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Some Comments on the Hydrological Regime of Amu-Bukhara Canal

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Abstract: Currently, there is a shortage of water resources in the world and in Central Asia due to the development of irrigation and population growth. In addition, long-term forecasts for Uzbekistan indicate a shortage of water resources over the next five years. The main purpose of this work is to study the hydrological regime of the Amu-Bukhara canal, built in the middle reaches of the Amudarya. In order to achieve this goal, the following tasks were performed: A linear scheme of the Amu-Bukhara canal was drawn up, data on the Amu-Bukhara canal receiving water from the Amudarya were collected, analyzed, and the impact of the canal on the Amudarya water regime was studied.

Keywords: hydrological regime, agriculture, water sources, dynamics of contraction, irrigation area.

Introduction

The Action Strategy for the Further Development of the Republic of Uzbekistan for 2017-2021 states that “further improvement of the reclamation of irrigated lands, introduction of modern water and resource-saving technologies in agricultural production”, global climate change and the Aral Sea catastrophe have a negative impact on agricultural development”. In his speeches on December 9, 2019 - the Day of Agricultural Workers, President Mirziyoyev said that the use of water resources and fertile lands and the prevention of looting is one of the most important tasks in the field. Accordingly, it is necessary to carry out complex scientific and practical work, taking into account the conditions of each region, efficient use of water, water distribution on the basis of strict limits, the search for additional water sources.

This also applies to the Bukhara oasis. Therefore, one of the urgent problems is to conduct research on the hydrological regime of the Amu-Bukhara canal, which supplies water to the Bukhara oasis. However, to date, its hydrological regime is not well covered hydrologically, except for the research of E.Rubinova, S.Sh. Mirzaev, V.A. Dukhovny.

Materials and methods

The main purpose of this work is to study the hydrological regime of the Amu-Bukhara

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canal, built in the middle reaches of the Amudarya. In order to achieve this goal, the following tasks were performed: A linear scheme of the Amu-Bukhara canal was drawn up, data on the Amu-Bukhara canal receiving water from the Amudarya were collected, analyzed, and the impact of the canal on the Amudarya water regime was studied. Water from the lake under the Cholkuvar bridge and the lake in the Jayron Nature Reserve in the Kyzyltepa Amu-Bukhara Machine Canal (ABMC) area of the Amu-Bukhara canal was analyzed.

