# 2015 AND BEYOND : EMERGING ISSUES ON WATER FOR POLICY AND RESEARCH – AN EXPERT PERSPECTIVE

## STATUS BOX

**Version no**.: 1.0 Date: 15 May 2008

**Author(s):** Laëtitia Citeau (OIEAU), Xavier Lafon (MEEDDAT), facilitators

**WP:** 3

**Deliverable** : 34

**Dissemination level**: Public

**Background**:

In the IWRM-NET description of work, MEEDAT is in charge of the identification of emerging issues on water for policy and research.

Following preparatory work on methods and existing foresight dedicated to water, a methodological workshop took place in Liège, June 2007. Its conclusions were used by a steering committee to organize a workshop in Paris, in April 2008.

This document presents the goals, methodology and main results of the process.

**Circulation and received comments:**

Will circulate among facilitators of Paris workshop, then among participants before validation.

**Comments** :

**Timetable for finalisation**:

- 15 May 2008

**Contacts**: Xavier Lafon(xavier.lafon@developpement-durable.gouv.fr), Laëtitia Citeau (l.citeau@oieau.fr)

**ERAC-CT-2005-0260025**

**IWRM-NET**

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

***Thematic priority***: Integrated water resource management

# DELIVERABLE N° 34

# 2015 AND BEYOND : EMERGING ISSUES ON WATER FOR POLICY AND RESEARCH – AN EXPERT PERSPECTIVE

Due date of deliverable: month 30 – June 2008
Actual submission date: month 28 – April 2008

***Start of the project***: 1 January 2006 ***Duration***: 5 years

***Organisation name of lead contractor for this deliverable***: WP3 - MEEDDAT

**Draft version 0.1**

| Project co-funded by the European Commission with the Sixth Framework Programme (2002-2006) | | |
|---|---|---|
| **Dissemination level** | | |
| **PU** | Public | **X** |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services). | |
| **CO** | Confidential, only for members of the consortium (including the Commission Services). | |

# CONTENT






Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr

Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

## EXECUTIVE SUMMARY

As a part of the research support network on Integrated Water Resource Management (IWRM-NET), the French Ministry for Environment (MEEDDAT) in collaboration with ECOBAG and Liège University developed a method to identify emerging issues on water for policy and research. It is a necessity to identify and initiate now strategic research works that will be delivered within 10 to 20 years, according to future needs of water managers and Water Framework Directive implementation.

We explored the long-term research needs to support further reviews and updates of RBMP in 2015 and more especially 2021 and 2027. Identifying future research needs also require anticipating how future societal needs and water system status and dynamics might evolve through a collaborative process gathering various actors interested in water policy.

To match these objectives, the Foresight workshop on "2015 and beyond: emerging issues on water for policy and research – An expert perspective" held in Paris on April 10 and 11th brought together river basin managers, policy managers, research programme managers, academics from different disciplines and representatives from civil society (NGO) to exchange their views on what will be the future research needs to support the WFD implementation after 2015.

To organise the discussion, two major issues were identified by the steering committee that prepared the workshop:

1. How to value aquatic systems taking into account socio-economic aspects? How to assess the efficiency of the first programme of measures in order to build up the further ones?

2. What new concepts and tools for a real Integrated Catchment Management? What tools or methods to be able to deal with unknown emerging isssues?

Break-out groups worked simultaneously in successive working sessions dedicated to:

- the gaps and problems unveiled during the first round of the RBMP;

- the future driving forces and their impact on water management;

- the key research questions that have long-term implications and should be addressed from a strategic research programming perspective.

The table summarize the key findings of working sessions : i) Main driving forces of future change, ii) the potential changes, iii) how they might influence the water management, especially the WFD implementation and iv) the most important research needs to respond to these potential changes.

| **Main future drivers** | **Future potential changes** | **Impacts on water management** | **Research needs** |
|---|---|---|---|
| Climate change | Changes in average temperatures, precipitation patterns, magnitude and frequency of extreme events (storms, droughts) | Impacts on water supply, water quality, management of extreme events like floods<br>Impacts on the capacities of water system for resilience | **What is the resilience of the ecosystems when faced with extreme perturbations?**<br>- Definition of indicators which are sensitive to limits and trends toward thresholds (biological and physical indicators but also socio-economic indicators) and development of early warning systems used by water managers to avoid reaching a tipping point<br>- Long-term hydrological and biological monitoring datasets for the detection of ecological effects produced by climate change.<br>- Mitigation and adaptation strategies for climate changes |

| | | | |
|---|---|---|---|
| Societal values and practices | Changes in social perceptions of fairness,<br>Changes in social perceptions of the environment, in social practices related to the environment<br>Changes in social behaviour | Impact on the recovery of costs – e.g. compensation for giving up water rights or changes in the economics of farming, increasing demand for the application of the 'polluter-pays' principle<br>The value of good ecological status (seen as a social object) could change due to changes in social values of the environment | **How to change social values and practices to improve the legitimacy of measures to conserve water and the perception of fairness and accountability?**<br>- There is need to provide people with an understanding of the many beneficial services provided by aquatic ecosystems to economic and social welfare.<br>**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**)<br>- Development of indicators to give a measure of more abstract issues such as human well-being<br>- Development of tools comprehensively taking into account the pattern of interactions between the ecological services, the social actors and the values they assert. |
| Other sectorial policies | Agriculture, land use and CAP<br>Energy<br>Transport policy<br>Industry<br>tourism | Changes in other sectorial policies may counteract the WFD implementation, e.g. a likely shift of transport of goods from road to inland waterways | **How can the legal frameworks be simplified to integrate different policies?**<br>- There is a strong need to develop ideas and come up with innovative proposals for institutional arrangements that could help to implement integrated water resource management better. |
| Regulation and institutions<br>Water governance | Future of the EU<br>Evolution of political priorities (EU enlargement, further policy integration)<br>Evolution of general regulations, especially public-market | Modification of the governance of water systems<br>Changes in allocation of WFD budgets, revenue and expenditure | **How to make the change from supply driven to demand driven water management and balance uses with ecosystem needs, but also balance between different uses?**<br>- Find ways to build trust and to engage stakeholders more effectively<br>- Create of learning processes between actors<br>- Facilitate communication between involved actors such as ministries, agencies, researchers, local stakeholders…<br>- Finde arrangements, institutions or capacities to work across different levels of government<br>- Develop transdisciplinary approaches in research which integrate non-expert views (e.g. stakeholders views)<br>- Develop new systems of payment for water and WFD to include more effectively the 'distributive' aspects of water economics across all aspects the hydrological cycle<br>**Does the current governance of the WFD allow it to be adaptative considering the future potential changes?**<br>- Develop scenarios/ foresight for water management which cover impacts of driving forces at different scales, role of actors and should enable to play through different topics<br>- Develop predictive tools for assessing the consequences of the programme of measures after its implementation |
| Technology and innovation | Development of new technologies | Biofuels, hydropower and desalinisation plants could have impact on water quantity and quality | - Assessing potential positive and negative impacts of new technologies on integrated water resource management |

# 1. WHY FORESIGHTS FOR RESEARCH POLICIES : THE NECESSITY TO LOOK AT EMERGING ISSUES AND THE LONG TERM FUTURE

## 1.1 CONTEXT

This report outlines the emerging issues on water that will impact research and water policies for the next 20 years, *i.e.* for the RBMP 2015, 2021 & 2027.

This Report is defined in the DOW as follows:

**Task 3.3 : Futures workshop within the IWRM.Net network (month 30)**
Task manager : MEEDDAT

A futures workshop will be organised using common practices and methodologies, and inputs from other networks identified in 3.1. The result will be an assessment : "2015 and beyond : Emerging issues on water for policy and research – An expert perspective". Dissemination will have to be designed in accordance with the recommendations of WP 6.

Right now, river basin managers are focusing on the implementation of the first river basin management plan (RBMP) to meet the WFD environmental objectives by 2015. They will have to review and to update this 1st RBMP after 2015.

Within IWRM.NET, the tasks led by the French Ministry for Environment (MEEDDAT), in collaboration with ECOBAG and Liège University, aim to identify the research needs to support this review and updating of the 1st RBMP in order to prepare pro-actively future RBMP 2015 but especially 2021 & 2027.

## 1.2 SCIENCE AND SOCIETY INTERACTING: THE NECESSITY OF "FORESIGHTS" FOR RESEARCH POLICIES

In the field of research and innovation policies, "foresight" helps to plan research and innovation efforts corresponding to future needs of society (see deliverable D31).

The first reason is that the time frame between the initiation of research and the delivery of its outputs can take many years: it is therefore necessary to imagine how society will look like in some 5, 10 or 30 years because it is this future society who will use what research and innovation will have been produced.

A second reason is that foresight enables a dialogue between science and society that leads to a better mutual understanding and commitment between researchers and their partners in society, which is needed because of two types of risks: 1. social indifference to research results; and 2. social questioning of technological choices made without enough participation of the whole society (the case of GMO is an example of such a crisis).

Therefore, engaging in a process of common identification of research priorities with the whole society is seen as a way to increase the "social robustness" of science and technology.

## 1.3 WATER RESEARCH AND POLICIES: ESSENTIALLY FUTURE ORIENTED ACTIVITIES

Moreover, foresight is needed for water research and policies to oppose the inclination to design policies in reaction to already patent evolutions of the state of water systems, in order to cure already occurring damages or to remedy existing environmental problems. Water policies should

also intend to be able to prevent damages to occur, and to be more pre-active than re-active. We need to be able to anticipate future evolutions.

