



EurAqua Position Paper on WFD needs under FP7

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Executive Summary

Through this position paper EurAqua, the European Network of Freshwater Research Organisations, would like to draw attention to WFD related research needs under the upcoming work programmes of FP7.

Important information for this paper was obtained via the EU Water Directors, who initiated an inventory of the WFD key issues and research needs, in 2005¹. Based on the replies received from all 25 European member states as well as contributions from Norway and Iceland, the Water Directors were able to identify the WFD research needs in 11 issue categories.² By utilising this inventory, EurAqua categorised the different knowledge gaps according to the level of priority under more research-defined topics. In this way, EurAqua hopes to be of assistance in the implementation of the WFD and would like to contribute in bridging the gap between science and policy.

Key Observation from the inventory on WFD key issues:

There are some fundamental gaps in the understanding of ecological processes, with particular emphasis on the impact of human activities on these processes. It was apparent during the initial phase of the implementation of the WFD, that the current scientific knowledge on the hydrological, chemical and ecological mechanisms occurring in water systems would have to be further developed in order to enable a sound and cost effective implementation.

Knowledge gaps

Five priority areas have been highlighted for further research:

1. Ecological status assessment: Insights and tools to assess the current status of the water system with respect to ecological status (expressed in appropriate biological indicators), and for substances for which detection limits are higher than the standards set for those substances in the environment. (these refers to chemical rather than ecological status).
2. Pressure and Impact Assessment: Models and tools to calculate the (combined) effects of several pressures, e.g. morphology, significance of pressures, historic

¹ "WFD key issues and research needs", to be found at:
http://forum.europa.eu.int/Public/irc/env/wfd/library?l=/framework_directive/thematic_documents/integrated_management&vm=detailed&sb=Title

² See Annex 1 for the full list

- pollution of sediments diffuse pollution on ecological status, models for load and impact of nutrients and POP's on inland waters, coastal areas and sea.
3. **Measure Assessment:** EU states find it difficult to perform a sound assessment of programmes of measures. Difficulties reported not only relate to the economic dimension of the assessment (estimation of the cost and of the benefits of the measures) but also to the assessment of the effectiveness of the measures which cannot be performed using sophisticated models and for which more simple, expert-based approaches still have to be developed
 4. **Economic instruments:** There are limited examples in which economic instruments have specifically addressed water issues up to now. The application of cost-benefit and cost-effectiveness analyses, performed at a river basin scale (national or even international) needs further development as well as the optimal or acceptable choice of a program of measures in uncertain and risky technical, economic and social contexts.
 5. **Monitoring:** By the end of 2007, all Member States should have made monitoring programmes operational in order to establish a coherent and comprehensive overview of water status (surface water, groundwater and protected areas) within each river basin district (EC Water Framework Directive; 2000/60/EC, Article 8. There is a gap between the monitoring data obtained in the programmes and their effective use in practical river basin management. The targeted identification of relevant ecological, hydromorphological and chemical indicators for the ecological status of different water bodies and status enhancements remains a challenge. Adequate methodologies and modelling tools that allow for targeted analyses of data, efficient data interpretations for planning and management purposes are lacking.

In the first call of FP7, priority Environment (including climate change), there is only one large-scale project open for tender. This topic attempts to cover many aspects also included in this position paper. However, one single project cannot bring thorough answers to all these questions posed, so there remains a need for further calls to complement the gaps.

1. Ecological status assessment

Introduction

Although the achievements of FP5 and FP6 have been taken into account, additional knowledge of ecological processes is required to assess the ecological status of water bodies, and to enable the implementation of cost effective packages of measures to reach the biological WFD objectives. Solid knowledge of ecosystem structure and function, forms the basis of the development of relevant biological indicators, as well as, the identification of thresholds for shifts in the biological structure of different types of water bodies. It is important to understand the interactions between physical, chemical and biological processes along the river continuum and across the terrestrial boundaries, when restoring water bodies at ecosystem scale, i.e. stream valleys or lake systems. Improvement of the biodiversity of both the water body and terrestrial ecosystems can link the aims of the Water Framework Directive (WFD) and the Habitats Directive. Information on the importance of longitudinal continuity of freshwater systems, right from the spring to the outlet in the sea, is important for fish, but also for the general biodiversity of other organisms in the river continuum. Presently such knowledge is scarce.

