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IWRM-NET

Towards a European-wide exchange Network for integrating research efforts on Integrated Water Resources Management

Thematic priority: Integrated water resource management

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Proposals for the 2d joint trans-national call

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Proposed IWRM-Net research needs for the second call

The list of research questions highlighted in this paper is derived from a series of workshops around Europe that considered short-term and long-term research needs. The results have now been combined to consider the scientific specification for the IWRM-net second call. For more information on the workshops (visit IWRM-Net website) and view WP2 and WP3. The following main issues were identified:

- Climate change impacts and adaptation for IWRM
- Water Scarcity and Drought
- Economics for IWRM: Social and *Environmental Evaluation for decision making and Incentive measures to regulate uses*
- Managing priority substances on a (sub) catchment scale
- Governance and integrated catchment management
- Dams, reservoirs and ecological continuity
- Science policy interface

In the supporting document is a table of strategic issues followed by the sub-headings. This is intended as a simplified version of the research priorities paper that should allow for easier selection of subjects in the future. The research agenda is based on a classification system for knowledge on the water system developed by WP3 and WP2. The IWRM-net research agenda is now available for download (click here) and the aim is to use this list as a continually updated working document to guide the development of research calls and collaborations between the partners.

ACTIONS to set the final scientific specification of the 2d call:

Prioritise your subjects with indicative amount of funding (use attached spreadsheet or online with googledocs)

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Climate change impacts and adaptation for IWRM

CONTEXT

Changes in the climate have an immediate impact on our water bodies because the hydrological cycle is intrinsically tied to our climate. For example global warming not only results in increased melting of snow and ice, but also augments the water-holding capacity of the air and amplifies evaporation. Water management needs to consider these impacts and be able to adapt its management to the impacts. Recent results from the modelling of climate and hydrology indicate the following trends for Europe (IPCC 2008):

- Temperature increase by one to several degrees Celsius by 2090-2099 in most parts of Europe, especially in the South-Eastern parts
- Increase in precipitation in northern Europe, decrease in precipitation in Southern Europe
- Seasonal shift of precipitation from summer to winter.

This means that climate change will affect water bodies in most places in Europe due to increased evapotranspiration, increased or decreased runoff, shifts in seasonality, and shifts in socioeconomic pressures. If the trends in hydrology are compared to today's regional water budgets, the most severe changes in hydrology are to be expected for southern Europe (Mediterranean region), and to a lesser extent to Eastern Europe (with sub-continental climate).

1. **CLIMATE IMPACTS ON HYDROLOGY AND ECOLOGICAL STRUCTURE AND FUNCTIONS**:

Starting with the natural science of water IWRM needs to consider aspects such as the increased intensity of water cycling, as well as seasonal and regional changes in the distribution, frequency and intensity of precipitation that may lead to various consequences:

- ***physical changes*****:** water temperature, river and lake ice-cover, stratification of water masses in lakes, water discharge including water level and retention time, altered seasonal flow regimes and more severe/ more frequent flow extremes (floods and low flows)
- ***chemical changes*****:** oxygen content, nutrient loading, water colour
- ***biological changes:*** structure and functioning of freshwater ecosystems.

Changes in these variables may affect the functioning of aquatic ecosystems, their ecological integrity, the ecological services supplied, and also their potential to sustain livelihood. Impacts range from lowering of groundwater tables, more frequent and higher floods to increased algae growth in rivers and seasonal mismatch of life cycles of organisms.

2. TYPOLOGY, REFERENCE CONDITIONS & BIOLOGICAL ASSESSMENT:

When looking at the time scales of the WFD, we need to anticipate its potential effects in order to react adequately and incorporate methods of adaptation into the WFD manager's operations. A Euraqua conference in 2008 raised a number of issues that should be considered and following on from the natural science applications above, the impacts need to be related to reference conditions, ecological thresholds used to set the good/moderate boundary and thereby the WFD objectives. Water managers need to know how climate change impacts will be reflected in terms of water body status and classification.

3. INTEGRATED (HYDROLOGICAL/ MORPHOLOGICAL /BIOLOGICAL/ SOCIOECONOMIC) MODELLING OF RIVERS, LAKES and GROUNDWATER.

In order to support decision making the use of models needs to incorporate the whole range of issues for water management. If we just look at pollutants, climate change will affect chemical mechanisms and then, the impact of pollutants on water bodies (nature of pollutants, transfer of pollutants through and toward water bodies, combination with other pollutants, toxicity of pollutants).

Climate change can also influence the quantity and mode of water use of the human societies affected, e.g. increased water abstraction for agricultural irrigation and increasing demand for drinking water. These indirect socioeconomic effects of climate change on surface waters and groundwater are assumed to exceed the direct ones and in combination, they account for serious pressures on water availability, the ecological status of water bodies, and may increase conflicting water uses e.g. energy production, fishery, navigation, irrigation and tourism. Then these socio-economic aspects need to be considered, bringing in a complexity for modelling that will be challenging to develop effectively.

4. LONG-TERM ADAPTATION MEASURES FOR WATER QUALITY AND QUANTITY

As water managers now consider how to adapt to a changing climate, they must also consider how uncertainty in climate change impacts can be incorporated in the RBMPs and how will the programmes of measures be assessed for ‘no regrets’?

Potential measures that may mitigate undesirable effects of climate change should avoid producing other undesirable effects (as large reservoirs do). In general, they should enhance natural storage of water in the catchment, and increase the resilience of water bodies, including self-purification and the availability of habitats at low flow conditions. In addition, river management should adapt to higher or more frequent floods and droughts to come.

Examples of potential sustainable measures that may mitigate undesirable effects of climate change include:

- Enhanced recharge of wetlands and groundwater during winter, structural measures that increase retention of water in the catchment including use of wetlands,
- seasonal management of drainage ditch systems, gradual change towards forest and crop plant species that consume less water,
- improved control of wastewater discharge especially during summer, re-oligotrophication of lakes, restoration, re-meandering and adaptation (wider but shallower) of river channels,
- relocation of levees,
- minimum flow rates downstream of reservoirs.

Efforts to ‘regionalize’ or downscale results supplied by global climatic and hydrological models have proven to be difficult and always increase uncertainty. Hence, analyses focussing on larger river basins will create more reliable climatological scenarios to build on compared to smaller rivers. As large rivers are often subjected to several human pressures that are sensitive to climate change (e.g. drinking water supply for agglomerations, water use by industry and power plants, inland navigation), these may be seen as preferential, study areas.

EXPECTED OUTPUT / IMPACT

1. CLIMATE IMPACTS ON HYDROLOGY AND ECOLOGICAL STRUCTURE AND FUNCTIONS

Development of quantitative projections of changes in precipitation and river flows seasonal shifting of cyclic processes, cascade effects, including hydrological changes due to water supply by alpine glaciers in summer effect on ecosystems due to increased warming leading to a better understanding of the consequences on inland navigation and industrial use (e.g. hydroelectric power)

Improved understanding on what are the effects of climate change on key variables for the management of surface water and groundwater

- e. g. river management during periods of low flow
- lowering of groundwater tables,
- incomplete hydrological mixing of lakes during winter,
- loss of hydrological connectivity between lakes and river systems,
- reduced river flow,
- more frequent and higher floods,
- increased algae growth in rivers,
- seasonal mismatch of life cycles of organisms,
- less dilution of contaminants in rivers

Improved knowledge on the effects of climate change on key variables for the management of surface waters, as hydromorphology, ecosystem processes and services,

2. TYPOLOGY, REFERENCE CONDITIONS & BIOLOGICAL ASSESSMENT

Improved knowledge of effects of climate change on populations of Natura 2000 target species, expansion of invasive species, water body type, reference status, GES and GEP.

