

**SPACIAL AND BRANCH ANALYSIS OF WATER CONSUMPTION
IN THE RĂUT RIVER BASIN**

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The water consumption in the Răut river basin is influenced by present status of water resources and by economic activities from respective zone. The objectives of this research are: the evaluation of abstracted and used water by usage categories and administrative-territorial units; identification of problematic situations in the water use and water management; the elaboration of recommendation for rational use of water resources in various economic and social activities.

Key words: *water use, Raut, river basin, agriculture, household.*

Introduction

Răut river is the right tributary of the Dniester River and the longest river (286 km) that is wholly in the Republic of Moldova. Raut River basin has an area of 7760 km², about 23% from country area. In the Raut river basin includes districts Dondușeni, Drochia, Florești, Sîngerei, Telenești, Orhei and Bălți municipality, as well as a significant part of Soroca and Rascani districts.

Along the time, changes exercised by people on the environment, through completed economic activities, affects water consumption from hydro graphic basin Raut, and insufficient presentation of statistical data in the region represent one of the most principal impediment of development and implementation, in the future, the projects focused on socio-economic sustainable development of human settlements activities and providing of its them with water. For this purpose are necessary activities of analysis and assessment of water resources management from basin Raut.

Results and discussions:

In period 2007-2014, from the Raut river basin was captured, on average 15,5 mln.m³ of water (table 1, figure 2) or 1,8% from total volume of water (854 mln.m³) captured in Moldova. From the Răut river bed was captured 4,6 mln. m³, most of which in Orhei, Floresti and Balti towns.

Table 1.

The volume of water captured in the river Raut (average 2007-2014)

Hydrographic basin	Total		of surface			undeground		
	mln. m ³	%	mln. m ³	%	% ⁷⁵	mln. m ³	%	%
Răut	15,5	1,8	2,4	0,32	15	13,1	10	85
Raut river bed	4,6	0,5	0,37	0,05	8	4,20	3	92
Total RM	854	100	728	100	85	128	100	15

Sources: tables 1-2 and figures 1-2 are developed by the author after Annual Reports (2007-2014) on Generalized Indices of water management in the Republic of Moldova. The Basin River Direction of Agency „Apele Moldovei”.

Until the connecting of Balti municipality at the water pipe Soroca-Balti-Râscani (2006), from local underground sources they were annual captured over 7 mln. m³ of water, which were destined priority for public water supply. Currently, from the groundwater sources are captured over 13 million. m³ of water or about 85% of the total volume of captured water.

⁷⁵ The share of total volume of water abstracted in the respective river basins

From underground sources is supplying Florești, Orhei, Drochia, Sângerei, Telenești, Mărculești and Ghindești towns, and the absolute majority of the rural areas from the perimeter of respectively river basin. Water supply to settlements from the territory is made from artesian wells, springs and wells.

In period 2007-2014, reduces the amount of abstracted water from 17 mln.m³ to 14,5 mln. m³, including groundwater from 13,3 mln. m³ to 13,0 mln. m³, and surface water from 4,3 mln. m³ to 1,5 mln. m³ (figure 2). Changing of hydro graphic regime basin and of the water abstracted is influenced by basin area, by intensification of human activities and changes in food sources as well as variation of the river course [3, p. 21].

As mentioned, majority volume of water is abstracted from groundwater sources, but the aquifer is closely linked to the amount of water extracted and used, which due to increased water consumption can generate aquifer instability. To reduce the excess of evaporation, regulation of surface runoff and groundwater and subsequent use of water for agriculture and industry should be built and landscaped artificial lakes. Otherwise degree of assurance and river basin water consumption will be reduced.

The average consumption of water in the river basin Raut is 13,7 mln. m³. About ¾ (10,3 mln. m³) of water captured is used for agricultural purposes, including 16% (2,1 mln. m³) for irrigation (table 2). In the household purposes are used, also, about 16% from the captured water in the Răut river basin. In addition, the communal companies provide public water supply services to budgetary organizations, industrial enterprises and to services sector. For technological purposes are used only 9% of captured water. The highest consumption of water used for technological purposes can be seen in food businesses, stations for commercialization of fuel, in the building industry, in the transport and service enterprises.

Table 2.

The volume of water consumption in the Raut river basin (mediate 2007-2014)

Hydro graphic basin	Total		Households		Technological		Irrigation		Agriculture	
	mln.m ³	%	mln.m ³	%	mln.m ³	%	mln.m ³	%	mln.m ³	%
Răut	13,7	100	2,26	16	1,19	9	2,15	16	10,3	75
Răut river bed	3,7	100	1,24	33	0,7	19	0,38	10	1,8	47

Due to the presence of Orhei, Bălți and Florești towns, in the Răut river bed the share of water used for household (33%) and technological purposes (19%) is much higher and the share of agriculture is much lower (47%) towards the summary share in the respective basin (table 2).

