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Water resources efficiency

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Abstract. The problem of water resources is a major global concern, with significant implications for the environment, health and economy. In Romania, this problem manifests itself through quantitative and qualitative deficits of water resources, pollution and their inefficient exploitation.

Keywords: water resources, water cycle in nature, fluidity.

1. Introduction

Main aspects of the water resources problem:

- Quantitative deficit:

There are areas where water resources are insufficient for local needs, especially during periods of drought or in arid areas.

- Qualitative deficit:

Water pollution, caused by industrial, agricultural or domestic discharges, affects the quality of water and makes it unsuitable for consumption or irrigation.

- Water pollution:

Sources of pollution include:

- Nutrient pollution: Nitrogen and phosphorus from agriculture reach surface waters, causing algal blooms and reducing dissolved oxygen.

- Untreated wastewater: Untreated domestic and industrial wastewater contributes to the contamination of water sources.

- Industrial pollutants: Chemicals and heavy metals discharged by industry pollute water.

- Emerging contaminants: Microplastics and pharmaceuticals in wastewater are a growing problem.

- Inefficient exploitation:

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Outdated infrastructure, losses in distribution networks and unsustainable agricultural practices contribute to the inefficient exploitation of water resources.

- Impact of climate change:

Droughts, floods and rising temperatures aggravate the problem of water resources, affecting the quality and availability of water.

Solutions and courses of action:

- Infrastructure investment:

Modernization of water treatment plants, water supply and sewage networks, and implementation of efficient irrigation systems.

- Integrated water resources management:

Efficient management of water resources, taking into account all aspects: quantity, quality, multiple uses and protection of aquatic ecosystems.

- Promotion of sustainable agricultural practices:

Reducing the use of pesticides and chemical fertilizers, adopting efficient irrigation techniques and promoting crop rotation.

- Public awareness and citizen involvement:

Educating the population on the importance of water conservation and on everyone's responsibility in protecting water resources.

- Water protection legislation and policies:

Implementation of clear and coherent policies, with strict water quality standards and sanctions for polluters.

- Research and innovation:

Development of new and efficient technologies for water treatment, monitoring water quality and identifying pollution sources.

In Romania, the problem of water resources is acute, and concerted and urgent actions are needed to ensure a sustainable future for water resources.

2. Method: Water resources

Method: WATER RESOURCES: - Atmospheric: water from the Earth's atmosphere - On land: - glacial water - water from the slopes - river water (hydrographic network) - lake water (lakes and closed seas) - groundwater - deep - karst - Oceanic: - seas and oceans

Water resources on the globe: underground: 0.1%; surface: 0.9%; ice caps 2%; Saltwater 97%

Forms in which water is found in nature

In the atmosphere: water vapor, fog, clouds

Precipitation: rain, hail, snow, dew, frost

Glaciers, icebergs

Hydrographic network

Seas and oceans

Aquifers

Transition from one form to another: the hydrological cycle through: evaporation, precipitation, runoff, freezing

Usable water resources world average: 5000 m³/capita/year European average: 3000 m³/capita/year Romania: 1700 m³/capita/year - 0.22% of the world resource - 0.37% of the world population Canada: 110,000 m³/capita/year Australia: 21,800 m³/capita/year Russia: 16,000 m³/capita/year U.S.A.: 10,000 m³/capita/year France: 4,300 m³/capita/year China: 2,800 m³/capita/year Egypt: 90 m³/capita/year

WATER RESOURCES OF ROMANIA • Surface waters: - inland rivers: - length: 79,000 km - average volume: 40 billion m³ - average flow: 1,250 m³/s - specific flow: 1,700 m³/person/year - Danube: - volume 170 billion m³ - 20*10⁹ m³/year belong to Romania - natural lakes: no. 122 (insignificant values) • Groundwater: - total volume: 9*10⁹ m³/year - usable volume: 6*10⁹ m³/year • Black Sea water: - cooling processes - desalination (insignificant volumes)

River basin:

The area of land from which all surface runoff flows through a succession of streams, rivers and possibly lakes, towards the sea, in a river with a single mouth, estuary or delta.

Sub-River Basin:

The area of land from which all surface runoff flows through a succession of streams, rivers and possibly lakes, towards a specific point in a watercourse (a river confluence or a lake).

