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COMPARATIVE RESEARCH OF INDICATORS OF FRESH WATER UTILIZATION ASSESSED IN DIFFERENT COUNTRIES AND REGIONS

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Abstract

Freshwater is a symbol of the concept of “life” in the modern world because the existence of human society, as well as flora and fauna is conditioned by this unique resource. However, water productivity differs greatly which indicates the existence of insufficient socio-economic tools for that resource and low efficiency of using those tools as it is shown by the study of freshwater resources in different countries and regions of the world as well as economic unions. Especially through the qualitative indicator of the utilization of freshwater resources, it is possible to find out the factors influencing the freshwater and the state of its utilization in a certain country or region of the world which makes it possible to develop an effective policy in the field and rational use of this unique resource. The importance of this issue and the ways of policy improvement became a subject of discussion in the program of the RA Government for 2021-2026.

***Key words**:* fresh water, annual freshwater withdrawals, water productivity, freshwater consumption indicators, classification of countries according to freshwater consumption indicators, the best and the worst indicators, irrigation system.

Introduction

The "Freshwater utilization" section of the World Development Indicators published by the World Bank on fresh water resources, their quantity, utilization and a number of other indicators, presents the main indicators of the sector. This publication, as a matter in fact, includes almost all indicators related to the water resources in almost all countries worldwide. Such a publication is valuable not only in terms of providing information on freshwater resources, but also in providing an opportunity to compare data on freshwater resources in different countries, which can lead to clear and accurate conclusions about the development of the water sector. It is noteworthy that these data make it possible not only to make comparisons between transboundary water using two or more countries, but also to complete data for different groups of countries based on these data, thereby formulating the water sector policy and its components. All this is possible due to the general and unified methodology developed on the fresh water utilization which is especially important in the development of complex targeted programs for the water resources usage in the Republic of Armenia. In this sphere, there are not only different interpretations of the concepts and terminology used, but also often diametrically opposed statements about the same phenomenon by different authors, which complicate the process of implementation of programs of fresh water utilization and policy development.

The study of productivity indicator of freshwater in the Republic of Armenia, the analysis of its dynamics, as well as the problem of reducing water losses are especially important.

Problem statement and methodology

The publication of the World Bank makes it possible to unify the terms used creating the methodological basis of this sphere of study, to take them out of their "national case" and to internationalize the sphere.

In the "Freshwater" section, the World Bank's experts define the following key concepts and their content, or, in other words, how these databases were formed. This methodology has been developed through the definition of the following concepts.

Renewable internal freshwater resources flows refer to internal renewable resources (internal river flows and groundwater from rainfall) in the country.

Annual freshwater withdrawals, total (billion cubic meters). Annual freshwater withdrawals refer to total water withdrawals not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for agriculture and industry are total withdrawals for irrigation and livestock production and for direct industrial use (including withdrawals for cooling thermoelectric plants). Withdrawals for domestic uses include drinking water, municipal use or supply and use for public services, commercial establishments and homes. Data are for the most recent year available for 1987-2002.

Annual freshwater withdrawals, agriculture (per cent of total freshwater withdrawal). Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals are total withdrawals for irrigation and livestock production for agriculture. Data are for the most recent year available for 1987-2002.

Annual freshwater withdrawals, industry (per cent of total freshwater withdrawal). Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for industry are total withdrawals for direct industrial use (including withdrawals for cooling thermoelectric plants). Data are for the most recent year available for 1987-2002.

Annual freshwater withdrawals, domestic (per cent of total freshwater withdrawal). Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for domestic uses include drinking water, municipal use or supply, and use for public services, commercial establishments and homes. Data are for the most recent year available for 1987-2002.

Water productivity, total (constant 2010 US$ GDP per cubic meter of total freshwater withdrawal). Water productivity is calculated as GDP in constant prices divided by annual total water withdrawal.

People using at least basic drinking water services, urban (per cent of urban population). The percentage of people using at least basic water services. This indicator encompasses both people using basic water services as well as those using safely managed water services. Basic drinking water services is defined as drinking water from an improved source and provided collection time is not more than 30 minutes. Improved water sources include piped water, boreholes or tube wells, protected dug wells, protected springs and packaged or delivered water.

People using at least basic drinking water services, rural (per cent of rural population). The percentage of people using at least basic water services. This indicator encompasses both people using basic water services as well as those using safely managed water services. Basic drinking water services is defined as drinking water from an improved source, provided collection time is not more than 30 minutes. Improved water sources include piped water, boreholes or tube wells, protected dug wells, protected springs, and packaged or delivered water [1].

