



COST Office

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Proposal for a new COST Action

COST Action 869

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

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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 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 ground waters 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.

Part I TECHNICAL ANNEX

ABSTRACT

The eutrophication of surface waters and the contamination of groundwaters due to elevated nutrient inputs have a serious impact on ecosystem health in many countries. The Water Framework Directive (WFD) requires improvement to the quality of surface and groundwaters; this may require 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 the Action is to undertake a scientific evaluation of the suitability and cost-effectiveness of different options for reducing nutrient loss to surface and ground waters at 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.

A - 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 (e.g. diminishing industrial losses through industrial decline) and targeted options (e.g. 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 1990's, 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 level. These aims were achieved through (i) definition of conceptual models of P cycling in EU agricultural systems, (ii) studying P transfer in surface and sub-surface runoff at a range of scales, and (iii) 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 this Action is sustainable land use and farm management in order to reduce erosion and surface runoff. There is some attempt to study sediment-associated contaminants such as pesticides and P in this Action. 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. The COST Action proposed here builds on the recommendations that came from this workshop.

This COST Action will focus 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 conflictory 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.

B - Objectives and Benefits

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 ground waters at 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 at 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, what did work and what did not, what could be improved?

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 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 should provide the European states and Water Authorities with data for future recommendation in the management and restoration of polluted waters, also taking into account potential ecological consequences of mitigation options.

The 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 will support the creation, improvement and consolidation of networks and partnerships between complementary research and advisory teams from many COST countries. It will also improve the education and training of young scientists and promote their mobility.

C - Scientific Programme

The activities will be divided into 4 Working Groups (WG) that will have strong links and interactions between them as follows:

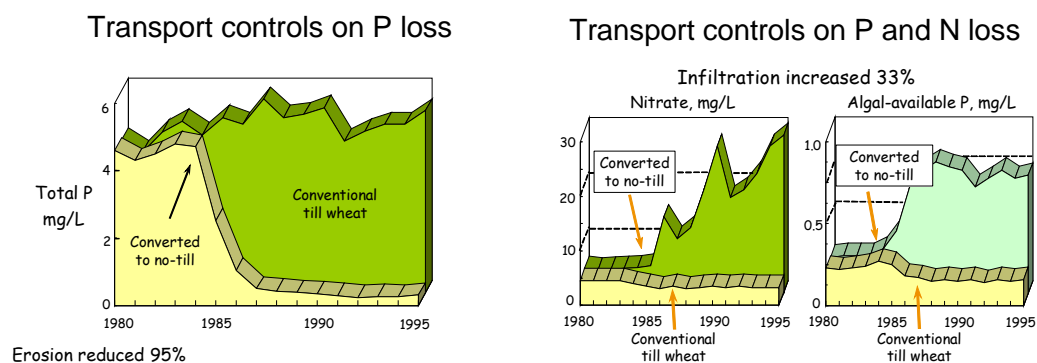
- WG1 Localisation of critical source areas in catchments**
- WG2 Influence of nutrients on ecological processes in surface waters**
- WG3 Mitigation options**
- WG4 Evaluation of projects in example areas across the EU**

The Action will integrate 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 will focus 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 ground waters 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 the figures below.



The left figure shows that after conversion to a no-till system the loss of total P via erosion was reduced with 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 vs. particle bound), and on total P vs. nitrate.

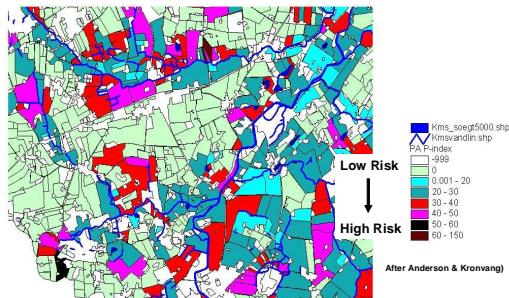
The Critical Source Area (CSA) concept has been developed in the USA to explain the observation that for many catchments: “90% of P loss may be accounted for by 10% of the land area in 1% of the time.” What this means is: most P loss recorded as river P loads may be

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. Undertaking this COST Action will lead to more reliable measures to ensure mitigating actions meet the targets of the WFD.

In this Working Group (WG) 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 below:

P loss risk index for Denmark



Using the Source – Transfer – Delivery model of P losses, the milestones of this WG are:

- 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.

The expected deliverables of WG1 are:

- 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, so-called 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 wide-spread problems throughout the EU territory, resulting in numerous water bodies that are at risk not meeting the 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, linkages 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 pressures. 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 on ecosystem level (or on 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 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. Especially 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.

The 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 we aim at assessing 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:

- 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 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.

The expected deliverables include:

- 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 of 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 relation 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, and
- 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 e.g.:

- 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 place 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 (e.g. buffer strips; artificial wetlands). Therefore, the influence of several conditions, e.g. 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, also other factors will be taken into account, such as feasibility, acceptance by important actors (farmers, citizens, local policy makers), ease of implementation, side effects on other nutrients (e.g. 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.

The milestones of WG3 are:

- 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 local scale.
- Evaluate the strengths and weaknesses of mitigation options based on experiences during implementation.
- Relate options to current agri-environment programmes within the different EU countries, and study which measures are suitable for varying implementation policies.

The following deliverables are expected:

- 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 scale.

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, at supra-national, national, regional, river basin or catchment scale.

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 diagram below).

