OVERVIEW MAP OF MAIN TRANSBOUNDARY SURFACE WATERS IN WESTERN, CENTRAL AND EASTERN EUROPE

The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

UNEP/DEWA/GRID-Europe 2007

OVERVIEW MAP OF MAIN TRANSBOUNDARY SURFACE WATERS IN EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA

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PART 2
TRANSBOUNDARY SURFACE WATERS

SECTION I

Major Findings of the Assessment

MONITORING TRANSBOUNDARY RIVERS AND LAKES

MONITORING IN EECCA AND SEE COUNTRIES

The longstanding cooperation on monitoring and assessment under the Water Convention have encouraged EECCA and SEE countries with common transboundary watercourses to develop joint monitoring programmes and harmonize their methodologies. The *Strategies for monitoring and assessment of transboundary rivers, lakes and groundwaters*[1] have been developed to assist EECCA and SEE countries in this endeavour.

As the river basin forms a natural unit for integrated water resources management, monitoring programmes should be designed for entire river basins. This is still difficult to achieve in most EECCA countries, where water management is not always based on river basins, due to inappropriate legislation and inappropriate institutional capacity and/or the enormous size of some transboundary basins.

A specific problem for the assessment of transboundary waters in EECCA countries arises from the widely used "maximum allowable concentrations of pollutants for a specific water use" (MAC) or water quality standards that seem to be more stringent than the water quality criteria and objectives often used in other parts of the UNECE region. It is often impossible to comply with these norms, partly due to the lack of appropriate measuring devices and partly because financial and human resources are lacking. Given the experience of other countries, particularly those applying the Water Framework Directive, future joint assessments should be based on water quality objectives or even ecologically based objectives, rather than MAC values. However, it is not realistic to expect EECCA countries to amend their national legislation in the short term.

Adopting a step-by-step approach, transboundary commissions could take the lead in this process by using water quality and environmental objectives in their daily practice. They should also agree on assessment methods to be used jointly within their transboundary basin. A promising example is cooperation between Moldova and Ukraine on the Dniester basin, where data from two of the six agreed-upon measuring stations are already being gathered and exchanged. Almost all of the 30 agreed-upon physico-

[1] Strategies for monitoring and assessment of transboundary rivers, lakes and groundwaters, UNECE, 2006 (ECE/MP.WAT/2006/20).

chemical parameters are being measured, but no measurements are being taken for the agreed-on three biological parameters and four radioactive determinands. In both countries, water laboratories have been designated as well as the entities responsible for data management and information exchange.

In EECCA, the ongoing reform of ministerial environmental departments and water agencies is an opportunity to harmonize responsibilities for water management and improve cooperation among entities involved in monitoring and assessment, including new partners (e.g. the research community and academia), and to designate appropriate institutions to supervise, guide and contribute to monitoring and assessment.

Insufficient and instable financing, a decrease in supply of the stations with spare parts, insufficient replacement of stations and laboratory devices with up-to-date equipment, the worsening situation regarding sampling and sample transport from remote stations, and departures of qualified staff were among the reasons for the decline of monitoring and assessment activities in the early 1990s. After a decade of decline, the funding situation has improved considerably, also due to foreign assistance programmes. However, attempts to upgrade existing monitoring networks still result in unreasonable suggestions to re-activate previously existing networks. Unless a thorough analysis of information needs is made, which is the most basic requirement for a decision on the number of stations, their location, parameters and frequency of measurement, informed decisions cannot be taken. There is a need to set priorities jointly agreed with the major actors, both nationally and in the transboundary context.

It should also be recalled that water monitoring is only one of the many sources of data/information on the conditions of transboundary watercourses. For example, in Georgia, assessments of transboundary waters also use estimates of pollution loads based on industrial production analysis. Data should also be gathered from other sources and disciplines such as agriculture, recreation, sociology, ecology and economics. Often local governments and municipalities are able to provide data on water purification and sewage utilities, factories, farmers and/or irrigators. The results of self-monitoring (monitoring of effluents and wastewater discharges by industries or municipalities, often under the conditions of their discharge license) is a valuable additional source of information for transboundary water assessments. Increasingly, these systems are being set up in EECCA and SEE, but their use is still limited to big industrial undertakings. Thus so far no such data are being used for transboundary water assessments.

In many EECCA countries, the labour and operating costs of sample collection and field analysis, laboratory analyses and data processing, interpretation, reporting and production of outputs have often been underestimated. Ignorance and inadequate assessments of these costs have been among the reasons why activities ceased after international assistance projects ended. It is therefore important that such international assistance projects be embedded in the national plans and that systems requirements be adapted to countries' resources so that operations can continue after a project is completed. Furthermore, there have been cases in which international projects had overlapping objectives, duplicated work and did not involve the right actors, thus wasting resources without improving monitoring and assessment. Recipient countries have a responsibility to streamline donors' efforts and avoid duplications and waste. At the same time, donors should respect recipient countries' priorities and indications.

Storage of data and information probably remains the weakest point in EECCA countries, where water, environmental and health agencies often rely on hard copies of data. It is of utmost importance that policymakers and planners better understand the various steps in data management. This will facilitate data exchange among the institutions undertaking the monitoring and assessment, including joint bodies.

It is wise and economically efficient to start the development of programmes step by step and stressing the need for harmonized methodology and the use of same or similar principles in assessing the status of shared water bodies. In this process, the EECCA and SEE countries sharing waters with EU countries will have a specific role to play: they are a bridge between western and eastern praxis in monitoring, and they could serve as models for introducing "modern" monitoring and assessment praxis as stipulated in the Strategies, step by step.

