

IMPLEMENTATION OF GUIDELINES FOR MONITORING OF TRANSBOUNDARY WATERS IN THE MORAVA RIVER BASIN

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Abstract: The presented paper is focused on results of co-operation between the Czech and Slovak Republics in preparation and implementation of a monitoring programme of transboundary part of Morava River. The design of the system is based on the UN ECE Guidelines on Monitoring and Assessment of Transboundary Rivers, taking into account also requirements coming from the Water Framework Directive and national legislation in both participating countries. The work has been done in the framework of the Pilot Project Programme on Transboundary Rivers under the UN ECE Water Convention.

Keywords: Surface water, monitoring, assessment, information needs

EINFÜHRUNG DER RICHTLINIEN FÜR MONITORING DER GRENZÜBERSCHREITENDEN FLÜSSE IN DER EINZUGSGEBIET DER MARCH

Zusammenfassung: Der vorgelegene Beitrag präsentiert die Ergebnisse der Zusammenarbeit zwischen der Tschechischen Republik und der Slowakischen Republik bei Vorbereitung und Einführung eines Monitoringprogramms für den Grenzüber tretenden Teil des Marches. Der Entwurf des Monitoringsystems ruht an den UN ECE Richtlinien für Monitoring und Bewertung der Grenzüber tretenden Flüsse und nimmt Rücksicht auf die Förderungen hervorgegangenen aus der EC-Wasser-Rahmenanweisung Der und aus der Legislative der beiden beteiligten Staten. Die Arbeiten wurden im Rahmen eines Programms für den Pilotenprojekt – gezielten auf die Grenzüber tretenden Flüsse - unter der UN ECE Wasser Konvention geleistet.

Schlüsselworte: Oberfläche Wasser, Monitoring, Bewertung, Information Bedarfe

1. Introduction

The UN ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes was established in 1992 at Helsinki and entered into force in October 1996. Already during 1994 the signatory countries decided to start a work programme on monitoring and assessment, so as to be able to give guidance and support in this field. About 25 countries and international organisations have taken part in its activities in the last years.

In 1996 the Guidelines on Water Quality Monitoring and Assessment of Transboundary Rivers (UN ECE 2000) were issued and revised in 2000.

After the adoption of the Guidelines in 1996, it was agreed to start series of pilot projects on transboundary rivers in the UN ECE region. Eight river basins were proposed by countries to be included in the Pilot Project Programme. One of them was the Morava River – the upstream Danube River tributary -, which is shared by the Czech and Slovak Republics, and also Austria in its lower section. However, in the Pilot Project Programme only Czech and Slovak Republic participated.

2.

Approach

An essential element of the Guidelines prepared under the UN ECE Water Convention is that the process of monitoring and assessment needs to be seen as a chain of activities with starting point lying in the analysis of the relevant water management issues and the specification of information needs which are in the top of the known “monitoring cycle”. These were the subject of the Pilot Project Programme. Whilst in the first phases of project activities from identification of uses/functions of water, identification of criteria and targets for these uses/functions and issues, water legislation, inventory of available relevant information, surveys (to supplement missing information), up to analysis of water management issues - were done in the second phase – and also in this paper - was focused on the successive steps containing defining of information needs, strategies for monitoring and assessment and recommendations for improvement of monitoring and assessment (Figure 1).