Therefore, the precautionary principle is an even stronger necessity to look into the future at plausible evolutions and events, even if there is a lot of uncertainty. Actually a precautionary behaviour is about being able to adapt and react.

Exploring the future is part of this approach for action and measures to be as legitimate as possible, and to build the necessary research strategy that will help reduce uncertainty.

Additionally, the objective of sustainability particularly implies looking at future evolutions because it is intrinsically a dynamic concept. It is therefore not a surprise that more and more environmental policies (the Water framework directive, the Marine Strategy, …) prescribe long term future environmental objectives (good ecological status of waters by 2015 or 2021, Environmental quality goals for 2021 in Sweden…). Sustainability requires not only pre-activity (to anticipate future evolutions in order to be able to react in time) but also pro-activity, which means that we want to anticipate possible futures in order to be able to change them and to propose an alternative desired future. Therefore, research strategies aiming at supporting water policies need to be more pro-active, helping us to shape innovative desirable futures.

# 2. ORGANISING KNOWLEDGE AND REPRESENTING FUTURE EVOLUTIONS

## 2.1 BACKGROUND

Starting from the difficulties that the river basin managers faced in building up the 1st RBMP's, we explored long term strategic research needs for which scientists should initiate works today to deliver outputs available for water management within 10 years. These outputs will support the future water management plans.

Identification of future research needs requires exploring collectively what could be potential threats, opportunities and likely future developments that are at the margins of current thinking and planning. Indeed, research outputs will be useful and used only if expected by water managers. This means that the strategic research needs should be legitimated by a common commitment from scientists and water managers.

## 2.2 A TWO STEP PROCESS

A 2 step collaborative process was used to identify long-term strategic issues.

The first step of this process, involving foresight specialists, research managers and water managers, in the period before June 2007, aimed:

- to identify methodologies that could be used to highlight long term research needs in a collaborative way by gathering water managers, scientists, stakeholders and users together;
- to define broad fields of knowledge that were missing for the first step of WFD implementation.

This step was based on:

- A questionnaire that asked European water managers their feelings concerning, knowledge gaps related to major issues for the future, and methodological limits that they faced during the development of the 2015 scenarios for the WFD;

- A workshop in Liège in June 2007 that analysed the questionnaire results and the foresight methods to start the process of identification of research issues that might be important for future water management.

The second step started with a workshop in Paris in April 2008. The objective was to propose a selection of future strategic issues related to integrated water resources management and to discuss and reword these issues as long-term research needs. This objective will be achieved through collaborative work with river basin managers, research programme managers, academics from different disciplines, representative from civil society.

## 2.3 PARIS WORKSHOP

**Objectives?** The main objective was to identify long term research needs related to integrated water resource management with a strong focus on the WFD implementation, based on anticipating future needs of water managers for the production and the implementation of the further WFD cycles and to anticipate how future societal needs and the state of water system status might develop. Another objective of this workshop was to foster dialogue through a collaborative process between the various actors interested in water policy.

**Who attended?** The workshop brought together practitioners *i.e.* river basin managers, policy managers, research programme managers, academics from different disciplines, and representatives from civil society (NGO). Participants were representative of different spatial scales (regional, national and European) and different European countries. Attendance of the 40 persons was by invitation only. List of participants is in Annex II.

**Outcomes?** The outcomes expected, and accomplished, were long-term research needs in order to develop recommendations for research and to feed future calls for research proposals (IWRM-NET programme, 7th Research Framework Programme (FP7), national research programmes…), developments (Interreg, Life...). Emerging issues for decision-making were also identified and will be circulated among water practitioners.

**Who are the workshop outcomes targeted at?** The outcomes will be disseminated to the European Commission (DG Environment, FP7), IWRM-NET partners, national Water/Policy managers, river basin managers and research institutions

The workshop was a good opportunity for participants to look beyond the normal planning horizons, to help plan in advance the research agenda in support of water policy, to exchange views with a diversity of actors from different fields and parts of Europe on what future research will be needed for integrated water management and, to explain their expectations and to take part in the research and policy planning process.

**Methodology**

To organise the discussion, 2 major issues were identified by the steering committee preparing the workshop:

1. How to value aquatic systems taking into account socio-economic aspects? How to assess the efficiency of the first programme of measures in order to build up the further ones?
2. What new concepts and tools for a real Integrated Catchment's Management? What tools or methods to be able to deal with unknown emerging issues?

Four groups worked simultaneously, two on each of the major issues.

Three working sessions were scheduled during the two days. These sessions had different objectives and expected outcomes:

1. Statement of the needs: What gaps or new problems, unveiled during the first round of the RBMP, need to be investigated for reviewing the next management plans?
2. Discussion on emerging issues: Which issues likely to evolve or uncertain are relevant because they would impact the future of water management?
3. Research needs: Broader discussion on issues, check the relevance of the issues previously identified, identification of research questions and issues and prioritisation.

Outcomes of each session were presented and discussed in plenary. Key statements were given in plenary sessions with only a few presentations.

Brainstorming methodologies were used during the working sessions.

## 3. EMERGING ISSUES – REFRAMING KEY CONCEPTS

Several concepts and representations associated with WFD and Integrated Catchment Management may need to be developed more precisely.

For some participants, WFD was part of ICM since several other directives take place in the same "catchment"; for other participants, ICM could be considered as the means to reach the objectives of the WFD.

It comes out of these different perceptions that it should be relevant to speak about a "Water System" that include the natural, social, economic and technical dimensions of water resources and the associated ecosystems and territories. This stresses the importance of non-sectorial projections into the future.

Therefore the workshop discussion focused on following reformulated questions:

- How to value the Water System? How are these values developed by actors considering their uses, practices and representations, considering water functions? How are these values used to build Management Plans & Programmes of Measures (PoM)? How to assess the efficiency of the first PoM with regard to the Directive's goals and to its impacts on the Water System in order to develop further ones?
- What are the concepts and tools for a real Integrated Management of the Water System? Or, for managing directives, such as WFD, what are the concepts and tools needed to integrate all dimensions of the related Water System? What are the tools or methods to be able to deal with unknown emerging issues?

The working groups identified a range of similar issues.


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

# 4 GAPS IN KNOWLEDGE RELATED TO THE PERCEPTION OF THE WFD AND THE RIVER BASIN MANAGEMENT PLANNING (RBMP)

Current deficiencies in our ability to develop integrated water resource management emerged as a result of exposing the participants' different perceptions of WFD, and its implementation through RBMP. There were thematic gaps of knowledge and overlapping gaps in scientific methods & approaches.

Thematic gaps of knowledge are presented first, from a need to better describe and understand ecological systems to stakeholder's participation. Many of these gaps are interrelated. Transversal approaches that need to be deepened are then depicted.

## 4.1 ECOLOGICAL SERVICES

We don't yet know how to recognise all ecological services and value them, here and now. A major gap in knowledge remains to identify and assess values with regards to different functions of the ecosystems. Focus is needed on the relationship between ecological function and value, and between a set of different functions and an aggregated value of the ecological services.

Considering the dynamics of ecological systems and relationships with social systems, there is a need to question indicators & models with regard to their accountability for the impacts of climate change, to the interconnectivity of data, and their comparability. Furthermore, biological responses are not well understood, and even with the best data and models, remain very uncertain

## 4.2 THE "WATER SYSTEM"

Referring to DPSIR framework (Driving forces, Pressures, State, Impact and Responses), it emerged that:

- the complexity of cause-effects relationships between D, P, S and I require more knowledge;
- there are gaps concerning the consequences (and assessment) of the actions of management (responses) in these cause-effects relationships within the Water System in both short and long term;
- there are gaps between the complexity of the "water system" and simple representations of it such as, for example, the models that give a simplified view of systems;
- there are gaps between the uncertainty of level of scientific assessment and the level of confidence the managers put into these assessments;
- predictive tools are required.

## 4.3 INTERACTIONS BETWEEN ACTORS, VALUES & ECOLOGICAL FUNCTIONS

People are not homogenous and do not share common perceptions of the ecosystems. There is a need to look at the very different relationships everyone has to water, e.g. tap water, river water, floodwater, etc. These relationships are seldom, if ever, connected in people's minds as they are in water cycle. Understanding how to show these connections to the general public and demonstrate the effectiveness of measures, as well as the impacts of their actions, will improve the legitimacy of measures and the perception of fairness and accountability.


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

Heterogeneity in perceptions of values of the Water System induces much higher uncertainty about the assessment of ecological restoration benefits than the uncertainty on costs. The timing and place of delivery of these benefits are issues not yet understood? Cultural differences, across Europe and across sectors, and their consequences, e.g. on perceptions, have not yet been fully explored.

Because of the dynamics between the social, economic & ecological, in practice, there is a lack of ability to address the whole range of relevant pressures, find integrated responses, or even develop models to better understand actors, interests and strategies.

## 4.4 GOVERNANCE OF THE WFD

### 4.4.1 Integration of policies

Policy integration across sectors and levels is needed at a higher level than is currently found.

The WFD requires action from many different actors, but there is a lack of information about who should be involved, how and at what level of responsibility.

### 4.4.2 Governance of the WFD, involvement of stakeholders

Involvement of stakeholders, i.e. participation in a way that is meaningful to them, is not yet seen as a routine procedure. In particular, questions remain about the means to: identify the interest of stakeholders, negotiate a balanced stability between these interests, coordinate the different levels of stakeholders, bring together multi-sectors interests to identify win-win situations.

