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May 14 - 15, 2007, Rovaniemi, Finland

Teemu Ulvi, Mika Visuri and Seppo Hellsten (eds.)

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PREFACE

"The European Symposium on Spatial Planning Approaches towards Sustainable River Basin Management" was held in the Arctic Centre in Rovaniemi, Finland, on 14 - 15 May 2007. The Symposium was organised by the Baltic Sea Interreg IIIB project "WATERSKETCH - Principles, tools and systems to extend and harmonise spatial planning on water courses in the Baltic Sea Region".

The overall aim of the symposium was to present and discuss some of the cross-cutting issues on spatial planning approaches to sustainable river basin management as well as demonstrate the main results of the Watersketch project. There were more than 30 scientific and pragmatic approaches from all over Europe presented in the symposium. The symposium was attended by a large and active audience consisting of river basin managers, environmental and spatial planners, authorities, consultants and researchers.

Main themes presented and discussed in the symposium were:

- European legislation on water courses and spatial planning
- Approaches to sustainable river basin management
- Decision-support systems related to river basin planning
- Tools and methods in river basin planning
- Public participation and the Water Framework Directive
- GIS & environmental data management

This report on the proceedings consists of the presentation abstracts submitted before the symposium. The abstracts have undergone a review procedure carried out by the members of the organising committee.

On behalf of the organising committee in Oulu in May 2007,

Editors

The organising committee:

Dr Seppo Hellsten, Finnish Environment Institute (Finland), chair
Mr Teemu Ulvi, Finnish Environment Institute (Finland), co-chair
Mr Mika Visuri, Finnish Environment Institute (Finland), secretary
Prof Henning Sten Hansen, National Environmental Research Institute (Denmark)
Prof Linas Kliucininkas, Kaunas University of Technology (Lithuania)
Ms Dörte Krahn, TuTech Innovation GmbH (Germany)
Prof Walter Leal, TuTech Innovation GmbH (Germany)
Prof Ireneusz Zbicinski, Technical University of Lodz (Poland)

CONTENT

Opening Session

Principles, Tools and Systems to Extend Spatial Planning on Water Courses – are there new solutions for river basin management?

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Introduction

River basin planning already has long traditions in water pollution control terminology. Terms such as Integrated River Basin Management (IRBM) and several others that are even more sophisticated have generally been applied. A new, practical pan-European approach has been adopted in the Water Framework Directive (WFD). According to the WFD, all European river basins should be covered by river basin management plans (RBMP) with the ultimate goal to reach good ecological status or potential in all waterbodies before the year 2015. Baltic Sea is one of the most fragile marine areas in Europe, with very sensitive brackish water-oriented flora and fauna. It has been suffering from heavy eutrophication and enrichment by some harmful substances. In such a region, one of the most important ways to reduce these harmful environmental impacts is proper river basin planning. According to the objectives of the WFD, this includes wide basic data collection in water body status assessment and planning different kinds of measures for river basin management. This requires significant efforts in all the EU member states.

The Baltic Sea Interreg IIIB project "Principles, tools and systems to extent spatial planning on water courses – WATERSKETCH" is being realised between 2004 – 2007 in order to clarify and analyse the ambiguous and conflicting interests in water course planning,. The main aims of the project have been to find answers to the following questions:

1) What are the main directives and conventions related to the use of river basins as well as the river basin management?
2) How are these demands expressed in the regional scale land use planning now and in future, especially in relation to the formulation of the river basin plans according to the WFD?
3) What are the most common problems in the Baltic Sea river basins?
4) Are there any common tools to be utilised in river basin management?
5) How can we disseminate information on sustainable river basin planning?

International legislation and river basin management on the regional scale

In addition to national legislation, there are more than 30 European directives and other international conventions related to river basin management (Frederiksen & Mäenpää 2006). The review showed that some directives, such as the WFD, contradict with other directives, e.g., the one concerning renewable energy sources, which promotes development of hydropower with significant degradation in riverine environments. In general, most of the member states surrounding the Baltic Sea are fully implementing the goals of the WFD in their national legislation. River basin districts have been established, with authorities formed to apply the WFD (Frederiksen & Mäenpää 2006). On the other hand, there is no clear picture on how the programmes of measures are going to be realised in order to reach good ecological status in the watercourses.

One key issue for successful implementation of the WFD is involvement of the public (Hansen & Mäenpää 2007). Public participation is strongly emphasized in Article 14 of the WFD. It requires that the Member States encourage involvement of all stakeholders into the implementation process, especially into the RBMP. Public participation is important, especially in the drainage basins, where non-point sources account for the main proportion of the loading imposed on the water body.

Outcomes of the project case studies

The case studies formed the central part of the Watersketch project and covered some of the most relevant problems seen in river basin management in the Baltic Sea Region. The German case study was focused on the Hamburg metropolitan area, where severe problems were raised especially by the management of contaminated river sediments (Heise et al. 2007). The Harbour of Hamburg is suffering from inputs of contaminated river sediments from the large international Elbe river basin. Also, the continuous dredging operations create several problems related to the sediment disposal and the high content of priority substances.

The Danish case study covered rural areas in the Northern Jutland, where the intensive agriculture degrades the possibilities to reach the good ecological status in the unique freshwater system Limfjorden (Broch et al. 2007). Limfjorden is surrounded largely by fields and intensive agriculture consisting of a high number of cattle. Phosphorus inputs to this partly brackish ecosystem have been significantly reduced, but the loading of nitrogen is still too high and could be reduced mainly by limitations of agriculture.

In the Polish case study, problems related to the large Jeziorsko reservoir were investigated (Skrzypski et al. 2007). The reservoir was originally created for flood protection and irrigation purposes at the Warta river basin, but there has been change in its use because of increasing recreational use and even the high nature protection values of the wetlands recently established in the area. The main problem in the area at present is the uncontrolled release of non-purified wastewaters, which causes both eutrophication and hygienic problems in the reservoir. Also, conflicts in various water management alternatives are being met.

The Lithuanian case study encompassed the Minija river basin, with demands of increasing tourism, nature protection and integrated coastal zone management present (Kontautas 2007). The Minija River is a unique spawning and breeding area for sea trout and salmon. Increasing tourism with uncontrolled construction work and several other man-made obstacles as well, such as old dams and hydropower stations, are having negative effects on the ecological status of the river.

Four of the Finnish case studies covered major problems present in a forest-dominated northern river basin, the Oulujoki River (Hellsten et al. 2007). It is a typical large northern boreal river fully developed for hydropower production. The main environmental goals called for by good ecological potential were determined for the main river stretch. The first case study showed that the effects of restoration measures focused on habitat improvement and changes in flow regime without significant effect on hydropower production are very limited. Another environmental problem in the whole river basin is the high proportion of non-point source loading of the total loading imposed to the river. This loading originates mainly from agriculture and forestry, and locally from other sources as well, e.g., from peat production. The effects of non-point source loading on small lakes surrounded by forestry activities were studied at the head waters of the river. This second case study demonstrated difficulties in the determination of ecological status of humic lakes and could not point out good ecological indicators of loading caused by forestry drainage and fertilisation. On the other hand, effects from non-point source loading, originating largely from agriculture, could be seen in the ecological status assessment of the Muhosjoki River. One of the final conclusions of this third case study was that in order to be able to reach good ecological river quality, the land use-derived non-point source loading has to be decreased, which is a challenging but possible task in river basin management.

Also, criteria for assessing conservation values of Natura 2000 areas in relation to the implementation of the WFD were developed and put into practice in the fourth case study of the Oulujoki river basin (Hellsten et al. 2007). The study was focused on the definition of water body-related wetlands and their management. Lake Lentua (90 km^2) is one of the most well-known large lakes without any hydromorphological changes in northern Finland. In spite of its protection status, some signs of changes have been recognised and it was emphasized that certain management plans, including measures at a forest dominated river basin, should be realised.

The Kokemäenjoki River case study in Finland focused on finding solutions for the conflicts between the different forms of uses and the stakeholders' interests in the land areas and coastal waters in the famous river delta (Hiedanpää et al. 2007). Several stakeholders' meetings were organised and hot spots with conflicting interests were determined in order to help spatial planning in future.

Valuable tools for river basin management

One of the main results of the Watersketch project is the development of a web-based toolbox for river basin management. Most of the tools used in the Watersketch case studies are collected in the toolbox for further and wider use in different tasks of sustainable river basin planning (see toolbox.watersketch.net). A total of six different tools will be presented in the toolbox. **Web-HIPRE** is a tool for multicriteria decision analysis (MCDA) using value-tree structure. **RiverLifeGIS** is a software for hydrological and water quality computations on river catchments using geographical information (GIS) and monitored water quality data. Contributions from the public can be easily managed in river basin planning through the **Public Hearing Database**, as in any kind of other spatial planning processes. **Priority Game Generator** offers a possibility to create web-based priority games offering citizens the possibility to attempt for themselves the often difficult act of balancing various interests against each other. With the **REGCEL** tool, the ecological impacts of changes in water level fluctuation in lakes can be assessed. The **DHRAM** tool offers a possibility to assess the harmful impacts of flow changes in river ecology. All these tools are also presented and described by Ulvi et al. (2007).

Conclusions

The Watersketch case studies clearly demonstrated that the state of most of the rivers running to the Baltic Sea is only moderate or locally even poor at present. With the exception of the Warta River and the Reservoir Jeziorsko, which are suffering from non-purified wastewaters, the main reason for river state deterioration is land use derived non-point source pollution including nutrients, suspended solids and harmful substances. This loading originates mainly from agriculture and forestry especially in the northernmost part of the area (Heikkinen et al. 2006). In order to be able to reach a good ecological state in the rivers, the non-point source loading should be reduced significantly, and the main methods for this should be known. The Watersketch project provides a set of tools for this challenging work. One of the most important conclusions of the project is also that integrated, environmentally sustainable land use planning of river basins requires as effective integration of the water and land management policies as possible.

The Watersketch project has also developed cooperation between the communities by including scientists and practical planners also as main users of river basins into the same working groups of the project. Good examples of the results gained can be found in a web-based book of sustainable river basin planning, where some of the Watersketch approaches on river basin planning have been presented. Most of the available information is downloadable at project webpage www.watersketch.net, including newsletters and project reports. Watersketch project has also organised several workshops ranging from international and transnational events to national level training sessions for practical planners. The most significant outputs excluding the last half-year of the project covered 6 transnational seminars, 27 tool training sessions for different stakeholders and participation in 47 national or trans/international seminars. The published results included 14 articles and 4 academic theses.

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Session 1
Legislation in Relation to River Basin Management

The Water Framework Directive – spatial and institutional integration

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Introduction

The Water Framework Directive (WFD, 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy) came into force on 22 December 2000. It provides a framework for EU water policy aiming to establish an integrated approach to the protection, improvement and sustainable use of water in Europe.

This new way of planning for environmental standards is a challenge to institutions in Member States. Different water issues, other environmental objectives and spatial (land use) planning need to be managed in an integrated way. Moreover, demands for stakeholder integration and economic and territorial efficiency all point to a need for coordination and integration of various processes related to the management practise in institutions or departments in charge. It follows that more effective coordination between water management institutions and other institutions is required, such as spatial planning, nature protection and land use.

The purpose of this paper is to discuss the prospects of environmental integrated planning and management in the context of the Water Framework Directive, on the basis of key issues in eco-system based approaches to environmental management, such as spatial fit and institutional interplay. Moreover, it is to identify key issues in administrative procedures that management institutions need to address if the WFD goals are to be pursued, and potentials for putting the integrated river basin management into practice, especially in the context of spatial planning and institutional coordination.

Methods

The method used is to describe the legal framework for integrative practice and explore the strength of integration inscribed in the WFD, as well as other procedural elements in EU legislation supporting integration. Moreover, we analyse the interaction of different directives and identify cross-cutting issues. The main information derives from analysis of the EU directives and guidelines related to water management and other environmental objectives. Legislation meant to implement procedures securing policy coherence and integration of environmental issues in policies has also been analysed, as well as sector policies affecting land use. The analysis has focussed on the role of WFD in the strategic policy circle and how strongly the integration to other legislation is expressed in the WFD. Moreover, the procedures within the WFD and securing integration with other directives are analysed, and cross-cutting procedures that could allow for common processes, tools and databases are identified.

Main Results

The paper set focus on three issues that will require attention in the implementation of the WFD. The first is the need for management practice which includes a spatial approach and the establishment of common databases for the cross-scale management of river basins within the River Basin District, and for integration with management objectives with other administrative or physical boundaries, such as land use and habitats. Large parts of the information used for the production of the plan will have a spatial expression – such as protected areas, monitoring networks, and part of the pressure and impact analysis. As these procedures are also, to different degrees, found in other directives on water or habitats (see Table 1), administrative and territorial efficiency could be improved by creating a common spatial database.

The second is the need to incorporate the WFD objectives into policies regulating driving forces – notably land use affecting policies, such as agriculture, transport, energy and urban development. The Strategic Environmental Assessment is seen as the tool to ensure this integration. It is evident that eventually parallel procedures should be coordinated to as large an extent as possible. This is relevant for different planning processes and single elements within these, such as public consultation. "Information and dialogue fatigue" may be a real problem, if the public is presented to different plans and policies without the necessary coordination in terms of issues and timing. This calls for further thinking in terms of institutional design and coordination platforms.

Table 1. Cross-cutting issues in the Directives directly related to WFD.

Cross cuttings	Monitoring and Data Collection	Management Plan	Designation of Areas	Public Consultation
Water Framework Directive	Yes	Yes	Yes	Yes
Habitat Directive	Yes (surveillance)	Yes ("if necessary")	Yes	Under specific circumstances
Bird Directive	No (only inventory)	Yes	Yes	No
Bathing Water Directive (New)	Yes	Yes	Yes (annual identification)	Yes
Urban Wastewater Council Directive	Yes	No	Yes	Only information
Drinking Water Directive	Yes	No	No	Only information
Nitrates Directive	Yes	Yes	Yes	No
Sewage Sludge Directive	Yes	No	No	No
Plant Protection Products Directive	Annual list of products	No	No	No
IPPC Directive	Partly (Specific installations)	No	No	Yes
EIA Directive	No	No	No	Yes
SEA Directive	No	No	No	Yes
Seveso Directive	Collect information	No	No	Yes

The Water Framework Directive in the Baltic Sea Region Countries – vertical implementation, horizontal integration and transnational cooperation

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Introduction

The European Union Water Framework Directive (WFD) was adopted in 2000. The WFD takes an integrated approach to water management and its objective is to achieve “good water status” for all waters in Europe by 2015. In the following paper, we investigate how the WFD has been implemented in 11 countries in the Baltic Sea Region (BSR). The aim is to investigate the consequences of the WFD implementation on the national spatial planning systems and to take a closer look at the relationship between spatial planning and water management planning. The countries investigated are Belarus, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, the Russian Federation and Sweden.

Method

The study is based on 11 country reports and 3 case studies performed in 2006. The country reports describe the various national spatial planning systems and water management systems and in particular, their adaptation to the demands put forward in the WFD. In addition, the connection between the WFD implementation and spatial planning systems, including legislative and institutional aspects, is analysed. The analysis is based on three analytical approaches; *vertical implementation*, *horizontal integration* and *transnational cooperation*. The approaches are related to the demand of an integrated approach for managing river basin districts (RBD) and setting up river basin management plans (RBMP). By *vertical implementation* we refer to the integration between organisations directly involved with water management. *Horizontal integration* stands for the integration between water management and other sectors, such as spatial planning. We refer to the integration of international river basins as *transnational cooperation*.

All the 11 performed country reports describe the national spatial planning and water management systems and their adaptation to the demands put forward in the WFD *before* and *after* the WFD implementation. Additionally, the trans-national dimension has been investigated.

Main Results

Applied WFD principles

The assessment of the application of some WFD principles related to spatial planning shows that many were new for the BSR countries. This implies that changes had to be made in order to adapt to the Directive. It is also evident that efforts have been made. Among the non-EU countries, Norway is implementing the Directive. Some of the WFD principles are being applied in Belarus and Russia as well.

A principle already rooted in some BSR countries was the "river basin as a planning and management unit". Here the WFD implementation has led to an enforcement of the principle. The same development can be seen for the principles "assignation of international river basin districts and transnational cooperation" and "public participation".

The principle of "river basin authorities" was not that well applied in the investigated countries before the WFD, and this principle has not been that well implemented yet.

The principle to establish "river basin management plan" was not applied in the investigated countries before the adoption of the WFD, but this principle has been implemented after its adoption. The same goes for the principles "economic analysis of water use", "water quality objectives in legislation" and "combined approach for point and diffuse sources".

Vertical implementation

Regarding the vertical implementation, the WFD implementation has been adapted to the hydrological and the prevailing institutional settings in water management. All investigated EU countries seem to have a minimalist approach in the WFD implementation, implying that changes have been carried out without making any radical modifications.

Two models of river basin management can be identified. The first model has the main river basin authority located at national level; the second model has the main authority at the regional level. The local level is often given the operative tasks in water management.

Coordination bodies have been established in all the investigated EU Member States. Their function is mainly consultative and monitoring, and they will support the work of water management units as well as of those authorities from other sectors. Moreover, the coordination bodies work as a participatory platform where national, regional and local public actors as well as private stakeholders and non-governmental organisations (NGO) have the opportunity to participate in the elaboration of the RBMP.

Horizontal integration

In most countries, the WFD implementation has not had any greater influence on the integration between water management and spatial planning yet. Water issues were and are included in spatial planning. However, the degree of integration varies. The introduction of the WFD implies that the linkage between spatial planning and water management will be reinforced in some countries. The established coordination bodies are potential means for integrating spatial planning and water management. However, this role is not stressed in all countries. The relationship between the RBMPs and spatial plans will be of great importance for integrating spatial planning and water management. What this relation will look like will become clearer when the drafting of the RBMP starts.

Mismatching geographical boundaries of the spatial planning units and the RBD, the different timing of spatial plans and RBMP and lack of resources, i.e., time and money, may hamper synergy between water management and spatial planning. There is also the risk that the spatial plans and the RBMP may overlap. In some countries, legislation related elements are lacking to facilitate integration. A tentative cooperation field between water management and spatial planning is public participation, where experiences from spatial planning could provide input on how this issue could be dealt with in water management. Another already existing cooperation field is the Environmental Impact Assessment.

Transnational cooperation

All investigated countries share at least one river basin with a neighbouring country. In general, the WFD implementation appears to have initiated and improved transnational cooperation. This observation is based on the notion that international RBDs have been appointed, agreements have been signed and commissions or working groups have been set up to deal with WFD issues.

Conclusions

The EU Member States in the BSR as well as Norway are on their way to implement the WFD. Some principles are also applied in Belarus and the Russian Federation. Additionally, the Directive has stimulated transnational cooperation. The integration between spatial planning and water management can be further developed in all investigated countries. There is a distinction between water management and spatial planning. Spatial planning is characterized by consensus and the task to balancing different kinds of needs, i.e., social, economic and ecological. Water management has traditionally been focused on command and control of the resource water. Consequently, spatial planning and water management have had different goals and different understanding. It is therefore important to cooperate between experts at all levels in order to facilitate integration between water management and spatial planning.

Sustainable river basin management under the Water Framework Directive and the protection of drinking water resources

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Introduction

In the Netherlands, 40 % of the drinking water is produced from surface water. Due to the shortage of space, these resources are often found in combination with other activities, such as those pertaining to industry or agriculture, in the same neighbourhood. These combinations impose strong demands on the water management of the river basin and the legal instruments that are at hand.

The Water Framework Directive (WFD, 2000) ensures sustainable availability of good quality groundwater and surface water. Current drinking water directives are partially addressed in the WFD, along with 'new' obligations such as the river basin approach. This study, ordered by the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM), describes the influence of implementing the WFD on the protection of drinking water resources, not only with respect to drinking water regulations, but also concerning other related regulations, for example, the regulation on spatial planning.