MONITORING IN WESTERN AND CENTRAL EUROPE

In Western and Central Europe, the knowledge regarding the state of water bodies and possible trends is relatively good. Monitoring results have been used as the basis for various water protection measures; however, there has also been a need to improve the situation. Therefore, during the last 5–10 years significant changes in developing and especially harmonizing the monitoring programmes and their methodological basis have taken place in Western and Central Europe.

At present, monitoring, assessment and reporting activities in EU countries are mostly steered by the obligations of different water-related directives.

The key directive concerning monitoring is the Water Framework Directive (WFD).[2] The main pressures on water resources are documented as a result of the implementation of the Urban Waste Water Treatment Directive,[3] the Integrated Pollution Prevention and Control Directive[4] and the Nitrates Directive[5] as well as the Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment of the Community.[6]

The status of water bodies (including their chemical and ecological status) will be documented in 2009 following the provisions of the Water Framework Directive. This forthcoming status assessment of the water bodies will incorporate information received under the other above-mentioned directives. The monitoring- and assessment-related activities under the Water Framework Directive could thus be seen as a kind of guide for monitoring, assessment and reporting for water bodies in EECCA and SEE.

Annex V of the WFD and the detailed guidance documents, developed under the Common Implementation Strategy on the Implementation of the Water Framework Directive, provide a sound basis for developing a harmonized monitoring and assessment system for all types of water bodies in the entire EU area.

The programme for monitoring the status of water bodies (rivers, lakes, transitional waters and coastal waters) is based both on the use of hydrobiological characteristics, supported with some key physico-chemical determinands, and on surveillance of certain harmful substances, including priority substances. The WFD also takes into account hydrological variations during the monitoring period.

The advantage of monitoring programmes that comply with EU legislation is a harmonized methodology in a large region with different types of pressure factors and water bodies. The programme has been established to continue for a longer period, with certain assessment and reporting intervals – for example, 2015 as the deadline for the second report.

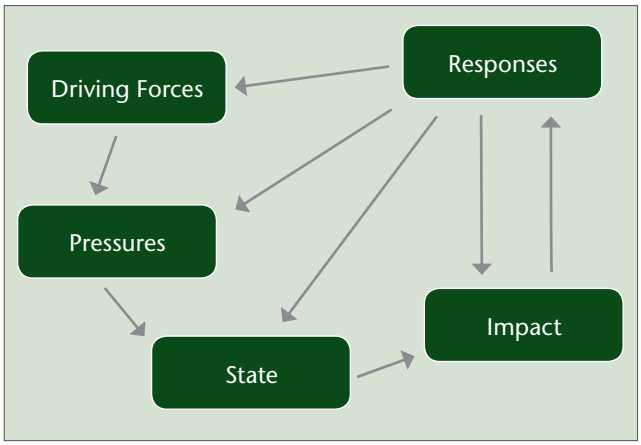
[2] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for European Community action in the field of water policy as amended by decision No 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy.
[3] Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment.
[4] Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control.
[5] Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources.
[6] Council Directive 76/464/EEC of 4 May 1976 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community.

PRESSURES

The 2004 review by the secretariat on "Water and sanitation in the UNECE region: achievements in regulatory aspects, institutional arrangements and monitoring since Rio, trends and challenges"[1] already identified the most challenging water management issues in the UNECE region as a whole and examined further steps to be taken regarding water policies and technical/methodological work. The present assessment of transboundary waters has shed more light on particular issues of concern for countries with economies in transition and countries with market economies.

In Section II of this Part, the river basin's various uses and functions and related water management issues are described and the pressures on water resources, the status of the water bodies, the transboundary impact caused by the pressures, and future prospects, i.e. the potential improvement of the status, provided that certain management measures (responses) are put in place. Such an approach generally follows the logic structure of the "Driving Forces-Pressures-State-Impact-Responses (DPSIR) framework" adopted by the European Environment Agency (EEA) and broadly used under the Water Convention.

The Driving Forces-Pressures-State-Impact-Responses (DPSIR) framework.



The DPSIR framework assumes that social, economic and environmental systems are interrelated. These links are illustrated conceptually by driving forces of environmental change, which create pressures on the environment. These in turn affect the state of the environment. The subsequent changes in status, or "impacts", include impacts on ecosystems, economies and communities. The negative impacts will eventually lead to responses by society, such as the development of policies for river basin protection. If a policy has the intended effect, its implementation will influence the driving forces, pressures, status (state) and impacts.

In order to systematically describe and analyse pressures on water resources, a number of basic documents were used. These included the *1994 Recommendations to ECE Governments on the Prevention of Water Pollution from Hazardous Substances,* which provide an indicative list of industrial sectors/industries for which discharges should be based on the best available technology. As concerns agriculture, the *1992 Recommendations to ECE Governments on the Protection of Inland Waters against Eutrophication* and the *1995 Guidelines on the Prevention and Control of Water Pollution from Fertilizers and Pesticides in Agriculture*[2] have also been used. These also include the United Nations International Standard Industrial Classification of All Economic Activities.

The following paragraphs address the main pressure factors in general terms and provides typical examples of pressure factors from human activities in the various river basins. For a detailed description and analysis, reference should be made to Section II of this Part.

