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DYNAMICS AND BRANCH STRUCTURE OF WATER CONSUMPTIONS IN THE REPUBLIC OF MOLDOVA

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Keywords: river basins, water use, agriculture, household

Abstract. The purpose of this research consists in the elucidation of spatial and branch aspects of the water use in the river basins of Republic of Moldova.The main topics presented in this paper are: 1)the dynamics of water use; 2)spatial and branch profile of water use and its dynamics: 3) existing problems in the evaluation and monitoring of water use. To achieve these objectives were used traditional methods of geographical and economic research. Also, the content of the present study is focused on the methodology to elaborate the management plans of hydrographical basins and their chapters on economic analysis of water use in the river basin. of Republic of Moldova.

INTRODUCTION

The hydrographical network of the Republic of Moldova comprises 2 hydrographic districts (HD): Dniester and Prut-Danube-Black Sea (PDBS), which includes 4 drainage basins, including the rivers Dniester, Prut, Danube rivers and rivers, which are flowing directly into the Black Sea. The last two drainage basins form the Danube-Black Sea Hydrographical Space (DBS HS), which together with the Prut river basin form the second hydrographic district – PDBS (figure 1).

Within the boundaries of the Republic of Moldova, the Dniester river basin occupies an area of 19.2 thousand km²,which is more than ¼ (26.5%) of the total area,over 72 thousand km², of this river's basin.Also, **Dniester HD** holds 57% of the total area of the Republic of Moldova (RM).The hydrographic network Dniester's HD is represented by 1591 rivers, including 5 with a length of 100 km and 153 with a length of more than 10 km, 51 lakes and about 1,7 thousand ponds.The length of the Dniester River, on the territory of the RM is 652 km or

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≈1/2 of its total length of 1350 km [4].Being asymmetrically distributed to the main axis of the Dniester Valley,the left area of the basin (within RM) is 3.5 thousand km² (18%) and the right one of 15.7 thousand km² (82%).The main right tributaries of the Dniester River are Raut, Bâc (155 km), Botna (146 km) and Ichel (98 km), and on the left - Iagorlâc (73 km), Camenca (52 km) and Râbniţa. The largest tributary is the river Râut, with a length of 286 km and a drainage area of 7.8 thousand km^2 or over 40% of the total area of Dniester Hydrographical District within the RM.