3.INTEGRATED (HYDROLOGICAL/ MORPHOLOGICAL /BIOLOGICAL/ SOCIOECONOMIC) MODELLING OF RIVERS, LAKES and GROUNDWATER.

Integrative scenarios for the future hydrology, typology, ecology and usability of rivers, lakes, estuaries and coasts, accounting for climate, socio-economics, management & governance. This requires the improvement of integrated (hydrological/ morphological/ biological/ socioeconomic) models for water managers to understand and predict how a water body will react to climate changes (regional or river basin scale).

Efforts to ‘regionalize’ or downscale results supplied by global climatic and hydrological models have proven to be difficult and always increase uncertainty. Hence, analyses focussing on larger river basins will create more reliable climatological scenarios to build on compared to smaller rivers. As large rivers are often subjected to several human pressures that are sensitive to climate change (e.g. drinking water supply for agglomerations, water use by industry and power plants, inland navigation), these may be seen as preferential, study areas.

A tested methodology to assess the risk and effects of rising temperatures in inland waters which can be used by operational water managers (and their advisors) to assess the risk on a regional level. Depending on test results input to policy makers as a basis for additional policy on remediation.

4. LONG-TERM ADAPTATION MEASURES FOR WATER QUALITY AND QUANTITY

Efficient mitigation strategies towards multiple stressors & adaptation measures that cope with uncertainty of the processes involved and that enforce robustness and resilience of natural and societal systems. Such measures encompass water efficiency and conservation to mitigate water stress, spatial planning and river basin management, as well as awareness for, monitoring, detection and early warning of changes in water availability or hazardous events.

ANNEX 1. CONTEXT CLASSIFICATION ATTEMPT

Item (not all items are relevant for each question)	**Options**
Geographical / Climate zone:	Dependent on question
Basin zone	Focus on large rivers, Wetlands, Lakes, Aquifers
Ecozone (or water bodies)	Depending on differing climatic scenarios, work in north, east, south and west Europe may be dedicated on different thematic foci
Political practice	Partially work should promote the integration of the goals of the WFD and Natura 2000 directives, e.g. in the analyses of climate effects on reference status and linked biological assemblages.
Type of research / user dedication	Fundamental / mono-disciplinary / process insights / biodiversity; Integrative (natural and social sciences, economics); Applied (end users are water managers and their advisors);
(Proposed) Disciplines involved	Hydrology; morphology; soil and water chemistry; ecology; modelling; with links to socio-economics ;
(Proposed) Water uses involved	Cooling for power plants and likewise, inland navigation, hydropower generation; Drinking Water; Fishing, Tourism; partially with links to agriculture and forestry.
(Proposed) (Water) policies involved	WFD, partially links to Natura 2000
Research Focus	Pressures + State + Scenarios + Adaptation measures + DSS
Other suggestions????	Work should be streamlined with that of other finished or running large national or EU projects. Hence, work should be targeted • to fill knowledge gaps on climate effects on biodiversity and ecosystem services that have not been dealt by previous projects, • to further develop integrated multidisciplinary modelling, • to evaluate the efficacy of various potential mitigation measures.

ANNEX 2. POSSIBLE RESEARCH QUESTIONS

(Taken from WP2 & national consultations; order of topics does not reflect priority):

1. **CLIMATE IMPACTS ON HYDROLOGY AND ECOLOGICAL STRUCTURE AND FUNCTIONS**:

- quantitative projections of changes in precipitation and river flows seasonal shifting of cyclic processes, cascade effects
- hydrological changes due to water supply by alpine glaciers in summer effect on ecosystems due to increased warming
- consequences on inland navigation and industrial use (e.g. hydroelectric power)
- What are the effects of climate change on key variables for the management of surface water and groundwater
    - e. g. river management during periods of low flow
    - lowering of groundwater tables,
    - incomplete hydrological mixing of lakes during winter,

- loss of hydrological connectivity between lakes and river systems,
- reduced river flow,
- more frequent and higher floods,
- increased algae growth in rivers,
- seasonal mismatch of life cycles of organisms,
- less dilution of contaminants in rivers

2. TYPOLOGY, REFERENCE CONDITIONS & BIOLOGICAL ASSESSMENT:

- Potential changes of water body types and reference conditions in rivers, lakes, and wetlands, incl. target species acc. to Natura 2000 directive
- development of an indication system for climate impact on the achievement of GES / GEP in water bodies

3. **INTEGRATED (HYDROLOGICAL/ MORPHOLOGICAL /BIOLOGICAL/ SOCIOECONOMIC) MODELLING OF RIVERS, LAKES and GROUNDWATER.**

- ecological services and biodiversity
- seasonal mismatch of life cycles of organisms after climate-induced temperature increase with seasonal dynamics of abiotic factors, such as water and light availability
- Impact of changing land-cover and use (in particular agriculture, forestry & energy plants) on water quality and quantity
- allocation of minimal flows downstream of reservoirs
- focus on river or lake systems with best regional climate scenarios available, especially large catchments, and sections of large rivers.
- uncertainty due to the limitations of climate models
- Scaling issues between climate and hydrological models.

4. LONG-TERM ADAPTATION MEASURES FOR WATER QUALITY AND QUANTITY

- Development of principles of an adaptive multi-sectorial ‘climate-proof’ water management, that does not only cover classic fields of water management as water quantity, quality and hydromorphology, but also provide recommendations for land use planning in the catchment, water governance and other relevant socioeconomical aspects (e.g. pricing of water, development of alternative water resources, development and implementation of water-saving production techniques).

Water Scarcity and Droughts

CONTEXT

The Communication addressing the challenge of water scarcity and droughts in the EU (SEC(2007)993) notes that the number of areas affected by drought went up by almost 20% in the last 30 years and so the EU proposed a series of policy options and all levels and across a number of issues. This call for research aims to support these policy issues.

For clarity water scarcity (or water stress) means that demand exceeds the exploitable supply and is an issue for many member states across the European continent. Drought means the temporary decrease in water availability, purely from the supply side, due to precipitation below the normal recorded levels.

1. BALANCED DECISION MAKING FOR WATER SCARCITY AND DROUGHT.

In making water management decisions one needs to assess the options based on the socio-economic and environmental impacts. This includes water abstraction (and in particular management of seasonal water demand including tourism and irrigation) or using non conventional water resources e.g. desalinated water, treated wastewater or water of a low quality. (It refers to the origin of water out from the natural hydrologic cycle.) The selection of the most appropriate option should be based on a full impact assessment that also takes into account the energy, infrastructure, possible adverse impacts on the economy, society and the environment, including impacts on health (in particular for waste water reuse, rainwater harvesting), impacts on the quality and quantity of water resources[1] (all options) and a financing strategy that will ensure the recovery of all costs including environmental and resource costs, as well as relevant contributions by the different users.

Specifically for those areas affected by seasonal droughts there is a need to better understand the impact of drought on ecological processes and all the components of the hydrologic cycle

2. KNOWLEDGE AND DATA MANAGEMENT

The collection and sharing of knowledge and data is a core issue for IWRM-net in that, partners are interested in the exchange of knowledge between scientists, policy makers and water managers.

A concrete EU wide initiative is Global Monitoring for Environment and Security (GMES). Within the GMES Land Service, a land cover inventory has been established showing areas under water scarcity pressure as well as their changes over time. Concrete applications for improved irrigation management have already been tested with Spanish and French regional authorities as well as support to WFD reporting in cross- border river basins[2].

A number of on-going projects related to the 6th Framework Programme for Research and Technological Implementation, such as AQUASTRESS, RECLAIM WATER, GABARDINE, MEDINA, MEDESOL, PLEIADeS or FLOW AID, are delivering scientific and technological progress in the field of water scarcity and droughts, among other scientific aspects.