[1] Prepared for the first Regional Implementation Forum on Sustainable Development (Geneva, 15-16 January 2004) as document ECE/AC.25/2004/5 and Add.1 and Add.2.
[2] ECE Water Series No. 2, Protection and Sustainable Use of Waters – Recommendations to ECE Governments (ECE/CEP/10).

CROP AND ANIMAL PRODUCTION

Water use for crop and animal production in EECCA countries (some 50–60% of available water resources) is quite comparable with the situation in countries in Southern Europe, especially Greece, Italy, Portugal and Spain. However, water-use efficiency is much lower, and the magnitude of water pollution problems caused by agriculture is greater.

In general, crop and animal production cause increased levels of nutrients and pesticides in transboundary water bodies due to surface run-off from agricultural land, leaching and – specifically in a number of transboundary waters in the Aral Sea basin – return waters from irrigation channels.

Pollution by nitrogen and phosphorus compounds is well measured, but often badly documented and publicized in EECCA and SEE countries. In transboundary rivers in EECCA and SEE, pollution levels seem to be decreasing. This is chiefly a consequence of the still difficult economic situation and high fertilizer prices rather than of good agricultural practice. With the expected economic growth and the need to increase agricultural outputs, nitrogen and phosphorus will regain their importance as pollutants unless stringent "command-and-control" measures to cut application rates and good agricultural practice are more widely used.

Although the use of certain dangerous pesticides has been banned in countries with economies in transition, unauthorized use of pesticides (reported from some transboundary river basins) and leakages from old stocks of DDT will continue to be an important pressure factor. However, data on the concentration of pesticides in transboundary rivers are mostly unavailable: either no measurements are being carried out, or the measurements do not include sediment or biota.

Base flow from groundwaters carries nitrates and pesticides into transboundary rivers, for example, in watercourses such as the Chu and Talas and their tributaries. The relative importance of this phenomenon is not yet well known in many basins; however, the assessment of the transboundary aquifers already provides a lot of basic information.

The impact of animal husbandry (livestock breeding and grazing) on transboundary waters, particularly in the mountainous and foothill areas of the Caucasus and Central Asia, also remains little understood, although evidence of adverse effects on the many smaller rivers in these areas is growing.

Watercourses created by human activity (irrigation canals and drainage channels to collect return water from irrigation) are abundant. In the Aral Sea basin, their "management area" covers hundreds of thousands of square kilometres, and their length totals many thousands of kilometres. In Uzbekistan alone, the total length of main irrigation canals (about 450) and drainage canals (400) is 156,000 km, and their total management area amounts to about 1,100 km^2. Water delivery and use are being hampered by increasing vegetation growth in the canals, which lessens their carrying capacity; by algae blooms, which lead to deteriorating water quality and sanitary conditions; and by increasing pollution, sediment transport and sedimentation, which affect the operation of hydraulic structures.

Diffuse discharges from agriculture and the continued extensive agricultural use of water protection zones along rivers contribute to increasing chemical and bacterial pollution of water resources. Adverse effects of irrigation on aquatic- and water-related ecosystems include loss of biodiversity and extinction of whole ecosystems.

In Western and Central Europe, agriculture is also one of the most prominent pressure factors. In river basins, particularly in Central Europe, the relative importance of agriculture as pressure factors is increasing, given the decreasing amount of pollution from point source, most notably municipal and industrial wastewater treatment plants, due to investments in point source control. Agriculture in other river basins, particularly those in the basin of the Black Sea, the Mediterranean Sea and parts of the East Atlantic, is a pressure factor similar to that in countries in transition. The pressure greatly varies among basins due to countries' specific hydrometeorological conditions (e.g. need for irrigated agriculture), crop types and production patterns.

MINING AND QUARRYING

The mining of metal ores has a distinct impact on transboundary waters in the Caucasus, transboundary tributaries to the Danube and transboundary rivers discharging into the Mediterranean Sea. The impact of mining in Portuguese-Spanish river basins seems to be rather limited; however, abandoned mines remain as a significant pollution source.

The impact of mining on transboundary waters in Central Asia is less visible, mostly due to the relative importance of other pollution sources. In Central Asia, however, the pollution level will most likely increase given national plans to further develop mining and ore processing.

Mining activities, although decreasing, have also an impact in the sub-basins of the Rhine. Adverse effects, sometimes visible over a long distance, include hydraulic changes, thermal pollution, and pollution by chlorides and heavy metals. Mining of hard coal has significantly changed groundwater flow in parts of the Rhine basin, and opencast mining of brown coal requires lowering the groundwater level in parts of the Rhine, Elbe and Oder basins.

Pollutants from mining of metal ores that are of utmost concern include lead, copper, zinc, cadmium, uranium and, in some cases, mercury from gold mining. While pollution abatement technologies exist for these hazardous substances, their use in countries with economies in transition is limited to the minority of industrial plants that are economically viable.

The extraction of crude oil is another pressure factor. Surface run-off from oil production fields located in transboundary water basins is a general problem for many watercourses in the EECCA region; however, information about the relative importance of this type of pollution is still scarce.

MANUFACTURING

In many countries, manufacturing is one of the most prominent pollution sources, with a strong impact on the status of transboundary water resources.

Water-use efficiency in EECCA countries remains low compared to that in Western and Central Europe. Since the information on water use for various sectors of economy provided by countries was rather limited, water-use efficiency as a means of saving water and generating less pollution will be examined at a later stage.

