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The Formation of Water Collector-Resources Drainage Network of Zarafshan Oasisand the Questions of Recycling

HayitovYozil Kosimovich[1]JumaeyaTozagul Azamovna[2]ToshbekovNurbek Ahmadovich[3] NazarovaFiruza Ahmedjanovna[4]

[1]Professor, Doctor of Geographical Sciences,Department of Ecological Geography, Bukhara State University

[2]Teacher of the department of Ecology and Geography, Bukhara State University

[3]Teacher of Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Bukhara branchUzbekistan, Email id: khayitov@umail.uz

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Abstract:
This article discusses some of the issues of formation and quantitative assessment of return flow, i.e, collector- drainage flow formed on the irrigated lands of Zarafshan oasis.Results of hydromorphological data on major trunk sewers located in the regions and the dynamics of collector- drainage flow and degree of mineralization both in time and in space were studied. The recommendations and suggestions were given for effective re-use of return water of the Zarafshan oasis and as well as the additional water resources for irrigation of certain crops.

Keywords*: Zarafshan Oasis, Water Resources, Irrigated Land, Collector, Drainage, Return Flow, Quantitative Assessment, Recycling.*

INTRODUCTION

Today, as a result of the extensive use of water resources and their quantitative decline and deterioration in quality are causing a number of problems around the world. At the same time, the use of river water in Central Asia is growing from year to year. This also applies to the Zarafshan oasis. Unfortunately, these problems in the Zarafshan oasis are not sufficiently covered in hydrological studies. Therefore, one of the most pressing issues in the Zarafshan oasis is the study of the dynamics of collector-drainage water which is irrigated and formed in the fields.

MATERIALS AND METHODS

Improving the reclamation of irrigated lands in the Zarafshan oasis and increasing their productivity is unimaginable without collector-drainage networks. The collector-drainage networks built and commissioned in the middle of the last century in the oasis were reconstructed during the years of independence of our country. The efficiency of large collector networks such as Northern and Central Bukhara, Ogitma, Porsonkol has also been increased. *See the table № 1 below.*

Table 1 Information about large main collectors in Zarafshan oasis

№	Collectors	Started year	L, km	Q, m^3/s	Water collected areas
Samarkand region					
1	Siyob	1961	35,15	10	Samarkand
2	Bedona	1953	37,2	5	Bulungur
3	Great Black	1930	26,5	7	Bulungur, Jomboy
4	Korasuv	1933	43,1	20	Payarik
Navoi region					
1	Shodibek	1953	61,1	5	Navbahor, Konimex

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1	Duldul	1953	48,8	18,5	Navbahor, Qiziltepa
3	Katta Zovur	1967	39,4	7	Qiziltepa
Bukhara region					
1	Dengizkultashlamasi	1956	126,4	70	Kagan, Bukhara, Jondor, Karakul, Alat
2	Northern Collector	1948	139,9	56,5	Gijduvon, Shofirkon, Romitan, Peshku, Vobkent
3	Central Bukhara collectors (MBK)	1955	95,1	80	Vobkent, Bukhara, Romitan, Jondor
4	Ogitma	1969	68,7	100	Shofirkon, G'ijduvon
5	Porsonkol	1974	62	15	Alat, Karakul, Vobkent, Bukhara, Romitan, Jondor
6	General water collection tract (GVST)	1991	155	74	Alat, Karakul, Jondor, Kagan, Karavulbozor
7	General Karakul	1967	15,52	5	Alat, Karakul
8	Central Alat	1956	16	5	Alat, Karakul
9	South Olot	1958	15,52	2,2	Alat Karakul
10	West Karakul	1960	13,9	1,5	Alat, Karakul
11	Bibishirin	1948	139,9	46	Gijduvon, Romitan
12	West Romitan	1966	60,1	8	Romitan, Jondor

Note: L is the length of the collector, Q is the water permeability.

According to the State Committee for Nature Protection of the Republic of Uzbekistan, the volume of return water generated in the irrigated lands of Zarafshan oasis in 2007-2011, ie the annual flow of collector- drainages, is 3035.2-4239 mln. m3. A large part of this amount of water falls on the collector- drainages, which collect water from the fields of Bukhara region. *See the table № 2 below.*

Table 2 Formed on irrigated lands of Zarafshan oasis changes in the volume of collector-drainage water during 2007-2011

Regions	Length of collectors, km		Collector-drainage waters volume, mln. m3				
	2008	2011	2007	2008	2009	2010	2011
Samarkand	219,2	219,2	535,0	516,2	572,1	660,0	547,1
Navoi	217,0	217,0	559,2	553,5	574,0	555,0	574,7
Buxoro	622,6	718,4	2218,3	1965,5	2209,9	3024,0	2132,0
Total	1058,8	1154,6	3312,5	3035,2	3356,0	4239	3253,8

Note: The table is based on the data of the State Committee for Nature Protection of the Republic of Uzbekistan.