Analysis

An analysis has been carried out on existing and new regulations, both on the European community and national level. These regulations include the Water Framework Directive and the Drinking Water Directives (75/440/EEG and 98/83/EC), along with their implementation in Dutch legislation. Additionally, an evaluation in practice has been made of the effectiveness of the current protection of drinking water resources with respect to legal and quality aspects.

Finally, a proposal has been formulated to ensure suitable site-specific protection of drinking water resources for other functions. The general approach taken in this proposal will also make it more utilizable by other European Member States.

Results and Measures

The aim of the WFD is to achieve a level of protection at least equivalent to that provided in earlier legislation. There is already an obligation to report on the protection of drinking water resources. New is the river-basin approach set out in the WFD. This means that in water management, the effect on downstream water quality needs to be taken into account, especially when specific quality standards (e.g. drinking water resources) are involved. This holds for measures that directly influence water quality, such as the issue of permits for spills and the use of pesticides. However, this is also true for the admission of new substances to the market and the formulation of quality standards with neighbouring countries at border crossings situated in a river basin.

Existing regulations on substances in the environment and standards related to drinking water production also conflict with each other. Streamlining standards and substances in the different relevant national pieces of legislation is therefore advised. In this way, discussions between the water administrator and drinking water company on the substances that cause problems in drinking water production are cleared up.

According to the WFD, it is mandatory for European Member States to identify water bodies containing drinking water abstraction points in a so-called 'Register of protected areas' and to carry out measures to achieve drinking water objectives assessed at the abstraction point. One possible measure is to draw up a dossier set up by all parties involved, and offer a framework for suitable protection and measures for that area. This measure is designed to accommodate the specific reaction to pollution of each drinking water resource (lake, canal and river) and the fact that the influence of such spatial factors as agricultural or industrial areas varies per resource. Firmly establishing water quality in the spatial planning policy is advised, for example, to reduce point and diffuse pollution. The current Water Assessment in use in the Netherlands is not an adequate instrument in this regard.

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Harmonising Water Management in a Natura 2000 site According to the Water Framework Directive – Case Lentua

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Introduction

Relevant Natura 2000 areas are to be included in the register of protected areas of the Water Framework Directive (2000/60/EC, WFD). However, the environmental objectives for these areas and the basis of selecting the Natura 2000 areas in relation to WFD are not specified. This study applies national approach developed for identifying relevant values of Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC) into practical water management in a national pilot study. The work aims to provide one of the first examples of harmonized water management according to Natura 2000 and WFD. The presented approach and recommendations are presented as guidelines. The general outline of the approach is seen applicable in countries implementing the WFD.

Assessment of Lake Lentua

Lake Lentua is a lake of 90 km^2 water area and total catchment size of 2 065 km^2 located in Oulujoki cathment area in Kainuu region, Northern Finland. The lake, located at Nature Reserve Friendship national park co-governed by Finland and Russia, has been included only partially in Natura 2000 network.

Protected Natura 2000 area of Lake Lentua consists of 6591 hectares including ten Natura habitats of annex II (Airaksinen & Karttunen 1998) and eight bird species recognized in the Birds Directive annex I (Vainio 2005, Meriruoko 2005). Three habitats and four bird species were considered water dependent according to the national approach (Kokko & Hokka 2005, Leikola et al. 2005).

The maintenance plan of the Nature Reserve Friendship national park is identified as the suited planning instrument in which water management objectives and actions are proposed to be included. The maintenance plan is recommended as one Programme Of Measures (POM) recognized by the WFD (Article 11). Similarly, establishing buffer zones along rivers in cooperation with spatial planners is proposed as a POM. The specific role of Lake Lentua as a proposed type reference lake in the Finnish lake typology of WFD is emphasized in defining study requirements of the current status.

Background studies of Lake Lentua water chemistry (Markkanen et al. 2001, Virtanen unpubl.) and sediment (Sandman et al. 1994) indicate a slight increase in eutrophication from 1960s to 1990s captured in the long-term deep monitoring station. Littoral macrophyte monitoring results of the early 1980s and 2004 cannot be compared due to methodological changes and small sample size of 2004 monitoring.

Main habitat type of Lake Lentua is oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) covering 4790.5 hectares (72 %) of the Natura area. Other water depended habitats, i.e., (1) dystrophic lakes and ponds and (2) transition mires and quaking bogs, both account for less than 1 % of the protected area; the exact area of these habitats has not been stored into the Finnish Natura 2000 database (Finnish Environment Institute 2005).

Recommended Water Management

Based on the interpretation of directives, three guiding principles that cut across the water management in Lake Lentua were specified.

1) As a general guideline, reaching good status as defined in the WFD should not jeopardize the favorable conservation status required by the Habitats Directive and the Birds Directive.
2) The protection of water-dependent Natura 2000 habitats and species is given first priority in setting the water management practices.
3) The water management practices are implemented following the WFD whenever this is possible without a conflict with the objectives of the Natura 2000 Directives.

It was proposed that maintaining the oligotrophic conditions of Lake Lentua that form the basis for the main Natura 2000 habitat and the protection of the area is equal to maintaining the good water status.

Objective 1

Maintain the oligotrophic conditions of Lake Lentua by securing the favorable conservational status of habitat oligotrophic waters containing very few minerals of sandy plains, as required by the Habitats Directive.

Objective 2

Prevent deterioration of the good status of Lake Lentua by implementing necessary measures as required by the WFD (article 4a.i).

The objectives were followed when recommending water management based on existing biological data, identified Natura 2000 values and the reference lake status. Five water management actions resulted:

Management Action 1

Assess the current ecological and chemical parameters of Lake Lentua in accordance to the WFD quality elements for establishing reference conditions and impacts from eutrophication.

Investigations of ecological status consisted of five surveys (phytoplankton, benthic invertebrates, fish studies, macrophyte and phytobenthos studies and diatom study) required for establishing reference conditions due to data gaps and earlier findings. For surveys, six potential impact sites were proposed, together with the repetition of earlier macrophyte and diatom studies.

Management Action 2

Consider delineating Lake Lentua into various water bodies in case ecological and / or chemical parameters support this.

In case results of the surveys indicate a need for delineating Lake Lentua into smaller water bodies (minimum size 50 hectares), the introduction of more specific management objectives may be relevant.

Management Action 3

Carry out comprehensive nature inventories in the Lake Lentua Natura 2000 area complementing the inventories of summer 2005, especially in terms of the habitats and species relevant for the WFD.

Inventories of Natura 2000 values are recommended due to data gaps. Recording water-dependent habitats and species is emphasized for identifying specific areas in the maintenance plan of the national park. Bird counts seem to indicate that the black-throated diver *(Gavia arctica)* may have ceased to breed on Lake Lentua after 1996. The breeding success of both the lesser black-backed gull and common tern seem to have decreased significantly from 1996 to 2005. Improved conservation of these species need more attention in the maintenance plan.

Management Action 4

Design an extended monitoring programme of Lake Lentua covering both Natura values and quality elements of the WFD.

Due to varying frequencies of chlorophyll-a monitoring, differing methodology of macrophyte monitoring, ecological data gaps and incomplete Natura 2000 inventories, an extended monitoring programme covering both Natura 2000 and WFD is proposed. Such programme is built on the ecological studies and Natura 2000 inventories (management activities 1 and 3) and executed in 3 years' rotation.

Management Action 5

Design and implement a buffer zone and sedimentation pond plan for decreasing nutrient leaching into Lake Lentua.

Based on the eutrophication studies of Lake Lentua and identified land use patterns, two areas for creating buffer zones and sedimentation ponds are proposed; one at the eastern shores with most agricultural land and forestry areas, and another one in the north, along the Kaarneenkoski and Vuonteenkoski rapids collecting nutrient-loading from forestry and fish farming. The creation of buffer zones and collection ponds cooperation by water managers and spatial planners is recommended as one POM.

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Session 2
Practical River Basin Planning and Management Approaches

Needs and possibilities to promote water pollution control by river basin scale land use planning in Finland

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Land use deteriorates riverine environment

The state of most rivers in Finland is only moderate or locally even poor at present. The main reason for this is land use-derived diffuse pollution. Agriculture, forestry, and locally also peat production increase the leaching of suspended solids and nutrients, and thus deteriorate the riverine environment. In order to be able to reach good ecological quality of the rivers, the target of the EU Water Framework Directive, the land use derived loading has to be decreased. At the present, this can be done with many kinds of water pollution control measures and structures, such as field ditch retainers, sedimentation basins, buffer zones and wetlands.

Spatial perspectives in water pollution control

The river basins in Finland are large, their channel networks are long, and the land use derived loading sources are scattered over the whole basin area. Here, as generally in the riverine environment, the relative environmental impacts caused by the loading, as also the effects of water pollution control measures, are largely related to scale. They can be significant in tributaries or small brooks soon below the loading source. On the other hand, the effects are also concentrated in the downstream and mouth areas of the rivers. New comprehensive methods covering the total river basin better are needed in order to be able to plan and implement cost-effective water pollution control measures for non-point source loading.

Improvements for the planning process

In order to promote integrated, environmentally sustainable land use planning of river basins, the water and land management policies and practices should be integrated as effectively as possible. Also the main requirements of effective river and diffuse source pollution control should be known. In this presentation the special characteristics of river ecosystem structure and functioning effecting planning and implementation of river pollution control are identified. Of these characteristics, the most important are the dependency of river biota on the transport of organic and inorganic matter from the land areas of the drainage basin and the environmental impact pattern of loading in flowing water (the concept of nutrient spiralling). Also, the key issues of practical pollution control are clarified. These issues include assessment of the present and target ecological status of the river, pressure identification, planning and realisation of water pollution control measures, and monitoring the environmental effects of the measures realised. A practical action plan is proposed for the estimation of the needs and possibilities to decrease the total loading imposed on the river in order to reach better water quality.

Management of Water Resources in Poland as an Element of the Baltic Protection Strategy

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Introduction

Trends and results of actions undertaken in Poland to reduce degradation of the Baltic Sea are discussed in the study. Specific economic conditions of water resources management in Poland are presented, and the main factors and sources of hydrosphere degradation are indicated. Advances in the reduction of pollutant load discharged to the Baltic Sea against development of the country sewage treatment system are described. Directions in the evolution of water resources management system in view of the implementation of the Water Framework Directive (WFD) are indicated.

Water Resource Management

Changes in the political and economic system and determination of ecological policy enabled intensified proecological actions. These actions have been strongly supported by the integration with the European Union and implementation of legal regulations. Principles of sustainable development of water economy were developed and included in the economic plan of the country. Programs for development of the municipal economy (covering construction of sewage treatment plants and landfills), water economy and water resources protection and also development of water retention systems in big and small reservoirs were prepared. Problems of water resources protection have been included in the regional programs of environmental protection setting up priorities. Poland's contribution to the international cooperation for the Baltic Sea protection was extended. A WFD implementation program was prepared.

Results of Actions (Selected Subjects)

Since 1900, water consumption for municipal and industrial purposes decreased by about 30 %. As a result, the quantity of sewage also declined remarkably. New production technologies have been introduced. Over a thousand sewage treatment plants have been constructed and modernised. Sewer systems have been developed. At present, over 90 % of sewage is treated, while in the past it was only 65 % (however, 30 % is still treated in mechanical sewage treatment plants). Removal of biogenes started in 1995, and in 2005 the process was applied to 35 % of sewage. Pollutant loads discharged with rivers to the Baltic Sea are reduced successively. The amount of heavy metals decreased considerably and recently also the total phosphorus, volatile phenols, total suspended matter, total nitrogen, BOD_5 and sulphates have been reduced slightly.

Main Reasons of Hydrosphere Degradation in Poland

Despite many programs and investments, the contribution Poland makes to the degradation of the Baltic Sea is relatively high compared to other Baltic countries. This is partly determined by demographic conditions in the Baltic region. However, the main reason is underdevelopment of sewage and waste management systems. The factors contributing to the Baltic Sea degradation include:

- introduction of polluted waters of the Vistula and Oder rivers to the Baltic Sea,
- introduction of polluted waters of the Pomeranian rivers to the Baltic Sea,
- discharge of pollutants from seaside towns, including municipal utilities, ports, shipyards, industrial plants, fish processing and tourism,
- discharge of pollutants from ships sailing on the Baltic Sea (mainly crude oil),
- deposition of atmospheric pollutants (especially nitrogen),
- discharge (sinking) of different substances during sea catastrophes and military manoeuvres (wars in the past).

A dominating role in deterioration of the ecological status of the Baltic Sea is played by sources located on the mainland, in the central and southern parts of the country. Despite a significant development of municipal-sewage infrastructure (especially in cities), large pollutant loads are still discharged to the waters of the Vistula, Oder and Pomeranian rivers. The main sources of pollutants discharged to rivers, lakes and underground waters in Poland include:

- discharging municipal sewage to sewer systems which is either insufficiently treated or not treated at all; among sewage components, the most dangerous are biogenic substances, e.g. phosphates, and coliform bacteria measured by the Coli titer,
- uncontrolled discharges from many local sources (discharges without sewers),
- discharge of industrial wastewater insufficiently or wholly untreated (many types of pollutants, including hazardous substances),
- discharge of sewage generated by agriculture and animal farming and uncontrolled discharges from local sources (both farming and municipal, from agricultural farms without sewer systems) carrying biogenic substances and liquid manure,
- discharge of salty mining waters and rainwater (from road maintenance in winter season),
- discharge of hot water (from cooling towers in power plants),
- surface water runoffs (rainfall and snowmelt) from agricultural lands (waters enriched with fertilizers and pesticides),
- surface water runoffs from industrial areas and poorly managed landfills and numerous illegal waste disposal sites (waters polluted with many types of hazardous substances),
- dry and wet deposition of atmospheric pollutants, including acid-forming substances (SO_2, NO_X) and dusts,
- inflow of polluted waters from neighboring countries (mainly via the Oder from the Czech Republic and Germany).

Specific Conditions of Water Management in Poland

The water resources of Poland in terms of the number of inhabitants amount to only approx. 1 400 m^3/capita and are comparable to Egypt. The growing water deficit and stepping in subregions constitute a barrier for sustainable development. An additional obstacle are periodic floods and droughts. Their occurrence is determined first of all by climatic factors (the highest rainfalls in summer, most of them evaporate). The losses increase due to insufficient retention in forests (only 28 % woodiness) and retention in reservoirs. Water reservoirs in Poland are an important element of water management, but the quality of collected waters is bad. From many reservoirs, water is transferred at long distances, usually to big cities. Deteriorated or bad quality of water resources is typical of most rivers and lakes. River runoffs change cyclically and acyclically, causing great differences in the quantity of discharged pollutant load. Many lakes are characterized by high degradability, including eutrophication. Soil acidification is high. Farm buildings are scattered, which hampers and delays the construction of efficient water and waste management systems. A large percentage of sandy soils facilitates the infiltration of pollutants to shallow ground waters. The level of ecological education is still low, particularly in rural regions. Specific geographic and social conditions should not be neglected in programming and accomplishing the tasks of water resources protection in Poland.

A quest for good ecological state of a northern boreal river - RiverLifeGIS in river basin management

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Introduction

The state of Finnish rivers has weakened over the past decades, mainly because of non-point source loading from different forms of land-use. In the near future these rivers should reach a good ecological state, the target of the EU Water Framework Directive (WFD). In this study, the possibilities to reach this target in a northern boreal river, the Muhosjoki River, have been estimated by making various loading scenarios. The study is a part of The Baltic Sea Interreg IIIB project "Principles, tools and systems to extend spatial planning on water courses – WATERSKETCH"

Study area

The Muhosjoki River (Fig. 1) is situated in the Oulujoki River basin in Northern Finland. The total area of its drainage basin is 537 km^2 and the length of the river is 59 km. Peatlands, mainly minerotrophic fens and peatland forests, account for about 46 % of the land area. The forest soils are podsols. The main target site of this study was the drainage basin of Vilmikko (M1) in the uppermost section of the drainage basin.

The average state of the river according to the data on water quality, diatoms and macrophytes ranges from good to poor (Table 1). In Vilmikko (M1), the average state was moderate. According to the WFD, the classification has been based more on the ecological quality parameters than on the water quality alone. There is, however, a clear dependency between the water quality and biological parameters. It was found that the total phosphorus (TotP) concentration explains more than 90 % of the variation in the diatom index IPS in the river (Hellsten et al. 2007).

Table 1. Average state of the Muhosjoki River according to the total phosphorus concentration, diatom indices and ecological quality ratios (EQR) of aquatic macrophytes (Hellsten et al. 2007).

	Tot. P concentration (µg l^{-1})		Diatom indices			Aquatic macrophytes	Average status
Site	Long term median	Diatom sampling date	IPS	GDI	TDI	EQR	
P3	97	110	14.2	15.2	8.9	0.24	Poor
M1	55	36	16.8	16.0	-	0.32	Moderate
M4	49	36	16.8	16.0	10.8	0.64	Good
M7	46.5	37	17.6	16.7	12.3	0.48	Moderate

Non-point source loading from forestry and agriculture constitutes the highest proportion of the total phosphorus loading in the Vilmikko drainage basin (Table 2), as

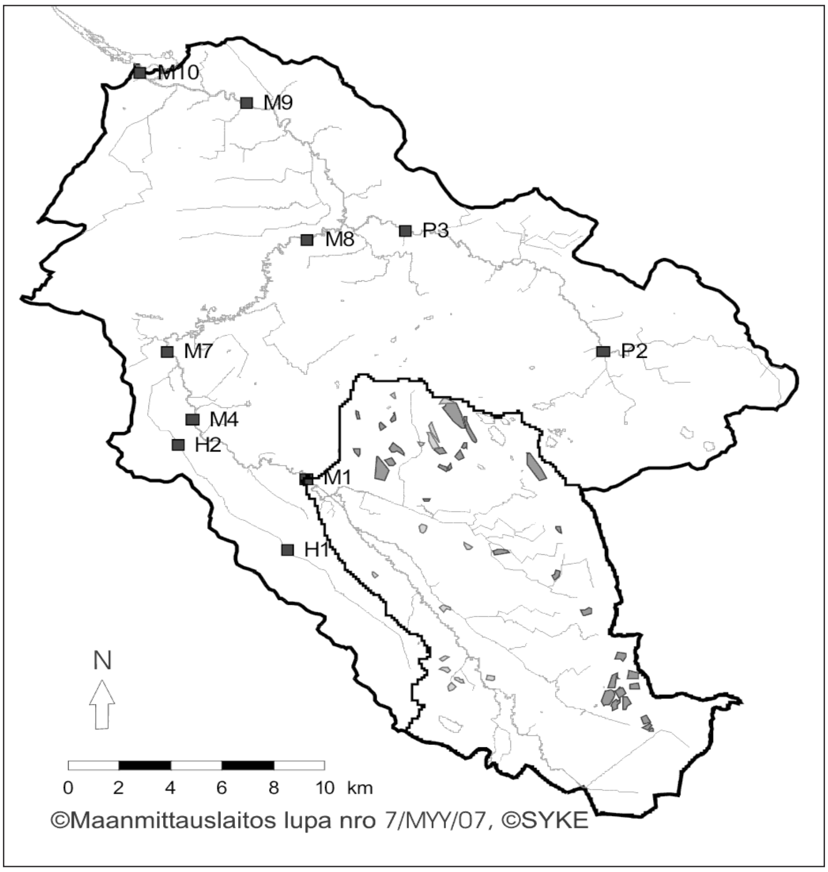

Fig. 1. The Muhosjoki River, sampling sites and drainage basin of the example site, Vilmikko (M1). Sites possibly suitable for wetlands to be constructed on peatland marked as grey.

generally in the whole Muhosjoki River basin. Here these pollutant sources account for about 64 % of the total phosphorus loading. On the other hand, the proportion of natural leaching is almost one-third of total loading.

Table 2. Total phosphorus loading (kg a^{-1}) in the Vilmikko river basin of the Muhosjoki River at present and according to the loading scenarios (LSC1-3) performed.