The characteristic elements of a river basin:

Area: [km²] •Length of coded watercourses: [km] •Water resources: [m³] •Shape: by the ratio between area and length •Average altitude: [m] •Altitude distribution pattern •Geological structure •Vegetative cover and its distribution on the surface of the basin •Climate •Orientation

The amount of theoretical water resources reaches high values compared to the requirements of this resource. Thus, the total theoretical resource is 136,600,000 thousand m.c., the existing resource according to the degree of development of the hydrographic basins being 40,482,841 thousand m.c. and the requirements of 12,265,698 thousand m.c. In 2006, the total raw water withdrawals in Romania were 5.29 billion m³. Water withdrawals have decreased from 20.4 billion m³ in 1990 to 5.29 billion m³ at present, due to: the decrease in agricultural activity (irrigation); the decrease in industrial activity; the reduction of water consumption in technological processes; the reduction of losses; the application of the economic mechanism in water management. Compared to the current population of the country, a specific resource usable in natural conditions results, of approx. 2660 m³ /capita/year, taking into account the Danube's contribution, respectively a

theoretical specific resource, of approx. 1770 m³ /capita/year, taking into account only the contribution of inland rivers, placing from this point of view our country in the category of countries with relatively low water resources compared to the resources of other countries. The main water resource of Romania is the inland rivers. The water quality monitoring activity was organized in 2006 mainly on the middle and lower water courses (over a length of 27,056 km), where the impact of human actions on the environment, respectively on the water quality, is manifested. Measurements were also carried out in reference sections of the water courses, located especially in the upper areas, where this impact is minimal.

For the physico-chemical assessment of the overall water quality, in each monitoring section, the values with a 90% assurance, respectively 10% in the case of dissolved oxygen, or the average values were calculated for each indicator, and these were compared with the limit values of the quality classes provided by the five-class quality standard, thus resulting in classification in one of the five quality classes. The indicators included in the five-class quality standard were divided into 5 main groups: • the “oxygen regime” group comprising: dissolved oxygen, BOD₅, COD-Mn, COD-Cr; • the “nutrients” group comprising: ammonium, nitrites, nitrates, total nitrogen, orthophosphates, total phosphorus, chlorophyll; • the “general ions, salinity” group comprising: dry filterable residue, sodium, calcium, magnesium, total iron, total manganese, chlorides, sulfates; • the “metals” group which includes: zinc, copper, total chromium, arsenic.

The metals lead, cadmium, mercury, nickel were classified as priority substances; • the group „organic and inorganic micropollutants” which includes: phenols, detergents, AOX, petroleum hydrocarbons. Other substances such as PAHs, PCBs, lindane, DDT, atrazine, trichloromethane, tetrachloromethane, trichloroethane, tetrachloroethane, etc. were classified as priority substances. The elaboration of the synthesis of the quality of surface running waters for 2006 was based on the processing of primary data regarding the physico-chemical analyses of waters, data obtained in 842 monitoring sections, located in hydrographic basins. During 2006, the overall quality of surface water, assessed according to the situation of the 842 monitoring sections, was distributed as follows: class I – 31.4%; class II – 46.1%; class III – 15.8%; class IV – 3.7%; class V – 3.1%; which means that depending on the total length of the rivers monitored in 2006 of 27,056 km: 8,051 km were classified in class I quality; 12,565 km in class II; 4,465 km in class III; 1,388 km in class IV and 587 km in class V. Compared to the total coded watercourses of 78,905 km, not taking into account pollution due to the natural background and considering that the length of unmonitored watercourses has water of quality I÷II, it results that 0.7% fall into class V; 1.8% into class IV; 5.7% into class III and 91.8% fall into class I÷II.

Tabel 1. Annual Budget of Continental Waters (Lyovici, 1979 citat de Hornberger et al., 1998)

Continent	Surface	Rain	Leakage	Evapotranspiration	Coefficient
Africa	$30,3 \cdot 10^6$	690	140	550	0,20
Asia	$45 \cdot 10^6$	720	290	430	0,40
Australia	$8,7 \cdot 10^6$	740	230	510	0,31
Europe	$9,8 \cdot 10^6$	730	320	410	0,44
North America	$20,7 \cdot 10^6$	670	290	380	0,43
South America	$17,8 \cdot 10^6$	1650	590	1060	0,36

Running waters represent one of the smallest parts of fresh water. However, man has been using them since ancient times. Every year the Planetary Ocean receives about. $1,200 \text{ km}^3$ of water from rivers. The participation of the hydrographic network differs from one continent to another, depending on a number of factors.

The existence of well-developed river systems in Asia (9 out of the 16 rivers with an annual flow of over $10,000 \text{ m}^3/\text{s}$) places this continent in first place (30.7%), followed by South America (25.3%), North America (17.6%), Africa (9.7%), Europe (6.8%), Australia and Oceania (5%) and Antarctica (4.9%). In terms of fresh water availability per capita, the situation is completely different: Australia and Oceania, which are in last place (among the inhabited continents) in terms of the volume of water drained, this time take first place with over $106,727 \text{ m}^3/\text{capita}/\text{year}$; follows in order: South America ($50,256 \text{ m}^3/\text{capita}/\text{year}$), North America ($22,222 \text{ m}^3/\text{capita}/\text{year}$), Africa ($10,020 \text{ m}^3/\text{capita}/\text{year}$), Asia ($5,743 \text{ m}^3/\text{capita}/\text{year}$) and lastly Europe ($5,302 \text{ m}^3/\text{capita}/\text{year}$). The world average per capita is $10,804 \text{ m}^3/\text{capita}/\text{year}$.