### 4.4.3 Governance of the WFD, Awareness raising, Transfer of knowledge and Education

Methods for water managers to engage with Stakeholders to develop both their knowledge of WFD are needed. Particularly, developing participation requires awareness raising. There are also gaps in methods to engage stakeholders that are either uninterested or unaware.

Education for all citizens is needed, and not yet provided, to develop a common understanding of the benefits of sustainable water management. Education for water managers is necessary to deepen understanding of wider social perspectives and break from a sectorial approach of water management. A holistic view of water requires integration of many viewpoints. There is a huge gap in this regard.

A related question is how to share experiences through communication and learning.

## 4.5 ADEQUACY OF ECONOMIC ANALYSIS METHODS

Based on rational individual preferences the economic methods implicitly proposed in the WFD do not fit to the evaluation of common values, shared by groups of actors. Especially when these values underpin the collective actions and representation that should be taken into account in RMBP through the public participation that WFD requires.


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

## 4.6 COST ALLOCATION

There is a gap in the explanations given for the rise of tap-water cost. This rise is inducing conflicts. There are few analyses of the conflict and its management caused by price rises due to the implementation of ecological improvements. There is a need to educate people to value the ecological use of water and to manage the valuation of non-use or intrinsic values of water with users.

Social fairness seems to be a central concept which is poorly explored in water policies. What is fair? Who pays for what? Who are the beneficiaries? This implies understanding social as well as technical issues surrounding collective measures to conserve water – particularly differences and similarities across Europe (e.g. managing the cost of irrigation to avoid individually drilled boreholes, changing use of septic tanks, etc.).

WFD requires a lot of investments and policy-makers don't seem to be aware of the very significant costs, yet it is a already a major concern.

Socio-economic indicators & models related to the assessment of the cost/effectiveness of measures are still needed to find measures that address the whole range of relevant pressures, find integrated responses, but also to better understand actors' interests and strategies.

## 4.7 ORPHAN ISSUES

- Allocation of water in and between RBs.
- Divergences between researchers and managers expectations appeared, e.g. in relation to spatial and time scales.
- Is the "good status" of water bodies, a scientific or a political question?
- Is good ecological status definable? How can we value unsubstitutable goods, (e.g. La Joconda?) or essential items (e.g. water)? Is water unsubstitutable?

## 4.8 TRANSVERSAL SCIENTIFIC APPROACHES, RELATIONS BETWEEN MANAGEMENT, SCIENCE & MONITORING

■ Transfer of knowledge and information exchange

It was commonly accepted that it is difficult to organise participation processes. One of the reasons for these difficulties is that people are uninterested or unaware of the problems or requirements of WFD implementation. So there is a need to provide people with an understanding of sustainable water management and its benefits.

There is also a need for a process to educate water managers, deepening their understanding of wider social perspectives because an holistic view of water requires integration of many viewpoints.

Furthermore, relevant information about best practices in other countries is often difficult to find. Something like a clearing house mechanism would be helpful.

■ Transdisciplinary approaches

There are two main types of methods which we can distinguish: socio-ecological and socio-economic methods.

The gaps related to these methods are varied but basically the same for both categories. There is a feeling that we are actually doing a lot of work on indicators and models. But the problem is the interconnectivity of data and availability of comparable indicators. Furthermore, there is a lack of indicators and models to improve detection of future changes. For example, the indicators and models available do not really account for the impacts of climate change. For socio-ecological methods, one reason is that biological responses are not well understood and, even with the best data and models, we still have great uncertainty. So this raises the question: Do we need to invest all our money in better models and data or do we have other approaches?

- Improving joint research

It appeared that it would be relevant to know which issues need to be solved at the international level. For some questions the national level maybe insufficient in terms of critical mass of scientists for example. So, developing trans-national research could be an objective of IWRM-NET.

It would be helpful to know if the programmes developed by water managers for the first RBMP, solved the problems.

## 4.9 CONCLUSION: DECISION-MAKING UNDER UNCERTAINTY

Gaps in knowledge stress the importance of finding a better understanding of ways and means to make robust decisions in conditions of uncertainty. We cannot always wait for the data, models, or information to come from research before we have to act.


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

# 5 THE MAIN FUTURE DRIVERS

The future of the WFD depends on many different drivers whose evolutions are uncertain. How agriculture, technologies, or climate change will evolve may strongly impact on our ability to implement WFD.

In this section, driving forces were identified by considering the following questions; their potential influence on river basin management and the ways these influences might affect the validity of key assumptions that underpin the WFD.

## 5.1 CLIMATE CHANGE

Scientific evidence shows that climate change will affect average temperatures and the precipitation patterns, as well as the magnitude and the frequency of extreme events like storms or droughts, all with consequences on water management (e.g. floods, water supply, water quality). Integration between the Flood directive and WFD will need to be detailed.

There are likely to be significant regional differences in the manifestations of climate change and also in their consequences. Therefore generalization is not relevant.

Ecosystems will adapt to climate-driven changes in hydrology and other climatic determinants. Their current capacities for resilience to maintain existing ecological services and functions will be challenged. Their composition, dynamics & functions may change. In particular, it is possible that evolution of good ecological status may be necessary to match natural evolution of a good and functional ecosystem.

Our ability to build models able to foresee these impacts and indicators that will provide first warnings of changes will be as crucial as our ability to cope with climate change impacts.

Mitigation and adaptation strategies for climate changes will be key drivers of water management.

## 5.2 TECHNOLOGY & INNOVATION

Until recently new technologies have been considered as progress for human beings and the source of solutions for many of the problems human societies face, especially environmental problems. We are becoming much more careful about potential positive and negative impacts of technologies. It is clear that some of them will impact strongly on integrated water resource management.

Bio fuels, hydropower, desalinisation plants are some emerging examples in which the potential disbenefits (eg land-take; increased energy use) and knock-on effects of the 'environmental' technology are increasingly significant concerns.

## 5.3 OTHER SECTORIAL POLICIES

Policies implemented by sectors will impact water management, including key areas of:

- Agriculture, Land-use and CAP
- Energy where strategic aspects and cost increases will affect production, transport, consumption and environmental impacts
- Transport policy. A likely shift of transport of goods from road to inland waterways may counteract the implementation of the WFD


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

- Industry
- Tourism
- World trade that is a cross-cutting issue and a crucial determinant for many sectorial policies (The world market can influence the development of certain economic activities, especially in the agricultural sector. For example farmers are planting more cereal crops this year because the price of cereals has been increasing over the past two years due to global droughts and shift to biofuel production.)
- Others environmental policies, including water policies, may impact on WFD implementation.
- REACH (European directive on Registration, Evaluation, Authorisation and Restriction of Chemicals)
- Flooding directive
- Pollutant controls that require a better understanding of old pollutants and efforts to assess the impact of new pollutants (e.g. endocrine disruptors such as human oestrogen)

## 5.4 DEMOGRAPHIC CHANGES

Ageing of the European population is expected to have an impact on water resource management. Yet the means and magnitude are not very clear. Will uses of water be different (quantity and services)? Will the ageing of population impact on the demographic and spatial structure? For example more elderly people may lead to an increase in the number of second homes, particularly in coastal areas as has been observed in recent years, with consequences on water use and waste water generation.

Migrations, permanent and temporary, inside Europe and outside Europe, will also impact on water management. Either type of migration will drive changes (rural depopulation, or increased demographic pressure on coastal and urban zones), alternatively local water systems may drive migrations (floods, water scarcity).

An increase in urbanisation is expected to impact on water management. Soil sealing arising from increased development might be one the main impacts as it leads to an increase of runoff with greater volumes of water in sewage systems and brings higher concentrations of chemicals and pharmaceuticals in runoff. Human pollution and water recycling will also be affected as will social vulnerability to floods or water scarcity.

Demography needs to be considered holistically in terms of quantity, structure and timescale to forecast its impacts.

## 5.5 CHANGING SOCIETAL VALUES & PRACTICES

Perceptions of the environment, derived from people's practices, are a key concept to understand and correctly assess if we want to be able to manage the water system and its actors. In particular, non-use & intangibles values are of increasing interest.

Changes in societal values may come through a better understanding what hydrological systems provide to society, but it may also come from an evolution of 'cultural' values 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 behaviours might evolve as a

result of changes in societal values linked to the environment. Will people's eco-behaviour become more widespread and efficient? So the "Virtual water" concept could be useful for this. People do not only consume water when they drink it or take a shower. The "virtual water" concept (introduced by Tony Allan in 1993) measures how water is embedded in the production and trade of food and consumer products. Virtual water has major impacts on global trade policy and research, especially in water-scarce regions, and has redefined discourse in water policy and management.

These values, taken together, form a pattern of social values associated to an ecosystem global value. Increasingly, it will become harder to take sectoral decisions in isolation that do not take into account the global pattern.

Will the value of good ecological status (seen as a social object) change due to changes in societal values related to the environment? The political repercussions could be strong.

Social justice, or fairness, appears to be a crucial driver for social actions. Changing perceptions of fairness will strongly affect the ability to implement integrated water 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.

Others drivers related will be the evolutions of data availability and transparency and of water and environmental awareness.

## 5.6 REGULATION & INSTITUTIONS

The future of the EU, especially with a view to 2020-2030 is a key consideration: will the EU become more centralized? Or will we see decentralization with responsibilities shifted to the Member States?

Evolution of political priorities (EU enlargement, further policy integration) will have impacts on the WFD. E.g. the Marine Strategic Directive, based on a similar ambition to the WFD, may strengthen WFD implementation.