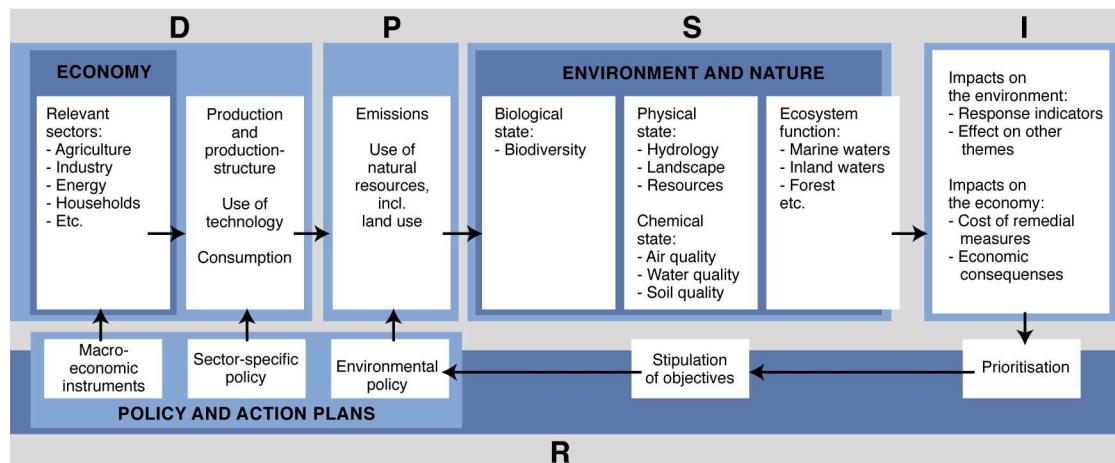


Diagram of the DPSIR concept

In cases where the DPSIR analysis reveals that nutrient loss from diffuse sources causes that water bodies are not fulfilling the WFD requirements of a good ecological quality, RBDA and catchment managers have to take responses through development of River Basin Management Plans (RBMP). Such RBMP's 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 a good ecological quality. 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 River Basin scale. Moreover, there is a great need for improving our common understanding of uncertainties related to implementation of different mitigation measures at River Basin scale in different regions of Europe, caused by different mechanisms such as inertia caused by time lags, retention, climate change impacts, etc.

The 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 (e.g. Nitrate Directive), national Action Plans, supra-national River Basin Action Plans (e.g. Conventional areas) and regional river basin Action plans for combating nutrient pollution, conducted at different scales during the last 1-2 decades. The large 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.

The objectives of WG4 will be reached by including the following 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 the Eastern European countries, which resulted in a dramatic change in fertilisation level, will be analysed and discussed.
- Select a number of demonstration projects at 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 scales 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 scales, 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 the selected demonstration projects.

Expected deliverables from WG4 include:

- 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 scale in various regions of Europe.
- Guidance on the risks and uncertainties involved when implementing general and targeted mitigation measures at various River Basin scales 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.

D - Organisation

Management Committee:

- Appointment of Action 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 [STSM], publications, etc.) to meet the general objectives of the Action and to maintain 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 STSM's, 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 results dissemination.
- 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 (e.g. 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 Action 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 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, e.g. soil erosion (COST 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 for scientists from less-developed countries, in the framework of **Short-Term Scientific Missions**.

Joint research activities should be undertaken based on the relationship within the networking established by the Action. These activities are expected to coordinate and progressively integrate separate research and development projects, presently 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.

The research groups ready to participate in this new COST Action represent a unique assembly of European scientists and advisors, with large experience in their particular fields. The consortium of academic and institutional researchers and advisors linked to research as listed below has a necessary and sufficient expertise, technical infrastructure and methodological know-how to successfully address the scientific, environmental and ecological aspects of this COST Action.

E - Timetable

The proposed duration of the Action is 5 years. Several tasks of this ambitious Action have long-term objectives that justify the time of 5 years, for example testing mitigation options in the field and monitoring of 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.

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				
END OF THE ACTION				

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 joined 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 catchment scale.

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.

F - Economic dimension

The following 25 countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, CH, CZ, DE, DK, EE, ES, FI, FR, GR, HU, IE, IL, IT, LT, LU, LV, NL, NO, PL, PT, RO, SE, SK, UK. Through previous networking (four International Phosphorus Workshops, held in Europe in 1995, 1998, 2001 and 2004; COST Action 832), and personal contacts established within each participating country, it is known that all leading European scientists in the field will participate.

On the basis of the national estimates provided by representatives the 25 countries indicated above, the economic dimension of the activities to be carried out under the Action has been estimated, in 2005 prices, at roughly Euro 33 million per year of the Action; means 165 million Euro in total for the duration of the Action. Any departure from this will change the total cost accordingly.

G - Dissemination plan

Knowledge and data coming out from the COST Action activities will be integrated and presented in **International Conferences**, for promoting the European know-how and increasing the international collaboration. Especially, collaboration is foreseen with the research network: “SERA 17 - Organization to Minimize Phosphorus Losses from Agriculture”. This network coordinates the research on this topic in the USA, but researchers from abroad can become member.

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, whereas the publication of **book(s)** would be welcome 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 could be distributed.

Teaching activities in Universities and post-graduate formation 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 the Water Authorities, the **general public**, **farmers**, **policy makers** and **stakeholders**, by appropriate direct contacts, information to the media and organisation of courses and seminars at the national level.