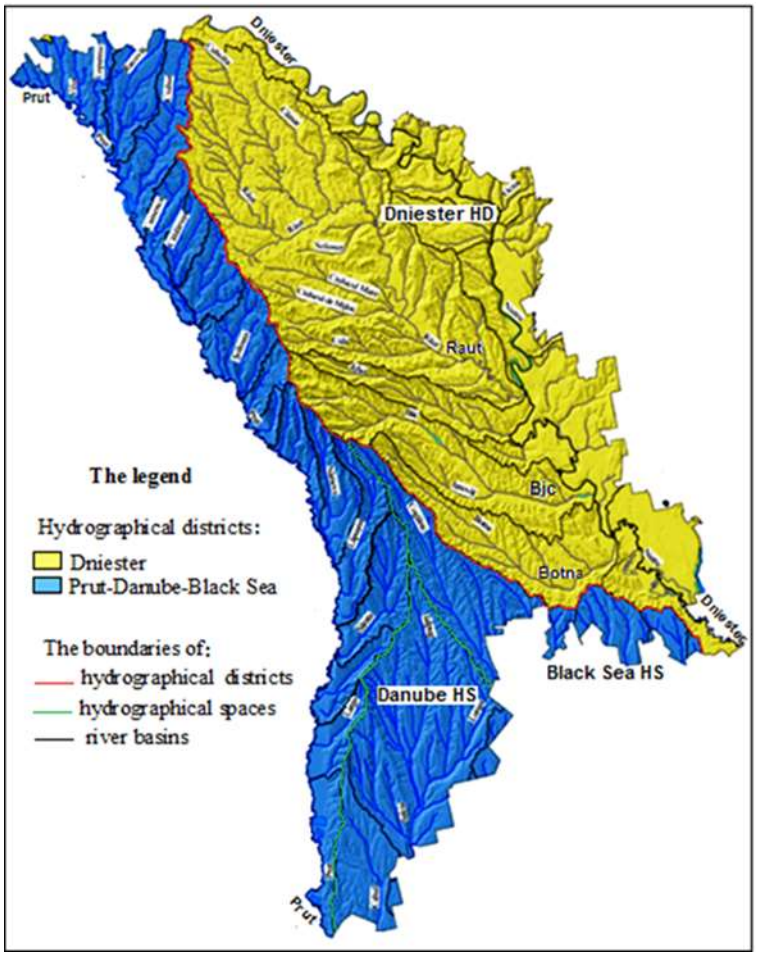

Fig.23. The hydrographical districts of Republic of Moldova

The multi-annual average volume of leakage is about 10 km^3 and average flow of flow is about 300 m^3/s.The maximum average flow rates of 450-500 m^3/s are recorded in April, and minimums, below 200 m^3/s in the winter months.The largest natural lakes along the Dniester river are Bâc (3.7 km^2), Roșu (1.6 km^2), Nistrul Vechi/Old Dniester (1.9 km^2). The largest artificial lakes are Dubasari on the Dniester river (67 km^2) and Ghidighici on the Bâc river (6.8 km^2). This network of aquatic basins provides regularization and evacuation of surface leakage, is used for drinking and technological water supply, for irrigation, navigation, fisheries, in tourism and recreational activities.

In the Dniester HD live 2.9 million inhabitants or ¾ of the total population of the Republic.In addition, within the Dniester basin are located the most important urban and industrial centers, including the municipalities of Chisinau, Balti, Tiraspol, Tighina and Râbnita, Thermoelectric Plant (TEP) from Dnestrovsk, the Ribnita metallurgical plant and the absolute majority of industrial enterprises.Therefore, the Dniester river basin contributes approximately 97% to the total volume of water used in the RM.

The **Prut-Danube-Black Sea Hydrographical District** occupies an area of 14.7 thousand km^2 or ≈43% of the Republic of Moldova's surface.The surface of the Prut river basin is 8.2 thousand km^2, and the surface of the DBS HS is 6.5 thousand km^2. The average annual leakage volume of the Prut river is 2.7 km^3, and ranges from 1.2 km^3 to 5 km^3.The average annual flow rate is 83 m^3/s, with fluctuations ranging from 40 to 162 m^3/s. On the territory of the Republic of Moldova, the main tributaries of the Prut river are the rivers Camenca (93 km), Ciuhur (90 km), Draghiste (71 km), Lapusna (70 km), Racovat (67 km) and Sarata (59 km).The main rivers of DBS HS are Ialpug (113 km), Cogâlnic (104 km), Cahul (45 km), Kitai, Sarata, Ceaga and Hadjider.Most of the surface of the Ialpug and Cahul drainage basins are located on the territory of the Republic of Moldova, and of the other rivers − in the Ukraine. Also, within the limits of the Prut river basin, there are 46 accumulated lakes.Costești-Stânca is the largest reservoir on the Prut river with an area of 59 km^2 and a volume of water of 1.4 billion m^3.Also, Lake Costesti-Stânca is also the most important hydropower node on the Prut River. Meadow lakes are concentrated in the lower course of the Prut River, including Beleu, Drăcele, Rotunda, Manta. They are destined for the protection of meadow ecosystems and their fauna and flora complexes, but are widely used for fisheries and recreational purposes. In the HS Danube-Black Sea 1452 were identified anthropic lakes, of which 5 accumulation lakes with a surface area of more than 1 km^2, including Taraclia, Congaz, Comrat, Caplani and Ukrainca.

The underground water reserves of the Dniester river basin are about 804 thousand m^3/day or over ¾ of the total underground water reserves of the Republic of Moldova [6].Underground waters are extracted through 5034 artesian wells or

≈2/3 of the total number of exploited wells in the RM.The largest underground water reserves are located in the districts of Anenii-Noi, Criuleni and Orhei from the Central Region, in the Balti municipality from the Northern Region and in the Stefan-Voda district from the Southern Region.

In the Prut river basin groundwater resources is 141 thousand m^3/day or 13% of total groundwater reserves of RM.For groundwater exploitation, are operating over 500 artesian wells, including 330 wells for drinking water supply.The groundwater reserves of Danube-Black Sea HS are estimated at 117 thousand m^3/day or only 11% of the total underground water reserves of the RM.

1. THEORY AND METHODOLOGY

The present research is based on recent analytical studies on the implementation of the Management Plan of River Basin, which is stipulated in EU Directive (2000/60/EC) on integrated water management [7]. For the study, the author has focused on management plans, which are being implemented, such as the Danube River Basin Management Plan [5], Management Plan of River Space Prut-Bârlad [8], Management Plan of PDBS HD [3].

The main methods, which are used in this study are: statistical, analytical, comparative, analogical, as well as consultation with competent authorities in the field of assessing and managing of water resources. Statistical method was widely used in processing of statistical information on the water use in the river basins of Republic of Moldova. The analytical method was used for: a) to identify quantitative and qualitative aspects of water use; b) diagnosis of situation of water use and elaboration of recommendations to prevent problematic situations in this field; d) definition of priority directions of activity optimization of water resources management in the river basins. The comparative method was applied for establishing the trends in the branch and spatial aspects of the water use.