The magnitude of water pollution problems in countries with economies in transition seems to originate from the abundant number of small and medium-sized industries, rather than the relatively low number of big undertakings, which were already capable of installing pollution abatement technologies and controlling pollution at the source. In addition, these big enterprises voluntarily carry out self-monitoring in an attempt to demonstrate their compliance with environmental standards.

Manufacture of refined petroleum products

A great number of transboundary watercourses in EECCA show increased levels of pollution by oil products, specifically discharges from oil refineries and surface run-off from refinery sites. Unless these countries comprehensively apply the measures set out in safety guidelines and other guidelines developed under the Water Convention and the 1992 Convention on the Transboundary Effects of Industrial Accidents (Industrial Accidents Convention), which in some cases require investments in the safety of industrial installations, a substantial reduction in oil pollution is unlikely. Countries with market economies did not report on this kind of pressure factor, as obviously high standards of pollution control at sources are complied with by the respective industry.

Manufacture of chemicals and chemical products; manufacture of basic metals and fabricated metal products

Accidental pollution from industrial installations and unauthorized discharges of hazardous substances (mostly at night and during holidays) remain major concerns in EECCA and SEE. Due to the high flow velocity of transboundary rivers and their tributaries in mountainous areas, a number of these events are beyond the detection capability of monitoring stations. The establishment of early warning and notification systems in transboundary mountainous and lowland rivers, which is currently being promoted by assistance projects, is a promising tool for the future. Future assessments are expected to shed more light on these industrial sectors/industries as a source of a great number of organic compounds with toxic effects as well as other hazardous substances.

As concerns manufacturing of chemicals and chemical products in Western and Central Europe, the assessments of the status of rivers in the basins of the Rhine and Elbe may serve as best examples. The Rhine basin, for example, is a basin with a high density of chemical and other industries, where more than 950 major industrial point pollution sources have been identified. These big and medium-sized enterprises operate their own treatment plants. However, in 2000, eight industrial enterprises were still responsible for a considerable share of the total emission of at least one of the following substances: Hg, Cr, Cu, Ni, Pb, N-total and P-total. The share of single enterprises varied between 1% (N-total) and 18% (Cr). In order to achieve the targets of the WFD related to the chemical status of surface waters, further measures have been identified as to nutrients, chromium, copper, zinc and PCB-153 as the relevant pollutants. Further "target" substances include nickel and its compounds, HCB and tributyl-tin.

Manufacture of paper and paper products

Obviously, the pulp and paper industry can become a significant pollution source in some transboundary waters, as has been reported by Finland, Lithuania, Romania and the Russian Federation. The following water-quality determinands are of concern: BOD_5, COD and some hazardous organic compounds, if bleaching processes are used.

Other manufacturing industries

A number of specific manufacturing industries, such as leather, sugar and fertilizers, are of concern, as they have a significant impact on the status of transboundary watercourses. Their relative importance will be assessed at a later stage.

HYDROPOWER GENERATION

The construction of dams and multipurpose reservoirs has many positive effects (hydropower generation, water supply, irrigation, low flows regulation, flood mitigation etc.), but also causes adverse effects. For example, the volume of biological active sediments may decrease, erosion and/or sedimentation processes in riverbeds may change, and migration of fish may become impossible.

Intense sedimentation, erosion of embankments and changes in the hydrological regime, resulting in a decrease in the self-purification capability of aquatic ecosystems, occur in lowland reservoirs. Eutrophication, a typical problem of reservoirs in lowlands, is intensified due to the shallowness and large water surface of many water bodies.

Although adverse effects of dams and reservoirs and their poor management on the downstream aquatic and terrestrial environment became obvious from the EECCA countries' assessment reports; hydromorphological alterations as a specific pressure factor have only been recognized and described by market economy countries (for basins shared by countries with market economies and some basins on borders between EU and non-EU countries). Therefore, future assessment reports will put more emphasis on this pressure factor, and examine its impact more comprehensively, including in countries in transition.

In EECCA countries, the poor management and operation of reservoirs, including those built on the interface between the high mountainous parts and lowland parts of rivers, causes a significant impact on the hydrological regime (e.g. river discharge, flooding, erosion) and water availability in the lowlands. The transboundary rivers in the Caucasus and, most notably, in Central Asia, are typical examples for this kind of pressure factor.

The conflict between consumptive and non-consumptive water use in transboundary basins in Central Asia for transboundary rivers regulated by reservoirs

Time period	Lowlands	Reservoir operation	High mountain areas
Summer	High water demand not satisfied due to small amount of water released from the reservoir	Low water release due to low energy demand and accumulation of high water discharge from upstream rivers	Large water discharges into reservoir due to melting of snow
Winter	Low water demand; flooding, bank erosion and other adverse effects may occur due to large releases of water from the reservoir	Large releases of water to satisfy high energy demand	Small water discharge into reservoir

SEWERAGE AND WASTE MANAGEMENT

Sewerage

As a rule, each person produces some 75 grams per day of BOD_5 and some 3 grams per day of phosphorus. Unless treated, sewage is an enormous pressure factor in each of the river basins.

Unfortunately, in many EECCA and SEE countries organic pollution is not being dealt with effectively because, over the last decade, the technical status of wastewater treatment plants has greatly deteriorated. Although wastewater treatment plants in big cities continue to operate (although with decreasing efficiency), most of the other treatment plants are out of order. For some cities, for instance in the Dnieper and Dniester basins, new treatment plants are under construction.