Research topics

Understanding ecosystem structure and function as a tool for assessing changes in ecological status.

Knowledge of ecosystem structure and function is essential to develop indicators which can forecast shifts in the ecological status of the water bodies caused by different pressures as changed hydrology, physical changes, loading with nutrients and toxic substances. This requires research studies at ecosystem level in order to develop efficient methods to identify the impact of the individual pressures and to develop cost-efficient methods to restore freshwater ecosystems. Uncertainty assessment of indicators and measures should be developed as part of the research activities. Priority on biodiversity of coherent freshwater systems including river valleys, right from the spring to the outlet in the sea will support development relevant tools at river basin scale to implement the WFD.

Funding scheme: Small or medium-scale focussed research collaboration projects.

Expected impact

Closing the knowledge gaps between these issues will allow the implementation of more efficient packages of measures to restore freshwater ecosystems by taking into account the dynamic interactions between hydrological, morphological, chemical and biological processes, both across the stream valley and along the freshwater system as well as measures at river basin scale. Knowledge of the impact of physical disturbance, eutrophication and toxic substances on freshwater systems is essential to define the relevant pressures and thereby elaborate on efficient action plans for the individual water bodies and the River Basin Management Plans. As can be foreseen now, effects of climate change on WFD biological objectives will need to be included in the second and third round of River Basin Management Plans.

2. Pressure and Impact Assessment

Introduction

The WFD requires the member states to assess the impact of different pressures. Taking into account the achievements of FP5 and FP6 projects, EurAqua recognises the difficulties of conducting impact assessment due to lack of models and methods to calculate the effects of several pressures, such as morphology, diffuse pollution and historic pollution as well as the mixed effects of different pressures, as expressed by many member states. Thus, near-future research should focus on improving knowledge on the effects of pressures. Special attention should be given to the impact of major pressures such as infrastructure affecting morphology, including effects of the construction phase, as well as diffuse and point source pollution. This also includes improved modelling of pressures related to diffuse pollution. Research needed includes fate and pathways of chemical compounds, effects on biota as well as integration of such information on tools and methods allowing cost-efficient assessment of ecological impact. Uncertainty assessment should be part of methods developed.

Research topics

Models of transport and impact of nutrients and POP's from inland waters, to coastal areas and the sea

Further development of catchments and river basin models for nutrient transport to coastal area and the sea requires further modification. Nitrogen models are comparatively well developed, while there is still room for improvement with regards to phosphorus modelling. In spite of reductions in phosphorus discharge from domestic wastewater treatment plants, phosphorus pollution continues to contribute strongly to eutropication in regional seas. Areas to be highlighted are: the effects of changed agricultural practices; nutrient losses during high rainfall events and discharge from historically polluted river beds. Other areas for consideration are; the development of models of transport and loads of POP's for inland waters; as well as models for coastal areas and sea; while focussing on pesticides and pharmaceutical residues. Research on POP's should also include uptake, concentrations and effects in biota including birds, amphibians and mammals

Funding scheme: small or medium-scale focused research collaboration project(s)

Expected impact

Substantially improved knowledge and models for phosphorus and persistent organic pollutants transport to, in and from inland waters to coastal areas and the sea will be achieved. Better understanding and assessment of the impact of accumulation of persistent organic pollutants in biota. S&T support to the development of methods and tools for impact assessment in line with the EU Water Framework Directive.

Impact of man-made structures and old industrial activities

Research on the long-term impact of differences in water flow and habitat suitability as a result of hydropower, structures for flood defence, irrigation and shipping, as well as the effects of shipping itself, and manmade structures on vulnerable groundwater resources is a necessity. Assessment methods for the short-term, and long-term effects of the infrastructure construction phase itself. Assessment of the impact of contaminated soils and old mining

areas on the chemical and ecological status of water bodies, including development of tools and DSS, must be documented and recorded in order to allow adequate identification of measures in highly populated areas.

