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Proposal for a new COST Action

COST Action 869

Mitigation Options for Nutrient Reduction in Surface Water and Groundwaters

Proposer: Dr. W.J. Chardon Ir. O.F. Schoumans Alterra PO Box 47 6700 AA Wageningen Tel + 31 317 474602 The Netherlands **COST Nat. Coord.:** D.A. Schoorel	**Proposer:** Prof. A.L. Heathwaite Centre for Sustainable Water Management The Lancaster Environment Centre Lancaster University Bailrigg Lancaster LA1 4YQ Tel + 44 1524 510255 United Kingdom **COST Nat. Coord. :** C. Reilly
Proposer: Dr. B. Kronvang NERI Department of Freshwater Ecology Vejlsøvej 25 DK-8600 Silkeborg Tel + 45 8920 1421 Denmark **COST Nat. Coord.:** G. Bramsnæs	**Proposer**: Prof. S. Rekolainen Finnish Environment Institute (SYKE) P.O. Box 140 FIN-00251 Helsinki Tel + 358 9 4030 0364 Finland **COST Nat. Coord. :** E. Auranen

TC Agriculture, Biotechnology and Food Sciences
Rapporteur: to be appointed

DRAFT

MEMORANDUM OF UNDERSTANDING

For the implementation of a European Concerted Research Action designated as

COST Action 869

"Mitigation Options for Nutrient Reduction in Surface Water and Groundwaters"

The Signatories to this 'Memorandum of Understanding', declaring their common intention to participate in the concerted Action referred to above and described in the 'Technical Annex to the Memorandum', have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 400/01 'Rules and Procedures for Implementing COST Actions', the contents of which the Signatories are fully aware of.

2. The main objective of the Action is to undertake a scientific evaluation of the suitability and cost-effectiveness of different options for reducing nutrient loss to surface and groundwaters at the river basin scale, including their limitations in terms of applicability under different climatic, ecological and geographical conditions.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at Euro 165 million in 2005 prices.

4. The Memorandum of Understanding will take effect on being signed by at least five Signatories.

5. The Memorandum of Understanding will remain in force for a period of five years, calculated from the date of first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter 6 of the document referred to in Point 1 above.

COST ACTION 869

"Mitigation Options for Nutrient Reduction in Surface Water and Groundwaters"

A. Abstract

The eutrophication of surface waters and the contamination of groundwaters as a result of elevated nutrient inputs have a serious impact on ecosystem health in many countries. The EU Water Framework Directive (WFD) requires an improvement to the quality of surface and groundwaters; this may call for a drastic reduction in nutrient loss from agricultural land with the related implications for the long-term economic and environmental sustainability of agricultural systems. The main objective of this COST Action is to undertake a scientific evaluation of the suitability and cost-effectiveness of different options for reducing nutrient loss to surface and groundwaters on the river basin scale, including their limitations in terms of applicability under different climatic, ecological and geographical conditions. Topics to be studied are:

- localisation of critical source areas of nutrient loss and transport routes in both surface and groundwater catchments;
- identification of areas where mitigation actions are most likely to be effective at minimising nutrient loss;
- temporal dynamics of nutrient losses;
- the influence of nutrients on ecological processes in surface waters and the role of groundwaters in controlling nutrient fluxes;
- evaluation of existing or finished projects on mitigation.

Keywords: Nutrient losses; eutrophication; surface water; groundwaters

B. Background

The role of nutrients in the eutrophication of surface water and the contamination of groundwater has long been recognised. Negative effects of eutrophication include: reduced biodiversity of aquatic ecosystems and surface water quality, algal blooms that restrict the use of surface waters for recreation, and excess nitrate concentrations that impact on drinking water production. Toxic algal substances have caused fish kills and animal and human diseases in the past. Phosphorus (P) is the element that often determines the ecological status in most European inland waters. To date, European-wide efforts have met the P problem by a combination of accidental (for example by diminishing industrial losses through industrial decline) and targeted options (such as increasing the number of households that are connected with sewerage systems, and precipitating P in sewage water treatment plants). Despite these reductions, water quality status remains poor in many rivers, lakes and estuaries. During the 1990s, the share of the total P input to aquatic systems attributed to agriculture increased to 50% or even 90% in many river basins.

Within Europe, the Water Framework Directive will force catchment management authorities to improve the ecological status of both surface and groundwater. Since both P and nitrogen (N) losses to surface and groundwater are largely driven by agriculture, there is an urgent need to determine the relationship between agriculture

and chemical and ecological water quality, because the first River Basin Management Plans have to be set up within a few years, and only cost-effective mitigation options should be implemented.

In July 1997 COST Action 832: Quantifying the Agricultural Contribution to Eutrophication started, it ended in August 2003 with a final conference. It aimed to develop a common technical understanding of the processes, forms and pathways of P loss in land runoff, and to develop a methodological framework for identifying the relative contribution of different diffuse P sources at the farm and catchment levels. These aims were achieved through definition of conceptual models of P cycling in EU agricultural systems, by studying P transfer in surface and sub-surface runoff at a range of scales, and by studying the impacts of diffuse P on surface water quality. Members from 17 countries contributed to this COST Action.

In 2004, COST Action 634: On- and Off-site Environmental Impacts of Runoff and Erosion started. One of the aspects studied in that Action is sustainable land use and farm management in order to reduce erosion and surface runoff. There is also some attempt to study sediment-associated contaminants such as pesticides and P. Consequently, future cooperation with this Action is foreseen.

In August 2004, the 4th International Phosphorus Workshop was organised on the topic: 'Critical evaluation of options for reducing phosphorus loss from agriculture'. The workshop was attended by 81 delegates from 18 different countries, and from widely varying agricultural systems and climatic conditions. This COST Action builds on the recommendations that came from this workshop.

This COST Action focuses on the steps that need to be taken within the WFD (and should be known) in order to effectively reduce the P losses from agricultural land to surface waters and groundwater. The Action will be undertaken in the context of balancing measures to reduce P losses with those necessary to reduce other nutrient losses such as N. Such measures are often conflicting and need to be considered as part of an integrated programme of measures. The aim of the COST Action is to:

- determine the techniques/tools that can be used to determine the main P sources, within the agricultural system as a whole, that contribute to the P losses to surface waters and groundwater, and also the main pathways.;
- determine the techniques/tools that can be used for evaluating the impact of a reduction of the P input on the ecological status of surface waters;
- evaluate different types of integrated mitigation options;
- evaluate implementation strategies for different types of basins/catchments.

Mitigation options (tested options as well as potential new options) will be discussed and formulated. The deliverable will be recommendations for sustainable and integrated mitigation options that are derived from typical, representative situations within Europe and are generic and not site-specific. This Action will bring together the current expert knowledge base – which we know to be fragmented into a number of independent groups – within a single COST Action. Consequently, cost-effectiveness under different conditions will be a major topic. Since P is the element that is limiting in most European inland waters, the focus of this Action is on P losses. However, positive or negative influences of mitigation options on the loss of fine sediment, nitrogen and pesticides to either surface water or other environmental compartments such as groundwater will be discussed during the Action. Finally, ongoing outcomes of the

discussions within this COST Action will be reported to the new board of the WFD dealing with the interaction between agriculture and water quality.