As a result of massive use for agricultural and household purposes a great impact on the water resources is caused by animal communal wastes, as well as by discharge of untreated wastewater. This has conditioned the massive pollution of the Prut river bed and its tributaries. The most polluted sectors from the Raut river basin are in downstream of Dondușeni, Florești, Bălți and Orhei, and the mouth of the Răut river into the Dniester river [1, p. 77].

Since 2007 until 2014, water consumption from Raut river basin decreased from 15,5 mln. m³ to 13,1 mln. m³ (fig. 1). Total water consumption decrease was due to the decline of industrial and agricultural activities, and to the massive destruction of irrigation systems and aqueducts. The main sources of water for irrigation are: Răut river bed, the largest tributaries of the upper and middle – Copăceanca, Cubolta, Căinari, Ciulucul Mic and from the lower course – Cula and Cogîlnic, as well as storage lakes Florești and Căzânești. Although, in the purpose of extending the agricultural land were undertaken the agro-technical works for arranging and expansion of the main river bed, during the last period is observed decrease amount of water used in the irrigation of land from 4,2 mln. m³ to 1,4 mln. m³.

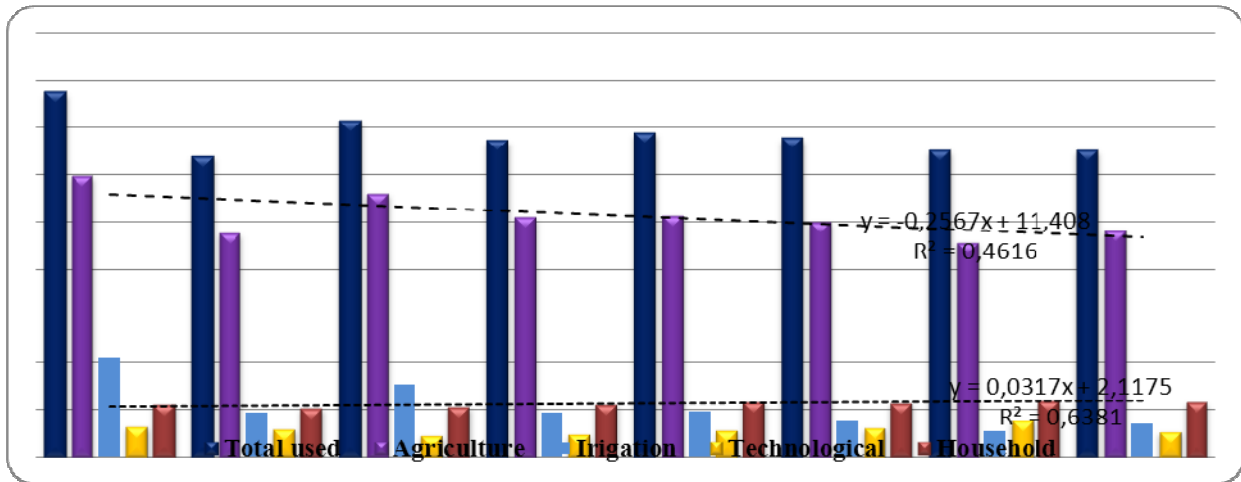


Figure 1. Dynamics, by category of use water in the basin Raut (mln. m³)

Răut river basin is based on Sarmatia limestone and clays rocks, which determine increasing of mineralization and hardness of water, and under these conditions the water is not recommended for irrigation [2, p. 110]. If exclude used water in the irrigation process, in the other agricultural activities showed an increase in water consumption (from 7,8 mln.m³ to 8,3 mln.m³). The decline in the agro-industrial complex determine slow reducing of volume water used for technological purposes (from 1,3 mln.m³ to 1,1 mln.m³). This situation is conditioned, a large extent, by economic and political instability and restricting of Moldovan exports to the Russian Federation, by the low competition of local products with imported goods, by restricted national retail market etc. These factors substantially limit the re-launch of the agri-food sector and other large industrial consumers of water resources.

The volume of water used for household purposes is growing slowly (from 2,2 mln. m³ to 2,3 mln. m³), conditioned by extension of the aqueducts from district centres and villages. These major projects were realized with financial support of the National Ecological Fund, Regional Development Funds and foreign partners in this field. The largest amount of water used for household purposes is registered in Balti municipality, and in districts Orhei and Florești, that a greater number of people. Also, the positive dynamics of household waste water consumption is due to use of water supplied through communal networks of supply centralized in various household activities, and the growth and processing of agricultural products.