Funding scheme: small or medium-scale focused research collaboration project(s)

Expected impact

Providing improved knowledge as well as better tools and assessment possibilities for impact of infrastructure and old industrial activities on hydrological regime, water quality and ecological status, with special attention given to heavily modified water bodies. Fostering better assessment strategies and improved quality in impact assessment related to new or changed infrastructure and hydropower installations.

Impact of climate change on hydrological regimes and water chemical status

Understanding climate change effects on hydrological regimes and the consequent impact on water quality will become increasingly crucial. This will be particularly relevant with respect to extreme high and low flows. It is predicted that these flows will increase in intensity in the future. Based on existing global and regional climate models as well as downscaling approaches, work should focus on reduced uncertainties of regional climate models through improved downscaling methods, and reduced uncertainties for predicted precipitation intensity. The effects of increased CO₂ dispersment into the atmosphere; increased temperatures and increased or reduced rainfall, on crop production and nutrient leakage from arable land should be addressed.

Funding scheme: small or medium-scale focused research collaboration projects

Expected impact

Assessment of the impact of climate change on production and nutrient leakage in different European agricultural regions. Improved modelling of climate change effects on hydrological regimes and risks for flooding and drought in Europe, specifically addressing current uncertainties in predictions of precipitation intensity.

3. Measures

Introduction

There is a need to build methodologies for evaluation of the ecological and economic effectiveness of measures and to develop a strategic framework for selection of best alternatives and scenarios. This subject is closely related to water policies, where cost-effectiveness of measures and benefits transfer approaches for assessing disproportionate costs are of prime importance. They need to be tested through applications in river basins. There is also a clear need to build strategies and methodologies for cost-effectiveness analysis in transboundary water bodies. In all aspects, uncertainty relating to measures implemented by different policies should be incorporated.

Research topics

Strategic framework for evaluation of optimal cost-effective rehabilitation measures

A strategic framework for the evaluation of optimum measures with respect to cost- benefit; and to effective rehabilitation; in order to reach good ecological and chemical status of water bodies and surrounding ecosystems, is needed and should be developed on water bodies and country specific levels (taking into account different national knowledge and data backgrounds).

Simple and practical tools and methodologies for analysis, prediction and simulation of ecological and socio-economic aspects of measures are also needed. One of the aspects that needs further research is the adjustment of the proposed methods to local conditions and experiences. Therefore, methodologies for the selection of the best alternatives of measures, focused on various scale (EU, region, country, river basin, smaller area etc) need to be developed and tested. Methodologies to compare demand management measures (pricing, taxation, regulatory instrument) and supply measures (investment, subsidies and financial transfers among economic agents) must be proposed. These comparisons should take into account at the same time the economics aspects and the water quality / quantity aspects.

Expected Impact

The research should contribute in a concrete way to the implementation of the WFD and assist the member states to establish the programme of measures as foreseen by WFD and the subsequent assessment of these measures. Inter comparison of methodologies is expected in view of identifying the most relevant for a coherent implementation by all member states.

4. Economics and the WFD

Introduction

The WFD requires the member states to develop programs of measures to reach good ecological status. These programs of measures (POM) should be cost-effective, for which economic analyses are needed. Economic analyses are also necessary for justifying the application of exemptions (WFD article 4). These tasks require economic analyses that are time consuming and require qualified staff. Thus, near-future research should focus on developing more simple expert based approaches to assess the effectiveness of measures, which can not be performed using sophisticated models.