This paper will study the statistical series on freshwater resources and make analyses and comparisons on this basis. They have made it possible to identify the state of freshwater utilization both in individual countries and in separate groups of countries. The efficiency of usage of fresh water resources and water productivity indicators in the Republic of Armenia was especially emphasized in the context of interstate combinations, and especially in identification of shortcomings in the sector and the elimination of current omissions through effective management.

Study outcomes

Taking into account the fact that the Republic of Armenia is a full member of the Eurasian Economic Union (EEU), Table 1 shows the indicators of freshwater withdrawal and use in the EEU member states. According to Table 1, the freshwater resources of the Republic of Armenia (6,9 billion cubic meters) are the smallest among the EEU member states, and the largest resources are in the Russian Federation (4312,0 billion cubic meters) or the EEU freshwater resources per country averaged 893,2 billion cubic meters. According to the data on the annual withdrawal of fresh water in the Republic of Armenia, it exceeds the indicator of Belarus by 2,2 times, while the population of Belarus exceeds the population of the Republic of Armenia by 3 times. This circumstance is

conditioned by the fact that the annual freshwater withdrawal indicator in Armenia (as a percentage of domestic resources) is 42,9 per cent, and in Belarus it is 4,5 per cent, in the Russian Federation it is the lowest – 1,4 per cent. It is noteworthy that in the structure of the use of fresh water withdrawn annually, the average breakdown of the water use in the EEU countries is as follows: agricultural - 70,25 per cent, industrial -17,50 per cent and household and drinking purposes – 12,25 per cent. Among the EEU member states, the largest share of fresh water used in agriculture in the total volume of consumption is in the Kyrgyz Republic (93 per cent), followed by the Republic of Armenia (90 per cent), then by Kazakhstan (66 per cent), while the largest volume of fresh water used in industry is in Belarus (32 per cent), then in Kazakhstan (30 per cent) and in Armenia and Kyrgyzstan they have the same size – 4 per cent each. Among the EEU countries, the highest water productivity was recorded in Belarus ($ 43), followed by the Russian Federation ($ 26) and the third in Kazakhstan ($ 9). In Armenia it was 4,0 US dollars, and in Kyrgyzstan – 1,0 US dollar.

The Republic of Armenia has 99,9 per cent of the urban population provided with at least basic drinking water services and Belarus has the lowest rate of 96,0 per cent, for rural population this indicator is the highest in Armenia with 100 per cent and Kyrgyzstan with the lowest rate of 82 per cent.

Table 1

Indicators of freshwater extraction and consumption in the EEU member states

	Flows	Annual freshwater withdrawals					Water productivity, GDP/water utilization	People using at least basic drinking water services	
	billion cu. m	billion cu. m	Per cent of internal resources	Per cent for agriculture	Per cent for industry	Per cent of domestic	2010 $ per cu. m	Per cent of urban population	Per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
Armenia	6,9	3,3	42,9	90	4	6	4	99,9	100
Belarus	34	1,5	4,5	32	32	36	43	96,0	98,3
Kazakhstan	64,4	20	31	66	30	4	9	98,1	92,3
Kyrgyz Republic	48,9	7,7	15,8	93	4	3	1	97,1	82,0
Russian Federation	4,312,0	61	1,4	..	..	..	26	98,6	92,6
Average for EEU countries	893,24	18,70	19,12	70,25	17,50	12,25	16,60	97,94	93,04
Total for EEU countries	4466,2	93,5	2,09	..	..	..	..	..	..

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

From a regional point of view, the study of indicators of freshwater withdrawal and utilization for Armenia and its neighboring countries is of considerable interest. Such a comparative analysis is important not only from the point of view of the study of indicators between the countries of the region, but also due to the fact that it is conditioned by the circumstance that these indicators can be used to determine which country “supplies” its neighboring country with the necessary resources, as

water flows from one country to another. According to geographical factors, freshwater from a country with a higher geographical location flows through rivers to countries with a lower geographical location. This is evidenced by the data presented in Table 2, which shows that the flow of fresh water in Azerbaijan amounted to 8,1 billion cubic meters, while the annual withdrawal of fresh water in that country amounted to 12 billion cubic meters, or this index relative to domestic resources accounted for 147,5 per cent. This means that about half of the fresh water withdrawn in Azerbaijan is produced in neighboring countries, particularly in the Republic of Armenia. It is sufficient to say that only 42,9 per cent of the internal fresh water flow of the Republic of Armenia (6,9 billion cubic meters) is extracted and the rest – 3 to 6 billion cubic meters per year flows to the neighboring country. It turns out that the Republic of Armenia greatly contributes to the development of Azerbaijan's economy by supplying the country with one of the most expensive resources in the modern world: fresh water free of charge.