C.1 Objectives

Main objective

The main objective of this COST Action is to undertake a scientific evaluation of the suitability and cost-effectiveness of different options for reducing nutrient loss to surface and groundwaters on the river basin scale, including their limitations in terms of applicability under different climatic, ecological and geographical conditions.

The evaluation will be used by water authorities in order to reach water quality targets set by the Water Framework Directive.

Secondary objectives

- To develop methodologies for localising critical source areas and hydrological transport routes within a river basin.
- To study the temporal dynamics of nutrient losses and temporal controls on the scope for reducing nutrient losses.
- To identify areas where mitigation actions are most likely to be effective, from an environmental, social and economic perspective.
- To study the influence of nutrients on ecological processes in surface waters within river basins under different conditions and on different scales, from ditches to coastal water, and the influence of ecology on the choice of mitigation options.
- To study example areas within Europe, where mitigating options can be tested and the effects can be monitored.
- To evaluate existing or finished projects on mitigation: in terms of what worked and what did not work, and what could be improved.

C.2 Benefits

European research and development activities on reduction of nutrient loss to surface water from agriculture will be coordinated, focused and strengthened within the present network. Exchange of information, young researchers and material as well as sharing research facilities through short-term scientific missions (STSMs) will significantly expand further knowledge and make more efficient use of national research funds. This will lead to added-value through the multidisciplinary nature of the work and the enhanced complementarities, mutual specialisation and better coordination of research effort.

Demonstration sites will provide the European states and water authorities with data for future recommendations in the management and restoration of polluted waters, also taking into account potential ecological consequences of mitigation options.

This Action is a wholly transnational and multidisciplinary collaboration that is beyond the scope of individual countries to provide the necessary finance, personnel and competence. This Action supports the creation, improvement and consolidation of networks and partnerships between complementary research and advisory teams from

many COST countries. It also seeks to improve the education and training of young scientists and promote their mobility.

D. Scientific programme

The activities will be divided into four Working Groups (WG) that will have strong links and interactions between them as follows:

WG1: Localisation of critical source areas in catchments

WG2: Influence of nutrients on ecological processes in surface waters

WG3: Mitigation options

WG4: Evaluation of projects in example areas across the EU

The Action integrates different aspects: to localise critical source areas in catchments, where mitigation actions are most likely to be environmentally, socially and economically cost-effective (WG1); to study the influence of nutrients on ecological processes in surface waters and the influence of ecology on the choice of mitigation options (WG2); to evaluate for various mitigation options the cost-effectiveness, implementation aspects, and the influence of scale, climate and other physical factors (WG3), and to evaluate ongoing mitigation projects in example areas across the EU (WG4).

WG1: Localisation of Critical Source Areas in Catchments

This Working Group focuses on the localisation of critical source areas for phosphorus loss in catchments, and on the determination, quantification and verification of (hydrological) transport routes and delivery pathways within river basins.

To reach the targets of the WFD and to restore and maintain ecosystem health, phosphorus (P) losses from agricultural land to surface and groundwaters will need to be reduced. Mitigation actions to reduce P losses must be addressed in a holistic and integrated manner because targets to reduce P losses may negatively impact on other mitigation options – the conflict between P and N reduction measures is well known and is illustrated in Figure 1.

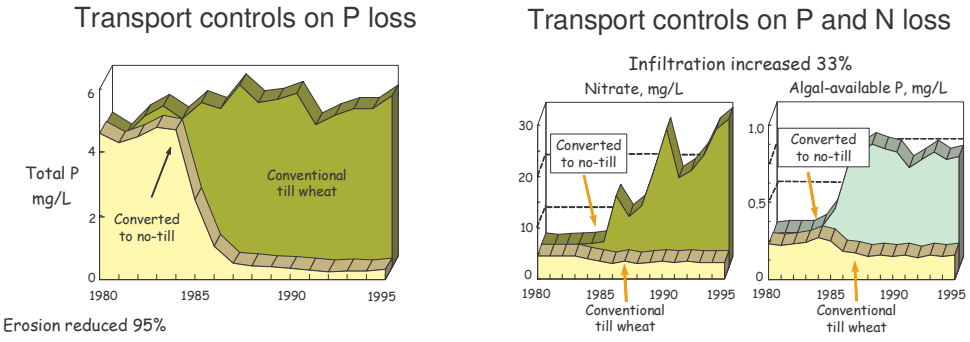

Figure 1. The conflict between P and N reduction measures.

The left figure shows that after conversion to a no-till system the loss of total P via erosion was reduced by 95% compared with conventional tillage. However, the right figure shows that this conversion strongly increased the loss of both nitrate and algal-

available P. This means that one option may have a completely different effect on P species (dissolved versus particle bound), and on total P versus nitrate.

The Critical Source Area (CSA) concept has been developed in the USA to explain the observation that for many catchments: 90% of P loss may be accounted for by 10% of the land area in 1% of the time. What this means is that most P loss recorded as river P loads may be derived from a relatively small catchment area where high P source areas and high transport risk coincide; this coincidence is quite rare and is usually related to major storm events that have sufficient energy to mobilise P loss via surface runoff. This observation has been validated by field evidence that shows that in many situations most P is transferred from agricultural land to water in association with surface runoff and hence rainfall events of sufficient intensity to generate particle movement. It is for this reason that there is much synergy with COST Action 634: On- and Off-site Environmental Impacts of Runoff and Erosion. However, this simple statement ignores subsurface routes of P loss which are important in groundwater catchments and in agricultural systems where surface runoff is rare. There is a need to develop the CSA concept further to understand the implications of subsurface pathways of P loss and to develop an integrated approach to deal with both P and nitrogen (N) losses to surface and groundwaters. Similar modes of transfer are operational for fine sediment and pesticide loss, so there is an opportunity to add value by incorporating these elements and the expert groups that work on them within this COST Action.

In the context of this COST Action, developing the CSA concept in an integrated way is an important route towards developing sustainable strategies for reducing P losses from agricultural land through the development of a range of mitigation options. This COST Action will lead to more reliable measures to ensure mitigating actions meet the targets of the WFD.

In this Working Group the CSA concept will be used as a framework to help determine the main P sources within the agricultural system as a whole that contribute to the P losses to surface waters and groundwater. An example of the CSA framework in action, showing fields with a varying risk of P loss in a catchment in Denmark, is shown in Figure 2.

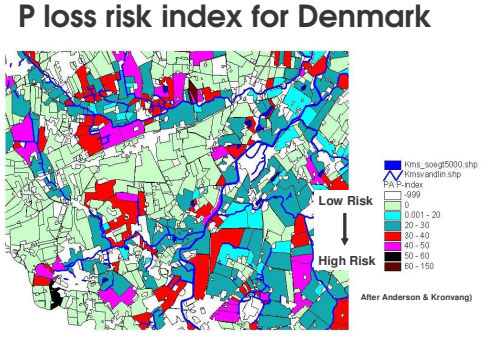

Figure 2. Fields with a varying risk of P loss in a catchment area in Denmark.