In Western and Central Europe, municipal wastewater treatment is usually not a pressure factor of particular concern, except in cases where the discharges from sewage treatment plants end up in relatively small tributaries. Municipal wastewater treatment in some new EU countries is sometimes below the required standards, but these countries

have still a transition period of some more years before the relevant Council Directives have to be fully implemented.

Some new substances, including pharmaceuticals, were also reported to interfere with treatment processes and require pollution control at source.

Breakdowns of municipal wastewater treatment systems have been repeatedly reported as the cause of significant discharges of polluted waters into the rivers; these breakdowns are also responsible for bacteriological pollution in some basins and sub-basins in Central and Eastern Europe.

Disposal activities

Tailing dams and waste storage ponds containing hazardous waste from mining and ore processing, as well as hazardous waste from metal processing and the chemical industry, are important pollution sources in some of the transboundary basins and more importantly in the sub-basins of their tributaries. For EECCA and SEE countries, there is a need for better guidance on the safe operation of these installations.[3]

Illegal waste disposal along rivers as well as old and often uncontrolled waste disposal sites are reported from a number of transboundary river basins in EECCA countries and some countries in the discharge basins of the Black Sea, the Mediterranean Sea and the Eastern Atlantic. If these dumpsites are not properly taken care of, they will generate increasing pollution.

Contaminated military sites are also a festering problem in some EECCA countries. Deposit of armaments and munitions inherited from the Soviet Union and waste disposal sites belonging to the military, including toxic and radioactive material threaten transboundary surface and ground waters. Their impact will be assessed at a later stage.

TRANSPORTATION AND STORAGE

Land transport

Water pollution from land transport was reported from the narrow river valleys in the Caucasus Mountains and the ranges of Central Asia as well as from some Portuguese-Spanish transboundary waters. The analysis of the Scheldt basin also revealed transport as a matter of concern, although the pressure on the aquatic environment (e.g. by polycyclic aromatic hydrocarbons) was difficult to estimate due to still lacking accurate data.

Water pollution from leaking cars and seepage from petrol filling stations is a general problem in EECCA countries, particularly in rural areas. Losses of crude oil and petroleum products during railway transport and leaking transloading facilities are also causes of increasing water pollution in these countries.

Transport via pipelines

As is the case with manufacturing of refined petroleum products, a number of transboundary watercourses in EECCA countries show increased levels of pollution by oil products due to leakages from pipelines crossing transboundary rivers or their basins.

Despite the many pipelines crossing transboundary watercourses in the entire region, only Portugal (Tagus River) has referred to the potential danger of pipeline accidents and consequences on the aquatic environment. One should recognize that some pipelines already have a high standard of operation and maintenance, as it is the case with the Marseille-Geneva pipeline, located in the Rhone basin (a multi-product pipeline along the Rhone River with a crossing of the Rhone downstream of Geneva, Switzerland). Many pipelines from oil fields in EECCA countries, for example, may not yet have such a high standard, and are potential pressure factors. UNECE therefore addressed these issues in the *2006 Safety Guidelines and Good Practices for Pipelines.*

TOUR OPERATOR ACTIVITIES

Along with the growth of urban populations and of tourism, the use of mountain areas and their watercourses for recreational purposes is increasing in the Caucasus and Central Asia. There is an urgent need to control the impact of recreation on mountain ecosystems, including rivers and lakes. It is also necessary to install hydrometeorological stations to warn tourists of extreme weather and high run-off. The intensive tourism in countries in South-Eastern Europe, particularly around Lake Ohrid and Lake Prespa, is another example of this kind of pressure factor.

[3] Such guidance is currently being developed by UNECE under the Water Convention and the UNECE Convention on the Transboundary Effects of Industrial Accidents.

STATUS AND IMPACT

The basins of transboundary rivers and lakes are widely heterogeneous from the social, economic and environmental points of view and display specific problems related to both water quantity and water quality. Nevertheless, some issues are common to most of the basins.

In many basins/sub-basins, the ecological and chemical status of transboundary rivers and lakes is under threat from a range of human activities leading to organic pollution (mostly from sewage), nutrient pollution (mostly from agriculture and sewage), pollution by hazardous substances (mostly from manufacturing and mining), and – in the case of rivers – hydromorphological alterations, mostly due to water construction works for hydropower production and navigation.

Although the relative importance of chemical and microbiological pollution varies greatly within the region, the contamination of drinking-water supplies is significant in EECCA and SEE, and water-related diseases such as cholera, dysentery, coliform infections, viral hepatitis A and typhoid are often reported.

The assessment showed that almost 20 per cent of transboundary rivers in Caucasus and Central Asia are in a “high or good chemical status”; this also applies to some transboundary tributaries to first-order rivers in Eastern Europe and SEE. Some of these water bodies, however, show signs of increasing pollution due to the ongoing revival of industry and agricultural production or are potentially threatened by mining and ore processing. The majority of the transboundary rivers included in the assessment fall into the category of “water bodies with moderate pollution”. “Polluted water bodies” in EECCA and SEE basins are transboundary rivers which: (a) take up their pollution load in lowland

areas due to intensive agriculture; (b) are in the vicinity of big cities and industrial centres; (c) have small water discharges; and (d) which take up their pollution load in foothills with intensive industrial (including mining) or agricultural water use. Cadmium, lead, mercury, phenols and oil products, as well as pesticides, are among the most serious pollutants.