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[1] According to Article 4.7 of the WFD when applicable

[2] taken from Report from the Commission to the Council and the European Parliament - Follow up Report to the Communication on water scarcity and droughts in the European Union COM(2007) 414 final [SEC(2008) 3069]

Within the implementation of WFD there needs to be an integrated management and collaboration between river basin planning and drought management plans and the IWRM-Net project hopes that it can facilitate the sharing of experiences for WFD and the communication on water scarcity and drought.

In the short term simple aspects such as the development of indicators for drought that could improve and extend similar work firstly across Mediterranean countries and then to rest of Europe, All this leads to the need identified to improve the operational management of drought.

An action focused on investigating Europe's risk from droughts was launched at EU level. This aims to identify the main gaps in research and the key steps forward in order to improve the current knowledge of the extent and impacts of droughts. This will lead to the development of a platform of exchange on drought issues between the research and policy communities. Any research should consider Member States research and technological activities related to the impacts and evolution of drought in a context of climate change (ES, NL, LU, UK, PT), consumer behaviour towards water using devices (UK), correlation between water and energy efficiency of dish washers and washing machines (UK), improvement of efficiency of water using devices (UK), improvement of agricultural practices including irrigation (CY, ES, FR), assessment of alternative water supply options (CY, FR), development of a data collection system for the evaluation of drought impacts (PT).

Currently many countries do not have confidence in many of the measures taken to manage water scarcity. Then there is the impact of the water scarcity on the economy and social impacts. There are very visible in times of crisis but what are the developments leading up to this and how can they be avoided before the crisis arrives.

3. DROUGHT and water scarcity MANAGEMENT

In 2007 a European network of experts on water scarcity and droughts produced a report on drought management plans[3] as part of the Common Implementation Strategy of the Water Framework Directive setting out recommendations for the development of operational drought management plans. With a range of issues within this there is need for support to Member States in taking action and the evaluation of many of the initiatives.

The Commission's Joint Research Centre is developing an observatory and early warning system on droughts. This will serve as a platform for forecasting, detection and monitoring and for exchange of information. It adopts a multi-scale approach, is in line with the subsidiarity principle and will provide consistent information at European level. The deadline of 2012 set in the Communication for the development of prototypes and implementing rules for an operational drought observatory and early warning system will need support to develop and improve indicators for the comparison of issues and to trigger management responses and by allowing for the harmonisation of surveillance of water scarcity and droughts it could support this development. But to improve the effectiveness of the indicators they need to be based on quality science and further investigation to the mechanics of hydrology in times of scarcity and drought will allow better management

3 Report available on http://ec.europa.eu/environment/water/quantity/scarcity_en.htm

EXPECTED OUTPUT / IMPACT

1. BALANCED DECISION MAKING FOR WATER SCARCITY AND DROUGHT.

The improvement of our ability to set appropriate measures - socio-economic, technical, legal, etc and allow adaptive management of water supply use to deal with drought and scarcity of water.

2. KNOWLEDGE AND DATA MANAGEMENT

Harmonise the compilation of historical, spatial and temporal data on selected river basins (as case studies) to represent watersheds that currently or often have drought issues and those that deal with water scarcity issues due to water usage.

The development of models and scenarios are considered important to ensure adaptive management for any circumstance that may arise in the future or perhaps develop an alert system that could forewarn countries to implement measures to mitigate and manage the impacts.

The research should provide all European countries with a series of indicators for drought that are typographically relevant and so a series of these will be developed for across areas in Europe that experience drought. By providing a pan-european approach to the research it will link with the expert group and provide a mechanism to share experience across member states that would mean the problem of droughts and water scarcity becomes less and less of an issues within Europe.

3. DROUGHT and WATER SCARCITY MANAGEMENT

Through improved scientific knowledge of how water availability variation during droughts water managers should be able to develop effective a harmonised system of surveillance which would then lead to the use of indicators supporting the work of member states to respond to the EU communication.

ANNEX1. CONTEXT CLASSIFICATION ATTEMPT

Item (not all items are relevant for each question)	**Options**
Geographical / Climate zone:	Across Europe
Basin zone	any
Ecozone (or water bodies)	Surface water basins Coastal Areas Groundwater
Political practice	To promote the WFD
Type of research / user dedication	Both fundamental research and applied? Water Ministries Water companies
(Proposed) Disciplines involved	Hydrology, Ecology Groundwater hydrology Socio-economics

	Water governance & law
(Proposed) Water uses involved	Drinking water, power plants, Agriculture Tourism
(Proposed) (Water) policies involved	WFD
Research Focus	Adaptation measures, multidisciplinary indicators, conjunctive use, socio-economic

ANNEX 2. POSSIBLE RESEARCH QUESTIONS

1. ASSESSING THE IMPACTS WATER SCARCITY AND DROUGHT.

- investigate the conjunctive use (groundwater-surface water), and aquifer recharge for drought management
- What are the benefits and impacts (social, economic and environmental) of using non conventional water resources (e.g. desalinated water, treated urban wastewater or water of a low quality).
- What are the socio-economic and environmental impacts of water abstraction, in particular management of seasonal water demand including tourism and irrigation.

2. KNOWLEDGE AND DATA MANAGEMENT

- Harmonise the compilation of historical, spatial and temporal data on selected river basins (as case studies) to represent watersheds that currently or often have drought issues and those that deal with water scarcity issues due to water usage. From this harmonisation development and improvement indicators for the comparison of issues and to trigger management responses.

3. DROUGHT/SCARCITY MANAGEMENT

- Improving the knowledge of the physical processes of water scarcity and drought that would allow improved management.

Economics for IWRM: Social and *Environmental Evaluation for decision making and Incentive measures to regulate uses*

{Keywords: environmental evaluation, social values, pricing policies, cost recovery, market-based instruments}

CONTEXT

Economic analysis can be considered a support for decision-makers in public policy design and assessment, in particular in the environmental field. The WFD main objective is to reach Good Ecological Status (GES) in 2015 (or 2021 or 2027) and economic instruments are required to build fair water management system to balance uses and to match the WFD environmental objectives. WFD explicitly refers to economic instruments, for example:

- art. 4: disproportionate costs
- art. 5: economic analysis of water uses
- art. 9: recovery of costs for water services
- art. 11: program of measures

The first main difficulty task for economic analysis is to assess the broad range of values related to water ecosystems services, some of these values are enhanced by social, perception and traditional practice in the use of water and by the environmental, political and institutional context in which water regulation is taken place. The second difficult task is the integration of these values into a decision-making process in order to make more transparent and acceptable any water policies

Members States have already a long tradition in the use of Economic tools. But it seems to be necessary to define a common framework for the use of economic instruments and of market-based tools to support the member states to achieve the WFD requirements.

Efficiency for economic instruments is also dependent of the specific and general contexts. Considering the specific context, economics tools quality requires perfect information on each value components and the ecological output. In the same way, attention must focus on uncertainties and the way to reduce them.

Considering the general context, efficiency requires to consider economic tools as a single part of a more global management system which is dependant on:

- Information
- Level of uncertainties
- Ecosystem approach
- Operational and adaptive governance of the water sector

1. Economics as a tool to support decision making

Economic evaluations are needed to calibrate the programme of measures (POM) supporting the River Basin Management Plan (RBMP). Member states have already done a lot of work on these issues and are waiting for a common guidance and feedbacks on the methods they use, strongly linked with the interpretation of WFD key concepts they did, *i.e.* GES, Good Ecological Potential and Highly Modified Water Bodies (GEP&HMWB), and disproportionate costs.

