3rd INTERNATIONAL SCIENTIFIC MEUSE SYMPOSIUM

THE MEUSE DISTRICT : CHALLENGES FOR TOMORROW

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ABSTRACTS

SESSION
INTRODUCTION

CHAIRMAN : C. Delbeuck

SESSION 1

EMERGING POLLUTANTS

CHAIRMAN : G. Odenkirchen

The Water Framework directive: sharing experience and meeting future challenges

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With the enforcement of the WFD, 170 hydrographic districts have been created within the European Union, amongst which 40 are international districts (covering 60% of the area). Internationally coordinated Management plans have been produced and published for the Danube, the Rhine, the Elbe, the Meuse and the Scheldt Districts. The positive role of the international commissions has been underlined, but the international cooperation on water resources management is still one the most difficult and exciting challenges that the competent authorities are facing in Europe.

The transnational exchange of information and feedback about methods and experiences has been fostered by specialized groups like the International Network of Basins Organisations (INBO) and in particular its European component, the EURO-INBO.

From the activities conducted in this network, it appears that a significant part of the Water bodies will not reach the good status by 2015. The most important issues today are the implementation and the funding of the programmes of measures, and their economic as well as social aspects. Numerous uncertainties still do exist, about the efficiency of WFD measures as well about the time lag between the implementation of the measures and the expected improvements.

Moreover, within several international district, the same priorities are not shared by all competent authorities and the coordination of the public consultation and participation is also still to improve.

As regards the adaptation to climate change, the European Commission and the State Members have adopted in November 2009 a guidance document, but very few 'non regret' measures have been adopted up to now and most of the adaptation measures will be considered only by the next management plan.

As a conclusion, significant progress has already been obtained since 2000, but major efforts are still to be done especially in international basins.

Framework and needs identified in France regarding emerging substances. Information foreseen to be relevant for the next WFD management plans

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In France emerging contaminants relevant for the aquatic environment are taken into account by various national plans and regional initiatives. These include pharmaceutical and veterinary residues, hormones and endocrine disrupters, CMR molecules, biocides, disinfectants, radionuclides, nanoparticles, ...

River basin management plans integrate actions associated to these substances by promoting their implementation on their respective geographic areas. Such actions mainly consist of knowledge and data acquisition, or less frequently they involve the identification of pollution activities to be controlled.

This presentation will highlight the main institutional incentives to cope with these pollutants at both national and regional scales, and which responses are being brought; in particular we will review some illustrative R&D projects dealing with various aspects of these contaminants, ranging from the identification of sources to the assessment of their spreading in the various aquatic compartments, of their biological impact, and of their possible effects on health.

New and old contaminants in the River Meuse catchment

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The European eel (*Anguilla anguilla* (L.)) in its yellow eel stage is an efficient bio-indicator organism for the monitoring of - especially lipophilic - environmental contaminants. A pollution monitoring network has been set up over Flemish waters, including sites on the River Meuse. This network generated status reports and distribution maps for 'old pollutants' such as PCBs, OCPs and heavy metals, some of them being of special concern for the Meuse catchment. But also new emerging contaminants such as brominated flame retardants and dioxins have been reported for the Meuse.

Some of these contaminants attain high toxicological levels. There is evidence that the ecotoxicological quality of Meuse eels does not allow normal migration and reproduction of this threatened species.

Strategy to manage emerging pollutant issues

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Vienna University of Technology

Emerging pollutants are anthropogenic chemical compounds analysed in drinking water, water bodies and in waste water. For drinking water supply from ground and surface water influenced by agricultural activity and/or waste water discharge such pollutants are well known for decades. Typical representatives of emerging pollutants were e.g. pesticides where the drinking water standard of 0,1µg/l was fixed even for some of them this was below detection limits at the time of decision.

From the two laws of thermodynamics we can derive that on a long term run all the anthropogenic compounds ever produced or newly developed and applied will be distributed all over the globe, even we are not yet able to measure their concentration. Progress in the sensitivity of chemical analysis and the production and use of new chemical compounds, materials and products result in an increasing number of pollutants which can and will be detected in water(s). This fact and basic principles of human and natural development have important consequences in regard to the pollution management.