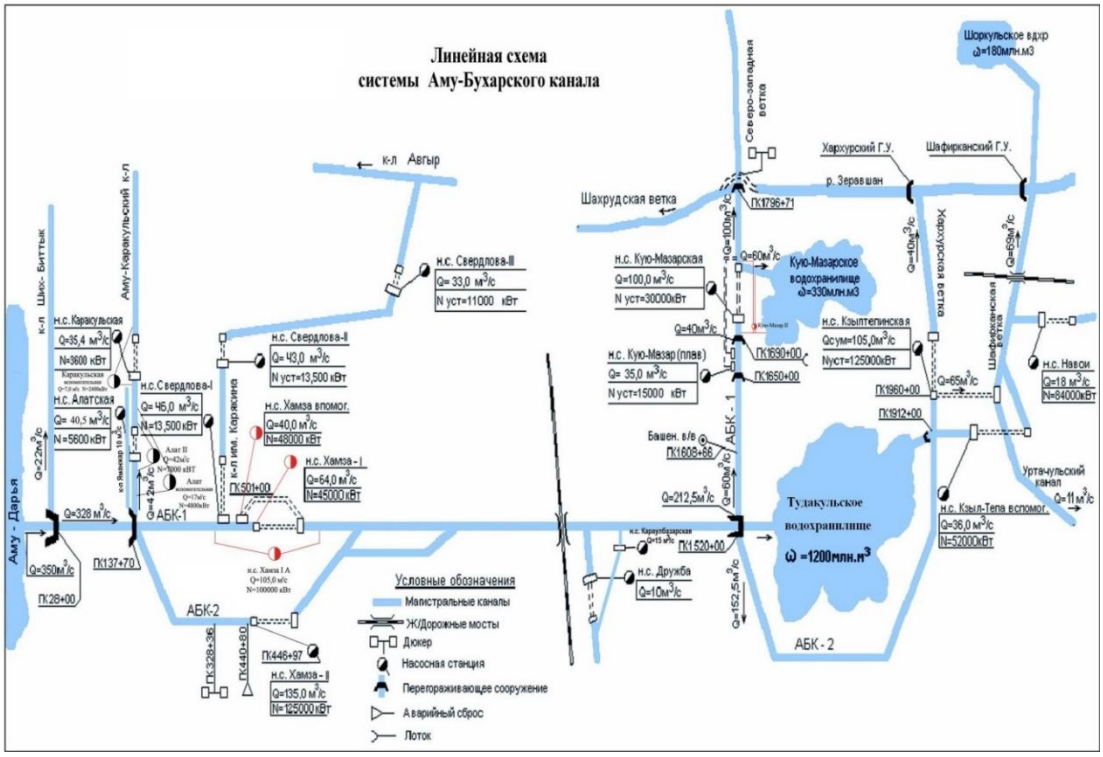

Figure 1. Line diagram of the Amu Bukhara canal

As can be seen from the above scheme, the Amu-Bukhara canal (ABC) is the main source of water in the Bukhara oasis, and 85-90% of water is used in irrigated agriculture. This is done through ABC-1 and ABC-2 pumping stations due to hard work and large amounts of electricity.

The main indicators of the Amu-Bukhara canals, which receive water from the Amudarya

Table 1

Channel Name	Construction phase, years	Length, km	Average water consumption, m3 / s	Irrigation area, thousand hectare
Amu-Bukhara Machine Canal	I,1965	197	100	377
Amu-Bukhara Machine Canal	II,1976	233	270	390

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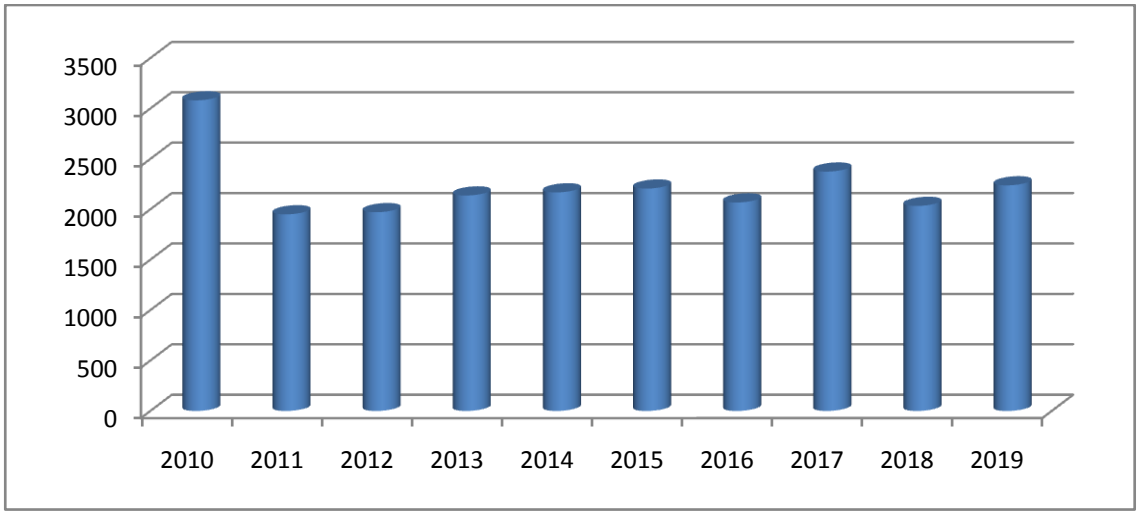
In this table, the hydrological indicators of the construction of the Amu-Bukhara canal were analyzed in stages. Construction of the ABC-1 stage was carried out in 1965, the length of the canal was 197 km, the average water consumption was 100 m3 / sec, the irrigation area was 377,000 ha, the ABC-2 stage was built in 1976, the canal length was 233 km, the average water consumption was 270 m3 / sec and irrigation area is 390 thousand hectares.