First of all, it should be noted that it is very difficult to fully assess the quality of collector-drainage water formed in the Zarafshan oasis. This is because continuous observations in this regard are only periodic and are mainly carried out to determine the level of mineralization of water. In order to make a comprehensive assessment of the quality of collector-drainage water, in the future it is necessary to study their chemical composition and contamination on the basis of all hydrochemical and hydrobiological criteria as well as to determine the amount of pollutants.

Taking into account the above, below we analyze the changes in the level of water mineralization of collector-drainage networks collecting water from arable lands in the Zarafshan oasis in 2008-2011 in terms of their secondary use. *See the table № 3 below.*

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Table 3Collector-drainage waters in the regions of Zarafshan oasis and the changes in the level of mineralization in 2008-2011

Regions	Mineralization rate, g / l			
	2008	2009	2010	2011
Samarkand	0,61-1,88	0,58-1,65	0,65-1,24	0,60-1,38
Navoi	1,45-2,84	1,60-3,60	1,53-3,11	1,60-3,80
Bukhara	2,40-5,60	2,70-5,10	1,96-5,98	2,21-6,01

Note: The table is based on the data of the State Committee for Nature Protection of the Republic of Uzbekistan

The level of mineralization of collector-drainage water formed in the middle part of the Zarafshan river basin, ie on irrigated lands in Samarkand and Navoi regions, is much lower than in Bukhara region. For example, during 2008-2011, the level of mineralization of collector-drainage water in Samarkand region varied in the range of 0.55-1.88 g / l. In Navoi region, the level of mineralization is slightly higher, ranging from 1.45 to 3.8 g / l.

According to the above tables 2 and 3, in the Samarkand region in 2007-2011, an average of 566.1 mln. m3 or in Navoi region on average 563.3 mln. m3 of return water with a relatively small degree of mineralization. If we add the amount of return flow in both regions, 1129.4 mln. m3 of additional water resources. It is possible to use this water as a secondary resource for irrigation of some types of agricultural crops in the future.

Below we focus on the issues of water received for irrigation purposes in the last quarter of a century, ie 1991-2013, and the dynamics of the return flow generated from them in the arable lands of Bukhara region. *See the table № 4 below.*

Table 4 Irrigated in Bukhara region and formed in the region and the annual change in return flow amounts

Years	Irrigated lands mln	Irrigated water, mln.m3	Return flow volume, mln.m3	The return flow %
1991	265,2	5188	2214	43
1992	266,9	4035	1964	49
1993	269,4	3938	2096	53
1994	272,1	4215	1938	46
1995	274,4	3722	1232	33
1996	272,2	4014	1394	35
1997	276,5	4512	1846	41
1998	273,7	3995	2334	58
1999	273,7	4098	2178	52
2000	273,8	4011	2186	55
2001	274,2	3608	1507	42
2002	274,2	4851	2024	42
2003	273,7	4302	2588	60
2004	273,7	4355	2540	58
2005	274,6	4342	2570	59
2006	274,9	5560	2614	47
2007	274,9	4002	2218	55
2008	274,9	3984	1966	49
2009	274,9	4704	2210	47
2010	274,9	4898	2215	45
2011	274,9	3827	1959	51
2012	274,8	3969	2348	60
2013	274,6	4021	2305	57
Ўрт	273,4	4267,4	2106,4	49,4

Note: The table is based on data from the Amu-Bukhara Irrigation Systems Basin Administration (ITHB).

It can be seen from the table that from 1991 to 2013, the ratio of collector-drainage water, ie return flow to the amount of water received for irrigation of lands in Bukhara region changed at different values. For example, the smallest amount of water received for irrigation was low-water in 2001, at 3,608 mln. m3. The smallest amount of collector water is 1232 mln. m3, which corresponds to 1995. The largest value of the volume of collector-drainage water received and generated from irrigation in the region was observed in the multi-water in 2006 when these figures amounted to 5560 mln. m3 and 2614 mln. m3.

According to the calculations, the largest relative values of collector-drainage water were recorded in 2003 and 2012, accounting for 60% of the amount of water taken for irrigation. During the accounting period under the study, ie within 1991-2013, the

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amount of return flow averaged 49.4% of the water received for irrigation. This figure is evidence that the region has great potential for efficient use of irrigated water.

It should be noted that the magnitude of the return flow in the arable lands of the region also has a negative impact on the groundwater regime. It leads to a deterioration of the ecomeliorative condition of irrigated lands in the oasis. Return waters with high levels of mineralization and contamination with various wastes cause great damage to the environment, especially to nature. In this regard, we believe that it is necessary to hydrologically assess and analyze the quality of return water formed in the region and to develop comprehensive measures and apply them in water management practice. It is also advisable to organize the widespread use of biological methods which are considered the most efficient and economical in terms of physical, chemical and other methods of treatment of return water in rivers with low water levels.