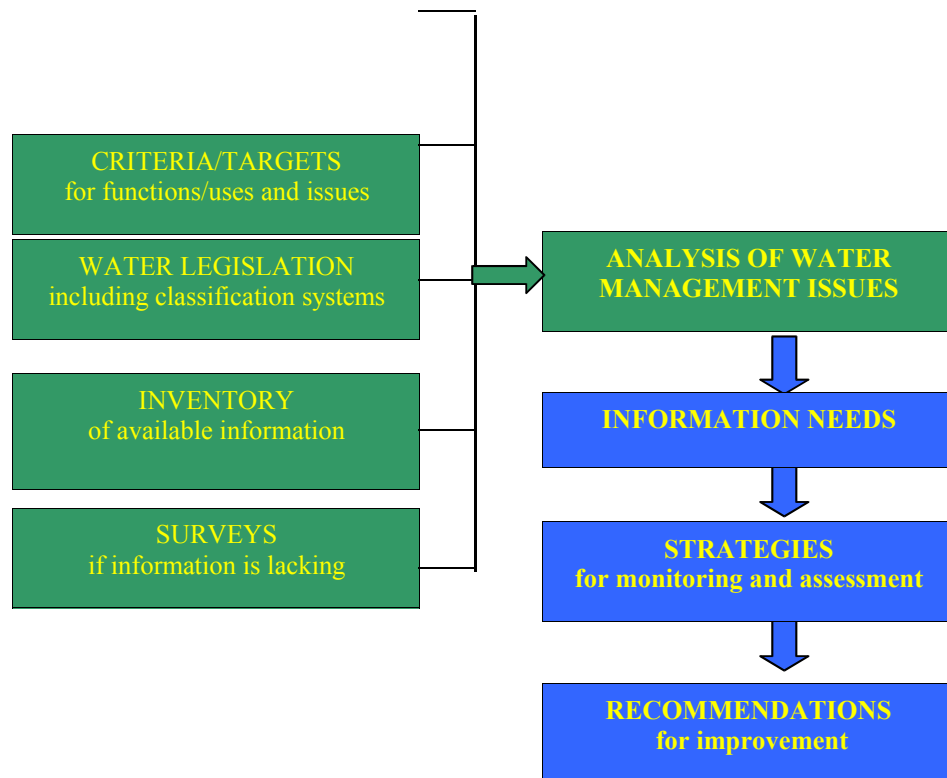


Figure 1 Analysis of Water Management Issues (UNECE, 2000)

3.

Information needs

3.1 Water uses and functions

For the good management of transboundary waters adequate information is necessary. To avoid problems like collecting of information, which is not to be utilised, or, in the opposite, recognising during planning process that important information is missing, identification of information needs is to be carefully dealt with taking into account the uses of waters, their functions, but also pressures, problems, and the water management measures required to deal with them.

On the basis of water management analysis in both countries, identification of water functions/uses and associated problems were done. The level of relation indicating also what is of transboundary relevance is shown in the Table 1.

Table 1 Relationship between functions/uses and problems in the Morava River basin

Functions/uses	Drinking water	Ecosystem functioning	Fishing	Recreation	Irrigation	Industrial use (incl. cooling waters)	Transport medium
Problems							
Flooding	CR						X
Organic pollution	CR	X	X	X			
Microbiological pollution	CR			X	X		
Eutrophication	CR	X	X	X			
Pollution with hazardous substances	CR	X	X	X	X		
Accidental pollution	CR	X	X	X	X	X	
River regulation		X	X				X
Salinisation		SR					

CR = Czech Republic - problems related to functions/uses specific only to the Czech part of the river basin
 SR = Slovak Republic - problems related to functions/uses specific only to the Slovak part of the river basin
 X - Problems occurring in both countries but not relevant to the transboundary section
 X - In yellow field - problems related to the transboundary section

3.2 Issues having an impact on water uses and functions and consequences for monitoring

3.2.1 Organic and microbiological pollution

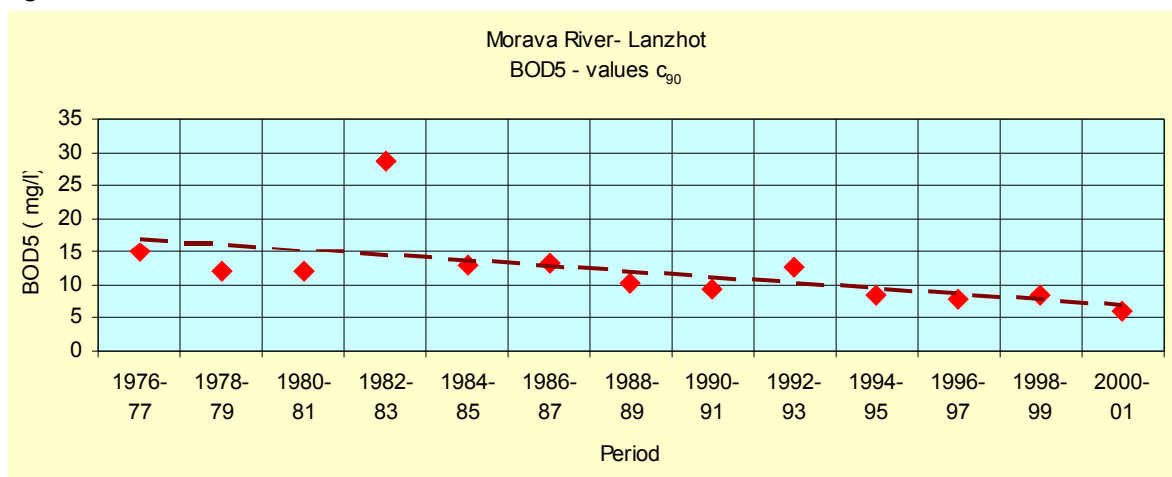
Proper functioning of the ecosystem including state of fish population can be affected by organic pollution, coming mainly from municipal and industrial sources. Organic pollution is usually also accompanied by microbiological pollution, which can influence the suitability of water for irrigation.