The evolution of general regulations, especially public-market, will impact land management and economic activities. In ten years time will we see a stronger push towards deregulation and liberalization, or a turn towards a stronger role for government and public owned water companies?

The evolution of governance frameworks will be crucial, as it will modify the interactions between policy makers and public.

The policy of public data transparency will also impact on the governance of water systems.

In the shorter term, allocation of WFD budgets, revenue and expenditure, will drive the WFD implementation.

## 5.7 SOME POSSIBLE TIPPING (PIVOTAL) POINTS AND WILDCARDS

Famine, epidemic, war (in Europe and anywhere), energy costs; major storms could all induce changes in the demand for food or the supply for food


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

Regional climate shifts, such as a disruption (perhaps a reduction) of the North Atlantic Oscillation could change the regional climate and hence radically alter the water cycle.

## 5.8 CONCLUSIONS

"Vision versus pragmatism – are we on the right road?"

The WFD is a very ambitious framework and that there might be the danger that the gap between what is desirable and achievable is too large. It was also questioned whether the WFD is still relevant in all details? Or does it need adjustment after 10 years? What about the different interests of actors?

The main points emerging from discussions are summarised:

1 - Is the WFD a no-regret policy? Could it take us the wrong way?

2 - Could the WFD be adapted to the list of driving forces?

- Are regional adaptations possible?
- How to integrate different sectors linked to water (energy, industry,…)?
- How to make the WFD more adaptive by rethinking the processes of governance (e.g.: tools, assessment)?
- How to bring more clarity to decision processes and the levels of decision?

3 - How to show and prove the benefits of water policy to society?

4 – How to develop control of the results (going beyond cost/benefit analyses)?

# 6. RESEARCH TOPICS

## 6.1 VALUATION OF ECOSYSTEM SERVICES

### How to value the ecosystem services of water system?

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 protection of ecosystem services is not explicitly mentioned in the WFD. But 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.

Valueing 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. Focus is needed on the relationship between ecological function and social value (social perception by an actor), and between a set of different functions and an aggregated value of the ecological services. The production of a kind of "IWRM ecosystem service calculator" (idea comes from Dr Norbert

Walz, Leibnitz-Institute of freshwater Ecology and Inland Fisheries) might be a very helpful for decision-making processes already explored in few different institutes.

This has a long-term element because 'blue skies' research on both natural and social processes is required to develop fundamental understanding. Yet that does not mean we should stop using current knowledge with its uncertainties in a "learning by doing" mode. The objective is to reach a better understanding of natural and social processes that make up 'ecological services'.

### How these values will change with time under global change?

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). Pressures on ecosystems change our perception of the values of ecosystem services. So the question is how to derive a methodology that is robust, adaptive and will respond to future change?

For example, the value of ecosystem services will change as water prices change. Ecosystem values are relative. Because these values are part of a system of values, when something in the system changes then all the values in the system 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. It is believed that in the long run 'full cost recovery' under the WFD will unconditionally lead to rising water prices and increase competition over the allocation of water.

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. This could lead to an even a faster rate of increase in water prices. So the question of how values will respond to higher prices needs to be addressed by the research.

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.

These questions should be addressed by the development of tools comprehensively taking into account the pattern of interactions between the ecological services, the social actors and the values they assert. In developing these tools, it will be necessary to develop a more systemic perspective of ecological services in order to better understand what the tools are designed to achieve and avoid unintended consequences arising from their application.

## 6.2 EVENT MANAGEMENT (SCENARIOS, ECOSYSTEM RESILIENCE, THRESHOLDS)

### How do ecosystems respond to extreme perturbations?

The concept of the ecosystem resilience is that ecosystems have an ability to maintain their functions when faced with a perturbation. The thresholds are revealed at the point at which ecological processes (and ecosystem services) are affected to the extent that the system changes.

It was felt that the new management strategies (in RBMPs) will be primarily directed at achieving targets for the ecological status of water. However, the effects of extreme pressures or events, such as when an ecological system passes over a threshold and collapses, also need to be

considered. A discussion followed on what was meant by extreme events, and although often this term is associated with flooding events, the term is used here more broadly than this. For example, an extreme event might also be a storm, a one off discharge or a longer-term accumulation of several pressures. The word 'events' was replaced by 'perturbations' to reflect this. It was also mentioned that the effects of events are not always negative and that this should be reflected in the description of this topic.

Discussion followed about what type of research may be of interest with respect to IWRM-net goals. It was suggested that indicators could be developed for each ecosystem. The purpose of these indicators would be to assemble an 'early warning system' that could be used by water managers and thus avoid reaching a "tipping point". Signals provided by these systems could be used as a tool in future RBMPs. In addition, the group also believed that there was a clear need for fundamental science in determining thresholds.

Research based on this topic would be directed not only toward WFD management but also toward the public in general. While there has been some work with case studies with respect to the resilience of ecosystems, it was felt that there was a need to develop European case studies. Case studies that explored the effects of ecosystem collapse could also serve to demonstrate the costs of these events in the form of scenarios.

## 6.3 EVALUATION OF THE PERFORMANCE OF THE WFD (MEASURING EFFECTS, ALTERNATIVES)

### What evaluation measures can be developed that may capture how programmes of measures (in RBMPs) and the resultant changes in water ecology, impact the human environment (e.g. well being)?

The WFD requires the preparation and implementation of a Programme of Measures (PoM) within River Basin Management Plans. It is anticipated that the success measures for the PoM will be limited to the reporting requirements of the Directive itself and thus unlikely to go much beyond basic chemical quality, ecological measurements and their incorporation into maps and graphs. However, if the spirit of the WFD as a new integrated and holistic way to look at environmental management is to be embraced, we will need to understand better how we can measure the wider benefits. In particular we need to know what the impact of an improvement (or decline) in the ecosystem goods and services delivered by the river catchment/basin in the human dimension would be. But how can we measure this? What indicators can be developed that will give us a measure of more abstract issues such as human well-being? This requirement is linked to the ways in which we value ecosystems goods and services.

The assessment of benefits of water policy to society will need the development of tools.

- Tools that describe the "Water System" (social, economic , environmental and technological components) with a better understanding of cause/effect relationships.

- Indicators which are sensitive to limits, not only biological and physical indicators but also socio-economic indicators; plus early-warning systems showing when resilience thresholds may be reached.

These tools should be able to address the requirement of:

- assessing the consequences of measures during their construction (predictive tools);

- assessing the consequences of measures after their implementation;


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

- cost-efficiency assessment.

The assessment of benefits of water policy to society will also need the development of new knowledge. Research should be focused on approaches that deliver results helpful in developing better ways to engage stakeholders. This refers not only to communication but also should encourage research that will trial different approaches (e.g. is it relevant to develop indicators with stakeholders to engage them and if yes, how to do it?). This second need will explore the possible future evolution of the interest of stakeholders.

These questions raise an issue for improvement of research policy and assessment.

Particularly, the robustness of our approaches, tools, methods against future scenarios has to be tested. The research need is to know if the current approaches, tools and methods can be adapted to test the WFD against future scenario policy.

Assessment begs a question of scaling effects from site level to large scale. Development of demonstration projects ("field laboratories") on a river basin scale could be encouraged – and possibly twinned with another country – involving water managers as well as researchers in framing the scientific questions and leading the assessment.

Effective ways of scaling up should be developed, and where good practices exist, these should be spread.

Tests of the robustness of WFD against future scenarios policy should be developed. The research need is to know how to do this testing at different scales (global, local)? Some information or tools exist at a global scale, also at European scale but at a local scale this kind of testing is not really available. The future scenarios should take into account the driving forces and the "other components" that have been identified as important for the long term WFD implementation (refer to the main drivers).

## 6.4 STRUCTURES OF COSTS/ PAYERS

An objective of thematic research in this field would be to widen and include more effectively the 'distributive' aspects of water economics across all aspects the hydrological cycle – for water and financial policy managers – to support development of new systems of 'payment' for water and WFD.

A second objective is to examine the economic 'flows' within a catchment (fundamental research, related to social justice). There is a consequence of the relatively narrow wording of the WFD in relation to economic analysis that can lead disproportionate costs being imposed on the poor e.g. who wins, who loses? Research is need on managing the conflicts; social justice aspects; polluter pays principle.

## 6.5 GOVERNANCE OF WATER (THE POLITICAL SCIENCE OF WATER POLICIES)

Two overall objectives are to develop more effective approaches to research management for research managers and more effective governance processes for policy developers. Both developments have parallel aspects.

They deal with:

- Capturing the positive aspects of a wide diversity of actors and disciplines

- New ways to develop consensus (this may include including breaking down the existing consensus) that reflect all concerns including the weaker and intangible aspects (eg social justice aspects) of policies and issues

The exploration of these research topics should allow us to understand how to make the change from supply driven to demand driven water management and balance uses with ecosystem needs, but also balance between different uses.

### "From water government to water governance on the institutional level"

Several topics interlink, but also need to be addressed independently by research

- How to build trust and find ways to engage stakeholders more effectively?
- How to create learning processes between actors
- How to move from modes of competition to modes of collaboration?
- How to facilitate the communication between involved actors such as ministries, agencies, researchers, etc.
- What are effective mechanisms for learning about best practice and sharing experience, on a national and a European scale?
- How to address the needs of multi-level governance? Research needs to be done to find arrangements, institutions or capacities to work across different levels of government
- What is the role of science in this field?

Considering the driving forces listed above, does the current governance (of the WFD allow it to be adaptive?

