Experiences gained from a research project on an integrated approach for management of transboundary waters on the new Eastern EU-border region

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Abstract

In the paper, the issue of integrated water management from the experiences gained from a just recently finalised EU FP5 research project ‘Integrated strategies for the management of transboundary waters on the Eastern European fringe’ (MANTRA-East) is elucidated. The project was initiated to facilitate the search for integrative strategies and integrative examples. In this paper we focus on general results from the project with particular emphasis on examples and selected results from one of the main study areas in the project, the Lake Peipsi and its drainage area. The lake is shared by one EU-accession state (Estonia) and one non-EU state (Russia), and thus of high relevance for the future environmental management of transboundary waters on the new EU border region.

The specific integrative approach used in the MANTRA-East project was based on the creation of alternative water management scenarios that combined input from the various scientific disciplines. Examples of this and other high-lights and experiences gained in the project are presented in the paper.

KEY WORDS: Eastern Europe, integrated water management, Lake Peipsi, transboundary, WFD

Introduction

Policy-makers and water managers have traditionally regarded water quality issues as mainly originating in one specific cause, and they have often taken the view that there is usually one straightforward solution to the pollution problem. Today, however, it is generally accepted that water-related problems are far more complex and problematic, and that simple cause and effect approaches are insufficient. It is now realised that abatement strategies must adopt a different approach, in which problems originating in diverse spheres are seen as interdependent. For example, local pollution problems may be interrelated with environmental change and socio-economic development to such an extent that a single disciplinary or sectoral approach can no longer provide a satisfactory solution. Another example is that water quality issues related to surface waters are now being correlated to both hydrological characteristics and terrestrial biogeochemical processes, including land use change and other basin-wide anthropogenic issues. A further aspect of this problem is the conflict between social and economic development on the one side, and environmental and pollution concerns on the other. Water policy analysts have therefore increasingly come to recognise that managing waters can no longer be regarded as an independent field of expertise and a separate domain of public policy. It is now accepted that the interconnections between water systems, other aspects of environmental systems, and human systems, are extremely important areas of study. Thus, it has become apparent that water and river basin management should be based on an integrated approach, involving planners, scientists, policymakers, end users, and the public.

Integration is the buzzword of today in water and river basin management, often used to demonstrate that the research being conducted is up-to-date, and to distance the results from traditional
conceptualisations. The term is however commonly used without further and deeper consideration. Far from being an accepted and easily understood notion around which there is consensus, the entire concept and exact definition of integrated water management (IWM), integrated water resource management (IWRM) and integrated river basin management (IRBM) is widely debated, and ambiguous, and a unanimously agreed definition of the concepts has yet to appear. The Technical Advisory Committee of Global Water Partnership has however adopted the following definition:

"IWRM is a process, which promotes the co-ordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems."

The definition does not, however, give us much indication of how this coordination (and integration) is to be achieved. Moreover, even though IWM, IWRM and IRBM currently practised in many regions worldwide, we still have not been able to ‘solve’ pollution and water management problems, and examples of ‘success stories’ are difficult to find. In the case of the new EU member states, the EU Water Framework Directive (WFD) will become a central tool for the future environmental water management and legislation of their river basins. However, while the EU’s environmental acquis and management doctrines will be adopted by the succession states, several studies have recognised that the environmental problems being faced in the succession states are far more severe than in the present Member States. Thus, there is a need for truly integrated and functioning basin-wide cooperative schemes for water management. Integrated river basin management is also central in the EU Water Framework Directive, and the implementation of this new principle requires comprehensive interdisciplinary analyses. In this respect, the experiences gained in the ongoing research project MANTRA-East ‘Integrated strategies for the management of transboundary waters on the Eastern European fringe’ may prove to be valuable. The project was initiated to facilitate the search for integrative strategies and integrative examples. One of the main case study areas was Lake Peipsi, the largest international lake in Europe. The lake is shared by one EU-accession state (Estonia) and one non-EU state (Russia), and thus of high relevance for the future environmental management of transboundary waters on the new EU border region. Major results from the second study area, the Vistula Lagoon, are given in more detail in the paper by Bielecka and Lewandowski (this volume).