Two focus points to consider these issues:

First, how to reveal non-market values related to water and water ecosystems, balancing the ecosystems functions (ecological, biological and chemical functions) with social values (depending on perception of people on the benefits derived from water and water ecosystems) The application of economic valuation methods to value water ecosystem services is not a new issue. Nevertheless, it seems that it is necessary to make some adjustments to clarify the link between the type of ecological service to be assessed and the type of economic valuation methods which is measuring the best its contribution to the well-being of society.

Aquatic ecosystems provide people with goods and services that are fundamental to human well-being. Nutrient recycling, habitats for plants and animals, flood control and water supply are among the many beneficial services provides by aquatic ecosystems. But despite a growing recognition of their importance, their value is often overlooked in decision-making and in public perception. The integration of the ecosystem services concept into decision-making processes and in water management would allow more sustainable development initiatives and management practices to take place. A better understanding of the contributions of ecosystem services to economic and social welfare would also help to raise awareness of public and stakeholders and so lead to a better acceptance of measures and the related costs.

Valuing ecosystem services requires transdisciplinary approaches. Research on both natural and social processes that make up or rely on ecosystem services is required to develop a fundamental understanding of what are ecosystem services, how they affect human well-being and how to value them taking into account environmental, economic and social dimensions. The values we place on the ecosystem services will change with time due to objective changes in ecological dynamics and subjective changes in social values. Pressures on ecosystems change our perception of the values of ecosystem services. For example, the value of ecosystem services will change as water prices change. The question of the relationship between water prices for household uses and the effect of rising prices on this sector has been raised. In addition to affecting the demand for water, rising water prices may cause households to assign lower values to other ecosystem services provided by water, such as biodiversity. Another sector that will be affected by rising water prices is agriculture. Rising prices for crops are having affects on agricultural land use and will also increase the demand for water. The question of how we make sense of ecological services is also an important part of this debate. There may be some functions of ecosystems that we are not yet aware of and therefore cannot 'value' and yet may be critically important to both ecological functioning and also provision of 'other' services. This suggests that the systemic aspects of ecological services needs greater research.

Second, how to integrate these values in the decision making process? Considering these values are revealed, the question is how to use them to support the decision making process. How to face the costs of POM and RBMP with potential environmental benefits and associated monetary benefits, to support or not their implementation.

- Cost-Benefits Analysis, Cost-Efficiency Analysis…
- POM and RBMP
- Disproportionate costs

The social perception of the environment is a key concept to understand and correctly assess if we want to be able to manage the water system and its actors. Changes in societal values may come through a better understanding of what are the benefits delivered by hydrological systems to the society, but it may also come from an evolution of 'cultural' values/perceptions i.e. the landscape, and from changes in policies to improve governance. Practices and values are intrinsically related; changes of values and changes of practices come together. Social behaviors might evolve as a result of changes in societal values linked to the environment.

Social justice, or fairness, appears to be a crucial driver for social actions. Changing perceptions of fairness will strongly affect the ability to implement an integrated water resources management. E.g. it could lead to compensation for giving up water rights, or changes in the economics of farming, etc.

This concept of social justice is of the utmost importance in tackling the issue of cost redistribution in an efficient way. A common wish for social fairness should lead to an increase in demand for the application of the 'polluter-pays' principle as arguments increase about responsibilities for water pollution. Besides, the values we place on the ecosystem services will change with time due to objective changes in ecological dynamics and subjective changes in social values (e.g. drinking water supply or the cost of food).

2. Economics as a regulatory tool to provide effective incentives:

The WFD propose to use economic instruments to manage water uses between different actors, regarding a principle of fairness and equity (polluters-pays, cost recovery) for the society. Many institutional arrangements and economic tools are suitable for providing the appropriate incentives for water use(r)s. Combination of these various tools has to be considered by the next RBMP and how it could reach incentives for an optimal management of the pressures on water resources.

- Market-based instruments (tradeable pollution rights, catchment allowance, quotas)
- Economic instruments such as pricing policies, taxes, payments and subsidies.

The following items need to be considered

Regulatory target
• Public use • Industry • Agriculture • Energy • Other activities…

Pressures to manage
• Qualitative impact (and ecological alteration) ▪ Organic pollution ▪ Chemical pollution • Quantitative impact (and ecological alteration) ▪ Water catchment ▪ Hydromorphology

EXPECTED OUTPUT / IMPACT

1. Economics as a tool to support decision making

In support of the current work on economic evaluations to calibrate the programme of measures (POM) supporting the River Basin Management Plan (RBMP) the expected ouputs should include systems on how to reveal non-market values related to water and water ecosystems, balancing the ecosystems functions (ecological, biological and chemical functions) with social values (depending on perception of people on the benefits derived from water and water ecosystems)

A better understanding of the contributions of ecosystem services to economic and social welfare. There may be some functions of ecosystems that we are not yet aware of and therefore cannot 'value' and yet may be critically important to both ecological functioning and also provision of 'other' services. This suggests that the systemic aspects of ecological services needs greater research *would also help to raise awareness of public and stakeholders and so lead to a better acceptance of measures and the related costs.*

IWRM-Net expects the research to use a trans-disciplinary approaches with both natural and social processes

IWRM-net would also like to investigate the relationship between water prices for household uses and the effect of rising prices on this sector has been raised.

One aspect is to focus on methodological issues, notably with regard to economic tools (cost-efficiency, cost-benefits analysis…) to reveal non-market values of the water system and the use of these values for the WFD interpretation and implementation. It also requires consensus on some WFD key concepts definition, *i.e.* GES, HMWB and disproportionate costs, to face the programme of measures costs with potential benefits.

IWRM-net would like to see the research produce methods and guidance on how to integrate these values in the decision making process.

The research should provide a harmonized definition of WFD concepts and methodology for water managers to justify the costs of measures to reach GES (and derogation), to balance water uses by developing economic instruments directly through water management policies or indirectly through water related policies (agriculture, industry, energy) that relates to the regulatory instruments considered in section 2.

2. Economics as a regulatory tool to provide effective incentives:

A second aspect is to deepen the conditions for efficiency of traditional (and currently used) instruments such as pricing policies (financial and fiscal instruments) and other water related policies instruments (subsidies for agriculture). Moreover, must be considered the potential benefits of combination with other economic instruments (permit trading, market based instruments, conservation easements).

ANNEX 1. CONTEXT CLASSIFICATION ATTEMPT

Item (not all items are relevant for each question)	Options
Geographical / Climate zone:	Irrelevant
Basin zone	All
Ecozone (or water bodies)	Irrelevant
Political practice	Relevant
Type of research / user dedication	
(Proposed) Disciplines involved	Social, Economics, Law, Policy, Governance, Hydrology, Ecology, Anthropology, History…
(Proposed) Water uses involved	Drinking water, agricultural uses, industrial uses, energy uses, recreation, fishing…
(Proposed) (Water) policies involved	Environmental liability Directive, other sectorial policies (agriculture, industry, energy)
Research Focus	Responses
Other suggestions????	to consider alternative economic market-based approaches

ANNEX 2. POSSIBLE RESEARCH QUESTIONS

1. ECONOMICS AS A TOOL TO SUPPORT DECISION MAKING

- Can we develop tools comprehensively taking into account the pattern of interactions between the ecological services, the social actors and the values they assert?
- How to assess welfare accruing from changes in the availability and quality of drinking water with contingent valuation or attribute-based choice modelling (choice experiments etc.)?
- How to assess the awareness of people regarding the importance of eco-system services accruing from the scarce resource water?
- How do we evaluate economic flows in environmental services?
- How can we evaluate financially the benefits of re-establishing functional aquatic ecosystems (e.g. tourism and nature benefits for communities)? Ecosystem services and wetlands/biodiversity
- How to quantify monetary benefits of hydro-morphological measures under WFD?
- How to define and improve the operating tools for management and the use of disproportionate cost?
- Improved and harmonized methods (e.g. cost-efficiency ; cost-benefits)

2. Economics as a regulatory tool to provide effective incentives:

- How to decide in pricing policies according to member states programme of measures. What are the effects of pricing policies?
- Which new systems of payment for water to include more effectively the ‘distributive’ aspects of water economics across all aspects the hydrological cycle (not only for drinking water)?
- How to allocate the correct charges fairly and transparently between the beneficiaries and the polluters?
- How will the social values of the water and the people’s behaviour and practices respond to higher prices of water use (full recovery of costs)?
- Which tools and measures to manage water through demand?
- How to balance different uses? How to balance uses with ecosystem needs?
- What are the cross-cutting effects of other EU policies on the management of water resources such as subsidies to agriculture?