The research needs are linked to an analysis of the governance of the WFD that is used nowadays or planned in the WFD itself to find out if the current management of the WFD will allow it to be adaptive. For example, we could think about research on reporting mechanisms to assess to what extent the WFD is a learning process.

There is a strong need to think about, develop ideas and come up with innovative proposals for institutional arrangements that could help to implement integrated water resource management better. Institutional capacities and the related organizational and management models are today not too well-suited for this task, and there is place for research projects investigating more effective institutional organisations. Otherwise integrated water resource management remains a 'nice' concept that is not being implemented in practice.

More particularly, it is important to consider the integration of the different directives that take place in Integrated Catchment Management. We should expect research on the process of developing legal frameworks; how can this process be simplified to integrate different policies?

## 6.6 SEDIMENTS ROLE IN WATER MANAGEMENT (INCORPORATED IN PLANS)

Understanding the relationship between sediment quantity and quality for river basin ecosystem functioning. How can sediment management be incorporated into RBMPs?


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

Sediments are considered by the research community and others, as represented by the SedNet community (a large FP6 network of researchers and stakeholders interested in sediment managment), to be an important part of the land/river system, which should therefore be considered as part of any integrated catchment management approach. Nevertheless, sediments and their role in supporting ecosystems is not recognised in the WFD text and therefore unlikely to feature (at all) in the first round of River Basin Management Plans, or even in the second. The immediate stakeholders are bodies such as port and drainage authorities. They need to dredge for channel improvement and have a resulting waste product for disposal, but the relationship between the volumes of dredged material and their quality varies according to a large number of factors that are not well understood.

In addition, the role that sediments play as a temporary or permanent sink for pollutants and the ways in which these become bio-available or are released into the aquatic ecosystem are not well understood, particularly in relation to storm events which give rise to increased mobility through scouring and flooding.

The link between soil, sediments, pollutant transport and bio-availability in the aquatic environment is a major research gap in the area of integrated catchment management.

## 6.7 CROSS CUTTING ISSUES AND COMMON APPROACHES

- There is a difficulty in proposing really innovative research in a particular area within an integrated interdisciplinary proposal because of the lack of understanding of the innovation among evaluators from 'other' disciplines (which can be counteracted to some extent by basing work in case-studies)
- There is a need for concrete objectives and 'territories' for research (which may not necessarily be spatial – they need to be defined).
- What about the history of water development – what can it teach us from an historic perspective?
- Story telling (ie from case studies) is a powerful way of communicating.
- We always need to consider the effects of uncertainty in a decision making process
- Develop scenarios / foresight for water management: they should address all relevant socio-economic, technological, political and ecological driving forces and help water managers to play through robust strategies. For that reason, they should cover impacts / inter-linkages of driving forces at different scales, role of actors and should enable to play through different topics.
- Transfer of knowledge and information exchange: there is a need to provide people with an understanding of sustainable water management and its benefits.
- Transdisciplinary approaches: trandisciplinarity should integrate non-expert views such as stakeholders views. So if we organise all research process in such a way, we have to formulate and translate from the very beginning stakeholders' problems in scientific questions.
- Improving joint research. It appeared that it would be relevant to know which issues need to be solved at the international level. For some questions the national level maybe

insufficient in terms of critical mass of scientists for example. So, developing trans-national research could be an objective of IWRM-NET. There is a global need for post-evaluation of the efficiency of transdisciplinary networks. Building transdisciplinary projects need time, efforts and network knowledge (finding competences from others disciplines) ; research funders should be aware of these difficulties and provide help to deal with them in their calls (two-steps process with sketch submitting and support coordination among proposals and applicants, …)

- In thinking about the cross-cutting issues, there is a need for understanding the 'Water System' from ecological and social perspectives rather than specific sectors or one particular discipline. This requires acknowledgement of the complexity and uncertainty associated with water managing and the pressure upon decision-makers and scientists to develop 'answers' at different time-scales and for different purposes. Building a 'big picture' of the water system is, by its very nature, a learning process. In many respects, the most significant obstacle to implementing the WFD for managing water more sustainably is the extent to which the processes of knowledge and decision-making around the WFD are designed as a learning processes.
- During this first round of thinking, it came out that they are often divergences between researchers and managers expectations (they may not be on the same time scales).


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

# APPENDIX 1. WORKING SESSIONS REPORT

## GROUP 1A. HOW TO VALUE AQUATIC SYSTEMS TAKING INTO ACCOUNT SOCIO-ECONOMIC ASPECTS?

**Participants :**

Xavier Poux (ASCA, Fr): Facilitator
Peter Allen-William (Environment Agency, UK) : rapporteur
Rob Cunningham (RSPB, UK)
Agathe Euzen (Paris I University, Fr)
Jean-Antoine Faby (OIEAU, Fr)
Lorenzo Galbiati (Catalan water Agency, Sp)
Xavier Lafon (MEEDAT, Fr)
Antonio Massaruto (Udine University, It)
Joop Vegter (TNO/RISKBASE, NL)

**Session 1 - What are the gaps and emerging needs?**

The discussion started by rephrasing the questions because the value of water does have not a real meaning. The value of water derives from the functions it provides, not the water volume. For example there is a difference between 'blue' water found in nature (in rivers, lakes and ground water) and 'green' water from pipes. Water has many valuable functions: Environmental, Social Health, Recreation, etc…

The discussions led to the identification of 5 gaps:

- Gap 1 – demonstrating the value of ecological services - identifying and assessing all the benefits. People are not homogenous. There is a need to look at the very different relationships they all have to water e.g. to tap water, river water, floodwater, etc. These are unconnected in many people's minds. Understanding is needed as to how to show the relevant connections to the general public and demonstrate the effectiveness of measures as well as the impacts of their actions to improve perceptions of fairness and accountability.

- Gap 2 – issue of uncertainty about the value of benefits (which have a much higher uncertainty than costs) Timing and place of delivery of benefits? Are there cultural differences across Europe? Differences in perception in different parts of Europe, or in different sectors, different areas, etc?

- Gap 3 – current economic analysis methods are inadequate for WFD implementation.

- Gap 4 - Education (transfer of knowledge) for all citizens to provide understanding of the benefits of sustainable water management. Education for water managers to deepen their understanding of wider social perspectives (difficult because they already think they know!) Providing a holistic view of water requires integration of many viewpoints. Is good ecological status definable? How can we value unsubstitutable, (eg. La Joconda?) but essential items.

- Gap 5 - Explaining why the cost of water supplied to homes is rising – how do we manage the conflicts which arise when prices rise, particularly to implement ecological improvements? What tools can we use to help people value the ecological use of water? How do we manage valuation of non-use or intrinsic values of water with users. Getting agreement to a common and objective

approach which is clearly fair. What is fair? Who pays for what? Who are the beneficiaries? Understanding the social as well as technical issues surrounding collective measures to conserve water – particularly differences and similarities across Europe? Eg managing the cost of irrigation to avoid individually drilled boreholes, changing use of septic tanks, etc.

**Session 2 – What are the emerging needs and research topics?**

**Four main topic areas had been identified following Session 1**

- Ecological Services
- Interactions between Functions, Actors, Values
- Structures of costs/ payers
- Governance of water (the political science of water policies)

Some cross cutting issues - Sectors eg agriculture, industry

Driving forces were identified -

- changes in policies - eg land-use, biofuels, CAP - all depend on actors and their values (NGO's)
- social justice – changing perceptions of fairness relating to compensation for giving up water rights, changes in the economics of farming, etc
- increasing urbanisation and its consequences (soil sealing, polluting, recycling) and costs
- mobility (temporary and permanent) of citizens (particularly effects on coastal zones) – 2nd homes, etc
- changing societal values –eg understanding what water hydrosystems provide to society, but also 'cultural' values ie landscape - and policies (governance)
- effects of changing climate, how will ecosystem capacities change – how resilient are they?

and new ways of

- interactions between policy makers and public
- perceiving the environment, particularly intangibles
- redistributing costs
- public private agreements

There were also some possible tipping (pivotal) points and wildcards identified

Famine

Epidemic

War

North Atlantic Oscillation

**Session 3 - Defining the issues and priorities for these topics?**

**(Why did we choose these topics?)**

Topic areas

**1. Ecological services**

This has a long term element because 'blue skies' research on both natural and social processes is required to develop fundamental understanding (but that does not mean stop using current knowledge with its uncertainties in a "learning by doing" mode)

Objective : better understanding of natural and social processes which make up 'ecological services'

**2. Interactions between Functions, Actors, Values**

Objective: develop consistent ways to evaluate the integrated effects of WFD PoM's across Europe for use by water managers in ten years time

Design of new methods for evaluation of effects of POM's; also policy research

ie Developing "trans-disciplinarity" (e.g. consider the decathlon which needs athletes with 'good enough' skills in many types of sport. Or do we think of Ronaldo who is a good defender as well as forward?)

Scaling effects from site to large scale - a general problem?

What about developing a "field laboratory" (demonstration projects) on a river basin scale – possibly twinned with another country – involving water managers as well as researchers in framing the scientific questions. But are these effective ways of working (what is the cost of scaling up)

**3. Structures of costs/ payers**

Objective: to widen and include more effectively the 'distributive' aspects of water economics across all aspects the hydrological cycle – for water and financial policy managers – to support development of new systems of 'payment' for water and WFD.