Water losses are on average, by 5,0 mln. m³ (fig. 2) or by 32% of the total volume of water captured, inclusive 20% technological losses, which is much lower than else in the watershed of the Republic, except the Dniester River [4]. Technological water losses may occur in the case of technical failures, incidents and accidents. Household wastewater losses are directly depends on the size of municipalities and their water consumption. Therefore, the greatest loss of water is observed in Balti (2,4 mln. m³ of the total water abstracted by 7,1 mln. m³) and in district Orhei (578 thousand m³ from volume by 1,9 mln. m³ of captured water).

Along with reducing the amount of abstracted water is observed reduction and losses of water consumption. Total water losses were reduced in the studied period from 9,7 mln. m³ to 2,5 mln. m³ (fig. 2), what is due, mainly; to multiple reduce consumption and technological losses of water used for irrigation. Also frequent technological losses occurring in the drinking water supply by undertakings in the respective services.

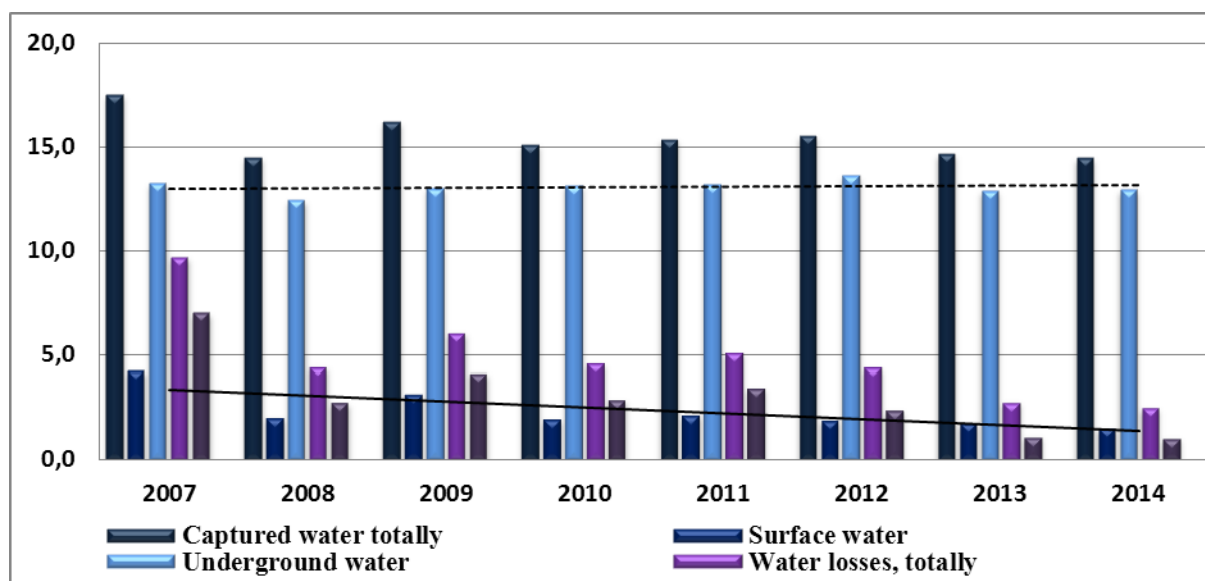


Figure 2. Dynamics of the volume of abstracted water and their losses in the basin (mln. m³)

The spatial distribution of water resources in the river basin is influenced by the amount and annual rainfall regime, by characteristics of relief, geological structure, groundwater character, number of tributaries, and by the influence of human activities. These factors, underlying water supply for Balti, urban and rural settlements from Raut river basin.

Superior Course of a hydro graphic basin Raut, has an area of 2,2 thousand km² and includes most of districts Dondușeni and Drochia. The Middle Course has an area of a3,4 thousand km² and includes Bălți city, Florești Sângerei and Râșcani districts. The Lower Course has an area of 2,2 thousand km² and includes districts Telenești and Orhei [2, p. 105].

In the Superior Course of the Răut river, were used, in average 2,3 mln. m³ or 17% the total volume of water used in the respectively basin. Providing of water is greater in the district Drochia, which is due to spring Cotova with relatively high flow, and the greater number of tributaries compared with Donduseni district. According to reports of territorial ecological authorities, the largest consumers of water in the Superior Course are municipal enterprises "Apă-Canal" Drochia (435 thousand m³) and Dondușeni and (81 thousand m³), specializes in providing drinking water to the population and budget organizations. Also, large water consumers are sugar factories in Dondușeni (150 thousand m³) and Drochia (112 thousand m³), irrigation district associations (150 thousand m³), big agricultural companies, poultry plants and dairy processing. Among service businesses is remarkable hospital from Drochia, sanatorium from Târnova, Dondușeni, educational centres, administrative buildings and trade centres.

