APPROACHES ON WATER QUALITY AND MANAGEMENT IN ROMANIA

Monica Popa[1], Dana Sirbu[1], Daniela Curseu[1], Marcel Sabin Popa[2] and Zaharie Moldovan[3]

[1]University of Medicine and Pharmacy, Dep. of Environmental Health, Cluj-Napoca, Romania
[2]Technical University Cluj-Napoca, Romania
[3]National Institute of Research and Development for Isotopic and Molecular Technologies, Cluj-Napoca, Romania

ABSTRACT

The paper presents the Romania's progress and plans to access European Union in the field of water resources. The current approach to water basin management and the challenges for Romania in complying the European Union model are presented. An overview of the concept of integrated management system envisioned for Romania is described, focusing the planned work to develop the decision support system tools for integrated water management.

Keywords: groundwater, rivers, water management, water pollution

INTRODUCTION

European Union accession is an important goal of the Government of Romania which anticipates being invited to join EU in 2007. As part of the accession process the national legislation must be harmonized to EU laws and directives, including those related to water. The development of the capacity for integrated water resources management is viewed by Romania as an important step in managing water resources more effectively. Historically, Romania has experienced significant economic losses from floods, accidental spills and droughts – costs that could be substantially reduced through improved capacity in monitoring, use of effective decision support system tools in managing water allocation and quality and implementation of a comprehensive communication network to ensure timely response by water users and the public to forecasts and warnings.

THE NATIONAL HYDROLOGICAL RESOURCES AND WATER POLLUTION ASPECTS

The direct discharge of wastes into natural watercourses is the main cause of their deterioration. It was estimated that streams in Romania receive nearly 6 875 million tonnes of pollutants per year, out of which chlorides, suspended substances, organic substances, ammonia, nitrates, phenols, sulphured hydrogen, phosphorus, cyanides, detergents, and pesticides are the most prevailing (National Commission of Statistics, 2004).

The deterioration of natural water quality has also caused great difficulties in the water supply, and an increasing cost of water to industry. Water use in Romania is estimated at about 36 billion m^3/year - about 27 percent of total water available (National Commission of Statistics, 2004). Of the water used, inner rivers and lakes provide 13 billion m^3/year (36 percent); the Danube River, 20 billion m^3/year (56 percent); and groundwater, three billion m^3/year (8 percent). The per capita water demand is relatively low, being about 890 m^3/capita/year (1990), while for the USA it is 2 650 m^3/capita/year (Yassi, 2003). In the short term, water use is expected to decline with the major reduction in industry and energy. With the recovery of the country's economy, water demand is expected to increase again. With the introduction of incentives for more efficient water use -economic pricing of water for industrial, agricultural and municipal consumption - there is great potential for reducing unit water consumption in the future.

Romania has developed ambient water quality standards and these are generally satisfactory. These standards have been used more to classify the rivers according to their present state rather than for desirable present or future state. At the national level, the global quality of the river water in Romania presents a high degree of territorial non-uniformity both from basin to basin and within basins, from one area to another (Table 1).

There are four main categories for water quality:

1. category I (clean drinking water);
2. category II (less clean water used for fisheries, town planning, recreation);
3. category III (water used for irrigation, power plants, industrial purposes);
4. category D (polluted).

Taking into account the national hydrological network of 70 000 km, the water qualitative level is established on river sectors representing a total length of 20 500 km (Table 2).

Table 1. Selected Romanian river water quality standards (mg/l)

River category	TDS	Cl	COD-Mn	NH4	Phenol	Cn	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
I	750	250	10	1	0.001	0.01	0.003	0.05	0.05	0	0.1	0.1	0.05	0.03
II	1000	300	15	3	0.02	0.01	0.003	0.05	0.05	1	0.3	0.1	0.05	0.03
III	1200	300	25	10	0.05	0.01	0.003	0.05	0.05	1	0.8	0.1	0.05	0.03

Romania has experienced chronic problems with flooding for centuries. The mountainous terrain, steep narrow valleys and frequency of torrential and sustained rains have combined to produce catastrophic floods in Romania. The National Water Authority has estimated that 500,000 people and 1.3 million hectares of land are at risk of floods every year in Romania (***H.G.188/22.02.2002).

Romanian rivers are being polluted by wastewater discharge estimated at about 10 billion m^3/year. Out of this quantity, only 10 percent is adequately treated, 60 percent is partially treated, and 30 percent is discharged without treatment. The major pollution sources are industrial waste, agricultural run-off, animal waste and municipal waste. Of these, industrial waste is the most hazardous to health. Extreme water pollution is generally a local phenomenon concentrated in river lengths downstream from industries and larger municipalities.