The main informational and statistical support of this study included: 1) Generalized Annual Reports on Water Management Indicators elaborated by the Basins Department of Agency „Apele Moldovei" [9]; 2) Annual Reports of Ecological Agencies and Inspection [10];5) analytical studies in this field, including of authors of this article [1]. The study comprised the 2007-2016 years.

2. RESULTS AND DISCUSSIONS

2.1. The analysis of water consumption by river basins and water catchment sources

In the analysed period (2007-2016), the total volume of water used was, on average, 786 million m^3, of which 676 million m^3 or 86% is captured from surface

sources (table 1).Also, about 670 million m^3 of water (85%) were used by the consumers from TAULBD (Territorial Autonomous Unit from the Left Bank of Dniester), including 552 million m^3 by the *Thermoelectric Plant (TEP) from Dnestrovsk* and about 21 million m^3 in Tiraspol and Bender (Tighina) cities.Maximum water consumption in the TAULBD is conditioned both by higher level of industrialization of the region promoted in the soviet period.

More than 760 million m^3 (97%) of the waters are used in the Dniester river basin, including 165 million m^3 (21%) from the riverbed of this river. From surface sources are used, on average, 666 million $m^3$of water or 88% of total volume, which is conditioned by major use of surface water by *TEP from Dnestrovsk*. Also, from surface sources are supplied majority of industrial companies from Rabnita and Dubasari towns, and big agriculture companies, especially for irrigation purposes. Only in Dnestrovsk,Chisinau andSorocacities over 90% ofcapturedwater is coming fromsurface sources. In theother localities, including TiraspolandBendercities iscapturedgroundwater, and the DniesterRiver andits tributariesmade only receiversfunction ofnaturalpollutedwastewater [1, p. 66]. On the right bank of Dniester, the maximum volume of water is use in the Chisinau (52 million m^3) and Balti (5 million m^3) municipalities, in the districts of Soroca – 2.4 mil. m^3, Anenii Noi – 3.8 mil. m^3, Orhei – 3.4 mil. m^3 and Căuşeni – 2.8 mil. m^3.

In the Răut river basin are used 13.7 million m^3 of waters (Table 1), which represents only 1.7% per total and 12% on the right bank of the Dniester[2].

At the same time, Raut river basin has a most contribution in water supply of Donduseni, Drochia, Rascani, Floresti, Sangerei, Telenesti and Orhei towns, and of majority rural localities from these districts. Also, in the right bank of Dniester, Raut basin contributes about 40% of water used in agriculture, including in irrigation purpose. Over 80% of total volume of use water is captured from underground sources [9]. In the the Bâc river basins are used 6.5 million m^3 of waters, which represents only 0,8 % per total and 5,6% of water used in right bank of Dniester. Almost the entire water quantity (97%) is captured from underground sources. The Botna basin river has a lowest share – 0,3% and over 80% of used water is captured from underground sources (Table 1).

Overall, in the water supply of the Republic, the **Prut-Danube-Black Sea Hydrographic District** (PDBS HD) contributes much less compatible with the Dniester river and its tributaries. In the PDBS HD are used, on average, 26.8 million m^3 of water or only 3.4% of the total volume in the RM and 23% in the right bank of the Dniester river (Table 1). The reduced share of PDBS HD is due both to its small size and to the presence of only small and medium towns and to pronounced agrarian and rural character [3, p. 40]. Despite much lower share

[2]Without Bender municipality, which is included in the TAU LBD

compared with the Dniester river, the HD PDBS has a primary role in water supply of many settlements in the west and south of country, including the urban and industrial centers as Edineț, Fălești, Ungheni, Hâncești, Comrat and Cahul.

Table 1.The volume of waters used in the river basins of RM (2007-2016 years)

River basins	Total			Surface sources			Underground sources		
	mil. m³	%	%[3]	mil. m³	%	%[4]	mil. m³	%	%
Dniester	**760**	**97**		**666**	**98**	**88**	**93.8**	**85**	**12**
Dniester riverbed	165	21		102	15	62	62.6	57	38
Răut	13.7	1.7	12	2.3	0.3	17	11.4	10	83
Răut riverbed	3.8	0.5	3.2	*0.4*	0.06	11	3.4	3.1	89
Bâc	6..5	0.8	5.6	*0.2*	0.03	2.7	6.4	5.9	97
Botna	2.3	0.3	1.9	*0.4*	0.06	19	1.9	1.8	81
Prut	**17.9**	**2.3**	**15**	**8.4**	**1.2**	**47**	**9.4**	**8.6**	**53**
Prut riverbed	6.9	1.0	6.0	5.1	0.7	74	1.8	1.6	26
DBS HS	**8.9**	**1.1**	**7.6**	**1.9**	**0.3**	**21**	**7.0**	**6.3**	**79**
Ialpug	4.0	0.5	3.4	0.7	0.1	16	3.4	3.0	84
Cahul	1.0	0.1	0.8	0.53	0.08	54	0.45	0.4	46
Cogâlnic	2.7	0.34	2.3	0.4	0.05	13	2.3	2.1	87
Kitai	0.26	0.03	0.2	0.01	0.01	3.4	0.25	0.2	96
Sărata	0.5	0.07	0.4	0.1	0.01	19	0.4	0.4	81
Hadjider	0.6	0.08	0.5	0.4	0.06	70	0.2	0.2	30
PDBS HD	**26.8**	**3.4**	**23**	**10.3**	**1.5**	**39**	**16.4**	**15**	**61**
Total	**786**	**100**		**676**	**100**	**86**	**110**	**100**	**14**
without TAU LBD	**116**	**15**	**100**	**73**	**11**	**62**	**43.8**	**40**	**38**