In the Middle Course, are used, on average, 8,2 mln. m³ or 62% the total volume of water used in the Raut river basin [4]. An important role in providing with water it has springs from Izvoare village, Florești district. In addition, some localities from this sector, including Bălți, are connected to the water pipe Soroca-Bălți, carrying abstracted water from the Dniester river. In the Middle Course is situated Bălți city - the most important urban and industrial centre from Răut basin with an annual consumption of about 5 mln. m³, as well as the towns Florești, Sângerei, Mărculești and Ghindești. As a result, the share of water used for household and technological purposes is higher compared to the other two sections of the respectively basin. In Bălți, the largest consumers of water are communal enterprises (4,1 mln. m³), food industry enterprises (445 thousand thousand), North TEP (228 thousand m³), building (44 thousand m³), medical centers and transports [5]. In the food industry, the highest water consumption is observed in grain processing factories SA „Floarea Soarelui” (163 thousand m³) and SA "Produse cerealiere" (30 thousand m³), dairy plant SA "Incomlac" (133 thousand m³), sausage factory SA "Basarabia Nord" (80 thousand m³), brewery SA "Beermaster" (26,6 thousand m³), Bread Factory (15,3 thousand m³). Also, it is remark Psycho-

neurological Boarding (37 thousand m³), factory for production of gypsum articles SA "CMC-Knauf", transport enterprises and construction of civil buildings. Outside of the Bălți city, along with agricultural enterprises, large consumers and suppliers of water are the companies of Association "Apă-Canal" from Florești (359 thousand m³) and Sângerei (276 thousand m³), Users Associations of water from Biruința, Mărculești, Ghindești and in rural areas, mineral water bottling S.R.L "Rusnac-Moldaqua" (210 thousand m³) from district Florești and S.R.L "Gelibert" (20,1 thousand m³) from Sângerei. In Florești district water consumption for technological purposes is much higher and maximum volume of water used in the building industry (production of glass), processing of grains, dairy and beverages enterprises.

In Inferior Course, are used, on average about 3,2 mln. m³ or 23% of the total volume of water used in the basin of the river Raut [4]. The maximum volume of water is used for agricultural enterprises. Utility companies delivered about 1 mln m³ of water, inclusive 720 thousand m³ in Orhei city and 140 thousand m³ in Telenești city. In recent years, rapid increases of volume of water supplied by utility and water users associations in rural areas. The supply of drinking water to the city Orhei is ensured, especially by spring Jeloboc. The biggest consumers of the industrial sector are food companies, mining and building materials companies. In the food industry are remark wine factories, beverages and canned factory SA Orhei Vit (242 thousand m³), poultry wine factories and the dairy [5]. Most mining companies with large water consumption are located in Orhei and Brănești from the same district. Major consumers of the service sector are health centres, educational, commercial and transport enterprises.

In Inferior Course there has been a slow growth in the volume of abstracted and used water, which is explained by its proximity to Chisinau and to the main thoroughfares. In addition, in many places in this area there is a positive dynamics of species number of population and economic activities, which reflects directly on the increase in water consumption. In this time, in the Middle an Superior Course marked by a reduction of water consumption, especially in industry and communal sector. The causes of this negative trend are: reducing of the number of resident population in most localities in the North Region, reducing the volume of industrial and agricultural production, the deplorable status of many water pumping stations and water pipelines.

Conclusions

The current status of water resources and economic activity influence water consumption in the Raut river basin. Even if the water from the river basin return just 1,8% from total volume of water of the country (854 mln.m³), it provides water consumption for about 23% from surface of the Republic of Moldova, especially from Balti city, from Floresti and Orhei districts.

About ¾ of abstracted water is used in agriculture, including 16% in irrigation. For household purposes are used 16% of abstracted water, and in industry only 9%. In the last period is registered considerable decrease of volume abstracted and used water for irrigation and industry. This situation is influenced by economic decline at the republican level, by reducing the efficiency of water supply services, advanced wears of pumping and captures stations, which causes great losses of water. The volume of delivery water is conditioned by the number and size of urban and industrial centres, of big agricultural farms in the territory. In addition, water consumption is influenced by climate, soil and geology of the respectively basin.

For rational use and maintaining the balance between water resources and consumption of these in the Raut river basin, it is necessary the extension of water supplies infrastructure, effective monitoring of natural, geo-demographical and economic conditions from territory.

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