Similarly, a number of transboundary rivers in Western Europe as well as Central Europe are in high and good status. Most rivers still belong to the category of "moderately polluted" water bodies or have a "fair water quality". There are also transboundary rivers or stretches of these rivers, for example in the Danube basin, that have been assessed as "polluted". Cadmium, lead, mercury, nickel and its compounds, tributyl-tin, hexachlorobenzene (HCB), dichloro-diphenyl-trichloroethane (DDT), lindane and atrazine are among the most serious pollutants.

Eutrophication is the worst phenomenon affecting transboundary lakes. It is increasing constantly except in areas where wastewater treatment has been effectively implemented and where small improvements are visible. In nearly all areas, increasing non-point loading from agricultural and forestry areas has spurred incipient eutrophication even in some lakes, which were earlier in good condition. High nitrate-nitrogen concentrations, particularly from fertilizers, are also a problem in groundwater (see separate groundwater assessment in Part 3). Insufficiently treated wastewaters from municipal treatment plants and return waters from irrigated agriculture also cause eutrophication in rivers (phosphorus compounds) and the sea (nitrogen compounds, sometimes phosphorus).

Geochemical processes have been repeatedly seen as an issue of concern in some river basins in the entire region due to high natural background concentration of heavy metals (mountain areas) or high turbidity (areas with peat extraction). Geochemical processes also cause high arsenic concentrations in some aquifers in SEE countries.

Deforestation, soil erosion and degradation of pastures (particularly in EECCA) are additional issues of concern. They will continue to be a problem for the proper functioning of water-related ecosystems and lead to higher risks of natural disasters as the implementation of response measures (e.g. afforestation) will take some time.

The effects of climate change are becoming visible in almost all of the analysed river basins. Most basins experience an impact of climate change on water quantity (e.g. decreasing water resources availability and extreme hydrological events, including severe floods and long-lasting droughts). With a reduction in precipitation of up to 30% over the last decade, water resources availability, for example, is decreasing in river basins in the discharge area of Mediterranean Sea. The effects of climate change on the ecological regime of rivers are also becoming visible in transboundary basins in Central Asia, where the rise in air temperatures leads to significant melting of glaciers, resulting in noteworthy changes of the rivers' hydrological and ecological regimes. Thus, climate change adaptation measures in water management and water-depended activities and services (e.g. agriculture, forestry, water supply, hydropower generation) are needed in the entire UNECE region.

Damage by floods became a costly water-quantity problem in the entire region. Too many countries still base flood prevention and mitigation solely on structural measures, such as the construction of dams and dykes and improved operations of dams and reservoirs. Holistic approaches to the prevention and mitigation of floods, applied particularly in basins in Central Europe, should be implemented more widely. These holistic approaches combine non-structural measures (e.g. giving more space to the river) with structural measures. There are also basins that suffer from the consequence of "man-made" floods, an example being basins in Central Asia where high water releases from reservoirs in wintertime for hydropower generation lead to downstream flooding.

Water sharing among countries in the same basins to satisfy demands of national economic activities (irrigation, manufacturing, energy production), continues to cause upstream-downstream conflicts, including adverse effects on the environment (e.g. the destruction of water-related ecosystems). Most affected are the basins in Central Asia (e.g. Amu Darya, Syr Darya, Ili) and the Samur basin.

RESPONSES

PRESSURE-RELATED RESPONSES

The assessment points to four challenge areas of further action to decrease pressures on transboundary waters: organic pollution, nutrient pollution, pollution by hazardous substances, and – in the case of rivers – hydromorphological alterations.

The relative importance of pollution and pressures due to hydromorphological alterations varies from basin to basin. This relative importance notably depends on past achievements in environmental protection and is strongly related to the effectiveness of implementing existing legislation and other measures related to integrated water resources management.

In many basins, tailor-made investments in the water sector are still needed, such as investments in municipal wastewater treatment plants and wastewater treatment in rural areas; these are often postponed in EECCA due to lack of financing or the preference given to investments in other sectors.

There is a remarkable difference in action undertaken/action needed to be undertaken to improve the status of transboundary waters in EECCA and SEE as compared to basins in Western and Central Europe.

A general comparison of the scale and severity of water management problems between various basins in the region is given in the table below, which shows that:

- Action to decrease water pollution from point sources (e.g. municipal sewage treatment, old industrial installations) is of primary importance in basins in EECCA and SEE;
- The fight against pollution from diffuse sources (e.g. agriculture, urban areas) is of much importance for action in basins in Western and Central Europe (the European Union (EU) countries, Switzerland and Norway).

The reason for such a clear distinction in further action needed is quite obvious:

- Over a period of some 15 years, countries in transition have suffered a decline in their economies, which came hand in hand with a breakdown of essential systems of water supply and wastewater treatment. These countries can substantially improve the status of their transboundary waters, if point pressures from municipal sewage treatment plants and discharges from old industrial installations were dealt with as priority tasks. This requires proper allocation of funds.

- In many countries with market economies, huge investments in point-source pollution control measures were made over two and more decades. This led to a substantial decrease of the pollution load from these sources hand in hand with an increase of the relative importance of the pollution load from non-point sources. Dealing with diffuse pressures (e.g. agriculture, urban land use) is therefore seen a priority task.