In terms of the use of domestic fresh water resources, the most tense situation among the neighboring countries of Armenia is in the Islamic Republic of Iran where 72,5 per cent of domestic resources are used, in Turkey the figure is 18,5 per cent, and in Georgia – 3,1 per cent. Despite such a picture, the water productivity index in Armenia was $ 4, in Azerbaijan - $ 4, in Iran - $ 6, in Turkey - $ 20 and in Georgia - $ 9. In other words, in Turkey one cubic meter water productivity is 5 times higher than that in Armenia. If we assume that the productivity of fresh water in Armenia would be not 4, but 20 US dollars, then the amount of GDP in our country could be not 13, but 65 billion dollars.

Table 2

Indicators of freshwater extraction and consumption in the neighboring countries of Armenia

	Flows	Annual freshwater withdrawals					Water productivity, GDP/water use	People using at least basic drinking water services	
	billion cu. m	billion cu. m	Per cent of internal resources	Per cent for agriculture	Per cent for industry	Per cent of domestic	2010 $ per cu. m	Per cent of urban population	Per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
Armenia	6,9	3,3	42,9	90	4	6	4	99,9	100
Azerbaijan	8,1	12,0	147,5	84	19	..	4	99,3	81,6
Georgia	58,1	1,8	3.1	..	22	..	9	100	96,2
Iran	128,5	..	72,5	..	..	..	6	97,4	89,0
Turkey	227	42	18,5	81	..	..	20	98,6	99,6
Average for countries	85,7	14,8	56,9	85,0	15,0	6,0	8,6	99,0	93,3
Total for countries	428,6	59,1	13,8	..	..	..	..	..	..

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

What is the pattern between the annual quantities of freshwater withdrawal and indicators of freshwater productivity? It is natural to think that the smaller is the quantity of freshwater withdrawal, the more efficient (productive) it should be. This principle is the basis of the theory of resource scarcity as a pricing factor. However, as shown in Table 3, such a logical assumption is true only under certain conditions or circumstances. In our example, there are many direct and indirect conditions and circumstances that "deviate" from this most important economic regularity or connection. In the field of water economics, the assertion that the economics of supply rather than demand is primary here [2, p. 79-100, 126-147]. The essence of the latter is that in any country or region fresh water resources are limited, they can not be artificially increased, for example, it can be done for consumer goods (clothes, shoes, etc.) or services. The next circumstance is conditioned by the essence of fresh water as a special consumer value, for fresh water is not a "common" product, especially when used in households, because any citizen of any country has a natural right to access fresh water resources. Undoubtedly, while studying the relation between the volumes of the withdrawn water and water productivity the structure of the economy of a given country is important. The share of agriculture in GDP, the way and efficiency of organizing the economy, the share of internal resources (formed in the given country) in the structure of withdrawn water, and the ideas and attitudes of the society and its members toward the water as an important resource is also important.

Table 3

Classification of the best and worst countries in terms of annual freshwater production (billion cubic meters)

	Flows	Annual freshwater withdrawal					Water productivity, GDP/water use	People using at least basic drinking water services	
	billion cu. m	billion cu. m	per cent of internal resources	per cent for agriculture	per cent for industry	per cent of domestic	2010 $ per cu. m	per cent of urban population	per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
India	1,446.0	647,5	44.8	90	2	7	4	96	91
China	2,813.0	594,2	21,3	64	22	13	17	97,7	86,2
United States	2,818,0	418,7	14,9	36	51	13	39	99,8	97
Pakistan	55,0	183,5	333,6	94	1	5	1	94,2	89,9
Mexico	409,0	85,7	20,0	76	9	15	15	100	96,6
Vietnam	359,4	81,9	22,8	..	4	..	2	98,6	92,6
Philippines	479,0	81,6	17,0	82	10	8	3	97,7	90
Japan	430,0	81,2	18,9	67	14	19	76	..	..
Brazil	5,661,0	74,8	1,3	60	17	23	35	99,5	89,7
Egypt, Arab Rep.	1,8	73,8	4,100,0	86	3	12	4	99,5	98,8
Russian Federation	4,312,0	61,0	1,4	..	..	..	26	98,6	92,6
Thailand	224,5	57,3	25,5	90	5	5	7	99,9	100