The lake Peipsi / Chudskoe case

The pilot area is the basin draining to Lake Peipsi (Estonian) / Chudskoe (Russian), shared by Russia, Estonia and Latvia. The lake and its drainage basin (Fig. 1) are extensively described by Nõges (2001; see also Nõges et al., this volume). This basin measures approximately 44000 km² and is a typical North-European lowland area of glacial origin, characterized by Palaeozoic bedrock, covered by unconsolidated glacial materials of variable thickness. Two two major rivers dominate the drainage area; the Velikaya in Russia and Latvia (mean discharge: 195 m³/s), and the Emajõgi mainly in Estonia (mean discharge: 68 m³/s). These two rivers account for nearly 65 % of the water discharge into the lake (Stålnacke et al., 2002), and thus are the most important when it comes to nutrient input. Lake Peipsi/Chudskoe is one of the biggest European lakes (3555 km²), and because of its shallow character (depth does not exceed 15 m) together with activities in the river basin, it is sensible to eutrophication problems (Nõges, 2001).
The MANTRA-East project and approach

The point of departure of the MANTRA-East project is the EU Water Framework Directive (WFD) as the central tool for the environmental management of transboundary river basins in Europe.

The project included a very diverse range of research activities such as:

- an examination and evaluation of a set of the most informative monitoring parameters used in ecological status assessments (i.e. WFD);
- an analysis of the trends in water nutrient quality and biota in lakes and their tributaries with special emphasis on Lake Peipsi and its drainage basin, given the recent dramatic change in land use and industrial emissions in most of the Eastern European region;
- tools that can simulate the transfer, retention, and losses of nutrients in supra-national and data-poor river basins;
- evaluation of the lake response to the recent dramatic and large-scale changes in river pollution loads of nutrients in the drainage basin of the Lake Peipsi;
- the use and role of environmental monitoring, database development, information generation and communication for policy- and decision-making and management within a limited number of European transboundary river basins;
- experiences gained in the development of a multi-thematic (socio-economic and environmental) GIS database for the Lake Peipsi and its drainage basin;
- analyses of institutional mechanisms, organisational cultures, as well as of decision-making and implementation processes in transboundary water management, based on a selection of European transboundary water case studies;
- recommendations for improved institutional and organisational processes, building on experiences gained in the project, and on a comprehensive study of conditions in other transboundary contexts.

The MANTRA-East project had three main objectives organised in 3 major research modules (Fig. 2). The first of these was to evaluate the applicability of the EU Water Framework Directive in the future EU border regions. This includes an assessment of the state of eutrophication (e.g. ecological status) in lakes and river basins, as well as the development of strategic lake and river basin tools
for source apportionment, retention, and time-trends in nutrient loads. The second objective was to
develop methods to improve communication and utilisation of scientific information. The third ob-
jective was to develop institutional mechanisms and policy instruments for decision making under
conditions of transition and uncertainty. The first objective was primarily the domain of the natural
scientists in the project, the second objective was mostly managed by geographers and information
specialists, and the third objective was the responsibility of the social scientists and policy analysts.
The underlying rationale behind this model was that scientific information produced by the natural
scientists was needed in the policy process, as well as knowledge of the policy process (decision-
making and implementation) itself. This information needed to be communicated to the actors in the
policy process, as well as to stakeholders and end users. The problem facing the project leaders was
that each objective was based on, and produced, different forms of knowledge, or, to put it in an-
other way, each objective was dependent on a different scientific paradigm. While respecting the
different disciplinary approaches and methods, it was necessary to find a way to integrate the
knowledge produced, and to create a fertile cross-pollination of ideas, concepts, and hypotheses.
The natural science approach was based on quantitative methods and the results that could be anal-
ysed through statistical methods and mathematic models. The communication of scientific knowl-
edge was studied through a combination of information cycle methodology and qualitative analyses
of communicative processes. The policy process, the involvement of stakeholders, and public par-
ticipation were analysed using a heuristic approach in which qualitative interviews, surveys, focus
groups, text analysis and institutional analysis were combined. The experience of the project team
was that understanding of each others epistemological viewpoints could, and was, increased by
continuous discussions of the nature of the problems and the best ways to solve them. In this way
the project adopted a problem-based methodology, attempting to elucidate the central aspects of
water management from various viewpoints. The difficulties with the approach were, after an initial
period, minimised and resulted in an increased understanding of each others’ scientific beliefs. The
next step was to develop an approach that was synergetic, and which resulted in a greater under-
standing of the problems of water management than if each discipline had simply presented indi-
vidual results which were then combined in a final report. The approach chosen was that of qualita-
tive-quantitative-qualitative scenarios.

