Project - Principles, tools and systems to extend and harmonise spatial planning on water courses in the Baltic Sea Region

A REPORT ON PLAUSIBLE SCENARIOS FOR SUSTAINABLE RIVER MANAGEMENT

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Introduction

This report has been prepared as part of the project “Watersketch“. It contains an overview of initiatives on river basin management in Europe and a set of plausible scenarios for sustainable river basin management.

Decisions related to the conservation of rivers basins are on a long time scale and have long-term implications. In order to succeed, the process must take into account the individual profiles, requirements and eco-physical conditions of river basins for the next 20 to 30 years not only in terms of hydrology but also consider residential and industrial developments. Climatic elements for example are one part of the decision-making process and their impacts can make the process easier or more difficult depending on the effectiveness and existence of adaptation measures. Climatic factors can often indirectly affect the planning of a river basin since floods occurrence or dry periods cannot be excluded in river basin planning.

It is hoped that this report will contribute to the discussion on sustainable river management in the Baltic and beyond.

Professor Walter Leal
Hamburg, December 2004

Section 1- Overview of approaches to rivers management in Europe

There has been a long evolution in the approaches taken in the management of water resources; from being unlegislated, government – centred, single issue based or sectoral and based on technological knowledge of the time, to the position of recent times where environmental, social and economic aspects all have to be considered and supported by technology not made subservient to it. For many years river management has been viewed essentially as river manipulation – straightening, establishing flood defences, damming etc. and left in the hands of engineers [1].

However, at present general approaches in many countries point towards one direction: how best to practically achieve integrated catchment management that emphasise systems thinking and community involvement. Such an approach is also imposed by EU Water Framework Directive (2000/60/EC) stressing the use of integrated river basin management scheme (WATECO (2002). The main objective of river basin management is to establish a balance between the existing natural functions of the river system and the developed aspects of the system – fulfilling society's expectations for industrial use, recreation, nature management, and agricultural purposes. River basin management should therefore be integrated and holistic to address this wide range of issues. It is closely related to integrated catchment management (ICM) the co-ordinated and sustainable use and management of land, water, vegetation and other natural resources on a water catchment basis so as to balance resource utilisation and conservation.

The term 'resource utilisation' has an economic inference and it is recognised that the sustainable use of our water resources must establish a balance between economics and ecology [1].

In the literature, integrated water management (IWM) or in some cases integrated water resource management (IWRM) is defined and interpreted differently. Some studies define integrated approach to watershed management rather vaguely, e.g., "consideration of all sources and uses of water in a particular river basin". IWM is sometimes replaced by adjectives like 'comprehensive', 'environmentally conscientious', 'incentive-oriented' and 'participatory' that water and water resources activities need to be associated with, in order to be sustainable. Others are somewhat more precise and define IWM as the interaction between three pillars:

(i) environment (i.e. ecology),
(ii) economy (e.g. cost-effective criteria, polluters pay principle, water pricing) as outlined by the OECD (1999) and
(iii) social performance (e.g. increased welfare), all including an overall frame covering legal aspects.

One aim of the Watersketch-project, similar to Water Master Plans, is to act as a facilitator or framework for integrated river-basin approaches which also consist of three pillars in 'harmony':

- public participation, such as involvement of water users and other interest groups and dissemination/exchange of information,

- political will and decisions, to ensure e.g. coherence with legal systems and resolving conflicts/water regime and

- technical appraisal and advice concerning problems and their solution which includes the proper understanding of dynamics of the physical and natural science dimensions of water issues. Yet other authors talk about integration in terms of natural scientific models.

Such ’integrated models’ normally make a clear distinction between research models and models to support policy making. Natural scientific research models are strongly process oriented in search for new scientific knowledge. Oppositely, models to support policy making (e.g., DSS-tools) are foremost problem oriented since they in theory should deliver usable results. In terms of the Water Framework Directive, the river basin approach is regarded as integrative, since e.g. the river basin management plans should cover all aspects of ecological sound management (Cave et al 2003) including all actors, stakeholders and stimulate public participation in the decision-making process [2]

The history of water management, for example in the Netherlands, is one of grass-roots, intensified co-operation, which moved from protection at household level centuries ago to regional and interregional co-operation at present [3]. The objective of achieving multipurpose outcomes to environmental problems in The Netherlands is assisted by legislation for mandatory stakeholder participation in spatial and infrastructure planning, and because integration is a part of Dutch culture. By linking the technical to the social, the policy analysis approach integrates engineering and design with broader political and societal interests, and attempts to bridge the historical divide between stakeholders and technical input.