Source tables 1-3 and figures 2-4 are elaborated by authors after data from „Generalized Annual Reports on Water Management Indicators"[9]

On average, over 60% (16.4 million m^3) of used water comes from underground sources (Tables 1), including 53% in the Prut river basin and 79% in DBS HS. The maximum share (> 80%) of water abstracted from underground water sources is attested in the settlements from the districts of Hâncești and Cimișlia located in the Cogâlnic river basin, and TAU Găgăuzia located in the Ialpug river basin [2]. The volume of water used from surface sources was on average 10.3 million m^3, including 8.4 mil m^3 from the Prut river basin and 1.9 million m^3 from the DBS HS [9]. The maximum share of surface sources is attested in the districts of Ungheni (68%), Edineț (51%) and Cahul (48%). Due to low flow and intensifying processes of climate aridity, the ability to explore surface water

sources is very low. In addition, phreatic water has increased mineralization which significantly limits the development of irrigated agriculture.

Despite the oscillating evolution conditioned by the pluviometric regime and the economic situation, the total volume of water used in the RM shows, during the analysed period, a tendency to decrease, which is observed in most hydrographical basins except the basins of the Bâc and Sarata rivers (Table 2).

Table 2.The dynamics of waters use volume in the river basins of RM, in million m^3

River basins	Years									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	*2016*
Dniester	**775**	**765**	**764**	**759**	**759**	**758**	**757**	**753**	**753**	**752**
Dniester riverbe	177	171	168	165	165	164	163	159	158	158
Răut	15.5	12.8	14.3	13.5	13.8	13.6	13.1	13.1	13.5	13.6
Răut riverbed	4.5	3.5	3.5	3.5	3.5	3.6	3.6	3.9	4.0	4.2
Bâc	5.4	7.1	7.1	6.7	6.1	6.7	6.5	6.5	6.7	6.4
Botna	2.6	2.3	2.4	2.1	2.2	2.3	2.2	2.2	2.2	2.2
Prut	**22.6**	**19**	**21.3**	**17.2**	**16.8**	**18.2**	**16.3**	**15.7**	**15.8**	**15.7**
Prut riverbed	9.2	7.3	7.9	6.5	6.2	6.5	6.3	6.0	6.4	6.3
HS DBS	**11.4**	**9.4**	**10**	**8.5**	**8.8**	**8.9**	**8.0**	**7.6**	**8.3**	**8.0**
Ialpug	4.8	3.9	4.0	4.0	4.2	4.1	3.7	3.7	3.8	3.7
Cahul	1.7	1.4	1.5	0.7	0.5	0.6	0.6	0.4	0.4	0.4
Cogâlnic	3.2	2.7	2.9	2.5	2.6	2.8	2.5	2.2	2.7	2.5
Kitai	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2.	0.2	0.2
Sărata	0.5	0.5	0.7	0.5	0.4	0.5	0.5	0.5	0.5	0.5
Hadjider	0.9	0.6	0.5	0.5	0.6	0.7	0.5	0.6	0.6	0.4
HD PDBS	**34**	**28.3**	**31.3**	**25.8**	**25.7**	**27.1**	**24.3**	**23.4**	**24.1**	**23.6**
Total	**805**	**794**	**795**	**785**	**785**	**786**	**782**	**777**	**777**	**776**
without TAU LBD	**140**	**124**	**126**	**115**	**114**	**115**	**111**	**107**	**107**	**106**

At the same time, in outside of the TAU LBD, there is a reduction by ≈1/4 of the of water used, including in the basins of the Dniester tributaries (Răut and Botna) by about 15% and in the PDBS HD by over 30% (table 2). The maximum decrease is stated in the Danube river basins, where predominates the surface sources, particularly in the river basins of the Cahul (4 times) and the Kitai (2 times).