Research topics

Effective use of cost-benefit and cost-effectiveness analyses for supporting EU water policies

Although the WFD promotes the use of cost effectiveness analyses (CEA) and cost benefit analyses (CBA) as decision support elements, their implementation in practice is hampered by several problems such as quantitative assessment of effectiveness of complex programmes of measures dealing simultaneously with demand management measures (including pricing and cost recovery issues), scaling issues, taxation, markets and regulatory instruments) and supply / infrastructure measures (investments, subsidies and other financial transfers and regulatory instruments also (up-scaling and extrapolation of costs and benefits from local case studies to river basins), the assessment of reference unit costs for a wide range of measures that will apply across Europe, and incorporation of uncertainties into economic assessment. There is a need to develop operational methodologies, in particular, concerning industrial pollution, agricultural pollution and quantitative resources management. Project proposals should be at the interface between water science and economics and be developed in close collaboration with water planners and managers at the river basin district level.

The topic is important in the context of the growing interest in the EU water policy of the analysis of costs and benefits of impacts on the environment and the policy reaction to those impacts. Experiences with economic concepts in the implementation of the EU Water Framework Directive (2000/60/EC) show that the theoretical advantages could be further improved for practical application. **(Policy relevant topic)**

Funding scheme: small or medium-scale focused research collaboration project

Expected impact

Improvement of the applicability of cost-effectiveness and cost-benefit analyses for supporting EU water policies. Development of reference methodologies and case studies covering a wide range of water management issues. Development of European cost and benefit databases to be used at the European level for conducting economic assessment of programmes of measures.

Integrated modelling to support the design for a program of measures

It is essential that crossed economic impacts of EU water policies measures in terms of pressure transfers among surface water and / or groundwater bodies, should be taken into

account. There is a need for the development of more integrated economic analyses at the catchment level, including the modelling of economic agent behaviours, and the ability to highlight direct and indirect, cumulative and opposite impacts of a program of measures on a set of pressures. Development of a methodology to represent supplementary costs associated to social, institutional and legal framework compared to a theoretically optimal program of measures. A better integration of economic modelling (including risk and uncertainty) into decision support systems at the catchment level is of prime importance.

The topic is crucial in the context of growing interest in the EU water policy, with regards to the Water Framework Directive (2000/60/EC), to provide more simple expert based approaches which can not be performed using sophisticated models. Practitioners need tools either to identify the less costly yet effective programs of measures or to justify derogations for not reaching the WFD objectives. **(Policy relevant topic)**

Funding scheme: small or medium-scale focused research collaboration project

Expected impact

Improvement of the applicability of economic concepts in EU water policies. Advance the state-of-the-art of approaches and methods to support the development and implementation of EU water policies. Improved rationalisation of the choice for measures for water policies.

Risk and uncertainty in scenarios and economic analysis for water policies

The development of programmes of measures for water resources management at river basin level is based on anticipation of medium to long-term evolution of pressure and impacts (baseline scenario development). Risks and uncertainties should be fully considered when developing baseline scenarios and programmes of measures. From an economic perspective, it may be optimal to delay the decision as long as uncertainty surrounding future evolution or the effect of planned measures is not reduced. This requires the development of specific methodologies to take into account risks (physical, social and economic), uncertainties (public policies, climate change, new standards, costs and benefits induced, behaviours...), technical progress (technological, biological, genetic...), absence of or poor quality data and time dimension (discounting principle) both in scenarios construction and in conducting economic assessment of alternative action programmes (cost benefits and cost effectiveness). Such methodologies should be tested and practical applications produced to serve as demonstrators.

The topic is important for the implementation of all water policies (EU - WFD, National, local). The traditional deterministic approach does not allow any more to answer practitioners' needs. It then exist a practical need for more realistic (stochastic at least) methodology to build scenarios and carry-out economic analyses (especially for the WFD). **(Policy relevant topic)**

Funding scheme: small or medium-scale focused research collaboration project

Expected impact

Provide tools and methodology to improve the applicability of economic concepts in EU water policies. Improve and transfer methodologies to support decisions and initiate debates among decision makers (and stakeholders).