Loading source	Loading at present		Loading according to the scenarios		
	kg a^{-1}	%	LSC1	LSC2	LSC3
Forestry	762	33		762	381
Agriculture	709	31			213
Scattered settle-ment	84	4		84	25
Peat production	44	2		44	30
Atmospheric fallout	8	0.3	8	8	8
Natural leaching	682	30	682	682	682
Total	2289		690	1580	1338

In order to reach a good state in the river, the total loading imposed to the river must be decreased. One means for this is the use of wetlands constructed on peatlands. The model for the wetland type, the Kompsasuo wetland, was still giving good purification results in 2002 after 16 years of use: Total N 52 %, NH_4-N 94 %, NO_3-N 57 %, Total P 47 %, PO_4-P 47 % and SS 31 %. Suitable places for the wetland type in the drainage basin were sought with the RiverLifeGIS program (Lauri & Virtanen 2002), based on the dimensioning instructions of the wetland type (Ihme et al. 1991, Ronkanen & Kløve 2005). The proportion of peatlands in the drainage basin is high, but only 2 % (360 ha) of the peatland area fills the dimensioning criteria of wetlands constructed on peatlands. In peat production areas, it has been noticed that in order to reach good results of purification, the area of the wetland constructed on peatland should be 2 - 4 % of the above drainage area. The results indicate that wetlands constructed on peatlands have good potentials for reducing the loading imposed on the river. Suitable places for the wetland type are not, however, evenly scattered all over the drainage basin (Fig. 1). It is, however, possible to decrease the loading also by using the other types of constructed wetlands developed, such as wetlands constructed on mineral soils and shallow ponds, etc. (Borch et al. 2003).

The loading scenarios and their results

Three loading scenarios (LSC) were performed by the RiverLifeGIS tool, a system for performing hydrological and water quality related computations on river drainage basins using monitoring and GIS data (Lauri & Virtanen, 2002). The system allows maps to be displayed and also serves as a user interface for various calculations. Typical data available in the RiverLifeGIS include watershed boundaries, a digital elevation model (DEM), and land use classification data. The DEM can be used with the existing river network to compute the water flow layer, which further defines the directions of water flow for all the points in the given catchment area. This forms a basis for many computations: e.g., the catchment area above any point in the river channel can be outlined and its area calculated. The resulting boundary can then be used to determine the loading derived from land use in that area, using the data on the loads characteristic for the various forms of land use at the different levels of water pollution control. The effect of this loading on the river water quality downstream of the loading source can also be calculated.

LSC1: No anthropogenic land-use derived loading

All of the anthropogenic, land-use derived loading was removed in this scenario, leaving only the atmospheric fallout and the natural leaching from peatlands and mineral soils. The results indicate that the TotP concentrations in the river water were at the level of 15 $\mu g\ l^{-1}$ in a natural state during the median discharge of 1.47 $m^3\ s^{-1}$ (Table 3). According to the general usability classification of water bodies in Finland, this natural phosphorus concentration is good but not excellent. It is, however, clearly lower than the long term median 55 $\mu g\ l^{-1}$ in the area at present.

LSC2: No agriculture

In this scenario the agricultural areas were removed from the drainage basin. The results indicate that removing all the agricultural areas from the drainage basin provides a TotP concentration of 34 $\mu g\ l^{-1}$ - again, a clearly lower value than the long term median at present (Table 3). The value attained is satisfactory according to the general usability classification. Closing down all agriculture, as also other means of livelihood in the drainage basin is not, however, realistic.

LSC3: The TotP loading at the level of good water quality in the river

This scenario calculates how much the TotP loading should be reduced to reach good river water quality (TotP < 30 µg l^{-1}) according to usability classification. Results of this scenario indicate that in order to reach the ambitious target of the WFD, the good state of the river, the TotP loading imposed to the river should reduced by 40 % (Table 3). If the natural leaching and fall-out are supposed to remain at the levels at present, the realization of this target requires that the loading both from agriculture and from forestry should be decreased over 50 % of the level at present. It is obvious that this target presumes as effective use of the existing methods in water pollution control as possible.

Table 3. The TotP concentration in river water (M1) during the median discharge 1.47 m^3s^{-1} according to the loading scenarios performed. The values used in the general usability classification of water bodies in Finland are also presented. The classification provides an idea about the average suitability of the water bodies for water supply, fishing and recreation (see details in http://www.ymparisto.fi/download.asp?contentid=34514&lan=EN). The quality class is determined as based on the natural quality of the water and human impacts. Total phosphorus is one parameter of the classification.

Scenario	TotP concentration (µg l^{-1})				
LSC1) No anthropogenic land-use derived loading		15			
LSC2) No agriculture			34		
LSC3) Effective use of existing methods in water pollution control		29			
General usability classification of water bodies in Finland					
TotP concentration (µg l^{-1})	Excellent < 12	Good 12 - 30	Satisfactory 30 - 50	Passable 50 - 100	Poor > 100

Conclusions

The average ecological state of the Muhosjoki River ranges from good to poor, that of the main target site, Vilmikko (M1), being moderate. In order to reach a good ecological state in the river - the ambitious target of the WFD - the total loading imposed to the river has to be decreased. This means that the non-point source loading both from agriculture and from forestry should be cut to half the present level. Obviously, this target presumes use of the existing methods in water pollution control that is as effective as possible. One potential method for water pollution control in the peat dominated drainage basin is artificial wetlands, constructed on suitable peatlands. The RiverLifeGIS proved to be a useful tool in making initial integrated plans for river pollution control.

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Management of an International River Basin District – the Torne River

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Introduction

The Torne River is one of the large river systems in northern Fennoscandia. The watercourse area measures 40 175 km², of which approximately 60 % lies within Swedish borders and the rest in Finland, with some minor areas in Norway. The main channel is one of the last free-flowing big rivers in Europe, and protected against construction. The river system is the most important habitat area for the smolt production of Baltic salmon and sea trout. The river is included into the Natura 2000 European network of protected areas both in Finland and Sweden.

As environmental issues have been gaining more weight, also the common management of this unique river basin district has been gradually emphasised, being nevertheless strongly dependent on external funding and project work (Puro-Tahvanainen et al. 2001, Elfvendal et al. 2006). Agreements between Finland and Sweden have been used as grounds for earlier cooperation, but establishing more stable forms of cooperation has been considered important in order to harmonise the work and increase the transparency towards local actors and people. Finally the implementation of the EU Water Framework directive has also set more demands for formal actions. In May 2006, a project, 'Best practices for the management of an international river basin district – Torne River', financed by EU Regional Development Fund (Interreg III A North) and national funding of Finland and Sweden, was started in order to suggest common guidelines for future cooperation between regional authorities.

Project

In the project, common recommendations will be given for practices in the management work of this international river basin district when defining, setting and agreeing upon environmental objectives, management measures and indicators for the status of the aquatic environment. This includes defining tasks demanding coordination as well as coordinating the essential tasks of responsible authorities in Finland and Sweden. When defining recommendations, demands of Water Framework Directive will be taken into account, as well as other legal demands.

In an earlier project, a typology for rivers and lakes of Torne River area was suggested (Elfvendal et al. 2001). In the current project, this typology in comparison with suggested national typologies, is tested using fish community composition for lakes and periphyton communities for rivers.

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The management and operation of the Lake Vesijärvi project: top-down or bottom-up?

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Introduction

A successful restoration and management project of the large eutrophicated basins of Lake Vesijärvi (110 km^2) was carried out by a reduction of external nutrient loading, biomanipulation and shore management, as a joint effort of local and national authorities, scientists, professionals and local inhabitants in the 1990s. The first biomanipulation in Finland was introduced to the management arsenal by the authorities when no improvement of the summer water quality had taken place for 12 years after the diversion of sewage loading. The mowing of common reed (*Phragmites australis*) from the shores where overgrowth was hindering the recreational use of the lake was introduced by local citizens and stakeholders. An active flux of opinions and information between authorities and local inhabitants was characteristic of the project. In the second Lake Vesijärvi project in 2002 - 2006, an extensive survey was carried out throughout the whole drainage area (515 km^2) on 3 000 farms and private houses as well as in the 1 300 summer cottages along the shores of the lake, and maintenance of selective fishing and guidance on the mesh limits of gillnets were carried out.

Bottom-up and top-down project management

The ecological management aimed at reinforcing both the "bottom-up" and "top-down" processes of the lake ecosystem which facilitate a lower biomass of phytoplankton (Keto & Sammalkorpi 1988). In project management, the "top-down" flux from the authorities and experts to local level emphasized management of both the lake and the catchment area, based on monitoring results of water quality, fisheries and external loading. Biomanipulation changed the basic principles in the local fisheries management by adding fish removal and emphasising stocking of predatory species in the restoration phase. Restoration of the Enonselkä basin (2 700 ha) was the first successful biomanipulation in Finland. The main effort in the mass removal of fish (1 100 tonnes) was carried out by commercial fishermen hired from nearby Lake Päijänne. Intensive stocking of the predatory pikeperch (*Sander lucioperca*) was carried out by Finnish Game and Fisheries Institute. These elements together were the core of the ecological lake management. Good success in both fish removal and pikeperch stocking, the end of algal blooms and improved fisheries-based lake value paved the way for social acceptance of the project. The active participation of local inhabitants represented a "bottom-up" flux from the grassroot level to authorities as well as organised project management. It emphasised joint volunteer work and local, shoreline management for recreational use, fishing and habitat improvement for pike *Esox lucius.* The local inhabitants were initiative in implementing the mowing of reed stands. Later in the project, they also joined in biomanipulation by constructing and using fishing gear. Maintenance of the improved condition also resulted in permanent vacancies for five fishers/lake managers and increased part time work in the 3rd sector. The maintaining selective fish removal and shoreline management were carried out jointly by local volunteers and employed lake managers at the end of the 1990s. Satellite projects in lakes of nearby municipalities repeating the same principles and methods were initiated after the successful restoration of Lake Vesijärvi.

Keys to the successful cooperation between local citizens and the project organisation

We find that the project was successful, since environmental sensitivity and awareness and other characteristic aims of environmental education were intrinsic in the local citizens. We attributed this to the fact that permanent rural settlement with its tradition of joint work and direct contact with the lake still existed in the region. Many aims of environmental education seemed to be innate in the minds of local citizens. This suggests that the aims of environmental education are realistic in practical environmental management.

Another prerequisite of the successful dialogue and cooperation was that the authorities were ready to revise the objectives of the project from purely water quality and fisheries oriented issues to the shoreline management, and gave official status and added resources to the work that had been initiated by local volunteers before the Lake Vesijärvi project.

The "spirit of Vesijärvi" - joint cooperation and search for partners instead of blaming, e.g., farmers - continued during the 2nd Lake Vesijärvi Project. The local media played an important role in creating a positive atmosphere, which facilitated the extensive surveys aiming at reducing the nutrient loading from dispersed settlement and agriculture which were carried out in all farms and real estates in the drainage area. We consider that - as in management of the ecology of the lake - in project management, both "bottom-up" and "top-down" were necessary and supported each other synergistically.

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Lake Management and Restoration in Lakepromo-countries

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Introduction

The Water Framework Directive (WFD) sets clear environmental objectives for water management in EU member states. The aim is that all European surface waters should reach a good ecological status or good ecological potential by the year 2015. It is quite a challenge, because up to one-fifth of the surface waters in Europe are in danger of becoming damaged. One cause for this is that in spite of water protection measures reducing nutrient loading from point sources, eutrophication is still a serious problem due to external nutrient loading from diffuse sources, internal loading and changes in the lake ecosystem.

The water body restoration and management require the cooperation of several different stakeholders and organisations. The lack of clear guidelines and definitions on responsibilities and duties may seriously complicate this cooperation. The national legislation concerning lake restoration is dispersed in many countries, restoration is subjected usually to legislation in many separate laws. The implementation of the WFD relies on participation of all players concerned and thus provides an unprecedented chance for founding new partnerships to ensure coherent and effective implementation.

The Lakepromo project looks for best practices and techniques to restore and manage eutrophicated surface waters. The main aim is to find 'a common language' between different stakeholders in the field of water management. Lakepromo is part-financed by the European Union (European Regional Development Fund) within the INTERREG IIIC Programme.

Lake Management And Restoration In Lakepromo-Countries

The Lakepromo compiled a survey (Ruokojärvi 2006) in eight countries (Finland, Denmark, United Kingdom, Spain, Estonia, Hungary, Germany and Russia) on lake management and restoration. Most Lakepromo-countries possess a good theoretical basis on water quality and related research. There is much information available on the principles of different restoration methods, physico-chemical reactions behind nutrient circulation and other phenomena related to water quality management approaches.

However, the restoration methods have usually been developed by the trial and error method. In particular, there is little knowledge of the long term effects, and this impedes identification of the best methods for each target area. More experience is needed to gather information on how to combine different methods to achieve synchronised results in different targets.

In all Lakepromo-countries, the insufficient funding and planning resources have been allocated to restoration projects and this does not correspond to the number of restoration initiatives and needs. Projects must be prioritised and the effects of each restoration measure need to be balanced against the costs.

Pilot Areas

From these eight European countries, 11 specific pilot areas (lakes, wetland areas, a lagoon, a village) have been chosen. For these pilot water areas, the best practices for water restoration are formulated and tested in cooperation with the international project group as well as the local stakeholders. Special emphasis is on the activation of local people to participate in water management planning.

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Insights into spatial planning and the Water Framework Directive – experiences from the INTERREG IIIC ENMaR project

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Summary

Due to its influence over the development and use of land, spatial planning has the potential to make an important contribution to meeting the goals of the Water Framework Directive. The ongoing ENMaR project (European Network of Municipalities and Rivers) is exploring this issue from a European perspective. Research findings suggest that although the Directive may not be the key motivating factor, that spatial planning is nevertheless making a positive impact on the water environment. This will clearly assist the achievement of the Directive's goals in the future.

Introduction

Spatial planning has a crucial role to play in meeting the requirements of the Water Framework Directive (WFD), and in encouraging sustainable water management more generally. Increasingly, governments and other stakeholders are acknowledging this, and are developing legislation and guidance to strengthen the contribution of spatial planning to sustainable water management. As spatial planning concerns the regulation of the development and use of land, it can play a central role in meeting challenges posed by the various environmental, economic and social demands that are placed on land resources. Consequently, spatial planning can help to encourage the development of win-win-win water management solutions where human societies are able to co-exist more sustainably with aquatic flora, fauna and natural habitats.

The ENMaR project

The role of spatial planning in addressing water issues is central to ENMaR, which is an ongoing INTERREG IIIC project due to complete at the end of 2007. The key aim of the project is to enhance the contribution of European municipalities to meeting the goals of the WFD. ENMaR encompasses seven partner organisations from five European countries; namely England, Germany, Latvia, Spain, and Sweden. Each country concentrates on a particular river basin. For example, the English case study is the Mersey and the German case study is the Weser. A network of over 100 municipalities within the partner countries has been established. Regular workshops within the case study river basins provide guidance and support to municipalities on key issues relating to the WFD. These workshops have been successful in bringing together municipalities and other key stakeholders, such as water service providers, farmers and environmental regulators, to discuss the WFD and how it will impact on their day-to-day activities.

ENMaR is organised around four key themes which are agriculture and forestry, spatial planning, tourism and water services. The University of Manchester, in association with the Mersey Basin Campaign, is responsible for the spatial planning theme. The contribution of spatial planning to meeting the requirements of the WFD has been explored during the project, and a range of good practice examples from the countries represented within ENMaR has been gathered.

ENMaR project findings

The findings of the ENMaR project to date are encouraging, and demonstrate that spatial planning is being used across Europe to generate improvements in water environments. In total, ten case studies (two from each of the participating countries) have been chosen which demonstrate the linkages between spatial planning and the water environment. Two of these case studies are discussed briefly below to provide an indication of these spatial planning activities.

- ***The River Mersey Development Plan (Stockport, England):*** The confluence of the Tame and Goyt rivers in the town of Stockport, which is close to the city of Manchester, forms the river Mersey. Stockport Council has been responsible for preparing the River Mersey Development Plan, the aim of which is to guide and secure waterside regeneration within the Stockport area. The implementation of the plan has involved significant investments such as the creation of a nature park, the development of a canoe trail, and the organisation of regular river clean-up events. These activities have improved the river and its surrounding environs. The plan has changed people's perceptions of the relationship between Stockport and the river Mersey, and has emphasised that the river should be valued as a key asset where traditionally people have turned their back on it.
- ***Designation of water protection belts in the city of Valmiera (Valmiera, Latvia):*** National level spatial planning legislation in Latvia requires protection belts to be established around water bodies. The aim of this legislation is to deliver benefits such as reducing the pollution of aquatic habitats and limiting development on floodplain land. Accordingly, the spatial plan for the city of Valmiera now includes protection belts around water bodies in their area which restrict development in a zone extending 10 metres from the average water level. A wider protection belt of 20 metres has been developed in floodplain areas. Details of permitted land uses in the protection belts are also included in the spatial plan. This approach will have clear benefits to water status in the area.

In most cases, these good practice examples have not been developed as a direct response to meeting the requirements of the WFD, and usually have the delivery of other water management objectives (such as reducing flood risk or protecting aquatic habitats) as their key motivation. Nevertheless, ENMaR has shown that spatial planning departments within local municipalities are becoming more aware of the WFD and of the role that they can play in meeting its key goal of working towards good water status in most of Europe's waters by 2015. It is also encouraging that municipalities are currently in the process of developing and implementing initiatives that are having a positive impact on water environments in their areas of jurisdiction. This bodes well for the achievement of the WFD's goals in the future.

Urban Zoning and Recreational Use of Territories of the Established Water-Protection Zones (WPZ) of the River Vuoksa

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Introduction

"Urban zoning and recreational use of territories of the established water protection zones (WPZ) of the river Vuoksa" is the spatial planning part of the international cooperation "VUOKSIAGAIN" project developed by Design Institute "Lenvodprojekt" as the next stage of the project "VIVATVUOKSIA" executed in 2002 - 2003**.** The Southeast Finland Regional Environment Centre, Regional Council of South Karelia and the Administrations of Vyborg and Priozersk districts of Leningrad Oblast took part in the project.

The spatial planning part was developed during 2005 - 2006 by Russian State Research and Design Institute of Urbanistics. The Neva-Ladoga Basin Water Administration of Ministry of Natural Resources of the Russian Federation was the customer of the project. The project was financed by the Finnish Ministry of Environment.

The purpose of organization of WPZs was to decrease water pollution due to the establishment of a special mode of economic and other kinds of activity in their territory. The aim of the work was to investigate modern land and water use inside the WPZs and to establish rules and regulations for further use of these territories according to sustainable development of this territory and in compliance with current legislation and standards of the Russian Federation and Subject Federation "Leningrad Oblast' (LO)". According to the Russian legislation, construction of dwelling houses, summer cottages closer than 100 m from the shoreline, the use of fertilizers and chemicals, grazing of cattle and ploughing of soil, felling of a forest, etc., are restricted or prohibited inside the WPZs.

One of the main directions was making the territorial zones for various kinds of recreation apparent, bearing in mind the preservation of nature functions of river-side territories and river waters and the limited use of shore belts. Another important task was trying to reduce the negative influence on environment and water resources from human activity by spatial planning methods.

Stages of the project

- study and analysis of modern land and water use on the WPZ of Vuoksa,
- estimation of the effects of anthropogenic pressure on the status of environment,
- revealing valuable natural complexes for the recreational purposes and for protection,
- working up the recommendations on development of settlements, maintenance of traditional kinds of economic activities, creation of new workplaces in

sphere of recreation, tourism and services, maintenance of the small business enterprises and development of a transport and engineering infrastructure,
- presentation of the project results in the official organizations and in the Administrations of Municipal Districts (MD) of LO, and
- dissemination of the project results by presentations at the conferences and International Exhibitions and in the media.

The Vuoksa River flows from the southeastern part of Lake Saimaa crossing after 13 km the border, and proceeds in a southeast direction across Karelian Isthmus and runs in two arms into Ladoga Lake: northern natural arm at Priozersk and southern artificial arm on River Burnaja.