Using the source–transfer–delivery model of P losses, the milestones of this WG are:

Milestones

- Develop measures to identify the location of potential critical source areas in catchments that represent both surface water and groundwater systems.
- Determine the key hydrological transport routes within different river basin typologies.
- Evaluate the pathways of P delivery within river basins by moving forward some of the challenges identified previously, particularly as they relate to source and sink localities within catchments.
- Evaluate the importance of time lags in the system both in terms of P delivery and in terms of the likely lag time between implementation of a mitigation measure and achievement of its full effect in receiving waters.
- Identify localities within river basins where mitigation actions are most likely to be environmentally, socially and economically cost-effective.

Deliverables:

- A review of existing methodologies used for identification of critical source areas of P loss in catchments.
- An assessment of the pathways of P delivery within river basins.
- An assessment of locations in catchments where mitigation actions are most likely to be effective in terms of P loss reduction and cost.

WG2: Impacts of Nutrients on Ecological Processes in Surface Waters

Scientists participating in WG2 will study the impacts of nutrients on ecological processes in surface waters within river basins under different conditions, from ditches to coastal waters, and the influence of ecology on the choice of mitigation options.

The implementation of the Water Framework Directive in EU Member States calls for understanding of impacts of loading on chemical and biological quality elements. The main emphasis has to be placed on the driving forces that strongly contribute to pressures (loadings). The second reporting step for Member States within the implementation of the WFD, 'river basin characterisation and risk assessment', was due in March 2005. The preliminary summary analysis of these reports indicates that eutrophication of surface waters is one of the most widespread problems throughout the EU territory, resulting in numerous water bodies that are at risk of not meeting the required good ecological quality by 2015. The other indication given by these reports is that agriculture is ranked as a primary contributor for nutrient loads causing eutrophication. Yet, scientific evidence of the actual effects of agriculture on different types of surface waters is scarce.

While there has been a great deal of scientific work investigating relationships between nutrient loading and water chemistry, impacts of nutrient loading on biological quality elements have received much less attention. In lakes and coastal waters investigations have focused on bulk attributes such as average chlorophyll, or total biomasses of phytoplankton in response to nutrient loads, but more subtle responses, and the ecological mechanisms involved, of phytoplankton, macrophytes and benthic invertebrate communities have generally received little attention. Such responses may also be important for trophic relationships and may serve as indicators of ecological quality. In the case of phytoplankton blooms, these represent departures from quasi-equilibrium between production and loss processes, and can be caused by

perturbations of either. Depth penetration of macrophytes is used in several European countries as an indicator for eutrophication. However, links between nutrients and other pressures and diversity, and effects of sediment chemicals on macrophyte communities have been hardly explored.

Benthic communities have been used as bio-indicators for assessing ecological quality of surface waters, especially of rivers and coastal waters, because these organisms are relatively sedentary, and thus are constantly exposed to the effects of pollution. The benthic organisms used are reasonably long-lived so the effects can be integrated over time; and they occur in high densities/diversity, so many different species can potentially react on many types of impacts. Benthic indices developed to describe the ecological impacts of pollution are, however, often rather site-specific or limited in their scope or targeted only for a single type of pressure. Laboratory experiments usually have investigated the relationships between selected chemicals or mixtures of chemicals and selected organisms or model ecosystems, but the interpretation of these results for assessing the causes of failures in ecological status in natural surface water bodies is difficult. Results from tank or mesocosmos experiments, where manipulations can be carried out under controlled conditions and responses can be monitored at the ecosystem level (or at a sub-level such as littoral or planktonic communities), are likewise difficult to interpret and transform to information that could be used to derive general pressure-impact relationships for practical management of water bodies, although successful cases/examples exist. For these reasons, more comprehensive and holistic assessments are needed for a more generic overview of the impacts of nutrient loading.

One special feature of nutrient loading originating from agricultural land is that, in the case of erosion, it may be accompanied by a high concentration of suspended solids. Also, N/P ratios may vary considerably, depending on transport mechanisms and agricultural production structure and practices. These 'side-effects' may result in reduced visibility and changing stoichiometry (N-P-Fe) in recipient waters, interacting with nutrient enrichment. They may also have an impact on the nutrient cycling between bottom sediments and productive water layers, and thus affect the burial of nutrients deep in the sediments. Specifically, the ecological effects of soil particles in aquatic systems are poorly known. Suspended soil may act as a source of P for algae, but it may also inhibit aquatic primary production by reducing the penetration of light in the water. In addition, clay particles can increase the settling of planktonic algae and affect organic matter mineralisation in the sediments. As a result, impacts on biotic communities may differ very much depending on different interactive processes. Research on these dose-response relationships has been insufficient and fragmented.

WG2 will collect, analyse and synthesise research results and information on ecological impacts of nutrient loading arising from past and ongoing international and national R&D projects. Furthermore the aim is to assess generalised needs for load reductions taking into account the interactions of P, N and light limitations, as well as sediment reactions, in different surface water categories.

A special emphasis will be given to the following milestones:
Milestones

- Review results and conclusions achieved by the past and ongoing EU R&D and COST projects (e.g. CHARM, STAR/AQEM, REBECCA, ECO-FRAME, EUROLAKES).
- Collect new information arising from national research projects, particularly those supporting the implementation of the WFD at the national level.
- Investigate the ecological impacts of nutrient loading originating from agriculture.

- Study ecological interaction of nutrients and particles in surface waters.
- Assess nutrient limitations in different types of waters and potential relationships between nutrient limitation and N/P ratios in loading.
- Evaluate possibilities to calculate generalised needs for load reductions based on the critical load concept.
- Produce a synthesis of the impacts of agricultural nutrient loading on ecological water quality that can be used when producing River Basin Management Plans and Programmes of Measures.
- Maintain and update the River Basin Manager's Toolbox (http://www.rbm-toolbox.net) developed by BMW and REBECCA projects.

Deliverables:
- A state-of-the-art synthesis and summary of the impacts of nutrient loading originating from agriculture.
- A review on interactions between sediment and nutrient concentrations in surface waters.
- An assessment of the spatial and temporal variations of nutrient stoichiometry and N/P limitations in lakes.
- Recommendations on how to evaluate critical or target loads for preparing River Basin Management Plans.
- An improved River Basin Manager's Toolbox.

WG3: Mitigation Options

The main goals of this Working Group are to inventory different types of mitigation options for reducing phosphorus loss, to study their effectiveness and costs under different conditions and the feasibility of their implementation.

In WG 1, different methodologies will be discussed and evaluated for quantifying the spatial variation in the contribution of all P sources to the pollution of surface waters within a catchment or river basin. Also, information on the major pathways (routes) to surface waters of these sources under different climatic conditions and for different types of landscape will be outlined. Within WG2 the relationship between the P and N loads and the aquatic ecological effects will be discussed, and the maximum critical load will be defined for different types of surface water in order to retain a good ecological status. Special attention will be paid to differences in ecological effects of dissolved versus particle bound P, since both forms require different measures for reducing loss to surface water.