Annual change in the volume of water received from the Amudarya to the ABC-1 canal

When we studied the analysis of the annual water volume change of the ABC-1 canal over the next decade (2010-2019), we found the following.

3081.16 billion m3 in 2010, 1950.5 billion m3 in 2011, 1971.5 billion m3 in 2012, 2137.3 billion m3 in 2013, 2168 billion m3 in 2014, 2205.9 billion m3 in 2015, 2068 in 2016, 1 billion m3, 2374.5 billion m3 in 2017, 2034 billion m3 in 2018, 2237.9 billion m3 in 2019.

When comparing water intake from the Amudarya to the ABC-1 canal between 2010-2019, the highest water volumes were 3081.16 billion m3 in 2010 and 2374.5 billion m3 in 2017, the lowest volume of water intake in 1950 was 1950.5 billion m3 / sec, in 2012 1971.5 billion m3, in 2016 it will be 2068.1 billion m3.

About water received from ABC-1 canal from 2010 to 2019 under the management of ABMC Alat district

INFORMATION

Table 2

Months, years		**2010**	**2011**	**2012**	**2013**
January	**M^3/sec**	139,54	113,88	105,06	85,19
	Mln/m^3	161,50	131,8	121,6	98,60
February	**M^3/sec**	113,54	168,06	108,22	102,43
	Mln/m^3	98,10	145,20	93,50	88,50
March	**M^3/sec**	73,7	134,8	125,5	206,5

	Mln/m^3	63,70	116,50	108,20	178,40
April	**M^3/sec**	184,26	94,68	257,99	204,40
	Mln/m^3	159,20	81,80	222,90	176,60
May	**M^3/sec**	223,26	172,69	240,97	208,56
	Mln/m^3	192,50	149,20	208,20	180,20
June	**M^3/sec**	286,57	232,06	312,15	211,00
	Mln/m^3	247,60	200,50	269,70	182,30
July	**M^3/sec**	397,80	256,71	295,25	317,13
	Mln/m^3	343,20	221,80	255,10	274,00
August	**M^3/sec**	832,99	312,50	209,03	291,55
	Mln/m^3	719,70	270,00	180,60	251,90
September	**M^3/sec**	395,72	199,88	126,39	177,78
	Mln/m^3	341,90	172,70	109,20	153,60
October	**M^3/sec**	277,08	111,18	72,92	145,83
	Mln/m^3	239,40	96,60	63,00	126,00
November	**M^3/sec**	297,45	51,62	46,30	92,71
	Mln/m^3	257,00	44,60	40,00	80,10
Total	**M^3/sec**	3566,16	1950,91	1971,50	2137,27
	Mln/m^3	3081,16	1685,59	1703,37	1846,60

2014	**2015**	**2016**	**2017**	**2018**	**2019**
97,46	123,72	88,47	104,20	102,04	146,28
112,8	143,2	102,4	120,60	169,30	341,1
81,71	188,66	125,81	163,43	134,09	199,54
70,60	163,00	108,70	141,20	116,20	172,40
134,8	93,8	111,3	101,9	142,6	116,1
116,50	81,09	96,20	88,00	123,20	100,30
135,88	179,40	168,87	173,61	99,88	181,83
117,40	155,00	145,90	150,00	86,30	157,10
177,43	236,92	215,39	300,69	190,39	147,22
153,30	204,70	186,10	259,80	164,50	127,20
301,97	333,22	331,70	311,46	239,93	231,25
260,90	287,90	286,60	269,10	207,30	199,80