Table 2. Evolution of the surface water quality (% of the reference length)

Year	Quality category			
	I	II	III	D
1989	35.00	22.00	18.00	22.00
1993	42.00	24.10	12.30	21.60
1996	54.00	20.00	11.00	15.00
2000	53.80	26.40	7.60	12.20
2004	53.50	30.13	5.64	10.73

A recent analysis by the Romanian National Water Authority indicates that about 600 accidental pollution releases have been recorded in Romania during 1992 – 2000. However, the cyanide spill in January 2000 has probably served as the primary catalyst for improvements in accidental spill detection and warning capabilities in Romania.

On January 30, 200, over 100,000 cubic meters of wastewater contaminated with cyanide and heavy metals were accidentally spilled from a tailings holding pond swollen with water from heavy rains and melting snow in the northern Romania city of Baia-Mare. The holding pond was designed to store cyanide-laden wastewater to be recycled and re-used in the gold extraction process. When the earthen dam was breached, the wastewaters traveled through ditches to the Lapus River, a tributary of the Somes River, into the Somes River, then across the Hungarian border into Tisa River. Ultimately, cyanide was detected in the Danube Delta several weeks after the spill occurred.

Pollution from agricultural sources affects both surface water and groundwater. It is mainly due to nitrates, phosphorous, pesticides, and run-off of silage effluent and slurry. The hydrographic basins are polluted annually by about 6.5 million tonnes of pollutants, including chloride, organic substances, ammonium, suspension particles, phenols, phosphor, cyanide, detergent, and pesticides.

The main sources of nitrates and phosphorous are mineral fertilizers and effluent of livestock, in particular animal manure. Nitrates and phosphorous can lead to the eutrophication of fresh and coastal water and the contamination of groundwater, threatening the quality of drinking water. Animal farms are an important pollution source to water. For instance, for an animal to gain one kilogram in weigh, it produces between six and 25 kilograms of residues (Manescu, 1996). Their removal and the cleaning up of the cowsheds uses huge quantities of water that have to be decontaminated. About 70 million m^3 of water per year (1994) is used this way in the livestock industry (the pig industry is the greatest polluter). These residues affect mainly the Somes, Mures, Bega-Timis, Vedea, Arges, Ialomita, Siret, and Prut rivers.

Pesticide residues in the different water bodies may often affect biodiversity especially in the case of aquatic ecosystems, but also in the case of terrestrial ecosystems linked to water. This is also a potential threat to water quality, which leads to increased costs for drinking water distribution.

Agricultural activities also have significant effects on the quantity of water, especially where irrigation is required. In particular, excessive abstraction can lower the water table and increase the desertification and salinization by the intrusion of seawater. The water within certain irrigation systems on a surface of about 200 000 hectares does not meet quality conditions, thus leading to land degradation and to crop reduction on these surfaces. Lakes are classified mostly in the first two quality categories. Nevertheless, some Delta lakes present a high degree of pollution (e.g. Matita, Puiu, Rosu). Lakes like Techirghiol, Balta Alba, and Amara are also polluted through bad quality water from irrigation systems.

The environmental quality of the Danube River Basin is under great pressure from a diverse range of human activities. Urban populations are generating pollution from largely inadequate waste treatment and solid waste disposal facilities (***Ordin nr. 645/I.O. / 30.10.1997). The modernization and intensification of agricultural practices and livestock production are the major sources of non-point source pollution of surface and ground water in the Danube River Basin. The Danube currently delivers 60 000 tones of phosphorus per year and about 340 000 tones of inorganic nitrogen per year to the Black Sea. Additionally, coastal settlements discharge their sewage directly into the sea, a situation even further exacerbated by the discharge of industrial wastes (e.g. the phosphate effluent from a single fertilizer factory in Romania is estimated to be equivalent to 13.4 percent of the load from the Danube).

Most of the inhabitants in rural areas (about 46.8 percent of the population) depend on groundwater for their drinking water source. In some areas, groundwater is heavily polluted with nitrates, pesticides, heavy metals and other toxic substances. Recently, it was conducted a nation-wide survey of the nitrate pollution of shallow wells. Out of a total of 12 554 wells surveyed, 4 558 wells (36 percent) showed nitrate concentrations exceeding the minimum acceptable standard of 45 mg/liter. The total number of people relying on these polluted wells for their water supply was estimated at about four million. Extreme nitrate concentrations reaching 1 500 mg/liter were detected from a sample in Cernica, the rural vicinity around Bucharest. Although the exact cause of this pollution remains to be confirmed through further investigation, it appears that the main sources of nitrate pollution are agricultural run-off and livestock waste. At present, the ground water network has shown a lower content of pollutants than in previous years (Popa, 2005).