Based on the outcome of the discussions within WG1 and WG2, an inventory will be made to summarise:
- mitigation options that reduce the impacts of different P sources
- measures that reduce the contribution via specific pathways
- measures that reduce the impact of P load in surface waters

Examples of options that could reduce the impact of different sources are:
- reducing P input or increase P output

- reducing P use within animal husbandry
- adding immobilising agents to manure or to the soil
- fertiliser and manure management.

The contribution via specific pathways can be reduced by for example:

- changes in cropping;
- cultivation management reducing erosion;
- buffer or riparian zones;
- sedimentation ponds and artificial wetlands

Possibilities to reduce the negative consequences of a historic P load of surface water are:

- stimulating the growth of submerged water plants
- removing biomass from ditches and streams, and placing it away from ditch borders
- removing sediment resuspending fish
- flushing eutrofied lake water with nutrient poor water.

Information on the costs of measures will also be gathered during this inventory. Thereafter, the effectiveness of these measures under different specified conditions within Europe will be evaluated. For this purpose published data and ongoing experimental studies (WG4) will be studied, presented and discussed. This will be a detailed technical evaluation of the effectiveness of mitigation options, because it is clear from literature that the variation in the effectiveness of specific mitigation options can be large (for example buffer strips and artificial wetlands). Therefore, the influence of several conditions, for example climate from north to south and east to west, landscape, soil type, and major pathways on the effectiveness of measures will be evaluated. Also, the plausibility of the results will be discussed (outliers), in order to categorise and classify the effectiveness of all mitigation options under different European conditions. The influence of the scale on which the measures have been applied within the catchment (field, farm, or small districts) will be taken into account. Information of local background conditions, or natural P losses, will be gathered in order to define the 'lower boundary conditions' for P losses. For example, the decomposition of peat in marine formations can lead to high background values for both N and P in both groundwater and surface water.

Although cost-effectiveness is an important factor for water managers and countries, other factors will also be taken into account, such as feasibility, acceptance by important actors (farmers, citizens, local policy makers), ease of implementation, side-effects on other nutrients (such as loss of N or heavy metals). Also those effects will be taken into account in order to derive a complete view of the strengths and weaknesses of mitigation options.

Milestones

- Derive an overview of potential mitigation options, and how they act upon P sources, pathways and inland surface water flow.
- Determine the effectiveness and costs of mitigation options under different conditions.
- Establish information about the influence of climatic conditions, landscape, soil type, scale and other factors on the effectiveness of mitigation options based on experimental observations on a local scale.
- Evaluate the strengths and weaknesses of mitigation options based on experiences during implementation.

- Relate options to current agro-environment programmes within the different EU countries, and study which measures are suitable for varying implementation policies.

Deliverables

- A review of mitigation options that are effective for various sources and transport pathways, made available via the Internet.
- A summary and synthesis of the interaction between P and N under varying field conditions, and of the way this affects possibilities of emission reduction.
- A review of the cost-effectiveness of different options under different circumstances.

The results of this technical evaluation of mitigation options can be used within WG4 to obtain an overall evaluation of different types of mitigation options at catchment and river basin levels.

WG4: Evaluation of Projects in Example Areas across the EU

The aim of WG4 is to exploit the existing European-wide knowledge from demonstration projects on combating nutrient pollution from diffuse sources in river basins, by implementing general and targeted mitigation measures.

The main aim of WG4 is to support and strengthen a European-wide understanding between scientists and catchment managers on how nutrient losses from diffuse sources can be successfully combated, by implementing different mitigation measures in River Basin Management Plans. To reach this objective WG4 will examine and discuss the results from a wide range of general and targeted mitigation measures, implemented for reducing N and P losses from diffuse sources in the different regions of Europe, on the supra-national, national, regional, river basin or catchment scales.

As part of the EU Water Framework Directive (WFD), EU Member States shall collect and maintain information on the type and magnitude of significant anthropogenic pressures on water bodies, leading to ecological impacts. Among these anthropogenic pressures is the loss of nutrients from diffuse sources, since excess nutrient loadings into rivers, lakes, reservoirs and estuaries lead to eutrophication which, through algae growth, can severely impact freshwater and marine ecosystems. River Basin District Authorities (RBDA) in Europe have to conduct an analysis for each catchment, based on existing data such as land use, pollution sources and water monitoring data. Such an analysis is often performed in a stepwise manner following, for example, the DPSIR concept (Driving forces, Pressures, State, Impacts, Responses; see Figure 3).

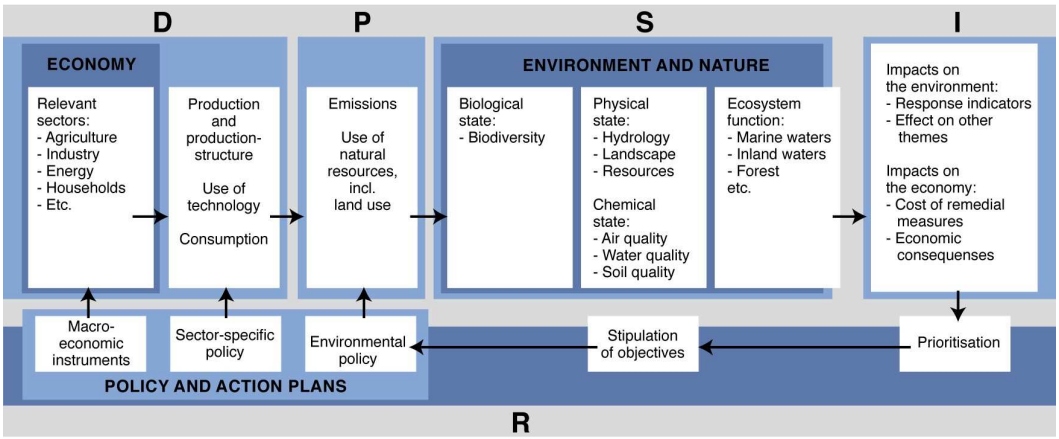

Figure 3. Diagram of the DPSIR concept

In cases where the DPSIR analysis reveals that nutrient loss from diffuse sources means that water bodies are not fulfilling the WFD requirements of providing water of good ecological quality, RBDA and catchment managers have to take action through the development of River Basin Management Plans (RBMP). Such RBMPs will have to incorporate different general and targeted mitigation measures that have to be adopted for reducing diffuse nutrient pollution in order to make each water body meet good ecological quality standards. Since both N and P losses to surface waters and groundwater are in many cases largely driven by agriculture, there is an urgent need in Europe to learn about the relationships between various general and targeted mitigation measures hitherto adopted and their resultant effect at the river basin level. Moreover, there is a great need for improving our common understanding of uncertainties related to implementation of different mitigation measures at the river basin level in different regions of Europe, caused by different mechanisms such as inertia caused by time lags, retention, climate change impacts, etc.

