses and broadleaved plants to establish in order to provide a winter food source for birds and mammals and to reduce soil erosion and water runoff to help to improve water quality.

Management requirements

- This option is only available on improved land.
- Remove straw after harvest and allow the natural regeneration of grasses and broadleaved plants.
- Do not cut before the 15th February.
- Do not apply slurry between harvest and 1 March.
- Do not store manures on the area.
- Do not supplementary feed on the area.
- Do not plough, cultivate or direct drill before 1 March
- Do not graze more than a maximum level of 0.4lu/ha at any one time.
- A stocking diary will need to be kept and made available for inspection
- There must be no use of herbicides except to spot treat notifiable weeds or invasive alien species such as spear thistle, creeping thistle, curled dock, broad-leaved dock, ragwort, Japanese knotweed or Himalayan balsam.

OPTION 31 Unsprayed Spring Sown Cereals Retaining Winter Stubbles.

Aims to encourage the growth of a wide range of broadleaved plants including rare species such as Cornflower, Shepherds Needle and Small-Flowered Catchfly. The aims also include providing both nesting sites and feeding areas for birds such as Skylark, Grey Partridge, Yellowhammer and Barn Owl, as well as mammals such as Brown Hare. Finally the measure aims to provide a range of nectar sources and other food plants for insects and other invertebrates. Some of these can assist with pest control, but others such as butterflies and bumblebees are of conservation concern in their own right. The measure also provides food source for overwintering birds.

Management requirements

- This option is only available on improved land
- Establish a crop by 15 May.
- There must be no use of herbicides except to spot treat notifiable weeds or invasive alien species such as spear thistle, creeping thistle, curled dock, broad-leaved dock, ragwort, Japanese knotweed or Himalayan balsam.
- Do not harvest before 1 August or until 14 weeks after sowing.
- Remove straw after harvest and allow the natural regeneration of grasses and broadleaved plants.
- Do not cut before the 15th February.
- Do not apply slurry between harvest and 1 March.
- Do not plough, cultivate or direct drill before 1 March.
- After harvest do not graze before 1 January and then not more than a maximum level of 0.4lu/ha at any one time.
- A stocking diary will need to be kept and made available for inspection

Technical Specifications include: Fertilisers, organic manures and lime are permitted to meet crop requirements. Insecticides must not be used. Fungicides should only be used if applied to the seed before sowing and molluscicides should only be used if direct drilling along with the seed. Provided the total area is maintained, this option can be moved from field to field within the farm's normal crop rotation.

The Glastir Targeted Element (TE) also contains a prescription to promote unsprayed spring sown cereal and linseed crops with the retention of winter stubbles - conversion from improved grassland.

<http://wales.gov.uk/topics/environmentcountryside/farmingandcountryside/farming/glastirhome/?lang=en>

FI – Southwest Finland

The objective is to protect the topsoil of arable land against the erosive forces of rain, melt and runoff waters, particularly during mild winters. Plant cover in winter promotes the survival of wild animals over the winter. The measure reduces soil erosion, nutrient leaching and carbon dioxide emissions caused by arable farming, improves soil structure through the accumulation of organic matter and the intensification of the soil's micro-organism activity and enhances biodiversity.

Outside the growing season, farmers must maintain at least 30% of the farm's total area of parcels eligible for agri-environment payments under vegetation or stubble or subject to reduced tilling in an acceptable manner. The parcel must be covered with plants until the seedbed is prepared or until a corresponding cultivation measure is taken. Plant-covered parcels should be located in parcels that are important to water protection, particularly in parcels adjacent to watercourses or main ditches. Reduced autumn stubble tilling on cereal, oilseed crop and seed spice parcels fulfils the condition if tilling is carried out with a cultivator, disc harrow, spring-tooth harrow, rotary spade harrow or a mini-plough in a single run.

Intensified plant cover in winter: At least 50% of the farm's total area of parcels eligible for agri-environment payments must be maintained under vegetation or stubble outside the growing season. The parcel must be covered with plants until the seedbed is prepared or until a corresponding cultivation measure is taken. Plant-covered parcels should be located in parcels that are important to water protection, particularly in parcels adjacent to watercourses or main ditches.

CIPMS/IKSMS (DE (SL), FR, LUX) Moselle-Sarre

Aim for having a soil cover during winter periods (periods of leaching). We must distinguish several categories of soil cover: (i) Grasslands (maintenance and re-grass) (ii)- Winter crops (iii)- Catch crops - nitrates traps (*cultures intermédiaires pièges à nitrates*="CIPAN").

DE – Weser

A winter cover crop is planted in late summer or fall to provide soil cover during the winter. This causes less nitrate available for leaching over winter and helps to reduce soil erosion and the mobilisation of pollutants. Example of crops that can be planted: winter catch crop (green rye, winter turnip rape) with late transition in February.

EE - Pandivere

According Estonian Water Act in a nitrate-vulnerable area (Pandivere area belongs to NVZ), from 1 November until 31 March, at least 30% of the land under cultivation and used by an agricultural producer shall be under plant cover. One third of the above percentage may be substituted by autumn ploughing the straw of cereals, rape or turnip into the ground. Plant cover means winter crops such as winter cereals, winter rape, winter turnip rape, grasses, legume grasses and herbs. In the rest of Estonia the measure is voluntary.

2. Extent of use of measure

IT – Liri-Garigliano e Volturno

Italy has continuing problems related to the hydrogeological conditions (the facts of Liguria are still under observation). Italy two innovative laws, 183/89 and Law 97/94, identified the need to intervene in mountainous and hilly areas, where erosion is strongest. Erosion is also due to the continuing abandonment of the mountain and the hill areas, which results in increased demand for passive defences in the valleys (levees, banks expansion, etc.) and significant increase in direct and indirect costs. The landslide risk areas are identified by river basin authorities, which then propose interventions aimed at structural and non-structural mitigation. Other institutions, such as mountain communities, carry out maintenance works. There are no restrictions and the measures

are applied throughout Italy.

NO - Børsesjø-Leirkup

Known among the farmers.

Most of the farmers who grow grain, do not plough in the autumn.

UK – various catchments

As part of Cross Compliance and under GAEC 1 Soil protection Review, all farmers in receipt of Single Payment Scheme in England, have to comply with Part 5 Post Harvest Management. After a winter crop (currently only restricted to combinable crops) the land cannot be left bare. It has to either be left as stubble, put into a cover crop, the next crop sown, a stale seedbed created or a rough surface created through primary cultivation.

The above options are dependent on the cropping cycle and rotation of the farm. The majority of arable farmers that rely on winter sowing will sow a winter sown crop so as to maximise yields. Those with differing soil types or those that grow more spring crops notably root crops, maize, vegetables and spring sown combinable crops will tend to leave the land cultivated to allow natural weathering through frosts especially, to work down the soil and kill off soil borne diseases. Some may plant a winter cover crop, particularly organic farmers to help increase soil organic matter levels, increase nutrient levels and some cases for natural fumigation. Other conventional farmers may also choose cover crops for these reasons but also can contribute towards their Entry Level Stewardship scheme option choices which scores 65 points per hectare (this equates to £65/ha). Winter fodder crops will depend on the farming preference and conditions. Uptake is sporadic and mainly situated in the west.

Uptake of agri-environment scheme options (Environmental Stewardship) in England only is:

Uptake of ES winter cover crop options - 31 December 2011		
Option	No. of agreements containing option	Option area (ha)
EJ13 - Winter cover crops	75	778.71
HJ13 - Winter cover crops	3	21.00
OHJ13 - Winter cover crops	1	16.00
OJ13 - Winter cover crops	9	168.94
All winter cover crop options	88	984.65

Option 28 under Glastir: Provided the total area is maintained, this option can be moved from field to field within the farm's normal crop rotation.

Glastir is a voluntary scheme - and as with the lower tier of the Countryside Stewardship Scheme in England, the AWE is open to all farmers provided they select sufficient options to qualify, whilst as with the HLS in England, the TE is only available to those farmers who can deliver against Government priorities (the difference in Wales being that these priorities are identified via a system of GIS layers, whilst in England the I understand that the priorities are defined by lines on maps).

FI – Southwest Finland

In Southwest Finland, the measure can be subdivided into the following 3 related measures. The application of and funding for these measures is mutually exclusive

- ó Plant cover in winter and reduced tilling
- ó Plant cover in winter
- ó Intensified plant cover in winter

Plant cover in winter and Plant cover in winter and reduced tilling

A livestock farm within agri-environment payments raising more than two livestock units of cattle, sheep, goats or horses cannot select the measure, nor can farms that have selected plant cover in winter or intensified plant cover in winter as an additional measure. The plant cover requirement can be fulfilled with nature management fields, but payments in the additional measure "Plant

cover in winter and reduced tilling” cannot be granted for this area. The plant cover requirement can also be fulfilled with areas included in a riparian zone contract, if the contract has been concluded for arable land. However, payments in the additional measure “Plant cover in winter and reduced tilling” cannot be granted for riparian zones. The payment in the additional measure cannot be granted for the Groups 2 horticultural crop area, if the additional measure “use of mulch in perennial horticultural crops” has been selected. Under cross-compliance, plant cover in winter is not required for managed uncultivated arable land. Managed uncultivated arable land with plant cover in winter can fulfil the plant cover requirement of the additional measure, but payments in the additional measure in question cannot be granted for it. Only single farm payments will be granted for it.

Intensified plant cover in winter: Same as above, except: all farmers can select the measure. Farms that have selected the additional measure “Plant cover in winter and reduced tilling”, “Plant cover in winter” or “Extensive grassland production” cannot select the measure.

CIPMS/IKSMS (DE (SL), FR, LUX) Moselle-Sarre

The measure is proposed to all farmers.

FR: This measure is available to all farmers: (i) Mandatory on vulnerable zones (ZV), (ii)

Outside vulnerable zones, on a voluntary basis, the measure is available to be applied on the degraded water catchments for the production of drinking water with financial compensation (through agri-environmental measures - MAE - supported financially by the Ministry in charge of Agriculture and / or the Rhin-Meuse Water Agency on the basis of European Agricultural Fund for rural Development - EAFRD). Conservation of grassland is mandatory for granting under the 1st pillar of the CAP. An obligation to maintain the amount of surfaces of permanent grassland exists also since 2010 – part of cross-compliance under the Common Agricultural Policy (CAP).

LUX: Yes. Temporary grassland, catch crops and winter crops are limited to arable land. The maintenance of permanent grassland is naturally limited to permanent grassland.

SL: In principle, without restriction. Grant is focused on the zones that the ministry of environment energy and transport has designed as being sensitive.

DE – Weser

This measure has been implemented in the past mainly in water protection areas. Here good experiences have been made with this measure, which is part of the agri-environmental programme since 2007. Test surveys promote these results. Every farmer whose plots are part of sensitive areas for nutrients reduction can apply. In the strategic investigation AGRUM Weser this measure was recommended for nearly 15% of the areas of concern.

EE - Pandivere

In nitrate vulnerable areas, it means that in the whole Pandivere region, it is obligatory according to the Water Act.

In rest of Estonia winter plant cover of at least 30% of the land under cultivation is required to get area support under the measure “environmentally friendly production” (one of the measures of Estonian Rural Development Plan 2007–2013).

3. Effects of measure

IT – Liri-Garigliano e Volturno

Effects of the measure include:

- Reduced erosion in the upper basin
- Environmental restoration of eroded areas causing an increase in biodiversity through the creation of phytocoe noses trees, shrubs and herbaceous;
- Beneficial effects for the reduction of carbon dioxide stored in plant biomass;

NO - Børsesjø-Leirkup

To prevent leaching over winter and help to reduce soil erosion and the mobilisation of pollutants.

UK – various catchments

Environmental Stewardship Organic Entry level and Entry level scheme (EJ13 Winter cover crops 65 points per ha)

This option aims to significantly reduce nitrate leaching on land where soil would normally be left bare during winter. In addition, in certain situations, cover crops may provide protection against soil erosion and loss of other pollutants carried in surface run-off water. Any land that is vulnerable to nitrate leaching, particularly light sandy soils, is eligible for this option. Heavy soils are not eligible. To be effective, cover crops have to be established early in order to take up sufficient soil nitrate before winter drainage leaches it below the depth of the developing plant roots. The cover crops should be destroyed in late January or February before they are too well developed. Delaying destruction of the cover crop has the potential to increase nitrate leaching the following winter.

FI – Southwest Finland

Intended effects are reduced erosion, nutrient leaching and carbon dioxide emissions. At the moment at least 30% of parcels are covered in winter. In general plant cover in winter reduces P in particulate form but increases soluble P. Not many relevant studies exist at the moment on quantified effects of the measures. It has been estimated that winter plant cover could reduce erosion and nutrient leaching about 10-15%. DRP increases, PP decreases, TP decreases, anyway.

CIPMS/IKSMS (DE (SL), FR, LUX) Moselle-Sarre

The purpose of the measure is to protect the groundwater resource against the nitrates by capturing the excess nitrogen post-harvest. It contributes also to minimise the erosion / loss of soil and to trap any greenhouse gas effect. However, caution should be exercised with regards to the chosen winter cover: the weeding of a winter crop or catch crop in the autumn could cause real problems for resources (surface and groundwater). The problem is a bare soil during a certain period with an increased danger of leakage and of infiltration. The intended effect of the measure is to trap excess nitrates.

Monitoring/Evaluation

FR: around 15 500 km² agricultural land, 50% are permanent meadows (high positive effect), 4% with winter culture trap for NO₃ (high positive effect); 40% with winter cultures (high positive effect on NO₃, but weak effect on pesticides). The assessment of this trend is conducted every four years through the evaluation of the nitrates action programme (controls on aspects of water quality, compliance practices recommended).

LUX: Currently, no data available, but there exists a monitoring of the amount of the participation in the different agri-environmental measures.

SL: Monitoring concerns only the financial aspect (grants) and none regarding the effect on the water protection. Generally, an observed effect is the reduction of the nitrates concentration in groundwater or the inversion of the growing trend.

Other intended effects are (i) Enhancement of biodiversity, (ii) Carbon Sequestration, (iii) Improving the life and soil structure, (iv) Limitation of soil erosion.

DE – Weser

Plant cover in winter reduces the nitrate leaching in winter accumulating it in the plants biomass and/or in soils. In average a reduction rate of 40 kg/ha can be achieved. This fertiliser potential can be used by the following crop rotation in spring.

Experiences from many surveys have shown that this measure is highly dependent to soil and climate properties. Therefore you can reach the objectives easily on light and middle light soils but not on heavy soils. The annual rainfall has to exceed 600 mm with an appropriate water yield in autumn. In dry areas this measure is hardly to implement and in mild winters a higher nitrate leaching rate follows due to the early starting N-mineralisation.

The implementation rate can only be monitored by the existing applications. Numbers are currently not available due to the first funding period. For years the impact control is regularly done on special survey plots by the chambers of agriculture.