**Figure 2.** The 4 four research modules in MANTRA-East (http://www.mantraeast.org)

### Major high-lights

- **Transboundary aspects are underestimated in the WFD implementation.** The number of
  prospective transboundary river basins districts (RBDs) under the Water Framework Directive
  will be around 30% (Nilsson et al., 2003). Area wise, the transboundary RBDs will consitute
  approximately 65% of the total area of prospective RBDs (Nilsson et al., 2003). Consequently it
  may then be argued that the 'soft' requirements in the WFD concerning the transboudnary RBDs
  (Articles 3 and 13 in WFD) may undermine the directive's requirement and high ambition of
  management and adminstration according to river basins (Nilsson et al., 2003).

- **Lack of comparative policy science studies hinder efficient water management planning.** A
  review of existing transboundary water management structures and practices in transboundary
water basins in Europe demonstrated a lack of well developed research and analysis on the implementation of water management policies and plans (Gooch et al., 2002). It was also shown that organisational and institutional aspects of implementing EU water policy (political, research, administration etc) and problems of communication and information exchange between different levels of governance as well as across borders present major difficulties for policy implementation.

- **Too large differences in water management competence between countries on the new EU-border.** On transboundary waters located on the future EU border, a growing gap in the formal frameworks (different administrative structures, norms and standards), practices, and information between different sides of the border – an EU member or accession state and a non EU state – present the major challenge of transnational implementation of EU water policy such as the WFD (Gooch, 2003a)

- **Stakeholders and the public- the key to successful implementation of water policies?** The study of theoretical models and a review of experiences of stakeholder and public participation in transboundary water management confirmed that involving multiple stakeholder groups in the development and implementation of EU and national water policies is critically important; however, this is not always feasible for various reasons. Traditionally, a major bottleneck in the implementation of environmental policies is created when experts produce a highly technical body of information that becomes incomprehensible to non-experts. Therefore, innovative approaches and technologies (e.g., semantic webs, citizen juries) must be developed and implemented in order to overcome this situation (Säre and Roll; this volume).

- **Transboundary Water Commissions ignores stakeholders.** Seven case studies examining various aspects of environmental information use from both theoretical and empirical perspectives for Nemunas River, Bug River, Oder River, Lake Neusiedl, Lake Constance, Elbe River and Spanish –Portugues Rivers were conducted (Nilsson and Langaas, 2003). Results show that transboundary commissions are largely expert/technical commissions. The socio-economic connotation of water management decisions may as a consequence be underestimated. One consequence is the lack of attention of transboundary commissions on the involvement of stakeholders.

- **Socio-economical information is important in the water management decision making process.** Environmental data is rarely used in the decision-making process unless it shows a direct and clear connection between and impact of the physico-chemical and biological conditions to changes in the economic and social situation in a given transboundary water region (Timmerman et al., 2002). Information for decision making, especially the analysis of the problem, needs to fall within the scope of expectations of the decision makers. For a transboundary water management situation this implies that, to be effective, an existing problem should be described from the viewpoints of the countries involved. Furthermore, the information should also allow for different solutions in the different countries (Timmerman et al., 2002).

- **Simplistic nutrient modelling tools efficient for pollution prevention strategies.** In transboundary river basins, riverine load modelling and source apportionment is more difficult than in other situations, because the required administrative statistics and GIS (spatial) data are not harmonious for each country. This is especially the case for the Lake Peipsi basin, which can be regarded as data-rich for the Estonian and Latvian part, and data-poor with respect to the Russian part. In the project, two models (MESAW and Polflow) were applied to assess the source, retention and transport of nutrients (Vassilijev & Stålnacke, 2003; Mourad et al. 2004). Both models were proved to be complementary and useful tools for the assessment of nutrient loads in past, present and future in transboundary drainage basins. With a minimum of large-scale maps and calibration of the model using data from a relatively data-rich part (Estonia), plausible nutrient emission estimations and load simulations can be obtained for an entire basin, including
data-poor parts (Russia/Latvia). The modelling of nutrient emissions and loads for future scenarios enables decision makers to identify priorities for water management, and evaluate the effect of various developments (see next bullet point). The same situation concerns Vistula Lagoon basin, which can be regarded data-poor with respect to Russian part and slightly data-richer for the Polish part. In the project, Mike Basin model was applied for Pasleka River to assess the source and loads of nutrients. These estimates were extrapolated to other rivers discharging to the Vistula Lagoon (Przedrzymirsk and Lewandowski, 2004). A comprehensive overview of major results from the Vistula Lagoon case study is given by Bielecka and Lewandowski (this volume).