- Anthropogenic activity and natural processes result in risks. Zero risk must never be a political goal as it cannot be achieved in principle. This also applies for drinking water consumption and water protection.
- Production and use of chemicals, pharmaceuticals, materials and commercial products are driving forces for economic development and human welfare but are also associated with risks which have to be managed.
- The complete absence of chemical compounds (pollutants) as a quality criterion for waters and drinking water can only be applied for those chemicals which have never been produced and whose production is banned globally for ever.
- There is scientific evidence that the risk or hazard for living systems caused by chemicals is bound to their concentration and/or dose.(EU-REACH). Synergetic effect of several micro-pollutants cannot be excluded
- Chemical compounds must not be classified as hazardous without a clear criterion for such a classification.
- Natural systems have a broad but limited capacity and rate for the decomposition of chemical compounds and for many of them the decomposition process is associated with the production of intermediate chemical compounds, most of them unknown. The decomposition processes are also bound to the presence of a great variety of trace nutrients
- There are well established scientific methods to determine maximum threshold values for concentrations (doses) in drinking water which correspond to an acceptable very low risk for human health. Similar methods are in development for aquatic ecosystems but there is still no consent regarding acceptable risks.
- We have to be aware that the number of emerging pollutants will increase and that we need a political and science based strategy to cope with this problem in order to avoid

unacceptable risks from drinking water for humans and for aquatic life in surface waters but also to prevent public uncertainty causing fear and irrational reactions which represent severe political problems.

Having in mind this background different strategies to cope with emerging pollutants are under development (NRW, Switzerland, Baden Württemberg). The strategy developed in NRW in the context of the political programme "Reine Ruhr" will be presented in more detail. The Ruhr river receives the waste water of ~2,5 Mio inhabitants from a heavily industrialised area and the runoff from agricultural areas and is the source of drinking water for about 5. Mio inhabitants. It represents an example for multipurpose water management with high relevance of micro-pollutants (known and emerging). Main aspects of the "Reine Ruhr" strategy for emerging pollutants can be summarised as follows:

- Linking drinking water quality and water protection in the catchment of the of raw water source (surface waters, ground water). The implementation of the WHO Water Safety Plans for the Ruhr catchment will be part of the strategy.
- Using the same parameters and standard values (GOW = health related indication value; LW = guide value) for quality assessment of dinking water and raw water sources (surface water used for drinking water abstraction) even the requirements will be different (probability, exceedance).
- Two threshold values for any emerging pollutant which are only used as a decision support criterion for the political and administrative action plan: immediate information and remedial action for drinking water supply if concentration >50 µg/l, information, start of risk assessment for standard value development and remedial action <50µg/l >0,1 µg/l, if substance has not a strong gene-toxic effect no action if <0,1 µg/l, in the case of strong gene-toxicity <0,01 mg/l)
- Risk assessment and standard development using the GOW and LW (guide value) investigation method developed by German EPA, 2003 http://umweltbundesamt.de/wasser/themen/downloads/trinkwasser/Empfehlung-Nicht-bewertbare-Stoffe.pdf
- For all organic micro-pollutants with a GOW or LW>10µg/l a precautionary standard of 10µg/l is defined, can be exceeded if reduction of emissions is not cost efficient.
- A new monitoring and data management system and a very detailed point discharge inventory have been developed to backup remedial action in the case existing standards are exceeded and in the case of emerging pollutant detection.
- The adaptation of the whole administrative structure to the action plan "Reine Ruhr" is on the way in order to safeguard rapid and efficient response of policy, authorities and information strategy to the detection of emerging pollutants.
- Micro-pollutant reduction technologies for drinking water and treated waste water are investigated in research projects in pilot and full scale.
- Based on the results of these investigations a combination of minimum standards for micro-pollutants at specific point sources (waste water treatment plants) and the application of an environmental standard principle (GOW and LW) for specific pollutants will be developed in order to maximise cost efficiency and successful implementation in order to safeguard water supply.
- This strategy aims to be applicable to all waters which are used for drinking water abstraction.
- For many micro-pollutants the standards for aquatic ecosystems might be lower than for human consumption.

