

## Experience of Ukraine in the Development of the Water Quality Control on Transboundary Rivers

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### Abstract

Ukraine is an important area for international co-operation in water management and protection on transboundary rivers. Development of the effective water quality control measures on transboundary rivers is an essential component in the Ukrainian water quality management policy for waters pollution abatement. The international water-related agreements provide good basis for development of national and international activities in this area. The following activities concerning water quality control development have been undertaken by Ukraine and neighbouring countries: a) harmonization of national regulations and standards; b) creation of transnational water monitoring networks to provide structured and well-balanced overall views of pollution status, as well as of the long-term development of water quality and pollution loads; c) prevention and control of accident pollution. Providing these measures is not an easy task, especially in countries, which face economical and environmental problems. The purpose of this paper is to present problems and needs of Ukraine in the field of development of surface water quality control on transboundary rivers and the Ukrainian experience concerning their decision.

*Key – words: water quality, control*

### Introduction

Economic development and urbanization of the territory have lead to excessive use of natural resources and significant degradation of the environment, particularly surface waters as it's most important component. Rational use and protection of natural resources, including water resources, are the most actual problem under these conditions.

The achievement of water quality objectives to ensure the ecological balance and utilization of water resources, such as drinking water and industrial water supplies, fishery, irrigation and recreation, in the catchment area of international rivers calls for concerted action in water quality control and management among the riparian countries.

Ukraine has a large amount of transboundary river basins with the neighbouring countries: the Republic of Belarus, the Russian Federation, the Republic of Moldova, Romania, Hungary, the Slovak Republic, Poland. In total, 75% of Ukraine's rives are transboundary (Fig 1). The most important transboundary rivers are Danube, Dnipro, Bug, Dnister and Siversky Donets rivers. The territories of the states with developed industry, agriculture and with large population are situated within the transboundary river basins. Transboundary rivers and their numerous tributaries are extensively used for navigation, fishing, drinking-water supply and satisfy the demands of agriculture and industry. They provide hydropower production, and are used for recreation, as well as for disposal of waste waters.



Figure 1. Main transboundary river basins of Ukraine

The large volume of pollutants (oil products, sulphates, chlorides, organic matter, pesticides, heavy metals and so on) arrive into the surface waters from point sources and non point sources of pollution every year. A municipal economy, ferrous and non-ferrous metallurgy, chemical production, agriculture are the main sources of river pollution (Figure 2). That is why water quantity and water quality become a limiting factor of usage of surface water resources and sustainable development of Ukraine and neighbouring countries. The national policy of sustainable development concerns a wide spectrum of integrated water management, including water quality management (Manukalo, 2002).

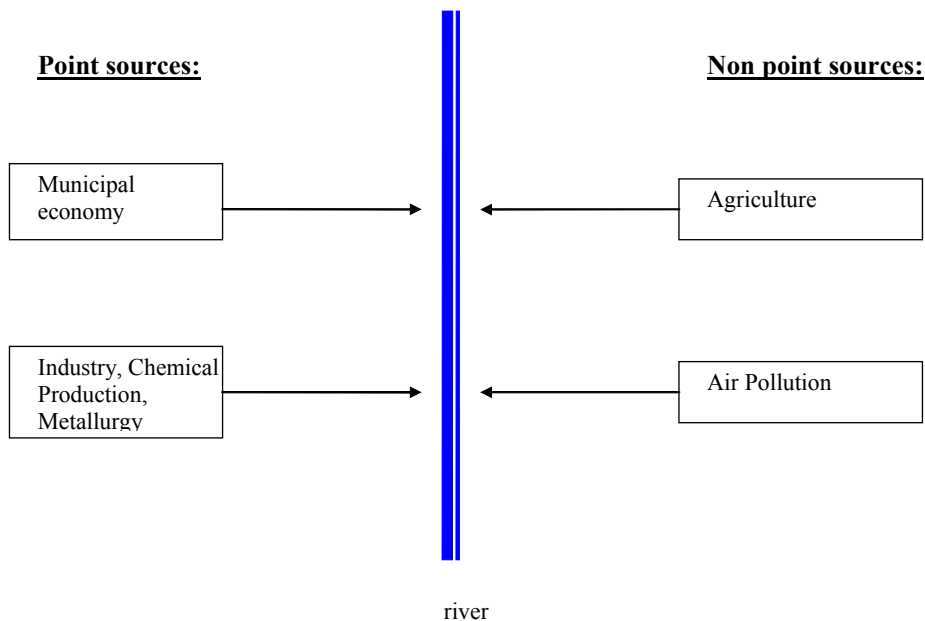


Figure 2. Main sources of water pollution of Ukrainian rivers

## Findings and Discussion

### *Water quality control as an essential component of water quality management*

The main objective of the water quality management programs includes:

- to ensure the healthy aquatic life in the aquatic ecosystem;
- to satisfy the quantity and quality requirements of different water users.