1	2	3	4	5	6	7	8	9	10
Italy	182,5	53,8	29,5	..	..	18	62	99,5	99,4
Uzbekistan	16,3	49,2	300,9	..	3	..	1	99,6	96,1
Turkey	227,0	42,0	18,5	81	..	..	20	98,6	99,6
Central African Republic	141,0	0,1	0,1	..	17	..	24	64,7	33,7
Fiji	28,6	0,1	0,3	..	11	..	48	97,8	88,7
Barbados	0,1	0,1	87,5	..	8	..	66	..	..
Gabon	164,0	0,1	0,1	..	10	..	137	89,6	55,1
Dominica	0,2	0	10	5	0	95	23	..	..
St Lucia	0,3	0	14,3	71	0	29	38	97,8	98,2
Grenada	0,2	0	7,1	15	0	85	60	..	..
St Kitts and Nevis	0,0	0	51,3	1	0	99	71	..	..
St Vincent and the Grenadines	0,1	0	7,9	0	0	100	94	..	..
Seychelles	..	0	..	..	28	..	119	..	..
Malta	0,1	0	44,4	64	2	34	307	100	100
Antigua and Barbuda	0,1	0	8,5	16	22	63	308	..	..
Maldives	0,0	0	15,7	0	5	95	828	98.3	99,9
Monaco	..	0	..	0	0	100	1,430	100	..
Luxembourg	1	0	4,3	1	5	95	1,431	100	98,8

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

It follows from Table 3, that the world's largest freshwater is withdrawn in India where water productivity is one of the lowest in the world (GDP against one cubic meter water is $ 4). Water productivity in China, which takes the second place, is $ 17, and in the United States, which is in the third place, is $ 39. It is also obvious that the share of internal flows in the volume of withdrawn water has a significant impact on the amount of water productivity in the mentioned countries. For these countries, this index was 44,8 per cent, 21,3 per cent and 14,9 per cent respectively. That is, the lower the weight of internal flows in the volume of withdrawn fresh water, the higher the water productivity. This pattern is clearly seen in the example of Pakistan, which is in the fourth place, where a small portion of annually withdrawn freshwater is domestic water, and most of the water used by that country comes from the water resources of neighboring countries. According to that, the water productivity index is 1,0 US dollar. The data presented at the end of Table 3 (countries with the worst annual freshwater withdrawal are tabulated) show that water productivity is relatively high in countries with low freshwater inflows and/or low inflows in withdrawn water resources. Let's just mention that in two countries with the highest water productivity, in Monaco and Luxembourg, it was 1430 and 1431 US dollars, respectively.

The results of our study show that freshwater resources are highly unequally distributed within individual countries or countries that are part of separate regions.There are many countries where the “lion's share” of annually withdrawn of freshwater is formed in the territory of that state, and in others due to the outflow of water from the geographical areas of those states. In other words, for this group of countries there is a great dependence on the volumes of annual freshwater withdrawal from

neighboring countries. This is the reason why in such cases disputes and conflicts (even military) over the "fair" distribution of water resources arise between neighboring countries.

The classification of the best and worst countries by the indicator of annual freshwater withdrawal (percentage of internal resources) is given in Table 4. According to the data, there is no significant correlation between indicators of annual freshwater withdrawal (percentage of domestic resources) and water productivity. This is the case, for example, for Bahrain, where the highest dependence on annual freshwater withdrawal (percentage of domestic resources) is a fairly high water productivity indicator of $ 214. Meanwhile, for Egypt and Turkmenistan, which, according to the mentioned classification take the "best" second and third places, the water productivity indicators are 4 and 2 USD, respectively. The table shows the list of countries (the first part of the table) whose freshwater withdrawal is highly dependent on the inflow of water resources from neighboring countries. The second part of the table also does not show a direct dependence between the "internal resources" and the fresh water withdrawal.