To control the effectiveness of the measure twice a year N-concentration in soil is monitored. Experts recommend a mandatory N-min control in spring to include the remaining N-potential in soil planning the spring fertiliser donation.

EE - Pandivere

The aim of the measure is to reduce the losses of nutrients, particularly nitrates, from arable land. It reduces erosion and surface runoff of nutrients into water bodies and leakages of nitrates into groundwater in winter and early spring period when these processes are especially intensive.

Winter plant cover stabilizes the soil by plant roots and mycelium. In spring the assimilation of nutrients by plants starts earlier, which also reduces nitrogen losses from fields.

From both agricultural and environmental point the crop rotations should be planned so that a substantial share of fields is covered by plants in winter. Besides winter crops and perennial grasses there is also a possibility to grow break crops, which assimilate the nutrients left into the soil from previous crops. Break crops are sowed as soon as possible after harvesting basic crop harvesting and are ploughed in directly before land freezing or in spring. The most common break crops are cruciferous (radish, white mustard, rape, turnip rape) grains (rye, barley, oats) and grasses.

Winter plant cover in Estonia has greater potential besides nitrate vulnerable area also in regions with steeper slopes or large fields.

Eroded or erodible soils form only 3.1% of the total arable land in Estonia. Particularly vulnerable to erosion are areas with slope more than 10%, but these areas are less than 2% of Estonian arable land.

On areas with over 10% slope, adequate agrotechnical methods shall be used for the cultivation of agricultural land to prevent erosion. Adequate agrotechnical methods are the following: cultivation of land across the slope, establishment of permanent pasture, cultivation of grasses, minimized soil preparation, establishment of protection strips on hillsides or on the shores of water bodies or other soil erosion preventing activities.

Summary

Conditions for an effective measure:

Establish cover crops early

Careful choice of winter crop important. Any risks for resources? (CIPMS)

Measure highly dependent on soil and climate properties

Annual rainfall to exceed 600mm + appropriate water yield in autumn

In dry areas the measure is hard to implement

In mild winters a higher nitrate leaching rate follows due to N-mineralisation starting early

Objectives reached on light/middle light soils, not on heavy soil

Plant cover in winter reduces P in particulate form but increases soluble P

- Little information available on effects of measure
- Literature:
- plant cover in winter can reduce erosion 10-40%, N leaching 10-70%
- undersowing of ryegrass with barley reduced N leaching 27-68% depending on soil

4. Method of implementation of measure

IT – Liri-Garigliano e Volturno

In Italy the possibility of implementation of this measure is high and the possibility of funding assistance through the mountain-specific laws (Law 97/94), the law on the establishment of mountain communities (Law 267 / 2000, Article 27) or the Hydrogeological Risk Act (Law183/89)

NO - Børsesjø-Leirkup

Part of a plan for the watercourse Børsesjø-Leirkup. Compulsory.

FI – Southwest Finland

Issued as part of Finland's rural development programme. Voluntary measure. Implementation takes place over a certain period, but parcels can be changed yearly as long as the area remains the same. Random controlling by regional agriculture authorities is conducted, if implemented.

UK – various catchments

In order to comply with their English Cross Compliance requirements, it is compulsory to ensure that the land harvested by combine harvester or mower is left in a state where soil erosion is unlikely. Planting the next crop or a cover crop are two such options to comply with this.

The Welsh Government (WG) implement cross compliance in Wales. It's regulatory arm – the Rural Inspectorate Wales undertake the cross compliance inspections. EA Wales works closely with RIW as an integral member of the cross compliance inspection team.

CIPMS/IKSMS (DE (SL), FR, LUX) Moselle-Sarre

FR: legal act (part of the action plan of the Nitrate Directive); mandatory part of the implementation of the Nitrates Directive; therefore not bringing financial compensation except outside the vulnerable zones. Outside the vulnerable zones there is compensation. Implementation / timescale: permanently (one time) for mandatory measures (vulnerable zones in the meaning of nitrates directive): following 5 year plans for voluntary measures. Controlled by the agricultural authorities for mandatory measures. For voluntary measures, the provider of the grant is controlling. Paper controls and on the spot controls.

LUX: agri-environmental measures. The establishment of catch crops and the establishment of temporary grassland are voluntary agri-environmental measures. The maintenance of permanent grassland is mandatory. Implementation time scale: Following 5 year plans. Paper controls and on the spot controls.

SL: "Rural development plan for the Saarland": it implements the rules of the EU (CE) n° 1698/2005 (EAGFD) for the period 2007-2013. Thus, it is consistent with the strategic guidelines of EU and with the strategic national federal plan. Agri-environmental measure on a voluntary basis. Implementation timescale: usually, following 5 year plans with the principle of sustainability. Financial compensation for the adoption or maintenance of the particular environment friendly practices, such as the protection of natural resources, if the measures exceed the legal "good practices". Control by the relevant agricultural authority.

DE – Weser

This measure is voluntary and offered since 2007. The Federal States compensate the income loss of farmers who have applied. The farmers have to apply at least for 5 years. The control is part of the contract and has to be reported as fertiliser amount and N-min-concentration in soil at determined times.

EE - Pandivere

As mentioned under point 2, in nitrate vulnerable areas, it means that in the whole Pandivere region, it is obligatory according the Water Act.

In rest of Estonia winter plant cover of at least 30% of the land under cultivation is required to get area support under the measure "environmentally friendly production".

To get the support for "environmentally friendly production", the farmer has to follow the following requirements on the arable land of the whole enterprise.

No	Baseline requirement (support will be paid for requirements going beyond the baseline requirements)	Additional requirement for environmentally friendly management
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1	It is not allowed to grow cereals in the same field for more than 3 successive years and the same cereal, legume, intertilled, fibre or oil crop species in the same field for more than 2 successive years.	The applicant must prepare an environmentally friendly production plan for the whole arable land (excl. permanent grassland) of the holding, which should include the following: 1) preparing a crop rotation plan, on the basis of which the applicant has to follow crop rotation in plant produce production; 2) every year, legumes or mixture of legumes and grasses must be grown in at least 15% of arable land;
2	In a nitrate-vulnerable area, from 1 November until 31 March, at least 30% of the land under cultivation and used by an agricultural producer shall be under plant cover.	3) in the time period from 1 November to 31 March, at least 30% of cultivated area must be under plant cover (e.g. hibernating crops, such as winter cereals, winter rape, winter turnip rape, grass plants, etc.) (the support requirement is established nationwide).
3	Usable agricultural area must be used for growing the agricultural crops sown or planted no later than on 15 June, using the agrotechnical methods meeting local standards and avoiding the spread of weeds, or the agricultural land in use must be kept as black fallow.	4) at least 15% of the area sown (incl. at least 10% of the area under cereals) must be sown with certified seed;
4	Up to 170kg of N per year on an average may be applied with manure on a hectare of cultivated area. Up to 30kg of P per year on an average may be applied with mineral fertilizers on a hectare of cultivated area and such an amount of N as is needed for agricultural crops and as is in compliance with the requirements provided by a regulation of the Government of the Republic. Quantities of mineral nitrogen exceeding 100kg per hectare shall be spread in parts. In a nitrate-vulnerable area, it is allowed to use an average of up to 170kg of N with manure and mineral fertilizers a year per one hectare of land under cultivation. Quantities of mineral nitrogen exceeding 100kg per hectare shall be spread in parts. In a nitrate-vulnerable area, it is not allowed to use an average of more than 140kg of the total volume of N with mineral fertilizers a year per hectare of land under cultivation. Amounts of mineral nitrogen exceeding 100kg per hectare shall be spread in parts. Agricultural producer must keep a field book	5) the allowed annual total application of mineral fertilizers and manure per hectare of field is up to 170 kg of nitrogen, of which 100kg with mineral fertilizers. In nitrate-vulnerable area, complementary provisions proceeding from the Water Act and stricter than the above mentioned requirements must be considered. 6) preparation of a fertilization plan which will include information about the planned fertilization in each year of commitment.
5	Applicant must participate in the environmentally friendly management training on the issues of soil and nutrients.	7) taking soil samples – once within the commitment period, the applicant must organize the sending of soil samples to an accredited laboratory for the determination of soil acidity, content of P and K that plants can assimilate, and content of organic matter, organic carbon or humus in soil. 8) taking manure samples – if more than 10 LU are kept in the enterprise, the applicant must organize the sending of manure samples to an accredited laboratory for the determination of dry weight, total N, ammonium nitrate and

		nitrate content of manure once within the commitment period.
6	Plant protection products may be used only under the conditions, for the purposes, in the manner and at the application rate specified on the labelling, and observing the number of applications and waiting periods before and after using the products.	9) in crop farming it is not allowed to use plant growth regulators and the use of glyphosates is only allowed after crop harvesting. In case of grasslands, it is only allowed to use glyphosates on seed fields before crop harvesting.
7	In areas surrounding springs and sinkholes and in a range of 10m from the boundary of the water or from the edge of a sinkhole, it is prohibited to use fertilizers and plant protection products and to engage in any other activities endangering water quality.	10) preparation of enterprise territory maps – the applicant applying for support in nitrate-vulnerable area must map the water bodies, areas of unprotected groundwater, wells, combined water intakes, sinkholes and springs and potentially hazardous water pollution sources etc.
8	Usable agricultural area must be used for growing the agricultural crops sown or planted no later than on 15 June, using the agrotechnical methods meeting local standards and avoiding the spread of weeds. Grassland established before the year of submitting the application must be mowed or grazed at least once before 31 July. The mowed grass must be removed or chopped no later than on 31 July. On grassland used for the grazing of livestock, stocking density must ensure the result similar to mowing. In case of insufficient result, grassland must be mowed once again. Sufficient stocking density should be approximately 0,5 LU per hectare. The required activities must be conducted in a way that allows them to be visually identified in the whole area indicated in the application.	11) in case of the fields bigger than 10ha, at least 2 m wide strips covered with perennial flora must be left or established to field edges bordering on the road. Those strips must be mowed.
9	The destruction or spoiling of single natural protected objects referred to in Art. 4(1) of the Nature Conservation Act is prohibited.	12) the applicant must include in the map of the reference parcels the valuable landscape elements established additionally by the legislation. Those valuable elements of landscape must not be damaged or removed during the commitment period.

In order to receive the support the applicant must participate in training on environmentally friendly management. The training subjects and the number of trainings shall be established by the regulation of the minister of agriculture.

The measure is taken in frame of Estonian Rural Development Plan 2007–2013.

The support rate for environmentally friendly management is 35.15 €/ha for basic requirements and 57.52 €/ha for basic and additional requirements.

There is no support for only plant cover in winter.

5. Organisation of implementation

IT – Liri-Garigliano e Volturno

Agencies, such as River Basin Authority, Mountain Communities, Park Authorities which, although for different institutional goals, manage the land and may contribute to the implementation of measures.

NO - Børsesjø-Leirkup

Administrating the implementation: farmers. Authority for controls: Skien municipality

FI – Southwest Finland

Responsible authority for administrating are the regional agriculture authorities.

Responsible authority for controlling are the regional agriculture authorities.

UK – England and Wales

Defra implement Cross Compliance which is overseen by the Rural Payments Agency in England and the Rural Inspectorate of Wales. Natural England implements the grants available for the winter cover crop options in England and Countryside Council for Wales in Wales.

CIPMS/IKSMS (DE (SL), FR, LUX) Moselle-Sarre

FR: (i) The services of the Ministry of Agriculture and the Ministry of Environment (mandatory measures), (ii) granting bodies (voluntary measures). Agence de Services et de Paiement (= French agency for payment: support agency for implementing the national financial tools).

LUX: Administration des Services Techniques de l'Agriculture (ASTA) = agricultural technical support services). Administration des Services Techniques de l'Agriculture (ASTA) = (agricultural technical support services).

SL: regional body for agriculture and landscaping.

DE – Weser

Sponsor and approving organisation are the Ministries for Agriculture of the Federal States or the chambers of agriculture, which are controlling the farmer reports as basis for the compensation payment and have additional controls by spot tests on the plots. Farmers have to apply.

EE - Pandivere

Responsible authority for implementation of the administrating the implementation Estonian Rural Development Plan 2007–2013 is Estonian Ministry of Agriculture.

Farmers are applying for the support from Estonian Agricultural Registers and Information Board. The cross-compliance requirements are controlled by Estonian Environment Inspectorate

6. Acceptance of farmers and involvement of stakeholders, social aspects

IT – Liri-Garigliano e Volturno

Acceptance of measures, including support of the European Community as an address already inserted into the PAC, which could not be high. Furthermore, these measures would help, even if minimally, to reduce the landslide risk.

NO - Børsesjø-Leirkup

Well accepted among farmers.

FI – Southwest Finland

Well accepted. Farm advice available. Farmers are responsible participants in selecting, applying and implementing. It is not known by local population.

UK – various catchments

Cross Compliance requirements for post-harvest management is now accepted but please note, potatoes, sugar beet, maize, field vegetables, salad crops, bulbs and rhizome production are not included within these requirements at the moment. Cover crop option will be determined by how well it aligns into a farmers' rotation. Many rotations are altered which affects uptake of this option in ELS, as the applicant has to commit to an agreed hectareage for the duration of the five years.

CIPMS/IKSMS (DE (SL), FR, LUX) Moselle-Sarre

FR: Land cover in winter is not a problem when it comes to grassland and the very present winter crops in the French part of the river basin. The difficulties appear to catch crops trap (CIPAN) in place during winter before the following spring crops: implementation cost, implementation date of the catch crop traps after the harvest of the previous crop, date and manner of destruction of the catch crop. Achieving 100% coverage in winter is contested in vulnerable zones (mainly by the farming community). Informational and decision support tools used: public events, publication, awareness rising by internet and meetings. Exchanges between the authorities and professional organisations. Participation of the farmers during the « Grenelle de l'Environnement » (= Grenelle Environment Forum)

LUX: High acceptance. Informational and decision support tools used: public events, publication, awareness rising by internet and meetings. It is up to the farmer where he is implementing the different proposed measure.

SL: Currently, 50% of farmers well accept the measure. Informational and decision support tools used: meetings organized by water management bodies; personal exchanges with advisor in the field of the watercourses protection. Exchange between farmers and advisors in the field of the watercourse protection.

DE – Weser

The measure optimises the fertiliser potential in soil and helps the farmer to save fertiliser and money. The experiences show that the acceptance of farmers is good, which is underlined by the life project WAgriCo as well.

Important issue regarding acceptance is the early involvement of farmers and the offer of appropriate advisory services. This is done in context with the implementation of the agri-environmental programme in different types and on different scales down to intensive personally advisory service to farmers.

EE - Pandivere

In frame of the project Baltic Compass the questioning of farmers in Pandivere and Põltsamaa-Adavere NVZ was carried out. The results of the questioning show, that in general farmers recognize the importance of winter plant cover, but there is continually a need to handle this topic during the training, as some farmers are still not aware of the importance of the measure.