Managing priority substances on a (sub-?)catchment scale

CONTEXT

The Priority substances annex in the WFD[4] lists the chemicals to be monitored and controlled as they provide a threat to ecosystem and human health. While the term "priority substances" is used in the WFD this can include agro-chemicals; heavy metals; hydrocarbons and endocrine disruptors. While current legislation will lead to a decline in sources of pollution, the current pollution and the persistence of many substances are believed to influence ecosystem and human health for years to come. As a background to this is the requirement to improve the integrated management of pollutants and ensuring the compliance of activities to reduce their impacts and links to sediment management (consideration must be made of the work undertaken within the SNOWMAN eranet)

1. Hazardous substances and their interaction with the environment

To substantiate this research is needed into the fate of these priority substances. The movement of substances through the water and groundwater is not well understood and predicting the movement will improve our ability to manage pollution. IWRM-net partners want to improve our modelling of hazardous substances in time and space integrating both surface and groundwater combined and this modelling be supported by high quality science.

The role of the soil in the interactions between water, pollutants and soil is not well understood and again linking with SNOWMAN partners this is an important aspect to consider. There is also links to the use of groundwater for managing other issues such as droughts e.g. what are the risks of pollution when storing water

IWRM-net partners have recognised that an understanding of the effects of multiple substances interactions and synergies on the environment is important for water management bringing together knowledge on Ecotoxicology (linking to the biota) and non point source pollution. The research also need to consider sinks, where pollutants can accumulate and thus cost-effective measures can be found to deal with the pollution.

2. Tools for diagnosis and risk assessment

Using improved knowledge on the dynamics of pollutants in the environment and the interaction and cumulative impacts water managers will need to develop and update reference threshold values (Environmental Quality Standards) for chemicals, notably in the context of the Water Framework Directive (2000).

Agriculture is an important industry and often cited as a source of diffuse pollution but an important part of the economy and they need to be involved in finding cost effective methods

EXPECTED OUTPUT / IMPACT

1. Hazardous substances and their interaction with the environment

To improve the scientific knowledge on hazardous substances and their interaction with the environment, substantiating the research into the fate of these priority substances

[4] http://ec.europa.eu/environment/water/water-framework/priority_substances.htm

To assess the effects of chemicals on aquatic ecosystems subject to multiple and chronic exposures (mixtures of low doses of e.g. pharmaceuticals, pesticides, endocrine disruptors)

Creation of an integrative database for unsaturated and saturated soil zone (cover soil) including pF (retention), porosity, structure Highly polluted areas (Groundwater)

2. Tools for diagnosis and risk assessment

IWRM-Net partners would like this knowledge to be adapted and used to assist in the development of river basin plans and the programmes of measures to achieve good ecological and chemical status.

The aim would be to support the development and updating of reference threshold values (Environmental Quality Standards) for chemicals, notably in the context of the Water Framework Directive (2000). There is a requirement for ecological indicators, biosensors and biomarkers of eco-toxicological risks that can be used in the field that will support river basin management to diagnose toxic impacts in multi-stressor situations, to understand the interactions with other stressors and to predict ecosystem recovery after implementation of corrective actions by managers.

More specifically a tested methodology to assess the risk of violating regulatory thresholds which can be used by operational water managers (and their advisors) to assess the risk on a local level is required. Depending on test results input to policy makers as a basis for additional policy on remediation. By focusing on the sinks or worst case scenarios such as sandy areas there will be cost effective management solutions developed to deal with pollutions sources in the long-term.

ANNEX 1. CONTEXT CLASSIFICATION ATTEMPT

Item (not all items are relevant for each question)	Options
Geographical / Climate zone:	Irrelevant;
Basin zone	Lower River basin (lowlands) Estuary Lakes Aquifers coastal waters
Ecozone (or water bodies)	Irrelevant;
Political practice	Irrelevant;
Type of research / user dedication	Fundamental / mono-disciplinary / process insights; Integrative (natural sciences); Applied (end users are water managers and their advisors);
(Proposed) Disciplines involved	Hydrology; Hydrogeology, Morphology; Soil and water Chemistry; Ecology ,
(Proposed) Water uses involved	Recreation; Drinking Water; Fishing
(Proposed) (Water) policies involved	Bathing directive; ….
Research Focus	Pressures + State
Other suggestions????	see also Annex and WP2-WP3

ANNEX 2. POSSIBLE RESEARCH QUESTIONS

RELEVANT TO THIS RESEARCH TOPIC (TAKEN FROM WP2).

1. Hazardous substances and their interaction with the environment

- Improve our modelling of hazardous substances in time and space integrating both surface and groundwater combined.
  - o Movement of pollutants through soil and groundwater linking to using aquifers to store water, how does pollution migrate (dispersion);
  - o Improve our understanding of the processes involved in the transfer/residence times of agro-chemicals in basins and the movement of diffuse pollution.
- Research for establishing soil buffer capacity for pollutants and tools for better estimation of soil buffer capacity on priority pollutants in the recharge areas of the groundwaters
  - o Creation of an integrative database for unsaturated and saturated soil zone (cover soil) including pF (retention), porosity, structure Highly polluted areas (Groundwater)
- understanding the effects of multiple substances interactions and synergies on the environment
- What are the sinks where the pollutants will accumulate (e.g. groundwater, sediments in lowland river stretches, estuaries), what are the transfer and residence times of these pollutants in the river basin? How do the substances move in (between) soil, sediments, rivers, groundwater, biota? How do the substances degrade in the various media? What are the risks of regulatory thresholds being violated in sinks?

2. Tools for diagnosis and risk assessment

- Scientific research for linkage, impact between environmental objectives for pollution
- Develop new methods for estimation of the background content of metals, oil, hazardous substances, nitrates and of the anthropogenic input related to the Water Framework Directive.
- Scale effect on the water quality assessment/ Comparison with other European countries
- With specific reference to the Drinking Water Directive, research needs to be done on ARSENIC removal from groundwater; techniques for this and the improvement of the cost effectiveness of these techniques - how much money can you afford to spend on removal?
- Assessing the effectiveness of measures to control pollution/mitigate against the effects, this links to questions on how do you stimulate chemical/physical changes. With the assessments on effectiveness should there be development of new management strategies
- diagnostic of ecotoxicity of substances

Governance and Integrated Catchment Management

CONTEXT

Water governance relates to consistent management, cohesive policies, processes and decision-rights for the management of water resources.

Integrated Water Resources Management (IWRM) is a participatory planning and implementation process, based on sound science, which brings stakeholders together to determine how to meet society's long-term needs for water and coastal resources while maintaining essential ecological services and economic benefits[5]. Worldwide, water policy and management are beginning to reflect the fundamentally interconnected nature of hydrological resources and the Water Framework Directive is the European Union means to implement IWRM and the principles associated with this across Europe.

1. River Basin Management Planning

To achieve this, the implementation of the Directive has to deal with the complex typology of water resources in Europe. Many of the rivers cross the boundaries of many member states, bringing many international water management issues, not just within EU member states but also between EU states and non-EU states. But the process is not just about international politics - the process needs to consider the regional and local level also.

