

URBAN WATER RESOURCES MANAGEMENT IN ROMANIA - PERSPECTIVES FOR THE SUSTAINABLE DEVELOPMENT IN ORDER TO SUPPLY WATER TO HUMAN SETTLEMENTS

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Abstract. Romania is the beneficiary of an important complex of water resources. As various forms of water pollution can be found, some sources of water become unusable, so that the demand/supply ratio acquires a more complex significance. Generally, fertilizer, livestock industry waste, household effluent can be regarded as the sources of water pollution due to nitrates etc. The Environment Authority has established provisional guidelines concerning the controls on discharge of substances. The principles for the sustainable management of water resources, recommended by Rio Conference (1992), and the European Union regulations, lay at the foundation of the concept of integrated water management in Romania as well, where the problems of water usage are combined with the protection and conservation of natural ecosystems.

Keywords: romanian water resources, pollution, causes, quality standards, measures, sewerage systems, monitoring, conservation, management, sustainable development

1. Current Situation of Water Pollution in Romania

In Romania, measurements of water quality in nationwide public water areas were conducted from 1993 according to the new environmental quality standards of which the restrictions on substances that are harmful to human health, such as cadmium etc., have been revised. According to the results of the measurements, there were 33 measurement points which recorded a level of pollution

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exceeding the environmental standard, out of 5,708 measurement points nationwide, indicating that the points at which the standard was not achieved was 0.58% of the total number of measurement points.

As for conformity to the environmental standards concerning human health, because of the revision made to the standards, it is difficult to evaluate the status of conformity to the standards over the years. However, if calculated based on the conventional method to figure out the ratio of non-conformity (the ratio of the number of samples of which the level of pollution exceeded the standard, against the total number of samples examined), the ratio of non-conformity to the old environmental standard was 0.01%, which has improved steadily since 1989.

In the monitored areas where classifications of the environmental standards are applied concerning items pertaining to preservation of the living environment, the environmental standards per BOD (or COD), a typical water quality index used to measure organic pollution level, were achieved in 76.5% of all water areas; while 23.5% of total water areas have not yet met the standard. The breakdown of areas achieving the standard by water area is rivers 77.3%, lakes and reservoirs 46.1%, and sea area 79.5%. The achievement ratio is especially low in closed water areas such as lakes and reservoirs, and medium and small rivers in urban areas.

As regards other forms of water pollution, contamination of groundwater by substances such as: trichloroethylene etc.; contamination by organic tin compounds in vast areas; the pollution of public waters by the outflow of hazardous substances due to accidental long-term turbid water due to dam construction (applicable to limited areas); acidification, caused by natural factors, of rivers, lakes and reservoirs; impact on the environment by thermal drainage from large power stations pose problems (Compania Nationala Apele Romane, 2006).

2. Main Causes of Water Pollution in Romania

Tightened restrictions have proven effective to control pollution caused by effluent from factories and workshops. On the other hand, effluent associated with daily living such as cooking, laundry, bathing etc., has not been controlled satisfactorily due to inadequate sewage systems, and so on.

The cause of pollution in closed water areas such as lakes and reservoirs etc., is that due to physical features unique to closed water bodies, water often stagnates causing a favourable condition for contaminants to accumulate. The other cause of pollution in these areas is the socioeconomic factor. Population and industries are concentrated in water front areas.

In rivers in urban areas where population and industries concentrate along them, and in lakes and reservoirs of which the surrounding areas are increasingly

urbanized, such as Tulcea or Braila, sewage systems can not catch up with the increase in population, and the pollution is encouraged by drain water, especially by household effluent (Galatchi, Vladimir, 2007).

As described above, recent water pollution is mainly caused by organic pollutants, and countermeasures against effluent from daily living are especially needed immediately. Besides this, water pollution is caused by unspecified sources i.e. contaminant effusing from urban areas, land creation sites, farming lands, often washed out by rain etc. Other causes include nutrient salts eluting from the bottom sediment consisting of deposits which are the result of long-term water pollution. Conditions of these factors should be studied and appropriate measures must be taken.