River Basin District Authorities have to fulfil the requirements of monitoring surface water and groundwater under the WFD, by establishing a monitoring network and adopting sampling protocols designed to provide a coherent and comprehensive overview of the ecological status of water bodies in river basins. The monitoring programmes implemented should, however, also be able to detect the benefits of mitigation measures implemented to combat diffuse nutrient losses in river basins throughout Europe. Such monitoring requirements demand that harmonised sampling protocols are developed that can cope with the wide ranges in catchment geology and hydrology existing in European river basins, in order to enable a precise and reliable documentation for the short-term and longer-term effects of different mitigation measures implemented.

The objective of WG4 is to contribute to the development, implementation, monitoring and assessment of River Basin Management Plans across Europe, by learning from the experience gathered in EU Directives (for example the. Nitrate Directive), national Action Plans, supra-national River Basin Action Plans (for example in conventional areas) and regional river basin Action Plans for combating nutrient pollution, conducted on different scales during the last two decades. The extensive knowledge already established by European scientists and river basin managers involved in combating diffuse nutrient pollution will be documented, and evidence from selected demonstration projects in river basins will be used for further knowledge building.

Milestones

- Establish an overview of different general and targeted mitigation measures implemented for combating diffuse nutrient pollution on a supra-national, national, regional and river basin scale during the last two decades in Europe.
- Harmonise analysis of the effect of general mitigation measures adopted against diffuse N and P pollution in catchments, by applying trend analysis to monitored data in selected demonstration catchments where point source nutrient loadings are of minor importance. As a special case the collapse in the agricultural sector in eastern European countries, which resulted in a dramatic change in fertilisation level, will be analysed and discussed.
- Select a number of demonstration projects of different scales that can be used as example studies for river basin managers in developing and implementation of River Basin Management Plans.
- Provide evidence from demonstration projects on the effect of different general and targeted mitigation measures implemented at different catchment levels to combat diffuse N and P losses.
- Establish a harmonised sampling protocol that allows an assessment of the effects of mitigation measures against diffuse nutrient pollution to be detected for a given period with a certain precision and accuracy covering European river basins having large differences in hydrological responses.
- Investigate the risks and uncertainties of implementing general and targeted mitigation measures for combating diffuse nutrient pollution at different river basin levels, including the role of time lags in different geological provinces of Europe, and retention mechanisms in surface water, wetlands and groundwater.
- Establish an overview of the cost-effectiveness of different general and targeted mitigation measures hitherto adopted in European river basins through use of selected demonstration projects.

Deliverables

- A European-wide overview of demonstration projects where general and targeted mitigation measures have been adopted for combating nutrient pollution from diffuse sources.
- A handbook for river basin managers on the necessary steps involved when setting up River Basin Management Plans for combating diffuse nutrient losses with examples from demonstration projects conducted in Europe.
- Guidance on how to establish a sampling protocol for assessment of the effects of implementing general and targeted mitigation measures at the river basin level in various regions of Europe.
- Guidance on the risks and uncertainties involved when implementing general and targeted mitigation measures at various river basin levels in different regions of Europe.

It is expected that the interactions between many different European teams will lead to more demonstration projects, urgently required to provide recommendations and convince regulators, decision makers and the general public of the applicability and sustainability of mitigation options.

E. Organisation

Management Committee:

- Appointment of Chair, Vice-chair and Working Group leaders.
- Planning of Management Committee meetings and of Scientific Meetings and workshops.
- Assessment and report of the progress made by the different Working Groups to meet their respective objectives, in the framework of the focus and direction of the Action.
- Coordination and critical appraisal of the previous, ongoing and planned activities (meetings, Short-Term Scientific Missions [STSMs], publications, etc.) to meet the general objectives of the Action and to maintain a clear focus and real collaboration between the scientific, environmental and ecological aspects.
- Promotion of cooperation and of data exchange between the Working Groups.
- Promotion and approval of STSMs according to the recommendations of an ad hoc evaluation committee.
- Preparation of the annual reports.
- Establishment and update of a Website for internal communication and dissemination of results.
- Organisation of contacts and common workshops with the appropriate ongoing COST Actions and other relevant technology or scientific platforms, to address problems of common interest , such as erosion abatement.

Working Group leaders:

- Planning the appropriate Scientific Meetings.
- Coordination of the activities within the Working Group, in the framework of the objectives.
- Promoting the set-up of joint research and the writing of common publications.
- Report on the WG progress to the Chair and Management Committee.

Short-Term Scientific Missions

Within the different Working Groups, research will be coordinated by the set-up of appropriate cooperation between the participating institutes. The research will be strengthened and intensified by the exchange of young scientists between the different organisations from the participating countries.

Meetings of the different Working Groups will be organised separately to enhance the exchange of information and ideas, to stimulate the synergy between scientists, institutes and countries, to address specific topics and to plan joint experimental work. **Combined meetings and scientific workshops** of the appropriate Working Groups will enhance the integration of activities, addressing primarily the interfaces between the different fields; the information obtained in a specific WG can have important implications for the other WGs. For example, the spatial and temporal dynamics of P losses (WG1), ecological aspects (WG2), and existing field experience (WG4) will influence the evaluation of mitigation options (WG3). The outcomes of the evaluation (WG3) will be further tested on critical source areas (WG1) within example areas in Europe (WG4).

Inter-COST workshops with appropriate other ongoing COST Actions will also be organised, to address topics of common interest, for example soil erosion (COST Action 634).

Exchange and mobility of scientists will strengthen the cooperation within the Working Groups and favour the **training of young scientists**, with a special focus on scientists from less-developed countries, in the framework of STSMs.

Joint research activities will be undertaken based on the relationship within the networking established by the Action. These activities will coordinate and progressively integrate separate research and development projects, currently fragmented and supported at the national level. They should also stimulate the preparation of Integrated Projects, to address specific problems, to be submitted in the context of present and future European Framework Programmes.

F. Timetable

The duration of the Action is five years. Several tasks of this Action have long-term objectives that justify the five year period; for example testing mitigation options in the field and monitoring the effects under different weather conditions is a time-consuming process. The timetable is spaced out by the meetings of each WG which will be held once a year. Combined meetings and workshops of the appropriate WGs, and Inter-COST Workshops will be held to address problems at the interface of WGs and different ongoing COST Actions, and will allow for the cross-fertilisation of outputs and ideas.

Table 1. Overall timetable

Year 1		*Year 2*		*Year 3*		*Year 4*		*Year 5*	
START – Planning meeting	Separate planning meetings of each WG Workshop + MC meeting	Scientific activity inside each WG, STSM's Separate or combined meetings of WG	Annual MC meeting International-P Workshop	Scientific activity inside each WG, STSM's	Separate meetings of WG Annual MC meeting Joint workshop of all WGs	Scientific activity inside each WG. STSM's Separate or combined meetings of WG	Annual MC meeting Workshop + MC meeting	Scientific activity inside each WG. STSM's	Final workshop, publication E N D O F T H E A C T I O N

Phase 1 (Year 1 and 2) deals with the analysis of desk studies, modelling and monitoring of existing activities. During this phase, the following main themes are foreseen for the Working Groups:

- WG1: Comparison of methodologies for detecting Critical Source Areas (CSA).
- WG2: Processes in surface waters, indicators, critical values.
- WG3: Overview of potential mitigation options.
- WG4: State-of-the-art of field experience with mitigation options.