Objective: to examine the economic 'flows' within a catchment (fundamental research – relates to social justice)

E.g. Who wins, who loses? Managing the conflicts; social justice aspects; polluter pays principle; etc

(Comment: there is a consequence of the wording of the WFD which is relatively narrow in relation to economic analysis that can lead to disproportionate costs being imposed on the poor.)

**4. Governance of water (the political science of water policies)**

Objective; develop more effective approaches to research management - for research managers

Objective; develop more effective governance processes - for policy developers

- Capturing the positive aspects of a wider diversity of actors

- Developing new ways to develop (including breaking down the existing) consensus that reflects all concerns including the weaker and intangible aspects (social justice again)


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

**Importance of cross cutting issues and prioritisation**

- Sectors eg agriculture, industry, etc
- Difficulty of proposing really innovative research in a particular area within integrated interdisciplinary proposals because of the lack of understanding among evaluators from 'other' disciplines (can be counteracted to some extent by basing in case-studies)
- Prioritisation needs to be within the topic areas - what is important is the transdisciplinary nature.
- Need for concrete objectives and 'territories' (not necessarily spatial – needs to be defined) for research
- What about the history of water development – what can it teach us?
- Story telling is a powerful way of communicating
- Finally, remember the need to consider

■ climate change adaptation and mitigation and

■ effects of uncertainty

.

## GROUP 1B. HOW TO VALUE AQUATIC SYSTEMS TAKING INTO ACCOUNT SOCIO-ECONOMIC ASPECTS?

### Participants

Bob Harris (University of Sheffield, UK) : Facilitator
Dennis Collentine (University of Gävle, Sweden): Rapporteur
Natacha Amorsi (OIEAU, Fr)
Mike Bonell (University of Dundee, UK)
Jos Brils (Deltares/TNO)
Laëtitia Citeau (OIEAU, FR)
Sephen Midgley (SNIFFER, UK)
Marie-Perrine Miossec (ONEMA, Fr)
Geoff Whitman (University of Newcastle, UK)

The focus of the group was on the broader questions identifying topics of long term research related to integrated water management rather than a focus on "socio-economic aspects". The series of workshops followed a progression through three phases; identification of gaps, possible research topics and priorities/issues. The results of this progression led to the five topics of research presented below.

### Research topics (not ranked)

#### 1. Event management (scenarios, ecosystem resilience, thresholds)

***How do ecosystems respond to extreme perturbations?***

It was felt that the new management strategies (in RBMPs) will be primarily directed at achieving targets for the ecological status of water. However, the effects of extreme pressures or events, when an ecological system can be tipped over the edge of a threshold and collapse, also need to be considered. A discussion followed on what was meant by extreme events, and it was thought that often this term is associated with flooding events but what the group meant by the use of extreme events was broader than this. An extreme event could also be a storm, a one off discharge or a longer-term accumulation of pressures. The word extreme was replaced by perturbations to reflect this. It was also mentioned that the effects of events are not always negative and that this should be reflected in the description of this topic.

Discussion followed about what type of research may be of interest with respect to IWRM-net goals. It was suggested that perhaps indicators could be developed for each ecosystem. The purpose of these indicators would be to assemble them into some type of 'early warning system' that could be used by water managers and thus avoid reaching a "tipping point". Signals provided by these systems could then be used as a tool in future RBMPs. In addition, the group also believed that there was a clear need for fundamental science for determining thresholds.

Research based on this topic would be directed not only toward WFD management but also toward the public in general. While there has been some work with case studies with respect to the resilience of ecosystems it was felt that there was a need mentioned for developing European case studies. Case studies that explored the effects of ecosystem collapse could also serve to present the costs of these events in the form of scenarios.

**2. Valuation of ecosystems (effects of changes in water prices)**

***Value of ecosystem services will change as water prices change, how will the values respond to higher prices?***

Ecosystem values are relative. These values are part of a system of values and when something in the system changes then all values in the system change. The group discussed the relationship between water prices for household uses and the effect of rising prices on this sector. 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. It is believed that in the long run that 'full cost recovery' under the WFD will unconditionally lead to rising water prices and increase the competition over the allocation of water.

Another sector that would be affected by rising water prices is agriculture. Rising prices for crop production are having affects on agricultural land use but will also increase the demand for water. This could lead to even a faster rate of increase in water prices. As a topic, this research not only involves social science research but also research on ecosystems and the services provided.

**3. Sediments role in water management (incorporated in plans)**

***Understanding the relationship between sediment quantity and quality for river basin ecosystem functioning. How can sediment management be incorporated into RBMPs?***

Sediments are considered by the research community and others, (e.g.as represented by the SedNet community – (a large FP6 network of researchers and stakeholders interested in sediment managment), to be an important part of the land/river catchment system, and which should therefore be considered as part of any integrated catchment management approach. Nevertheless, sediments and their role in supporting ecosystems is not recognised in the WFD text and therefore unlikely to feature (at all) in the first round of River Basin Management Plans, or indeed in the second. The immediate stakeholders are bodies such as port authorities. They, which need to dredge for channel improvement and have a resulting waste product for disposal, but the relationship between the volumes of dredged material and their quality varies according to a large number of factors that are not well understood.

In addition, the role that sediments play as a temporary or permanent sink of pollutants and the ways in which these are become bioavailable or are released into the aquatic ecosystem are not well understood, particularly in relation to storm events which give rise to increased mobility through scouring and flooding.

The link between soil, sediments, pollutant transport and bioavailability in the aquatic environment is a major research gap in the area of integrated catchment management.

**4. Social science role involvement *(demand management, allocation conflicts and the WFD) Exploring methods for conflict resolution.*** (awaits text from Geoff)

## 5. Evaluation of the performance of the WFD (measuring effects, alternatives)

***What evaluation measures can be developed that may capture how programmes of measures (in RBMPs) and the resultant changes in water ecology, impact the human environment (e.g. well being)?***

The WFD requires the preparation and implementation of a Programme of Measures (PoM) within River Basin Management Plans. It is anticipated that the success measures for the PoM will be limited to the reporting requirements of the Directive itself and thus unlikely to go far much beyond basic chemical quality, ecological measurements and their incorporation into maps and /graphs. However, if the spirit of the WFD as a new integrated and holistic way to look at environmental management is to be embraced, we will need to understand better how we can measure the wider benefits. In particular we need to know what the impact of an improvement of (or decline in) the ecosystem goods and services delivered by the river catchment/basin on the human dimension would be. But how can we measure this? What indicators can be developed that will give us a measure of more abstract issues such as human well-being? This requirement is linked to the ways in which we value ecosystems goods and services (2 above), itself a research need.


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

## GROUP 2A. WHAT NEW CONCEPTS AND TOOLS ARE NEEDED FOR INTEGRATED CATCHMENT MANAGEMENT?

### Participants

Kevin Collins (Open University, UK): Facilitator
Philippe Vervier (ECOBAG, Fr): Rapporteur
Hannah Büttner (IFOK, D)
Tim Hess (Cranfield University, UK)
Gaëlle Nion (OIEAU, Fr)
Daniela Past (Federal Environment Agency, Au)
Luc Pereira-Ramos (Seine-Normandie Water Agency, Fr)
Anne Probst (CNRS, Fr)
Joseph Smitz (University of Liège, B)

The working group started from the questions:

- What new concepts and tools for a real Integrated Catchment Management?
- What tools or methods to be able to deal with unknown emerging issues?

The process of discussing and identifying research needs to support WFD implementation beyond 2015 was undertaken in 3 sessions:

Session 1 = identification of knowledge gaps related to experiences in the first round of WFD and the River Basin Management Planning (RBMP)

Session 2 = identification of long term issues than can impact on water management or managing for WFD implementation

Session 3 = identification of the key research areas that require scientific support to improve the second round implementation of the WFD

### Session 1: Identification of knowledge gaps related to experiences in the first round of WFD and the River Basin Management Planning (RBMP)

We began the first session by exploring our understanding of the WFD. What characteristics did we associate with the WFD and river basin planning? We noted the WFD and RBMPlanning is a long complex issue and process with many different objectives, stakeholders and approaches. Part of the challenge is that the WFD and RBMPlanning is still experienced as a 'black box'. Experiences to date suggest that the second round of implementing the WFD requires more coordination among actors, integration and multi-disciplinary approaches.

#### 1.1 - Thinking about terminologies.

During discussions among the participants, it emerged there were several concepts and representations associated with WFD and Integrated Catchment Management. For some of the participants, WFD was part of a ICM since several other directives take place in the same "catchment". For other participants, ICM could be considered as a means to reach the objectives of the WFD. The group felt it was therefore relevant to speak about the "Water System" that includes the natural, social, economic and technical dimensions of water resources and the associated ecosystems and territories.

Therefore the working group propositions can be understood as :

- What new concepts and tools are required for a real Integrated Management of the Water System or for managing directives, such as WFD, by integrating all the dimensions of the related Water System?
- What tools or methods to be able to deal with unknown emerging issues?

### 1.2 - Main issues related to current knowledge gaps.

Three main issues have been identified concerning knowledge gaps:

1 - A complete 'big picture' of the "water system" is missing.

2 - Governance of the WFD

3 - Which research needs can only be solved at the international level?

Two additional questions were also identified, which may indicate a different type of knowledge gap:

- Do we know the problems that have been solved in the 1st RBMP? This question may be important because of the complexity of the Water System. In other words, we think we have solved a problem, but in reality, the problem may continue elsewhere in the system because we do not have a 'big picture' understanding of the situation we are trying to improve.

- Is the "good status" of water bodies, a scientific or a political question? This arose out of discussion around the purpose of the WFD: 'good ecological status' is not easy to define and it is not clear when we will have achieved it.