3. Threats Caused by Water Pollution

Approximately 70% of the sources of city water in Romania are from surface flowing water such as rivers, and can be affected significantly by water pollution. Underground water that accounts for approximately 30% of the total sources of city water was considered to be of good quality, until pollution caused by substances such as trichloroethylene etc. became actualized. There is a number of city water systems affected by water pollution in their sources.

Recently, the excess increase of algae due to eutrophication in reservoirs sometimes causes foul smell or taste in city water. In 2002, 28 city water systems were affected by foul smell and taste, disturbing approximately 3 million people (Negulescu, 2004).

To control water pollution occurring in the sources of city water systems, system operators are taking measures such as introduction of high-grade water purifying facilities. However, a contaminated water source is an enormous burden to the system operators from the stand-point of safety of city water, and can raise the cost of water treatment operations.

City water must be maintained at a safe and reliable quality for its users at all times, and the sources of water systems are desired to be maintained as pure as possible. Therefore, preservation of the quality of city water is becoming increasingly important.

Approximately 70% of the fresh water supply of industrial water in Romania depends on river water (approximately half of it is used for industrial tap water) such as surface water and infiltration water. Industrial water is used for many purposes such as for raw material, processing and washing of products etc., and is sometimes affected by contamination of river water.

Industrial water is generally treated by chemical sedimentation. Sometimes the disposition of sludge made from the contaminant of river water created through this treatment process raises a problem.

With the advance of recent urbanization, there are occasionally cases where effluent from cities flows into agricultural water, causing substantial damages to agricultural production as well as the living environment in farming communities.

Currently, the number of areas (of 5 ha or more) that are affected by polluted agricultural water is approximately 552 nationwide, total area of approximately 43,200 ha. The ratio of damages caused by the effluent from cities (including household effluent in agricultural communities) is highest of all, and accounts for 84% of total damaged area.

The result of the investigations conducted for two years since 2005 indicates that the number of areas damaged has increased by 10%, and the total area damaged has decreased by 2.9% as compared to the result from 2000. The total newly damaged area was approximately 12,000 ha, and 91% of the total area was damaged by effluent from cities.

Types of damage that the fishing industry is suffering from due to water pollution include:

1. deterioration of fishing environment and damages to boats and equipment due to floating objects on surface water, deposits etc.;
2. destruction or incomplete development of marine organisms due to algal blooming or even oil contamination;
3. soiled or rotten boats and equipment due to oil contamination etc.

4. Environmental Quality Standards in Romania

Environmental quality standards concerning water pollution are set as targeted levels of water quality in public water areas, and they should be achieved and maintained. The standards are classified in two categories:

1. the levels to be achieved and maintained to protect human health;
2. the levels to be achieved and maintained to preserve the living environment.

In the health category, uniform standards are set for public water areas, while in the living environment category standards are set for each classified type of water area depending on the purpose of usage of the water area. According to the type of area designated, a specific standard can be applied.

The environmental quality standards concerning the protection of human health were revised, substantially after 1989. The standards currently specify 23 items including:

- heavy metals such as cadmium, lead etc.;
- organochlorine compounds such as trichloroethylene etc.;
- agricultural chemicals such as simazine etc.

In addition to these, the standards were set as guideline levels for items that require close monitoring, in order to better understand the condition of water quality and further promote the prevention of water pollution (Guvernul Romaniei, 1999).

For items of the living environment category, standards per BOD, COD, and DO are specified. In order to prevent eutrophication, standards for nitrogen and phosphorus have been newly set for coastal areas, in addition to the standards for lakes.

Concerning the removal of the bottom sediment containing hazardous substances, provisional removal standards are established for bottom sediment containing mercury or PCBs.

5. Restrictions on Effluents in Romania

In an effort to preserve the water quality in public water areas, the Romanian Water Pollution Control Law sets nationally uniform standards for effluent discharged from specified factories into public water areas.

Some standards set for hazardous substances have been added to these nationally uniform standards, and some have been tightened, in conformity with the environmental standards concerning human health. New standards have been set for seven items of organochlorine compounds including dichloromethane etc., and 13 items of agricultural chemicals including simazine etc., and standards for lead, arsenic etc. have been tightened.

For those areas in which the environmental quality standards can not be met or maintained only by satisfying the nationally uniform effluent standards, can establish local more strict standards in addition to the national standards.