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 1, 2021, Pages. 6085 - 6095
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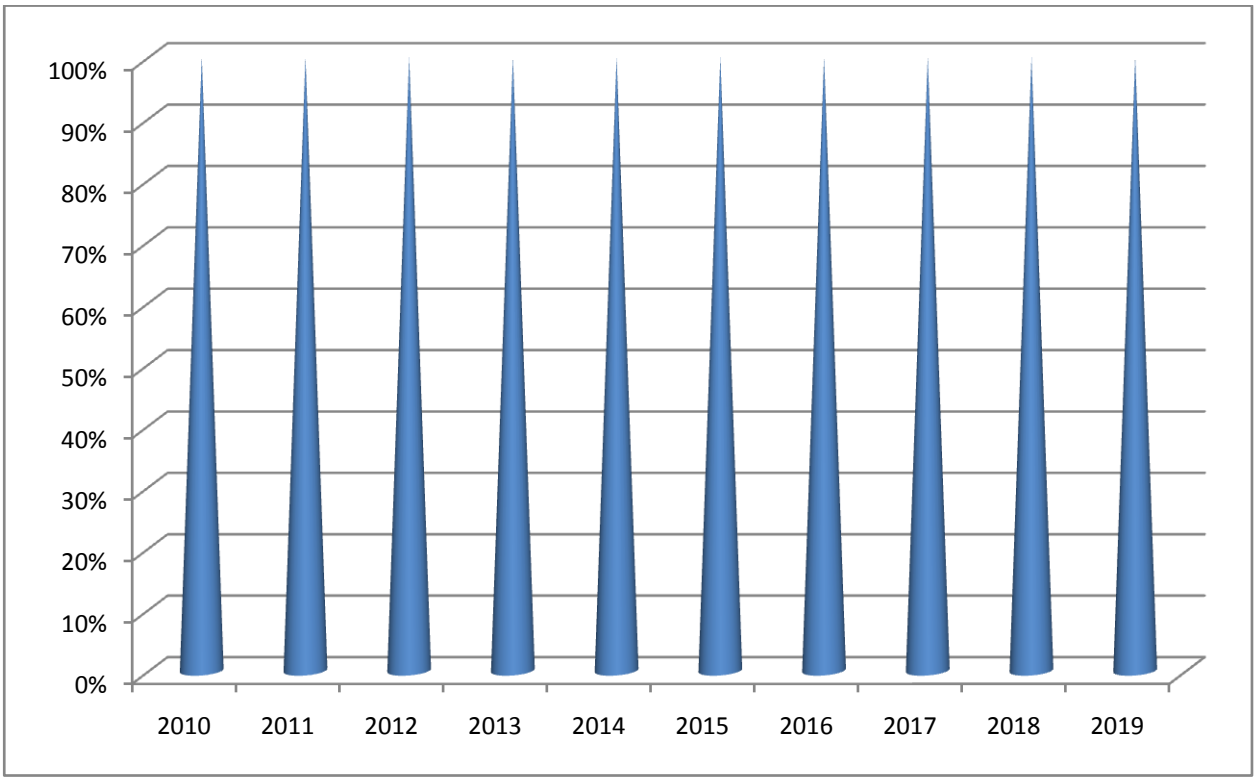
385,42	371,30	320,72	368,52	318,06	370,02
333,00	320,80	277,10	318,40	274,80	319,70
311,34	313,77	244,91	286,34	273,03	318,98
269,00	271,10	211,60	247,40	235,90	275,60
213,08	77,89	160,42	183,33	176,97	211,92
184,10	67,30	138,60	158,40	152,90	183,10
137,38	84,72	113,31	121,18	93,63	153,94
118,70	73,20	97,90	104,70	80,90	133,00
103,36	104,17	77,08	105,67	130,09	70,72
89,30	90,00	66,60	91,30	112,40	61,10
2167,95	2205,95	2068,10	2374,45	2033,98	2237,94
1873,10	1905,90	1786,84	2051,53	1757,36	1933,58



Annual change in the volume of water taken from the Amudarya to the ABC-2 canal

When we studied the analysis of the annual water volume change of the ABC-2 canal over the next decade (2010-2019), we found the following.