In this political process the values of all stakeholders should be considered not just on the basis of real costs. IWRM as a process is a means to understand and make decisions based on the many values apportioned to water. There are a number of examples from around the world such as cooperative agreements in America and benefits sharing in Africa that show how such principles can be implemented. The question for the river basin planners around Europe is how the principles fit into the complex mix of European States.

Across Europe there is a complex mix of institutions and actors in the water field and the management of water impacts on all of our lives. Multi-layer governance is a term used to describe the situation which water managers need to deal with. The concept of integration between these institutions and actors is a complex process and there is often not one solution but a using IWRM principles the aim is to make Europe the best in the world in terms of water resource management and the implementation of the WFD can show the rest of the world how to achieve sustainable use of water resources. Particularly important are the power relations between various stakeholders, the dialogue and the resolution of conflict. Any project would need to consider the methods used in any planning process and look for the criteria for success in any river basin.

2. Education & Communication

Fundamental to all of these integrated management issues it the use of effective communication and education. These are considered vitally important aspects of planning for water resources and tools and techniques need to be improved and refined for Europe, improving and building the capacity for water management.

When trying to implement the principles of IWRM there is a need to talk to a wide range of people. Using a variety of methods can be confusing and with so much information available to people in the days of mass media can be difficult to achieve effective communication with your target audience. Keeping stakeholders up to date of the river basin planning progress by effective communication and participation in water management is a goal of IWRM. But this needs to be developed on a long-term basis as many 'projects' for IWRM delvier high intensity communication that is not sustainable. The development of capacity to deal with the communications and education is vital.

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[5] http://www.usaid.gov/our_work/environment/water/what_is_iwrm.html

In this political process the trust between partners is very important to develop ideas about short-comings on water policy and River Basin Management Plans (RBMP). Trust needs to be developed and investigated for water management so that information and knowledge can flow freely and decisions taken on this knowledge. For the first river basin plans there have been a number of criticisms about the process so far and some questions raised about how much scientists are involved in the RBMP process?

3. Integrated Coastal Zone Management

The concept of integration extends not just across the political boundaries. The integration of the freshwater and marine resources also requires further attention with the publication of the Marine Strategy Framework Directive. Integrated Coastal Zone Management has been a field in its own right for a number of years but the synergies and integration with Integrated Catchment Management have not been realised and there is a need to examine the links between the two processes and how Europe can efficiently bridge the divide between the terrestrial and marine environments.

EXPECTED OUTPUT / IMPACT

1. River Basin Management Planning

Develop and assess the consistency of river basin planning across a variety of scales including international basins, involving EU and non EU states. By providing a comprehensive assessment the aim will be to allow the sharing of experience and to involve stakeholders and boundary workers in the research to learn as the programme develops. Aim to harmonise data display and level of detail to be presented in the draft River Basin Management Plans

The outputs should be an assessment of how the WFD has implemented the principles of IWRM. Then the shortfalls should be highlighted and guidance provided on how cost-effective measures can be transferred across Europe according to the typology of the river basin.

Specific investigation should be made into how the diverse organisations can be brought together to make fair and efficient decisions regarding the sustainable use and development of water resources for the specific regions considered, at each scale (international, regional and local)

The expected outputs would include guidance on the institutional and financial contexts that facilitate integration of water resource management using co-creation of knowledge in the research on how to set up a transparent and sustainable management systems for water resources.

The IWRM-net second call wishes to investigate the challenges and opportunities for effective integration based on the first river basin management plan. This is proposed as a scientific review of river basin management planning across Europe to see how the implementation has been done and look to how the process can be improved the next time round.

2. Education & Communication

Guidance and knowledge exchange for communicating water management across the river basin should be developed. This should highlight how each method and example has improved and built the capacity for water management.

For the development of participation methods for engaging stakeholders the impact is expected to be a sustainable solution to improving the numbers of people involved in the process of water management. This should be on a long-term basis.

In terms of education IWRM-net is looking for innovative solutions to exchanging knowledge in the field of water management with the whole range of actors in the field of water management and the public. Specifically within the river basin planning process the development of the relation between scientists, policy makers and water managers should be investigated and recommendations for improvement provided across European examples.

3. Integrated Coastal Zone Management

The expected impact for integrating the marine and terrestrial spheres is to provide solutions to integration at a number of levels. IWRM-net would like to examine the processes at the EU level and the integration of the WFD and MSFD at the policy level. A pan-european study should be undertaken to assess how the process of river basin management planning has integrated with the land and marine planning processes in the coastal and transitional waters.

ANNEX 1. CONTEXT CLASSIFICATION ATTEMPT

Item (not all items are relevant for each question)	Options
Geographical / Climate zone:	All
Basin zone	All
Ecozone (or water bodies)	
Political practice	International & regional politics,
Type of research / user dedication	Economics, Politics, management theory, Planning.
(Proposed) Disciplines involved	
(Proposed) Water uses involved	Industry, agriculture, domestic
(Proposed) (Water) policies involved	Water Framework Directive
Research Focus	Administration and management.
Other suggestions????	

ANNEX 2. POSSIBLE RESEARCH QUESTIONS

- Promote consistency in the river basin plan by assisting in harmonising data display and level of detail to be presented in the draft River Basin Management Plans
- Communication - Ensure effective communications through out the EU in developing the first plans, keeping stakeholders up to date of the river basin planning progress and improving the effectiveness of the communications. Ensure capacity is built to deal with the communications aspects.
- Develop strategies for the integration of river basin with coastal management and the integration of the Water Framework Directive with the Marine Strategy Directive.
- How to create institutional and financial contexts that facilitate integration of water resource management
- Demonstration of land-use (& vegetation) management on a catchment scale to manage water resources
- What about international comparison in river basin management planning?

Dams, Reservoirs and Ecological continuity

{Keywords: river continuity (ecological continuity, sediment transportation), hydro-peaking, residual waters}

CONTEXT

Dams are an element of the water system spatio-temporal dynamic. Operation of dams can serve different water uses, but dams also have impacts on river ecology:

- River connectivity disruption
- Consequences of flow regulation on biological elements and habitats (minimum flows, hydro-peaking)
- Modifications on sediment transport

Ecological status and ecological potential of rivers in relation to dams has to be further supported by knowledge, to develop common standards for ecological assessment and classification of water bodies. The following issues highlight current areas where research is in particular needed to develop decision support systems embedding high level knowledge into practical tools.

Associated with these issues is also the possible impacts of climate change and any alteration to the hydrological cycle and will affect aquatic ecosystems and thus the management of dams and reservoirs. The aim is to balance water uses and the regulatory tools to manage these impacts.

Economics issues need to be developed to manage both water environmental objectives and water user requirements. Priorities are to develop information and knowledge on costs, benefits, values and economic instruments as well as developing a better understanding of actors systems, institutions and perceptions. Changes in society, consumption, need for resources, energy intensity should be looked at in a long-term foresight approach.

An integrated approach at basin level with transdisciplinarity research activities is considered as well necessary in order to improve communication and a better understanding between scientists, stakeholders and policy makers. This communication also needs to occur across political boundaries as many impacts of dams and reservoirs cross member states and this needs to be considered in improving the sustainable management of water resources.

Barriers such as dams impede fluvial connectivity and all European river systems are concerned with and there is a strong need to rehabilitate healthy fluvial ecosystem processes: GES is function of abundance, age and structure of fish fauna and then, fish migration must be re-established to reach this goal. There is a strong link between connectivity disruption and habitat quality. The complexity of ecosystems has to be considered, not only fishes but also macro-invertebrate and plants. There is a need to define referential conditions for ecological continuity

The will to maintain a balance between preserving a good ecological status in hydro-systems and providing for multiple uses of water has conduced (some) Member States to impose constraints with respect to bypassed sections downstream of dams, setting a minimum value for the guaranteed flow that guarantees at all times, the survival, circulation and reproduction of the species living in the river before construction of the installation.