Corresponding with people's increased concern in the quality of city water, the "Basic Policies of Preservation of Water Quality in the Sources of City Water to Prevent Problems in Specified City Water and Irrigation Systems" was decided upon by the Government, in conformity with the Law Concerning the Measures for the Protection of Water Quality in Water Resources Area for the Purpose of Preventing Specific Trouble Drinking Water Supply. In the mean time, the Romanian National Environment Agency was inquired about the establishment of a range for specified effluent standards concerning the formation of trihalomethane, in consideration with the results from the effluent fact-finding investigations.

Requests were made by seven city water system operators from four counties for the concerned counties to promote the enforcement of the project for preservation of raw water quality used in city water systems. As a result of these requests, counties plans for the project have been determined for three operators

of city water systems in two counties, and determination of other plans are under way for four operators in three counties.

The Romanian Environmental Protection Law specifies that, in case of a water pollution accident, the owner of the facility concerned is to take emergency measures, and that the facility owner is to notify the prefect of the concerned county of the measures taken.

6. Measures for Domestic Effluents

One of the problems that are contributing to water pollution in public water areas is effluent associated with daily living such as cooking, laundry, bathing etc.

In order to promote the measures to control domestic effluent it is important to improve not only sewerage systems but also various other drainage treatment facilities such as community plants, drainage facilities for agricultural communities, individual treatment equipment of mixed-effluent etc., according to the actual condition of each area. At the same time, measures such as increasing people's awareness toward the issue, encouraging people to participate in activities to reduce domestic effluent, should be promoted as well.

The National Environment Agency in Romania formulated the "Guideline for Guidance on the Promotion of Measures to Cope with Domestic Effluents", and holds a Water Environment Forum periodically as part of measures. By the partial amendments made to the Water Pollution Control Law, stipulations on measures for domestic effluent such as clarification of responsibilities to be assumed by the administration and the people concerning domestic effluent; and systematic promotion of measures for domestic effluent, have been improved according to the revised Water Pollution Control Law, prefects of counties are working on the designation of the areas for which intensive measures should be taken. Support was provided toward designated municipalities for their determination of a program for the promotion of measures against household effluents, establishment of facilities to purify water channels severely polluted by household effluent, development of facilities for collection of used oil and making soap from it and so on.

7. Sewerage System in Romanian Human Settlements

To support healthy growth of a city, improve public hygiene, ensure a good living environment, and to preserve the quality of public water areas, sewerage systems are vital and fundamental facilities.

Currently, a systematic project to improve sewerage systems is under way. One of the major objectives of this project is to improve sewerage systems, in

middle-and small-sized municipalities, where the provision of sewerage systems are significantly behind. Another key objective of this project is to promote sewerage system operations as well as their high-grade treatment technologies to meet the requirements of the European Union. Moreover, it is also aiming at the achievement of the water environmental quality standards, prevention of flood and improvement of the living environment in urban areas, conservation of the natural environment in lakes and reservoirs, improvement of the living environment in agricultural communities, mountain villages, and fishing communities along the Danube River and in the Danube Delta; and promotion of effective use of treated sewage water and sludge.

Various projects to develop sewerage systems were conducted. These projects include: public sewerage systems; watershed sewerage systems; sewerage channels in urban areas; specified public sewerage systems; and specified public sewerage systems for environmental preservation. For those areas in which drastic improvement is needed, a project to promote improvement of sewerage systems by fully utilizing projects that are operated independently by the local authorities, in conjunction with the projects supported by the Government, has been enforced.

From the standpoint of the effect that the improved sewerage systems can produce in conservation of water quality in public water areas, a project has been enforced, having as objective to foster the relation between the residents and the clear water in the community. And in addition to the measures for controlling domestic effluent which have been enforced on days with fine weather, a project aiming at collecting and treating polluted urban runoff has been established.