This abstract includes the main principles of the project concerning the territory of the southern arm of the River Vuoksa within the Priozersk MD of LO.

Summary Information of The Study Area

Land area is 16 555 ha, among them forests 64 %, agricultural lands about 30 %, settlements 2 %, and others 2 %. The forests are in federal property, the agricultural lands are in regional property.

The population is 4 500 inhabitants, all of them rural. There are 14 settlements on WPZ territory of the southern arm; most of them are small villages. Such settlement system was typical for this place as the disperse farm settlement system allows to avoid damaging and to reserve the fragile nature of Karelian Isthmus. The main branches of economy are dairy cattle-breeding, fishery and tourism.

Nature resources

- Favorable climate
- Picturesque landscapes
- Natural resources of forests including mushrooms and berries
- Alteration of lake sites with river sites;
- Various fauna: birds, fishes, water and hoofed animals
- Fish resources

Infrastructure

The electrified railway and highways are going through the territory. Local roads have a low quality road cover, there are no internal water routes. A large majority of rural settlements and places of recreation are not provided by engineering networks and constructions.

Historical and cultural heritage

There are a lot of places of interest, such as the rests of ancient town Tiversk, the Losevo's redoubt and rapids, churches, historical military monuments and memorials, and archeological monuments.

Environmental status

The major factors influencing on the environmental status are:
- flood risk of shore areas,
- radon risks,

- pollution of soil, surface and ground waters,
- abrasion and erosion of shores,
- non-purified and only primarily purified waste waters,
- disposition of the dairy cattle-breeding farms on the shoreline,
- unsatisfactory condition of the authorised dumps and the big number of uncontrolled dumps, and
- uncontrolled tourism.

The Main Objectives

Water protection zone (WPZ) project had several objectives:

- the maximal preservation of natural, historical and cultural heritage,
- construction and equipment of summer cottages, camping sites, motels, hotels, creation of the ethnographical and ecological educational tourists centers, etc., with all modern conveniences (systems of water supply, sewage removal and waste recycling),
- reconstruction and new construction of engineering networks and objects in settlements,
- construction of dwelling houses in settlements only,
- pulling down of the old recreational houses without engineering networks,
- taking the milk cattle-breeding farms off the shoreline belt,
- involving farmers and countrymen in development of rural tourism, and
- organisation of mini-farms for mentally disabled children.

Results of the Project

Zoning territory of WPZ was established and rules for each zone use were determined. The following main zones were allocated (Fig. 1):

- settlements,
- the organised recreation (existing, reconstructed, new camping sites, motels, hotels, night lodgings, etc),
- rural tourism,
- agriculture including collective gardens,
- engineering/transport infrastructure and
- forests.

Conclusions

Urban zoning of territories in a combination to an establishment of a special mode of economic and other kinds of activity in WPZ will allow to lower anthropogenic pressure on the river-side territories and on water bodies, and will promote preservation of the environment, unique natural complexes of Karelian Isthmus and development of sustainable nature and water use in region. The results of the project are important for the activity of the Municipal District Administrations.

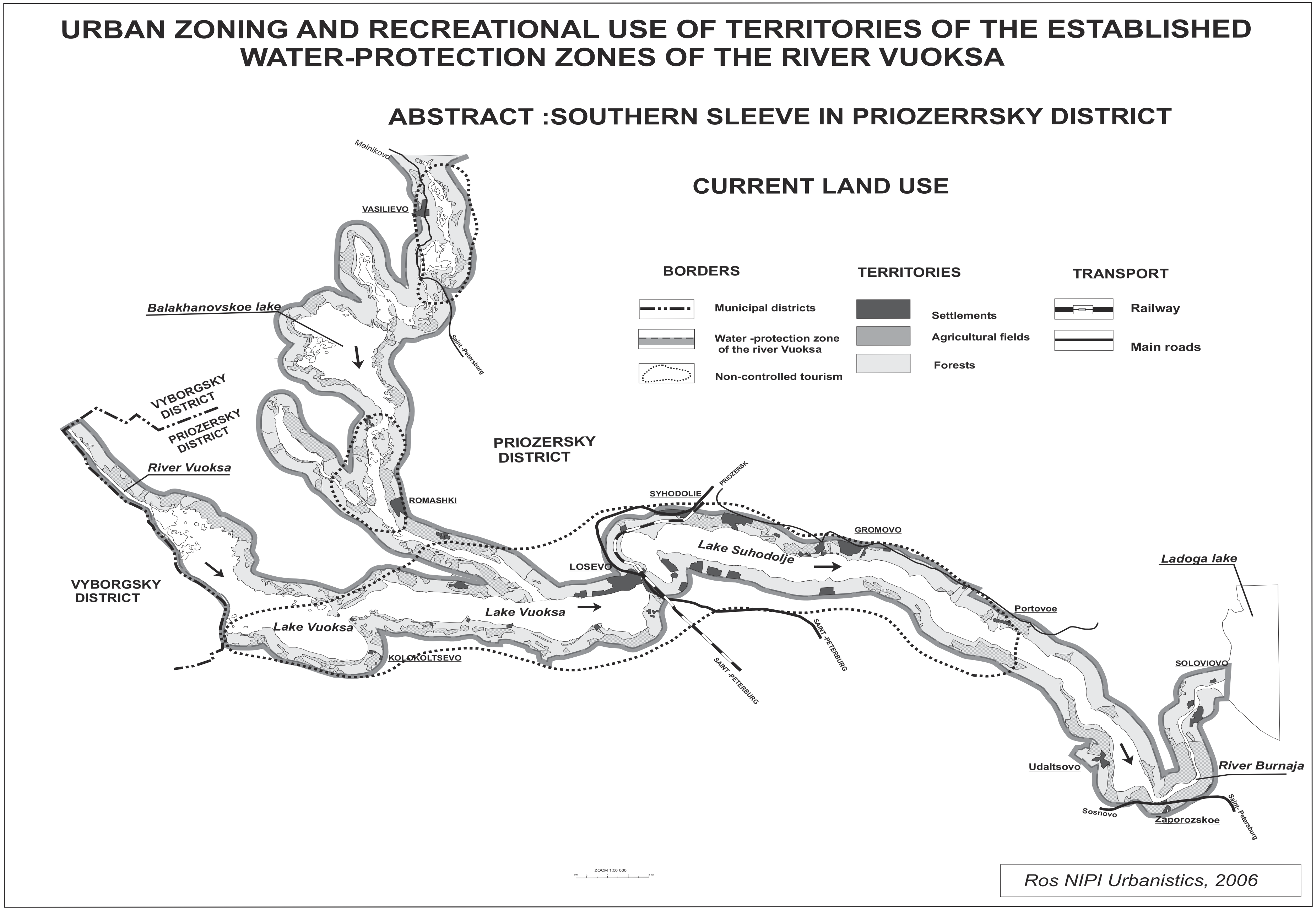

Fig. 1. Example of water-protection zones.

Case study of Integration of Water Management Issues in Spatial Planning process in Jēkabpils district

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Background

The case study was performed in Spring 2006 within the frame of the EU programme of INTERREG IIIB project *"Transnational River Basin Districts on the Eastern Side of the Baltic Sea Network - TRABANT"* activities. The assessment on the links between water management issues and spatial planning by content analyses has been based on the Spatial Plan of the Jēkabpils District in Latvia (further in the text - The Plan) approved in 2003. In that time, the main requirements of the EU Water Framework Directive (WFD) have just been transposed to the National Law on Water Management (autumn 2002). However, there was no straight legal demand on the integration of river basin management issues into spatial plans yet in force.

Characteristics of Jēkabpils district

Jēkabpils district is situated in the Southeastern Latvia covering 2 998 km^2. In 2006, there lived about 53 thousand inhabitants. Administratively, the district has got three towns and 20 municipalities. Land use is characterised by forests and bogs covering 53 % of area. Other land use types are agriculture land 38 %, waters 3 %, roads/yards 3 % and others 3 %.

Planning and water management issues

According to the river basin approach, Jēkabpils district is situated in two river basins – the Daugava and the Lielupe. From the spatial planning perspective Jēkabpils district belongs to Zemgale planning region.

The environmental issues including water management have been traditionally reflected by spatial plans in Latvia. The Spatial Plan of Jēkabpils District is no exemption in this respect. Firstly, it provides general description of the water resources in the district, e.g., natural water bodies (the main rivers and lakes) are listed and both river basins are mentioned. Groundwater is described in general terms. However, the water management units as identified by the WFD will bring additional aspect in characterization of the water bodies in future.

With regard to pressures and impacts to water resources, the Plan describes wastewater treatment system in the district in terms of the waste water discharged and water consumption. The existing hydroelectrical power plants have been reviewed here. The Plan addresses the key point source polluters of the groundwater, as pig farms, petrol stations, and unused artesian bores. However, the Plan does not include information about diffuse sources of pollution, e.g., leakage from agriculture.

The priority fish water areas are listed in the Plan, as well as water bodies where water protection and quality improvement actions are necessary. However there is no information about protected areas for drinking water supply.

Regarding monitoring networks – need for monitoring and results from monitoring are only briefly mentioned in the Plan. This is due to the fact that municipalities in Latvia are not in charge of the environmental monitoring.

The Plan set the environmental objectives which are rather general. Among others, it points out that the water quality shall not be worsened. The programme of measures points out necessity of reconstructing the wastewater treatment plants and stricter approach to issuing permits for small hydropower stations.

The spatial planning requires the public participation – in early stage of the planning initial public hearing is organized. Later the draft plan is published for public consultation as well main hearing is organized. During the development of the plan many stakeholders are consulted to integrate their views in the plan.

Main conclusions

In general, the Spatial Plan of the Jēkabpils District deals with water management issues. Majority of the Water Framework Directive requirements have been already partly covered; for example, general description of river basins, assessment of the pressures, listing nature protection areas, as well as setting up the environmental objectives.

Some of the issues are very briefly covered, such as monitoring of the water quality, economic analysis, and programme of measures.

Public participation as a tool has been implemented in the development of the spatial plan. This experience could be taken over by the river basin management planners.

Session 3
Watersketch Tools

The Watersketch Toolbox – tools and methods for river basin planning and management

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Introduction

The Watersketch Toolbox offers general information and practical tools and methods for sustainable river basin planning and management. The Toolbox can be found on the Internet at toolbox.watersketch.net, and will be finalised in June 2007. It is an output of the Baltic Sea Interreg IIIB project "Principles, tools and systems to extend spatial planning on water courses - WATERSKETCH".

The Watersketch Toolbox is designed for assisting environmental specialists, spatial planners, and decision-makers in river basin planning processes. The Toolbox aims especially at offering assistance in preparing river basin management plans required by the WFD.

Main contents

The Watersketch Toolbox offers a wide set of information about basic principles of river basin management, such as the main elements of water quality, human pressures, new environmental objectives set by the WFD and possible measures for improving different quality elements. The Toolbox also offers hints and ideas regarding various methods for citizen and stakeholder participation within the planning processes, and a lot of information on different pieces of EU legislation in relation to water.

In addition to basic information, there are several practical tools applicable in various kind of problems and phases in river basin planning. Tools and their features are described in detail. Also, the user instructions and a set of examples from real-life tool applications and tests carried out in the Watersketch case studies can be found.

Tools

There will be a total of six tools available in the Watersketch Toolbox. Some of these are available for download to the user's computer, while others can be used via the Internet. The tools are presented in detail by Ulvi et al. (2007).

RiverLifeGIS

RiverLifeGIS is a software for hydrological and water quality computations on river basins using geographical information (GI) and monitored water quality data. Originally, it is an outcome of the RiverLife project carried out in Finland in 1998 - 2001 (Lauri & Virtanen 2002). Since then, it has been used and further developed in several planning, research and development projects. RiverLifeGIS offers the possibility to analyse diverse GIS data and visualise results as maps without expensive commercial software. The tool can be downloaded to the user's computer.

Typically, GIS-data needed include watershed boundaries, watercourses, Digital Elevation Model (DEM) and land use data (Lauri & Virtanen 2002; Rintala et al. 2006). For example, RiverLifeGIS can be applied for

- estimation of land-derived nutrient loading,
- estimation of changes in nutrient concentrations in water due to the changes in loading,
- estimation of the effects of water pollution control methods on the loading and concentrations on the river basin scale,
- searching suitable locations wetlands constructed on peatland,
- definition of the upper drainage areas for any chosen point, and
- estimation of the erosion sensitivity of ditches.

Web-HIPRE

Web-HIPRE (**HI**erarchical **PRE**ference analysis on the **W**orld **W**ide **W**eb) is software working within the www-environment for multicriteria decision analysis (MCDA). The software is created by the Helsinki University of Technology (Mustajoki & Hämäläinen 2000).

The process of MCDA, also Web-HIPRE application, begins with structuring the problem, including the definition of the overall goal, essential criteria and alternatives resulting in a value-tree. After that, the alternatives are evaluated in respect to each criterion, and the criteria weighted according to their importance. This process results in the overall values of the alternatives indicating a preferential rating.

The Web-HIPRE analysis can be either done as an expert/decision-maker analysis or an analysis with several stakeholders/decision-makers. The analysis supports the creation of a common language between stakeholders and the improvement of stakeholders' understanding of their own values and objectives as well as those of other stakeholders. It also highlights the essential compromises between opposing objectives that have to be made when the appropriate alternative is chosen. As a possible outcome, stakeholders may create a shared understanding of issues regarding agreement and disagreement.

Public Hearing Database

Public Hearing Database is a tool for handling contributions from citizens in public consultation phases in any kind of spatial planning processes. The tool has originally been developed by a former Danish County of North Jutland, and it has been applied mainly in regional land-use planning. The database works on Microsoft Access platform, and it can be downloaded to the user's computer.

The spatial planning authorities receive contributions to the plans from the public in various formats. Regardless of the delivery format of the contributions (letter, email, blank forms on the Internet, etc.), all of them can be handled by the database. Contributions received by letter have to be added to the database manually from the scanned digital file. The contributions received by email can be simply copied and pasted to the database. The system can also be programmed for adding the contribution given through the blank forms on the website directly into the database.

In the database, the contributions can be divided into statements in different categories according to the issue the contribution relates to. The authorities can utilise the database when compiling the condensed evaluation of the contributions and making recommendations based on them on each issue to the political decision-makers. It is possible to make reports during the process. After a decision, the database allows generating reply letters automatically to each contributor, laying out how the contributions were handled. The contributions given and the statements of the authorities on them can be directly printed from the database in a publication format. If a contribution contains questions based on facts, the authority can answer the question directly through the database. If the database is connected to the Internet, the answer can be published on the website by merely clicking the mouse.

Priority Game Generator

An Internet-based priority game offers citizens the possibility to try for themselves the often difficult balancing of various interests against each other. It is a kind of solitaire game with only one player. First the citizens are asked to assign weights to some main issues and then to evaluate the effect of the various alternatives on each issue. The user has 1000 points, which are distributed amongst the various alternatives by a simple mathematical formula. The user should give weights varying from 'Very important' to 'Not important at all'. Finally, the game illustrates the result of the priorities set by the user. Before playing, the player has to select the alternative they prefer. Thus the player can compare his first intuitive choice with the more analytical one his priorities. (Hansen & Kristensen 2006).

There are many application possibilities for priority games in various spatial planning projects, also in river basin planning. The priority game has to be particularly planned and always programmed for a new project. For this reason, the Priority Game Generator for creating a corresponding game for any planning process has been prepared in the Watersketch project.

REGCEL water level analysis model

The REGCEL model can be utilised in assessing the impact of water level fluctuation in regulated lakes and comparing regulation alternatives. The model has been developed by the Finnish Environment Institute (SYKE) (Hellsten et al. 2002). The model can calculate values for more than 50 water level parameters, which describe indirectly the impacts of water level fluctuation on the littoral fauna and flora, some fish species and birds nesting near the shoreline. Also, some parameters describe the impacts on scenery and recreational use. (Marttunen et al. 2006).

The analysis consists of several steps starting from the determination of the regulated and re-calculated/natural water levels. Then the indicators describing the effects of water level fluctuation on the littoral environment, fish, birds and recreational use have to be identified. Finally, the most critical water level changes for the status and use of watercourses may be identified. (Hellsten et. al. 2002).

The results of the REGCEL model can be applied, for example (Hellsten et. al. 2002), as follows:

- to obtain an general picture of impact of regulation or water level fluctuation,
- to identify the most significant impacts,
- to compare the impacts or regulation alternatives, and
- to support the designation process of heavily modified water bodies according the WFD.

DHRAM water flow analysis method

The Dundee Hydrological Regime Assessment Method (DHRAM) developed by Black et al. (2000) in Scotland is based on the Indicator of Hydrologic Alteration (IHA) method (Richter et al. 1996). Using this method, the alterations in the hydrology of the watercourse can be assessed. The model compares differences between the flow data measured or modelled in an impacted and non-impacted state of the river. The alteration in river hydrology has a harmful impact on the river ecology and affects the natural biota. The method does not have any measured biological response, and therefore is only descriptive.

The DHRAM model calculates several discharge factors from the flow data. The factors are divided into five different groups. In every group, the mean values and coefficients of variation of the data are used as indicators. There are thus a total of ten summary indicators used in the comparison between non-impacted and impacted situations. The alterations are calculated as absolute changes (%).

The discharge factor groups and their descriptions (Richter et al., 1996) are listed below:

- Group 1: Magnitude of monthly water conditions (mean flow)
- Group 2: Magnitude and duration of annual extremes (minimum and maximum flow values of every 1, 3, 7, 30 and 90 day-long periods)
- Group 3: Timing of annual extremes (days of annual maximum and the minimum flow)
- Group 4: Frequency and duration of high and low flow pulses (greater than the 75th percentile of flow and, respectively, less than the 25th percentile)
- Group 5: Rate and frequency of change in conditions (increase or decrease of mean flow within consecutive days and the number of flow reversals).

The factors above describe indirectly, for example, the environmental variation, stress and disturbance and seasonal stress needed for specific life cycles, i.e., fish spawning and reproduction.

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Session 4
GIS and Environmental Data Management

Internet-based GIS in assisting Sustainable River Basin Management and Planning in the Watersketch project

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Introduction

Geographical Information Systems (GIS) solutions are frequently used for spatial planning projects, and increasingly being published as interactive applications on the web. The choice to use interactive as opposed to static maps has its obvious advantages, and the choice to place the maps online with multiple functions creates a new set of advantages for a wide array of possible users. This abstract discusses the work done in the Watersketch project in terms of the MapViewSVG internet-based GIS-application and provide suggestions for further improvement.

Emergence of Internet-based GIS

In general, environmental issues have changed from being caused by point sources (such as pollution from industrial purposes) to diffuse sources (such as acidification, eutrophication and issues caused by traffic (Anderberg 2000)). The result of this development has been that the issues are increasing in geographical scale, time and complexity and therefore require a larger amount of information input. Changing environmental issues demand a change in management approach, and tools influenced by integrated holistic thinking have been emerging in effect, such as Integrated Coastal Zone Management and Integrated River Basing Management.

A Decision Support System (DSS) incorporating GIS has increasingly been implemented in these approaches in order to handle the complexity of many spatial planning challenges (Voss et al. 2004). The advantage of the GIS software is its ability to incorporate many layers of information, whose only common factor is the geographic placement, and thus, be able to view all aspects, which may affect an area at the same time. Today environmental projects are not only broad in regard to the number of scientific disciplines involved, but also frequently cross-border projects involving many different nationalities. Hence, communication between partners as well as to the public benefit from visual tools that can aid with sharing of information. The use of Internet-based maps has increased considerably within just a few years in a multitude of applications, and has been employed in many differentiated projects spanning from management of wetlands (Mathiyalagan et al. 2005) to public health services (Maclachlan et al. 2007). The web-based GIS solution is an obvious choice, and some of the reasons for this are:

- Public participation is promoted through internet exposure, which increases the chances of implementation success (Hansen & Prosperi 2005).
- The Internet is used by everybody in the scientific community today and is therefore an inescapable asset to any large-scale environmental project.
- High quality interactive visual presentation on the Internet is increasingly demanded in most projects.