Table 4

Classification of the best and worst countries in terms of annual freshwater production (in per cent of domestic resources)

	Flows	Annual freshwater withdrawals					Water productivity, GDP/water use	People using at least basic drinking water services	
	billion cu. m	billion cu. m	per cent of internal resources	per cent for agriculture	per cent for industry	per cent of domestic	2010 $ per cu. m	per cent of urban population	per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Bahrain	0	..	5,967,5	..	..	..	214	..	..
Egypt, Arab Rep.	1,8	73,8	4,100,0	86	3	12	4	99,5	98,8
Turkmenistan	1,4	..	1,983,6	..	..	..	2	100	97,6
United Arab Emirates	0,2	2,8	1,866,7	..	2	..	154	..	..
Saudi Arabia	2,4	22,6	943,3	88	3	9	32	..	..
Libya	0,7	5,8	822,9	83	5	12	8	..	..
Sudan	4	26,9	673,3	96	0	4	3	73,8	53,2
Qatar	0,1	0,2	387,5	..	2	..	700	..	..
Mauritania	0,4	1,3	337,0	..	2	..	5	89,3	49,9
Pakistan	55	183,5	333,6	94	1	5	1	94,2	89,9
Uzbekistan	16,3	49,2	300,9	..	3	..	1	99,6	96,1
Syrian Arab Republic	7,1	14,1	198,3	..	4	..	..	99	95,2
Israel	0,8	..	189,2	..	..	..	249	100	100
Yemen, Rep.	2,1	3,5	168,6	..	2	..	5	79,1	54,7
Azerbaijan	8,1	12	147,5	84	19	..	4	99,3	81,6

1	2	3	4	5	6	7	8	9	10
Peru	1,641,0	13,6	0,8	89	2	9	12	95,6	75,6
Panama	136,6	1	0,8	43	1	56	39	98,1	92,9
Norway	382	3	0,8	28	41	31	180	100	100
Bolivia	303,5	2,1	0,7	92	2	7	13	99,4	78,1
Guyana	241	1,4	0,6	94	1	4	3	100	93,9
Suriname	99	0,6	0,6	70	22	8	7	98,2	90
Colombia	2,145,0	11,8	0,5	54	19	27	27	99,9	86,4
Angola	148	0,7	0,5	..	34	..	144	71,2	27,4
Bhutan	78	0,3	0,4	94	1	5	7	98	96,7
Fiji	28,6	0,1	0,3	..	11	..	48	97,8	88,7
Sierra Leone	160	0,2	0,1	..	26	..	16	75,8	50,1
Central African Republic	141	0,1	0,1	..	17	..	24	64,7	33,7
Congo, Dem. Rep.	900	0,7	0,1	..	21	..	49	69,3	22,8
Gabon	164	0,1	0,1	..	10	..	137	89,6	55,1
Papua New Guinea	801	0,4	0,0	..	43	..	53	85,8	34,6

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

Among the World Bank indicators on fresh water, without underestimating the role and effectiveness of other indicators, it should be noted that the efficiency of the use of this important natural resource is characterized by water productivity. Although freshwater has no alternative consumer value in the modern world, which makes it an exceptionally unique resource, water productivity varies greatly from country to country (Table 5). It is easy to see from the data in the table that the main indicator characterizing the efficiency of utilization of fresh water differs hundreds of times by countries. It should be noted that the Republic of Armenia is also not distinguished by the efficiency of utilization of fresh water being included in the list of the worst countries according to that indicator (21st place at the end).

Table 5

Classification of the best and worst countries in terms of GDP/water use

	Flows	Annual freshwater withdrawals					Water productivity, GDP/water use	People using at least basic drinking water services	
	billion cu. m	billion cu. m	per cent of internal resources	per cent for agriculture	per cent for industry	per cent of domestic	2010 $ per cu. m	per cent of urban population	per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Luxembourg	1	0	4,3	1	5	95	1,431	100	98,8
Monaco	..	0	..	0	0	100	1,430	100	..