When comparing water intake from the Amudarya to the ABC-2 canal between 2010-2019, the highest water volumes were 3329.5 billion m3 in 2017 and 3209.4 billion m3 in 2012, the lowest water intake was 2823.9 billion m3 in 2012, 2901 in 2019, 5 billion m3.

The above shows that the amount of water in the ABC-1 and ABC-2 canals for ten years

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Received 15 December 2020; Accepted 05 January 2021.

depends on the dynamics of contraction and expansion of existing irrigated arable land in the region, crop types, soil composition, groundwater regime.

About water received from ABC-2 canal from 2010 to 2019 under the management of ABMC Alat district

INFORMATION

Table 3

Months, years		**2010**	**2011**	**2012**	**2013**
January	**M^3/sec**	226,74	260,42	197,92	177,31
	Mln/m^3	195,90	225,00	171,00	153,20
February	**M^3/sec**	2335,65	2368,06	1422,45	2037,04
	Mln/m^3	201,80	204,60	122,90	176,00
March	**M^3/sec**	179,51	228,47	150,93	283,91
	Mln/m^3	155,10	197,40	130,40	245,30
April	**M^3/sec**	248,73	223,15	350,23	327,20
	Mln/m^3	214,90	192,80	302,60	282,70
May	**M^3/sec**	413,89	363,19	427,78	437,50
	Mln/m^3	357,60	313,80	369,60	378,00
June	**M^3/sec**	410,07	367,13	450,58	427,66
	Mln/m^3	354,30	317,20	389,30	369,50
July	**M^3/sec**	436,00	141,47	440,74	442,13
	Mln/m^3	376,7	358,10	380,80	382,00
August	**M^3/sec**	455,56	436,11	416,32	465,16
	Mln/m^3	393,60	376,80	359,70	401,90
September	**M^3/sec**	279,86	374,42	225,46	346,53
	Mln/m^3	241,80	323,50	194,80	299,40
October	**M^3/sec**	184,14	209,95	179,86	263,43
	Mln/m^3	159,10	181,40	155,40	227,60
November	**M^3/sec**	244,56	122,11	168,29	185,76
	Mln/m^3	211,30	105,50	145,40	160,50
Total	**M^3/sec**	5661,34	5604,86	4548,61	5547,92
	Mln/m^3	3075,20	3001,20	2823,90	3209,40

2014	**2015**	**2016**	**2017**	**2018**	**2019**

255,44	247,92	174,54	185,53	200,81	219,91
220,70	214,20	150,80	160,30	173,50	190,00
2540,51	2563,66	1821,76	1587,96	2042,82	2053,24
219,50	221,50	157,40	137,20	176,50	177,40
292,13	241,44	256,60	199,42	254,17	224,54
252,40	208,60	221,70	172,30	219,60	194,00
261,11	241,44	359,49	277,89	282,64	273,03
225,60	208,60	310,60	240,10	244,20	235,90
346,99	378,47	410,76	423,84	383,45	309,72
299,80	327,00	354,90	366,20	331,30	267,60
471,36	434,26	400,12	469,10	46,88	357,64
360,60	375.20	345,70	405,30	386,10	309,00
461,81	468,06	395,02	486,34	472,34	403,82
399,00	404,40	341,30	420,20	408,10	348,90
464,00	441,20	393,17	444,21	449,77	419,10
400,90	381,20	339,70	383,80	388,60	362,10
359,72	306,13	256,60	392,59	277,55	357,99
310,80	264,50	221,70	339,20	239,80	309,30
303,01	254,98	229,28	283,80	187,50	291,67
261,80	220,30	198,10	245,20	162,00	252,00
221,76	252,43	215,51	291,37	242,82	130,79
191,60	218,10	186,20	251,74	209,80	113,00
6118,40	6024,65	5133,56	5282,80	5547,92	5206,13
3310,80	3211,80	3018,80	3329,54	3204,90	2901,50

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Figure 2. 22.09.2020 - Amu-Bukhara canal (Olot district area)

Water has been pumped from the Amudarya to the Amu-Bukhara canal since 1962. In May-September this year, 208.2 million m3 of water was taken from the river into the canal. In subsequent years, the amount of water received in the canal increased from year to year and in 1968 reached 1.63 billion m3. In the following 1969, the volume of water taken from the river decreased almost 3 times and amounted to 0.587 billion m3.