Based on the inventory in the Morava River basin, it can be concluded that larger municipalities (above 10,000 PE) are equipped with waste water treatment plants with a mechanical-biological stage and a significant decrease in organic load – approximately 50 % - in the waters has been observed in the last decade. But there are still remaining some problems with smaller municipalities, incomplete sewerage systems and unreconstructed facilities of some factories.

The quality of the surface waters in the Morava River itself is characterised from slightly to moderately polluted from an organic pollution point of view. A comparison of BOD₅ values with the guide value given by Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life, showed certain non-compliance in the transboundary part of the Morava River. But as it is shown in the Figure 2, there is a clear downward trend in BOD₅ at the monitoring site Morava Lanzhot, which is located in the transboundary section.

Measurements of organic pollution in rivers as a result of receiving wastewaters is necessary to be able to meet compliance with the water quality standards and objectives set up for organic pollution and for the purpose of knowledge the cause-effect relationship between decreases in the organic pollution discharged and the resulting water quality. This also means that information on organic pollution discharged by waste water is needed. Information on the microbiological pollution of water is also necessary for assessment of compliance with the criteria for irrigation water.

Figure 2



3.2.2 Eutrophication

The input of nutrients, which sometimes cause excessive growth of algae in surface waters, can affect almost all uses identified in the Morava River basin. The origin of nutrients in the surface waters of the Morava River basin is mainly from municipalities and agricultural activities.

Nutrient removal is not yet a common aspect of the municipal waste water treatment process, and that means that large amount of nitrogen and phosphorus enters into the surface waters. Agricultural activities also contribute to the pollution of waters by nutrients, although in the last decade the consumption of fertilisers has decreased rapidly due to the economic transformation in both countries. Regarding the release of nutrients the inventory also showed that the role of inhabitants not connected to sewerage systems is not to be ignored.

The content of nutrients in the water in the transboundary section of the Morava River is mostly uniform and generally rather high. However, in the case of some tributaries and sections under large municipalities, the situation can even be worse. A high nutrient content results in an increase in chlorophyll-a, which can reach values exceeding 100 $\mu\text{g/l}$ in the summer period in the lower stretch of the Morava River. Despite this still not satisfactory state, a downward trend for ammonium-N and phosphates is observed in the Morava River.

Both countries are implementing steps to decrease the release of nutrients into waters, e.g., by intensification of WWTPs nutrient removal, and the preparation and implementation of a code of good agricultural practice. Directives on UWWT and the Nitrates Directive are aimed at protecting waters from the adverse effects of nutrients and both Czech and Slovak Republic are in the process of the Directives implementation.

In order to assess compliance with the water quality standards for water uses and to assess the effectiveness of the measures taken, information on the status of nutrients and chlorophyll-a should be available.

3.2.3 Hazardous substances

Diversity of industrial activities, including the chemical, machine, textile, and paper industries and leather processing in the Morava River basin, presents a risk for biota living there and can affect majority of uses and ecological function of the river. The risk of the release of hazardous substances from old landfills, which originated in the previous period, also exists, especially during exceptional hydrological and meteorological events.