### 1.3 - A complete big picture of the "water system"

We referred to DPSIR framework : Driving forces, Pressure, State, Impact and Response.

It came out that :

- the complexity of cause-effects relationships between D, P, S and I required more knowledge ;

- they are gaps concerning the consequences (assessment) of the actions of management (Responses) in these cause-effects relation ships within the Water System at short and long term ;

- they are gaps between the complexity of the "water system" and simple representations of it such as for example the models that give simplified view of systems ;

- they are gap between the uncertainty of level of scientific assessment and the level of confidence the managers put into theses assessments ;

- predictive tools are required.

During this first round of thinking, it came out that they are often divergences between researchers and managers expectations (they may not be on the same time scales).


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

### 1. 4 – Governance of the WFD

Three main issues were related to the governance of the WFD:

1. Stakeholder engagement in the WFD and RBMP process. Several aspects of stakeholder engagement were discussed, including:

- how can managers engage with Stakeholders who are not familiar with WFD?
- how best to share and communicate experiences?
- how to negotiate between the interests of stakeholders?
- how to identify the interests of stakeholders?
- how to coordinate the different levels of stakeholders?
- how to bring together multi-sectors interests to identify win-win situations?

2. The second issue was linked to discussion on integrated management that is required for WFD implementation. It was suggested that 'clever management' is needed, but the meaning of 'clever' was not discussed in detail. The suggestion that it would be helpful to know which research needs can only be solved at the international level might be relevant here..

3. The third issue is linked to the question to know how to allocate water in RBs. This was not discussed in detail, but links to the questions in (Session 1.3) concerning how the big picture of the Water System is understood and what contributes to good ecological status.

### Session 2- Identification of long term issues than can impact on water management or managing for WFD implementation.

The working group addressed two main points:

- the short and long term components that should be taken into account by the management of the WFD
- what future developments are likely to occur in the water policy?

In discussion, we defined Short Term (2015), Medium Term (2021) and Long Term >2030.

### 2.1 - Short and medium terms

The only component identified was the question to know, within the WFD implementation process for the first round, where the "euros" are coming from and to what they are allocated?

### 2.2 - Long term

We identified the components that could impact the WFD implementation beyond 2021.

Some of theses components are the Driving Forces that have been identified as playing an expected important role in the WFD implementation processes. Other statements were also made.

Among the important driving forces, we identified changes of

- Climate;
- Water Practices;
- Demography (numbers + structure ; for example the forecast migration of populations to see coasts);
- World Trade (land management, which crops where?);
- Lande-use patterns / urbanisation;
- Sectors (tourism, industry,…);
- Energy Strategy;
- Social patterns;
- Policy priorities.

We also noted that WFD long term implementation should take into account:

- Taking long term view on short term spending ;
- Water quality will change according to the change of various factors (agricuture, demography,…);
- mitigation and adaptation strategies for Climate Changes;
- social reaction to future water problems (what is considered important now, may not be considered important in the future - eg conserving wetlands in a drought climate);
- Technology innovation;
- Water as a transport medium;
- changes in the way we think about rivers (for example: is a river a biodiversity reservoir or hydropower capacity?);
- increases in awareness of water and environmental issues.

Much of the above links to the issue identified in Session 1 concerning understanding and representing the complexity of the Water System.

### 2.3 What future developments are likely to occur in the water policy?

Four main points emerged in the discussion:

1 - Is the WFD a no-regret policy ? Could it take the EU the wrong way?

2 - Could it be possible to adapt the WFD to the gaps we identified in Session 1? Some of related questions linked to the "list" included:

- are regional adaptations possible?
- how to integrate of different sectors linked to water (energy, industry,…)?


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

- how to make the WFD more adaptive by rethinking process of governance (eg: more tools, more assessment,…)?

- How to bring more clarity of decision processes and levels of decision?

3 - How to prove benefits of Water policy to the society?

4 – How to develop controls of the results (Cost/benefits analyses)?

**Session 3 - Identification of research need for scientific support of the WFD and River Basin Management implementation**

In the final session, the working group identified five issues that required research to support the long term WFD implementation, and a statement concerning the importance of reducing constraints on further international collaborative research efforts in order to improve opportunities for integrated research.

The 5 issues are ranked.

### 3.1 : How to Assess Benefits of Water policy to Society?

This first main issues can be addressed by two ways.

1St way : Developing tools

It came out that it was necessary to develop:

- tools that describe the "Water System" (social, economic , environmental and technological components) to a better understanding of cause/effect relationships.
- Better indicators which are sensitive to limits and enable prediction

These tools should enable:

- assessment of consequences of measures during their construction (predictive tools);
- assessment of consequences of measure after their implementation;
- cost-efficiency assessment.

2St way : Developing knowledge

This second way will focus on research that should deliver results that should help to develop better ways to engage stakeholders. This way is more than communication. It should encourage research that will develop different approaches (for example: is it relevant to develop indicators with stakeholders to engage them and if yes, how to do it?). This second way will explore the possible future evolution of stakeholder interests.

### 3.2 Testing the robustness of WFD against future scenarios policy

The research need is to know how to do this testing at different scales (global, local)?

The future scenarios should take into account the driving forces and the "other components" that have been identified as important for the long term WFD implementation.

### 3.3 Testing the robustness of our approaches, tools, methods against future scenarios

The research need is to test the robustness of our current approaches, tools and methods against future scenarios.

### 3.4: Does the current governance of the WFD allows it to be adaptive?

The research needs are to link to the analysis of the governance of the WFD that is used nowadays or planned in the WFD to assess whether the managing of the WFD will allow it to be adaptive. For example, we could think about research on reporting mechanisms to assess the extent to which the WFD is a learning process.

### 3.5 : How to integrate the different directives that take place in Integrated Catchment Management?

Research on the process of developing currnet legal frameworks (eg Directives) could be used to develop suggestions and improvements for simplifying the process and enabling more integrated policies?

## GROUP 2B. WHAT NEW CONCEPTS AND TOOLS ARE NEEDED FOR INTEGRATED CATCHMENT MANAGEMENT?

### Participants

Adriaan Slob (TNO): facilitator
Axel Volkery (European Environment Agency): rapporteur
Marc Benoit (INRA, Fr)
Bernard Barraqué (CNRS, Fr)
Patrick Flammarion (ONEMA, Fr)
Irene Huber (PTKA, D)
Stuart Kirk (Environment Agency, UK)
Anne Lieutaud (MEEDDAT, Fr)
Martin Pusch (Leibniz-Institute of Freshwater Ecology and Inland Fisheries, D)
Sophie Richard (Agro-ParisTech-ENGEF, Fr)
Irina Valarié (General Council of the Hérault department, Fr)

### Session 1

The group picked up the question "what gaps / problems have come up in the first round of the implementation of the WFD that need to be considered in the 2nd round?"

Each group member made a brainstorm first and then shared his / her ideas with the rest of the group. The group commented then briefly and asked clarification questions etc. The following points were raised that can be grouped into the following categories

- Management
  - Policy integration (across sectors / levels): Several people said that the WFD requires action of many different actors, and it is not clear who should be involved and how. Furthermore, with reference to the case of France it was pointed out that it is not always clear who is responsible for what, which causes confusion.
  - Participation (awareness raising): in addition it was argued that the WFD requires active participation, but there are problems how to engage stakeholders that are either not interested or not aware.
- Finance:
  - the WFD requires a lot of investments and policy-makers are not aware of the gigantic costs
- Methods
  - Socio-ecological (indicators, models): Are they climate proof? Do not account for impacts of climate change. Problem is also the interconnectivity of data, indicators to compare. Furthermore, biological responses are not well understood, and even with the best data and models, we still have a large uncertainty about it.
  - Socio-economic (indicators, models): related to assessing the cost/effectiveness of measures, finding measures that address the whole range of relevant pressures, find integrated responses, but also models to better understand actors interests and strategies.

- Information exchange:
  - A cross/cutting theme – often it is difficult to find the relevant information about best practice in other countries that could help. Something like a clearing house mechanism would be helpful.
- Decision-making under uncertainty
  - In sum, we need to have a better understanding, of how we can make robust decision under uncertainty. We cannot always wait for the data, models, information from research.

**Session 2**

Coming back from the plenary, the group reviewed quickly the work. Regarding long/term needs / questions the group started an ad-hoc discussion about "Vision versus pragmatism – are we on the right way?" Several members raised the issue that the WFD is a very ambitious framework and that there might be the danger that the gap between what is desirable and achievable is too large. It was also questioned whether the WFD is still relevant in all details? Or does it need adjustment after 10 years? What about the different interests of actors?

In a group discussion process the group members then decided to tackle the question of potential important driving forces in a two step approach:

- What are key driving forces and how could influence river basin management?
- How could they change the validity of key assumptions that underpin the WFD?

The following driving forces were raised:

- Climate change
- Demographic change
  - Ageing of population
  - Migration: inside EU / outside EU?
  - Urbanisation / Coastal development? A lot of people live in coastal areas, will they move in rural areas that are less vulnerable to flooding?
- Energy production / water demand – how will it develop?
- People's behavior / eco-behavior – will people become more efficient?
- Public-market / deregulation- (re)-regulation – will in ten years time we see a stronger push towards deregulation and liberalization, or in turn a stronger role of government and public owned water companies?
- The Future of EU; especially with a view to 2020?30: will the th EU become more centralized – competencies to Brussels? Or do we see a decentralization – competencies shifted to the member states)

- Will transport policy counteract WFD? Intended shift of transport goods from road to inland waterways counteracts WFD.
- Increasing / decreasing transparency of data
- Application of the polluter-pays principle – people reported that there are increasing arguments about who is responsible for water quality / pollution.
- New pollutants / better understanding of old pollutants: new pollutants like endocrine disruptors will come to play a bigger role, and new technologies might spot pollutants in smaller quantities, raise understanding about problematic effects.
- The future of water policy
  - REACH: relationship to WFD?
  - Flooding directive: relationship to WFD?