A place and value of the water quality control in the general planning of water quality management process are presented at the Figure 3.

It is obviously, effectiveness of the water quality management depends on the availability of regular and reliable information on:

- pollutant discharges from point- and non-point sources, directly into the rivers and their tributaries;
- quality/ pollutant characteristics of the river and their spatial and temporal variation;
- environmental weathering of pollutants in the affected aquatic ecosystem;
- transportation, migration and pathways of the pollutants within the aquatic ecosystem;
- water quality requirements of the intended water uses.

One of the principal terms of obtaining this information is a creation and maintenance of water quality monitoring system which can carry out observations, processing of data and provision users with systematic information about water quality status of water bodies. This information is the key prerequisite for accurate assessments of the water quality and the magnitude of water problems. Moreover, water quality management and protection within transboundary river basins calls for harmonized and comparable the water national monitoring programs.

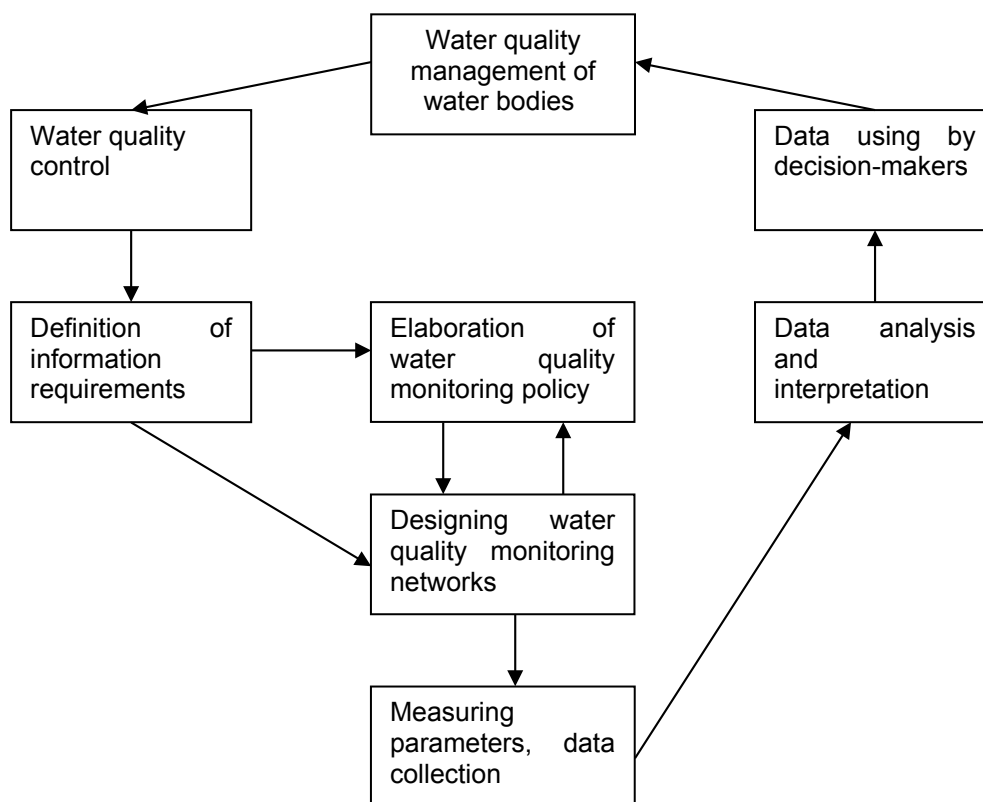


Figure 3. Place and value of water quality control for the water quality management

Present state, principal problems, new challenges in the area of development of surface water quality monitoring in Ukraine are considered below.

### *Present State of the Surface Waters Monitoring*

In Ukraine, the national activity in the field of surface water quantity and water quality monitoring is regulated by the Water Code of Ukraine, the Law on Environmental Protection, the Law on Hydrometeorological Activity and a number of Regulations of the Cabinet of Ministers of Ukraine. The institutional activity in this field is undertaken by a number of governmental bodies. Generally, the present surface water quantity and water quality monitoring systems in Ukraine were inherited from the former Soviet Union.