Non-point source pollution due to fertilizers, pesticides and herbicides on agricultural land has decreased during the last four years. At the hydrographic basin level, the average concentration of these substances in water was below the maximum allowable limit in the mentioned period.

THE NATIONAL STRATEGY FOR WATER MANAGEMENT

The Ministry of Environment has a nation-wide monitoring system comprised of:

- a) 275 slow (monthly) and 65 fast (daily) monitoring stations for surface water;
- b) 55 seasonal monitoring stations for lakes;
- c) 280 seasonal monitoring stations for groundwater.

To some extent, the Ministry of Environment also monitors industrial discharges but, with inadequate supporting legislation, low fines and a shortage of equipment and staff, enforcement is limited. Although there are more than 2000 stations for cleaning bad quality water, almost half do not function properly (Popa, 2005). At present, water pollution phenomena have been confirmed, and this has implied the need for careful monitoring and a proper legislative framework.

ROMANIAN INTEGRATED WATER MANAGEMENT SYSTEM

The Ministry of Water and Environmental Protection has elaborated a national strategy for water resource related disaster mitigation and management and action plan (Figure 1). The architecture includes the coordination of emergency warning and the actions of the rapid response center of each basin. The decisional support system must be able to solve different levels of conflicting water management criteria and seek management or development that is economically attractive, ecologically sound, socially acceptable and technically feasible.

The main objective of an effective integrated water management at the basin level is to satisfy the demand of all stakeholders, given the possibilities and limitations of water supply. The balance between supply and demand should be implemented through appropriate institutions and policies taking into consideration both water quality and quantity, as well as the social and economic development in the basin and protection of the environment.

To support the decisional support system, a package of forecasting models for the water resources system has to be added, as well as a monitoring and control system and of hydro-technical systems (Figure 2). The integration of the hydrological informational system together with data from different hydro-technical systems will feed procedures (simulation, optimization, expert system etc). The main task is to design the architecture of the decisional support system and the linkage with other systems, taking into account that it will benefit from the meteorological forecast models, hydrological forecast models, pollutant dispersion models and optimum water supply models.

The decisional support system includes:

- International survey for integrated water management, describing individual models and their respective applications, data requirements (including topographical and cadastral information);
- Current application in Romania describing the current computer-assisted applications of the system for water management including data requirements, software tools and outputs and indicate whether the models are used to support real time decision making or to support research and analytical studies on water management issues;
- Elaboration of decisional support system for integrated water management in Romania developing and adapting international models to Romanian water management problems.