5. Monitoring

Introduction

It remains a major challenge to identify the most relevant indicators and components that i) give reliable information on the ecological and chemical status of different water bodies, ii) can be employed for the assessment of reference conditions in different water body types, iii) can be employed for an effective enhancement of the ecological and chemical status of water body types (link to ecological processes, impact assessments, and measure assessment). Adequate biological, hydro morphological and physico-chemical assessment and analytical methods as well as innovative modelling tools are required that allow for both a targeted, EU-wide harmonised analysis of monitoring data series, and for the interpretation of the obtained monitoring data with regard to their application in RBM. In accordance with this, optimisation of future monitoring programmes is required at both national and international scale. This will in turn enhance network efficiency and focus on the identified, most relevant status components within EU river basin systems (water phase, suspended matter, biota, sediments).

Research topic

Optimising monitoring systems and development of methodologies for the interpretation of monitoring data and their practical use in effective river basin management

Development of standardised methodologies and feasible modelling tools to analyse, assess and interpret monitoring data outputs in order to enhance their suitability for generating adequate and cost-efficient catchment management measures must be initiated. Ecological, hydromorphological and/or physico-chemical parameters or their combinations that are most significant under different conditions (natural and affected by anthropogenic pressures) for indicating the current ecological and chemical status, indicating the relevant pressures and enhancing the quality status of different water body types where required should be identified. Modelling tools for the analysis of monitoring time series, the identification of relevant indicators and the targeted interpretation of data, including uncertainty issues must be employed. Elaboration of solutions for harmonised analytical, assessment and interpretation methodologies for EU-wide applications must take place.

Funding scheme: small or medium-scale focused research collaboration project

Expected impact

A targeted determination of the most significant and relevant status components as well as groups of parameters will lead to an enhancement of cost efficiency of measure definition and implementation in the context of the WFD.

Adequate methodologies and modelling tools as well as feasible uncertainty assessments will assist decision makers and stakeholders in EU member states to make efficient use of monitoring data for river basin management. Harmonised methodological approaches and relevant indicators for the description of ecological status of different types of water bodies will contribute to a coherent WFD implementation by all member states.

Annex I

Full list of sub-issues and priorities from EU Water Directors inventory.

| No | Category | Sub-issue | Priority | Timing |
|----|--|---|----------|-----------|
| 1 | Knowledge on ecological processes | Relationship between hydromorphological and biological conditions | High | 2007 |
| | | Objectives for hydrology (minimum flow) | | 2007 |
| | | Hydrology – ecology and morphology – ecology links. These need to be quantified so that measures to address these pressures, that will result in required degree of improvement in ecological improvements, can be determined. | | 2007 |
| | | Everything concerning the connection/effect between/on hydrological, hydromorphological, hydro geological factors/processes and the status of the ecosystems | | 2007 |
| | | Development of common EU-wide biological assessment methods | | 2007-2008 |
| | | Research of the relevance of substances and links between chemicals and status | | 2007-2008 |
| | | Reinstalling river continuity in order to allow fish to migrate. A lot has been done on ascent constructions, but knowledge on the conditions regarding the downstream migration of fish is currently lacking and not yet covered adequately by research. | | 2007 |
| 2 | Impact assessment | Closing down old underground mining areas, which impact the water quality and might have negative effects by causing temporary flooding | High | 2007 |
| | | Quantification of the need to internationally reduce the atmospheric deposition of anthropogenic loads of nutrient, heavy metals and POP's, SO ₂ (acidification) | | 2007 |
| | | Elaboration of models for load of N, P and POP's on coastal areas and sea | | 2007 |
| | | Mechanism for transport of N and P in land and water | | 2007 |
| | | POP's in biota | | 2008 |
| | | Further elaboration of the impact of autonomous developments in society on quality elements and parameters representing the status of surface- and groundwater ("baselines in practice"). | | 2008-2009 |
| | | Impact of hydropower | | 2007 |
| | | Impact from agricultural activities on water bodies | | 2007 |