The reason for this can be explained by the fact that this year in all rivers of Central Asia, including the Zarafshan River, the flow is 1.5-1.7 times higher than normal.

In the following years, that is, from 1970, the amount of water taken into the canal increased again from year to year. Its largest value during this period was in 1985 and amounted to 6.22 billion m3. It should be noted that this year the annual flow of the Zarafshan River was less than the norm (4.9 km3), more precisely 4.54 billion m3.

During the next period, 1986-1991, the amount of water received in the canal decreased sharply, ranging from 4.2 to 4.7 billion m3. After that, in 1992-1993, the amount of water received in the canal decreased further and amounted to 3.8-3.9 billion m3, respectively. However, in low-water 1999-2001, the amount of water taken from the river increased to 5.3-5.9 billion m3. The latter, more precisely in 2009-2012, the volume of water received in the canal was almost the same, varying in the range of values from 4.6 to 4.9 billion m3.

Result and discussion

The results of scientific research and analysis show that since 2010, the annual volume of water received from the Amudarya to the Amu-Bukhara canal has stabilized. Taking this into account, we determined the years corresponding to the maximum, minimum and average values of the amount of water received in the Amu-Bukhara canal in 2010-2019. In 1985, the amount of

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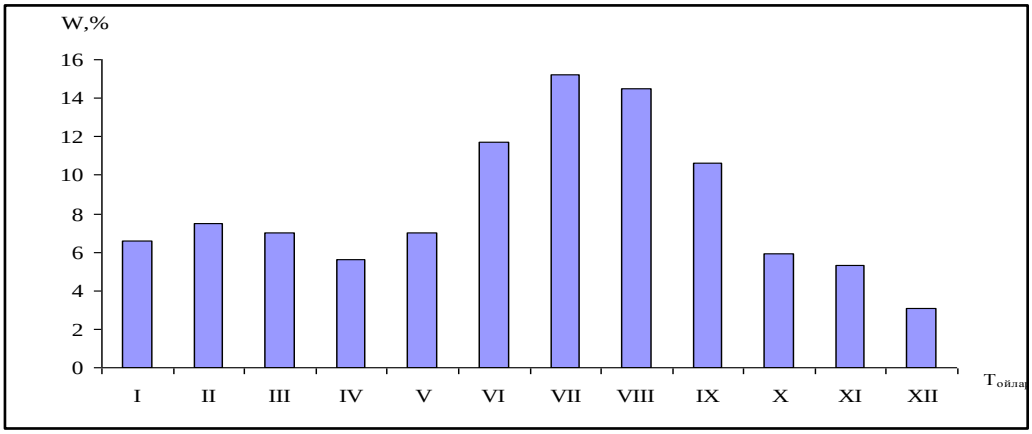
Received 15 December 2020; Accepted 05 January 2021.

water received in the canal was the highest, in 1993 it was low water and in 2002 it was close to the average water year.

For these years, we studied the monthly distribution of water flow in the canal throughout the year.