The group then tried to evaluate the importance of the driving forces, and due to time constraints did not manage to make the second step of analysing the impacts on the key assumptions. Also the discussion about the importance of the driving forces could not be finalised for all driving forces.

- Climate change:
  - Strong importance, but dependent on the region: it is hard to generalise
  - Flood directive - WFD - IWRM should look at this in more detail
  - Value of good ecological status changes – it is very important, might have strong political repercussions
  - Indicator / model changes – not clear what but might put a lot of work into question.
- Ageing of population – group could not decide on the importance
- Technology: the following items were raised in a first round:
  - Biofuels / hydropower are of importance for water managers
  - Virtual water might become important
  - Desalinization plants are an example of new technologies that could change the rules of the game
- Migration
  - Good for some, bad for others – again dependent on the region, could relive stress in one region, but increase it in the other region.
  - Will migration be regulated by water?

**Session 3**

The group reviewed the results from the 2nd working group and decided to vote on the importance of them to get a snapshot picture of what the group is thinking. For this exercise every member received 4 points that she/he could allocate freely. The results were:

| | |
|---|---|
| Climate change | 12 |
| Population habits/behavior<br>Changing demand | 7 |
| Energy production | 5 |
| Increasing/decreasing transparency | 3 |
| Agriculture developments | 3 |
| Pricing water | 3 |
| Technological progress | 1 |
| New pollutants | 1 |
| Future of the EU | 1 |

The group then continued to develop key research questions that have long-term implications and should be addressed from a strategic research programming perspective. Four questions / topics were defined:

- Develop scenarios / foresight for water management: they should address all relevant socio-economic, technological, political and ecological driving forces and help water managers to play through robust strategies. For that reason, they should cover impacts / inter-linkages of driving forces at different scales, role of actors and should enable to play through different topics.
- How to make the change from supply to demand driven water management and balance uses with ecosystem needs, but also balance between uses?
- How to value ecosystem services of water? This is not only an economic topic, but rather a socio-economic topic. Production of a "IWRM ecosystem service calculator" (*Walz*)? How to derive a methodology that is robust, adaptive and responds to future change?
- The last point that took a lot time was the topic of "From water government to water governance on the institutional level". This includes several topics that interlink, but also need to be addressed independently by research>
    - How to build trust and find ways to engage stakeholders more effectively?
    - How to create learning processes between actors
    - How to move from modes of competition to modes of collaboration?
    - How to facilitate the communication between involved actors such as ministries, agencies, research etc.


Xavier Lafon (MEEDDAT) – xavier.lafon@developpement-durable.gouv.fr
Laëtitia Citeau (OIEAU) – l.citeau@oieau.fr

- What are effective mechanisms for learning about best practice / sharing experience, on a national and a European scale?
- How to address the needs of multi-level governance?
- What is he role of science in this field?

In general there was a feeling that there is a strong need to think about, develop ideas and come up with innovative proposals for institutional arrangements that could help to better implement integrated water resource management. It was felt that institutional capacities and the related organizational and management models are today not too well-suited for this task, but that we also have little understanding of what would constitute a more effective institutional organisation in that respect. Otherwise integrated water resource management would remain a nice concept that is not being implemented in practice.

## APPENDIX 2. LIST OF PARTICIPANTS

| Last Name | First name | Organisation | E-Mail |
|---|---|---|---|
| Allen-Williams | Peter | Environment Agency<br>UK | peter.allen-williams@environment-agency.gov.uk |
| Amorsi | Natacha | International Office for Water (OIEAU)<br>France | n.amorsi@oieau.fr |
| Barraqué | Bernard | National Centre of Scientific Research (CNRS)<br>Laboratory Technology, Territories and Societies (LATTS) | barraque@enpc.fr |
| Benoit | Marc | National research Institute of Agronomy (INRA)<br>Department of Science for Action<br>France | benoit@mirecourt.inra.fr |
| Bonnell | Mike | University of Dundee<br>UNESCO HELP Centre<br>UK | m.bonell@dundee.ac.uk |
| Brils | Jos | Deltares/TNO Built Environment and Geosciences Business Unit<br>The Netherlands | jos.brils@tno.nl |
| Büttner | Hannah | IFOK Gmbh<br>Department of Environment<br>Germany | Hannah.buettner@ifok.de |
| Citeau | Laëtitia | International Office for water (OIEAU)<br>France | l.citeau@oieau.fr |
| Collentine | Denis | University Of Gävle<br>Department of Business administration and social science<br>Sweden | dce@hig.se |

| | | | |
|---|---|---|---|
| Collins | Kevin | Open University<br>Open systems research group<br>UK | k.b.Collins@open.ac.uk |
| Cunningham | Rob | Royal society for the protection of Birds<br>Water Policy team<br>UK | rob.Cunningham@rspb.org.uk |
| Decker | Sonia | Seine-Normandie Water Agency<br>France | decker.sonia@aesn.fr |
| Euzen | Agathe | Paris I University<br>department of geography (PRODIG)<br>France | agathe.euzen@univ-paris1.fr |
| Faby | Jean-Antoine | International Office for water (OIEAU)<br>France | ja.faby@oieau.fr |
| Flammarion | Patrick | National Agency for water and aquatic ecosystems (ONEMA)<br>France | patrick.flammarion@onema.fr |
| Galbiati | Lorenzo | Catalan Water Agency<br>Spain | lgalbiati@gencat.net |
| Harris | Robert | University of Sheffield<br>Catchment Science Centre<br>UK | r.harris@shef.ac.uk |
| Hess | Tim | Cranfield University<br>Integrated Environmental Systems Institute<br>UK | t.hess@cranfield.ac.uk |
| Huber | Irene | Project Management Agency Research Centre Karlsruhe (PTKA)<br>Germany | Irene.huber@ptka.fzk.de |
| Kirk | Stuart | Environment Agency<br>Integrated Catchment Science<br>UK | stuart.kirk@environment-agency.gov.uk |
| Lafon | Xavier | Ministry of Ecology, Sustainable Development and Spatial Planning (MEDAD)<br>Department for research and future studies<br>France | xavier.lafon@developpement-durable.gouv.fr |
| Lavarde | Patrick | National Office of water and aquatic systems (ONEMA)<br>General Directorate<br>France | Patrick.lavarde@onema.fr |

| | | | |
|---|---|---|---|
| Lieutaud | Anne | Ministry of Ecology, Sustainable Development and Spatial Planning (MEDAD)<br>Department for research and future studies<br>France | anne.lieutaud@developpement-durable.gouv.fr |
| Massaruto | Antonio | Udine University<br>department of economic sciences<br>Italy | Antonio.massaruto@uniud.it |
| Midgley | Stephen | Scotland and Nothern Ireland Forum for Environmental research (SNIFFER)<br>Scotland | Stephen@sniffer.org.uk |
| Miossec | Marie-Perrine | National Office of water and aquatic systems (ONEMA)<br>Directorate of Scientific and Technical action<br>France | marie-perrine.miossec@onema.fr |
| Narnio | Guillaume | UNESCO HELP<br>France | gnarnio@yahoo.fr |
| Nion | Gaëlle | International Office for water (OIEAU)<br>France | g.nion@oieau.fr |
| Past | Daniela | Federal Environment Agency (UBA)<br>Austria | daniela.past@umweltbundesamt.at |
| Pereira-Ramos | Luc | Seine-Normandie water Agency<br>Directorate of the Programmes and territorial Policy<br>France | pereira.luc@aesn.fr |
| Poux | Xavier | Applied Action Science (ASCA)<br>France | xavier.poux@asca-net.com |
| Probst | Anne | National Centre of scientific research<br>Laboratory of functional ecology (ECOLAB)<br>France | anne.probst@ensat.fr |
| Pusch | Martin | Leibniz-Institute of Freshwater Ecology and Inland Fisheries<br>Germany | pusch@igb-berlin.de |
| Richard | Sophie | AgroParisTech-ENGREF water management, actors and practicers (G-EAU) department France | Richard@engref.agroparistech.fr |
| Slob | Adriaan | TNO Environment and Geosciences<br>Department of Innovation and | adriaan.slob@tno.nl |

| | | | |
|---|---|---|---|
| | | Environment<br>The Netherlands | |
| Smitz | Joseph | Liège University<br>Aquapôle<br>Belgium | j.smitz@ulg.ac.be |
| Valarié | Irina | General Council of the Hérault department<br>Department of Water and Aquatic Environments<br>France | ivalarie@cg34.fr |
| Vegter | Joop | TNO/RISKBASE<br>The Netherlands | joopvegter@mac.com |
| Vervier | Philippe | ECOBAG-ADERA<br>France | directeur@ecobag.org |
| Volkery | Axel | European Environment Agency<br>Scenarios and Forward Studies Group<br>Danemark | axel.volkery@eea.europa.eu |
| Whitman | Geoff | Newcastle University<br>Centre for Rural Economy<br>UK | g.p.Whitman@ncl.ac.uk |