This philosophy for environmental problem solving that considers the problems, the solutions and the people, is valid for stream rehabilitation, where the challenge to meet the technical and community needs is paramount [5]. The boundaries of regional water management areas are defined by the local watershed and catchment boundaries. It has eventually become clear that the inflow of water in one system is also the outflow of water from a system located farther upstream. Interregional co-operation has become absolutely essential. The process of enlarging the scale of the water management authority has been dictated by the growing complexity of water-related problems, i.e. flooding, dryness, water quality, shrinking of land due to drainage, but also increases in population and related urbanisation [3]

In the UK, for example, multipurpose river restoration (improving leisure, wildlife and the watercourses) is facilitated through strong community-technical connection, involving local partnerships between local authorities, businesses and community groups. Disciplinary input to river management, which has historically mirrored the progression in stream management values, nowadays involve engineers, landscape architects, geomorphologists, ecologists and others [5]

In most of the new EU countries, the responsibilities and resources of regional/local authorities are too limited to really contribute to effective water management at a river basin level. Moreover, as legislation and decisions applying to freshwater are often approved at a central level, they do not necessarily fit with the specific river basin situation, which limits the effectiveness of measures and laws. In the trans - boundary river basins, agreements and institutional relationships between countries are normally managed through national authorities, although there are often informal contacts and data exchanges between water authorities at lower administrative levels [8]

Multiple sources of useful knowledge have been gained through EC Framework Programmes, EU Member States bilateral/multilateral programmes, partner countries' programmes, communities and private sector.

In the MANTRA-East project, for example, the creation of alternative water management scenarios that combine input from the various research modules was used as an approach to sustainable river management [2].

However, different approaches have been employed and combined to identify targets and indicators for river management including handling problems such as those created by sediments. The first, the most simple, the "policy-oriented" approach, uses the critical loads which have been agreed upon in international treaties (e.g., the 50% reduction scenario within the Rhine Action Plan, later also adopted for the North Sea).

The second, "ecosystem", approach uses historical data describing the response of the coastal system to changing loads and identifies indicators. This approach incorporates an attempt to discriminate between a natural state and an anthropogenically altered state.

A third, "regional management", approach is based on consultation with local, national and other authorities and identifies their criteria for indicators or critical loads. This encompasses a broader range of indicators than those based on scientific arguments alone. [6]

The Driver-Pressure-State-Impact-Response Framework (DPSIR) approach is confronted to the root and branch approaches. The latter approaches primarily address only policy aspects of management while the drawback with DPSIR is the lack of policy elements (i.e. the Drivers and Pressures are too simply addressed) [2]

The overall long-term approach is to enhance the integrated and sustainable development an use of aquatic resources in - a so far neglected – trans - boundary European catchment of a dense system of trans-boundary rivers in such a way as to:

- Provide a framework for the possible most intensive exchange of data and information between the countries, sharing the river catchment, with due concern to existing (and desirable) bi-and multilateral international agreements and to the requirements of the Water Framework Directive of the European Union. (with the ultimate objective of establishing really operative and continuously updated international data bases of the entire catchment);

- Promote the improvement of the water- and environmental monitoring systems, so as to be able to prevent the occurrence of accidental water pollution events and to launch timely emergency actions, when such events happen;

- Identify the most important, basin-scale water resource management and water quality control options that could help overcome the trans - boundary resource sharing (allocation) and pollution issues [4]

All in all, these elements are aimed at allow sustainable river basis management to move away from being a mere theoretical approach, towards being established as good practice.