At the end of Year 2 a summary will be made of the available information, which will be used for filling in the Website and for progress reports. The results will be discussed during a meeting which could be linked to the 5th International Phosphorus Workshop in Denmark, and a programme will be discussed for Phase 2 (Years 3, 4 and 5). This

phase will deal with applications and testing, and the following main themes are foreseen for the Working Groups:

- WG1: Application of CSA methodologies under different conditions.
- WG2: Evaluation of the impact of reduction in P and N loads.
- WG3:Cost-effectiveness of mitigation options.
- WG4: Applicability of mitigation options at the catchment level.

The number of workshops and small meetings to be organised will depend on the budget that is available for the Action. The Website will be updated regularly, progress reports will be produced yearly, the Action will be finished with a final report and several publications are foreseen.

G. Economic dimension

The following 25 countries have actively participated in the preparation of the Action or otherwise indicated their interest: Austria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

On the basis of national estimates provided by representatives of these countries, the economic dimension of the activities to be carried out under the Action has been estimated, in 2005 prices, at roughly EUR 165 million. This estimate is valid on the assumption that all countries mentioned above, but no other countries, will participate in the Action. Any departure from this will change the total cost accordingly.

H. Dissemination plan

Knowledge and data coming out of the COST Action activities will be integrated and presented in international conferences for promoting the European know-how and increasing international collaboration. Collaboration is foreseen particularly with the research network: SERA 17: Organization to Minimize Phosphorus Losses from Agriculture. This network coordinates research on this topic in the USA, with researchers from outside the USA being able to join the network.

Original results of research and development done in the context of this COST Action will also be published in international peer-reviewed journals, if possible as common, multi-author and multi-institutes papers. Common review articles are also expected, and the publication of book(s) if and when appropriate and timely.

As a complement to these activities, a Website containing useful information and progress reports will be established and electronic newsletters will be distributed.

Teaching activities in universities and postgraduate training will also take advantage of the knowledge and experience acquired during the COST Action. Young scientists and engineers will thus be trained and informed on the latest developments in mitigating nutrient losses.

Special effort and initiatives will be undertaken at different local, national and European levels to improve the dissemination of results to water authorities, the general public, farmers, policy makers and stakeholders, by appropriate direct contacts, information given to the media and the organisation of courses and seminars at the national level.

COST Action 869

"Mitigation Options for Nutrient Reduction in Surface Water and Groundwaters"

ADDITIONAL INFORMATION NOT PART OF THE MoU

	List of experts, COST Action on Mitigation options				62	25	67	32	
*	denotes expert that could be asked for MC				1	2	3	4	**WG**
				country					
*	Bundesamt für Wasserwirtschaft, Inst. Kulturtechnik und Bodenwasserhaushalt, Petzenkirchen	Peter Strauss	+43.7416 5210 8-31	AT			1		peter.strauss@baw.at
	Agric. Res. & Education Centre Raumberg - Gumpenstein, A - 8952 Irdning	Andreas Bohner	+43 3682 22 4 51 - 294	AT			1		andreas.bohner@raumberg-gumpenstein.at
*	Institute for Soil Science, University of Agriculture, Vienna	Axel Mentler	+43 1 47654 3106	AT	1				h310t2@edv1.boku.ac.at
	Austrian Agency for Health and Food Safety - AGES, Inst. Soil Health Plant Nutrition, Vienna	Heide Spiegel	+43 50 555 34121	AT			1		adelheid.spiegel@ages.at
	FAL-Reckenholz, Group Water Protection, Zurich	Volker Prasuhn	+41 44 377 7111	CH	1			1	volker.prasuhn@fal.admin.ch
*	ETHZ, Inst. for Plant Sciences, Lindau	Emmanuel Frossard	+41.52 354 9140	CH			1		emmanuel.frossard@ipw.agrl.ethz.ch
*	EAWAG, Dept. Water and Agriculture, Swiss Fed. Inst. for Environ. Sci. and Technol., Duebendorf	Christian Stamm	+41 44 823 5565	CH	1			1	christian.stamm@eawag.ch
	idem	Martin Frey	+41 44 823 5071	CH	1				martin.frey@eawag.ch
	Kantonale Zentralstelle für Ökologie, Sempach	Josef Blum	+41 41 460 24 10	CH				1	josef.blum@lu.ch
	EAWAG, Swiss Fed. Inst. Environ. Sci. Techn., Limnological Research Center, Kastanienbaum	Beat Mueller	+41 41 349 2149	CH		1			beat.mueller@eawag.ch
	Idem	Miriam Reinhardt	+41 41 349 2153	CH		1			miriam.reinhardt@eawag.ch

	List of experts, COST Action on Mitigation options				62	25	67	32	
*	denotes expert that could be asked for MC				1	2	3	4	**WG**
				country					
*	Dept of Wetlands Ecology, Inst. of Landscape Ecology, Acad. Sci. Czech Rep., Trebon	Hana Cizkova	+420 38 470 6182	CZ		1			hana.cizkova@uek.trebon.cz
*	Hydrobiological Inst. AS CR, Ceske Budejovice	Josef Hejzlar	+420 38 902 5876	CZ	1	**1**			hejzlar@hbu.cas.cz
	Institute for Land Use, University of Rostock	Bettina Eichler	+49 381 498 2174	DE			1		bettina.eichler@uni-rostock.de
*	(UFZ) Centre for Environmental Research, Leipzig - Halle Ltd., Falkenberg	Ralph Meissner	+49 393 8697113	DE	1				ralph.meissner@ufz.de
	Dept of Hydrol. Modelling, UFZ Centre for Environ. Res. Leipzig Halle, Magdeburg	Michael Rode	+49 391 8109650	DE	1				michael.rode@ufz.de
	Dept of Soil Science, UFZ Centre for Environmental Research, Magdeburg	Gregor Ollesch	+49 391 8109660	DE	1	1			gregor.ollesch@ufz.de
	Inst. Bodenkunde, Univ. Hannover, Hannover	Peter Schweigert	+49 511 762 8068	DE			1		schweigert@ifbk.uni-hannover.de
	Bureau for Sustainable Agriculture (BSA), Hanhofen	Klaus Isermann	+49 6344 2983	DE			1		isermann.bnla@t-online.de
*	Inst. of Freshwater Ecology and Inland Fisheries Dept Limnology of Shallow Lakes and Lowland Rivers, Berlin	Horst Behrendt	+49 3064 181683	DE	1			1	behrendt@igb-berlin.de
*	National Environ. Research Inst., Silkeborg	Brian Kronvang	+45 89 20 1421	DK			1	1	bkr@dmu.dk
	Idem	Hans Estrup Andersen	+45 89 20 1488	DK	**1**		1		hea@dmu.dk