The heavy metal content in the Morava River itself is low; a higher content of zinc and mercury was observed occasionally. Higher concentrations of these metals are regularly found in some tributaries downstream from specific industries and larger municipalities.

As far as specific organic pollutants are concerned, PCBs were found in several reaches and occasionally lindane, which is supposed to be a consequence of historical

pollution. The survey revealed that in the Morava River, the substances from a group of PAHs create a potential risk for the aquatic ecosystem.

Both countries regulate discharges of selected hazardous substances in water. By implementing the EU legislation, the provisions of 76/464/EEC and of Directive 2000/60/EC will also have to be respected.

Those hazardous substances, which are discharged or released in significant quantities, should be monitored in surface water. Therefore both countries have endeavoured to compile an inventory of hazardous substance discharges and use of pesticides in agriculture, have conducted surveys of the presence of hazardous substances in waters and sediments. But it is assumed that complete, comprehensive information on the emissions of those substances into surface waters will need more time. In the meantime, hazardous substances, presence of which was already confirmed in rivers, are to be involved into the monitoring programme. Continuously, additional survey is recommended to enhance knowledge on hazardous substances in the Morava River, with regular optimisation of monitoring programme in the light of new information.

3.2.4 Physical disturbances in the river system

In the Morava River basin, aquatic and water-related ecosystems play a significant role. The acknowledged status of the valuable wetlands and floodplains of international importance strengthens this factor. River engineering present in watercourses and adjacent floodplain areas has resulted in pressures on the ecosystems, causing, above others, the changes of the natural flood regime and anthropogenically induced modification of habitats. In order to be able to evaluate the extent of physical disturbance of the rivers in the Morava River basin, mapping and evaluation of hydromorphological characteristics will be necessary. Such information could also be used in the process of prioritising revitalisation measures.

3.2.5. Flooding and accidental pollution

In the Morava River basin, the occurrence of flood events represents a specific issue, both in relation to the main river and its tributaries. In recent years several serious flood events with considerable damage affecting human living assets and water quality occurred. Steps to improve flood forecasting, warning and protection systems have been taken by both countries, including improvement of monitoring of quantitative hydrological data. In addition, both countries are also involved into the international "Accident, emergency, warning system" (AEWS) established in the frame of the ICPDR.

3.2.6 Impacts on ecological quality of watercourses

One of the objectives of water management policy is the improvement of the status of water and the protection of the aquatic and related terrestrial ecosystems. Likewise, Directive 2000/60/EC defines the achievement of the good status of surface waters as one of the key objectives, which means the achievement of both a good ecological and chemical status.

Ensuring good ecological status is closely connected to the previously mentioned problems identified in the Morava River basin, such as organic and nutrient pollution, the occurrence of hazardous substances and physical disturbances to the river system. To obtain reliable information on the ecological status of the surface waters in the basin, suitable monitoring and assessment methods are needed. The methods have to cover also biological quality elements as they integrate effects of all above mentioned issues.

3.3

Management targets

There have been elaborated national environmental strategies covering also water-related tasks in both countries. The main targets of state environmental policies in the field of water management are rather similar, which can briefly be summarised as follows:

- Protection of water, including aquatic ecosystems
- Reduction of pollution of watercourses
- Transposition and implementation of EU legislation
- Increase in percentage of population connected to a sewage system and the insurance of adequate treatment to fulfil Directive 91/271/EEC
- Stepwise introduction of integrated approach within the water management by means of legislation, economic, tax, regulatory, permitting and self-government tools
- Improved control of hazards from accidental spills and of risks from accidents
- Introduction of environmentally sound sectoral policies, reduction in pollution from industry, with special concern for hazardous substances, implementation of best available techniques in industry, mining and services
- Introduction of environmentally sound policies in agriculture, forestry and landscape
- Implementation of sustainable flood protection
- Successive restoration, rehabilitation and conservation of biota and biodiversity corresponding to respective water bodies and floodplains within the river basin

Monitoring and assessment of water status is essential in the process of water management, and is covered by legislation of both countries. Results of monitoring and assessment should form the basis for setting up policy strategies, assessing the achievement of policy objectives, evaluating compliance with use-related water quality standards, planning process in river basin and informing of the public. The information from water monitoring serves further to support state administrative decisions in the water sector.