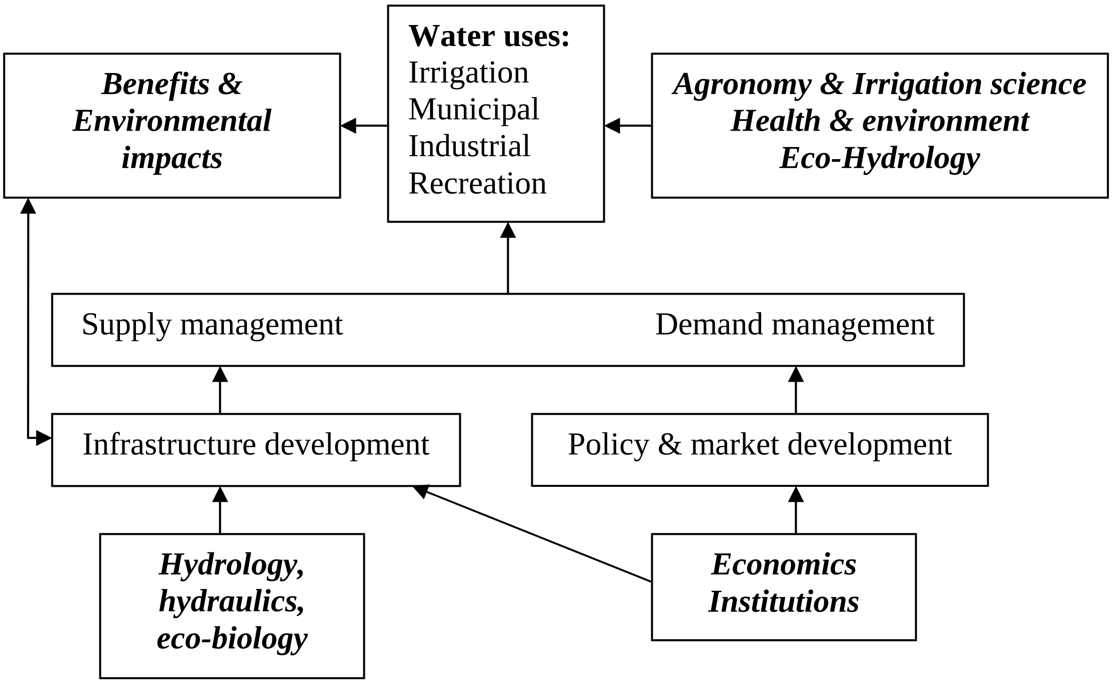

Figure 1. Water resources management system

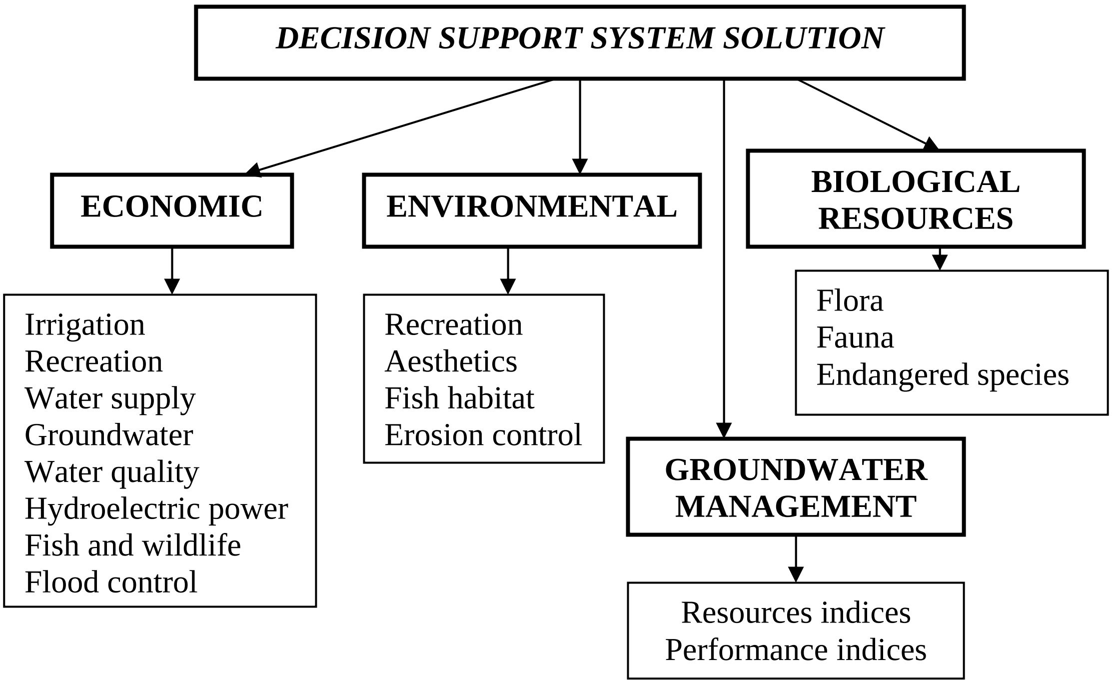

Figure 2. Composite decision tree

CONCLUSIONS

In Romania, the concern with water resources, increasing environmental awareness and a series of natural resources “crises” as the drought of summer 2003 and the floods of spring 2005 have coalesced to reinforce a trend toward comprehensive management and interdisciplinarity planning. The overall thrust of such efforts in water planning and management underscore among many others goals:

- The internalization of a wide range of costs and benefits of water management decisions;
- Increased emphasis on anticipatory planning and an enlargement time horizon;
- Commitment to participatory planning through the empowerment of many additional parties-at-interest;
- Contingency planning and richer menu of planning and management options;
- Use of risk assessment in order to define the range of acceptable and assumable risk in decision making;
- A discernable trend toward comprehensive or unified management along with special efforts to involve all levels of government and to attain support of the individual citizens;
- Integrated ground- and surface water management and the use of each basin as a management area;
- Preference for non-structural solutions and for conservation measures that recognize that neither availability nor requirements should be treated as unalterable;
- The emerging coordination of water with other natural resources, especially land-use control and planning.

The end result of resolving such tasks will be a contingency preparedness for change, the ability to cope pragmatically with the challenges of transboundary interdependencies, the appreciation of long-term planning and the capacity to manage peacefully and in a pro-active manner, long standing conflicts about shared water resources between different users, communities and states.

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