- Visualisation of milestone results to financial bodies is important, and is expected be a tool for communicating the progress of project preparation.

Generally, the strength of Internet-based GIS is its ability to reach the third parties of the project, such as the general public, meaning that any interested party will, in principle be able to access a limited version of the GIS application and perform simple actions such as pan, zoom and click layers off and on. However, the users will also be able to perform advanced actions such as queries by simply installing a viewer. The possibility of zooming in on the area of interest to the individual user, and only choosing to view the relevant data to this individual, makes the interactive map an asset in a project directed towards many scientific fields, where each user might have a different focus. The individual users can then sort through and discard any unnecessary information.

Web-GIS solutions; ArcIMS and MapViewSVG

There are several possibilities for choosing an application for publishing GIS maps on the Internet. Here we have looked at the applications of ArcIMS from ESRI and MapViewSVG which are very different in regards to both preparation of the maps and the resulting outcome. The ArcIMS (Internet Map Server) program provides both a simple solution in which the interactive map is created by following a wizard-application, and a more advanced solution where layout and functions can be customised through the source files (ArcIMS, ESRI). The advanced solution requires learning the methods for customising the webpage and ArcXML (the applied programming language), which can be time-consuming for the creator. However, learning the many functions of the ArcIMS will result in many possibilities for creating an advanced Internet-based GIS solution with all the functions of the original GIS project. Although there are advantages of being able to create a webpage with a more impressive layout and a multitude of functions, several disadvantages to the ArcIMS solution must also be considered. The program has to be purchased and acquiring the ability to take advantage of all the provided possibilities of the program can, as mentioned, be time-consuming (Maclachlan et al. 2007). The question which should be raised is whether or not the advanced tools rewarded by this application can justify the added time needed for preparation, since there are other options available.

Another solution is the MapViewSVG (Scalable Vector Graphics) extension for ESRI ArcGIS. SVG is a highly compact vector image format, developed by the World Wide Web Consortium, with a high quality of graphics and is therefore possible for use on web pages (www.esri.com). The MapViewSVG extension provides a wizard for exporting data from the users GIS project to an SVG file and thus easily publish and showcase it on a web site. A wizard application guides the user through options of layout and functionality. There are a number of template styles for the layout to choose from and additional options for adjusting background colour, frame size, overview map, logo and legend. With regard to the functionality of the page it is also possible to choose which layers to add the option of viewing attribute data and querying to. There are also options regarding the measuring tool and the zoom function but not all the functions from a GIS project can be applied on the produced web site. With a small amount of time spent on learning to customise the source files it is possible to make further changes in the web site, however still making the MapViewSVG less time-consuming than the ArcIMS. The main strength of the MapViewSVG solution is that it is possible to create a presentable interactive map without any previous knowledge of the technique, and with minimal experience. It is limited in functionality, compared to ArcIMS, but in many ways easier for the creator of the interactive map. In light of the above described differences between the two applications, the MapViewSVG was chosen for the Watersketch project. The main reasons for this are that no real reproductive functionality are needed since the main purpose for the map was to assist in visualisation of data for partners and interests. Also, the use of resources for the task of publishing the maps should be kept at a minimum.

The Watersketch Project

In the Watersketch project the interactive GIS maps are used in the Toolbox to present the case study areas as an addition to the summaries (toolbox.watersketch.net- Case areas). They are to assist the reader in understanding the case area described in the report and is hence an added tool of visualising complex data within the project area. The interactive maps can also later be expanded with regards to both functions and accessible data, and have the potential to be incorporated into a fully developed DSS. The maps contain information on e.g., land cover, river network and infrastructure (Fig. 1).

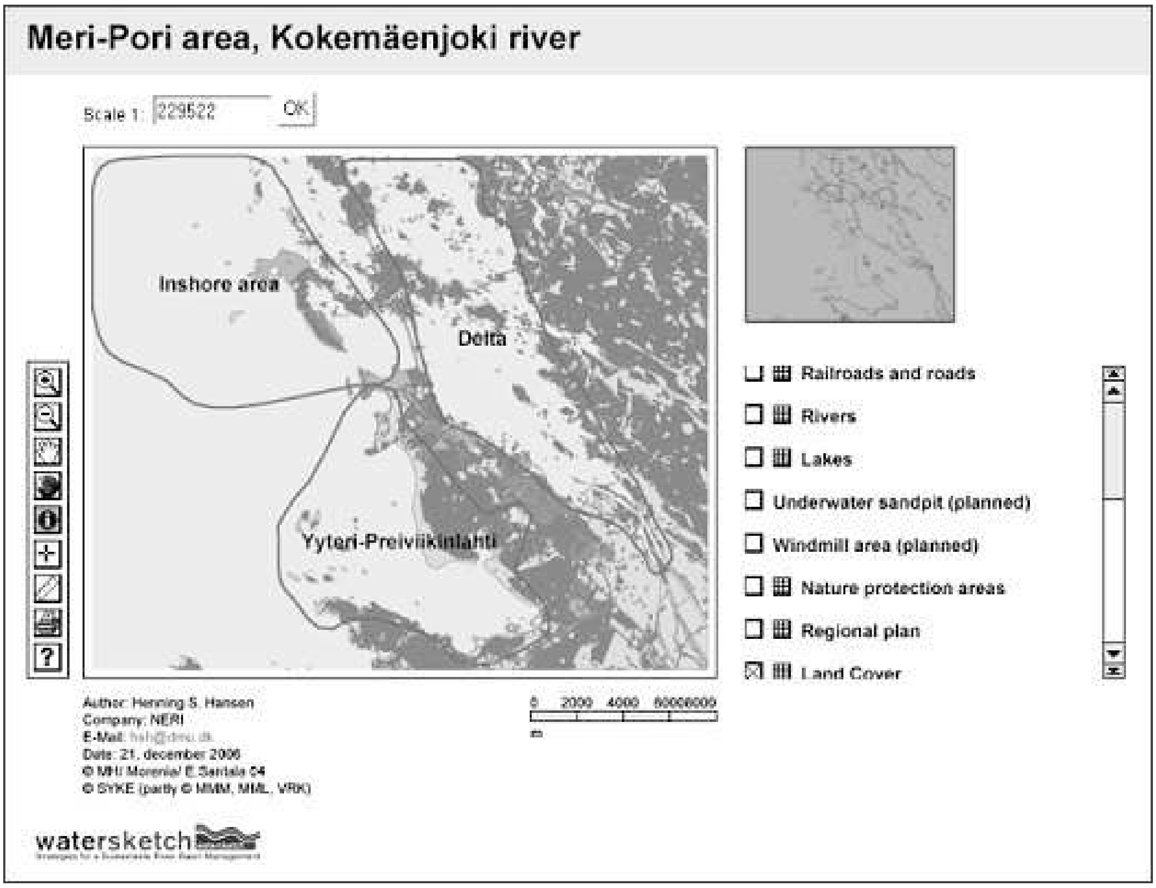

Fig. 1. Interactive map for the Meri-Pori area in Finland (toolbox.watersketch.net).

On the basis of the Watersketch project, several conclusions can be drawn of the potentials and barriers of the Internet-based MapViewSVG solution, which is presented below (Table 1).

When setting up the MapViewSVG, it is important to present several questions, such as "*Who is the receiver?*", "*What will the data be used for?*" and "*Which resources are available?*". By asking these central questions, it will be possible to produce the most cost-effective Internet-based GIS solution. Mostly, problems occur when too much information is made available online minimising functionality on account of this overload of information. Therefore, the user is to make sure that only data layers, which are directly relevant to the specific case area are made available. This can be difficult when targeting a wide array of actors, such as planners, scientific entities, students and the general public. Furthermore, the presentation and preparation of data are costly both in terms of time and money, so appreciating that goals must be coupled with resources available, is essential in achieving success.

Table 1. Potentials and limitations of MapViewSVG.

Potentials	Limitations
– Easy overview of a complex reality via interactive map. – Multiple functions from ArcMAP available (in form of buttons). – Aimed at a multitude of interests. – Makes it possible to show copyrighted material online. – Great in many phases of project, as in initial brainstorming phases and project presentation. – Inexpensive licence.	– Limited functionality in most cases for advanced GIS solutions. – Copyright issues. Some maps may not be available even for visual presentation. – No reproductive capacity/export function. – Heavily generalised data. Details limited if loading is to be kept at a minimum. – A large amount of resources are needed for presentation and preparation of data. – Several technical limitations and errors. – A viewer is needed.

Conclusions and final comments

The SVG-solutions were essential in the workings of the Watersketch Toolbox, not so much in the case study research and workings, but in the presentation of these to legislators and parties not involved directly in the production of the case-study reports. It shows great potential as an additional tool for visualising data and in making it available for as wide a number of interests as possible. Although the SVG is not directly a tool such as the WebHIPRE, which is part of the Watersketch Toolbox, it has proven a great advantage throughout the project initialisation and should remain an asset to the future users of the Watersketch Toolbox. The SVG remains, then, a limited addition to many stages of a Decision Support System, but nevertheless a valuable one seen as an addition to any similar future projects.

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Using ISO 19115 Metadata for Information Management and Spatial Planning in the Coastal Zone

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Introduction

Responsible management and planning relies on efficient information infrastructures to facilitate information sharing both horizontally among Federal and State offices in Germany and vertically among national and international administrative bodies. Standardised procedures based on the ISO19115 Geographic Information - Metadata have been developed and implemented with special emphasis on the coastal zone. The North Sea and Baltic Sea Coastal Information System NOKIS provides the means to search and retrieve information from the German coastal environment and related research projects (Lehfeldt & Reimers 2004).

Cooperation in NOKIS bridges the information gap between sectoral views such as coastal engineering and ecology. The NOKIS metadata profile contains all ISO 19115 core elements that are used in the German Spatial Data Infrastructures on State and Federal level, as well as within INSPIRE (INfrastructure for SPatial InfoRmation in Europe) proposal for an EU directive. Finding data and information context is an essential requirement in the frameworks of Integrated Coastal Zone Management (ICZM) and the EU Water Framework Directive (WFD).

The WFD aims at good ecological and chemical status of all water bodies following the principles of integrated water resources management based on river basins, transparency and stakeholder participation (European Parliament and the Council of the European Union 2000). The agreed methods are monitoring networks for assessing status and modelling for assessing impacts.

Especially the WFD implementation process presents a new approach to data and information collection and reporting. NOKIS depicts a successful bottom-up approach to a coastal metadata profile, and to web services related to the presentation of environmental data sets and planning tasks, which is applied in Federal and State institutions charged with coastal and WFD responsibilities.

NOKIS Information Infrastructure

A versatile infrastructure has been built around the NOKIS metadata repository. For the creation and maintenance of the metadata, the NOKIS editor is used. This software helps the user in creating valid ISO 19115 metadata by indicating missing or wrong elements and by providing aids for the editing of certain elements. It includes the ability to work with templates, to import existing metadata from other metadata sources and a basic workflow for the handling of editing and viewing rights of the metadata. Other system components include the search on www.nokis.org, the metadata extraction tool DB2XML or the Planning Tool for Coastal Surveys (PLATIN).

The search on the web site (expert search) includes a map based interface which provides an easy access to geospatial information. Research shows that most information sources have a spatial relationship, which makes them searchable in a geospatial context.

The NOKIS coastal information infrastructure is designed as a Service Oriented Architecture (SOA) using web services wherever possible. Many of the NOKIS components are potentially usable as web services: coordinate transformation, catalogue services, or gazetteer service.

NOKIS Planning Tool

One of the most demanded applications within NOKIS is the Planning Tool. It exists in different customizations: as a planning tool for the coastal survey planning and as a planning tool for monitoring networks for the EU Water Framework Directive. *The Planning Tool* offers the user a Rich Client Frontend for the generation of planning information. The desktop application contains 3 sections:

1. Information tool for search and import of existing planning information like surveys or monitoring stations
2. Planning section for creating new information and analysing them in context with the imported data
3. Polygon editor with implementation of basic GIS features and the coordinate transformation Proj4.

It also allows data import from different GIS formats and stores its information in a configurable NOKIS metadata repository making it searchable for other applications using the Catalogue Service interface from the Open Geospatial Consortium. Since the Planning Tool is based on NOKIS infrastructure, metadata from the standard repository may be taken into account during the process of planning.

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Session 5
Tools and Models in River Basin Management

Applying Ecological Risk Assessment Approaches in River Basin Management Planning

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Introduction

Degradation of water quality and benthic habitats due to agricultural and silvicultural catchment alterations and urbanization constitute a major threat to aquatic ecosystems all over the world (Thornton *et al.* 1999, Malmqvist & Rundle 2002). Environmental legislation, such as EU Water Framework Directive (WFD) and Clean Water Act in USA, tackle this problem by setting environmental quality objectives for water bodies and demands for integrated assessment of environmental pressures and risks of failing the quality objectives. Due to the high spatial and temporal variation in land use, hydrology and ecological conditions at the river basin scale, such assessment is not an easy task. Novel tools are urgently needed for basin scale pressure and impact assessment. Among such tools integration of Ecological Risk Assessment methods (ERA) into river basin management processes has proven promising (e.g. Ohlson & Serveiss 2007).

Environmental quality objectives of WFD rely on ecological classification based on biological quality elements. The ongoing debate on WFD classification tackles with the question on whether the status should be defined according to an integrated assessment of different biological quality elements or according to so called One-out, All-out (O-o) principle. The integrated assessment combines monitoring results of multiple biological elements, for example, by averaging the EQR values, whereas the O-o principle suggests that the biological quality element indicating the worst ecological status defines the ecological status (Sandin 2005, Vuori et al. 2006). When tested with real data, the O-o principle may result in highly biased and erroneous status assessments (e.g., Sandin 2005). Development of the Finnish classification system (FinEQ) is based on integration of multiple metrics and biological quality elements. The methods for integrated assessment include harmonization of the ecological quality ratios (EQR) of individual metrics and application of Weight-of-Evidence methods (WoE) commonly used in ecological risk assessment (ERA). My aim here is to present principles and examples of ERA methods in status assessment of water bodies and discuss advantages of such approaches for river basin management planning.

Assessment of the ecological status of water bodies

WFD demands expression of the status class as Ecological Quality Ratios (EQR), i.e., ratios between the observed biological metric values and the reference value. For classification, the calculated EQR values should be divided into five status classes: high, good, moderate, poor, and bad. Integration of multiple metrics and quality elements in defining the status class has been considered suitable for ecological status classification in Finnish surface waters by Vuori et al. (2006). However, they also suggest that the cautionary principle intrinsic to the O-O principle should somehow be integrated in the classification process. I argue that such system could be developed following the principles and methods of WoE included in ERA processes. The current FinEQ assessment system includes the following steps:

STEP 1. The ecological quality ratios (EQR values) for the biological samples are calculated by dividing observed metric values with the reference values (observed/expected ratio) or vice versa if the metric values increase in relation to the anthropogenic pressures (e.g. phytoplankton biomass, expected/observed ratio).

STEP 2. Different metrics and quality elements are made comparable by scoring each individual EQR value according to the following rules: EQRs in high status class = 10, good = 8, moderate = 5, poor = 3 and bad = 1. The scoring approach is analogous to the index of biotic integrity developed by Karr (1981). Second, metric scores are transformed back to EQR values by dividing the given score by the maximum score 10. Finally, the integrated EQRs are calculated as averages of the score-based EQRs across different biological elements and metrics. The following class boundaries are then applied for the average values: high = 1-0.8, good = 0.8-0.6, moderate =0.6-0.4, poor = 0.4-0.2, bad = 0.2-0.

STEP 3. Final classification is based on the status of biological quality elements versus physico-chemical quality elements. In principle, the poorer of the two groups defines the status class (Vuori et al. 2006). However, expert judgement and weight-of-evidence consideration is needed when evaluating the relevance of the classification results. Quality elements and monitoring results should be weighed according to their relevance and reliability and strength of associations with pressures.

Applying ecological risk assessment in status assessment

The framework of ERA consists of three major phases (USEPA 1998): (1) problem formulation, (2) analysis, and (3) risk characterization. Problem formulation is a planning and scoping process aiming at establishing the goals and focus of the risk assessment. Its end product is a conceptual model that identifies the environmental values to be protected (the assessment endpoints), the data needed, and the analyses to be used. The analysis phase generates profiles of environmental exposure and the effects of stressors. The exposure profile describes the magnitude and patterns of ecosystems' exposure to environmental pressures/stressors. The ecological effects profile summarizes data on the effects of the pressures and relates them to the assessment endpoints. Risk characterization integrates the exposure and effects profiles as well as information about pressure sources. Risk characterization also needs to assess uncertainties and draw the inference on the credibility of results by weight of evidence.

My view is that classification of the ecological status of water bodies is analogous to the ERA process. One needs to integrate multiple lines of evidence including different classification metrics and assessment of the reliability of site-specific monitoring data in relation to what is known about characteristics of the ecosystem and anthropogenic pressures that it is currently facing or has faced in the past. Further, as Ohlson and Serveiss (2007) point out, integrating ERA and Decision Analysis techniques enhances development of sound management alternatives and their prioritization. A case study on applying ERA methods in classification is presented, and their usability in management planning is discussed.

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MOSDEW, a new approach to Integrated Water Resources Management

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Introduction

MOSDEW (**MO**del for **S**ustainable **DE**velopment of **Wa**ter Resources) was developed at the Institute of Landscape Ecology as a regional model for integrated water resources management (IWRM). The approach bases on a Geographic Information System (GIS) and correlates land and water use management with natural site parameters. The model shows the causal links between global climate and socioeconomic change, site potential, agricultural productivity, economic benefits and ecological, hydrological and economic impacts. Thus it can be used as a planning tool for strategic evaluations of possible future developments for integrated water resources management. MOSDEW was developed as part of the EU-funded RIVERTWIN project (2004 - 2007), integrating results of up to 11 sub-models to finally establish an application-oriented expert system that supports, at a strategically level, the management plans required by WFD (Water Frame Directive).

As reference regions, the Neckar River basin (Rhine River tributary in Germany, approx. 15 000km^2) had been chosen as the pilot water basin with the relatively best data availability. To show the principal transferability, the approach was transferred to the Ouémé River basin (Benin, West Africa, approx. 50 000 km^2) and partially also to the Chirchik River basin (Uzbekistan, Central-Asia, approx. 22 000 km^2).

Coupling, Application and Communication

Important coupling and integration determinants for a decision support system are set by:

- decision objectives / administrative requests
- modelling issues and structure
- availability of data.

While the basic modelling framework and general approach has been proven to be transferable, the MOSDEW modelling framework has been developed in adaptation to the specific determination triangle of each water basins' ambience.

The RIVERTWIN integration concept is a GIS-based loose coupling strategy. This means that sub-models principally run the simulations of the modelling frame autonomously, but defined conventions assure standardised inputs and outputs (spatial and temporal scales, interfaces and formats) throughout the whole modelling chain (Fig. 1). The main integration geometries are the WFD reporting units. An important integration task was to identify gaps and deficits and finally to harmonise them either by sub-models' adaptations or by GIS algorithms e.g. by (dis-)aggregation. Thus, GIS techniques and algorithms enable, e.g., the integration of socioeconomic (land and water use) content with natural site parameters.