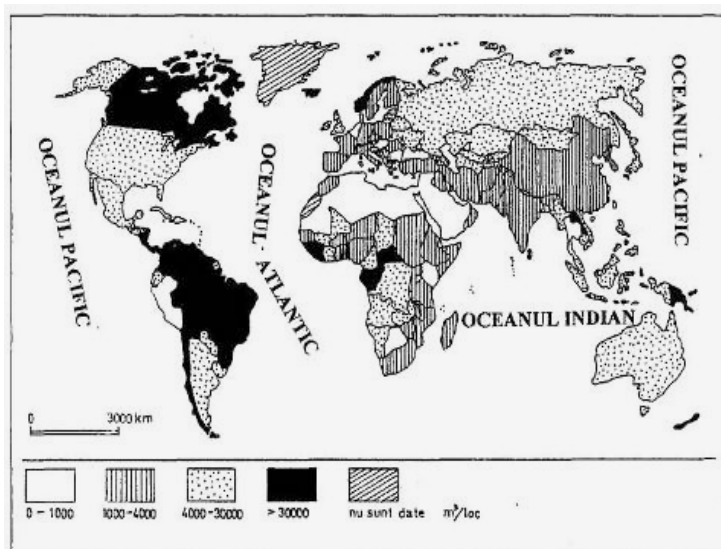


Fig. 1. Earth's water resources related to the number of inhabitants (Ressources mondiales, 1992).

However, even within continents, there are very large differences, or even within the same country (Australia, South America, Africa, North America, etc.). In this regard, we can cite the Sahara and Kalahari deserts in Africa, the central deserts in Australia, the Atacama Desert and the Patagonian Plateau in South America, the Mexican Plateau and the Great Basin Plateau in North America, which are far from the average continental index of water availability.

The European continent has the highest availability of fresh water per capita in the western sector of the Scandinavian Peninsula, where the value of this index is over 12 times higher than the continental average. The average is exceeded only by Northern and Eastern Europe, in the high mountainous region of the Alpine-Carpathian-Balkan chain and in some sectors of Western Europe. Values close to the continental average are found in some sectors of Western Europe, the Iberian and Italian peninsulas. The lowest values (two to three times lower) are specific to Central Europe; the latter case is not explained by the lack of water resources, but by the massive concentration of inhabitants, where densities often exceed the value of 200-300 people/km². By country, Norway has the highest availability of fresh water per capita, while Hungary ranks last.

The water resources of the rivers in Romania are estimated at 37,000,000,000 m³/year, which means that the value of the availability index per capita is approx. 1,650 m³. Reality shows that the percentage increases 5 times because the Danube also passes through the territory of Romania, which has an average annual flow at the entrance to the country of 5,300 m³/s (170,000,000,000 m³/year). The water requirement in Romania increased from a total of 1.4 km³ in 1950 to 43 km³ in 2000 (tab. 2). During the same period, the supply of drinking water was 113 million m³/year in 1950 and 2.5 billion m³/year in 1987.

Tabel 2. Romanian Dynamic necessary of water (Zăvoianu, 1993)

Year	Total km ³	From Waters	From Danube	From rivers
1950	1,4	0,15	0,25	1,0
1955	1,0	0,21	0,29	1,5
1960	2,6	0,36	0,34	1,9
1965	4,7	0,50	1,70	2,5
1970	9,1	1,00	4,60	3,5
1975	14,4	1,20	6,20	7,0
1980	20,0	2,10	9,10	8,8
1985	22,0	2,40	10,50	9,1
1990	36,0	L 3,20	18,80	14,0
2000	43,0	4,50	19,50	19,0

3. Discussions and conclusions

The concept of the three “Rs” – reduce, reuse, recycle is often used as a starting point in debates on sustainability and environmental protection. This approach can also be useful when it comes to responsible water use: reducing consumption, reusing water where possible, and only lastly recycling wastewater.

Much of the wastewater from industrial and domestic consumption returns directly to ecosystems, without being treated or reused. Wastewater can be used to produce drinking water, energy, food.

By introducing fewer pollutants into the wastewater collection system, we help protect the environment and drinking water sources. The principle is the same for homes, farms and factories.

There is a need to treat and reuse wastewater while reducing the amount of wastewater produced and the pollutants it contains.

Water must be managed efficiently!

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