Section 2- River Management issues in EU countries

Management of trans-boundary waters is particularly complicated since there is not one government to manage international waters and bordering states may have different languages, cultures, as well as different water management legislation and institutional structures. Another problem is the fact that it has been observed (e.g. by UN-ECE) that monitoring networks and natural science results often work sub-optimally from a policy-making and management perspective. This is often due to lack of communication between the scientists, designing and implementing monitoring activities, and policy makers, as the users of the environmental information [2]

In the new EU countries, the need to involve the public in water management planning process is stressed in several national legislative acts, guidance documents etc. but its actual implementation has not always been so successful. The authorities in post-Soviet countries often lack the experience and knowledge on public involvement methods and strategies, its practical organization and the use of public comments and recommendations. It is often complained by governmental officials and experts that local people lack of interest in taking part in water management planning and they possess low awareness level [7]

Some issues of relevance in river management in EU countries are:

a) Sediments

Sediments are the storage compartments of aquatic ecosystems. Moreover, water bodies are downstream of land and the atmosphere and are the ultimate sinks for the products of human activity. Sediment quality is a barometer of human impact on the atmosphere, land, and water. The evidence for many long-term environmental trends comes primarily from sediments.

Sediments are analyzed for a wide variety of purposes, such as to understand lake history through paleolimnology, to determine their roles as nutrient or contaminant sinks or sources, to assess sediment quality of dredged material, or to monitor the responses of aquatic systems to remediation or natural recovery.

Almost all sediment studies require physical and chemical characterization. Particle size distribution, water content, total organic matter or carbon content, nitrogen, and phosphorus are commonly determined.

Although sediment contamination can be a financial liability, clean sediments have no direct commercial value. Cost of environmental monitoring is funded publically and is funded to variable levels over time.

Analytical methods that are inexpensive, easy to operate, rapid, and, if possible, portable, could enhance environmental monitoring capability, including the collection of long-term records that are so important to discerning subtle, regional and global human impacts from the variability due to natural, long-term background cycles.

b) Non-point source pollution

It is a common fact that the activities that take place in watersheds affect water quality. Over the past 20 years industries and municipalities across the Baltic have done a great job cleaning up industrial pollution and sewer discharges. Today, an important contribution to water pollution comes from stormwater. Every time it rains, the rainwater washes off driveways, roofs, parking lots, roads, agriculture fields, construction sites, forestry operations, and other surfaces carrying with it contaminants to streams, lakes and groundwater. This type of pollution is known as nonpoint source pollution (NPS). It is difficult to control it since there are many variables (Table 1).

Table 1- Types of Nonpoint Pollutants and Their Impacts

Pollutant	Nonpoint Source	Impacts
Bacteria	Livestock, pet waste, septic systems, and boat discharge	Introduces disease bearing organisms to surface water and ground water, resulting in shellfish bed closures, swimming restrictions, and contaminated drinking water
Nutrients (phosphates & nitrates)	Fertilizers, livestock, pet waste, septic systems, suburban & urban development, and soil erosion	Promotes algae blooms and aquatic weed growth which can deplete oxygen, increase turbidity, and alter habitat conditions.
Sediment (Soil)	Construction, driveways, ditches, earth removal, dredging, mining, gravel operations, agriculture, road maintenance, and forest operations.	Increases surface water turbidity which in turn reduces plant growth and alters food supplies for aquatic organisms, decreases spawning habitat and cover for fish, interferes with navigation and increases flooding risk.
Toxics & Hazardous Substances	Landfills, junkyards, underground storage tanks, hazardous waste disposal, mining, pesticides and herbicides, auto maintenance, runoff from highways & parking lots, boats and marinas	Accumulates in sediment posing risks to bottom feeding organisms and their predators, contaminates ground and surface drinking water supplies; some contaminants which may be carcinogenic mutagenic and/or teratogenic can bioaccumulate in tissues of fish and other organisms including humans.
Airborne Pollutants (i.e., acid rain, nutrients & metals)	Automobile and industrial emissions	Reduces pH in surface water which alters habitat and reduces natural diversity and productivity; increased nitrogen may enhance eutrophication of coastal waters. Mercury accumulates in fish tissue threatening bald eagles and people.