1	2	3	4	5	6	7	8	9	10
Maldives	0	0	15,7	0	5	95	828	98,3	99,9
Equatorial Guinea	26	..	..	..	..	..	715	78,1	30,8
Qatar	0,1	0,2	387,5	..	2	..	700	..	..
Singapore	0,6	..	..	..	..	..	654	100	..
Denmark	6	0,6	10,6	25	20	55	492	100	100
Ireland	49	0,8	1,5	..	7	83	456	97	98,1
Switzerland	40,4	2	5	8	32	60	379	100	100
United Kingdom	145	8	5,5	13	14	71	337	100	100
Antigua and Barbuda	0,1	0	8,5	16	22	63	308	..	..
Malta	0,1	0	44,4	64	2	34	307	100	100
Congo, Rep.	222	..	..	..	..	..	280	87,1	45,7
Israel	0,8	..	189,2	..	..	..	249	100	100
Sweden	171	2,7	1,6	4	58	38	243	100	100
Armenia	6,9	3,3	42,9	90	4	6	4	99,9	100
Azerbaijan	8,1	12	147,5	84	19	..	4	99,3	81,6
Egypt, Arab Rep.	1,8	73,8	4,100,0	86	3	12	4	99,5	98,8
India	1,446,0	647,5	44,8	90	2	7	4	96	91
Eritrea	2,8	..	20,8	..	..	..	3	89,7	27,8
Guyana	241	1,4	0,6	94	1	4	3	100	93,9
Mali	60	5,2	8,6	98	0	2	3	92,2	68,3
Philippines	479	81,6	17	82	10	8	3	97,7	90
Sudan	4	26,9	673,3	96	0	4	3	73,8	53,2
Lao PDR	190,4	3,5	1,8	..	5	..	2	94,4	75,6
Myanmar	1,003,0	..	..	..	..	..	2	93	76,9
Nepal	198,2	9,5	4,8	98	0	2	2	89,1	88,7
Turkmenistan	1,4	..	1,983,6	..	..	..	2	100	97,6
Vietnam	359,4	81,9	22,8	..	4	..	2	98,6	92,6
Afghanistan	47,2	..	..	..	..	..	1	95,9	57,3
Kyrgyz Republic	48,9	7,7	15,8	93	4	3	1	97,1	82
Madagascar	337	13,6	4	96	1	3	1	85,8	36,3
Pakistan	55	183,5	333,6	94	1	5	1	94,2	89,9
Tajikistan	63,5	11,2	17,6	91	4	6	1	96,2	75,6
Timor-Leste	8,2	..	14,3	..	..	..	1	98,3	69,7
Uzbekistan	16,3	49,2	300,9	..	3	..	1	99,6	96,1

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

Let us now take a closer look at the movement of the water productivity indicator recently considering it as the main indicator for assessing the efficiency of the utilization of fresh water resources which is calculated in terms of the ratio of GDP of a country to the water resources used to achieve that GDP, as well as attaching the importance to the role of fresh water in the development of the RA economy. Table 6 shows the movement of GDP, freshwater intake and water productivity (GDP/ water intake amount) in Armenia in 2000-2019 according to which the index of water

productivity in Armenia increased during the mentioned period 4,7 times, from 1,02 US dollars in 2000 to 4,77 US dollars in 2019. However, the comparison of the water productivity index of the Republic of Armenia with the water productivity indices of other countries reveals the inefficiency of that index in the Republic of Armenia.

Table 6

Movement of GDP, indicators of freshwater intake and water productivity (GDP/water intake) in Armenia in 2000-2019

Years	GDP		Water intake		Water productivity, GDP / water intake	The average annual number of de jure population, 1000 people
	Million US dollar	Per capita, US dollar	Million cubic meter	Per capita, cubic meter		
1	2	3	4	5	6 (u. 2 / u. 4)	7
2000	1,912,0	593	1,871,2	580,9	1,02	3,221,1
2005	4,900,0	1,523	2,770,6	861,1	1,77	3,217,5
2010	9,260,0	2,844	2,126,4	653,1	4,35	3,256,1
2011	10,142,0	3,363	2,438,3	808,6	4,16	3,015,6
2012	10,619,4	3,512	2,941,1	972,6	3,61	3,024,1
2013	11,121,3	3,680	2,955,1	977,9	3,76	3,022,0
2014	11,609,5	3,852	2,860,2	949,0	4,06	3,013,8
2015	10,553,3	3,512	3,271,7	1,088,9	3,23	3,004,6
2016	10,546,1	3,524	3,181,9	1,063,4	3,31	2,992,3
2017	11,527,4	3,869	2,865,4	961,7	4,02	2,979,4
2018	12,457,9	4,196	2,714,4	914,2	4,59	2,969,0
2019	13,672,7	4,615	2,865,4	967,2	4,77	2,962,5

The source was compiled by the authors based on data from National accounts of Armenia, 2013, RA Statistical Committee (SC), 2013, page 23, National accounts of Armenia, 2020, RA SC, 2020, page 9, Chronological series published by the RA SC - https://armstat.am/am/?nid=12&id=14004