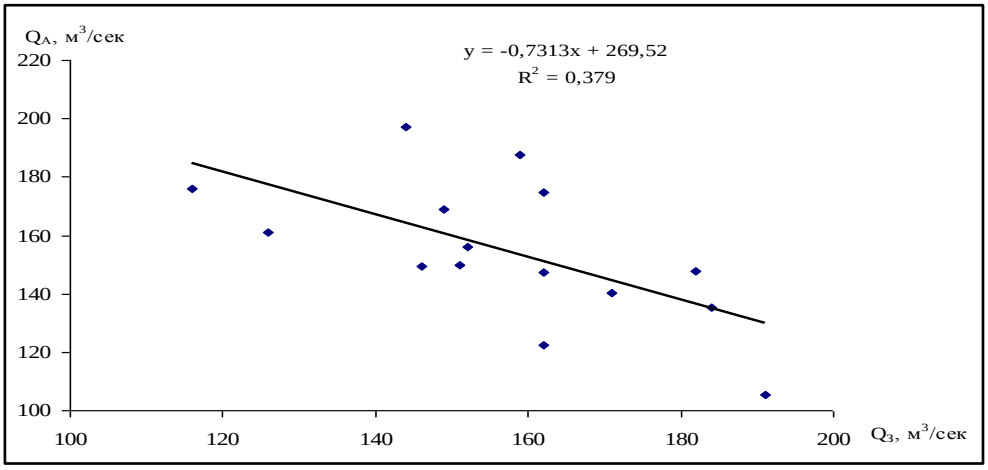


Distribution of Amu-Bukhara canal flow by months during 2002 with average water

Based on the following histogram, we analyze the monthly distribution of the Amu-Bukhara canal flow during the average aquifer in 2002. This year, 4.851 billion m3 of water was pumped into the canal from the Amudarya. It can be seen that 52% of the annual flow falls in June, July, August and September.

In January, February and March of this year, the amount of water taken into the canal was 21%. Of course, this water was used for saline washing on irrigated lands in the Zarafshan oasis.

In the next stage of the work, we studied the relationship between water consumption in the Amu-Bukhara canal and the average annual water consumption in the Zarafshan (Dupuli) river during 1980-2002.



The relationship between the Amu-Bukhara canal and the Zarafshan (Dupuli) river average annual water consumption

This graph indicates that there is an inverse relationship (r = 0.62) between the variables

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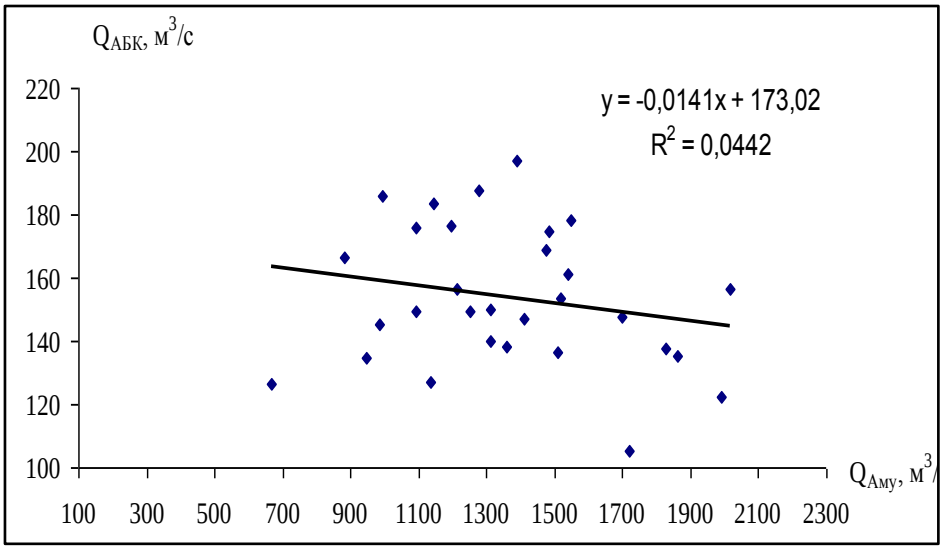
under study. More precisely, during the years when the Zarafshan River was under water, a lot of water was taken from the Amudarya through the Amu-Bukhara canal.



The relationship between the Amu-Bukhara canal and the Amudarya (Kerki) river average annual water consumption

As mentioned above, we studied the relationship between water consumption in the Amu-Bukhara canal and water consumption in the Amudarya. As can be seen from the graph, the points in it are scattered and the coefficient of even variability is r = 0.21. This means that the amount of water taken into the canal does not depend on the water level of the Amudarya. The study of the hydrological regime of the existing canals in the country, including the Amu-Bukhara canal, is of scientific and practical importance.

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