Summary:

Generally accepted

NO – B-Leirkup: known among farmers: no ploughing in summer

CIPMS/IKSMS LUX: High acceptance, SL: 50% acceptance

DE – Weser: helps farmers to save fertiliser and money. Early involvement and advisory service

Difficulties:

UK – Uptake sporadic, mainly in west. CC requirements for post-harvest management accepted, but some crops are excluded. Depends on farmers rotation

CIPMS/IKSMS FR – implementation cost, catch crop traps, date and manner of destruction of the catch crop. 100% 'coverage in winter' goal is contested by farmers.

7. Financial aspects of the measure**IT – Liri-Garigliano e Volturno**

Specific funding allocated to institutions such as the mountain communities through the CAP could provide a strong incentive to implement the measure. Until 2004 in Italy, direct funding for the mitigation of risk was available. Today, excluding emergency interventions, there are funds for underdeveloped areas.

NO - Børsesjø-Leirkup

Economical support divided into different erosion risk levels: Low risk- 0 NOK/decare (10 daa=1 hectare), Medium risk- 70 NOK/daa, High and very high risk- 135 NOK/daa

FI – Southwest Finland

Funding from Finland's rural development programme (EAFRD). No cost efficiency evaluation has been made. Some synergy effects can be found with direct sowing.

Plant cover in winter and reduced tilling: The costs of nature management fields show a difference in margin compared with the average gross margin of cereals. The costs of direct sowing and autumn stubble tilling show a difference in net profit compared with ploughing. The starting point in calculating the support level is that the measure can be implemented on a cereal farm as nature management fields (grass), direct sowing in the spring or autumn stubble tilling. It has been assumed that the required 30% plant cover or reduced tilling is possible with four likely combinations that include nature management fields, managed uncultivated arable land, reduced tilling, direct sowing or grass. Costs per hectare have been calculated for these combinations. The most expensive alternative for implementing plant cover is grass cropping. Costs per hectare and the estimated implementation percentages of plant cover alternatives have been used to calculate the average costs when using self-owned machinery, at contracting prices or as an alternative in which ploughing is carried out with self-owned machinery and other tilling methods through contracting. Farmers need time to learn and digest the measure.

Plant cover in winter: The calculation has been made following the same principles as the calculation for the measure "Plant cover in winter and reduced tilling". This measure does not include reduced tilling, which will increase costs per hectare. There are three likely alternatives for implementing the measure. Farmers need time to learn and digest the measure.

Intensified plant cover in winter: The calculation has been made following the same principles as the calculation for plant cover in winter. Farmers need time to learn and digest the measure.

Plant cover in winter and reduced tilling: the payment for the measure is 11 €/ha.

Plant cover in winter: the payment for the measure is 30 €/ha.

Intensified plant cover in winter: the payment for the measure is 45 €/ha.

These measures are mostly saving costs, there are some establishment costs like sowing (nature management field) and harvesting, but support covers them.

UK – various catchments

Grant funding is available through ELS as mentioned above for planting winter cover crops and farmers can receive £65/ha for complying with these prescriptions- this is for five years and can be rotated around the farm to align with the crop rotation.

CIPMS/IKSMS (DE (SL), FR, LUX) Moselle-Sarre

FR: If compensated then EAGFD, national and basin water agency. The cost of implementation of nitrate crops traps (CIPAN) was evaluated in the context of the AEM, financed outside of vulnerable areas. In vulnerable areas, there is no financial compensation.

LUX: Co-financed by EAGFD. Supplementary implementation costs and income foregone (partly). Compensated: (i) 80 €/ha for non-winterized catch crops, (ii) 120 €/ha for hardy catch crops (iii) 225 €/ha for the establishment of grassland on arable land for 5 years.

SL: Contribution of the EAGFD; Funds issuing from joint program for the improvement of agricultural structures and the seaside protection (federal level). Further funds of the local ministry of environment, energy and transport. +/-19 M€ are engaged.

DE – Weser

Compensation payments of 70 €/ha are paid by the Programs of the Federal States. The cost effectiveness of the measure can be calculated by the ratio of the compensation payment in comparison with the decrease of the autumn N-min. It's in average 2.3 €/kgN.

EE - Pandivere

Funding from Estonian Rural Development Plan 2007. No cost efficiency evaluation has been made.

8. Legal aspects**IT – Liri-Garigliano e Volturno**

DPR 14 aprile 1993

DPCM 23.3.90

183/89

Legge 267/2000, articolo 27

97/94

NO - Børsesjø-Leirkup

N/A

FI – Southwest Finland

No

UK – various catchments

None known

CIPMS/IKSMS (DE (SL), FR, LUX) Moselle-Sarre

FR: Achieving 100% coverage in winter vulnerable zones is set for 2012. The forecast could be difficult to be reached.

LUX: The proposed agri-environmental measures sometimes don't offer enough possibilities, so that the farmer makes the choice to refrain from participating.

SL: No obstacles known

DE – Weser

The farmers don't like very much to commit to such a contract for at least 5 years, because the economic effects can be estimated hardly due to the determined crop rotation and additional conditions (i.e. special pesticide application) have to be regarded. Over that high administrative burden prevent farmers to apply.

EE - Pandivere

No legal obstacles

9. References**IT – Liri-Garigliano e Volturno**

N/A

NO - Børsesjø-Leirkup

N/A

UK – various catchments

Department for Environment Food and Rural Affairs (DEFRA). *Farming Advice Service*. Available online: www.defra.gov.uk/crosscompliance/guidance/documents/soil-protection/

DEFRA. *An Inventory of Methods to Control Diffuse Water Pollution from Agriculture (DWPA): User Manual*. Prepared as part of Defra Project ES0203 (2007), Available online: http://archive.defra.gov.uk/foodfarm/landmanage/water/csf/documents/UserManual_Jan07.pdf

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Glastir. *The All Wales Element (AWE) – General Guidance*. Available online:

<http://wales.gov.uk/docs/drah/publications/100915glastirgeneralguidanceen.pdf>

Glastir. *All Wales Element (AWE) - Technical Guidance – Options 28 and 31*. Available online:

<http://wales.gov.uk/docs/drah/publications/100915glastirgeneralguidanceen.pdf>

Links to DTC websites at:

<http://www.edendtc.org.uk/>

<http://www.wensumalliance.org.uk/>

<http://www.avondtc.org.uk/>

This is the DTC's latest newsletter with a link to their website:

<http://www.catchmentchange.net/wp-content/uploads/2011/11/The-Demonstration-Test-Catchments-ProjectFinal.pdf>

FI – Southwest Finland

Puustinen, M., Turtola, E., Kukkonen, M., Koskiahio J., Linjama, J., Niinioja, R., Tattari, S. 2010. "VIHMA- A tool for allocation of measures to control erosion and nutrient loading from Finnish agricultural catchments." *Agriculture, Ecosystems & Environment* Vol. 138, Issue 3-4 (2010). Available online: <http://www.sciencedirect.com/science/article/pii/S016788091000157X>

European Agricultural Fund for Rural Development. *Rural Development Programme for Mainland Finland 2007-2013*. Available online:

http://www.maaseutu.fi/attachments/newfolder_0/5yNX8hBfo/Rural_Development_Programme_for_Mainland_Finland_280411_EN.pdf

CIPMS/IKSMS (DE (SL + RLP), FR, LUX). (RLP did not provide information) Moselle-Sarre

FR:

Ministère de l'Écologie, du développement durable, des transports et du logement. „Projet arrêté relatif au programme d'action national à mettre en oeuvre dans les zones vulnérables afin de réduire la pollution des eaux par les nitrates d'origine agricole“ 14 October 2011. Available online: http://www.developpement-durable.gouv.fr/spip.php?page=article&id_article=24696

LUX: http://www.asta.etat.lu/asta2.data/Composants/New_Pages/agri.environnement/brochure_EG2011.pdf

SL:

For Information:

www.saarland.de

EE - Pandivere

<http://www.envir.ee>

<http://www.pria.ee>

<http://www.agri.ee>

7. Catch Crops

Contributing River Basins: Svärtaå (SE); Jylland and Fyn (DK); Liri-Garigliano e Volturno (IT); Weser (DE); NL.

1. Definition of measure

SE – Svärtaå

Catch crops are grown between two main cash crops with the purpose of reducing nitrogen leaching. To ensure a high effect on the leaching, they should be ploughed in late autumn when the soil temperature is low and the mineralization is ceasing or early in the spring before the sowing of the next main crop.

Requirements

To be eligible for compensation from the agri-environment support scheme, the catch crop must be established with a normal seed rate in relation to the purpose. If it is not satisfactorily established, compensation will not be given. After harvesting of the main crop, it is not allowed to use (e.g. harvest, graze) the catch crop or to apply fertilizer, manure or crop protection products before the permitted day for terminating the catch crop. It is, however, allowed to mow the catch crop.

The earliest date for ploughing is 10th October in the Svärtaå river basin (central Sweden) and 20th October in the south of Sweden for under-sown lay crops. For after-sown catch crops (e.g. rye), the corresponding date is 1st January for the whole country. To get compensation from the agri-environment support scheme, farmers have to enrol for a 5-year period. Only those farmers growing catch crops with an extent of at least 20% of the spring sown area will receive compensation.

DK – Jylland and Fyn

The measure* is used with the objective to lower nitrogen loss from cultivated fields. The cultivation of catch crops will ensure nitrogen uptake in autumn where plant available nitrogen is otherwise at risk for being washed out during late autumn and winter.

Catch crops are grown in the time span between two main cash crops. Guidelines are set up for the time of establishment of catch crops, ploughing of the crop and types of plants suitable for use. Finally, a catch crop must be followed by a spring sown main crop.

Types of crop to be planted and time:

- Lay out of grass, crucifers and chicory
- Grain or grass sown before or after harvest of main crop, but not later than August 1st
- Crucifers sown before or after harvest of main crop, but not later than August 20th
- Grass for seeds which after harvest is used as catch crops (ploughed in after 20th of October and followed by a spring sown crop)

Plant density and crop establishment

The establishment of the catch crop should be according to normal farming principles in order to have an efficient nitrogen up-take in autumn. This indicates that the crop must successfully establish. If lay out or establishment of the targeted catch crop is not successful, the farmer must document that he has taken care of the crop as a crop that could be harvested in order to have the crop accepted as catch crop. This holds true for the recommended time of sowing, sowing technique, plant density and re-sowing. The germination of wasted seeds from previous main crop cannot count as a cultivated field of a catch crop. Lay out of catch crops must be in main crops as cereals or main crops with equal harvest time. Lay out of catch crops in crops with late harvest is only accepted for maize.

Fertilization

No fertilization on the catch crops is allowed; however, depending on the type of catch crop, grazing is allowed.

Requirements regarding succession of crops

Areas with catch crops must be followed with a spring sown main crop.

Requirements regarding soil tillage:

Areas with catch crops cannot be ploughed or soil tillage takes place, sprayed or in any other ways be destructed before the October 20th. For catch crops laid out in maize, the soil tillage cannot take place before March 1st.

Alternatives to catch crops:

In order for farmers to keep high flexibility in terms of their choice of crop rotation, it has been made possible for the farmers to select some alternative measures to substitute the growing of catch crops. For each alternative measure, a ratio for reduced nitrogen loading is defined to be able to calculate the amount of alternative measures needed to implement in order to substitute the effects of growing catch crops.

The alternatives are:

- Reduction in farm level N-quota
- Lay out of intercrop (special crop laid out before July 20th and no tillage before September 20th; expected to be used before sowing of winter wheat as main crop)
- Having another farmer to cultivate catch crops on behalf of you
- Establish a new cultivation of perennial energy crops
- Separation of manure in two parts (a liquid and a solid part) and burning the fibre fraction (solid part)

Also if a farmer cultivates more catch crops one year than needed, he can “save” the number of the catch crops grown beyond the demand this year and grow less catch crops the next year in the amount equal to the area of catch crops saved up from the year before.

**Please note that besides the “targeted” catch crops all farmers in the whole country having more than 10ha of farmland must also comply with rules of growing “basic” catch crops equal to 10 or 14% of the farmland cultivated with annual crops, the percentage differing whether or not animal manure spread on the farm is below or above 0,8 AU (Animal Unit). Finally some farmers may face a third kind of catch crops which are the “environmental” catch crops, grown as a requirement of the individual farmers legal environmental approval negotiated in order to be able to increase the number of animals on the farm without increasing nitrogen loss.*

IT – Liri-Garigliano E Volturno

The Measure aims to promote sustainable use and management of agricultural land in the region, in particular by promoting the preservation of water resources, soil conservation, preservation and enhancement of biodiversity and rural landscape and the improvement of air quality.

NL

Catch crop after maize

After growing maize, on sandy or loess soils, the cultivation of a catch crop is required. Catch crops are grass, winter rye, fodder radish or cabbage leaf. As of 2010, also winter wheat, winter barley and triticale can be used. The sowing of a catch crop after corn is intended to avoid nitrogen leaching in autumn and winter. Therefore, the catch crop should be grown immediately after harvesting the corn. This can be done under the corn seed or planting after harvest of corn. The catch crop may not be destroyed before February 1st of the following year.

If a farmer is late in sowing a catch crop or no catch crop is sown at all, this is an offense. The Dutch

Food and Consumer Product Safety Authority (nVWA) controls this and may impose a fine when an offense is detected. In addition, CAP payments are reduced.

DE - Weser

Catch crops help to reduce the mobilisation of agricultural pollutants by increasing nutrient uptake and reducing surface run-off and soil erosion. Catch crops are fast-growing crops that are grown simultaneously with or between successive plantings of a main crop.

2. Extent of use of measure

SE – Svärtaå

The compensation for catch crops from the agro-environmental support scheme is directed to areas with high nitrogen leaching, which includes the Svärtaå river basin. The total extent of catch crops in Sweden was 120 000 ha (2010), which corresponds to 10% of the area with cereals, potato, sugar beets, legumes and oil seed crops, or 5% of all arable land.

NL

All farmers growing maize are required to grow a catch crop.

DK – Jylland and Fyn

A governmental agreement on future Green Growth and water protection from 2010 including the efforts set according to Danish RBMPs, describes the objective that the extent of the targeted measure catch crop should cover up to 140 000 ha. These targeted catch crops must be placed in areas with run-off directly to shallow coastal waters like lagoons or fjords excluding areas with run-off to more open coastal areas like the Waden Sea or the Belts. Besides, the catch crops must not be placed upstream lakes as the natural denitrification in lakes otherwise will lower the cost-efficiency of the catch crop.*

Within each sub-basin, the number of hectares of catch crops (as with other measures) is calculated based on the need for lowering the nitrogen loading to the marine environment. A quantitative objective of the total anticipated effect from catch crops in the sub-basin is established based on general information of the number of hectares of different main cropping systems in the basin. In light of this, a total number of hectares of catch crops is converted to a percentage on the farmland cultivated with annual main crops that must be cultivated with catch crops each year.