Potential measures to improve water quality of the river Meuse with respect to emerging substances

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Research and management discussions on the water quality development of the river Meuse focus more and more on the presence of emerging substances. In order to get a quantitative overview of the type of substances and the presence thereof, at several locations in the international river basin the water quality with respect to emerging substances has been routinely monitored in the past years. Measurements reveal the presence of many emerging substances, which may be grouped in plant protection products (mainly herbicides), pharmaceuticals (including x-ray contrast media), and industrial chemicals. These groups and even individual compounds within groups may have different sources. Therefore, a suite of efficient measures to reduce loads of emerging substances is needed to improve the water quality at water basin level, to ensure sustainable ecological development of the river Meuse, and to reduce risks for potential conflicts with user functions of the river. These may include both measures at regional, at national, at river basin scale, and at European level. When implementing measures to reduce loads of emerging substances, effects of autonomous developments, such as changing flow patterns related to climate change, should be incorporated.

Key words: emerging substances, measures, river basin

SESSION

AMICE Project

CHAIRMAN: G. Lavergne

General presentation of the AMICE project

M. Fournier

EPAMA, France

- Definition of AMICE (Adaptation of the Meuse to the Impacts of Climate Evolutions), duration and budget
- Goals : examine impacts of climate change on low-flows and floods, propose a serie of measures to adapt water management in the Meuse basin, realise a set of climate-proof investments, communicate on climate adaptation
  Outputs achieved and planned
- Presentation of Partners involved (FR, BE, DE, NL)
- Presentation of the Interreg IV B Program supporting the Project

Analysis of climate change scenarios and the impacts on hydrology of the Meuse basin

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[2]Université de Liège, Belgique

- The multiplicity of potential futures for the Meuse basin : multiplicity of economic scenarios, of GCMs and RCMs -> some climate trends are clear (droughts) and others are much more uncertain
- The climate scenarios chosen for the Meuse basin by the AMICE Partnership : presentation of the methodology to select scenarios
- Impacts of those scenarios on the hydrology through the analysis of future floods and low-flows : methodology and results
- Overview of future investigations within the AMICE project : impacts on the water levels, economical consequences, climate-check of existing water management measures

Promotion of a network of natural areas as an adaptation measure to climate evolutions

M. Lejeune

RIOU vzw, België

- The network of water retention areas throughout the Meuse basin – illustration through the three AMICE developments
- Role of wetlands in natural water retention and buffering of water discharge variations : small-scale / large-scale impacts

Conservation of water retention areas as a good way of combining climate adaptation, sustainable development and involvement of local communities : first elements from the AMICE Partners

Adaptation of the major water infrastructures to climate change and increasing water demand

M. Linsen

Rijkswaterstaat, The Netherlands

- Major water infrastructures in the Meuse basin – illustration through the three AMICE investments (hydropower dams, water storages, channels and sluices)
- Impacts of climate change on the management of these infrastructures (management of uncertainty)
- Impacts of increasing water demand on the management of these infrastructures (water uses on the Meuse, population growth, management of priorities)
- First adaptation responses proposed by the AMICE Partners

How flood crisis management can help enhance the adaptive capacity of populations to climate uncertainties

M. Fournier

EPAMA, France

- Flood crisis preparation as a necessary complement to flood protections
- Flood crisis management in the countries of the Meuse basin : differences of organisation and responsibilities
- Flood crisis management software to improve the reaction and organisation of emergency services : the illustration from Wallonia (APS), France (OSIRIS) and the Netherlands (FLIWAS)