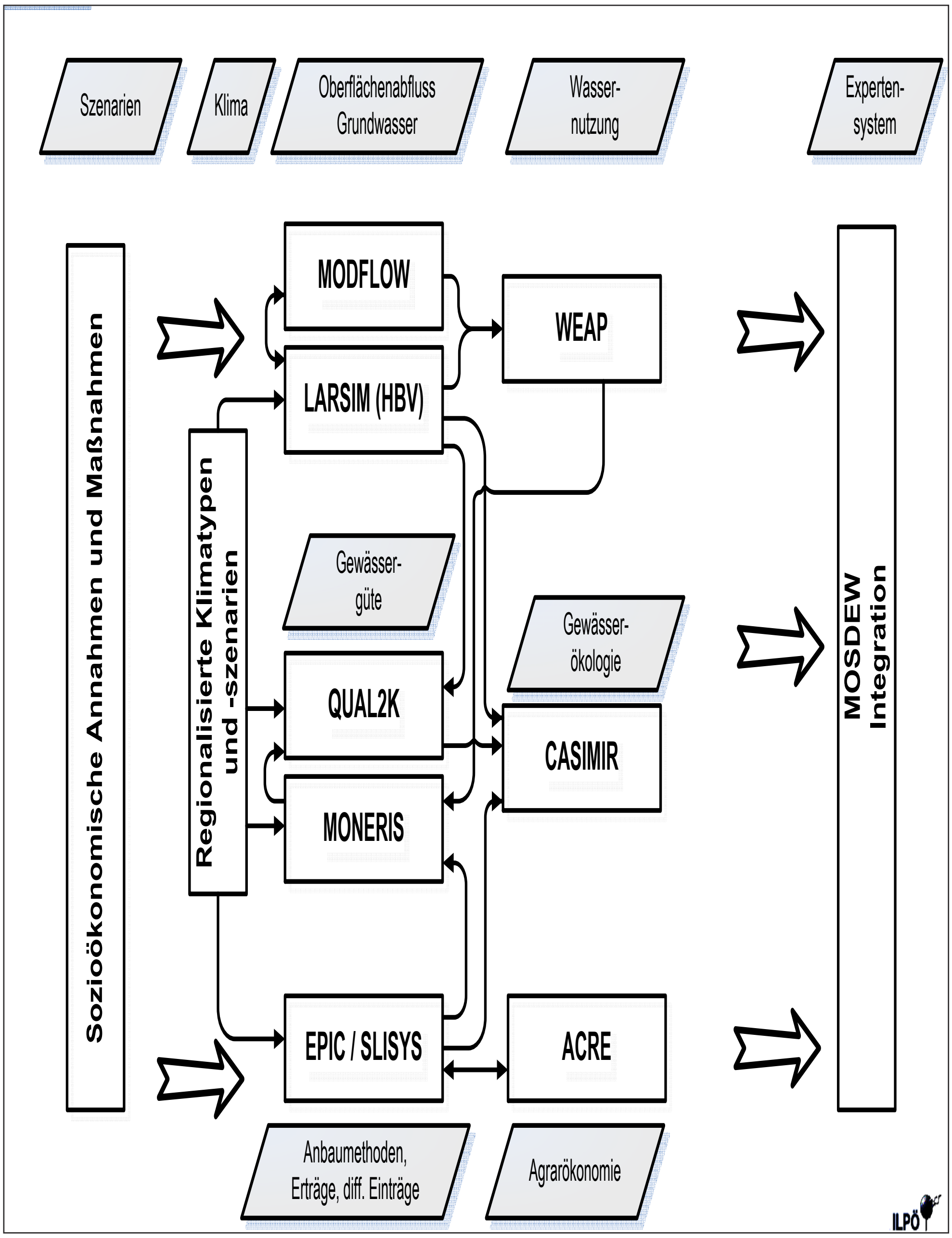

Fig. 1. The modelling framework.

While models are calibrated taking a reference year and historical year with measured "real" data, the interesting challenge comes from the water management/planning point that is interested in: "what happens, if…" As sub-models in RIVERTWIN are not dynamically coupled, not all potential options of possible futures can be queried at any time. Instead, a systematic series of planning relevant cases has been defined to be able to "explore" the respective possible range of interesting results (or of possible water management futures).

In RIVERTWIN, three main levels have been defined as the modelling framework:

- Climate sequences and types
- Socioeconomic scenarios (two plus the reference year)
- Interventions and possibly intensities.

The specific number and details of modelling cases at the levels and their combination had been defined for each River basin in an intensive iterative process among the modellers and between modellers and stakeholders. Ideally the adapted framework of the respective river basin represents the specific diversity of interesting water management question in a very efficient way. For the Neckar River basin, e.g., intensities had become an additional multiplication level (Fig.2).

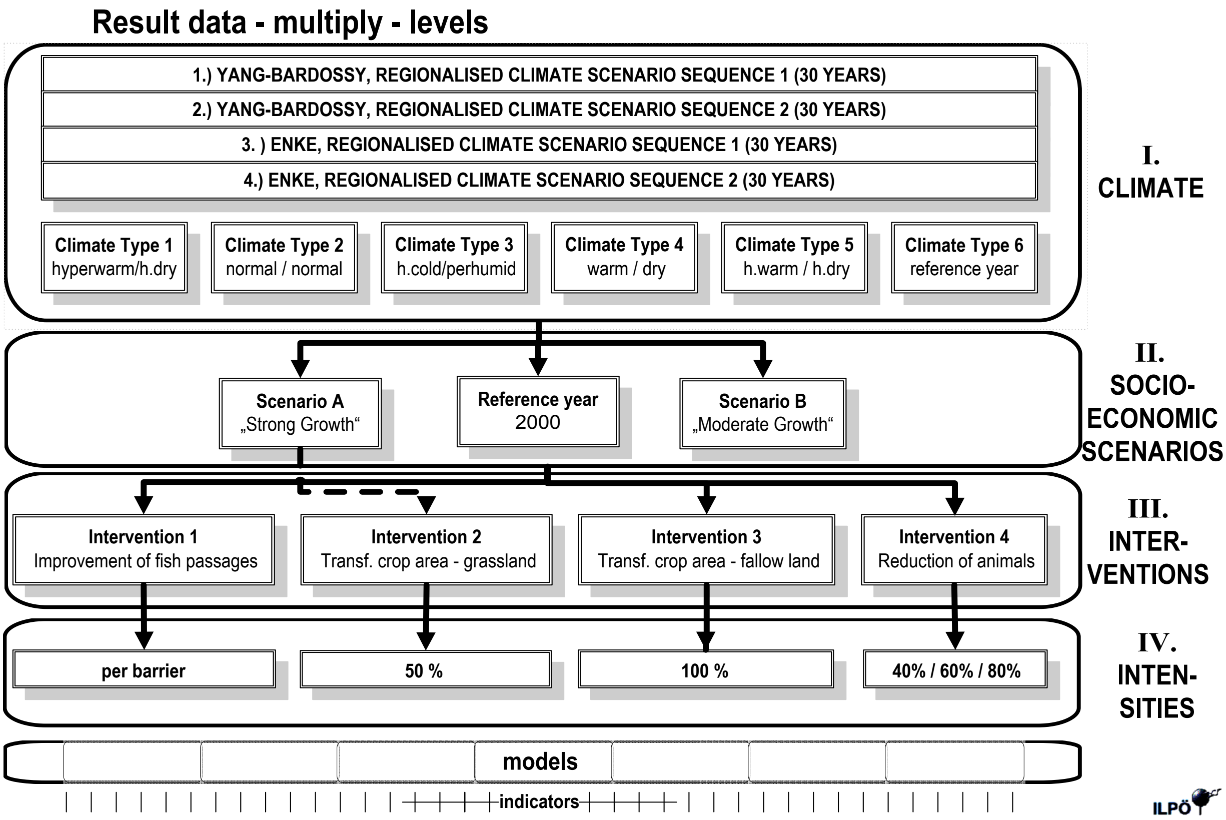

Fig. 2. Modelling example from Neckar River basin.

Although not all cases had strictly to be modelled by all models (e.g. improvement of fish passages had no feedback effects on other models than the freshwater ecology/fish habitat model) an overall of approx. 1 000 cases had to be modelled in the Neckar River basin.

These results are transferred to the unified MOSDEW database. Via an internet graphical user, interface data can be queried in form of tables, maps and figures. Possible developments can thus be checked if indicators surpass thresholds.

This approach includes a central data integration (model interface) and maintenance process and allows a decentralised use (web interface) without specific software. Providing both interfaces, the MOSDEW approach opens a communication port between the scientific and the stakeholder/administration world and establishes a plumbable and traceable data warehouse that fits perfectly to the necessities of multifunctional or integrated water management.

Conclusion

The shown integration approach by "interfacing" and "model framing" fits perfectly to achieve reasonable and transparent results in a reasonable time. The MOSDEW approach shows that IWRM may not only be achieved by "simple" engineer soluions, although best engineer input is essential. Good engineer handicraft has to be involved in a mutual communication process. The iterative and interactive process for the model framework design provides the necessary awareness and understanding. Otherwise even the best scientific output may not need the planner's demands.

Application examples in South America, West Africa and Central Asia showed that the integration architecture is open for the integration of new content (sub-models), own modules (Printz & Lang 2002) or adaptations by different request and sub-models.

The idea for MOSDEW as an interface-based expert knowledge system is to have an instrument which enables decision makers to gain answers that emerge by rapid changing and uncertain futures like 'global climate change' or fundamental socio-economic changes. Thus, MOSDEW can be a vital model for evaluating management strategies as required by the EU-WFD implementation of river basin management plans.

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You can learn more about MOSDEW and query the GUI at:
http://www.ilpoe.uni-stuttgart.de/projekte/rivertwin

Waterwise – a planning tool for adaptive land and water management

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Introduction

Water and space are inextricably linked. External pressures thus result in chains of impacts and responses that are intertwined and interactive. Recognizing this, the development of methods for integrated design of water and land management systems is seen as one of the key elements in the EU NeWater project (Pahl-Wostl & Kabat, 2004; www.newater.info). Thematic aspects that should be considered simultaneously are:

- water quantity interactions, via both surface water and groundwater,
- water quality interactions, via both surface water and groundwater,
- various functions (nature, agriculture, and so on..) that are dependent on surface water and groundwater.

But the danger of such a combination of requirements is that they can lead to the development of modelling systems that are cumbersome to use. And looking for acceptable water management solutions by 'trial and error' can be highly frustrating; such experiences can cause policymakers to turn away from IWRM (Integrated Water Resources Management) and lead to deadlocks in the solving of persistent water management problems. There clearly is a need for models that are more versatile than 'conventional' simulation models.

Modelling Method

The modelling system 'Waterwise' (Van Walsum et al. 2005) attempts to provide such an alternative. Instead of (yet another) simulation system it provides a framework for answering 'inverse' policy questions. Simulation models can be used for answering questions of the type: 'What is the effect of reducing fertilization of agricultural lands by 25% on the water quality at the stream basin outlet?'. The inverse question would be: 'Where and by how much should the fertilization of agricultural land be reduced in order to comply with a WFD-goal at the stream basin outlet and at the same time keep the income reduction of agriculture as low as possible?'. Waterwise can answer such a type of question and at the same time take various types of stakeholder preferences into account.

Waterwise uses mathematical programming (e.g. Hillier & Lieberman 2001) for the model formulation. Many economic models are anyhow formulated in that manner, making it relatively straightforward to arrive at an integrated model if the hydrology is formulated in the same way. Such a type of model involves three types of elements:

- decision variables corresponding to land- and water use options,
- constraints providing a (simplified) system description,
- objective functions relating to the decision indicators.

The system can be implemented in a simple or sophisticated manner:
- by filling the model equations using simple cause-effect relationships;
- or by using simulation models for performing computational experiments and then feeding the results as 'coefficients' into Waterwise.

Results and Discussion

The system has been implemented for the Beerze and Reusel region in the Netherlands, thus providing a test set. One of the computational experiments we did was to let the model find a cost-effective solution for achieving a water quality goal at the stream outlet. The cost of the generated solution was compared to a 'generic style' solution, involving a general reduction of fertilization of agricultural land. It turned out that the Waterwise solution involved 40% less income loss than the generic-style solution.

Suggested solutions can be counterintuitive, thus deepening insight into regional system functioning. In the above example, it is economically efficient in some parts of a basin to relax the environmental constraints on agriculture in order to (efficiently) reach a certain goal at the stream basin scale. Such a differentiated approach can also help in obtaining stakeholder support, because the provided analysis is not only used 'against' certain groups of water users. The message here is to *not* think 'one-dimensionally' about how to achieve environmental goals. This is an important key to building the 'water-space partnerships' that are so badly needed for solving today's and tomorrow's land and water management problems.

The method is now being further developed within the NeWater project by including aspects of uncertainty.

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Session 6
Decision Support Systems in River Basin Planning

Application of Web-HIPRE decision support tool for a sustainable development of Minija river basin

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Introduction

Minija river basin is located in the northwestern part of Lithuania. The length of the Minija River is 202 km and the catchment area is 2 942 km^2. Lakes cover only 0.6 percent of the area of the basin, while bogs and marshes cover 5.2 percent of the catchment area. The share of forested area in the Minija River basin is about 21 %. The southern part of the Minija river basin, Nemunas river delta and Curronian lagoon make up a unique natural water system (Morkūnas & Mališauskas 2006).

The natural delta complex is an important vicinity for about 300 species of birds, from which 40 species are included in the Red Book of Lithuania. Delta meadows are among the most important staging posts for migrating water birds and wading birds in Europe. Upland bogs and wet meadows are abundant in rare species of flora and fauna (Meinert 2005).

Agriculture has been prevailing in the rest of the river basin until the middle of the 1990s. Apart from agriculture, most local inhabitants are also engaged in fishing. In particular, fishing is popular in the southern part of the basin, where the river enters the Curonian lagoon. New activities like ecological farming and water tourism are emerging in the region. Water tourism and agricultural tourism are being developed on the coastline of the Curonian lagoon and in the Nemunas Delta Regional Park. Agricultural tourism also has strong potential in the area of Zemaitija National Park. Tourism and related activities are very important to the local economy (Tourism development in lower reaches of Minija river and Curonian lagoon 2005).

Structuring Decision Support Procedures

Goal

This case study provides considerations towards environmentally sound, economically balanced and socially agreeable development of Minija river basin. Decision support procedure was performed by applying Web-HIPRE software tool (URL: http://www.hipre.hut.fi/). The software was developed at Helsinki University of Technology.

First order criteria

The general concept of sustainability addresses balance between social, economical and ecological development (Nath et al. 1996):

- socially desirable, fulfilling people's cultural, material and spiritual needs in equitable ways,

- economically viable, paying for itself with costs not exceeding income,
- ecologically sustainable, maintaining the long-term viability of supporting ecosystems. The Minija river basin example provides equal manifestation for all three dimensions of sustainability (Fig. 1).

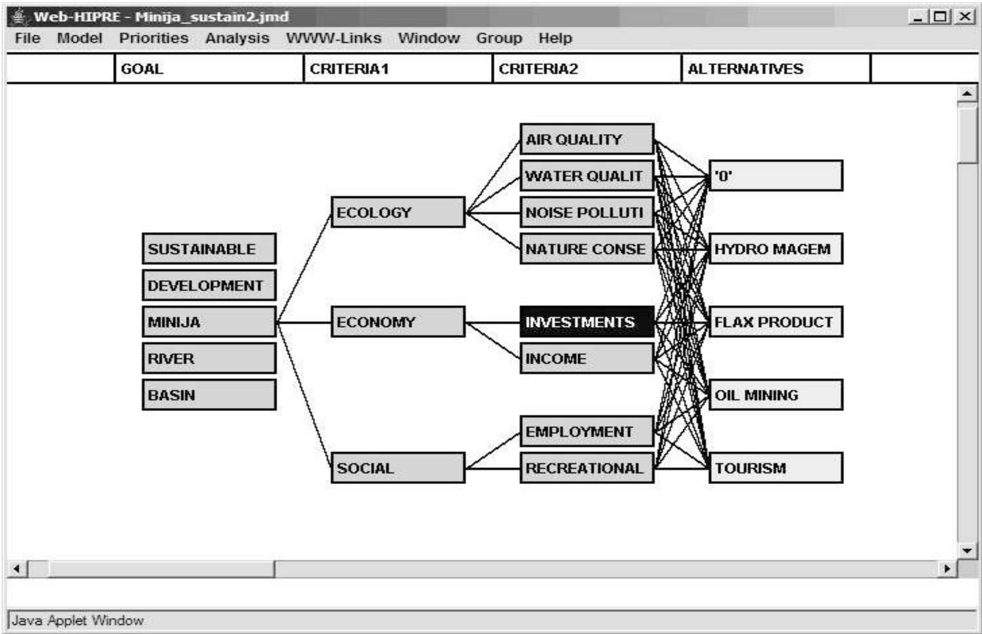

Fig. 1. Value-tree for a sustainable development of Minija river basin.

Second order criteria

Identification of relevant criteria was approached by considering local conditions in the Minija river watershed as well as available sources of information (see Fig. 1). Ecological/environmental characteristics refer to surface and ground water quality, possible increase of ambient air and noise pollution. Conservation of wildlife and biodiversity was considered as one more criteria important to support ecological sustainability.

Considerations towards economical development of the Minija river basin were based on balance between hypothetical investments and incomes.

Degree of employment and fulfilment of recreational needs of local people and visitors were decided to be essential criteria for social development of the river basin.

Alternatives

The experts, familiar with the Minija river basin, were asked to make a discussion in order to come up with the suggestions relevant for the development of the region. It was suggested that present situation or “0 alternative” would make a benchmark for predictive scenarios.

Water resource management including reconstruction or building up of small hydropower stations was included into the alternative “Hydro management”.

Traditionally agriculture is significant activity in the river watershed. Flax fibre production and processing have opportunity contributing to the long-term economical and social development of the region. As a result, experts have suggested alternative “Flax production”.

Today Minijos Nafta is the leading oil producing company in the Baltic States. Currently Minijos Nafta is engaged in an active resource exploration programs and it makes prerequisites for further expansion of oil extraction activities. Thus, the experts have considered that "Oil mining" alternative would make an important share to the local economy.

Experts have concluded that unique nature, rich wildlife and vital ethnographic traditions have high potential for water and agricultural tourism development in the Minija river watershed, especially in its southern part. This alternative was named "Tourism".

Results of the Analysis

The decision support analysis has provided considerations and major trends towards sustainable development of the Minija river basin (see Fig. 2).

Results of the analysis have showed that the highest priority was given to the "Tourism" alternative. This alternative is more than two times higher if compare to the "0" alternative, which presents "status quo" situation. The major input to the alternative "Tourism" was given by the social criterion.

The next priority was "Hydro management" alternative. Here the prevailing criterion was ecological / environmental concern.

The "Oil mining" alternative was prioritized as the third one. The dominant criterion in this alternative was economical interest, while ecology and social issues had comparatively low impact.

The lowest priority was given to the "Flax production" alternative, which was slightly higher as to compare to the "0"

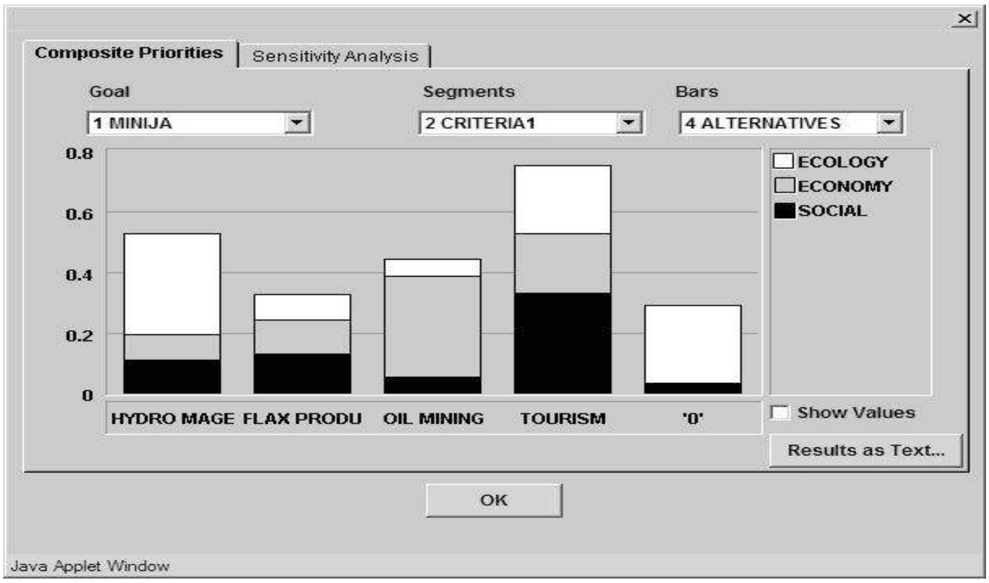

Fig. 2. Composite analysis graph of Minija river basin development.