In an effort to revive small streams in urban areas in response to people's need for a peaceful and pleasing urban living environment, various projects are being carried out. These include:

- sewerage system model project of sewerage system with amenities being carried out in five locations, a sewerage system utilizing treated sewage water;
- recycled water sewerage system projects in 13 locations (two new projects), a system utilizing treated sewage water for flush toilets in urban areas where demand for water is pressed;
- sewerage system with improved appearance model projects, a project aiming at improving the appearance of sewerage facilities by planting trees and creating promenades around rain-water ditches in urban areas;
- sludge recycling model projects, whose objective is to promote the utilization of sludge generated in sewage treatment processes for construction purposes, by aggressively using the sludge products in construction projects of sewerage systems.

Also a project was started with the objective to develop a sewerage system that can provide diverse service functions for urban life by actively utilizing added values of the sewerage system facilities such as the space around facilities, treated water, sludge etc., and the project also aims at promoting a strategic urban development utilizing these functions provided by the sewerage facilities. Additionally, the sewerage system project to cope with snow which is aiming at maintaining city functions during winter in areas with heavy snow fall was implemented in nine cities, and a project to promote incorporative development of sewerage and park facilities, was also implemented.

In an attempt to help promote sewerage projects smoothly, studies on various issues were conducted. These issues include:

- the basic policies of the sewerage development program and its rationalization;
- design and construction methods of sewerage facilities;
- rationalization and raising efficiency of sewerage technologies treatment and disposal methods of sludge generated from sewage treatment;
- technology for small-scale sewerage systems;
- upgrading of treatment facilities, the environment of treated water, and utilization of treated water;
- measures for rain water from a standpoint of sewerage system management;
- collection and utilization methods of energy resources generated in sewerage systems;
- improvement of durability of sewerage facilities;
- sewerage technologies to cope with environmental changes;
- measures for the diversified role of sewerage systems;
- maintenance and justification of sewerage systems.

Also, in order to improve sewerage technologies and efficiency of operation, application of new technologies model projects, in which various new technologies and construction methods are actively introduced, are being carried out.

8. Monitoring System of the Water Quality in Public Water Areas

The National Environment Agency continuously carried out monitoring plans, and surveys of water quality in public water areas, out of all necessary support to execute constant monitoring of the water quality in public water areas, in accordance with the Water Pollution Control Law. The monitoring is conducted in the areas where the necessity of the water quality monitoring is high, such as the areas that have been designated to be applicable for the environmental quality standards.

In order to strengthen the monitoring system of water quality in public water areas, it is necessary to promote the automation of monitoring at certain points where intensive monitoring is needed. Currently, measurements taken by automatic water quality monitoring devices are approved as an official measurement method for the environmental quality standards concerning pH and DO. Investigations have been conducted to study the possible official approval of measurements by automatic water quality monitoring devices for COD as well (Galatchi, 2006).

The Romanian National Environment Agency provided support toward local pollution research centres, etc. for their purchase of water quality analyzers, in an effort to enhance the monitoring systems of prefectures and administrative ordinance-designated cities.

In order to monitor the status of conformity to the effluent standards, the local authorities of administrative ordinance-designated cities demand factories or workshops for pertinent reports, or make on-the-spot inspections as necessary. Depending on the results of these monitoring activities, they take necessary administrative measures, such as orders for improvement against factories and workshops. The National Environment Agency also provided support toward the concerned local authorities for their development of telemetric water quality monitoring systems.

9. Purification of Lotic Waters

As measures for purifying rivers, various projects have been conducted. These projects include:

- the purification water induction project, in which the condition of a polluted river with a low flow rate is improved by mixing in the purification-purpose water induced from a large river;
- the direct purification project, in which heavily polluted river water is purified by the gravel contact oxidation method;
- the sludge dredging project, where the bed of a river containing large amount of accumulated organic matter is dredged to reduce the sources of offensive odours and pollution.

As measures to control turbid water and eutrophication in dam reservoirs, aeration and the removal of nutrient salts are performed in watersheds.

Within the areas requiring extensive measures against domestic effluent, there are a number of areas where development of domestic effluent treatment facilities such as sewerage systems etc. is not expected to be constructed in the near future, despite the fact that the pollution in the area caused by domestic effluent is substantial and measures should be taken immediately to preserve the

living environment. To solve this problem, the Romanian National Environment Agency has been enforcing projects for installation of purifying facilities of waterways polluted by domestic effluents. This project is to execute a purification process directly to the polluted waterways and small streams which do not fall under the categories of “rivers” or “city sewage waterways”.