The percentage of targeted catch crops cannot exceed 20% of farmland cultivated with annual crops. The percentage for each subbasin is set once in the lifetime for each RBMP (once every 6 years).

The total number of hectares of targeted catch crops covering all subbasins with run-off directly to enclosed marine waters in total must be up to 140 000 ha.

Control/evaluation: Each farmer must to the authority once a year report on the use of fertilizer on the farm and on selected crops, including amount of catch crops grown.

** Please note that besides the "targeted" catch crops, all farmers in the whole country having more than 10ha of farm land must also comply with rules of growing "basic" catch crops equal to 10 or 14% of the farmland cultivated with annual crops, the percentage differing whether or not animal manure spread on the farm is below or above 0,8 AU (Animal Unit). Finally, some farmers may face a third kind of catch crops which are the "environmental" catch crops, grow as a requirement of the individual farmers legal environmental approval negotiated in order to be able to increase the number of animals on the farm without increasing nitrogen loss equally.*

IT – Liri-Garigliano E Volturno

The measure can be used in the programming of the crops. It is already regulated by information and legislative information contained in the Rural Development Plans: green manure crops should be sown before 15 November and stay on the field at least until next March 31. The crop needs to ensure appropriate coverage.

DE - Weser

This measure is an important part in the programmes of all federal states and is primary chosen for arable or vegetable farming. Every farmer with plots in sensitive areas can apply. In the River Basin Weser this measure is recommended for more than 450 000 ha which is 32% of the arable land of concern.

3. Effects of measure

SE – Svärtaå

The objective of catch crops is to reduce nitrogen leaching to surface waters to mitigate eutrophication in coastal waters and the open sea. Various field experiments in Sweden show good results on the effect of catch crops on nitrogen leaching (e.g. Aronsson and Torstensson, 1998; Torstensson and Aronsson, 2000). It is especially effective in areas with sandy soils. The reduction in leaching varies normally between 25 and 50% depending on soil type, when it is ploughed down, plant species used, climate, etc.

The area and the location of catch crops are registered annually, and the effect is assessed with the use of simulation tools. According to an estimate for the year 2005, the nitrogen leaching was reduced with c. 1700 tons over a total area of 160 000 ha in Sweden, (Johnsson et al., 2008).

Besides the effect on N-leaching, catch crops will also mitigate the release of greenhouse gas emissions from cereal production in a changed climate with increasing temperatures, rainfall and CO₂ concentrations (Olesen et al., 2004).

DK – Jylland and Fyn

The objective of catch crops is to reduce diffuse N loading in the rivers in order to reduce N loading to coastal waters, thereby lowering nitrogen concentration in the coastal water and limiting planktonic algae growth. Less algae will make the water clearer and thereby improve growth conditions for Eelgrass (*Zostera marina*). Eelgrass is the main biological quality element in Danish coastal waters in first generation RBMPs. The cultivation of catch crops will ensure the uptake of nitrogen (and other nutrients) in autumn, otherwise there is potential risk for being washed out during autumn and winter.

Nitrogen

In the RBMPs, the average effect of catch crops in reduced loss of nitrogen from the root zone is 26 kgN/ha/a. Using N-retention on sub-basin level, the effect on reduced loading to the aquatic environment per hectare varies between 11-16 kgN/ha/a. The calculated total annual effect from 140 000 ha of targeted catch crops in reduced loading to the aquatic environment is 1950 tonnes of nitrogen, averaging to 13.9 kgN/ha/a.

Phosphorus

In the RBMPs, no account of phosphorus is taken in relation to the measure catch crops.

Pesticides

No positive or negative influence on pesticide pollution load is expected, as the catch crop does not force aside cultivation of a main crop needing pesticide.

Effect

The effect on reduced nitrogen loss to surface water is expected to occur within the first year of cultivation when plant available nitrogen is taken up or else there is potential for wash out. However, in cases where the farmer uses some of the acceptable alternatives to catch crops, the effect may not be seen right away depending on the alternative. The effectiveness of the catch crop varies depending on both soil type in the cultivation zone and the nitrogen retention potential of the soil below the root zone (e.g. below 1m). Also, the drainage of the soil may influence the effect of the catch crops as

drainage function is a fast lane movement of water, decoupling the influence of retention on the nitrogen loading. In principle, the level of knowledge on the effect of soil type on nitrogen uptake efficiency and on retention is quite high, however the ability of using the knowledge in an administrative detailed way and at the same time in a resource efficient and costless way is not easy. More research on crops varieties and their efficiency in N uptake and co-existence with main crops is needed in order to provide a wider selection of options for the farmers.

IT – Liri-Garigliano E Volturno

The effects of the measure, should also lead to a reduction in water consumption, as well as providing a cover, vegetated land, and reduce overexposure to the sun. From an economic view in Puno, this could result in reduced prices of fruit and vegetables.

DE - Weser

Experiences from many surveys have shown that this measure is highly dependent on soil and climate properties. Therefore, you can reach the objectives easily on light and middle light soils but not on heavy soils. The annual rainfall has to exceed 600 mm with an appropriate water yield in autumn. In dry areas this measure is hardly to implement. In high areas catch crops are hardly cultivate because of the shortened growing season.

The implementation rate can only be monitored by the existing applications. Numbers are currently not available due to the first funding period.

For years the impact control is regularly done on special survey plots by the chambers of agriculture.

To control the effectiveness of the measure, N--concentration in soil is monitored twice a year. Experts recommend a mandatory N-min control in spring to include the remaining N-potential in soil planning the spring fertiliser donation.

4. Method of implementation of measure

SE – Svärtaå

Catch crops are included as one of the most important measures in all programs and plans for reducing the eutrophication of coastal areas and the sea. The measure is voluntary and promoted within the RDP.

Catch crops alone are compensated with 900 SEK/ha (c. 100 €/ha); together with spring cultivation, the compensation is 1600 SEK/ha (ca. 170 €/ha). Instead of receiving a fixed yearly amount for the 5-year contract period, it is also possible to select compensation that will be adjusted every second year for actual costs and prices on fuel, crop products etc.

NL

General requirement when growing maize.

DK – Jylland and Fyn

The measure will be implemented in 2013/2014 through a legal notice prepared by the Danish AgriFish Agency (part of the Ministry of Food, Agriculture and Fisheries) and implemented in the annual guidance document on fertilization and green soil cover published by Danish AgriFish Agency. In this document, the percentage of farmland grown with annual crops that must also be cultivated with targeted catch crops is set for each subbasin within specific river basins. Also, specific requirements on how to cultivate catch crops are given if the crop is to be accepted as a catch crop. The implementation is compulsory and each farmer must report once a year to the Danish AgriFish Agency on how many hectares of catch crop have been grown and/or to which extent alternatives to catch crop are used (included in the report on use of fertilizer, animal manure etc.) Based on this reporting, a yearly disk control is made. Also, a certain percentage of farms will be selected randomly for physical controls.

IT – Liri-Garigliano E Volturno

The measure is already active in several Italian regions that favour crops, also responding to the new

challenges of the Health Check and the EU economic recovery plan under Action 1 and, in particular, to Measure 214. Key actions related to the challenge "Water management" means the operations related to "land management practices (e.g. tillage methods, crops, diversified crop rotations)" and "water-saving technologies (e.g. efficient irrigation systems)".

DE - Weser

This measure is voluntary. The Federal States compensate the income loss of farmers who have applied. The farmers have to apply at least for 5 years. The control is part of the contract and has to be reported as fertiliser amount and N-min-concentration in soil at determined times.

5. Organisation of implementation

SE – Svärtaå

The Swedish Board of Agriculture is the responsible authority for administration and implementation at a national level and the County Board Administrations on a local level. The County Board Administrations are also responsible for controls.

NL

The Dutch Food and Consumer Product Safety Authority (nVWA) controls this and may impose a fine when an offense is detected. In addition, CAP payments are reduced.

DK – Jylland and Fyn

The Danish AgriFish Agency (part of the Ministry of Food, Agriculture and Fisheries) is responsible for implementing the legal notice and preparing the annual guidance document on catch crops (both targeted catch crops as well as basic catch crops). Also the Danish AgriFish Agency is responsible for making disk controls of the farmers annual reporting on fertilization and green coverage (mainly catch crops) and to prepare physical random checks. The farmer is responsible for cultivation of the targeted catch crop or implementation of selected alternatives. Every year in March, farmers have to file an annual report to The Danish AgriFish Agency. Once every six years, the Nature Agency (part of the Ministry of the Environment) is responsible for setting the percentage of annual crops for each subbasin that must be cultivated with targeted catch crops.

IT – Liri-Garigliano E Volturno

Implementation has already passed through the law and the implementation of measures under the Rural Development Plans, and good agricultural practices. The usual practice involves the following activities: deep ploughing carried out close to the harvest of previous crop and shallow soil preparation before planting the crop. The fertilization is carried out with chemical fertilizers.

DE - Weser

Sponsor and approving organisation are the Ministries for Agriculture of the Federal States or the chambers of agriculture, which are controlling the farmer reports as basis for the compensation payment and have additional controls by spot tests on the plots.

6. Acceptance of farmers and involvement of stakeholders, social aspects

SE – Svärtaå

The extent use of catch crop shows that it is a relatively well accepted measure by the farmers as long as the compensation covers the expenditures.

NL

General requirement.

DK – Jylland and Fyn

The farmers and farmer organizations are not keen on this measure. They argue that the amount (percentage of crop rotation) of catch crops already grown as a basic measure (which are 10 or 14% depending on amount of animal manure spread on the field) is tough enough and very costly as no compensation to the farmer is given.

If targeted catch crops up to 20% of the cultivated area are to be grown in addition to the requirements for growing basic catch crops (10 or 14%), this may force some farmers to change the main crop from winter wheat to spring barley and thereby lose a great income as the yield and price of barley are much lower than for wheat. As a result of this resistance from farmers, the political decision has been to give the farmers a possibility to use some alternatives instead of catch crops (see above), hereby bringing in flexibility to the catch crop measure. The farmer must once a year report to which extent targeted catch crop (as well as basic- and environmental catch crops) is grown and to which extent one or more alternative is used. The year 2013/2014 is the first year of using the possibility of implementing alternatives. Despite this flexibility, farmers are still not keen on this measure.

IT – Liri-Garigliano E Volturno

Acceptance of measures, including support of the European Community already part of the CAP, is not high.

DE - Weser

The measure optimises the fertiliser potential in soil and helps the farmer to save fertiliser and money. The experiences show that the acceptance of farmers is very good, which is underlined by the life project WAgriCo as well. Important issue regarding acceptance is the early involvement of farmers and the offer of appropriate advisory services. This is done in context with the implementation of the agri-environmental programme in different types and on different scales down to intensive personally advisory service to farmers. Meanwhile this measure is established as “good farming practice” also in not founded areas.

7. Financial aspects of the measure

SE – Svärtaå

Catch crops are financed through the EU agro-environmental support scheme. The cost for an under-sown catch crop has been calculated to c. 650 SEK/ha (c. 70 €/ha) based on (Focus on Nutrients, 2012):

Type of cost	Cost for catch crop, SEK and (€)
reduced yield	150 (16)
seed	300 (32)
sowing	100 (11)
increase of weed	100 (11)

Several studies have shown that cultivation of catch crop is a cost-efficient measure. In the impact assessment for the Baltic Sea Action plan (Naturvårdsverket, 2009), the cost-efficiency for catch crop together with spring cultivation was estimated to 187 SEK (c. 20 €) per kg reduced nitrogen to the sea. In a recent report from the Swedish Board of Agriculture (Jordbruksverket, 2010), the corresponding cost was estimated to 166 SEK (18 €). Where the conditions are favourable locally, considerably lower costs have been estimated, e.g. for the Rönneå river basin a cost of 44 SEK (c. 5 €) per kg reduced nitrogen leaching was calculated (Larsson et al., 2005).

NL

No payments for the implementation of this measure. If a farmer is caught being too slow planting catch crop after maize, he will be sanctioned, both by being fined, as well as losing part of CAP money.

DK – Jylland and Fyn

The estimated cost of the measure is calculated to be about 55 €/ha/a of cultivation and equal to about 4 € /kg of reduced nitrogen loading. The use of alternatives is also handled as measures with no compensation. As no direct compensation is given, the cost of the measure must be sustained by the farmer themselves. However, at the same time as the politicians decided for this measure to not be compensated, an ease on soil tax was given to the farming sector in general with higher total value for the sector than the cost of income loss from growing target catch crops. The use of catch crops as compulsory measure is due to its proven status as one of the most cost-efficient measures.

IT – Liri-Garigliano E Volturno

The CAP and specific funding sources could provide strong incentives to implement the measure.

DE - Weser

The cost effectiveness of the measure can be calculated by the ratio of the compensation payment in comparison with the decrease of the autumn N-min. It's in average 1 to 3 €/kgN.

8. Legal aspects

DK – Jylland and Fyn

Having been first implemented during 2013/2014, no information on legal obstacles has been observed yet. In cases where the farmer does not comply with the demands of growing targeted catch crops in the defined subbasins, the farmer may receive a fine in the end (reduction in the single farm payment scheme).

IT – Liri-Garigliano E Volturno

A4 Act Dir 91/676/EC of the Council concerning the protection of waters pollution by nitrates from agricultural sources-DM 07.04.2006. In soils subject to considerable erosion, in the case of agronomic use of effluents to the outside the period of duration of the culture main, there shall be a vegetation cover by vegetation spontaneous catch crops

B9-Directive 91/414/CEE Council Act concerning the marketing of plant protection products: use of products authorized.

Ministerial Decree No. 13286 of 10.18.2007-Rule 2.1 This rule provides only for the ban of burning of stubble and residues cultivation. Rule 2.2 of the rotation crops. The use of monoculture Cereal is permitted for a period not over 5 years. good agronomic and environmental condition. 97/94.

DE - Weser

The farmers don't like very much to commit to such a contract for at least 5 years, because the economic effects can be estimated hardly due to the determined crop rotation and additional conditions (i.e. special pesticide application) have to be regarded. Over that high administrative burden prevent farmers to apply.

9. References

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Torstensson, G. and H. Aronsson. 2000. Nitrogen leaching and availability in cropping systems with recurrent use of liquid manure and catch crops. *Nutrient Cycling in Agroecosystems* 56: 139-152.

NL

<http://www.hetInVloket.nl/onderwerpen/mest/dossiers/dossier/scheuren-van-grasland-en-vanggewassen/vangewas-na-mais>

DK – Jylland and Fyn

Report on potential measures including catch crops (in Danish – English summary at page 11):

http://www2.dmu.dk/Pub/FR625_Final.pdf.

8. Application techniques of manure

Contributing River Basins: Pandivere (EE); Svärtaå (SE); Lechinta (RO); Scotland (UK); Weser (DE); NL.