The volume of water used from surface sources, on the right bank of the Dniester river, shows a much more pronounced reduction trend of about 35% (Figure 2), including in the rivers Raut, Botna, Ialpug, Cogalnic and Cahul rivers − by over 60%. in the Prut River by over 50% [9]. In addition, in the DBS HS the

volume of water used from surface sources has been reduced by about 4.5 times (from 4.5 million m^3 to 1.0 million m^3)'

At the same time, the volume of waters used from underground sources, on the right bank of the Dniester River, registers a slow growth, which is observed in most river basins.This situation is due to the recent extension of the centralized water supply network, especially for the household needs of the rural population and the majority of water is abstracted through artesian wells built and modernized with the financial support of the National Ecological Fund, German Technical Assistance Fund (GIZ) and other financing sources [3, p. 41].

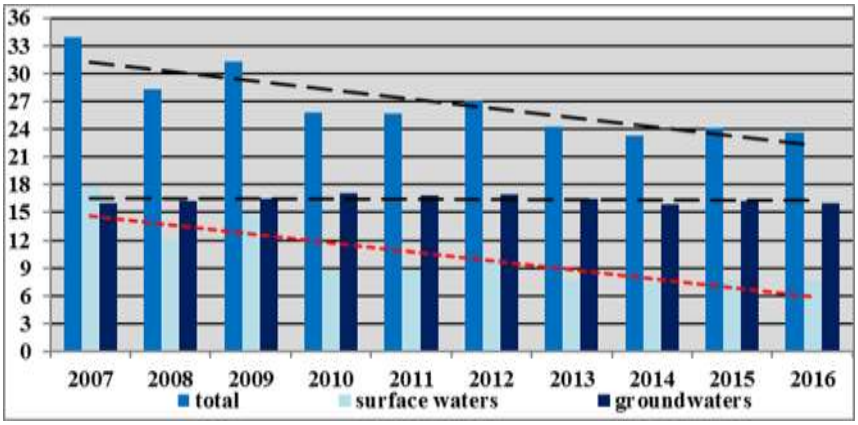

Fig.24. The dynamics of the water use volume in the PDBS HD, in million m^3

At the same time, a great part of newly built water supply networks are not completed with centralized sewerage networks and wastewater treatment plants, which significantly increases harmful impact on the natural environment and the human body.

About ¾ of total volume of used waters in the RM, including in the ***Dniester river basin*** are used by industrial enterprises (table 3), especially by TEP from Dnestrovsk. Also, energy companies with high water consumption are TEP-2 (925 th sm^3) and TEP-1 (209 ths m^3) from Chisinau, TEP from Balti (20 ths m^3), as well as hydroelectric power stations from Dubasari, but the volume of water used by them is not included in the Generalized Water Country Indicators Reports developed by the River Basin Directorate of the Moldovan Water Agency. A similar situation is witnessed in the Costesti-Stânca hydroelectric node, jointly exploited by RM and Romania. The role of food industry and agriculture is more reduced, comparing to other river basins, excepting in the Criuleni, Anenii-Noi and Ştefan-Vodă districts, with a traditional irrigation agriculture, partially destroyed.

In the right bank of Dniester river, on the second positionare situated the agro-food companies, especially sugar factories from the northern region and food company from Chisinau [10]. Among the service companies we can mention medical institutions from Chisinau municipality and from Dubasari and Calarasi districts. Also, in the Dniester riverbed and in the Raut, Botna and Bâc river basins, share of water used for technological purposes is significantly lower than the share of water used for household and agriculture (Table 3).

Table 3. The average volume of water used, by main categories of usage, in the river basins of RM