Diffuse pressures from agriculture

In Western and Central Europe, the legal framework to cut down pollution has been established many years ago (e.g. EU Directives; national legislation in the EU countries, Norway and Switzerland) and technical guidance to control water pollution by fertilizers and pesticides in agriculture is broadly available. However, given reports by EU countries located in the drainage basins of the Mediterranean Sea, the East Atlantic Ocean, the Baltic Sea and the Black Sea, the impact of agriculture on the quality of water resources is most striking, also because the implementation of these pieces of legislation and recommendations seems to take more time than expected. Experience has also shown that command-and-control approaches need to be supplemented by voluntary measures and innovative financing schemes.

Although currently classified as "widespread but moderate", diffuse pressures from agriculture in EECCA and SEE basins will increase in the future alongside the revival of economy; thus, the use of fertilizers and pesticides will be much higher than in the last decade, causing negative effects on transboundary waters. Apart from legal and regulatory measures, it is important to focus on educa-

RELATIVE IMPORTANCE OF PRESSURES IN TRANSBOUNDARY RIVER BASINS

Scale and severity of problem *	Basins in EECCA and SEE	Basins in Western and Central Europe
Widespread and severe	**Point pressures:** municipal sewage treatment, old industrial installations, illegal wastewater discharges, illegal disposal of household and industrial wastes in river basins, tailing dams and dangerous landfills	**Diffuse pressures:** agriculture, urban land use
	Abstraction pressures: agricultural water use / water sharing between countries	**Abstraction pressures:** agricultural water use (Southern Europe)
	Morphological pressures: hydroelectric dams, irrigation channels	**Morphological pressures:** hydroelectric dams, river alterations
Widespread but moderate	**Diffuse pressures:** agriculture (except in some basins in Central Asia, where the impact is severe)	**Other (point) pressures:** industries discharging hazardous substances
Limited but severe	**Other (diffuse, point) pressures:** non-sewered population, mining and quarrying	**Other (point) pressures:** mining and quarrying
Limited and moderate	**Other (point) pressures**: new industrial installations	**Other (diffuse, point) pressures:** non-sewered population, municipal sewage treatment

* In this generalization of river basins in the region; "widespread" means that the problem appears in many river basins, whereas "limited" indicates that only some basins are affected.

tion, training and advice to promote understanding of good agricultural practice and respect for existing legislation by various economic entities.

Abstraction pressures

Abstraction pressures within the national parts of the basins (in particular, water use by irrigated agriculture in EECCA, SEE and South-Western Europe) are among the most important water-quantity issues. In some basins, particularly in Central Asia, the predominant water use for agriculture has also led to such water-quality problems as salinization of soils and high mineral salt contents in water bodies.

In a transboundary context, there are at least four areas of existing or potential conflicts over water. One area is the conflict between hydropower production and irrigational agriculture, which is particularly obvious in the basins of the Amu Darya and Syr Darya. Another area is the conflict between hydropower production and navigation, which became obvious in rivers shared by Kazakhstan and the Russian Federation, where new (private) operators are now managing reservoirs formerly managed under government responsibility. There is another conflict potential, namely the conflict between water use for economic activities and water for the maintenance of aquatic ecosystem. This conflict is particularly pronounced in the basin of the Ili River, shared by China and Kazakhstan. Also in other basins in EECCA and SEE, ecological requirements of the water bodies are rarely considered and win-win solutions to mitigate existing – and avoid future – conflicts over water resources are not yet drawn up. In many basins in the EECCA region, water allocation among riparian countries continues to be an issue, because disagreement still exists over use quotas for the upstream and downstream users belonging to different States, as it is the case for some rivers in the discharge area of the Caspian Sea.

Hydromorphological pressures

One often overlooked problem in basins in EECCA and SEE (with the exception of reports from Central Asian countries and the Russian Federation) is linked to pressure arising from hydroelectric dams, river alterations, irrigation channels and other hydromorphological changes in river basins. The assessment of water resources in such river basins as the Danube, Elbe, Rhine, Meuse and Scheldt has clearly pointed to the severity of these pressures and has stimulated action to counteract them.

Other pressures

Other pressures in EECCA basins mostly refer to big industrial enterprises which recently became operational; these seem to cause fewer problems, as they were equipped with adequate wastewater treatment technologies. However, given economic development, it should be expected that, the relative importance of this type of pressure will increase in the future.

As concerns other pressures in basins in Western and Central Europe, a particular challenge area still to be addressed by proper response measures is the control and reduction of pollution by new substances produced by the chemical industry, including new pharmaceuticals that cannot be eliminated in wastewater treatment processes, as well as the control of pollution by priority substances given provisions of the Water Framework Directive and other applicable directives. In some other basins shared by countries with market economies, untreated or insufficiently treated industrial wastewater is still of concern and breakdowns of municipal wastewater treatment systems are the reason for significant discharges of polluted waters into rivers. The legal framework exists with the relevant directives, and compliance with these directives is needed to achieve a good status of water bodies. In some new EU countries, inappropriate wastewater treatment is still a problem, and the national sewerage and wastewater treatment plans are targeted to fulfil the requirements of the relevant directives by 2010 and 2015, respectively.

Other point pressures also refer to mining. In some basins, the mining industry (e.g. copper, zinc, lead, uranium mining) is one of the most significant (past or new) pollution sources, and a number of storage facilities (including tailing dams for mining and industrial wastes) exert significant (or at least potentially significant) pressures. In parts of the region, mining of hard coal has also significantly changed the groundwater flow. Opencast mining of brown coal, particularly in parts of Central Europe, is also lowering the groundwater level. Thus appropriate measures need to be implemented in many cases to control the adverse impact on water quality and quantity. After the termination of mining activities, rehabilitation measures need to be implemented to avoid further adverse impacts on aquatic and terrestrial ecosystems and/or to restore damaged landscapes and ecosystems, as is done in basins such as the Elbe, Oder and Rhine.