1. Definition of measure

EE - Pandivere

Promotion of the usage of best available technology for manure application.

Training of farmers to explain the necessity to incorporate the manure into the soil as quickly as possible (in case of solid manure) and to show the advantages of direct injection of manure into the soil (in case of liquid manure).

According to the Estonian Water Act, manure (both dry as well as liquid manure) has to be incorporated into the soil during 48 hours. Good Agricultural Practice advises to do it as quickly as possible after spreading. A farmer shall keep a field record in which information is entered concerning the area of land under cultivation, the characteristics of the soil, yields, the types and volumes of fertilisers and plant protection products used, and the times of fertilisation. A person keeping livestock of more than 300 livestock units and using liquid manure technology in a livestock facility or a person who spreads, based on a contract, liquid manure of livestock the quantity of which corresponds to 300 livestock units has to prepare a liquid manure spreading plan before spreading the liquid manure. The plan has to include the amount of liquid manure, the area of application, technology used, groundwater protection degree, surface water bodies and water intakes in the spreading area. The liquid manure spreading plan has to be approved by Environmental Board. The plan is approved for 3 years.

In areas surrounding springs and sinkholes and in a range of 10m from the boundary of the water or from the edge of a sinkhole, it is prohibited to use fertilisers and plant protection products and to keep manure in a manure stack. Littering and filling of sinkholes is prohibited.

In NVZ, it is prohibited to use fertilisers and plant protection products and to keep manure in a manure stack in areas surrounding important springs and sinkholes and at a range of 50m from the boundary of the water or from the edge of a sinkhole.

SE – Svärtaå

This measure includes injecting slurry into the soil as opposed to applying it to the soil surface (e.g. for application into established lay crops) and shallow, light harrowing after surface applied manure soon after application in growing crops (e.g. for spring application of slurry and solid poultry manure to winter wheat).

NL

‘Emission poor application’

Manure should be applied in such a way that emissions are reduced as much as possible (‘emission poor application’). There are different conditions for arable land and grassland.

Arable land

On arable land ‘Emission poor application’ is required. Arable land refers to land on which at least part of the year a crop is grown other than grassland. Uncultivated land is land which does not show that it is evenly covered with a crop.

Liquid manure

With respect to the application of liquid animal manure on arable land, the following rules apply:

- On cultivated arable land the manure needs to be put immediately in slots in the floor. The slots should not be wider than 5 cm.
- On cultivated arable land the manure needs to be put immediately in slots in the floor. The slots should not be wider than 5 cm and less than 5 cm deep.
- Or the manure should be applied on the surface and simultaneously be incorporated in one pass

with one machine, so that the manure is ploughed under or mixed thoroughly with the soil immediately after application. The manure is then no longer visible on the soil surface.

Solid manure

With respect to the application of solid manure, the manure should be applied on the surface and incorporated in maximal two directly consecutive swaths, so that the manure is ploughed under or mixed thoroughly with the soil immediately after application. The manure is then no longer visible on the soil surface.

Grassland

Liquid manure

On pastures 'Emission poor application' is required. In 2011, manure application on grassland on sand and loess soils was allowed directly on or in the ground. However, as of January 1st 2012, manure application on sandy and loess soils is only allowed if manure is applied directly into the soil (no drag feet allowed anymore).

On grassland on clay and peat soils manure must be applied immediately on or in the soil. Here's how you can use emission:



On the ground means: in strips between the grass, where the grass is tilted or laterally pushed. The strips are up to 5 cm wide and are at least 15cm apart.

In the ground means in slots with a maximum width of 5cm.



Solid manure

The application of solid manure on pasture does not have to be 'emission poor'.

Exceptions

In the following situations, 'emission poor' manure application is not required:

- On arable land on the island of Texel.
- On soils used solely for the cultivation of grass or fruits, the application of solid manure. Unless this land has a slope of 7% or more.

RO – Lechinta

What are the requirements for the measure in your River Basin, concerning the following aspects:

- Type of technique to be applied: *On the fields with slope greater than 12%, in maximum 24 hours from the application, the organic fertilisers are incorporated into the soil. In the project area are taken the following measures: (i) waste collection/delivery to communal-level facility; (ii) provision of equipment to facilitate handling at the communal-level facility – tractor with trailer and loader; (iii) management of livestock waste to stimulate breakdown and composting; (iv) provisions for spreaders for field application of composted material; (v) provision of vacuum tanker and injector for handling and field application of the effluent. The responsibilities will be set out in agreements between the PMU and the local authorities.*

Summary of the investment programs (numbers) in livestock and household waste management, in the frame of the Integrated Pollution Control project, at the national level:

Item	Year					Total
	2009	2010	2011	2012	2013	
Communal storage facilities	26	33	25	15	-	99
Household bunkers	1.590	2.300	1.500	1.010	800	7.200
Handling and application equipment sets	20	21	21	17	7	86
Household waste bins	9.400	6.300	6.300	6.300	1.200	29.500

- Type of nutrient source (liquid manure, solid manure, compost)
- Characteristics of nutrient source (for example, restrictions on content or its quality)
 - Timing of application (time of the year, but also weather conditions – for example, during periods of low wind speed): *according the annex 3 at the end of the document with some exceptions*
- Area applied: *it is not applied on buffer strips and protected areas for drinking water supply*
- Soil condition: *the soil must not be frozen or covered by snow*
- What is the time commitment for farmers? *For NVZ areas the time commitment is permanent*

UK – Scotland

CAOM: 'This measure involves cutting slots in the soils, injecting the slurry and then closing these slots after application. Injecting slurry as opposed to applying it to topsoil makes it possible to directly reach the active soil layer in order to reduce nutrient leaching. In addition, direct ground injection systems directly inject pressurized slurry into the ground. It could also involve other types of techniques, such as split application, band application and variable rate application.

Requirements for the measure in your River Basin, concerning the following aspects:

- Majority of manure currently spread via conventional chain and flail rotary systems. Majority of slurry spread via vacuum tanker and splash plate system. Other less common methods include trailing shoe, shallow and deep injection and band spreading slurry, compost)
- Characteristics of nutrient source (for example, restrictions on content or its quality): Would need to be slurry and possibly macerated to avoid blockages.
- Not exceeding crop requirement, NVZ restrictions will apply in specific areas which prevent spreading during specific time periods
- Area applied avoiding application on frozen, snow covered or waterlogged land: Organic fertilisers cannot be applied within 10m of any surface water or wetland (cross compliance) or 2m of a drainage ditch.
- Maintenance and calibration of machinery: Machinery must be maintained in a good state of repair. (CAR GBR)

DE – Weser

This measure involves cutting slots in the soils, injecting the slurry and then closing these slots after application. Injecting slurry as opposed to applying it to topsoil makes it possible to directly reach the active soil layer in order to reduce nutrient leaching. In addition, direct ground injection systems directly inject pressurized slurry into the ground. Furthermore this measure helps to reduce mineral fertiliser by slurry application in spring.

2. Extent of use of measure

EE – Pandivere

The measure is proposed to all farmers in Estonia.

SE – Svärtaå

The measure is proposed to all farmers who keep livestock on slurry based systems.

NL

This measure applies to all Dutch farmers.

RO – Lechinta

The measure is proposed for all NZVs at national level. The measure is targeted for the areas declared NZV. On monitoring/Evaluation of a) the rate of implementation, this information are gathered by the Agrochemical and Pedological Studies Office (APSO) and at this moment we do not have this information.

UK – Scotland

- Is the measure proposed to all farmers in the RBD? At Member State level? *Application methods which reduce the amount of Ammonia lost to the air, or reduce the risk of run-off would be of benefit to most farmers who apply slurry.*
- Does the measure target specific types of soil or farming type? *Farmers who keep livestock on slurry based systems.*
- Monitoring/Evaluation of a) the rate of implementation:
 - o How many hectares are covered by the measure? What is the current coverage and what is the targeted coverage? *Most farmers in Scotland would be able to apply via the competitive SRDP.*

DE – Weser

This measure has been implemented in the past mainly in water protection areas. Here good experiences have been made with this measure, wherefore the measure is part of the agri-environmental programme since 2007 in arable and grassland areas with higher livestock farming. Test surveys promote these results. Every farmer whose plots are part of sensitive areas for nutrients reduction can apply. In the strategic investigation AGRUM Weser, this measure was recommended for nearly 9 % of the areas of concern.

3. Effects of measure**EE - Pandivere**

The aim of the measure is to reduce the losses of nitrogen through emissions into the air and leakages into ground and surface waters. The use of best manure application technology is particularly important in case of liquid manure. The loss of ammonium nitrogen into the air is less than 5% in case of direct injection of liquid manure into the soil. The loss of ammonium nitrogen into the air is about 50%, if the manure is simply spread onto the soil. Direct injection into the soil also considerably reduces surface runoff, which is particularly important for reducing phosphorus load to surface water bodies.

According to the survey data made in 2009/2010, most of the liquid manure was spread by dragging hoses, only few new large farms used the direct injection technology. In Pandivere area stoney soils are rather common and it is limiting the use of direct injection technology.

Field experiments made by Estonian Research Institute of Agriculture show the good correlation between extra yields and used liquid manure application technology. For example the yield of barley with direct injection technology was 4,2 t/ha, when manure was incorporated into the soil 1 hour later, the yield was 3.4 t/ha, 24 hours later the yield was 3.1 and 48 hour later 2.8 t/ha. Such data gives the possibility to convince the farmers during trainings that proper manure application technology is also profitable to themselves and not only an environmental requirement.

SE – Svärtaå

- The aim of the measure is to reduce phosphorus losses via surface runoff and macropore flow by placing the manure away from active flow paths and also by increasing the contact time and contact area between manure and soil.
- Intended effects: In experimental studies, incorporation of P has reduced the leaching of P through macropores in clay soils. In a recent Danish study with rain simulation on undisturbed clay cores, incorporation of cattle manure reduced the leaching with up to 50% compared to the cores where the manure was left on the surface (Glæsner et al., 2011).
- Neither the rate of implementation nor the effects of the measure is monitored or evaluated.
- The measure is also reducing air emissions of ammonia by up to 70% (Jordbruksverket, 2010a).

NL

The manure policy in the Netherlands is based on the Nitrate Directive. This directive includes agreements on the amount of nitrate that is allowed in ground and surface water. In order to achieve the objective of the Nitrates Directive, measures are taken with respect to fertilization.

The main components of the manure policy are:

- Application standards for nitrogen and phosphate from all sources of fertilizers that are allowed to be used in the cultivation of crops. This provides each crop with exactly that amount of fertilizer it needs.
- Instructions for how manure is used and the periods in which this is applied. The manure is applied at the right time and in the most efficient way to the crop. This reduces losses to the environment.
- A system of animal permits which sets limits to the number of animals for production that may be kept. This ensures that no more manure is produced than can be used in the cultivation of crops.
- Rules for the removal of manure from livestock farms. So that it is always known where the manure comes and goes.

RO – Lechinta

What pressure(s) does the measure aim to address? The surface water and groundwater pollution with nitrates

What are the expected and actual effects of the measure in terms of the following indicators:

- Reduction in nitrogen load - YES
- Reduction in phosphorous load - YES
- Reduction in pesticide/pollutant load (E. coli) – N/A
- Impacts on biological quality elements (Fishes, Benthic macroinvertebrates, Macroalgae, Phytoplankton)
- Other environmental benefits not related to water

Please provide assessment/description of the expected and actual effects on the basis of any monitoring / evaluation activities, but also from relevant evidence from literature and experts

Is timing of application more important than the technique of application in terms of effect on water quality? *Both are important*

What is the time scale of the measure to become effective? What is the certainty of measure effectiveness? The effects of the measure can be observed both immediately and in time, because by applying the organic fertilizers in a wrong way, the surface water can be polluted in short time from the application and by applying the fertilizers in a correct way, the concentration of the nitrates is lower in the surface water.

Is there need for further research (and monitoring) on the effectiveness of measure? Please specify. Yes, there are needed other researches, too. This measure and his effects are depending from many variables.

UK - Scotland

What are the expected and actual effects of the measure in terms of the following indicators:

- Reduction in nitrogen load : would expect reduced Ammonia losses to the air, less risk of surface run-off
- Reduction in phosphorous load : reduced risk of run-of
- Reduction in pesticide/pollutant load (E. coli):, possibly through reduced risk of run-off
- Impacts on biological quality elements (Fishes, Benthic macroinvertebrates, Macroalgae, Phytoplankton), if less risk of run-off less should reach watercourses
- Other environmental benefits not related to water, less ammonia releases to air – less air pollution, odour etc.

Is timing of application more important than the technique of application in terms of effect on water quality? Timing is very important, if applied at correct time and in correct quantities more N will be used by crop and less risk of leaching

What is the time scale of the measure to become effective? What is the certainty of measure effectiveness? Would expect to see benefit early on.

DE – Weser

This measure increases the efficient of nitrogen balance and reduces the deposition losses and nutrient leaching in soil. It's preferential choosing in arable land with light soils. Because of bad effects to sod is less adapted in grassland.

The implementation rate can only be monitored by the existing applications. Numbers are currently not available due to the first funding period. Additional indicators are the autumn N-min or nitrate concentration in leakage water. Experiences show autumn N-min-reduction up to 10 kgN/ha.

4. Method of implementation of measure

EE - Pandivere

For farmers keeping livestock of more than 300 livestock units, the measure is compulsory according the law. In nitrate vulnerable are it is obligatory for farmers to participate in training on environmentally friendly management. There is a booklet about environmentally friendly manure management for farmers. In Estonia, the measures of rural development, including support for purchasing new machinery, is financed by the Estonian Rural Development Plan 2007–2013. For this Estonia is using money from the European Agricultural Fund for Rural Development (EAFRD) and state budget. To get support for new technologies farmers have to apply it from Estonian Agricultural Registers and Information Board. The rate of the support is depending on the location and age of the farmer 35-60%.

SE - Svärtaå

This measure is included in a “proposal for action plan” for reduction of nutrient losses and climate gases to 2016 issued by the Swedish Board of Agriculture (Jordbruksverket, 2010b).

The measure is mainly voluntary, but for farms with more than 400 animal units it is possible to prescribe this measure as a requirement for the permit. There is possibility get compensation with up to 30% of the investment via the agro-environmental support scheme.

NL

Legal requirement. No compensation, since it is a basic measure.

RO – Lechinta

Issued as a legal act, programme, plan: Yes, “The Action Programme for vulnerable areas to nitrates from agricultural sources at the level of administrative units”, approved by the Decision 21130/DC/14.10.2010 (according to The Governmental Decision 964/2000 witch transpose the Nitrates Directive into Romanian Legislation)

Voluntary or compulsory: compulsory for NZVs

Implementation time scale (at one time / over a period): every year

Implementation of control requirements

UK - Scotland

Issued as a legal act, programme, plan. No specific legal requirements to use a particular application technique. Other than to maintain application equipment in good condition and to use a downward projectory splash plate in NVZ areas

Voluntary measure

DE – Weser

This measure is voluntary and offered since 2007. The Federal States compensate the income loss of farmers who have applied. The farmers have to apply at least for 5 years. The control is part of the contract and has to be reported as fertiliser amount and N-min-concentration in soil at determined times.