Discussion

The application of Web-HIPRE_decision support system provides decision makers and planners with an effective tool. Further more, experience has shown that it acts as an excellent vehicle for discussion and the development of the consensus. It gives possibility for better understanding and structuring of complex issues related to the decision (Eastman et al. 1995).

Analysis of development scenarios has revealed that some of the supposed activities in the Minija river basin are conflicting. Thus, authors do not consider simultaneous implementation of several supposed activities, but compared 'pure' development scenarios. Differently than Minija river basin case study, Web-HIPRE could support decisions on complex implementation of activities, however it would require further quantitative assessment of planned activities.

Process of river basin planning and management strongly incorporates aspect of mapping, thus, further development of Web-HIPRE, as Geographic Information Systems (GIS) friendly tool, would receive appreciation of river basin planners and managers.

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Creation of Cost-Efficient Program of Water Protection Measures Supported by Multi-Criteria Decision Analysis

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Introduction

The EU Water Framework Directive (WFD) poses a new challenge for the member states: a good ecological state for fresh waters has to be reached by the year 2015. This task is challenging because of the numerous human activity pressures that are affecting the water bodies. Due to the number of pressures, the scope of the possible measures to deal with them is large and the impacts and costs are diverse. Public participation also plays an important role in the planning processes. Therefore, there is a great need for systematic and transparent approaches to support the creation of appropriate and just Water Management plans (according to the WFD) to overcome the new challenges.

This paper presents an approach to support the selection of cost-effective water protection measures to improve the ecological state of a water body. The approach combines expert evaluations and scientific data about impacts of measures on different ecological quality elements and produces effectiveness indexes for the measures. The indexes describe the effectiveness of measures to improve the ecological state of a water body relative to each other. The indexes are illustrative and the diverse impacts of different measures can be transparently expressed through them. The approach is implemented in collaboration with different stakeholder groups and supported with multiple-criteria decision analysis (MCDA) (see e.g., Keeney & Raiffa 1976, Belton & Stewart 2002).

The Approach

The approach consists of three main steps:

1. **Define present state of a water body:** The impacts of different pressures on ecological quality elements are assessed in pressures-impacts matrix. The most important ecological quality elements regarding the water body are identified and the relative importances of these elements in improving the ecological state of the water body are evaluated.
2. **Evaluate measures:** Measures to improve the ecological state of the water body are identified. The scale of identified measures and their impacts on the ecological quality elements are evaluated.
3. **Calculate effectiveness indexes of measures:** MCDA-model (Fig. 1) is used to calculate the effectiveness indexes of measures.

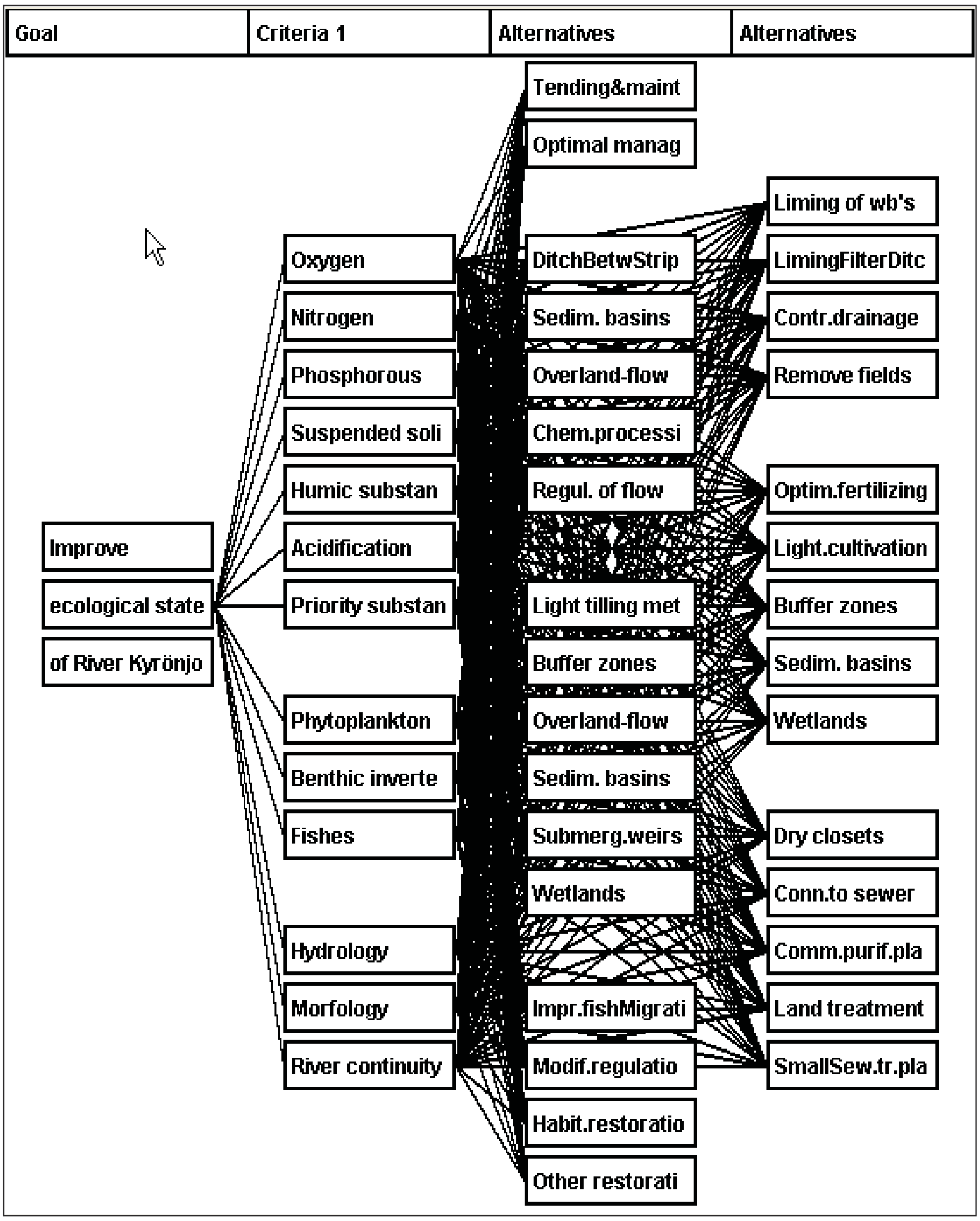

Figure 1. A value-tree (MCDA-model) to calculate the effectiveness indexes of measures. An example from the River Kyrönjoki case study.

The River Kyrönjoki Case Study

The approach was created and tested in River Kyrönjoki within the Watersketch project (www.watersketch.net). Earlier, in the BERNET CATCH project (www.bernet.org), the Preliminary Management plan for the River Kyrönjoki (Rautio et al. 2006) has been composed. In the Preliminary Management plan, human pressures to the water body are identified, environmental status of the river and aims of water protection are defined and preliminary program of measures is compiled. In the River Kyrönjoki case study the approach was created and used to produce effectiveness indexes for the water protection measures identified in the preliminary program of measures. The approach was implemented in collaboration with the River Kyrönjoki Work Group consisting of members from the West Finland Regional Environment Centre and other interest groups. One questionnaire was sent to the group and six workshops were held to support the process.

The Results

The relative effectiveness indexes of water protection measures at River Kyrönjoki are illustrated in Figure 2. These indexes describe the measures relative effectiveness to improve the ecological state of the main channel of the River Kyrönjoki. Similar indexes were produced for the side channels (Rivers Kauhajoki, Jalasjoki and Seinäjoki) of the River Kyrönjoki as well. The effectiveness of measures in the main and side channels varies due to the various pressures affecting the catchment. Through these indexes the measures were compared. The measures were also analysed according to their costs, feasibility (social, technical and juridical), uncertainty, risks and time perspective. Finally, the cost-effective and feasible measures were identified and included into the final program of measures in the Management Plan of the River Kyrönjoki.

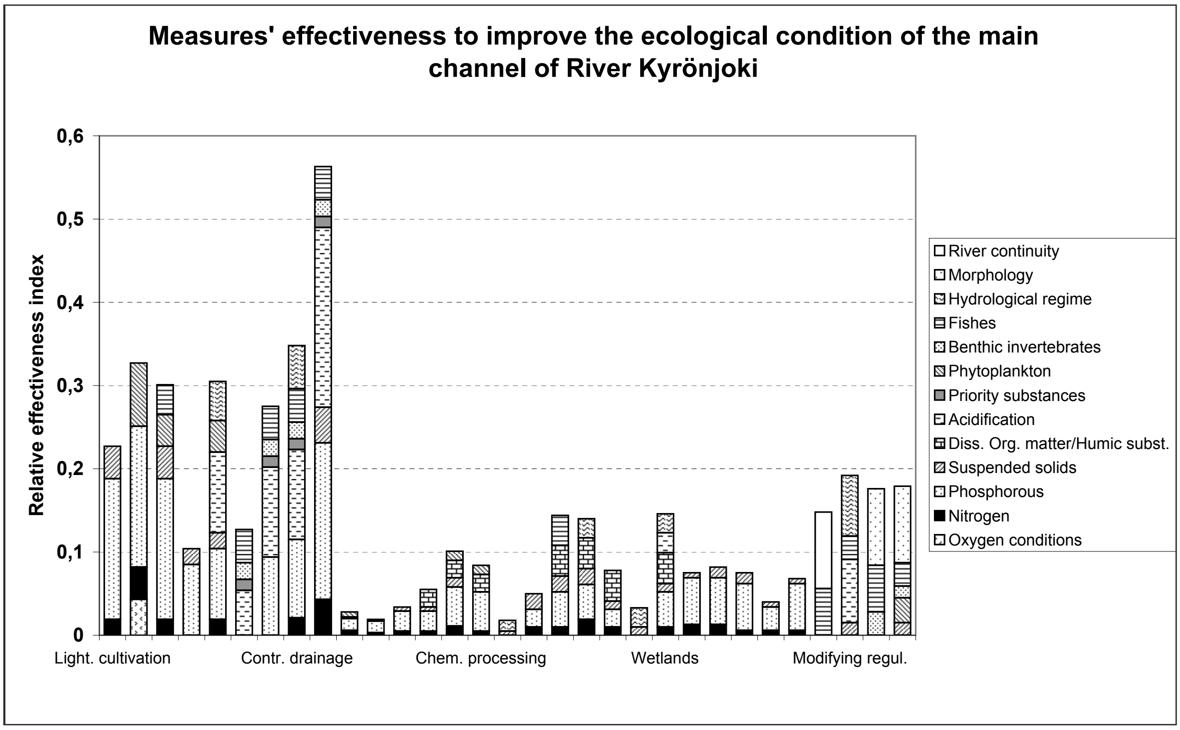

Figure 2. The relative effectiveness indexes of water protection measures in the River Kyrönjoki main channel.

The process of forming the relative effectiveness indexes was found fruitful and constructive for discussions in the River Kyrönjoki Work Group. Furthermore, the indexes were found to be illustrative and understandable to disseminate the discussions and conclusion to a wider audience. All together, the indexes and the process of formulating them proved to support the creation of final program of water protection measures and participation of stakeholders in the process.

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Population viability modelling: assessing the scenarios for the Vistula River Valley

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Introduction

The Vistula is the biggest river in the Baltic Sea catchment area. The Vistula river basin is recognized as important ecological corridor in the EECONET, connecting southern and northern parts of the Central European Lowland (Liro 1995). The floodplain area represents an extensively managed landscape, with high nature values, including specific habitats like riparian forests, islands and ox-bows, providing high biodiversity of aquatic and terrestrial species. Several integrated management plans existed for the Vistula Valley, but none has ever been fully implemented by successive authorities. At present flooding issues are addressed for the middle stretch of the river the including two major activities: potential development of two new dams at Płock and Wyszogród; and various contrasting proposals to manage the problems that have arisen with the operation of the aging Włocławek Dam (WWF 2001).

Methods

The Decision Support System (DSS) was implemented for the first time to assess the potential management plans of the Vistula Valley in the Polish-Dutch project "Vistula Econet Development and Implementation (VEDI)" (Romanowski et al. 2005). Several scenarios of expected and hypothetical development elements for the 135 km long section of the Vistula Valley from Warsaw to Włocławek in Central Poland were formulated by stakeholders, including scenarios of:

- Maximum river regulation and infrastructure development (construction of two new dams; removal of all trees inside the dikes; development of roads, dikes, motorway etc.)
- "Brave vision" for Vistula valley renaturalisation (decommissioning of the present dam at Włocławek and some of the dikes; removal of some of the settlements in the river valley; natural succession within the flood plain)
- Reforestation (conversion of low-productivity agricultural fields into forest plantations and natural forest succession).

Detailed digital maps outlining the changes to the vegetation complexes and all spatially explicit elements were prepared for each scenario (Matuszkiewicz et al 2005). Set of sixteen vertebrate and invertebrate species indicative for representative habitats for natural river valley was selected. Although species were analysed, the results may be viewed as exemplary for a guild of species of similar size and ecological requirements (eco-profiles). The habitat model LARCH (Chardon et al. 2000, Verboom et al. 2001, Groot Bruinderink et al. 2003) was calibrated for local conditions and used to assess current population viability and threats to the species selected.

Results and Discussion

The results of the study indicate that at present most of the species analysed form viable local populations arranged in sustainable networks and that many of potential developments pose significant threat to the biodiversity in the Vistula Valley. Two dams, if constructed in Wyszogród and Płock, will destroy natural islands, causing pronounced 50 - 97 % reduction of the avian populations (i.e., Little tern, *Sterna albifrons*) nesting in the study area, and the parallel decrease of several semi aquatic species. Other activities, considered by the authorities as "anti-flooding", like intense river regulation and removal of the riparian forests inside the dikes, may additionally negatively effect waterfowl and many mammals especially the beaver *Castor fiber*, reptiles, amphibians and invertebrates. The construction of new roads may lead to fragmentation of habitats and many local populations of small mammals, reptiles and amphibians may come in a 'danger zone' and lose viability (Fig. 1). However, the results of the LARCH modelling in fine landscape scale are adequate to be used for the optimal planning of new fauna passages and to minimize the negative effects of habitat fragmentation. Both aforestation and natural succession of vegetation are beneficial for many forest species, including the Middle spotted woodpecker *Dendrocopus medius* and Pine marten *Martes martes*, however, it may have negative influence on species of open habitats like the Corncrake *Crex crex*. The results provide additional indications of the effects of possible measures on two Natura 2000 areas designated in the study area. As development plans are only allowed if they have no significant effect on the favorable conservation status of the species and habitats, the designation of the Middle Vistula valley area as Natura 2000 site has strongly reduced the options for intense river regulation and building dams.

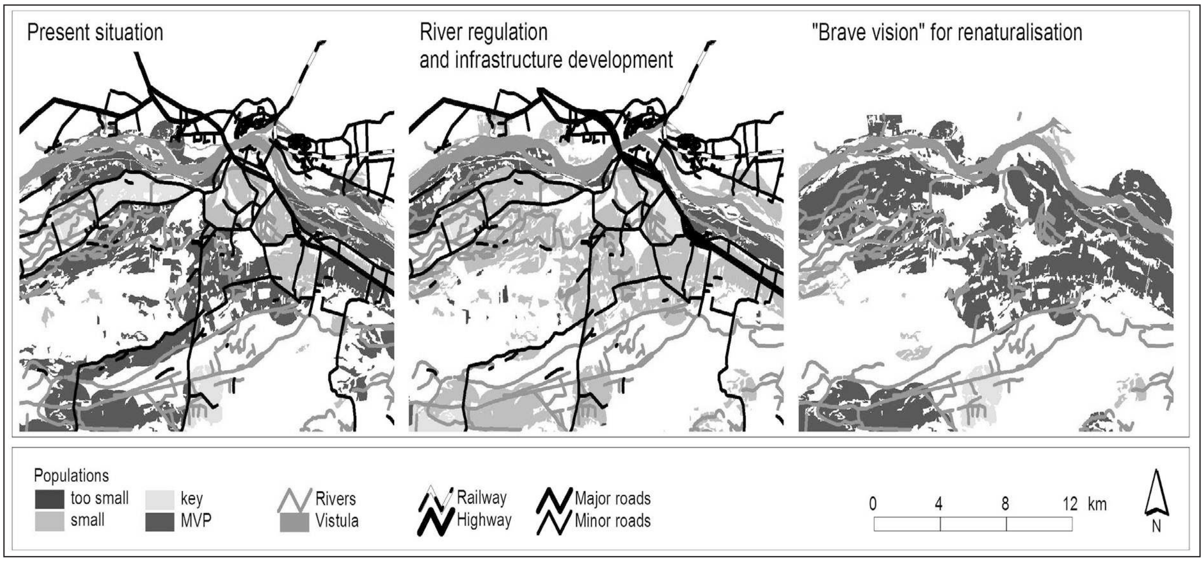

Figure 1. Fragmentation of populations of the Great crested newt (Triturus cristatus).

The implementation of DSS supported with the stakeholder approach and scenario modelling shows how Vistula Valley ecosystems can be affected in the future. This approach allows to foresee ecological consequences and provide expertise for the spatial planning. The use of Population Viability Model allows not only to analyse changes to population numbers, but further to assess how the fragmentation of habitats influences sustainability of populations and in consequence, the biodiversity of the area.

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Cost-effectiveness analysis to prevent nutrient emissions by diffuse sources – Baltic Sea catchment area of Germany –

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Introduction

The reduction of nutrient emissions by diffuse sources is a key factor for the protection of the Baltic Sea. The main contributor to diffuse nutrient emissions is current land use, requiring changes to achieve a reduction. Potential changes include rearrangements in land use, changes in tillage or usage of fertilizers, prohibitions or a combination of all measures. Such measures within land use or new combinations will cause costs which emerge from less crop yield, higher efforts in land cultivation or a combination of both. The calculation of these costs is of great importance for policymakers willing to achieve an obliged reduction goal at minimal costs. Therefore, the objective of this study was to calculate cost-effective solutions for nutrient load reductions to the Baltic Sea by minimal social costs. This research was undertaken within the framework of a PhD scholarship of the German Federal Environmental Foundation (Mewes 2006).

Used Data

The study is based on available emission data for six diffuse pathways in the German catchment area of the Baltic Sea from Mecklenburg-West Pomerania and Schleswig-Holstein by means of the model MONERIS (Behrendt et al. 2000, 2003, data received from the Institute of Freshwater and Inland Fisheries in Berlin). Thereby, the investigated area is differentiated in 19 river catchments. Moreover, data on nutrient supply, removal and surplus, on digital land use and soil data for the investigated area is used as well as literature analysis and evaluation.

Approach

Starting from the nitrogen and phosphorus emissions and immissions by evaluating the MONERIS-data, the amount of nutrient reduction is defined. Linking nutrient emissions and land use by literature analysis, areas with high nutrient reduction potential can be constituted. Different abatement measures are offered and their effectiveness (nutrient reduction) is determined. Taking into account the implementation costs of these measures, the cost-effectiveness for the abatement measures can be calculated. With the help of a cost-effectiveness-analysis different scenarios are compared resulting in cost-effective solutions.

Nutrient abatement measures

For deriving nutrient abatement measures, it is most important to know how emissions vary under different land use and soil types. Therefore, land use and soil data is evaluated for the investigated area. Afterwards, appropriate nutrient abatement measures for the investigated area are chosen.

The following abatement measures are considered:

1. special advisory service for an optimal land use for water protection (including less fertilizer, no erosion, crop cultivation, etc.),
2. measures in livestock husbandry,
3. rearrangements in land use on sandy soil,
4. reestablishment of wetlands on marshy soil and
5. buffer strips.