The water quality monitoring system in Ukraine was developed in the mid 1970-s. At that time it was as efficient as monitoring systems of developed countries. As compared to the USA and Western European Countries, it was poorly developed in terms of laboratory and sampling equipment, logistical support; however, it was better organized in terms of other components: almost all observation sites were provided with measured and calculated hydrological parameters, routine aquatic biology observations were initiated and national reviews on water quality were published.

Presently, the largest part of work on water quality monitoring in Ukraine is being carried out by the following authorities:

- the Ministry of Ecology and Natural Resources: a) co-ordination of monitoring activity of different institutions; b) organization of monitoring of sources of human impact and zones of their direct influence; c) organization of the services for special inspections of analytical control; d) monitoring of groundwaters;
- the State Hydrometeorological Service – provides with water quantity and water quality monitoring of natural water bodies, baseline monitoring;
- the State Agency of Water Resources– monitoring of man made water systems and hydroconstructions in places of water intakes and waste water discharges;
- the Ministry of Health – monitoring of drinking water supply sources, monitoring of drinking water quality.

The State Hydrometeorological Service, which is subordinated to the Ministry of Emergencies of Ukraine, operates the most extensive surface water quantity and quality monitoring networks, including observation networks on the Black Sea and Azov Sea.

The goal of the surface water quality monitoring system is to collect systematic data on the quality of water bodies and to provide them to the central administrative and economy authorities, as well as to all organizations concerned with systematic information and predictions of level of pollution of water bodies and emergency information on acute variations in the level of water pollution.

The planning and implementation of observations are determined by the following principles:

- comprehensiveness and frequency of observations;
- co-ordination of the time of sampling with regular hydrological events and measurement of parameters using unified methods.

The system is based on a network of fixed points (sites) of observation located at water bodies both in the areas of anthropogenic impact and in unimpacted locations. The sites are selected on the basis of the present use of a water body for the needs of economy and future development plans.

Today, the water quantity monitoring system of the State Hydrometeorological Service consists of 375 hydrological observing points located in 6 major river basins and 60 observing points on 15 reservoirs and 8 lakes. The purpose of observations is to obtain data (water levels and water discharges) required for hydrological forecasting, to study space-timely conformity of hydrological regime, to compile the water cadastre, to estimate water balances and water resources, to assess of influence of the human activity upon water resources and the regime of water objects.

The observations of the surface water pollution are carried out on 140 rivers, 15 reservoirs, 8 lakes and estuaries, by 255 points of observations including 406 measuring sections. The observations of surface water pollution are based on physical, chemical, and biological parameters with simultaneous measurement of hydrological parameters. The measurement of physical and chemical parameters is conducted at all observing points, and biological parameters are measured at 20% of the observing points. Sampling based on an obligatory standard program which includes the measurement of 35-40 physical and chemical

parameters carried out in major hydrological phases 4 times a year for reservoirs and lakes and 6-7 times a year for rivers.

The samples are sent to analytical laboratories belonging to regional organizations of the State Hydrometeorological Service. Data obtained from analytical laboratories go to the Central Geophysical Observatory for recording and processing. This organization prepares, publishes and disseminates the information about water quality to concerned users. Water quality is estimated by means of analysis of the frequency and value of maximum allowable concentration exceedances for individual substances, as well as the information on the events of high and extremely high pollution.

The water quality monitoring systems of the Russian Federation, the Republic of Belarus, the Republic of Moldova and Ukraine (these countries were the republics of the former Soviet Union) function on similar principles. These countries use the basin approach of river basin management. These factors help to coordinate activities in area of water quality monitoring between Ukraine and these neighboring states.

On the other hand, the above mentioned water quality monitoring system has limitations and problems, the most important of which are as following:

- a lack of clearly formulated goals and objectives of monitoring system reflecting its relationship with water quality management activity;
- unclear distribution of responsibilities between national authorities involved in the monitoring, poor co-ordination among them, resulting in duplication of some functions and loose of the others;
- quite limited possibility for estimation of special parameters of pollution and detection of emerging issues;
- insufficient number of observation of bottom sediment and suspended solids, physical parameters of habitats, concentrations of toxicants in organs and tissues of biota, ecotoxicological parameters;
- outdated instruments and equipment and, as the result, quite limited possibilities to detect toxicants, pesticides, and heavy metals;
- a lack of modern information technologies and limited possibilities for dissemination, processing and presentation of information;
- water quality assessment based on outdated and inflexible the maximum allowable concentrations system;
- inadequate financial and logistics support of the monitoring activity.