The index of water productivity calculated by the World Bank, in fact, characterizes the size of the country's GDP achieved from the use of one cubic meter of water. This index can be considered as one of the key parameters of the use of fresh water resources, or, in other words, it can be defined as a measure of the efficiency of utilization of water resources. According to the latest publications of the World Bank on this index, it fluctuates strongly both by individual continents and individual countries. The difference is especially big in the international combinations of indices of individual countries. Thus, this index, calculated for 2015, has the lowest value (in US dollars in 2010 per one cubic meter of water) in countries such as Afghanistan, Madagascar, Pakistan, Kyrgyzstan, Tajikistan, Uzbekistan (GDP/water use ratio is 1,0), Laos DF, Myanmar, Nepal, Turkmenistan and Vietnam is 2,0, Eritrea, Guyana, Mali, Philippines and Sudan is 3,0, and in Armenia, Azerbaijan, Egypt and India – 4,0. Note also that, grouped by income level, this figure is equal to 4,0 for a group of low-income countries, as well as for a group of middle-income countries, 15 and 57 for a group of high-income

countries. For comparison, the following countries have the highest water productivity indices: Luxembourg (1431), Monaco (1430), Maldives (828), Equatorial Guinea (715), Qatar (700), Singapore (654), Denmark (492), Ireland (456), Switzerland (379), United Kingdom (337), Antigua and Barbuda (308), Malta (307) Republic of the Congo (280), Israel (249) and Sweden (243) [1]. In the neighboring countries of the Republic of Armenia, water productivity indices were 9 in Georgia, 6 in the Islamic Republic of Iran and 20 in Turkey [1].

The study of relevant data also proves the low efficiency of fresh water use in the Republic of Armenia [3]. It follows from their analysis that from 2011 to 2019 freshwater losses were significant. Thus, in 2012 the loss accounted to 754,0 million cubic meters (which accounted for 25,6 per cent of water intake in 2012), and in 2019 the total losses amounted to 741,7 million cubic meters or only 25,9 per cent of the water intake that year. That is, in the mentioned period the index of water losses increased by 0,3 points.

The analysis proves that the data on fresh water losses in Armenia are conditional, as they do not reflect the real situation. The reason for the latter is that the economic structures in the system of water use do not promote the reduction of losses, but on the contrary, they contribute to the inefficient use of water resources.

The program of the Government of the Republic of Armenia for 2021-2026 [4] emphasizes the increase of efficiency of the water systems and water resources management of the country which testifies the need to expand the management toolkit in the field of water relations and increase their efficiency. In particular, it is mentioned that the policy of water sector of the government is aimed at providing the population with supply of drinking water (water supply) and drainage (wastewater treatment), reliable, stable, safe and accessible irrigation water supply services and the development of reforms in the water sector.

The activities of the government are based on ensuring the modernization of water systems, attracting investments, increasing the efficiency of the management of state-owned water systems, improving the legislation regulating the sector and efficient and economical use of water resources.

Projects of reservoir construction will continue to manage surface runoff. Due to them, we will have additional water resources, a management system of efficient water flow by creating opportunities for the supply of gravity irrigation water. 15 reservoirs will be designed and their construction will begin.

In order to solve the existing problems in the field of irrigation, in order to improve the situation, it is envisaged to:

- carry out necessary legislative and structural reforms;
- continuously equip irrigation systems with modern water metering equipment and equip with data collection and control system;
- carry out a comprehensive technical audit and develop and apply capital investment approaches and criteria on its basis;
- implement capital investments for the rehabilitation of irrigation systems and investment policy.

The government will promote the use of new technologies to save water including the introduction of drip irrigation and sprinkler irrigation systems as well as the use of compensation mechanisms of irrigation water charge.

By 2023, it is planned to complete the reconstruction of inter-economic and in-house irrigation networks. With the construction of irrigation systems, 7,3 million kWh of electricity will be saved annually and irrigated lands will increase by 1373 hectares. In 105 settlements of five provinces about 259,1 km of internal economic systems will be restored. Extremely destroyed and emergency sections of 8,2 km long and 54,1 km long 22 second-class canals will be restored. Due to this, the access to

irrigation water supply will be expanded, the losses in the rehabilitated areas will be gradually reduced by about 7 per cent and a stable, uninterrupted water supply will be provided to those lands.

The government will implement investment programs in the field of drinking water. By the end of 2023, urgent restoration works of water supply and drainage systems of 11 cities, 6 rural settlements and 41 rural settlements and restoration of distribution networks will be carried out.