In areas outside those that have been designated as requiring extensive measures against domestic effluent, waterway purifying projects that are established independently by each municipality have been implemented.

10. Conservation of Water Quality of Lentic Water Bodies in Romania

For lakes and reservoirs and other enclosed water bodies particularly with significant pollution sources, the rates of achieving environmental quality standards are lower than for other areas, because the loads of pollutants are significant and pollutants tend to accumulate. In, addition, the inflow of nitrogen, phosphorus and other chemicals leads to the progress of eutrophication.

To improve the water quality of vast closed water areas, it is necessary to reduce total amount of pollutants flowing into the waters. Area wide total water pollutant load controls were institutionalized for overall reduction in the loads of pollutants flowing into waters, but it is still necessary to improve the water quality of these waters.

They specify the reduction targets of loads at target year by source (industry, household and other). The reduction targets by source are 12% from domestic sources, 9% from industrial sources, and 2% from other sources. To achieve these targets, the improvement of sewage systems has been promoted and other comprehensive measures depending on the circumstances of each area have been taken. These measures include: measures for domestic effluents such as development of community plants, drainage facilities for agricultural communities, combined-purpose septic tanks etc. measures for industrial effluent, such as effluent standard for area wide total pollutant load control and so on (Romanian Waters National Agency, 2001–2006).

Since lakes and reservoirs are enclosed water bodies, pollutants tend to accumulate easily. Thus, the achievement status of the environmental quality standards is lower than that of rivers and sea areas. Eutrophication in these areas is creating various problems in irrigation systems. Lakes and reservoirs that need immediate measures to meet the environmental quality standard are to be designated, and the water quality conservation plan for lakes and reservoirs is to be determined for those lakes and reservoirs, so that various measures can be taken comprehensively and systematically. These measures include:

- projects for conservation of water quality, such as development of sewerage systems etc.;
- restrictions against sources of pollutants;
- preservation of the natural environment around lakes and reservoirs.

There are ten lakes and reservoirs that have been designated as above. Eutrophication originally referred to the phenomenon in which the water of lakes is gradually fertilized by nutrient salts such as nitrogen, phosphorus etc., that are supplied from its watershed, followed by consequences on the living organisms. However, due to the centralization of population and industries, nutrients are flowing into sea areas, and into the lakes and reservoirs. Overflow of these nutrients causes the bloom of algae, thus the water quality is deteriorated progressively, causing serious environmental problems.

Eutrophication not only lowers the clarity or mars the appearance of lakes and reservoirs, but also causes filtration hindrance in water purification plants, offensive odor or taste of drinking water etc. It also contributes to occurrences of algal blooming in sea areas, resulting in damages to the fishing industry.

In consideration of these issues caused by eutrophication, measures have been taken against nitrogen and phosphorus which are nutrients causing the problems. The environmental quality standards concerning nitrogen and phosphorus for lakes were established, and the designation of types of areas was completed, and effluent standards concerning nitrogen and phosphorus were established. Restrictions of pollutant load concerning nitrogen and phosphorus in accordance with the laws have been enforced.

11. Concluding Remarks

The water supply deficit in Romania is caused by the absence of, or insufficient infrastructure in some regions, as 66% of the rural population (representing approximately 6.75 million people), does not have access to centralized water supply, and only 92% of urban inhabitants in Romania have access to the system. The ability to pursue infrastructure expansion, rehabilitation and modernization has been limited by a lack of investment and financial resources. Supply issues are further influenced by excessive consumption of water resources due to low water tariffs and a general lack of awareness of the importance of water conservation among the population. A major cause of nutrient pollution in Romania is the inadequate treatment of wastewater. Inadequate treatment is rooted in inefficient, or absence of infrastructure. Industrial pollution is also a consequence of outdated infrastructure, weak enforcement of regulations and the absence of economic incentives to promote cleaner production. In turn, infrastructure weaknesses are rooted in the limited availability of finances for

upgrading and modernization. The trends in development of water resources aim at enhancing the water storage capacity by damming some river courses and by optimizing water consumption. Romania's current water policy is based on international recognized principles of good water management – namely integrated water resources management.

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