An obligation of joint monitoring of surface water quality of transboundary waters, assessment and exchange of information is given also by joint Agreement on co-operation on transboundary waters between the Governments of Slovak and Czech Republic signed in December 1999.

3.4 *Monitoring objectives*

The specific objectives for transboundary monitoring of surface waters in the Morava River basin are derived from water uses and functions analysis, as well as from existing legislation and are the following:

- Assessment of actual water status in a river basin including chemical and ecological status
- Assessment of the water quality with criteria given for support fish life and for irrigation
- Assessment of quantitative hydrological data for operational and regulatory hydrology
- Assessment of effectiveness of measures taken for water quality improvement
- Assessment of water quality trends and pollution loads

3.5 *Selection of indicators*

As a further step, indicators linked to specific water functions/uses and associated problems had been identified in the Morava River basin. To ensure that indicators were derived for all aspects of a problem – from its origin, through its effect on aquatic system up to the measures taken to cope with the problem, DPSIR scheme was used.

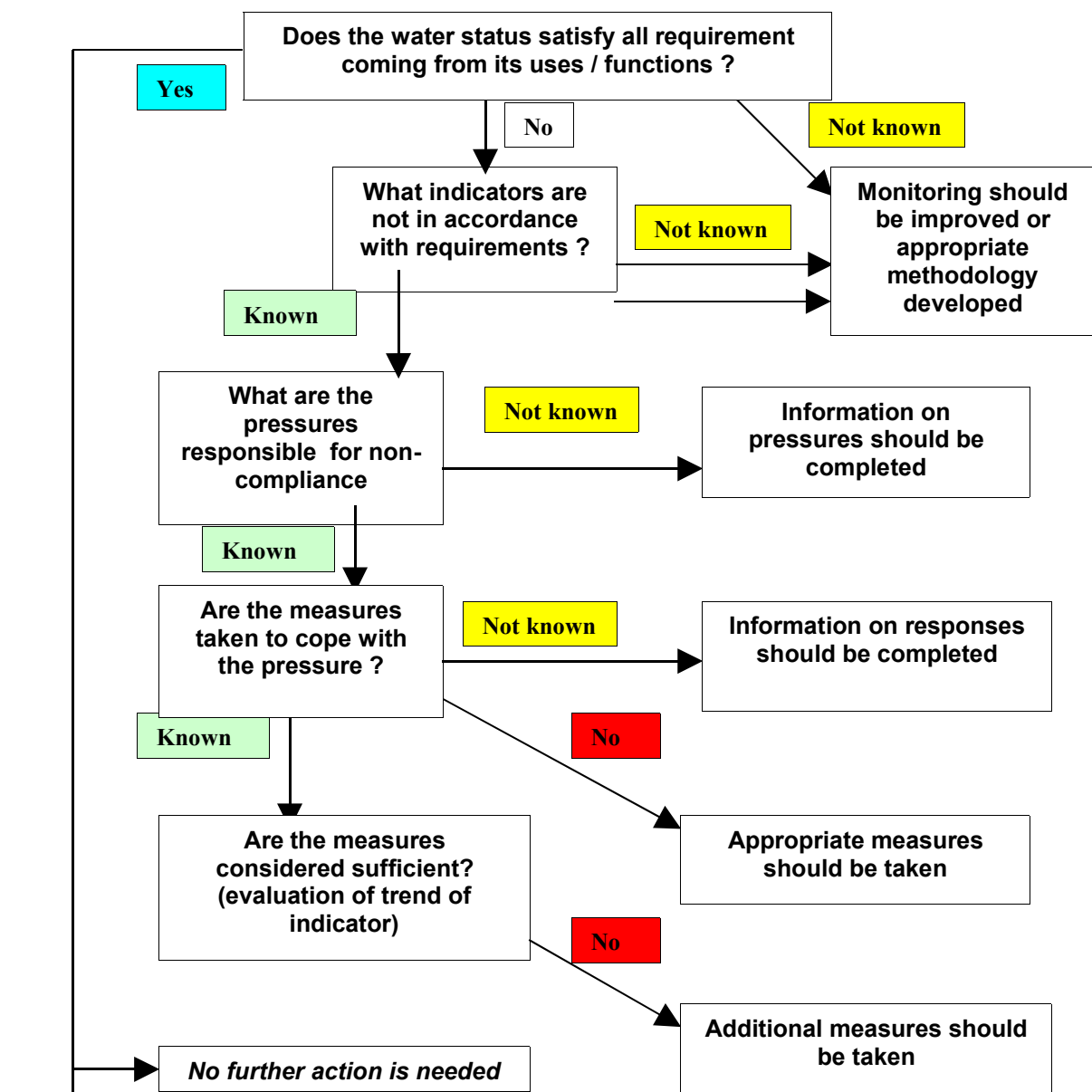
Appropriate parameters related to identified indicators were also derived and can be divided to those, which are obtainable from monitoring programmes and the others, which are collected by other means. The latter include parameters related to driving forces, responses and partly to pressures. They are collected from different sources – statistical office, polluters themselves, different water management institutions, from strategies established in the water sector, and many others.