Above mentioned deficiencies make difficult to develop the international co-operation of Ukraine with its western neighbors (Poland, Slovak Republic, Hungary and Romania) and to develop water quality management within the Danube and Bug river basins. The water quality monitoring networks operate in the Danube river basin countries mainly in an isolated way. The exceptions were limited to some border sections monitored by neighboring countries in the framework of bilateral agreements.

### *New Challenges*

During the last decade, the fundamental water-related agreements were achieved in the European region: in 1991, the Convention on Environmental Impact Assessment in a Transboundary Context; in 1992, the Convention on the Transboundary Effects of Industrial Accidents; in 1992, Convention of Protection and Use of Transboundary Watercourses and International Lakes (Water Convention); in 1992, the Convention on Protection of the Black Sea from Pollution; in 1994, the Danube River Protection, in 1996, the Guidelines on Water Quality Monitoring and Assessment, Convention; in 1998, the Convention on Access to Information, Public Participation in Decision-making; in 2000, the European Water Framework Directive. These agreements are the good basis for development of national and international activities for water quality management and water quality monitoring on transboundary rivers.

An essential element of these agreements 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 specification of information needs which are in the known monitoring cycle. The strategic goals of the agreements is to maintain and to improve the status of water resources as to quantity and to quality, to prevent and to control water pollution.

The reliable data sets on the water quality/pollution of a river could be obtained from implementation of properly designed ambient monitoring program. The program includes the following activities:

- updated water quality standards;
- selection of parameters which determine water quality;

- standardizing of laboratory procedure;
- international laboratory intercalibration;
- international data exchange;
- integral quality assurance: analytical procedures and statistical evaluation;
- improvement and harmonization of collection of information;
- representative network of sampling points;
- prevention and control of accident pollution;
- policy – legislative framework leading to: a) environmental clean-up; b) emission control.

Parameters, which are usually determined during water quality/pollution monitoring programme, and which will be considered as parameters in water quality objectives, include:

- conventional water quality parameters (temperature, pH, conductivity, total dissolved solids, suspended solids, dissolved oxygen, Na, K, Ca, Mg, Cl, SO<sub>4</sub>, HCO<sub>3</sub>, BOD<sub>5</sub>, COD, nutrients, NH<sub>4</sub>, NO<sub>2</sub>, NO<sub>3</sub>, PO<sub>4</sub>);
- heavy metals (Cd, Pb, Cu, Cr, Zn, etc);
- organic micropollutants (oil components, PAHs, phenols, pesticides, etc);
- radioactivity indicators (Sr-90, Cs-137);
- microbiological indicators;
- biological indicators;
- water quantity parameters (discharge, flow velocity).

In order to implement this program, the trans - international monitoring network should be established. This network should be based on the national surface water monitoring networks. Stations of the water quality observation should be established at:

- border sections;
- upstream/downstream of major cities and tributaries
- downstream of the largest point sources of pollution, "hot spot";
- ecologically vulnerable areas;
- connecting to control of water use for drinking water supply.

Each monitoring station can have up to three sampling points located on the left or right side, or in the middle of a river. The minimum sampling frequency is 12 times per year for chemical determinants in water and two times per year for biological parameters.

The analytical methodologies for transboundary water monitoring program could follow two approaches depending on the aim of the monitoring program, such as:

- regular monitoring for establishing pollution levels and trends by manual sampling. In this case, collection of samples is flexible and may involve a large number of sites and positions of observation;
- early warning monitoring by automatic measurements. In this case, it is difficult to change sites/positions of observation, and there are some limitations in detection and analytical techniques.

In order to assure the validity, reliability and comparability of the pollution monitoring data, quality control measures should be enforced during sampling, analysis and data processing. The major elements of the quality assurance program include:

- sampling and analytical protocols;
- uniform instrumentation;
- skilled personnel;
- intralaboratory quality control;
- interlaboratory quality control.