5. Organisation of implementation

EE - Pandivere

Responsible authority for administrating the implementation Estonian Rural Development Plan 2007–2013 is Estonian Ministry of Agriculture.

Farmers are applying for the support from Estonian Agricultural Registers and Information Board, which is also responsible for training.

Responsible authority for control is Estonian Environment Inspectorate. In Estonia large animal farms (over 300 AU of cows or piggeries > 2000 places for pigs with a live weight of more than 30 kg or 750 places for sows) must have integrated environmental permit. These farms are controlled by Estonian Environment Inspectorate every year.

SE - Svärtaå

The responsible authority for administrating the implementation is Swedish Board of Agriculture on a national level and County Board Administrations on a local level. The responsible authority for controls is County Board Administrations.

NL

Controls are performed by nVWA (physical controls) and DR (administrative controls).

nVWA may also check on animal health and food security; DR is responsible for agricultural payments.

RO – Lechinta

Responsible authority for administrating the implementation: The farmers which are applying the organic fertilizer and the village hall.

Responsible authority for controls: The Environmental Guard and in some cases APIA (Agricultural Payment and Intervention Agency).

UK - Scotland

Responsible authority for administrating the implementation: n/a

Responsible authority for controls: SEPA and Scottish Government enforce controls relating to the application of slurry

DE – Weser

Sponsor and approving organisation are the Ministries for Agriculture of the Federal States or the chambers of agriculture, which are controlling the farmer reports as basis for the compensation payment and have additional controls by spot tests on the plots.

Farmers have to apply.

6. Acceptance of farmers and involvement of stakeholders, social aspects

EE - Pandivere

In frame of the project Baltic Compass the questioning of farmers in Pandivere and Põltsamaa Adavere NVZ was carried out. The results of the questioning show, that in general farmers recognize the importance of proper manure handling in water protection. Almost 90% of farmers estimated leakages from manure storages and during manure spreading on filed as the main water pollution problem in agriculture. According, the questioning of about 2/3 of farmers strongly or partly agreed with the statement that there is no good technology for the precise application of manure

SE - Svärtaå

There is no information or judgement of farmers' opinion on this measure. The information about this measure is disseminated mainly through the environmental extension service program "Focus on Nutrients", the County Board Administrations and the Swedish Board of Agriculture. As this is a voluntary measure, the initiative comes from the farmer. Since the odour will be reduced using this

application technique, the local population would certainly be in favour for this measure.
Level of acceptance by local population: Full acceptance

RO – Lechinta

Informational and decision support tools used to provide clear information for farmers: The halls in the NVZ areas have the obligation to official communicate to the farmers the forbidden periods for the application of the organic fertilizers. The forbidden periods are established by APSO for each locality in the NVZ area, taking into account the climate conditions and the way of using the soil, according to annex 3 – the interdiction calendar for the protection against the nitrates pollution from agricultural sources.

Farmers' involvement in the process of selecting and implementing: before the approval of the Action Programme there were public consultation and information meetings. The public consultation of the Programme was opened for 6 months.

UK - Scotland

Farmers' opinion on the measures (well accepted or not): not sure

Informational and decision support tools used to provide clear information for farmers: uptake likely to be increased through pushing the economic benefits of better nutrient use

Level of acceptance by local population: would expect local resident to be in favour due to reduced odour

DE – Weser

The measure optimises the fertiliser potential in soil and helps the farmer to save fertiliser and money. Farmer communities for the required equipment can also help to reduce the costs for this measure. The experiences show that the acceptance of farmers is very good, which is underlined by the life project WAgriCo as well.

Important issue regarding acceptance is the early involvement of farmers and the offer of appropriate advisory services. This is done in context with the implementation of the agri-environmental programme in different types and on different scales down to intensive personally advisory service to farmers.

7. Financial aspects of the measure

EE - Pandivere

No special cost efficiency evaluation has been made.

As mentioned under point 3, the minimizing of losses of nitrogen is increasing the yields.

SE – Svärtaå

- Funding sources: Up to 30% of the investment can be funded through the agro-environmental support scheme.
- What costs have been calculated (and how)? The extra cost for slurry injection when buying this service is c. 1 €/m³ of slurry. For a farm with 2600 m³ slurry production per year (e.g. 120 dairy cows), investing in a slurry injection equipment would cost c. 3.3 €/m³ of slurry (Jordbruksverket, 2010a). Since the ammonia losses will decrease and nitrogen will be saved, the net cost will be lower, resulting in a span between c. 0 – 3 €/m³ of slurry corresponding to c. 0 – 3 €/kg P.
- Implementation based on Cost-efficiency evaluation? Yes, since it is voluntary, it will mainly be implemented where both risks for P-losses and savings of N are considered high. The total effect is difficult to estimate but assuming a P-loss reduction of 2% of the surface applied amount and a cost of 0 – 3 €/kg applied P will result in a cost-efficiency between 0 and 150 €/kg reduced P.

RO – Lechinta

- Is there compensation for the measure? The farmers can prepare projects for buying machines for

spreading the organic fertilizers

- Is implementation based on Cost-efficiency evaluation? NO, this measure is compulsory for the farmers in NVZ areas
- What are the funding sources for the measure? The farmers are providing the founding sources. There can be added founding from European projects. In the areas of the Integrated Control of the Pollution project, there were bought machines for spreading the organic fertilizers from the budget of the project.

UK - Scotland

- Is there compensation for the measure? No compensation required but will be a significant investment cost.
- What is the per hectare payment that farmers receive? n/a
- What costs have been calculated (and how), i.e.:
 - o Investment costs (total cost to set up the measure)? Not sure
 - o Operational costs (total cost to run / maintain the measure)? Not sure, although work rates may be reduced compared to conventional methods of spreading slurry
- What are the funding sources for the measure? SRDP
- What is the total investment foreseen for the measure? Not sure
- What amount of funding do you have earmarked for 2007 – 2013? £1.5bn

DE – Weser

Compensation payments of 30 €/ha are paid by the Programmes of the Federal States.

The cost effectiveness of the measure can be calculated by the ratio of the compensation payment in comparison with the decrease of the autumn N-min. It's in average 3 €/kgN.

8. Legal aspects

EE - Pandivere

No legal obstacles

SE - Svärtaå

No legal obstacles

RO – Lechinta

N/A

DE – Weser

The farmers don't like very much to commit to such a contract for at least 5 years, because the economic effects can be estimated hardly due to the determined crop rotation and additional conditions (i.e. special pesticide application) have to be regarded. Over that high administrative burden prevent farmers to apply.

9. References

EE - Pandivere

<http://www.envir.ee>

<http://www.pria.ee>

<http://www.agri.ee>

SE – Svärtaå

Glæsner, N., Kjaergaard C., Rubæk G.H. and J. Magid. 2011. [Interactions between soil texture and placement of dairy slurry application: II. Leaching of phosphorus forms](#). Journal of Environmental Quality 40:344-351.

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Jordbruksverket, 2010b. [Minskade växtnäringsförluster och växthusgasutsläpp till 2016 – förslag till handlingsprogram för jordbruket.](#) Rapport 2010:10. Jordbruksverket. (In Swedish)

NL

<http://www.hetInvloket.nl/onderwerpen/mest/dossiers/dossier/gebruik-en-uitrijden-meststoffen/dierlijke-mest>

RO – Lechinta

<http://www.inpcp.ro/en/page/21/Waste%20handling%20and%20manure%20application%20system.html>

9. Provide capacity of manure storages

Contributing River Basins: Pandivere (EE); various catchments in Scotland, England and Wales (UK); Svärtaå (SE); NL.

1. Definition of measure

EE – Pandivere

The requirements for manure storage facilities according Estonian Water Act:

If more farm animals than 10 LU are kept in a livestock building, the farm should have a manure or liquid manure storage facility, of which the storage capacity must be the stocks of at least eight months. In cowsheds where animals are kept on deep litter, there is no need for a manure and liquid manure storage facility.

UK – Scotland

Requirements for the measure concerning the following aspects:

- Capacity and type of storage: Land managers are required to provide 6 months slurry storage or a lesser amount with a detailed Farm waste management Plan under the requirements of the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) (Scotland) Regulations 2003. Within NVZ areas they are required to compile with the minimum no spread period of 22 and 26 weeks so within these areas in Scotland these are the minimum storage requirements. The type of storage is land manager dependant, but must comply with the design specification set out in the SSAFO regs above. We have earth bank lined and unlined lagoons, above ground slurry stores, below ground shuttered concrete or panelled storage tanks etc.
- Does the storage have to be covered: Storage only needs to be covered if the farm falls under the IPPC regs for pigs and poultry.
- Does the required storage size vary with location / type of farming: The SSAFO regs specify 6 months or a lesser amount back by a Farm waste management plan. With the increase in livestock numbers on farms slurry facilities have not been increased in capacity at the same rate on farms, thus on most livestock units the average slurry storage capacity would be around 3.5 months.
- Requirements for the construction (robustness, leakage-tightness): All storage facilities must be impermeable and built in accordance with specific design criteria written into the Schedules of the SSAFO regulations.



SE – Svärtaå

Adequate capacity for manure storage within and outside nitrate vulnerable zones (NVZ) according to the regulation.

Animal units	Livestock type	Minimum storage requirement (months)	
		within NVZ	outside NVZ
>100	Cattle, horses, sheep and goats	8	8
	Other (e.g. pig, poultry)	10	10
10-100	Cattle, horses, sheep and goats	6	6
	Other (e.g. pig, poultry)	10	6 ^a
2 -10	Cattle, horses, sheep and goats	6	0
	Other (e.g. pig, poultry)	6	0

^a 10 months will apply from Jan 1st 2013

These are minimum requirements and for some farms, it may be necessary to have an even larger storage capacity to avoid spreading during periods when the risk for leaching losses or soil compaction is high.

NL

According to the Dutch Fertiliser Act, all livestock farms are required to have manure storage facilities, which are large enough for the storage of manure of their animals for the period August 1 – March 1 (7 months). This is the period in which manure application is prohibited. The amount of manure is equal to the number of animals that the farmer is allowed to have according to the environmental permit, times the amount of manure production by the type of animal. For the amount of manure per animal, tables exist with average numbers, if the farmer can prove that because of diets or housing, the amount of manure produced by his animals is less than according to those average numbers, he is allowed to adjust for this, but the burden of proof is at the farmer. The farmer is also allowed to have less storage facilities if the farmer can prove that the number of animals is less than he is allowed to have according to his environmental permit, or when he can prove that his manure is exported from his farm and otherwise applied in an environmentally friendly way (e.g. contracts with manure processing facilities).

<http://www.hetInVloket.nl/onderwerpen/mest/dossiers/dossier/vervoer-handel-en-opslag-meststoffen/minimale-opslagcapaciteit>

UK – England and Wales

The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010 and the Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (Wales) Regulations 2010 apply to all stores built or substantially altered since 1991:

- Stores must have a minimum of 4 months storage, including 5 year storm event rainfall. The type of storage is the choice of the farmer.
- There is no requirement for covers, except if the farm falls under the IPPC regs for pigs and poultry. Grants are available for these in certain (CSF) catchments.
- There is no variation in the rules for location or farm type.
- Construction must be to published standards (CIRIA 126) for the type of construction chosen.

The Nitrate Pollution Prevention Regulations 2008 and the Nitrate Pollution Prevention Regulations (Wales) 2008. Implement the Nitrates Directive and apply to all farms within areas designated as a Nitrate Vulnerable Zone.

- Stores must have a minimum of 6 months storage for pig and poultry, and 5 months for all other slurry, including average rainfall. The type of storage is the choice of the farmer. This storage to be in place by 1 January 2012.
- There is no requirement for covers, except if the farm falls under the IPPC regs for pigs and poultry. Grants are available for these in certain (CSF) catchments.
- There is no variation in the rules for location or farm type.
- Construction must be to published standards (CIRIA 126) for the type of construction chosen.

2. Extent of use of measure

EE – Pandivere

The measure is obligatory for all farmers. If the manure storage facility belongs to a farm building in use before 1 January 2002 and located in a nitrate-vulnerable zone, the requirement should be met by 31 December 2008. Beyond the nitrate-vulnerable area, the requirement should be met by 1 January 2010.

UK – Scotland

The measure is proposed to all farmers within Scotland. The measure is applied nationally across Scotland, but is targeted in NVZ areas and Diffuse Pollution Priority catchments.

SE – Svärtaå

The measure is proposed to all farmers, but different rules apply within and outside Nitrate Vulnerable Zones.

NL

Measure applies to all farms with livestock.

UK – England and Wales

Is the measure proposed to all farmers in the RBD?

SSAFO applies to all farms in England and Wales producing slurry. NVZ requirements apply only within designated areas (62% of England, <3% of Wales).

How many farmers have taken up the measure?

We have been notified of over 4000 slurry stores since the SSAFO Regulations came into force in 1991.

3. Effects of measure

EE – Pandivere

The aim of the measure is to give the farmers the possibility to avoid manure spreading in non-vegetation period and on frozen soil or snow. According Estonia legislation (Water Act), organic and mineral fertilisers may not be spread from 1 December to 31 March and in any other period when the ground is covered with snow or is frozen. In 2009-2010, the inventory was made where manure storages of all farms larger than 10 animal units in Pandivere and Adavere-Põltsamaa NVZ were inspected.; the results were as follows:

- 67% of all animal units in NVZ are kept in large farms (>300 animal units).
- All 53 large farms have manure storages, but 1 liquid manure storages and 2 solid manure storages were smaller than 8 months capacity.
- 21% of animal units in NVZ are kept in medium farms (100-300 animal units).
- All 58 medium farms have manure storages, but 4 liquid manure storages and 7 solid manure storages were smaller than 8 months capacity.
- The number of animal units (3840) in the farms where the manure storage was smaller than 8 months capacity is 12% from total of medium and large farms animal units.
- 12% of animal units in NVZ are kept in small farms (10-100 animal units)
- From 125 small farms only 5 farms uses liquid manure technology. All these farms have manure storages, 1 storage is smaller than 8 months capacity.
- About 1/3 of small farms do not have storage for solid manure, but in farms where animals are kept on deep litter, there is no need for a manure storage facilities.

Proper manure management has - without any doubt - a great environmental effect. Particularly important is to have a liquid manure storage facility. Animal husbandry in Estonia is concentrated on large farms, often where more than 1000 cows are kept. This creates elevated environmental risk areas where manure handling according GAP principles is especially important. Investigation of two large farms in Pandivere-Adavere region in 2010 showed that in case of proper manure, no considerable

pollution of groundwater or surface waters was detected.