Software developments planned within AMICE to enhance adaptive capacity

SESSION 2

WATER – AGRICULTURE CHALLENGE

CHAIRMAN: Ph. Maire

The use of pesticides in France: Situation and perspectives of reduction

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This paper provides a status report on the use of pesticides in France (in fields crops, viticulture, fruit growing) on the one hand, and especially by production region and assesses in the other hand, the opportunities to reduce pesticide use from the current level and assuming different states of French agriculture, defined by levels of break.
The initial situation (pest pressure, rotation, yield, production, gross margins) is defined from the results of FADN in 2006 as well as surveys of farming practices in 2006 (field crops, viticulture). The assessment of potential reductions in use is generated from work performed in the groups “products”.
Regarding the situation, the use of pesticides by value falls to 67% in field crops, 8% forage, 15% vines, 5% fruit and 5% for horticulture and vegetables. The value of plant protection products is highly correlated to the indicator frequency of treatment. We can therefore consider that the distribution given above also reflects the TFI distribution. If the vine, horticulture and tree cover only 25% of pesticide use at the national level, they can be the source of strong local pressures. In viticulture TFI is close to 13 and to 17 in fruit (36 apples). In these sectors, regional variations can be strong, for the vine, for example, TFI ranges from 7 in Provence and to 22 in Champagne. In field crops, the pressure is also variable depending on the production: the TFI is 16 for potato, 6 for rapeseed, 4 for wheat and 2 for sunflower. Between major regions, the TFI varies only from 1.8 in the big east and the west to 3.2 in south-east and 3.4 in the North.
The analysis of levels of failure revealed the existence of a group of farms with important use of pesticides for the same production level as the others. Reductions in pesticide use are possible without a drop in production. A first break point is the adoption of systems of cultivation with low inputs of pesticides, the report called "semi-integrated agriculture". The adoption of these systems can reduce pesticide use by one third, with losses of production limited (6% in field crops). The margins of these systems calculated with 2006 prices are the same as the intensive group. Prices of 2007 give an advantage at the intensive group.
The goal of reducing 50% of pesticide use, recorded at the Grenelle Environment Forum, is the situation where all farms use integrated farming methods. This passage would be a considerable change in the crop rotation, establishment of orchards with disease resistant trees, introduction of new practices in viticulture. Production could decline by 12% in field crops and 17% in total crop. Widespread organic farming causing production declines much more important. The current prices of organic farming do not outweigh the already low yields.

Water quality in the Walloon region: efficiency of the nitrate action programs supported by the research

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GRENeRA, scientific partner of Nitrawal. www.grenera.be

Analyses monitored over six decades in Wallonia and particularly those from the groundwater of the Meuse hydrographic district have showed an increase nitrate concentration compared to 1975. The necessary transfer time for nitrate from the top soil to the aquifer zone is estimated from 10 to 20 years, depending on the thickness and the nature of the unsaturated zone. The reason of this water quality degradation, from the agriculture contribution, has its origin in changes of practices between 1950 and 1970. Through this period, (1) an important decrease of grassland cover for the benefit of annual crops occurred as well as (2) an increasing use of N fertilizers (manure and mineral nitrogen) to intensify crop yields.

Up to now, due to loss of incomes factor, going back from annual crops to grassland is not conceivable. The first solutions are thus investigating an efficient use of nitrogen to minimize its content in the soil at the beginning of the leaching period. These solutions are to set restricted periods to spread fertilizer (which includes manure storage capacities), to set limits on N application rates achieving optimal crop yield, to install catch crops. In the vulnerable zones of the Walloon region, these rules are controlled since 2008 by the measurement of the soil nitrate content at the beginning of the lixiviation period, so called 'PLN' (Potentially Lixiviable Nitrate-nitrogen). This control is realised each year in some 300 farms (~ 3% of the farms located in the vulnerable zones). Results are compared with annual 'reference' values established by the two scientist teams, partners of Nitrawal (a government advising body), based on observations realised in parcels with good practices. Replication of poor results over 3 years leads to substantial penalities for the concerned farmers.

Lysimetric plots in the field conducted by GxABT in the Meuse hydrographic district since 2003 have showed that PLN is a good indicator of the nitrate concentration within the water percolating below the root zone. Moreover, observations realised since 2004 by GRENeRA in the groundwater of a small agricultural watershed (where farmers are framed and advised by Nitrawal) indicate that good PLN values are slowly leading to a water quality improvement of this monitored small water body. Anticipating the 10 or 20 years of transfer time, we may be optimistic concerning the effect of the action programs on the water quality in the Walloon region.