On the basis of this activity a proposal of the parameters that should be measured in the frame of monitoring programme of surface waters and effluents were prepared and are given in the chapter 4.

3.6 Requirements for presentation of information

Generally, information should be presented in adequate way not only to decision-makers responsible for water management in the river basin but also to public. Basic report prepared for decision makers should contain the following: results of measurement, evaluation of compliance of water status with requirements established for water uses, functions and ecological conditions and assessment of water status in relation to pressures and respective taken measures and recommendations for improvement, referring to measures taken in the field of water management. Interpretation of results should follow the scheme depicted in the Figure 3. Using this scheme should assure that information on water status is linked with other information on pressures having an impact on water status and also with measures taken to improve water status. Further, possible gaps in information can also be discovered.

Figure 3 Proposal of interpretation scheme.



Strategy for monitoring and assessment

Strategy definition and development

Strategy for water quality monitoring and assessment should predominantly reflect a comprehensive view of all relevant circumstances influencing as well water bodies as their aquatic ecosystems and their broader environment. As both countries, the Czech and Slovak Republics are entering in EU, the fulfilling of the requirements of the EC Directives, esp. those concerning hazardous substances and establishing of a framework for Community action in the field of water policy, will be obligatory. These bindings insist on an extension of monitoring, including additional monitoring components of the river ecosystem.

Both countries in question are also signatories of the "Danube Protection Convention" which brings some specific requirements given by the respective Commission. Within activities of the Commission a new List of Priority Substances for the Danube River Basin has been prepared and the final version of it will be approved this year.

Tools needed for satisfying monitoring and assessment objectives

In the past there was very little information on an impact of different pressures on ecosystem and therefore little attention had been given to some kinds of pressures.

With purpose to improve possibilities of interpretation of monitoring results for river basin management, and simultaneously to be cost effective, combination of physicochemical analyses (of water, sediments, suspended solids, biota), biological surveys, ecotoxicological testing and mapping of the quality of habitats for aquatic biota is advisable.

When monitoring the effluents besides of the general parameters attention should be paid to monitoring of hazardous substances. For surface water quality monitoring in the transboundary part of the Morava River two specific human uses – irrigation and recreation fishing are of priority concern. As the fish communities are rather rich there it is necessary to safeguard the fish population from harmful consequences resulting from discharge of hazardous pollutants into waters. For setting up effective routine monitoring of hazardous substances, a complete inventory of hazardous substances and register of their use in agriculture is needed. As far as the ecology, the main problem lies in the need of development and implementation of suitable methodologies for assessment of the data from biomonitoring in accordance with the WFD. This is the urgent need for the coming years.

Selection of monitoring parameters and media

Selection of monitored parameters should be tailor-made and should involve appropriate spectrum of parameters adequate representative for the main water uses and functions as well as for the all specific problems. First of all, parameters specified in EU Directives and national legislation should be introduced.