| No | Category | Sub-issue | Priority | Timing |
|----|--------------------|---|----------|--------|
| 3 | Measure assessment | Limitation of negative impact of flood defence works | High | 2007 |
| | | Assessment of hydromorphological rehabilitation measures for river types | | 2007 |
| | | General insight in the most effective and cost effective measures (e.g. should we focus on chemical water quality improvement, or focus on improvement of the habitat quality, or which combinations of those?) | | 2007 |
| | | Decision support systems for the selection of the best alternative in the programme of measures | | 2007 |
| | | Methodologies to deal with social and economic issues to develop future scenarios | | 2007 |
| | | Elaboration of models for prediction | | 2007 |
| | | Decision support systems taking account the availability of data, the quality of data, the scale to which available data apply, and resulting uncertainties. | | 2007 |
| | | The decision support systems may focus on various levels of scale (EU, region, country, river basin, smaller area etc) | | 2007 |
| | | Assessment of the impact of measures on the chemical and biological quality of surface and ground waters using "practical and well considered approaches" | | 2007 |
| 4 | Economy | Economy - cost/benefits and cost recovery problems | High | 2007 |
| | | Scale of the analysis for individual elements (pressures) of the cost-effectiveness analysis | | 2007 |
| | | Dealing with changes to cost recovery mechanisms as potential measures within the first POM | | 2007 |
| | | Developing business as usual models and dealing with less than full application of other water policies in the cost-effectiveness analysis. | | 2007 |
| | | Incorporating the time related costs of measures in the cost-effectiveness analysis (e.g. related to capacity constraints, industry investment phases etc.) | | 2007 |
| | | Translating standards for GES/classifications schemes into specifications of environmental benefits from a human (anthropogenic) perspective | | 2007 |
| | | Establish reliable benefits transfer approaches for assessing disproportionate costs. | | 2007 |
| | | Assessing disproportionate costs in protected areas where there is flexibility in meeting WFD related objectives. | | 2007 |
| | | Coordinating cost-effectiveness analysis in transboundary water bodies. | | 2007 |

| No | Category | Sub-issue | Priority | Timing |
|----|---------------------------------------|---|------------------------------------|--------|
| | | Dealing with uncertainty about measures given differencing levels of uncertainty across sectors contributing to pressures (e.g. agriculture/water industry) in an even handed manner. | | 2007 |
| 5 | Monitoring | Aspects of different monitoring network's optimisation | Medium | 2007 |
| | | Linking monitoring and modelling | | 2008 |
| | | Relations between the monitoring and the entire assessment of status of WBs. | | 2007 |
| | | Development of techniques for Ecological Monitoring | | 2008 |
| 6 | Data management | Data aggregation, GIS data management, appropriate database formats for storing water related data | Medium | |
| 7 | WFD policy questions | Linking ecological and socio-economical models | Medium | |
| | | Tools for presentation to show the effects of different measures and scenario's | | |
| | | Community education and involvement in decision making | | |
| | | Approach to evaluation of artificial irrigation canals (in period of year without water) | | |
| 8 | Water resources and demand management | Water conservation, saving, water saving in irrigation, reuse of treated wastewater, new water sources (e.g. desalination), water management in drought prone regions | Low (covered by existing projects) | |
| 9 | Groundwater management | Development of common approach for quantification of diffuse pollution – expressed by nutrients and other parameters (i.e. heavy metals, specific organic pollution) | Low (covered by existing projects) | |
| | | Methodology for monitoring and chemical status evaluation on karstic GW bodies | | |
| 10 | Knowledge on physical processes | Interaction groundwater - surface water - sediments | Low (covered by existing projects) | |
| | | Trends in coastal erosion | | |
| | | Saline intrusion; what is meant by 'significant intrusion'. Insight in intrusion mechanisms needed. | | |
| 11 | Policy assessment | Assess the effectiveness of the implementation programme. Evaluation of environmental results of implemented programmes of measures (e.g. the effects of completed wastewater programs on the chemical, ecological status of water bodies in selected sub-river basins, urban waste water directive; lessons to be learned) | Low (covered by existing projects) | |