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*	denotes expert that could be asked for MC				1	2	3	4	**WG**
				country					
*	Dept. of of Agroecology, Danish Inst. of Agric. Sciences, Research Centre Foulum, Tjele	Goswin Heckrath	+45 8999 1715	DK	**1**		1		goswin.heckrath@agrsci.dk
	idem	Gitte H. Rubaek	+45 8999 1859	DK	1		1	1	gitte.rubaek@agrsci.dk
	idem	Charlotte Kjaergaard	+45 8999 1864	DK	1		**1**	1	C.Kjaergaard@agrsci.dk
*	Estonia Tallin Technical Univ., Järevanna 5, 10132 Tallin, Estonia	Enn Loigu	+372 620 2002	EE		1			ennloigu@edu.ttu.ee
*	Univ. de Santiago de Compostela, Dep. de Edafologia y Quimica Agricola	Fernando Gil Sotres	+ 34 981 563100 ext. 14984	ES	1				edgils@usc.es
	Univ. de Córdoba, Córdoba	José Torrent	+34 957 218472	ES			1		cr1tocaj@uco.es
	Dept. de Bioquimica de Suelos, Inst. de Invest. Agrobiol. de Galicia, Santiago de Compostela	Carmen Trasar-Cepeda	+34 981 590958	ES	1				ctrasar@iiag.cesga.es
*	Univ. de Sevilla, Dep. de Ciencias Agroforestales	Antonio Delgado	+34 954 486 452	ES			1		adelgado@us.es
	Dept. of Applied Chemistry and Microbiology, Univ. Helsinki	Helinä Hartikainen	+358.9 191 58323	FI			1		helina.hartikainen@helsinki.fi
	MTT Agrifood Research Finland, Jokioinen	Eila Turtola	+358 3 41 881	FI			1	1	eila.turtola@mtt.fi
	idem	Riitta Lemola	+358 3 41 881	FI			1		riitta.lemola@mtt.fi
*	idem	Risto Uusitalo	+358 3 41 881	FI	1				risto.uusitalo@mtt.fi
*	Finnish Environment Inst., Helsinki	Seppo Rekolainen	+358 9 4030 0364	FI		1			seppo.rekolainen@ymparisto.fi
	Idem	Petri Ekholm	+358 9 4030 0239	FI		1			petri.ekholm@ymparisto.fi

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*	denotes expert that could be asked for MC				1	2	3	4	**WG**
				country					
*	INRA - Station d'Hydrobiologie Lacustre, Thonon les bains Cedex	Jean Marcel Dorioz	+33 4.50.26.78.19	FR				1	dorioz@thonon.inra.fr
*	INRA, Dept. Environnement et Agronomie, Villenave d'Ornon Cedex	Christian Morel	+33. 5 5712 2502	FR			1		morel@bordeaux.inra.fr
	National Technical Univ. of Athens	Maria Mimikou	+30 210 7722880	GR	1		1	1	mimikou@chi.civil.ntua.gr
*	idem	Yiannis Panagopoulos	+30 210 7722880	GR	1		1	1	ypanag@chi.civil.ntua.gr
	Dept. Environ. Engin., Techn. Univ. of Crete, Polytechnioupolis	Nikos Nikolaidis	+30 2821037785	GR	1		1		nnikolai@mred.tuc.gr
	Hellenic Centre for Marine Res., Athens	Nikos Skoulikidis	+30 22910 76394	GR		1	1		nskoul@ath.hcmr.gr
*	RISSAC HAS, Budapest	Peter Csatho	+36.1 212 1891	HU			1		csatho@rissac.hu
*	idem	Tamas Németh	+36.1.3564 682	HU				1	nemeth@rissac.hu
*	Teagasc, Johnstown Castle, Wexford	Hubert Tunney	+353.53 42 888	IE	1		1		
*	Trinity College Dublin, Dept. Zoology, Dublin	Kenneth Irvine	+353 1 6081366	IE		1			kirvine@tcd.ie
	Dept. Biosystems Engin., Univ. College Dublin, Dublin	Nicholas Holden	+353 1 7167460	IE	1		1		nick.holden@ucd.ie
	Dept. Agric. & Food Engineering, Univ. College Dublin	William Magette	+353 1 716 7205	IE	1		1		
*	Tel-Hai Academic College, Dept Biotechnology and Environmental Sciences, Upper Galilee	Iggy Litaor	+972 4 6900978	IL	1				litaori@telhai.ac.il
*	Hebrew Univ. of Jerusalem, Dept. Soil & Water Sciences, Rheobot	Moshe Shenker	+972 8 9489349	IL			1	1	shenk009@umn.edu

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	EC General Dir., Joint Res. Centre, Ispra (VA)	Fayçal Bouraoui	+39 0332 785173	IT	1		1		Faycal.bouraoui@jrc.it
*	Water Research Institute (IRSA-CNR), Bari	Antonio Lo Porto	+39 080 5820527	IT	1		1	1	antonio.loporto@ba.irsa.cnr.it
	Water Research Institute (IRSA-CNR), Bari	Monica Garnier	+39 080 5820529	IT			1	1	monica.garnier@ba.irsa.cnr.it
	idem	Antonio Leone	+39 0761 357363	IT			1	1	leone@unitus.it
*	Univ. di Torino, Dept. Agronomy, Forestry and Land management, Torino	Carlo Grignani	+39 011 670 8777	IT	1		1	1	carlo.grignani@unito.it
	idem	Dario Sacco	+39 011 670 8787	IT	1		1	1	dario.sacco@unito.it
	idem	Laura Zavattaro	+39 011 670 8776	IT	1		1	1	laura.zavattaro@unito.it
*	Water Manag. Inst. of LUA, Parko6, LT-5048 Kedainiai	Antanas Sigitas Sileika	+370 347 68100	LT			1		sigitas@water.omnitel.net
	idem	Kazimieras Gaigalis	+370 347 68100	LT	1				syzak@kaunas.init.lt
	idem	Saulius Kutra	+370 347 68100	LT			1		Kutra@water.omnitel.net
	idem	Ausra Smitiene	+370 347 68100	LT	1				ausrac@kaunas.init.lt
*	CRP-Gabriel Lippmann, Luxembourg	Lucien Hoffman	+352 470 261400	LU			1		hoffmann@lippmann.lu
*	Latvia Univ. Agric., Dept Environ. Eng. Jelgava, Latvia	Viesturs Jansons	+371 30 29851	LV	1		1		viesturs.jansons@llu.lv