The challenges are now (1) to maintain a good balance between rules, controls and penalties and (2) about rules, to take into account the necessary delay time to see the positive impact of a rule on the groundwater and avoiding so too efficient (for the environment) but also too costly (for the farmers) imposition of 'good practices'.

Future policy scenarios for agriculture in Flanders and impact on water quality

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The objective to meet water quality standards in agricultural area in the Flemish region is challenging, looking at the present state of surface and groundwater quality. The evolution of the gross nutrient balance over 1990-2007 shows that great efforts have been made, but water quality standards are still not met everywhere. Water quality standards as stated in the European Nitrate directive are taken as the main target for the environmental policy regarding agriculture.

Two policy scenario's looking at 2030 were developed for the Flemish agriculture within a fixed context of economic development and with policy measures differing in ambition level regarding manure application, manure processing and low level nutrients in animal feed as main instruments regarding effects on water quality. These policy measures have been analysed in terms of costs and effectiveness. The outcome is modelled for the pressure indicator gross nutrient balance. This indicator is taken as a proxy for the load of nutrients to water systems, both surface and groundwater. A new target of 43 kg N/ha for this indicator is proposed based on a general and straightforward relationship between pressure and state. Achieving this target means that agricultural activities are probably no longer an obstacle to meet the objectives of the Nitrate directive. In 2030 the scenario with highest ambition meets this target.

It wasn't possible to model the effect of these agricultural scenarios on the surface water quality, due to technical reasons and lack of time. However, water quality scenarios for the basin of the River Scheldt were developed, based on the programme of measures of the draft river basin management plan.. The decline of the agricultural nitrogen load to surface water is smaller in these scenarios than in the agriculture scenario's. Despite a clear improvement of total nitrogen and phosphorous concentrations, only a minority of the Flemish waterbodies meet the draft standards in 2027. Because off improving oxygenconcentrations nitrate concentrations show no improvement.

Key words: gross nutrient balance, agriculture, water quality, nutrients, scenario

Water and agriculture in perspective of the WFD

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SESSION 3

WATER, NATURE, BIODIVERSITY

CHAIRMAN: Kr. Van Looy

Longitudinal changes in macroinvertebrate assemblages of the Meuse River: a taxonomic versus functional trait diversity approach

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In 1998, the I.M.C. initiated a collaborative study among France, Belgium and The Netherlands, developing a consistent approach for collecting macroinvertebrate data from the Meuse River. The primary objective was to assess 'river condition' using benthic communities as indicators of biological and ecological variation in space and time. Five field campaigns were performed during the 1998-2005 period. Benthic macroinvertebrate assemblages were sampled in specific mesohabitats of selected sites along a 800 km stretch of the river.

The main changes in faunal assemblages were investigated using both taxonomic and functional trait-based approaches. Relationships between faunal variations and both physico-chemical gradients and man-made disturbances were examined. Species trait variations in benthic assemblages were related to faunal changes and habitat characteristics. Spatio-temporal dynamics of invasive species were investigated.

Between-sites differences in both taxonomic and functional structures of the Meuse benthic assemblages largely dominated temporal variation, even if alien species relative abundances exhibited important between-years variations in site communities. The same gradual shift from faunal assemblages dominated by insects, including stenotopic and rather pollution sensitive species (e.g. EPCTO), to communities dominated by more euryecic crustaceans and molluscs was observed along the longitudinal gradient, during the whole sampling period. The functional trait analysis underlined the role of marginal habitats in structuring benthic assemblages of the uppermost French sector, which supported the most diverse community. Downstream the macroinvertebrate community exhibited a poorer and less stable taxonomic and functional organization.

Key words: regulated river, river continuum, biological traits, anthropogenic impact, water quality

The current status and future of migratory diadromous fish populations and their habitats in the Meuse River. Towards a master plan for migratory fish in the international Meuse district

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The fauna of migratory fish of the R. Meuse comprises 10 species in a globally very bad demographic status at the scale of the basin, but with a variable status depending on species and on the different river parts. This contribution outlines the situation of these species, with a special attention to the Atlantic salmon (*Salmo salar*), as representative of anadromous migratory fish (growth in the sea and reproduction in fresh waters), and to the eel (*Anguilla anguilla*), as an example of catadromous fish (growth in fresh waters and reproduction in the sea).