The overall state of surface water comprises besides of water quality parameters also quality of sediments and biota living in the water course. Further, aquatic environment should provide adequate living conditions of the present organisms. Suitability of the conditions is reflected by species diversity, abundance and biomass of aquatic organisms. Monitoring of these characteristics is coming to the forefront in relation with the Water Framework Directive. Also to sufficient knowledge about the impact of different types of pressures should be given appropriate attention in the process of the parameters selection. The principle of monitoring tailor made will be implemented and increasing number of requisite parameters will be adopted during the coming years in a step-by-step approach. Responsibility lies with the bilateral Czech-Slovak Commission for Transboundary Waters.

Indication of monitoring locations and frequencies

Criteria for selection of monitored locations within the transboundary area are as follows:

- selected locality should be representative for the qualitative regime of the section
- hydrological measurements and qualitative sampling should be done at the same location
- sampling downstream the main tributaries and pollution sources should be highly important

Generally sampling frequency should reflect the variability in concentrations of monitored parameters, statistical significance and accuracy required for specific objectives and monitoring site should represent the characteristics of the locality. Selection of sampling locations in the transboundary part of the Morava River is given in /Adamkova, 2002/.

Recommendations for improvement

Required measures in accordance with general recommendations

Convention on the Protection and Use of Transboundary Watercourses and International Lakes includes provisions on monitoring and assessment. One of the most significant tasks, resulted from the Convention provisions, consists in the strengthening of measures to protect and use of transboundary waters in an ecologically sound way. The main areas in which improvement should be aimed at is effectiveness of monitoring and assessment system and cooperation in the frame of the river basin management. Effective systems for monitoring should be based on efficient communication of three riparian states in the river basin. The principal improvement tools for monitoring linkages should include:

- regular exchange of information,
- mutual consultations of methodologies,
- mutual assistance in measurement systems and experience of analytical techniques,
- regular cooperation in data processing and evaluation procedures

The presented recommendation should contribute and improve the work of the recently established Czech-Slovak Commission on Transboundary Waters.

Evaluation of current monitoring and assessment practices

Due to common history of the two riparian states, it could be stated that there have not been any essential differences among approaches of individual countries to current monitoring and assessment practices. Though, some improvements should be achieved in fields of monitoring of sediments pollution, of pollution caused by hazardous substances, of biological and microbiological pollution, of ecotoxicology of relevant effluents, of ecological monitoring and assessment. In the field of monitoring of dangerous substances, it is necessary to obtain a picture of relevant substances for the given area which should be afterwards introduced into regular transboundary monitoring. The area of monitoring of ecological status methodologies as well as data collection has not been completed yet.

Assessment of gaps in existing technical capabilities

After all analyses it can be stated that existing technical facilities in the Czech and Slovak Republics are generally sufficient for fulfilling of given tasks resulting from requirements of transboundary monitoring and assessment.

Potential gaps in current state of the transboundary monitoring and assessment could be considered to include the need to enlarge the scope of information on:

- Pollution caused by hazardous substances;
- Pollution by pathogenic organisms;
- Ecotoxicology;
- Ecological monitoring and assessment

Since the range of the above given substances is continuously broadening due to increasing usage and growing knowledge of their effects these gaps should be filled in a step-by-step way over the medium term. It is also necessary to introduce and harmonize new and mostly advanced and expensive analytical techniques.

Needs of the information flow system to support transboundary monitoring

To ensure effective river basin management within the individual countries in the transboundary river basin it is necessary to establish an efficient transnational information system enabling appropriate flow of the required data between the respective countries. This system should comply with data availability, their responsibility, upgraded media, passing of information to respective authorities, capacity building, presentation of information and information filling in archives on national levels.

Conclusion

With respect to the contribution of the Morava River basin to the Danube River and the Black Sea water quality, it is necessary to establish comprehensive protection of the environment while paying attention to both national issues and transboundary effects. Even though there has been a long tradition of transboundary co-operation within the river basin with Austria, transboundary co-operation of the new states after division of the former Czechoslovakia is in the phase when support of the project could be much valuable.

In this way, the Pilot Project plays an important role within the process of setting out the framework of transboundary activities and taking into account the requirements of respective conventions, recommendations of the ICPDR, the UN ECE guidelines and the Water Framework Directive as well as recently upgraded national legislation. Therefore, it can be presumed that the information and conclusions coming from the presented work will be of great importance and use for achievement of more advanced level of co-operation within the bilateral transboundary commission in the future.

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