Cost-effectiveness analysis

For the comparison of the different abatement measures, a cost-effectiveness analysis is carried out based on simplifying assumptions, e.g., for analysing the large-scale area the whole area is regarded as a unit. After determining the effectiveness of the nutrient abatement measures with the help of a literature analysis, the costs of the abatement measures are calculated. The following assumptions have been made: no subsidies are considered, the cost accounting of the production method (standard gross margin minus fixed costs minus labour costs) is used. Typical crop rotations are chosen for the calculation of the opportunity costs depending on soil fertility as follows: winter rape - winter wheat - winter barley cultivated on fertile sites and winter rape - winter rye - winter barley cultivated on less fertile sites. Both the costs and the effectiveness for each measure are combined in a cost-effectiveness analysis. Based on these results, scenarios for achieving the defined reduction objective are developed. Ranking the cost-effectiveness of the different measures for each river catchment, measures are found reducing nitrogen and phosphorus to minimal costs.

Prospect

Generalisation was and is necessary to gain and handle information for the large scale catchment area. Establishing land use scenarios reducing nutrient emissions the following aspects could not be taken into account: long nutrient residence time in either soil or inland water, increasing atmospheric N-deposition due to traffic and combustion, etc., and other nature conservation goals like for example biodiversity. Thus, the results of this study deliver first insight and basic information for the strategic orientation of the water protection policy. For the implementation of measures the cooperation between land- and water management has to be strengthened. The approach of this study is also of significance for the implementation of the European Water Framework Directive.

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Euro-limpacs Decision Support System - A tool to integrate environmental, social and economic data for catchment management in the context of climate change

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Introduction

Euro-limpacs is an Integrated Project funded by the EU designed to assess the effects of future global change on Europe's freshwater ecosystems. As part of the project, a Decision Support System (DSS) is being developed in order to assist decision makers in understanding the implications of climate change for catchment management. The purpose of the Euro-limpacs DSS is to provide catchment managers and stakeholders involved in the catchment management process with tools for assessing the likely changes to the status of freshwater ecosystems under different scenarios or catchment management strategies, in the context of climate change. Such tools are needed to aid the implementation of the emerging policy framework, including the Water Framework Directive, and should consider the increasing focus on ecosystem services within ecosystem management. Identifying management measures that represent the best value for money is also of increasing concern for managers.

The DSS integrates data from diverse sources including environmental, social and economic data into a decision support framework based around Multi-Criteria Analysis (MCA). The structure of the DSS is flexible and generic so that it can be applied to any catchment in Europe and can incorporate already existing user data into the analysis. It will encapsulate relevant outputs from the Euro-limpacs project in the form of models, databases and expert opinion and present this in a form suitable to guide users' decisions and indicate issues and areas within catchments where further investigation is needed.

Integration of users' requirements

Consultation with potential users of the DSS indicated that it should be user-friendly and not require undue effort to apply. For this reason, the approach of the DSS is 'broad but shallow', integrating a wide range of environmental, social and economic parameters but not requiring users to apply complex models. Complex, dynamic models used by partners in the Euro-limpacs project (for example, the nitrate model INCA-N) have therefore not been directly integrated within the DSS. However, outputs from these models or other models that users already apply within their own catchments can be incorporated into the analysis.

Modules of the DSS

The DSS is based on a GIS platform that allows users to compare, using MCA, a set of scenarios of climate change or land management strategies. The user specifies which criteria form the basis of the comparison of scenarios, as this depends on the particular circumstances within the catchment being assessed. Decision criteria may, for example, include variables such as mean flow, nitrate concentration, sediment loads, biodiversity indicators or stakeholder benefits. In order to make the DSS generic, it has the facility for users to incorporate user-defined variables into the analysis. This allows variables that are not assessed in the Euro-limpacs project but are important in a particular user's application to be considered.

Each of the criteria will have different values under the different scenarios and strategies. The tools, databases, models and expert guidance from Euro-limpacs will provide the basis for assigning values to each of these criteria. Where users have introduced user-defined criteria into the analysis, the values of those criteria must be defined by the users themselves using, for instance, their own data, external modelling or expert judgement.

Using a multi criteria analysis approach, these scenarios or strategies can be compared in order to determine, for example, which option offers the best strategy to address a particular environmental problem or to aid the development of mitigation strategies to counter the effects of climate change.

The GIS basis of the DSS will also allow the comparison of different areas within catchments for each of the scenarios. For instance, the variation in impact between subcatchments can be explored so that, in addition to identifying key criteria to be addressed, the DSS will be able to identify key geographical areas within catchments where action is needed.

Session 7
Public Participation in River Basin Planning

Challenges for Public participation in River Basin Management and Planning

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Public participation is regulated by article 14 and annex VIIA of the Water Framework Directive, claiming the importance of providing information and involving the public to carry through successful implementations of the Water Framework Directive. Three levels of participation are mentioned: a) information, b) consultation and c) active involvement. Thus, the Member States have to publish the necessary documents in the river basin management process in three rounds – 2006, 2007 and 2008, and each round contains a consultation process, where the public is invited to comment within a six months period.

According to the Directive, Member States shall encourage active involvement of the public, implying that the Member States must make clear efforts to facilitate and promote active involvement. There are several ways to involve people actively to the river basin planning process. Following the various ladders of participation, access to information is seen as the basis for all participation – but access to information is not participation in itself. The lowest level of participation is referred to as consultation. The plans and proposals are developed by authorities, after which the public can react to these. The authorities are responsible for the planning process and make the final decisions and are not obliged to take the comments into account. The higher level of participation requires active involvement of the public in the planning process and perhaps even in the decision-making. The consultation process is facilitated by the emergence of the Internet and the maturing GIS technology. The Internet supports the spread of information to the public as well as the public's feedback to the authorities, and GIS technology assists the authority in visualising the various planning alternatives.

Even though public involvement is generally accepted as being essential to the implementation of the Water Framework Directive, it is not an easy task. The planners and decision makers are confronted with several challenges, and involving citizens in decision-making processes is a learning process for all partners involved. However, we have tried to set some precise recommendations for carrying out the public involvement in river basin planning.

Why do we need public participation?

The following potential benefits are envisaged: Increasing public awareness of environmental problems; improving the quality of management plans using the knowledge, experience of different stakeholders; public acceptance and commitment to the decision taken; more transparent and more creative decision making; social learning and experience. Thus if participation results in a constructive dialogue with all relevant parties involved then the various publics, government and experts can learn from each other's water awareness.

Recommendations: *Explain detailed the reasons for the participatory process.*

When should the public involvement start?

The public should be involved as early in the planning process as possible, in order to get the maximum benefits from the public involvement, at least, before the crucial decisions are made. By involving the public actively and with the right timing, the authorities can learn and make use of the views, experiences and knowledge of the citizens and obtaining higher acceptance of the decisions to be made. The timetable, which is linked to the programme cycle of the Water Framework Directive, is a determining factor in timing public participation. The authority should realise, that the consultation is not only an opportunity for the public to become involved – but also an opportunity for the authority really to use the comments from the citizens to develop better plans! A case in which the public involvement might be seen as to late is when the involvement is used to choose among possible sites for a new dam supporting hydropower production, without having had the opportunity to consider whether the dam is needed, or the electricity could be provided through other means.

Recommendations: *Start the public involvement as early as possible and try to find other planning processes, which are running in parallel with river basin planning giving possibilities for synergy and mutual support*.

How should the consultation be arranged?

There are no detailed procedures in the Directive on how the participation should be done. Previously, public meetings were the most common way of arranging public participation, but the Internet has totally changed this. Thus, the Internet is now used widely to inform the public as well as to having dialogues with the public through discussion forums and e-mails. There is still a bias towards the well educated people, but even elderly people have adopted the Internet as a natural way of communication. This gives the authority a wide range of possibilities to design and target the participatory process to the various groups of stakeholders utilising chat rooms on the Internet, virtual reality – and perhaps even SMS - to attract the young generations. Regardless of the participatory strategy chosen, it is important that there is little confusion concerning the scope of the public involvement. Thus, the authority is obliged to inform about the purpose of the public involvement, the participatory methods used, and the expected output of the participation. Transparency and access to information are crucial for a successful participatory process. The various steps in the decision-making processes must be detailed described for the public, and all information needed must be available for the public through easy accessible sources like the Internet.

Deciding upon the level of involvement is perhaps the most difficult issue. Inevitably this decision will depend on the complexity of the river basin management plan in question, but generally all water bodies should aim at the higher levels of involvement – i.e. real participation characterised by dialogues and discussion through mutual exchange of information and ideas. Obviously, river basin planning can be very complicated - balancing social, economic and environmental factors against each other. One way of doing this could be to focus on the visions and consequences of the various planning alternatives without going into the technical details behind the plans. This requires what can be called a dual-public strategy, where all citizens within a river basin district) represent one public, whereas a group of stakeholders constitutes another public. The participation for the broad public is carried out through public hearings and Internet based public dialog and consultations. The public participation involving the stakeholders can be based on focus groups interviews, round the table discussions etc. facilitating the discussion of mere technical details.

Recommendations: *The Internet is an outstanding tool for spreading information to the public, and should be an important tool in involving the public. The authority must explain the scope of the public involvement and how the process will be carried out. The process must be transparent and all needed information available for the public. The water body authority should aim at public involvement using real participatory means through a dual-public approach. Make use of GIS and Virtual Reality technologies to inform the public about the various alternatives.*

Who should be involved?

When you are planning the participatory process, one of the most important issues is to define the public to be involved in the consultation. Often the term “stakeholder” is used to refer to any person, group or organisation, which has an interest or “stake” in an issue. They may be affected by the decisions or outcomes or may have an influence on it. This also includes those who might not (yet) be aware of their influence or what kind of effects decisions might have on them. Make a more or less comprehensive evaluation of the stakeholders and their needs, views, attitudes and values. Remember to involve all stakeholders and different groups of the river basin district. The authorities must pay special attention to groups, which are normally absent in the participatory process. Furthermore, take into account that they might need different kinds of tools to participate.

Recommendation: *Aiming at the dual-public approach mentioned in the above recommendations will reduce the discussion of the public to stakeholders, which must involve all groups of people within the river basin district paying special attention to groups which are normally absent in public participation.*

Handling feedback to the citizens

A positive participatory phase requires that the public complains and ideas are handled seriously by the decision-makers and having visible impact on policies. The best way of ensuring this impact will be to clearly state how the results of the public involvement will be taken into consideration in the final river basin plan. Handling comments from the public is therefore very important. It is recommended to store all comments and feedback in a public hearing database keeping track of all communication between the public and the authorities. The database approach furthermore facilitates the analysis of the consultation.

Recommendations: Explain *for the public how their feedback is handled by the authority. Set up a public hearing database for storing all comments and feedback from the public.*

Evaluation of the public consultation

The authority must keep in mind that an assessment of the participatory process during and after the consultation is essential. First of all it is important to realise that public participation can be carried out in many different ways depending on the current situation – i.e. it is difficult to set up a one for all set of step-by-step guidelines on how to do public participation in river basin planning. Therefore, the authority must follow the process and adapt the public involvement if needed, and at the end the responsible authority must prepare a more detailed evaluation of the consultation – aiming at learning from the gathered experiences.

Recommendations: *Carry out a running evaluation of the participatory phase in order to improve the process at later stages.*

Public Participation in River Basin Management

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Introduction

The Water Framework Directive ("WFD") obliges the Member States to introduce public participation in the making of river basin management. Since water management may have potentially significant effects on the environment, the Strategic Environmental Assessment ("SEA") Directive and the Environmental Impact Directive ("EIA") will often apply as well. Due to the river basin approach of the WFD, various Member States need to cooperate in international river basin districts. This raises the question whether the applicable legal framework is sufficient to govern public participation in river basin management, in particular where various Member States are involved.

Scope

The WFD provides that the public can participate in the production, review and update of the river basin management plan. If the plan is likely to have significant environmental effects, the SEA Directive makes an environmental assessment, including a consultation of the public, mandatory. The EIA Directive prescribes public participation in the making of decisions to implement the river basin management plan, if an envisaged project may have significant effects on the environment as well as on personal health and well-being. At least those who are (likely) affected by these decisions or have an interest in them ("the public concerned") should be invited to participate in the decision-making. The public concerned includes environmental NGOs. Where citizens and environmental NGOs from other Member States are among the public concerned, the Member States need to cooperate in order to ensure that they can participate as well. The public concerned can express opinions, which may be relevant to the plans or decisions. The decision-maker should take these opinions into account in decision-making.

Procedure

A. Preparation of a river basin management plan

The WFD obliges the Member States to publish and make available for comments to the public:

(a) a timetable and work programme for the production of the plan, including which consultation measures will be taken
(b) an interim overview of the significant water management issues at least two years before its envisaged entry into force

(c) draft copies of the river basin management plan at least a year before its envisaged entry into force. Other information should be made available on request.

The public should have at least six months to comment on those documents. In addition, where applicable, the SEA Directive obliges the authorities to give the public an early and effective opportunity to express their opinion on the draft plan.

B. Implementation of a river basin management plan

If the implementation of the river basin plan results in a project likely to have significant effects on the environment, the public participation procedure of the EIA Directive should be followed. The authorities need to inform the public concerned early in the decision-making process of:

- the proposed activity about which a decision will be taken,
- the nature of possible decisions or the draft decision,
- the public authority responsible for making the decision,
- the envisaged procedure: when it begins, to whom comments and questions should be sent, time and venue of any envisaged public hearing, and give an indication of relevant information and where it can be found,
- and that the activity is subject to a national or transboundary environmental impact assessment procedure.

The WFD contains no specific provisions governing public participation where a river basin district covers the territory of more than one Member State. The SEA and the EIA Directives only oblige the Member States to consult another Member State if they prepare a plan or a project which is likely to have significant effects on the environment of another Member State. This means that the Member States involved in an international river basin will need to create an appropriate public participation procedure for the preparation and implementation of a river basin management plan.

Judicial Review

The WFD and the SEA do not oblige the Member States to create judicial review opportunities in the preparation of a river basin management plan. Only the EIA Directive prescribes that – in accordance with the relevant national legal system - members of the public concerned:

(a) having a sufficient interest, or alternatively
(b) maintaining the impairment of a right (where the administrative procedural law of a Member State requires this as a precondition),

have access to a review procedure before a court or another independent and impartial body established by law to challenge the substantive and procedural legality of decisions, acts and omissions subject to public participation procedures. Environmental NGOs have access to the court as well, because either their interest must be deemed sufficient or they must be deemed to have rights capable of being impaired for this purpose. The EIA Directive leaves it to the Member States to determine what constitutes a sufficient interest or impairment of a right. Yet any interpretation must be consistent with the objective of giving the public concerned wide access to justice. In this way, the stakeholders can enforce their right to effective participation in the decision-making process through the courts. The EIA Directive does not create specific rules for judicial review in case more than one Member State is involved in the public participation procedure. That makes it likely that the courts will need to create rules for this purpose.

Conclusions

The introduction of public participation in the making of river basin management plans and decisions will give environmental NGOs and the public more influence over the decision-making process. The legal framework created by the WFD and SEA Directive gives the impression that public participation in the preparation of river basin management will be quite informal, particularly since it need not be followed by judicial review. By contrast, in the preparation of implementing decisions, the public concerned can enforce its participation rights under the EIA Directive through court proceedings. Yet the legal framework only consists of elementary requirements. That does not ensure that public participation is more than a symbolic gesture. The task of elaborating detailed rules is left to the Member States. Inevitably, this will result in disparities in the legislation of the Member States. This will make public participation in international river basin districts a complicated task. Therefore, arranging public participation in international river basin districts will first require the establishment of common rules for public participation procedures in the preparation and implementation of river basin management plans.

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Co-production of knowledge in restoring salmon passage into the River Oulujoki

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Introduction

There is growing interest in improving public participation in environmental policy-making by using local knowledge. The need to address a diversity of knowledge – including local knowledge and expertise – is topical in the case of environmental issues and problems that are knowledge intensive (Fischer 2000). In addition, the 'linear model' of policy influence which assumes a one-way flow of information – from science to policy and society – has received much criticism in recent years (Pellizzoni 1999; Eden 1998).

The EU Water Framework Directive guides the member states to aim towards good ecological potential, also in heavily modified water courses, and to get the citizens involved more closely. The latter aim is not reached by 'hearing' citizens but taking them as partners into the knowledge production processes of water resource management. Thus, we need new methodological solutions which, on the one hand, allow citizens and stakeholder groups participate in their own terms and which, on the other, can be used to make information commensurate for decision-making.

This paper focuses first on two major problems in the production and integration of knowledge in environmental research and management. Secondly, the paper stresses the need to find out how knowledge is co-produced by local and non-local actors in order to benefit both. It presents the case within different kinds of knowledge are combined by using interactional expertise and mixed methods in the process of the social impact assessment of the river restoration project. Interactional experts translate, mediate and rework knowledge between stakeholders, citizens, scientists and administrators.

The OuLo project (2006-07) deals with the possibilities of restoring salmon runs in the River Oulujoki and offers an example of a broadly-based survey carried out in cooperation with scientists and administrators. The aim of the on-going survey is to find out the biological, juridical and social preconditions and impacts of restoring salmon runs. This project was preceded by another one in the lower part of the river in 2005 after the completion of the first fishway at the river mouth (Laajala et al. 2006).

The River Oulujoki is one of three large rivers in Northern Finland that have been harnessed for hydropower for 50 - 60 years without any provisions for fish passage. The hydropower companies are obliged to compensate for the losses caused by dam construction by annual planting of fish, including juvenile salmon and trout. A fishway constructed to the lowermost dam of the river opened the route for migratory fish into a 40 km river stretch and two potential tributaries in late 2003. The successful first years of fishway operation and the results of a preliminary survey have provoked pressure towards restoring salmon runs further into the river.

Especially in heavily regulated and constructed rivers, stakeholder participation is crucial for the successful process of restoring salmon runs. Rehabilitating migratory fish in the case of the River Oulujoki is evidently long-span, and therefore, the commitment of different parties to the project and interaction between planners, authorities, stakeholder groups and citizens is vital. The aim of social impact assessment in the River Oulujoki is, first, to explore the aims, wishes and doubts among the stakeholder groups and citizens with regard to restoring the fish runs, and based on that, to find out secondly if there is a common will to have the runs restored. The final aim is to evaluate the social impacts of proposed plan(s) on the life in the municipalities of the area and even more widely in general.

Methods

The research process and methods of the social impact assessment are participatory. Data for the first part of the study was gathered by interviewing representatives of stakeholder groups, collecting document material and participating in workshops and public meetings. Based on the findings from this data, three alternative models of restoring the migratory fish runs were settled, and the aims and criteria for restoring fish runs founded from the first round were sent back to the stakeholders in order to get feedback. The alternative models will be introduced to stakeholder groups and citizen in workshop meetings and by questionnaires, and adjusted after feedback. The models will be judged in tandem with stakeholder groups by using Multicriteria Analysis (MCA). Eventually, the social consequences on local communities and the target area of proposed project development will be assessed based on the chosen alternative models.

Results

The preliminary results from the River Oulujoki shows that most stakeholder groups frame the salmon river restoration broadly and link not only the fishery values to it but also issues such as a better image for the municipalities (due to 'salmon river'), which might attract tourists, the business sector and new dwellers. The value of the river environment as a whole (as an environmental good) is increasing among all stakeholder groups. The pressure for improving river habitats, recreational possibilities and scenic values in the heavily regulated and constructed river is pronounced. In this way the aims for restoring salmon runs are many-sided and should be critically evaluated in the decision-making alongside juridical, biological and other sociological information.

The methods of knowledge co-production will be developed and finally evaluated within the OuLo project. The careful planning but also flexibility during the participatory research process is crucial. It seems that we need new understanding about how to nurture interactional expertise and ways of knowledge exchange between local and certified (scientists) experts and administrators.

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