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*	Alterra, Wageningen UR, Wageningen	Oscar Schoumans	+31 317 474478	NL	**1**		1		oscar.schoumans@wur.nl
*	idem	Wim Chardon	+31 317 474602	NL			1		wim.chardon@wur.nl
	idem	Piet Groenendijk	+31 317 474425	NL	1			1	piet.groenendijk@wur.nl
	idem	Caroline van der Salm	+31 317 474355	NL	1		**1**		caroline.vandersalm@wur.nl
	idem	Gert-Jan Noij	+31 317 474376	NL			1		gert-jan.noij@wur.nl
	idem	Phillip Ehlert	+31 317 474794	NL			**1**	1	phillip.ehlert@wur.nl
	RIZA, Lelystad	Paul Boers	+31 320 298429	NL		1			P.Boers@riza.rws.minvenw.nl
*	Centre for Soil and Environmental Research, Jordforskbygningen	Nils Vagstad	+47 6494 8100	NO	1			1	nils.vagstad@jordforsk.no
	idem	Marianne Bechmann	+47 6494 8130	NO	1		1		marianne.bechmann@jordforsk.no
	idem	Bent Braskerud	+47 6494 8100	NO			1		bent.braskerud@jordforsk.no
*	Dept. Plant Environ. Sci., Norwegian Univ. of Life Sciences, Ås	Tore Krogstad	+47-64 96 55 67	NO		1			tore.krogstad@umb.no
*	Inst. of Soil Science and Plant Cultivation, Dept. of Soil Fertility and Fertilization, Pulawy	Janusz Igras	+48 81 886 3421 ext. 225	PL	1		1		ij@iung.pulawy.pl
	Dept. Land Reclamation Environ. Management, Univ. of Warmia and Mazury, Olsztyn	Katarzyna Glińska-Lewczuk	+48 89 5234349	PL	1	1	1	1	kaga@uwm.edu.pl
*	Inst. Land Reclamation Grassland Farming, Falenty, Westpomeranian Res.Centre, Szczecin	Piotr Burczyk	+48 91 423 1908	PL	1		1	1	bpiotr@wp.pl

	List of experts, COST Action on Mitigation options				62	25	67	32	
*	denotes expert that could be asked for MC				1	2	3	4	**WG**
				country					
	Agricultural Univ., Dept. Agric. Environ. Chemistry, Lublin	Piotr Skowron	+48 81 445 69 95	PL	1				piotr.skowron@ar.lublin.pl
	Sedimentation Lab. Warsaw Agric. Univ., Warsaw	Leszek Hejduk	+48 22 59 35 287	PL	1		1		Hejduk@alpha.sggw.waw.pl
*	IPIMAR, Dept. Aquat. Environment, Lisbon	Graca Cabecadas	+351 21 3027 190	PT		1			gc@ipimar.pt
*	Agrochem. Plant Nutrition Dept., (RISSA), Bucharest	Emilia Dorneanu	+40-021-318 4349	RO	1				dorneanu@icpa.ro
*	idem	Dana Daniela	+40-021-318 4349	RO	1				danadaney@yahoo.com
*	Swedish Univ. of Agricultural Sciences, Dept. Soil Sciences, Uppsala	Barbro Ulén	+46 18-671251	SE	1		1		Barbro.Ulen@mv.slu.se
	idem, Inst. Environm. Analysis, Uppsala	Mats Wallin	+46 18 67 3125	SE	1		**1**	1	Mats.Wallin@ma.slu.se
	Dept. of Economics, Gävle University, 801 76 Gävle	Dennis Collentine	+46 26 67 5093	SE	1		**1**	1	Dennis.Collentine@hig.se
*	SMHI - Swedish Meteorol. and Hydrol. Inst., Norrköping	Berit Arheimer	+46 11 495 82 60	SE	1		1	1	berit.arheimer@smhi.se
	idem	Jörgen Rosberg	+46 11 495 81 81	SE	1		1		jorgen.rosberg@smhi.se
	idem	Charlotta Pers	+46 11 495 83 85	SE		1			?
*	SMHU, Slovak Hydrometeorological Institute, Slovakia	Peter Roncak	+421 2 5477 1247	SK		1			Peter.Roncak@shmu.sk

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				country					
*	Agricultural University of Nitra, Slovakia	Jaroslav Antal	+421 37 6514 707	SK	1		1		Jaroslav.Antal@uniag.sk
*	ADAS, Salisbury	Paul Withers	+44 1722 417491	UK	1		1		paul.withers@adas.co.uk
	ADAS, Wolverhampton	Ken Smith	+44 1902 693308	UK	1		1		ken.smith@adas.co.uk
	idem	Steve Anthony	+44 1902 693124	UK	1		1		steve.anthony@adas.co.uk
	idem	Martyn Silgram	+44 1902 693354	UK	1		1		martyn.silgram@adas.co.uk
	ADAS Gleadthorpe, Meden Vale, Mansfield, Nottinghamshire	Rebecca Humphrey	+44 1623 848357	UK	1		1		rebecca.humphrey@adas.co.uk
*	Centre for Sustainable Water Manage. The Lancaster Environ. Centre, Lancaster University, Bailrigg, Lancaster	Louise Heathwaite	+44 1524 510255	UK	1				louise.heathwaite@lancs.ac.uk
	Environmental Science Dept., Lancaster Univ., Lancaster	John Quinton	+44 1524 593654	UK	1		1		J.Quinton@Lancaster.ac.uk
	Idem	Jim Freer	+44 1524 593563	UK				1	j.freer@lancaster.ac.uk
	IGER, North Wyke, Okehampton, Devon	Phil Haygarth	+44 1837 883534	UK	1		1		haygarth@bbsrc.ac.uk
	Idem	Roland Bol	+44 1837 883507	UK	1				roland.bol@bbsrc.ac.uk
	Idem	Patricia Butler	+44 1837 883514	UK	1				Patricia.butler@bbsrc.ac.uk
	Idem	Kit MacLeod	+44 1837 883507	UK	1			1	Kit.Macleod@bbsrc.ac.uk

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*	denotes expert that could be asked for MC				1	2	3	4	**WG**
				country					
	Idem	Steve Granger	+44 1837 883512	UK			1		steve.granger@bbsrc.ac.uk
	Environment Agency	Rachael Dils	+44 1491 828422	UK			1		Rachel.dils@environment-agency.gov.uk
	idem	Neil Preedy	+44 117 9142935	UK	1				PreedN.Bristol4.HO@environment-agency.gov.uk
	idem	Larissa Naylor	+44 117 9142639	UK				1	larissa.naylor@environment-agency.gov.uk
	idem	Bill Brierley	+44 777 1555096	UK		1			bill.brierley@environment-agency.gov.uk
	Agric. Environ. Div., Rothamsted Research, Harpenden	Phil Brookes	+44 1582 763133	UK			1		philip.brookes@bbsrc.ac.uk
	Aquatic Environments Res. Centre, Univ. of Reading	Penny Johnes	+44 118 378 8747	UK		1		1	p.j.johnes@reading.ac.uk
	Univ. of Exeter, Dept. Geograpy, Exeter	Des Walling	+44 1392 263345	UK	1				D.E.Walling@exeter.ac.uk
	Centre for Ecology and Hydrology, Wallingford	David Boorman	+44 1491 838800	UK			1		dbb@ceh.ac.uk
	idem	Helen Jarvie	+44 1491 838800	UK		1			hpj@ceh.ac.uk
	idem	Linda May	+44 131 4454343	UK		1			lmay@ceh.ac.uk
	idem	Mike Hutchins	+44 1491 838800	UK	1				mihu@ceh.ac.uk
	Centre for Ecology and Hydrology, Dorset	Mike Bowes	+44 1305 213500	UK		1			mibo@ceh.ac.uk

	List of experts, COST Action on Mitigation options				62	25	67	32	
*	denotes expert that could be asked for MC				1	2	3	4	**WG**
				country					
	idem	John Hilton	+44 1305 213625	UK			1		jhi@ceh.ac.uk
	idem	Jim Smith	+44 1305 213500	UK		1			jts@ceh.ac.uk