River basins	total	household		technological		agriculture					
						total		ex. irigation		irigation	
	mil. m³	mil. m³	%	mil. m³	%	mil. m³	%	mil. m³	%	mil. m³	%
Nistru	**760**	**113**	**15**	**578**	**76**	**67**	**8.8**	**25.5**	**3.4**	**41**	**5.4**
Nistru riverbed	165	103	62	21	13	41	25	5.7	3.4	35	21
Răut	13.7	2.3	17	1.2	8.5	10.2	75	8.2	60	2.0	15
Răut riverbed	3.8	1.3	33	0.7	18	1.8	49	1.4	38	0.4	11
Bâc	6.5	2.6	40	1.3	19	2.9	45	2.7	41	0.2	3.5
Botna	2.3	0.3	13	0.1	4.2	1.8	78	1.3	59	0.4	19
Prut	**17.9**	**3.8**	**21**	**1.6**	**9.2**	**12.3**	**69**	**8.3**	**47**	**4.0**	**22**
Prut riverbed	6.9	3.0	44	1.1	15	2.7	39	1.6	23	1.1	17
HS DBS	**8.9**	**2.2**	**24**	**0.3**	**3.5**	**6.0**	**68**	**4.7**	**52**	**1.4**	**16**
Ialpug	4.0	1.0	24	0.13	3.2	2.6	65	2.3	59	0.26	6.4
Cahul	1.0	0.1	13	0.03	3.0	0.5	51	0.3	30	0.21	21
Cogâlnic	2.7	0.9	32	0.06	2.2	1.8	69	1.4	52	0.44	17
Kitai	0.26	0.04	17	0.02	6.8	0.2	76	0.2	74	0.01	2.4
Sărata	0.5	0.13	25	0.01	1.7	0.4	72	0.3	54	0.09	18
Hadjider	0.6	0.06	10	0.07	11	0.6	92	0.17	28	0.39	65
HD PDBS	**26.8**	**5,9**	**22**	**2.0**	**7.3**	**18.4**	**69**	**13**	**49**	**5.4**	**20**
Total	**786**	**121**	**15**	**580**	**74**	**85.2**	**11**	**38,5**	**4.9**	**46.7**	**5.9**
without TAU LBD	116	**58**	**50**	**12**	**10**	**45**	**39**	**31.3**	**27**	**14**	**12**

As a result of the absolute predominance of industrial enterprises from the left bank of the Dniester River, especially of TEP from Dnestrovsk, the total volume of water used in the RM for technological purposes registered an insignificant reduction (Figure 3). As a result of the decline in the volume of industrial productions based on massive water consumption, as well as the transition to technologies with lower water consumption, on the right bank of the Dniester river there is a negative dynamics of the volume of water used for technological purposes.This trend is more pronounced in the cities, which supply

water from the Nistru River basin and river Raut river, including in Balti (-41%), Chisinau (-11%), Soroca, Floresti Sangerei, Teleneşti, Rezina, Orheia nd Criuleni.

For household needs were used, on average, 113 million m^3 or only 15% of water consumption in the Dniester basin (table 3), which conditioned by maximum consumption from Dnestrovsk TEP.However, from Dniester riverbed over 60% of water are used for household needs, because it provides drinking water to the population of the major urban centers of the country, including Chisinau (44 mil. m^3), Bender (20 mil. m^3), Tiraspol (18.6 mil. m^3), Râbniţa (11.2 mil. m^3), Balti (3.4 mil. m^3), Soroca (630 ths m^3), Aneni Noi (383 ths m^3). Moreover, communal enterprises predominate in the most urban centers on both banks of Dniester [10].

The volume of water used for domestic purposes recorded negative dynamics of about 10% (figure 3).This trend is conditioned by the similar reduction of the volume of water used for these purposes in the cities of the Central Region of the RM, which supply water from the Dniester riverbed, including Chisinau, Ialoveni, Anenni Noi, Criuleni and Dubasari, as well as in the waters underground from the basin of the river Bâc. However, there is a positive dynamic of the volume of water used for domestic purposes in the Raut (+16%) and Botna (+35%) river basins, which are predominantly captured from underground sources.

In agriculture are used 67 million m^3 or only 8,8% of the water used in the Dniester basin, including 1% in the TAU LBD. In the right bank of Dniester, share of agriculture exceed 40% of the water used. However, in basins Raut and Botna, the share of agriculture is over 70%. As a result of the higher share of agriculture from total volume of on the right bank of the Dniester River, the volume of water used for these purposes in the Dniester Basin shows a more pronounced reduction trend compared to the volume of water used for technological purposes.Thus, the volume of water used in agriculture decreased by ≈10 million m^3 (16%), from 77 million m^3 to 65 million m^3 (fig. 3).The maximum reduction in the volume of water used in agriculture is also caused by the decrease in the volume of water

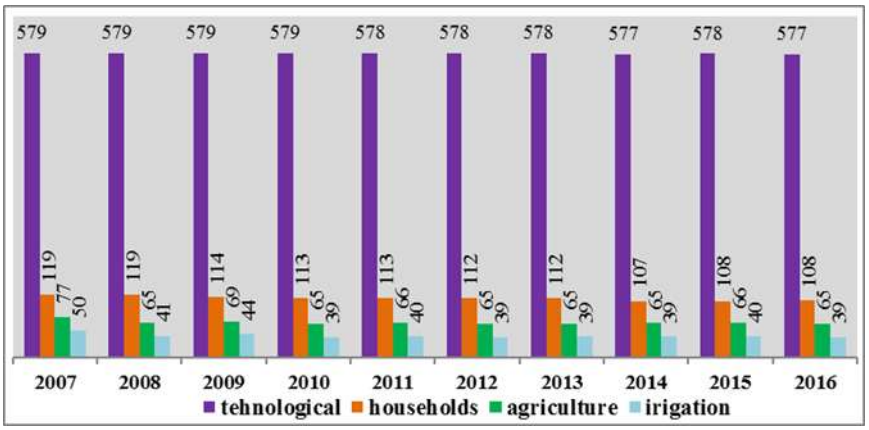

Fig.25.The dynamics of the water use volume, by the usage categories, in the Dniester's HD, in million m^3

captured from the Dniester riverbed, as well as in the Raut and Botna river basins. At the same time, in the Bâc River basin of the is observed an increase of 40%.