Another key question relates to how populations respond to variations of discharge, in particular with regard to hydro-peaking practices. There is a lack of accurate information on the frequency and range of flow peaks and their effects are different on fauna.

Impoundment of a dam leads to the trapping of sediments in the upstream part of river catchment. Sediment deficit causes river bed degradation, altered river ecology (habitat conditions) and river morphology. There is a deficit of knowledge on the role of sediment regime restriction on river functions. A catchment approach is needed to improve the general knowledge on sediment budget. The degradation of water beds influence groundwater and humid zones conditions. As for ecological continuity, there is a strong need to define adequate ecological reference states of affected river reaches.

With reference to sediment budgets the potential curative solutions are dealing with dynamic bed stabilization, the linkage of waterways and the river bank renaturation. Preventive solutions are dealing the passability of sediments (in a context of sediment deficit) and the remobilisation possibilities for different dams' types. The feasibility also requires to anticipate the potential impacts of draw-off and transparency of operations. With reference to reservoirs there is a requirement to understand how the size and character affect water quality (e.g. temperature, oxygen saturation) and sediment transport (e.g. reservoir flushing)?

Hydropower is a challenging issue at the nexus between water and energy policies. On the one hand, hydropower is a strategic issue for energy production. Our modern societies are totally energy-based. Hydropower is a renewable energy, and hydropower facilities tend to be developed as the European renewable Energy Directive is inviting member States. Hydropower contributes to decrease CO2 emissions and another technical argument is that hydropower provides a quick response to peak-load energy demand. Hydropower is largely used in European countries, especially Norway (more than 99%), Austria (60-70%), Sweden, Swiss, France (15%). On the other hand, hydropower is a strategic issue for water management. Energy policies then represent a highly strategic driver to consider regarding the water resource management and in particular WFD requirements (Good Ecological Status).

EXPECTED OUTPUT / IMPACT

1. Understanding Ecological continuity – the impacts of barriers

IWRM-net is aiming to Improve the management of waters, through common standards for ecological assessment and decision support systems embedding high level knowledge into practical tools. Today research challenges in the field of minimum flows, has to deal with new generation of habitat modelling, fish population responses to hydraulic habitat alteration and related dynamics population models. In addition, the use of models to support management and decision-making processes has to be further streamlined.

The research should aim to assess multiple causes of disturbance, including an overall assessment of the impact of hydro-systems fragmentation; and improvement of the understanding of interactions between explanatory variables (ecological continuity, sediment transport, flow regulation –residual flows, hydropeaking…). Reduction of uncertainties in data and models in order to integrate habitat, hydraulics and population dynamics as well as address multiple spatial and temporal scales.

2. Managing the barriers and restoring ecological continuity

Facing the impacts of dams on ecosystems and the WFD environmental objectives (*e.g.* GES or GEP), the purpose is to design cost-effective measures to restore fluvial connectivity and ecosystem functions. It requires an integrated large scale ecological knowledge to provide fundamental systematic information for ecologically, socially and economically optimized re-establishment of connectivity at different scales in European river catchments. Current habitat models need to be investigated to cope with the influence of sediment transport features as well as siltation effects.

In understanding flows and ecology there is a need to improve the characterization of hydrologic perturbation caused by hydro-peaking (reference conditions and characterization of hydro-peaking management), coupled with biological surveys and understanding of how communities are affected. In this context, more knowledge is needed to better quantify the interaction between stress and impact, and progress in defining mitigation measures and evaluation of efficiency.

3. Industry focus: Hydropower

The overall objective is to manage trade off between Renewable Energy Directive and Water Framework Directive for European waters. Efforts should address both technical and technological aspects as well as socio-economic aspects, integration of values and other policies.

ANNEX 1. CONTEXT CLASSIFICATION ATTEMPT

Item (not all items are relevant for each question)	Options
Geographical / Climate zone:	Countries with hydropower potential
Basin zone	Linked with concerned geographical zones
Ecozone (or water bodies)	Catchment scale
Political practice	Relevant
Type of research / user dedication	
(Proposed) Disciplines involved	Hydrology, Ecology, Hydro-morphology, Technology, Socio-economics, governance
(Proposed) Water uses involved	Energy
(Proposed) (Water) policies involved	Renewable Energy Directive
Research Focus	Driving Forces, State, Pressures, Impacts, Responses
Other suggestions????	to consider alternative economic market-based approaches

ANNEX 2. POSSIBLE RESEARCH QUESTIONS

1) UNDERSTANDING ECOLOGICAL CONNECTIVITY: WHAT ARE THE IMPACTS OF DAMS AND RESERVOIRS?

a) How to develop an appropriate methodology to identify barrier to fish migration? Need to define referential conditions for ecological continuity

b) How can the impacts of hydro-peaking (quick fluctuating flow levels) and/or residual flow be assessed? How do they affect river restoration programmes?

c) Which impact of altered sediment supply on river ecological functions and more generally on GES (difficulties to link bed morphology and physical conditions and habitat conditions/GES)?

d) How to extend operating habitat models versions to cope with the influence of sediment transport features as well as siltation effects?

e) How to improve our understanding of the relationship between flow and ecology based on appropriate data and site specific studies (linked to hydropower also)?

f) How does the size and character of reservoirs affect water quality (e.g. temperature, oxygen saturation) and sediment transport (e.g. reservoir flushing)?

2) HOW TO MANAGE IMPACTS OF DAMS AND RESERVOIRS?

a) How to develop effective fish passage criteria and management strategies of dams and hydropower taking into consideration fish behaviour in response of various parameterlike hydraulics for multiple species and life stages? (possible focus: can we develop fish migration facilities for extreme heights, e.g. sturgeon passage at the Iron Gate?)

b) How to develop innovative technologies for optimizing the removal of instream barriers and restoring instream habitats quality as well as locating new instream structures as sustainable water management requires it?

c) How to identify potential sites for new facilities taking in account water and energy stakes? How to improve efficiency of technologies in conciliation with WFD? In conciliation with increasing of energy demand?

d) How to maintain water quality during the process of infill of dams and the measurement of quality (considering the fluctuations of the state due to the infill process)?

e) How to improve the management of the trans-boundary issues associated with residual flow and hydro-peaking with hydro-power dams? (Hungary)

a) How to assess costs for mitigation and removal of barriers, for development of new infrastructure which are compliant with WFD environmental stakes (confrontation between the economic value of environmental services and hydropower values)? Social acceptance of restoration measures?

b) How to integrate hydrology, geomorphology, water, economics and social issues?

c) Which public acceptance for hydropower facilities (knowledge of values for decision making)?

d) Which legislation adaptation, institutional cooperation (tradeoffs WFD/Renewable Energy Directive)?

e) Which labelling system for hydroelectric facilities?

Science policy Interface

CONTEXT

An effective and efficient implementation of the Water Framework Directive (WFD) requires to improve the communication between research scientists and regulatory instances by developing a “science-policy interface”. This requires that close links be established between scientific/technical experts, policy advisers and water managers.

On the one hand, relevant scientific/technical knowledge should be made accessible in a timely and user-friendly fashion to policy advisors and water managers. On the second hand, policy gaps and needs should be identified and communicated in a timely manner (with anticipation) to the research community in order to feed the policy process with a continuous flow of innovative findings.

First, relevant scientific/technical knowledge should be made accessible in a timely and user-friendly fashion to policy advisors and water managers. On the second hand, policy gaps and needs should be identified and communicated in a timely manner (with anticipation) to the research community in order to feed the policy process with a continuous flow of innovative findings.