This table was adopted from Massachusetts DEP's NPS Fact Sheet #1

Over the years many groups and agencies have developed methods for controlling NPS pollution. These methods are called Best Management Practices, or BMPs. They can be as simple as seeding and mulching a site, or as complicated as engineered structures like nutrient control basins. In either case, the goal is to prevent pollutants from reaching the water.

c) Issues of sustainability

Sustainability issues (Fedra 2004) are often ignored although they are vital for river management. If river basin management is to succeed, a shift in current ways of dealing with rivers issues is necessary. Sustainable river basin management means:

- national and international co-ordination in fluvial environmental management between countries;

- assessments of problems, conflicts and constraints in water management, water quality, biodiversity and environmental protection;

- legislative and institutional framework, including the identification of areas where legislative enforcement needs to be strengthened and harmonized;

- identification of resource management options, including basin scale scenarios, water demand management, water quality management, nature and environmental protection;

- a long term management framework, i.e. institutional measures and capacity building, public participation, monitoring and evaluation of the international components of the water resources environment.

This is the only way to preserve our river landscapes as functioning integral systems, or rather to restore them and to successfully use their potential as waterways, ecological habitats or as tools for flood protection.

Section 3 - Some Plausible Scenarios

The intensity with which socio-economic and environmental change around the Baltic continues to increase and the ramifications of this process are becoming even more extensive and significant. Policy responses at all levels of governance and society will need to become more adaptable to cope with new conditions, risks and contexts. The future will always be shrouded by uncertainty and therefore accurate prediction is not a feasible goal.

However, it is possible to formulate scenarios, which can shed light on and offer insights about possible future developments. The information generated by such an approach can assist policy makers in their search for efficient, effective and equitable coping strategies and policy options for integrated and sustainable river basin management.

A scenario can be defined as a coherent, internally consistent and plausible description of a possible future state of the world (Parry and Carter, 1998). It is not a forecast because it cannot assign probabilities to any particular outcome. Instead, scenarios portray images of how society and its supporting environment could look like given different sets of assumptions and consequent conditions. Early scenario planning was undertaken by various military agencies. This strategic approach was then adopted by multinational companies, such as oil companies in the 1970s, seeking to improve their decision making.

The implicit rationale seemed to be to evolve better procedures for coping with future 'surprises', by forcing analysts to think laterally and radically. Scenarios typically contain qualitative storylines augmented by varying amounts of quantified data (Turner 2002). They can be informed by relevant history but not conditioned by it, except in the case of so-called baseline or 'business as usual (BAU)' scenarios. The latter can be utilised as benchmarks against which to portray other possible states of the world and are compiled with the aid of trend data. As far as socio-economic and environmental change in rivers areas are concerned, policy responses at all levels will need to become more adaptable to cope with new conditions. This section therefore suggests some descriptive scenarios (i.e. they set out a sequenced set of possible events in a neutral way) for integrated catchment/river basin management, also providing an alternative vision, i.e. illustrating what may happen is the scenario is not followed or realised.

In this section, scenarios have been used to inform present choices in the light of future alternatives, such as in the context of climate change mitigation and adaptation options. It should be emphasised that scenarios are not precise future predictions but methods to aid decision-makers in their efforts to cope with inevitable uncertainty. Here the aim was to portray the consequences of policy strategies that incorporate radically different views in a more visionary way.

Scenario 1 –Improving the response of river basins to changes in fluxes of nutrients and contaminants from the catchments.

Over the last few decades, as heavy industry in catchment areas in many countries has declined, and regulations on emissions and inputs to controlled waters have become more stringent, the water quality of both catchment and estuary in many countries have improved. The "peak" loading impact to the river basins in terms of nutrients and many metal inputs from the near-estuary and wider catchment zones was in the past.

However, a legacy of contamination still exists in the sediments, and the loss of intertidal area has led to a severe reduction of the ability of many river basins on the one hand and the estuary on the other hand, to trap nutrients, which instead get exported direct to the Baltic Sea. It is estimated that up to about 200 years ago, Baltic river basins have acted as a sink for all the riverine inputs of dissolved inorganic nitrogen (DIN) and phosphorus (DIP). There is therefore a need to improve the levels and speed of response of river basins to changes in flows of nutrients and contaminants, by monitoring agencies.

Alternative vision: no improvements in the response may mean that nutrients and contaminants will get accumulated. Contaminant concentrations would also remain at their current level.