Creation of the Early Warning Pollution System (EWPS) is a very important part of the integrated strategies for development of monitoring and assessment of water quality within transboundary river basin. The objectives of the EWPS are to trigger an alarm as well as to make a diagnosis to find the origin of the pollution. It consists of the following elements:

- communicative EWPS: establishment of a network of Principal International Alert Centers; agreement on international alarm procedures; availability of an effective international communication;
- hazard identification (list of hazardous substances): knowledge of expected accidental pollutants; risk analysis based on target values and identification critical risk factors (trigger values);

- alarm model forecasting the propagation of the pollutant plume including hydrological parameters;
- local screening of water quality (survey of quality target values): quick and reliable analysis; simple tests to supervise the water quality; capability to identify special pollutants.

In the Danube river basin countries, the so-called Principal International Alert Centers (PIACs) have been established. The Ukrainian PIACs has been created in the IZmail town which is located in the estuary of the Danube river. The principal goal of these centers is to provide an exchange of pollution warning messages among the Danube countries. The warning system has proved its efficiency for prevention of consequences of accident pollution which have been observed on the Danube, Prut and Tisza rivers during last years.

Co-operation of the Danube river basins countries is a good example of international activity in the area of development of the water quality monitoring. The legal basis of this activity is the Danube River Protection Convention. In order to implement goals of Convention, the Danube river basin countries have established the International Commission for the Protection of the Danube river (ICPDR).

The Danube river countries also agreed that ICPDR should serve as a common platform for implementation of the Europe Union Framework Directive (EU WFD) on a basin – wide scale. It means that the non – EU Danube river basin countries, including Ukraine, should also take the commitments to enforce the EU WFD in these countries.

The implementation of the EU WFD in Ukraine requires solution of the legislative, organizational, scientific and technical problems. In contrast to the EU WFD, the Ukrainian water legislation focuses on very strict limit values for emission but it does not include water quality standards for the period of water bodies use. Therefore the monitoring is concentrated on the pollution control, but obligations on elaborations of action plans of water quality improvement are not foreseen.

It is necessary to upgrade the programs of monitoring with strictly defined objectives and approaches. It is very important to improve the technical equipment of water quality observation and analytical control. The interdepartment programs should be created and implemented in order to improve the technical layout and equipment of monitoring.

It should be say that Ukraine, Russia and the Republic of Moldova have intensified their efforts on international rivers in order to introduce the European surface water monitoring principles and norms in their practical work. The UN Economic Commission for Europe has provided these countries with a technical assistance in this issue. The several join pilot projects granted by UNECE have been implemented on the transboundary Dnipro, Siversky Donets and Dnister rivers. These projects played an important role in demonstrating the usefulness of the European regulations on monitoring and assessment of surface transboundary waters and in implementing monitoring obligations under the Water Convention. They help to establish effective monitoring programs suitable in the specific economic context of the mentioned neighbouring countries.

In order to meet new challenges, the Ukrainian institutions, which are responsible for water related activity, have revised their departmental monitoring programs and have developed inter-state state programs of exchange of monitoring data. The perspective plan of development of water quality monitoring system based on principles of the European Water Framework Directive until 2013 has been elaborated by the State Hydrometeorological Service.

The improvement of water quality monitoring activity on transboundary rivers in the Eastern European countries can not be considered as a purely scientific and technical task. It requires the solution of complex of economical and organizational problems. Providing this activity is not an easy task, especially in countries which face economic, social and environmental problems. Political and economic changes in Ukraine have created a sever shortage of financial resources for hydrological and water management activities. The economical difficulties in Ukraine do not allow a complete support of the State Hydrometeorological Service. It compels us to solve the problems of technological development in a close connection with a financial provision. A use of risk assessment techniques will be one of the important steps in designing the monitoring network and programs, which are optimal from functional and economical points of view. Risk-based approaches will also be used to determine whether the chosen monitoring strategy will meet enough the information needs of different users.

## **Conclusions**

Creation and development of the effective water quality monitoring system and programs within transboundary river basins on a basin-wide scale is an essential component of elaboration and

implementation of the river basin management strategies for pollution abatement, river protection and restoration. These system and programs allow to obtain data about different types of pollutants and information about environmental status of rivers and its basins in general. It is very important for water users and ecosystems' health. The present state of the water quality monitoring system on Ukrainian transboundary rivers cannot satisfy the objectives of efficient water quality management. Development of water quality monitoring system in Ukrainian and its neighbors on the basis of EU WFD can be an instrument for improvement of water quality management. Taking in account that the State Hydrometeorological Service operates the most extensive water quality monitoring network in Ukraine, the measures of improvement of water quality monitoring system of the State Hydrometeorological service are carried out on a basis of the recommendations of the EU WFD presently.

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