UK – Scotland

The expected and actual effects of the measure in terms of the following indicators are: Better use of manure and slurry, applied to land when ground conditions are suitable and crop is growing, thereby reducing the potential run-off (diffuse sources of pollution) and making the nutrient available for the crop when it requires it. N and P are retained and used quickly by the crop instead of leaving the field and becoming pollutants in the water environment.

Reduction in nitrogen load, Not known

Reduction in phosphorous load, Not known

Reduction in pesticide/ pollutant load (E. coli) Not known

Impacts on biological quality elements (Fishes, Benthic macroinvertebrates, Macroalgae, Phytoplankton): reducing the run-off from field application will have positive impact of water quality and associated aquatic organisms

Other environmental benefits not related to water: Application to land when conditions are more suitable minimizes the risk of impact on the soil structure (reduce the extent of compaction and thus panning both of which increase the likelihood of pollution. – Better soil structure.

SE – Svärtaå

Aim of the measure

The main aim of this measure is to facilitate an appropriate timing of manure application, i.e. to reduce application at high-risk times for losses of nitrogen and phosphorus and to increase the crop uptake of N and P from manure.

Intended effects

See effects of the measure “Avoiding spreading fertiliser and manure at high risk times”.

Monitoring/Evaluation of a) the rate of implementation

No monitoring of implementation, but regular inspections are performed by the municipalities to ensure that the farmers comply with the regulation.

and b) the effects of the measure

The effect of this measure is not monitored.

NL

The manure policy in the Netherlands is based on the Nitrate Directive. This directive includes agreements on the amount of nitrate that is allowed in ground and surface water. In order to achieve the objective of the Nitrates Directive, measures are taken with respect to fertilization. The main components of the manure policy are:

Application standards for nitrogen and phosphate from all sources of fertilizers that are allowed to be used in the cultivation of crops. This provides each crop with exactly that amount of fertilizer it needs.

Instructions for how manure is used and the periods in which this is applied. The manure is applied at the right time and in the most efficient way to the crop. This reduces losses to the environment.

A system of animal permits which sets limits to the number of animals for production that may be kept. This ensures that no more manure is produced than can be used in the cultivation of crops.

Rules for the removal of manure from livestock farms. So that it is always known where the manure comes and goes.

UK – England and Wales

What are the expected and actual effects of the measure in terms of the following indicators:

Storage itself does not reduce pollution loadings, except in as much as good quality installations are less likely to leak or burst and because storage allows time for pathogens die off. Storage allows good/best practice in manure management to be followed, such as timing applications to crop need and avoid bad conditions; it is this aspect that reduces pollution.

From the implementation of SSAFO in 1991 to 2005, pollution incidents due to slurry reduced from ~700pa to ~100pa.

What is the time scale of the measure to become effective? What is the certainty of measure effectiveness?

The effectiveness has already been demonstrated. The challenge is to ensure that stores are maintained and replaced as they age and that those farms that have insufficient storage are brought up to standard. The UK is undertaking work to gather comprehensive data on the state of infrastructure and of compliance with both SSAFO and NVZ rules.

4. Method of implementation of measure

EE – Pandivere

According to the Estonian Water Act, all livestock facilities where livestock of more than ten livestock units is kept must be equipped with a manure storage of 8 months capacity.

The measure is therefore compulsory for all farmers in Estonia. In Estonia, the rural development measures - including support for constructing or reconstructing manure storage facilities - are financed according the Estonian Rural Development Plan 2007–2013. For this, Estonia is using money from the European Agricultural Fund for Rural Development (EAFRD) and the state budget. To get support for new technologies, farmers have to apply to the Estonian Agricultural Registers and Information Board.

The support for manure storages construction was completed in 2010 because according to the law, all farmers have to meet these requirements by 2010. The support rate was 80€ per animal unit in one year. The maximum sum for one farmer was 25 000 €/a. The support money was paid for 3 years.

UK – Scotland

Issued as a legal act, programme, plan believe legal act. The measure is voluntary unless land managers are causing a pollution problem; in this case, they must go above and beyond the legal requirements of the regulations. Scotland has seen a rise in the number of slurry storage facilities since 1991. SSAFO is responsible for implementation of control requirements.

SE – Svärtaå

Issued as a legal act, programme, plan: National regulations.

Voluntary or compulsory: Compulsory

Implementation time scale (at one time / over a period): Should already have been implemented in NVZ. For areas that will become NVZ from 2013 as a result of adoptions to the WFD status classifications, there will probably be an implementation period of some years.

Compensated (how? How much) or not: There is the possibility get compensation for up to 30 % of the investment (financed via RDP).

NL

Service Regulations (Dienst Regelingen; DR) and the Dutch Food and Consumer Product Safety Authority (nVWA) check both targeted and at random on the application standards. This means that not all companies are checked. The audits focus on companies that have a greater risk to exceed their usage limit, e.g. intensive livestock farms. Also non-risk farms are controlled, so as to give an overall picture of compliance of the manure policy. The control can be physical (on farm), but can also be administratively, based on farmers administrations.

Physical check

Physical checks are performed by the nVWA. The NVWA checks the application standards. For this check, farmers are required to show all their records. These records should be clear and transparent. If there are supporting documents, then these should also be included in the records. NVWA checks for the timeliness, accuracy and completeness of the records. From these records, the controller calculates how much fertilizer is used on the farm and confronts them with the amount of fertiliser the farmer is allowed to use.

Administrative control

The administrative checks are performed by the DR. Also with an administrative control, the amount a farmer has used is calculated and confronted with the amount the farmer is allowed to apply.

The amount a farmer is allowed to apply is calculated based on the number of hectares used, the type of crops, as of May 15th (as documented by the farmer himself), the phosphorous conditions in the soil etc. The amount of manure used is calculated by looking at the production at farm level, the import and export of manure at farm level, and the amounts of manure at the beginning and the end of the control period.

All manure that is produced or imported at the farm, which is not exported from the farm or in the manure storage at December 31st is assumed to be applied at the farm. This amount is then confronted with the amounts of resp. manure, nitrogen and phosphorous, that the farmer is allowed to apply.

For farmers that have applied for derogation, some additional requirements are checked: e.g. whether at least 70% of the agricultural area is grassland, soil sampling and analysis is performed, and whether there is a fertilization plan.

Soil less agriculture

Farms that have no agricultural land in use on May 15th, have no space for manure application for that particular year. Therefore, nVWA and DR will check whether all manure produced is disposed of (in an orderly manner, with proof) or is in stock.

UK – England and Wales

Issued as a legal act, programme, plan: National Regulations

Voluntary or compulsory: SSAFO compulsory when stores are built or changed, or when an improvement Notice is served. NVZ compulsory

Implementation time scale (at one time / over a period)

NVZ 3 year construction period allowed from new Regulations

Implementation of control requirements

SSAFO is reactive only. We would only take enforcement action if non-compliance was linked to pollution or a significant risk.

NVZ compliance is delivered through Cross Compliance inspections (RPA and RIW) and Environment Agency farm visits.

5. Organisation of implementation

EE – Pandivere

The responsible authority for administering the implementation Estonian Rural Development Plan 2007–2013 is Estonian Ministry of Agriculture. Farmers are applying for support from Estonian Agricultural Registers and Information Board. The responsible authority for control is the Estonian Environment Inspectorate. In Estonia, large animal farms (over 300 AU of cows or piggeries > 2000 places for pigs with a live weight of more than 30kg or 750 places for sows) must have integrated environmental permit. These farms are controlled by the Estonian Environment Inspectorate every year.

UK – Scotland

Responsible authority for administering the implementation and control: Scottish Government and SEPA

SE – Svärtaå

Responsible authority for administering the implementation: Inspection and enforcement guiding responsibility rests at the national (Swedish Board of Agriculture) and regional level (County Board administration). The guiding responsibility includes supporting, advising and evaluating inspection and

enforcement work.

Responsible authority for controls: Inspection and enforcement of the requirements that follows under the Environmental code is performed by the municipalities. The requirement that follows under Cross-compliance is performed by the county board administrations.

NL

Controls are performed by nVWA (physical controls) and DR (administrative controls).
nVWA may also check on animal health and food security. DR is responsible for agricultural payments.

UK – England and Wales

Responsible authority for administrating the implementation: Defra

Responsible authority for controls: Environment Agency

6. Acceptance of farmers and involvement of stakeholders, social aspects

EE – Pandivere

In general, farmers recognize the importance of proper manure handling in water protection. Almost 90% of farmers agreed that it is very important to have proper manure storage and avoid leakages from manure storages. Farmers estimated that the support for reconditioning manure storage facilities is the most important water protection measure in agriculture. About 2/3 of farmers agreed that manure storages are not meeting all the standards and 80% were of opinion that there is not enough support schemes to meet the requirements for manure storages. The local population is also putting pressure on farmers to implement manure handling requirements.

UK – Scotland

Farmers will accept the measure as it is necessary. Informational and decision support tools are used to provide clear information for farmers, e.g. in the form of an additional support tool PLANET Scotland (nutrient management tool for better application of fertiliser onto land). Land managers will make their own decisions on the type of slurry store to be constructed, the one that best suits their farming system, lagoon, above ground or below ground slatted tank, etc.

SE – Svärtaå

Farmers' opinion on the measures (well accepted or not): Relatively well accepted

Informational and decision support tools used to provide clear information for farmers: Information through diverse channels, e.g. the environmental extension service program "Focus on Nutrients", information from the County Board Administrations and the Swedish Board of Agriculture.

UK – England and Wales

Farmers' opinion on the measures (well accepted or not): Mixed, from discontent through grudging acceptance to recognition of business benefits

Informational and decision support tools: Published detailed guidance, website support, telephone helplines

7. Financial aspects of the measure

EE – Pandivere

The measure is mainly environmental. The farmers have an opinion that the cost of the manure storage is higher than obtainable profit from using manure as fertilizer during appropriate period. Before joining the EU in 2004, Estonian farmers did not get any state area support and the future in animal farming was quite unclear due to competition from neighbouring countries and market fluctuations. Therefore, many farmers were not sure about their sustainability and did not make any investments into manure management.

UK – Scotland

There is no compensation for the measure.

Funding sources for the measure is the Scotland Rural Development Scheme.

The total investment foreseen for the measure is ~38 million.

SE – Svärtaå

Funding sources: Up to 30% of the investment can be funded through the Rural Development Program (RDP).

What costs have been calculated (and how)? An example calculation for the extension of the capacity for an existing slurry storage for 5000 pigs from 10 to 12 months resulted in a cost of c. 3 €/m³ of slurry. For a new storage the corresponding cost, i.e. an extra storage capacity from 10 to 12 months, has been calculated to c. 2 €/m³ (Focus on Nutrients, 2010). The possible funding from the RDP is not accounted for in either of the calculations.

NL

This measure is part of Nitrate Directive, therefore a basic measure for which no subsidies are provided. The farmers have to pay for it themselves.

UK – England and Wales

Is there compensation for the measure? Grant schemes 1991-1994, and 2002-2004

- **What is the per hectare payment that farmers receive?** Nil other than single farm payment.
- **Calculated costs:** Investment costs: Variable dependent upon many factors

8. Legal aspects

EE – Pandivere

No legal obstacles, mainly economic problems

UK – Scotland

Not sure

9. References

EE – Pandivere

<http://www.envir.ee>

<http://www.pria.ee>

<http://www.agri.ee>

UK – Scotland**NL**

This measure is part of Nitrate Directive, therefore a basic measure for which no subsidies are provided. The farmers have to pay for it themselves.

SE – Svärtaå

Focus on Nutrients, 2010. [Har du räknat på höstspredning av stallgödsel till stråsäd?](#) Greppa näringen. Web page www.greppa.nu/skrifter/godarad/12godarad/ingenflytgodseltidigost (In Swedish).

10. Reduced tillage / conservation tillage / erosion control measures

Contributing River Basins: various catchments in Scotland, England and Wales (UK); Jylland and Fyn (DK).

1. Definition of measure

CAOM: Using discs or tines to cultivate the soil or direct drill into stubbles (no-till) will maintain organic matter and preserve good soil structure. Erosion-minimising cultivation will differ, among other things, according to the levels of residue cover left on the ground.

Denmark - Jylland and Fyn

There are two measures, both implemented as general measures. For both measures, the crop rotation of the farmer determines whether a farmer will apply to the measure or not.

1) Prohibition of soil preparation ahead of spring sown crops: No soil tillage is allowed from harvest to November 1st on clay and humus soils and from harvest to February 1st on sandy soils. Some exceptions exist:

- after harvest of potatoes soil tillage is allowed
- before cultivation of potatoes, soil preparation can be done from November 1st independently of soil types
- after harvesting sugar beets, soil tillage is allowed
- registered organic farmers do not have to apply to the prohibition measure
- fields with catch crops (basic-, targeted- or environmental catch crops) are not covered by the prohibition measure

In cases where the farmer wants to grow winter wheat, there are no restrictions on soil preparations after harvest when no catch crops are grown off the field.

2) Prohibition of re-laying fodder grass: In the period from June 1st to February 1st, fields with fodder grass are not allowed to be re-laid for other crops in general. However following exceptions exist:

- Fodder grass on clay soils may be ploughed from November 1st if the following crop is spring sown
- Fodder grass may be re-laid to new fodder grass before August 15th.
- Fodder grass may until August 15th be re-laid to (green-) cereal crop with under-sown grass if cereal crop is harvested as whole crop for fodder
- Registered organic farmers do not have to apply to the prohibition (measure)

This means that if a farmer wishes to make a grass whole crop later than June 1st, the field cannot be ploughed before after February 1st unless an exception is valid. This means that if winter wheat is to be grown after fodder grass, the fodder grass must be ploughed before June 1st.

UK – England and Wales

Description:

There are two main methods of reduced tillage:

- 1) Use discs or tines to cultivate the surface as a primary cultivation in seedbed preparation.
- 2) Or direct drill into stubbles (no-till).

Rationale: Minimal cultivation (rather than ploughing) may be the best way to maintain organic matter, preserve good soil structure and break up surface crusts. The resulting soil conditions should improve infiltration and retention of water, thereby reducing loss of P and sediment.

Mechanism of action: Maintaining good structure and promoting infiltration and through-flow reduces soil erosion risk. The reduction in surface run-off is particularly effective when a mulch of crop residues is left on the surface. Good structure also promotes the efficient use of soil nutrients. Conversion from

ploughing to minimum or no cultivation systems in the short-term will decrease total P concentrations in surface run-off but in the long-term can increase soluble P. NO₃ leaching is generally decreased to a small extent through reduced mineralisation of soil organic matter in the autumn, although there are likely to be small increases in drainage volumes.