Scenario 2 - Consideration of policy analysis in river basin management

Policy analysis of water quality improvement options, including in river basin management, often focuses on two complementary approaches. One policy question is: how effective are these measures at reaching the environmental targets, and at what cost? This is a cost-effectiveness issue: what measures or combination of measures are able to reach a certain water quality target at least cost?

The Water Framework Directive requires member states to carry out this analysis in all catchments and therefore these considerations represent real issues. But there are also wider policy issues. Each of the options available to decision-makers to improve water quality has wider impacts in a range of areas: e.g. on biodiversity, on regional economic growth, on unemployment rates. Multi-criteria analysis is a tool that researchers use to analyse the wider impact of policy options, and how they are perceived by a variety of "stakeholders" or interested parties. Its aim is to compare policy options by reference to an explicit set of evaluation criteria. In this scenario, stakeholders provide also input in identifying possible policy packages, as well as specific criteria within three broad categories (economic, environmental, and social). This is useful in particular for environmental and social impacts which are not always easily evaluated in monetary terms.

Due consideration to policies as outlined in this scenario means that policy packages that are likely to be used will be generated.

Alternative scenario: no consideration to policies in river basis management, or policies produced which disregards the stakeholder consultation and their views on options to improve water quality in river basins.

Scenario 3 - Increased scientific emphasis in river basin conservation

In this scenario, the use of a more scientific approach in river basis management is implemented. It can bring about a number of benefits. Firstly, it provides an opportunity to model the effects of specific guidelines of the Water Framework Directive and to go beyond existing limits and framework conditions to question accepted norms and procedures. Secondly, it also allows constructive impulses for future-oriented action. The rationale is to pursue a broad methodological approach, one that pays equal tribute to ecological, economic and social objectives.

A more scientific approach also allows the incorporation of testing and feedback elements into theoretical and practical models. This enables the derivation of scientific and organizational recommendations in the implementation of the results of official proceedings, regional processes, land-use planning, as well as other management systems. A further consideration in this scenario is that the evaluation of the effectiveness of policy can take place with respect to their ecological integrity, sustainability and their economic effectiveness based on a cost-benefit analysis. Ultimately, an increased scientific emphasis would lead to more precise and more acceptable recommendations directed at the political and administrative levels, at scientists, as well as at the practical planning level in the sectors land-use, agriculture, river engineering, nature conservation and water management. Systematic research is vital for a wide range of ecological activities, including those required to meet the targets set by the WFD.

Alternative scenario: no consideration to scientific data and settings in river basin management, with subsequent development of inaccurate policies and action plans.

Conclusions

Scenarios can be helpful in predicting possible trends and in this report a number of possible paths have been described. The list of scenarios presented here is by no means comprehensive, but offer an overview of some plausible possibilities, also outlining what may happen if they re not followed. As to the question what happens if wrong policies are placed, a following list provides an overview of the likely consequences [8].

Impacts on livelihoods and human health

- Direct threats to human life (via inundation, storm surge damages).
- Threats to food production capacity including decline in irrigation water quality, decline in crop yields, and degradation/disappearance of crucial ecosystems such as mangroves and coastal lagoons which act world-wide as fish and shell fish nurseries.
- Decline in health/living standards as a result of decline in drinking water quality, threat to housing quality, associated increasing health hazards linked to relocation, and spreading of disease vectors.

Possible displacement of vulnerable populations

- Relocation of impacted populations and associated political, economical, institutional, and cultural stress of both the displaced population and the host countries.

Impacts on infrastructure and economic activity

- Decline in land and housing property
  - Threats to major infrastructure (including strategic harbours, coastal roads, railways, health and school buildings)
  - Threats to major industry and services (including oil/petrochemical plants and tourism)
- Diversion of resources to adaptation responses to rivers or sea-level rise impacts
  - Increasing protection costs which may not be affordable to certain developing countries unless substantial aid is obtained.
  - Increasing insurance premiums
- Political and institutional instability, and social unrest
  - Threats to particular cultures and ways of life (e.g. in specific environments where retreat to higher inland areas is not feasible

Even with their limitations, the scenarios described in this paper are useful in showing the options available and it can be useful as a basis to orient national adaptation policies and to strengthen the support for preventive measures in river basin management in the Baltic region and beyond.

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