For irrigation are used, on average, 41,1 million m^3 (5,4%), including 32,5 million m^3 in the left bank districts (table 3), that have a more extensive and developed irrigation infrastructure. From Dniester riverbed is captured ¾ of the water used for irrigation [9]. On the right bank of Dniester for irrigation are used about 12% of captured water. The maximum volume of water used for irrigation is found in the districts of Stefan-Voda (1.8 mil. m^3), Anenii-Noi (1.5 mil. m^3), and Dubăsari (1.2 mil. m^3). As a result of significant reductions of the water abstraction from surface sources, the volume of water used for irrigation in the Dniester Basin shows a pronounced negative dynamic of over 20%, including more than 60% in the basins of its tributaries - Raut and Botna.

The Răut river basin has a primordial role in the provision of water to the communal and industrial enterprises, especially from Bălţi town, Floreşti, Sângerei and Orhei districts. Also, over 3/4 of captured water are used in agriculture, including 36% for irrigation, 17% for household sector and 9% in the technological purpose (Table 3), especially by food and mining companies. In the Bâc River Basin are located the Chisinau city and several medium-sized urban centers, such as Calarasi Străşeni Anenii-Noi, which is why the share of the communal sector is higher (40%). For irrigation and fisheries water is used only in the lower course of Bâc riverbed, in which goals are constructed artificial lakes. In the Botna river basin over ¾ of captured water is used in agriculture, including 20% for irrigation, especially in lake arrangement along its riverbed in the Ialoveni district.

In the period under review, total volume of used waters in the **Prut-Danube-Black Sea Hydrographical District**, on average, 26.8 million m^3 or only 3.4% from total volume of used waters in the RM and 23% on the right bank of the Dniester River. Also, ≈70% of water is used for agricultural needs (Table 3). The volume of water used in agriculture conditions directly the total volume of used water and its spatial distribution. Excepting the district of Ungheni the agriculture share exceeds 50% and in the districts of Briceni, Râșcani, Nisporeni, Hâncești and Cantemir - 80%. The minimum share for the districts of Ungheni (44%) and Cahul (50%) is due to higher dimensions and industrial specialization of these district centres. The volume of water used in agriculture, especially for irrigation, is conditioned by the surface of basins and administrative territorial units in the perimeter of the hydrographical area, by the water sources used for these purposes and by the presence of big agricultural farms in the region.

The volume of water used in agriculture decreased, on average, with ≈40%, from 25.8 mil. m^3 to 15.7 mil. m^3(Figure 4). Similar to the total volume of used water, the maximum decrease of water used in agriculture is stated in the Danube river basins where predominate surface sources [2], especially in the Cahul (4 times) and the Kitai (6 times) river basins of, as well in the Prut riverbed (2 times).

For irrigation, there are used, on average, 5.4 million m^3 (20%), inclusively 4.0 million m^3 (22%) in the Prut river basin and 16% in the DBS HS. Averagely, 472 thousand m^3 of water were used for irrigation in the Cogâlnic river basin and 407 thousand m^3 in the Hadjider river basin. The maximum share of water used for irrigation is stated in the basins of the Hadjider River (65%) and the Cahul River (21%), while in the administrative districts - in Briceni (54%) and Basarabeasca (31%). The relatively low volume of water used in irrigation is conditioned both by the natural conditions (low flow and insufficient rainfall) and the technical and economic possibilities of water used for irrigation in the region [3, pp.41-42]. The spread of irrigated agriculture has a pronounced azonal character. Thus, despite the fact that relatively uniform rainfall decreases from north to south, the volume of water used for irrigation and other agricultural activities is higher in northern regions. This situation is explained by the higher level of financial provision and the more pronounced commercial character of agriculture in this region.