The implementation of the WFD faces a number of issues:

- the difference in dynamics and expectations;
- the complexity of Integrated Water Management in general and the implementation of the Water Framework Directive, and in particular: the challenging amount of scientific disciplines to integrate, the variety of situations encountered within the European Union;
- the lack of overview of existing knowledge;
- the difficulty to align research and application;
- the difficulty to align research and application of research’s results;
- the challenge to programme research regarding policy needs;
- the different drivers…

Increasingly, it will become harder to take sectoral decisions in isolation that do not take into account the global pattern. It is a challenge to integrate the large variety of scientific disciplines and fields of knowledge involved. integrated water management is complex due to its geographical size, variations in governance and culture, spatial scales, institutional and cultural settings and stakeholders.

Research outputs are often not aligned to the needs of policy. First, results of research projects are often not known to the potential users. Second, research outputs are often communicated in such a way that they are not directly usable. This underlines the need for a transfer mechanism which would allow users to get improved access to technical information.

Projects funded by different mechanisms are very rarely coordinated and projects on a given theme are often operated without any horizontal links to other initiatives. This lack of communication and exploitation of synergies has huge economic consequences as innovative approaches developed at European level may simply be lost.

Key actors should establish close and sustained relationships:

- research providers developing RTD,
- consortia involved in demonstration projects,

- communicators and translators (e.g. scientific journalists, consultancies) able to “digest” and integrate scientific information and transfer it to policy makers and water managers,
- policy experts able to identify short, medium and long-term research needs and to interface research and water policies.

The drivers of researchers and policy makers are one fundamental problem in improving the science-policy interface. Policy makers are driven by societal needs and politics. Researchers are driven in the first place by curiosity. The fact researchers are more and more judged by their scientific publications, results in a strong commitment to publish, allowing only limited time to interact with policy.

Therefore, we need method to ease the dialogue and the understanding between the different actors and to implement collaborative research.

EXPECTED OUTPUT / IMPACT

The aim is:

- to elaborate scientific knowledge that bridges the gap between researchers and policy makers;
- to develop innovative methods for identification of research needs involving both scientists and policy makers discussing the corresponding research and policy agendas from the very beginning in order to ensure a more structured communication at all appropriate levels of policy formulation, development, implementation and review.;
- to develop tools to evaluate which type of research is needed (background information or tailor-made research/demonstration) in relation to the policy step of concern (e.g. next cycle of river basin management plans; POM, monitoring, revision of daughter directives,…);
- to investigate the role and methods of future-oriented studies (foresights/scenarios building) in IWRM
- to investigate the effectiveness of “collaborative research” in IWRM (research involving end-users –water managers and practitioners), and establish minimum standards and good practices in these approaches
- to provide tools in order to improve dialogue between actors and accompany development of efficient working relationships;
- to provide tools to improve the transfer of the results obtained and dissemination

ANNEX1. CONTEXT CLASSIFICATION ATTEMPT

Item (not all items are relevant for each question)	Options
Geographical / Climate zone	Irrelevant
Basin zone	Irrelevant
Ecozone	Irrelevant
Political practice	All
Type of research / user dedication	
(Proposed) Disciplined involved	Social, Anthropology, Economics, Law, Policy, Governance, Integrative (natural sciences), Hydrology, Ecology…
(Proposed) Water uses involved	All
(Proposed) Water policies involved	WFD
Type of research / user dedication	

Other suggestions	Support attempts to improve science-policy interface in the field of WFD implementation e.g. through the Common Implementation Strategy process

ANNEX 2. POSSIBLE RESEARCH QUESTIONS

How best to organize stakeholder dialogue, participation and perception?

- How to build trust and find ways to engage stakeholders more effectively?
- How to develop methods to facilitate a compromise between stakeholders and researchers?
- How to include recognition of the various phases of implementation of measures?
- What information should be provided and to whom?
- How to create learning process between actors? How to facilitate the communication between involved actors?
- How can we manage and reduce the asymmetry of information among stakeholders?
- How can we improve the evaluation of the impact of participation?
- Does access to information and legitimacy of stakeholders play a role (and how) to ease the public participation thanks to a homogenization of knowledge?
- How to communicate benefits of achieving environmental objectives to engage public interest?

Supporting document – Table of strategic issues

	strategic issues
	Sub topics

1 Which governance framework and tools for the water management?

1.1 How to improve the decision making process in water management?

Public participation

Adaptive management

Legal and institutional framework

Social values and practices

Science policy interface

1.1.1	*How best to organise stakeholder dialogue, participation and perception?*
1.1.2	*How to improve communication with citizens?*
1.1.3	*Does the current governance of WFD allow it to be adaptive considering the future potential challenges?*
1.1.4	*How can the legal and institutional frameworks be adapted/simplified to integrate different policies?*
1.1.5	*How to change social values and practices to improve the legitimacy of measures and the perception of fairness and accountability?*
1.1.6	*How to improve and develop methods that incorporate social capital in river basin management?*

1.2 What are the Tools and methods for implementing IWRM

Integrated River Basin Management

Indicators and models

Classification tools (water bodies)

Harmonization and inter-calibration

Classification tools

Economics, Environmental Evaluation

1.2.1	*Which decision support system to support decision making?*
1.2.2	*How to improve data monitoring? Which data do we need?*
1.2.3	*How does modelling of integrated datasets at different scales affect decisions as to programmes of measures that should be used towards WFD?*

1.2.4	*How to improve the definition of GES and GEP?*
1.2.5	*How to produce a set of reliable and sensible indicators?*
1.2.6	*How to develop interdisciplinarity (physical, chemical and ecological processes and socio-economic aspects)?*
1.2.7	*How to improve transfer of knowledge?*
1.2.8	*How to reveal social values?*
1.2.9	*How to value the ecosystem services of Water System?*
1.2.10	*How to design pricing policies?*
1.3	**How to develop framework for policies integration and assessment?**
	Framework for 1st RBPM assessment
	Compliance of European policies, of national policies
	Indicators for assessment
1.3.1	*How to manage the River Basin under the WFD – how can we assess the WFD, the RBMP?*
1.3.2	*How to improve integration of policies in River Basin Management Plan?*
2	**How to improve knowledge on state of water resource and pressures?**
2.1	**How to improve knowledge on ecological, chemical and physical processes?**
	Environmental flow regimes
	Interdisciplinarity
	Hydro-morphology and GES
2.1.1	*What are the gaps of knowledge on physical processes?*
2.1.2	*What are the gaps of knowledge on chemical processes?*
2.1.3	*What are the gaps of knowledge on ecological processes?*
2.2	**What are the current and the future impacts on the water system**
	Water scarcity and drought
	Climate change
	Ecotoxicity
	Diffuse pollution
	Cumulative impacts

2.2.1	*How could climate change affect the water system and ecosystems?*
2.2.2	*How are anthropogenic drivers affecting the water system and ecosystems?*
2.2.3	*How to develop an understanding of the cause-effect relationships?*

2.3 Reponses to pressures

How to manage the consequences of pressures e.g. prevention, mitigation and crisis management?

Integrated Pollution management

Adaptation to climate change

Water scarcity and drought

Floods

Global change (demography, land-use, energy…)

2.3.1	*How to face perturbations related to climate change?*
2.3.2	*How to improve the drought management?*
2.3.3	*How to improve the flood management?*
2.3.4	*How to improve the pollution management?*
2.3.5	*Which responses to face agricultural pressures?*
2.3.6	*Which responses to face industrial pressures?*
2.3.7	*Which responses to face energy policy (hydropower) pressures?*
2.3.8	*Which responses to face other anthropogenic pressures?*