Specific Lake Peipsi case-study high-lights

- **Lake Peipsi scenario results show the importance of controlling both point and diffuse sources.** In the MANTRA-East project, qualitative scenarios, 'storylines' or 'scripts', were developed (Gooch 2003b) and are presented in the paper by Gooch (this volume). The qualitative/explorative scenarios were then translated into quantitative GIS-layers. A nutrient transport model was then used to calculate the nutrient emissions, as well as transport and retention and the resulting nutrient loads into the lake (Mourad, et al., 2003). These estimated nutrient loads were then used to assess the ecological effect in lake Peipsi (Nõges T. et al., 2003b). The model results from the scenarios suggest that change of the amount of arable land will be the major factor controlling the future nutrient loads to Lake Peipsi. The results also show that the riverine loads of nutrient loads will change surprisingly little even under extreme future changes (Fig. 3). At present there is a clear decrease in the N:P ratios, at least in the Estonian rivers (Iital et al., 2004), which most likely is the reason for increased observations of Cyanobacterial blooms in the lake in recent years. Model calculations show that decreased phosphorus loads will decrease the risk of water blooms in L. Peipsi (Noges et al.; this volume). As the main proportion of phosphorus is coming through the two major rivers Velikaya and Emajõgi, the main attention should be paid to these two rivers. Connection to wastewater treatment plants and improved P-removal will give an immediate decrease especially for point sources in close proximity to the lake (e.g. Pskov city) and solve hygienic problems locally but long-term future strategies for nutrient load reduction should mainly focus on not increasing the agricultural nutrient runoff. Today, agriculture is responsible for the largest portion of the total loading to the lake (Stålnacke et al. 2002; Vassiljev and Stålnacke, 2003; Mourad et al. 2004) even though the losses from agriculture per unit area (e.g. kg/km²), is at a very low international level (Stålnacke et al. 2002: Stålnacke and Roll, 2002). So the future loadings will heavily depend on how the agricultural land will be used in future, e.g. how much of the present set-aside and abandoned land will be used in future and the intensity in the agricultural sector?
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- **First transboundary Geographical information system available for Lake Peipsi.** A GIS database containing more than 20 data layers arranged according to seven themes: Hydrology – Basic; Hydrology – Analytic; Land Cover; Pedology, hydrogeology and topography; Administration; Nature conservation areas; and Infrastructure was developed along with descriptive metadata and documentation. The database is disseminated via CD-ROM and is available via the MANTRA-East homepage (http://www.mantraeast.org). The successful development of the transboundary GIS database for the entire Lake Peipsi region has met a considerable interest among major actors involved in WFD based GIS implementation in transboundary rivers in Europe.

- **Arable land in Estonia and Russia will continue to decrease.** A land-use scenario study estimated that a decrease in the share of agricultural lands in Estonia by some 20-25% is likely to occur in the near future. At the same time, the share of forests will remain the same, as clear-cuts compensate the increase in the area. The future of natural grasslands stays unclear, as the former grasslands become overgrown due to abandonment of management, while new (pseudo) natural grasslands appear replace the abandoned fields (Sepp and Hiiemäe, 2003).

- **Agricultural development will determine future river nutrient loadings to Lake Peipsi.** The riverine modelling results suggest that change of the amount of arable land is a major factor controlling nutrient loads to Lake Peipsi (Mourad et al., 2003). Although connection to wastewater treatment plants and larger removal efficiencies for these installations can solve hygienic problems locally, strategies to prevent increased nutrient loads should mainly focus on agricultural nutrient runoff, especially in the Russian part of the drainage basin.

- **Nitrogen loads to Lake Peipsi have decreased - phosphorus levels surprisingly stable.** A comprehensive study of existing time series of water quality data in Eastern European rivers showed that large cuts in nutrient inputs do not necessarily cause an immediate response, particularly in medium-sized and large catchment areas (Stålnacke et
The fall of the Iron Curtain resulted in dramatic changes in Eastern Europe, including substantial reductions in the use of fertilizers and livestock production, as well as a marked decrease in water consumption by both the general population and industries. This situation has created a unique opportunity to study the way that rivers have responded to these changes. The impact of the mentioned reductions on concentrations of nutrients at 22 sampling sites on 17 Estonian rivers during the period 1986–2001 (for most of the sites) were examined (Iital et al., 2004). There were statistically significant downward trends (one-sided test at the 5% level) in total nitrogen (TN) concentrations at 20 of the 22 sites. These decreases in TN can be explained by the following: (i) radical reductions in the use of fertilizers; (ii) lessening of cultivated and ploughed areas and increased proportions of grassland and abandoned land; (iii) improvements in farm management practices. For total phosphorus (TP), significant downward trends were detected at only two sites, and there were also two upward trends. The TP trends can be explained by changes in phosphorus emissions, mainly from municipal sewage treatment plants. Considering the TN:TP ratio, we found 15 downward trends and one statistically significant upward trend (Iital et al., 2004).