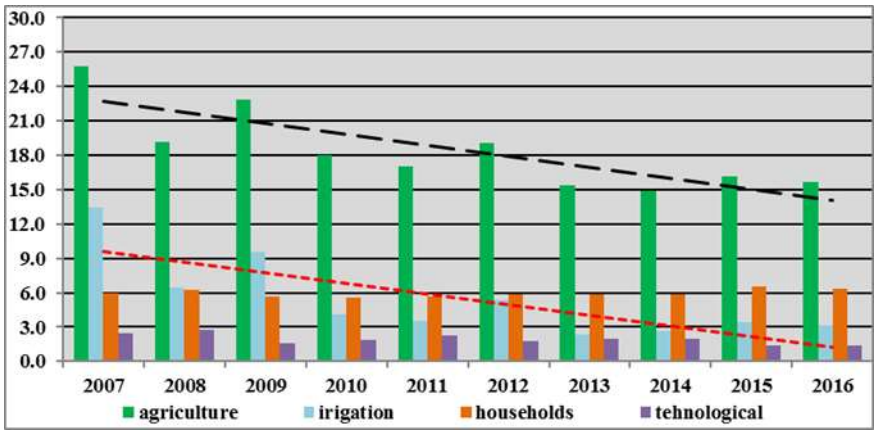

Fig.26. The dynamics of the water use volume, by the usage categories, in the PDBS HD, in million m^3

The total volume of water used in irrigation has decreased by over 4 times, from 13.5 million m^3 to 3.1 million m^3 (figure 4), and has determined the decrease of the total volume of used water, especially from surface sources. This situation is conditioned both by worsening economic situation in agriculture and intensifying of aridity processes as well as by the spread of the phenomenon of incomplete recording of water usage for these purposes. The highest decreasing rates in the volume of water used for irrigation is attested in the district of Edineț and in the medium size river basins of the Ialpug and the Cogâlnic.

For domestic needs there are used, on average, 22% of abstracted water or 5.9 million m^3, including 3.8 million m^3 (21%) in the Prut river basin and 2.2 million m^3 (24%) in the DBS HS. The volume of water used for these purposes is determined by the number and size of serviced urban centres and the rural areas which have extensive centralized water supply networks and perform water use registering. Thus, the maximum volume of water used for domestic purposes is registered in the districts of Ungheni (1.2 million m^3), Cahul (1.1 million m^3) and TAU Gagauzia (856 thousand m^3). As a result of the expansion of rural water supply networks that are supplied almost exclusively from underground water sources, it has similarly increased water volume and share for domestic needs (fig. 4). However, a large part of water for domestic needs supplied to population is widely used in the household for irrigation and breading farm animals etc.

For technological purposes there are used, on average, 2.0 million m^3 or 7.3% of the total volume of water used in the PDBS DH and 17% of water used for the same purposes on the right bank of the Dniester river (Table 3). The share of water used for technological purposes in the Prut river basin is higher (9.3%) and is

due to the presence of industrial centres such as Ungheni and Cahul. In the branch structure we find as predominant the food industry enterprises, followed by the mining and building materials enterprises, commercial and service centres, especially health and education institutions, markets and car wash stations. Most mining enterprises keep incomplete recordings not only of water management indices, but also of economic and financial activities and tax evasion is of especially large proportions, far exceeding declared activities and income.

The total volume of water used for technological purposes registers a fluctuating evolution on the background of a general decreasing tendency (≈2 times) marked by decline in the agro-industrial complex.

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Dniester basin contributes over 90% of the total volume of captured and used water, of which over 80% are enterprises from TAU LBD, which determines the overall situation in the Republic. The absolute majority of localities on both banks of Dniester are supplied from groundwater sources and Dniester River and its tributaries receiver function performs only natural wastewater discharged.

If we exclude Dnestrovsk TEP, then the total volume of used water in the RM is conditioned by the number and size of urban centres, as well as by the level of recording and monitoring of the water use for domestic and agricultural purposes, including irrigation, especially in rural areas. Thus, due to the incomplete presentation of water consumption data, especially outside localities, the official water management indicators do not contain the complete information needed to achieve efficient water resource management. At the same time, the official data available allow us to know sufficiently the situation regarding the water consumption in the river basins and the administrative-territorial units of the Republic of Moldova in order to effectively promote policies and strategies for the sustainable use of water resources.

Approximate 70% of abstracted water from PDBS HD is used for agricultural purposes (inclusively 21% for irrigation), 22% for domestic purposes and only 7,3% for technological purposes.

The volume of water used in agriculture, especially for irrigation, is conditioned by the surface of basins and administrative territorial units in the perimeter of the hydrographical area, by the water sources used for these purposes and by the presence of big agricultural farms and of zonal irrigation stations.

In the period under review, the volume of water used in the PDBS HD and in the right tributaries of Dniester river registers a significant decrease which is conditioned, mainly, by similar decreasing in water volume abstracted from surface water sources and used for different agricultural activities, especially for irrigation.

Despite recent significant expansion of water supply network, the most of rural population continues to use polluted water from wells. In addition, many of the water supply networks in rural areas are not completed with centralized sewerage networks and wastewater treatment plants which increases the harmful impact on natural environment and human body.

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