The Atlantic salmon, which disappeared from the R. Meuse in the years 1930-1940 because of a combination of factors (fisheries, pollution, dams), had benefited from restoration programs since the years 1980 (sewage treatment, fish ladders, restocking). These measures have contributed to the return, 70 years after their extinction, of adult salmons to the R. Meuse in the Netherlands as soon as 1994, to the Belgian Meuse since 2002 and to the Roer-Eifelrur in 2008. Improvements of the salmon habitat have also been beneficial to other anadromous migrants, such as sea trout, sea lamprey and river lamprey, which presently reach the R. Roer in the Netherlands and should soon reach the Belgian Meuse, at least up to the confluence with the R. Ourthe in Liège.

Previously widespread in the whole Meuse basin, the European eel exhibits since the years 1980 a general population decline in the freshwater habitats, which results from factors acting in the freshwater environment (water pollution, hydro-morphological degradation, bird predation), but also from a decrease, attributable to possible causes (lack of genitors, excess fishing, physical obstacles,etc.) in the number of wild young eels returning from the sea. In order to slow down this decline, the EU has proposed in 2007 a COUNCIL REGULATION (No 1100/2007) which has prompted the design of National Eel Management Plans for allowing the downstream migration to the sea of a sufficient number of adult fish. The objective is set to 40 % as biomass of the annual production existing before the major decline of the species. The measures to be taken mainly involve the reduction of direct mortality due to fishing and to entrainment of fishes into the industrial water inlets and into hydroelectric turbines, the improvement of the upward migration of young eels thanks to fish ladders, and to adequate restocking of young eels. It is in this context that the International Meuse Commission has undertaken in 2009 the definition of a Master Plan for Migratory Fish, of which the main lines are presented in the contribution.

River restoration and biodiversity under the WFD

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By investing in waste water treatment and agricultural good practices, basic action has been taken in order to achieve the objectives of the European Water Framework Directive (WFD). The environmental requirements set out in the directive are a new major challenge. Innovative and cost-efficient solutions are to be discussed aiming at restoring water courses, which served over centuries only for human purposes. Water uses and the requirements of sustainable and diverse ecosystems are conciliated via the approach of building so called stepping-stones. For this purpose spatially delimited water sections are restored. After restoration the water ecosystems as a whole will improve substantially, not only inside the restored areas (stepping stones), but also outside. River restoration measures deduced from the stepping stones approach will be presented.

Ecosystem services and river-basin management

J. Brils

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Societies (present and future generations) depend for their well-being on the goods and services provided by ecosystems. Such goods, comprise, *inter alia*, (drinking) water, food, fuel, medicines and building materials. Services are the benefits society obtains from ecosystems. Examples are: life support (such as fertile soils for agriculture), regenerative services (cycling of nutrients) and cleansing services (clean water). The well-being that nature imparts through our enjoyment and recreation is also a service. Biodiversity is commonly seen as metaphor for the health of ecosystems and is thus an important measure for the effective functioning of natural processes. The ecosystem services (ES) approach is rapidly attracting considerable interest at the global scale throughout environmental policy making, management and science arenas. Many see a huge potential in the application of the ES concept in support of the development and implementation of policies aimed at the sustainable use of our natural resources. The sustenance of ES for human well-being has also become a main EU environmental policy objective. A common understanding of the value of the goods and services that healthy river basin ecosystems can provide, and the diminution of these values by our actions, is an important key to a new approach to river basin management. This was concluded by the European Commission funded project RISKBASE (www.riskbase.info) that, amongst others, reviewed the potential of the ES concept for river-basin management in the context of the Water Framework Directive implementation. In the talk the RISKBASE ES related key-findings and recommendations will be addressed as well as the findings of the Deltares project 'Sustainable Use of Ecosystem Services' in which a small tributary of the Meuse (i.e. the 'Buulder Aa') is a case study.