UK – Scotland

To help control erosion in terms of basic measures, Scotland has ‘Diffuse Pollution General Binding Rules’ (essentially a statutory code of good practice http://www.sepa.org.uk/water/water_regulation.aspx). The rule most relevant to erosion (through cultivation) is quite general and states that ‘Land must be cultivated in such a way that minimises pollution of the water environment’. Although generally we would expect adherence to GAEC <http://www.scotland.gov.uk/Resource/Doc/47121/0020538.pdf> as a minimum and would also promote the good practice within The Farm Soils Plan <http://www.sac.ac.uk/consulting/services/f-h/fbs/publications/fsp/> which includes guidance on erosion control and minimum tillage, minimum tillage (min-till) using reduced cultivation techniques can protect soil structure and reduce the costs of cultivation while increasing or maintaining yields. A minimum tillage system may involve quicker and fewer passes at a shallower depth, or avoid cultivation by direct drilling. Min-till is suited to well-drained light to medium textured soils, although these systems do require careful control of compaction and weeds. Min-till can save time and money and in some cases could be better for the environment.

Recommended measures

- Time applications of manure to maximise nutrient use and help to increase topsoil stability. Organic inputs such as manure, straw, composted materials and non-agricultural bio-wastes may help to preserve soil organic matter and improve soil stability.
- Change seedbed cultivation to produce a coarser tilth. Fine seedbeds can increase erosion risk, destabilise soil structure and lead to the surface becoming sealed or capped.
- Consider sowing grass as part of a rotation to improve soil structural stability and make the soil easier to manage, especially on sites at risk from erosion.
- Cultivate compacted bare land left after potato harvest and field grazed forage crops as soon as possible.
- Consider using minimum or reduced cultivation (min-till) techniques where suitable.
- Retain stubbles for as long as possible over the winter period or leave soils roughly ploughed.
- Where possible, tramlines should run across slopes. Alternatively a buffer area at the bottom of the slope may also help to reduce run-off risk.

More specific guidance on minimum tillage is given in:

<http://www.sac.ac.uk/mainrep/pdfs/tn553minimumtillage.pdf> and:

<http://www.sac.ac.uk/mainrep/pdfs/tn580reducedtillage.pdf>

2. Extent of use of measure

DK - Jylland and Fyn

Likely uptake: Both measures are new and have not been used before. The two measures are general measures and apply to all farmers. As the measures are related to the crop rotation scheme, the choice of crop rotation of the individual farmer will determine whether or not the farmer will apply to the measures. As such, the measures are not targeted to specific areas or sub-basin but will be targeted to specific fields according to the crop rotation system of the individual farmer.

“Prohibition of soil preparation ahead of spring sown crops” - divided into two different prohibition periods according to the type of soil. For clay soils and humus soils the prohibition period is until November 1st and for sandy soils the prohibition period is until February 1st. This difference is due to the potential higher risk of N wash out for sandy soils than clay soils. Estimated number of hectares

covered by the measure is 110 000. The number of potential hectares with spring sown crops is actually much higher, but the estimated number of hectares on which catch crops is grown (all types of catch crops) is deducted as well as the area for potato cultivation and organic farming.

“Prohibition of re-laying fodder grass” - will mostly target farmers with either dairy cows or beef cattle. The majority of these farmers live in the western part of Denmark where sandy soils are more widespread. The estimated total number of hectares covered by this measure is 15 000.

UK – England and Wales

Practicability: No-till is unsuitable for light soils that are prone to capping. Minimum cultivation is less applicable in a very wet autumn and is only suitable where soil structural problems have been alleviated. Minimum tillage may increase resistant weed populations and therefore increase reliance on chemical control.

Likely uptake: Apart from the issues specified above, the largest barrier to uptake is likely to be the purchasing of new machinery. As such, it is only likely to be adopted on larger, pre-dominantly arable farms.

UK – Scotland

- Is the measure proposed to all farmers in the RBD? At Member State level?

The measure is open to all farmers in available guidance but is not currently actively promoted by SEPA because the focus is on compliance with basic measures (and there is a lack of advisory expertise in this area). So in theory yes, but implementation in terms of one to one advice on general compliance is targeted.

- Is the measure targeted to specific areas (if so, which ones and why)

See above. General compliance is targeted to diffuse pollution priority catchments

- Does the measure target specific types of soil or farming types?

General compliance in arable areas within priority catchments. There is some guidance on which soil types min till is suitable on see ref below

- Monitoring/Evaluation of a) the rate of implementation:

Unknown how many farmers have taken up the measure, but anecdotal evidence suggests that min till is popular due to reduced costs in the south east of Scotland

It is unknown how many ha are covered by the measure and there are currently no targets.

3. Effects of measure

DK - Jylland and Fyn

Objectives: The main objective of the two measures is to reduce diffuse N loading in the rivers in order to reduce N loading to coastal waters, hereby lowering nitrogen concentration in the coastal water and limit planktonic algae growth. Fewer algae will make the water more clear and hereby improve growth conditions for Eelgrass (*Zostera maritima*). Eelgrass is the main biological quality element in Danish coastal waters in first generation RBMPs. By preventing the stimulation of decomposition of plant material and thereof increased mineralisation in autumn and winter by prohibition of ploughing and soil tillage in general in the autumn a reduced wash-out of nitrogen from the root zone is expected.

Estimated effects:

- **“Prohibition of re-laying fodder grass”** - the estimated effect of reduced nitrogen loading to the water environment is estimated to 15.3 kg/ha/a. In total for the measure the reduced wash-out from root zone is 540 tonnes of nitrogen with an effect of 230 tonnes of nitrogen reduced loading. No effect on reduced phosphor loss is calculated for this measure, the estimated effect being too little.
- **“Prohibition of soil preparation ahead of spring sown crops”** - the total reduced nitrogen loading is 739 tonnes of nitrogen equal to about 6.7kg reduced nitrogen loading per hectare. Reduced phosphor loss due to lowered surface loss is estimated in total to be about 1 ton per year. This is quite low but is due to the fact that only half of the 110 000 hectares is estimated to be sandy soils

where soil tillage is prohibited until spring (clay soils tilled after November 1st is still exposed to phosphor loss from surface run-off) and of these 55 000 hectares only about 10% is actually soils with high risk of phosphor loss. This means that the majority of the reduced phosphor loss effect comes from only about 5% of the hectares covered by the measure why the total effect is calculated only to about 1 tonnes per year.

Timeline: The effect on reduced nitrogen loss is expected the same years as implementing the measures.

UK England and Wales

Effectiveness:

N: Decreases leaching by 0-25% compared with ploughing. On arable land with manure the reduction is at the higher end due to the higher labile N where manure is applied. Nitrite loss is thought to be similarly affected. NB The method is not applicable to all soils. There is a possibility that incorporation of large volumes of straw into a small volume of soil under a minimum tillage system may immobilise so much N that it restricts crop growth and creates a need for autumn application of N fertiliser.

P and –sediment: Defra project PE0206 (MOPS1) showed that reduced tillage systems can reduce P and sediment losses by 30-60% on clay soils and by up to 90% on loamy sand. The long-term use of minimum cultivations or no-till systems can increase dissolved P losses in run-off. However, in the UK intermittent ploughing is usually part of farm cultivation systems as a means of minimising compaction from discs near the soil surface and for weed control.

Risks: If minimal cultivation is carried out on soils with poor structure, the method is ineffective at best.

Other pollutants: The reduced power requirement of reduced cultivation systems should reduce carbon dioxide emissions. The method has no known effect on other pollutants, although it is possible that indirect losses of nitrous oxide could be increased due to greater compaction in the surface, although long term effects are unknown.

UK – Scotland

What pressure(s) does the measure aim to address? SS and associated nutrients and pesticides

What are the expected and actual effects of the measure in terms of the following indicators:

- Improved soil structure and stability SS and associated nutrients and pesticides
- Drainage and water holding capacity (reduces extremes of water logging and drought): see above
- Reduce the risk of runoff and pollution of surface water: depends on soil type see above
- Increase in soil organic matter and carbon sequestration: not sure – needs to be ploughed every few years as can be compaction issues
- Crop pests and diseases: min till associated with increased pesticide use
- Reduction in pesticide/pollutant load (E. coli) - see above
- Other environmental benefits not related to water: – concern there may be pollutant swapping i.e. N₂O

Is there need for further research (and monitoring) on the effectiveness of measure? Please specify. Yes starting with a review of benefits and drawbacks on a range of soil and climatic types.

4. Method of implementation of measure

DK – Jylland and Fyn

The measures was implemented first time August 1st 2010 through a legal notice prepared by the Danish AgriFish Agency (part of the Ministry of Food, Agriculture and Fisheries) and implemented in the annual guidance document on fertilization and green soil cover published by Danish AgriFish Agency. In this guidance document a description of the measures are present and when to apply to the measures.

The implementation is compulsory and each farmer must once a year state the crop rotation when applying for single farm payment to the Ministry of Food, Agriculture and Fisheries.

The farms selected for randomly physical control each year will, among others and according to the stated crop rotation in the single farm payment application, be check if the prohibitions are followed

In case the prohibitions are not followed a reduction in single farm payment may be judged.

UK – England and Wales

This is a voluntary measure mainly chosen primarily for agronomic benefits, though there are other benefits such as soil conservation and resource protection.

UK – Scotland

Issued as a legal act, programme, plan: guidance

Voluntary or compulsory: voluntary

Implementation time scale (at one time / over a period): over a period

Implementation of control requirements: not relevant?

5. Organisation of implementation**DK – Jylland and Fyn**

The Danish AgriFish Agency (part of the Ministry of Food, Agriculture and Fisheries) is responsible for implementing the legal notice and preparing the annual guidance document on fertilization and other farming regulation, including regulatory prohibition on soil preparations according to the two measures.

Also The Danish AgriFish Agency is responsible for preparing random physical checks on a certain number of farms each year, where also a check for complying with the two measures is performed.

UK – England and Wales

No responsibility unless the operation contravenes Cross Compliance and the Soil Protection Review requirements – if this is the case, the Rural Payments Agency investigate / prosecute and Natural England will advise on a method to improve. If a pollution incident is caused, through this (very low risk) then the Environment Agency would take the necessary steps to resolve and if necessary, prosecute.

UK – Scotland

Responsible authority for administrating the implementation: not relevant

Responsible authority for controls: not relevant

6. Acceptance of farmers and involvement of stakeholders, social aspects**DK - Jylland and Fyn**

The agricultural sector does not like the restrictions. However, only little critic of the measures have been raised by farmers and farmers unions. The critique points concern:

- when soil tillage is prohibited until certain dates according to soil types before a spring sown crop it will bring about a potential less favourable establishment of small seeded crops like vegetables with lower yields as consequence.
- deep soil tillage in autumn before planting fruit trees in spring is no longer possible.
- on clay soils for dairy farmers, it is no longer possible to grow winter wheat after two years of fodder grass but only spring barley which will lower yield and income as a consequence. The farmers union suggests that it is better to rule that catch crop must be grown after winter wheat instead.

These problems raised by the farmers are, however, estimated only to cover a very little area of farmland and no special exceptions has therefore been prepared.

Also organic farmers association has criticized the prohibition of re-laying fodder grass which will make it even more difficult for organic farmers to grow crops with high N-use (e.g. cultivation of rape-seeds normally sown late August/ beginning of September)

As a consequence the registered organic farmers no longer have to comply with the rules of the measures.

UK – England and Wales

Minimum tillage, no-till, zero till operations are well accepted in most part of the arable sector and are dependent on soil type, cost and cropping type. There appears to be no or little adverse environmental results.

UK - Scotland

Farmers' opinion on the measures (well accepted or not): mainly driven by cost savings

Informational and decision support tools used to provide clear information for farmers: see Farm Soils Plan <http://www.sac.ac.uk/consulting/services/f-h/fbs/publications/fsp/>. Also see

<http://www.sac.ac.uk/consulting/services/c-e/cropclinic/cropadvice/campaigns/minimumtillage/>

Farmers involvement in the process of selecting and implementing: It is the decision of the farmer

7. Financial aspects of the measure

DK - Jylland and Fyn

The two measures are pooled with other general agricultural measures of the PoM and the total cost for farmers for these measures are calculated as well at the total effect on reduced nitrogen loss. Based on these figures the estimated unit cost for reduced nitrogen loss is calculated (budget economic) to about 3.5 /kg N reduced using general measures. No direct compensation is given; instead, the cost of the measure must be barred by the farmers themselves. However, at the same time it has (by the politicians) been decided to give an ease on soil tax for the farming sector in general, with higher total value for the sector that the cost of income loss from implementing general and not compensated measures.

UK – England and Wales

There is no compensation for this measure unless on a site of historical interest and then farmers can receive £60/ha through Entry Level Stewardship.

Unsure of the operational costs.

UK - Scotland

There is no compensation for this measure, as the farmers save money.

8. Legal aspects

DK - Jylland and Fyn

As the measure was implemented for the first time in the farming period from September 2010 to August 2011, no experiences of implementation of the two measures has been gathered yet. There is also no information of legal obstacles at this point.

UK – England and Wales

N/A

9. References

Denmark - Jylland and Fyn

Report on potential measures including "Prohibition of re-laying of fodder grass" (in Danish – English summary at page 11): http://www2.dmu.dk/Pub/FR625_Final.pdf

An evaluation of "Prohibition of soil preparation ahead of spring sown crops" is found here (in Danish): http://www.mst.dk/NR/rdonlaes/60C50A41-4C31-49E2-BBA3-1D2FCADCDA3F/61974/FVM057_NogetforNogetendeligafraapportering.pdf

UK – England and Wales

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UK - Scotland

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<http://www.sac.ac.uk/consulting/services/c-e/cropclinic/cropadvice/campaigns/minimumtillage/>

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Abstract

The 2010-2012 work programme for the WFD Common Implementation Strategy confirmed agriculture as one of the major priorities to address to achieve the objective of good status of European waters in 2015. The Water Directors set up an Expert Group on WFD & Agriculture, succeeding the former Strategic Steering Group on this issue. The continuation of the long-standing "PRB-AGRI" exercise was thus endorsed for continuation and the Pilot River Basins Network on agricultural issues was renamed as "River Basins Network (RBN) on WFD and Agriculture", PHASE IV (2010-2012). The objective of the RBN was to support the Expert Group in its work, by offering feed-back from the field and ensuring technical support. Moreover, Exercise outputs were to be disseminated to all other river basin managers, stakeholders and to the EG members, with the overall objective of the network is to provide practical examples/cases of good practice in RBMPs. This report presents the output of this 2010-2012 exercise, concretely consisting of:

1. Evaluation of 10 selected measures in the Catalogue of Measures (CAOM), and CAOM enhancement: the report contains 10 short fact sheets (one for each selected measure), to be distributed among RB administrators, the EG members and as direct inputs to the Catalogue of Measures and, thus, to the new database.
2. Evaluation of specific issues in the RBMPs: the report contains 6 articles to serve as input for the EG in workshops, assessments or seminars held by the CIS/Commission as well as for distribution among RB managers and stakeholders.

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