Conclusion

As a result of the study, the general tendencies of utilization of fresh water in different countries and regions of the world, the patterns and regularities, the index of water productivity in this or that country, the main factors influencing it and the degree of dependence of individual countries on drinking water resources in neighboring countries were revealed. The importance of increasing the efficiency of utilizing water resources in the Republic of Armenia and the issue of increasing the efficiency of water resources and systems management in that sphere were especially emphasized. The ways that will make the achievement of solution of the mentioned problems possible were also mentioned.

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ՔԱՂՑՐԱՀԱՄ ՋՐԻ ՕԳՏԱԳՈՐԾՄԱՆ ՄԻՋԵՐԿՐԱՅԻՆ ԵՎ ՏԱՐԱԾԱՇՐՋԱՆԱՅԻՆ ՑՈՒՑԱՆԻՇՆԵՐԻ ՀԱՄԵՄԱՏԱԿԱՆ ՈՒՍՈՒՄՆԱՍԻՐՈՒԹՅՈՒՆ

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Ժամանակակից աշխարհում քաղցրահամ ջուրը «կյանք» հասկացության խորհրդանիշն է, քանի որ ինչպես մարդկային հասարակության, այնպես էլ բուսական և կենդանական աշխարհի գոյությունը պայմանավորված է այդ բացառիկ ռեսուրսով: Սակայն ինչպես ցույց է տալիս աշխարհի առանձին երկրներում և տարածաշրջաններում, նաև տնտեսական միություններում, քաղցրահամ ջրի պաշարների օգտագործման ցուցանիշների ուսումնասիրությունը, ջրի արտադրողականությունը խիստ տարբերվում է, ինչը վկայում է այդ ռեսուրսի նկատմամբ անբավարար սոցիալ-տնտեսական գործիքակազմի առկայության և այդ գործիքակազմի կիրառման ցածր արդյունավետության մասին: Հատկապես քաղցրահամ ջրի պաշարների օգտագործման որակական ցուցանիշի՝ ջրի արտադրողականության միջոցով հնարավոր է

դառնում պարզելու այս կամ այն երկրի կամ տարածաշրջանի քաղցրահամ ջրի և դրա օգտագործման վիճակի վրա ազդող գործոնները, ինչն էլ հնարավոր է դարձնում ոլորտում արդյունավետ քաղաքականության մշակումը և այդ եզակի ռեսուրսի ռացիանալ օգտագործումը: Այս հիմնախնդրի կարևորությունը և զարգացման ուղիները քննարկման առարկա դարձան նաև ՀՀ կառավարության 2021-2026 թվականների ծրագրում:

Բանալի բառեր. քաղցրահամ ջուր, քաղցրահամ ջրի տարեկան արդյունահանում, ջրի արտադրողականություն, քաղցրահամ ջրի օգտագործման ցուցանիշներ, երկրների դասակարգում ըստ քաղցրահամ ջրի օգտագործման ցուցանիշների, լավագույն և վատագույն ցուցանիշներ, ոռոգման համակարգ:

СРАВНИТЕЛЬНОЕ ИССЛЕДОВАНИЕ ПОКАЗАТЕЛЕЙ ИСПОЛЬЗОВАНИЯ ПРЕСНОЙ ВОДЫ В СТРАНАХ СРЕДИЗЕМНОМОРСКОГО РЕГИОНА

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В современном мире пресная вода является символом понятия «жизнь», поскольку существование человеческого общества, а также сохранение флоры и фауны обусловлено этим уникальным ресурсом. Однако, как показывают исследования ресурсов пресной воды в разных странах и регионах мира, а также в экономических союзах, показатели продуктивности использования воды сильно различаются, что указывает на наличие недостаточных социально-экономических инструментов, применяющихся для управления этим ресурсом, а также низкую эффективность использования этих инструментов. В частности, с помощью качественного показателя использования ресурсов пресной воды – показателя продуктивности, можно исследовать факторы, влияющие на состояние использования данного ресурса в определенной стране или регионе мира. Это, в свою очередь, позволит разработать эффективную политику в области рационального и целевого использования уникального ресурса. Актуальность данной проблемы и пути совершенствования политики в области управления водными ресурсами и водным хозяйством стали предметом обсуждения в рамках недавно принятой программы Правительства РА на 2021-2026 годы.

Ключевые слова: пресная вода, годовой забор пресной воды, продуктивность воды, показатели потребления пресной воды, классификация стран по отдельным показателям потребления пресной воды, наилучшие и наихудшие показатели, оросительная система.

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