GOOD GOVERNANCE

Although the policy, legislative, institutional and managerial framework for transboundary cooperation has been developed over the last decade, the assessment revealed a number of deficiencies that call for further action.

Transboundary level

Bilateral and multilateral agreements are the basis for determined and reliable cooperation. Some river basins are still not covered by agreements and some of the existing agreements need to be revised particularly with regard to such issues as joint monitoring (see below), warning for hydrological extreme events and industrial accidents, sustainable flood management, and sharing/allocation of water resources. Major gaps also relate to the incorporation of groundwater management issues, which should be overcome most urgently.

Joint bodies are a prerequisite for effective cooperation and the joint monitoring and management of transboundary waters as is demonstrated by the well functioning joint bodies for the rivers Elbe, Danube, Meuse, Moselle/Saar, Rhine, Oder, Scheldt and Sava as well as the Finnish-Russian waters and the Kazakh-Russian waters. For such other basins as the Chu and Talas and Albanian-Greek waters, joint bodies have also been set up but are still in their infancy.

Most other basins lack dedicated joint management; lack of political will for joint action and cumbersome national procedures (coordination between national authorities/sectors) often hamper negotiations over joint measures and delay agreements on the mandates and tasks of joint bodies.

In these cases, riparian countries may decide to establish, as a first step, specific joint working groups. In these groups, experts from different disciplines should meet regularly to agree upon joint measures on integrated water resources management, including the implementation of monitoring and assessment activities, as well as the related technical, financial and organizational aspects. This has led to positive results, even in the Amur River basin (China and the Russian Federation) and the Tumen River basin (China, Democratic People's Republic of Korea, and the Russian Federation), which in the past have had a high water-related conflict potential among the riparian countries.

As a second step, joint bodies, such as river commissions or other arrangements for cooperation should be foreseen, and particular efforts should be made to build and strengthen the capacity of these joint bodies. The setting up of permanent secretariats for joint bodies can be an asset.

In a number of basins shared by EU countries with non-EU countries, there is still a conflict in applicable legislation leading to different requirements in such fields as monitoring and classification of water bodies and performance parameters of treatment technology. With the reform of the Water Law in countries bordering the EU, an approximation to EU legislation may be accomplished soon, allowing upstream and downstream countries to rely on almost the same standards.

Other EECCA countries face additional challenges. Pollution control legislation based on very similar "maximum allowable concentration levels" allows straightforward comparisons between water quality in upstream and downstream countries, but the legislation seems to be unrealistic to be complied by wastewater treatment technology. Rather than amending legislation in the short term, a straightforward way may consist in a step-wise approach, i.e. setting "realistic" target values for water quality that can be achieved over the medium term, and making these target values intermediate goals in the joint river basin management plans.

National policies and legislation

National policies and legislation should be further developed to regulate economic activities so that they do not adversely affect water and water-related ecosystems. A particular issue is agriculture, where perverse incentives that subsidize the overuse of natural resources and the decline of ecosystem health should be removed.

Legislation should be drawn up and applied to reduce fragmentation between, and improve coordination among, government departments and institutions. This requires a clear definition of the responsibilities and duties of ministries for the environment, agriculture and forestry, transport, energy, economy and finance. Legislation should also provide for coordination with stakeholders, e.g. farmers' associations and water users' groups.

Monitoring, data management and early warning

Further issues for cooperation include joint monitoring and data management. Data upstream and downstream of the borders between countries are often not comparable due to uncoordinated sampling, measurement and analytical (laboratory) methods in riparian countries. Joint programmes on monitoring, data management and assessment are therefore the key to integrated water resources management. This also applies to transboundary groundwaters as the current low level of transboundary cooperation and deficient technical guidance hamper systematic monitoring and assessment of their status.

There is a need to secure national funding, as for many basins in EECCA, the availability of data too often depends on the lifetime of international assistance projects.

Early warning (quality and quantity) is another issue of concern. Although industrial accidents and severe floods were often an important catalyst for joint measures in transboundary basins, joint action should be taken on time to prevent disasters or reduce their consequences. In many basins, this requires the establishment of early warning systems for floods, droughts and accidental pollution.

River basin management plans

Plans for integrated water resources management in a transboundary context still need to be developed for almost all basins in the region and the countries' analysis has pointed to the essential elements to be included in these plans, river-basin-by-river-basin. Proper attention should be devoted to land-use planning and management given the potential positive and adverse effects of land use on the hydrological and chemical regimes of transboundary waters. Management plans should cover both surface water and groundwater bodies, although

the responsibility for protection and management may rest with different governmental authorities.

For river basin management plans, the identification and development of adaptive strategies towards effects of climate change on water management, including floods and droughts, on different levels of time and scale, and the identification of information needs in support of these strategies is also important. Such adaptive strategies should include the safe operation of water supply and sanitation facilities in urban and rural areas.

Platform for multi-stakeholder dialogues

There is a need for establishing a platform for a national interdepartmental and multi-stakeholder (e.g. Governments, NGOs, the private sector, water users' associations) dialogue on integrated water resources management. Early experience from the National Policy Dialogue under the EU Water Initiative that started under the Water Convention's overall guidance in Armenia and Moldova may serve as guidance for similar dialogues in other countries.