- **Ecological status of Lake Peipsi is between moderate and good.** The first assessment of the ecological status of L. Peipsi according to the WFD shows, that according to present hydrochemical and phytoplankton data the ecological quality of L. Peipsi is mainly moderate (Nõges & Nõges, 2003). According to the macrophyte and fish indicates the status is intermediate between good and moderate while zooplankton and benthic macroinvertebrates indicate good ecological status (Nõges P. et al., 2003).

- **Blue-green algal bloom more frequent in lake Peipsi due to lowered N:P ratio.** Changed relations of amounts of N and P in riverine loadings have caused the situation that N/P ratio both in rivers and in L. Peipsi lake has fallen below the critical ratio of 30. Besides N/P ratio, the concentration of phosphorus is an important factor determining cyanobacterial development. At high P level and low N/P ratio bloom forming blue-greens are favoured due to their ability to fix atmospheric N2 in the conditions of N-limitation. In L. Peipsi N/P ratio less than 30 gives the advantage for cyanobacteria (Nõges T. et al., 2003a). It is quite evident that the changed proportion of N and P in loadings to L. Peipsi have favored cyanobacterial blooms as the N/P ratio has fallen below 30 both in rivers and in the lake itself.

- **Natural variability important for ecological conditions in Lake Peipsi.** Analyses of historical water quality data in Lake Pepsi also shows: (i) a biological resilience in response to reduced nutrient level in the 1990s (ii) phytoplankton groups that demands less nutrients as cyanobacteria has become more dominating (iii) the ecosystem is affected by large natural inter-annual water level fluctuations (Kangur et al., 2003).

- **Lake modelling show importance of phosphorus reductions in Velikaya and Emjogi.** The ecosystem model SHALMOD, which was developed and calibrated for L. Peipsi (Pihlak et al., 2003) revealed that reduced riverine loading of nitrogen enhances the growth of cyanobacteria; increased riverine loading of phosphorus enhances the growth of both cyanobacteria and diatoms; phytoplankton growth is strongly influenced by weather conditions - in warmer water and at lower water levels much higher concentrations of phytoplankton may occur (Nõges T. et al., 2003b). Admitting the important role of climatic factor as force majour, the most important measures what could be done to achieve the further improvement of water quality in L. Peipsi would be reduction of phosphorus loading from both Estonian and Russian catchment. As the main proportion of phosphorus is coming into L. Peipsi through the two major rivers Velikya and Emajõgi, the main attention should be payed to these two rivers. Improved waste water treatment will decrease the present loadings to the lake. However, the agricultural nutrient losses must also be controlled in order to avoid an increase of present loads.

- **Fish production of Lake Peipsi is high.** In L. Peipsi the prevalence of ‘grazing food chain’ and modest ‘microbial loop’ are responsible for high fish production (Nõges T. et al., 2003b). The higher is the ratio of piscivorous to non-piscivorous fish, the less phytoplankton and the higher water quality is assumed. Considering fishery regulation, effective protection measures of piscivores - pike-perch, perch and pike should be worked out and implemented for sustaining high water quality.

- **Transboundary cooperation prevents overfishing in Lake Peipsi.** The total catch of fish in Lake Peipsi-Pihkva has declined. However, the value of catch is at approximately the same as in
1935-40 and 1971-90. In spite of somewhat different approaches to fishery and management goals in Estonia and Russia, the joint management of commercial fish resources has been successful in avoiding overfishing (Vetemaa et al., 2001).

**Concluding remarks**

The MANTRA-East project has clearly demonstrated that an approach can be developed that respects the integrity of individual scientific disciplines while at the same time combining and integrating approaches so that synergic results are obtained. The first basic step is to create a working atmosphere that combines mutual respect with scientific questioning, that is, representatives of the different disciplines must learn enough of each others approaches to be able to dispute both the methodology used and the results obtained. While this critical questioning will by necessity be restricted to a non-expert level, it is still important that research team members do not simply accept other disciplinary paradigms at face value. The use of scenarios has enabled MANTRA-East participants to build upon the knowledge and results of both natural and social science approaches, and to combine these in a reflective and alternate exchange in which qualitative and quantitative methodologies are combined.

In terms of the individual research tasks, results have led to an increased knowledge about various aspects of transboundary water and pollution-related problems. Overall, the activities have also demonstrated that the implementation of the Water Framework Directive is faced with a difficult task in transboundary river basin districts especially those located on the new European Union border and beyond.

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**References**