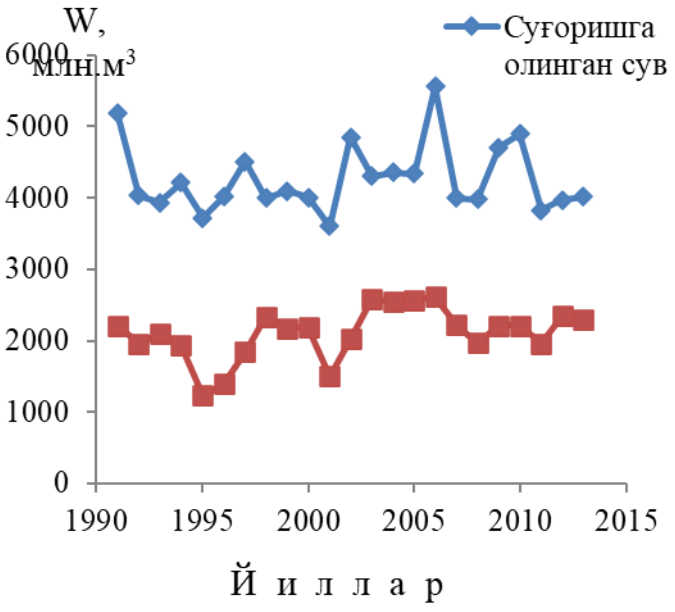

Figure 1. Irrigation in Bukhara region and return flow volume dynamics

The results of observations and analysis showed that the volume of return water, i.e the volume of collector-drainage water changes due to changes in the amount of water taken to irrigate the fields of Bukhara region as well. Therefore, our future research should focus on reducing the amount of backflow generated on irrigated lands.

Summing up the different interpretations of the terms “return waters” mentioned above, it can be said that they can be significantly reduced based on the research objectives. For example, to assess the efficiency of water use in irrigation systems, it would be more appropriate to use the term “return water” as a concept related to irrigation (Figure 2).

During the reporting period, ie in 2007-2011, the flow of collector-drainage water in the Zarafshan oasis varied in the range of 15.6 ÷ 17.1% in Samarkand region and 13.1 ÷ 18.2% in Navoi region. In the irrigated areas of Bukhara region during this accounting period.

The the flow of the formed collector- drainage fluctuated in the range of 64.8 ÷ 71.3% of the total volume received in the oasis. In general during this reporting period and Bukhara region accounted for about 67% of the flow of collector-drainage water formed on the irrigated lands of the Zarafshan oasis. The rest, or 33%, belongs to Samarkand and Bukhara regions (Figure 3).

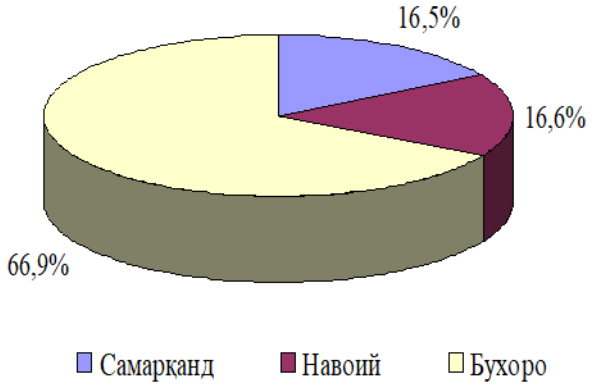

Figure 3: Zarafshan oasis of collector- drainage water flow due to distribution by regions.

During the reporting period, an average of 566.1 mln. m3 and in Navoi region - 563.3 mln m3 of collector-drainage water is formed. Their average annual total is 1129.4 million. m3. These waters, although secondary have a much lower level of mineralization, so they can be used as additional

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water resources for agricultural production and the needs of other sectors of the economy.

Based on our many years of research on the application of modern biological methods of collector-sewage treatment have shown positive results. This work was carried out in both natural and laboratory conditions. Laboratory experiments were conducted in the laboratory "Problems of Biotechnology" of Bukhara State University.

Here, in the laboratory the physical properties and chemical composition of the waters of the collector-drainage network of Bukhara region were first determined. The measures were taken to clean them by biological methods, i.e by growing high plants (pistachio, eichhornia, duckweed) in these waters. These experiments have yielded positive results and have shown that this direction is promising. On the other hand, such an approach to the treatment of collector-drainage water shows the great potential of the biological method and the reuse of treated water in various areas of agricultural production.

CONCLUSION

It can be concluded that a large part of the collector-drainage water formed in the Zarafshan oasis is now discharged into natural basins and forming lakes there. A certain part of the return flow is discharged directly into the Amudarya where causing a negative change in the chemical composition of the river water. According to these circumstances, one of the most pressing issues today is the protection of water in the oasis both in quantity and quality. This key issue involves a number of additional measures. The most appropriate of them should be aimed at minimizing and in some cases completely stopping the discharge of water into rivers, lakes and reservoirs. At the same time a special attention should be paid to the treatment of return water generated in the fields by economically viable biological methods and their use as a secondary resource.

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