Main characteristics of river flow of Kaskadarya river basin and their variability

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ABSTRACT: In the article, on the base of new hydrometeorological data the main characteristics of river flow of Kashkadarya river basin are identified. Calculation results are compared with the data of previous scientists. The values of the annual flow variability of the river of the studied basin are calculated for three periods. The decrease of the mean long-term flow volume in the second and third calculation periods is shown.

KEYWORDS: river, hydrological regime, discharge, flow volume, flow module, flow layer, calculation period, variation coefficient, flow decrease.

I. INTRODUCTION

It is known that for the first time the assessment of the river flow characteristics of mountain rivers of Central Asia was made by V.L.Schults [8]. Afterwards, in 60-s of XXth century similar studies were performed by scientists and specialists of NIGMI at Uzhydromet [3, 5, 6]. Similar studies were continued by Yu.N.Ivanov, V.E.Chub, A.A.Rasulov, F.Kh.Khikmatov and others. Results of these studies are used in relevant areas of hydrological and hydroeconomic calculations. For the period of more than sixty years rather extensive volume of material was accumulated which facilitated the refinement of the flow characteristics of the rivers of Central Asia region, including also Kashkadarya basin, which were determined before.

In relation to mentioned above, it is worth to mention that the assessment of hydrological regime of rivers on the base of new, longer data series of observations became very topical. The results of such studies are immensely necessary for solution of certain problems related to the issues of sustainable development of agriculture production of the country and its separate regions.

Proceeding from this goal, in this work we considered the issues of assessment of initial hydrological materials obtained for the biggest rivers of the studies territory, defined the main flow indices, variability of the annual river flow for different calculation periods.

On the base of available data the following main flow indices of studies rivers were calculated: mean long-term discharge (Q, м^3/c); flow module (M, l/s·km^2); flow layer ($У$, mm); flow volume - W, mln.m^3. The obtained results were compared with the data obtained by previous scientists - V.L.Schults and V.E. Chub (Table.1).

Despite differences in duration of calculation periods, the values of mean long-term characteristics of river flow almost coincide with results obtained by V.E.Chub [6]. This gives the reason to state that the changes in hydrological regime of rivers of Kashkadarya basin were insignificant during the last 25-30 years.

Table 1
Main indices of river flow of Kashkadarya river basin calculated for different calculation periods

River-gauging station	Source	Calculation period	F, km^2	Q, m^3/s	M, l/s km^2	Y, mm	W, mln. m^3
Kashkadarya- Varganza	I	1926-1960	468	5,46	11,7	368	172,2
	II	1926-2002	511	5,22	10,2	322	164,6
	III	1927-2020	511	5,23	10,2	322	164,9
Jinydarya - Dzhauz	I	1941-1960	163	1,43	8,8	277	45,1
	II	1941-1990	152	1,56	10,3	324	49,2
	III	1941-2020	152	1,44	9,5	300	45,4
Akdarya- Khazarnau	I	1927-1960	845	12,3	14,6	459	387,9
	II	1927-2002	845	12,1	14,3	452	381,6
	III	1927-2020	845	12,1	14,3	450	381,6
Tankhizydarya- Kattagan	I	1926-1960	427	4,3	10,1	318	135,6
	II	1951-2002	425	4,11	9,7	305	129,6
	III	1951-2020	435	3,92	9,0	284	123,6
Yakkabagdarya - Tatar	I	1930-1960	504	6,74	13,4	422	212,6
	II	1930-2002	514	6,11	11,9	375	192,7
	III	1930-2020	504	5,93	11,2	352	187,0
Uradarya - Bazartepa	I	1928-1964	1260	4,49	3,6	112	141,6
	II	1965-2002	1250	4,81	3,8	121	151,7
	III	1971-2020	1250	3,85	3,0	95	121,4
Kichik Uradarya- Gumbulak	I	-	-	-	-		
	II	1968-2002	1570	1,29	0,8	26	40,7
	III	1968-2020	1570	1,44	0,9	29	45,4

Note: I- according to V.L.Schults data; II – according to V.E.Chub data; III – according to the authors' data.

Long-term variability of river flow and hydrological characteristics is one of the actual problems of present hydrology. Up to now, i.e., during the last 35-40 years rather extensive volume of hydrological materials of observations was collected. This gave possibility to V.E.Chub [6] to refine characteristics of river flow of Kashkadarya basin determined before. In this work we considered the issues of the long-term variability of rivers of Kashkadarya basin, and their main indices were refined. Thus, calculations of values of variation coefficients were made for three selected calculation periods with the account of data which were not included to work of V.E.Chub (fig. 1).

As it is seen from fig.1, the values of variation coefficients for the rivers in the upper part of the basin for three calculation period are similar. However, in the last period (B) they are less regarding the values of previous calculation periods А and Б. It is worth to mention that for all rivers, besides Guzadarya (Pachkamar) and Uradarya (Bazartepa), the values of variation coefficients are to some extent higher in the last calculation period.

At the next stage we studied the quantitative change of the river flow which is of significant scientific and practical value for the planned organization of water economy for any territory in future. For this purpose the relevant computations were carried out for the following two periods: I. Conditionally natural period (up to 1970); II. Period of intensive land use (1971–2020).
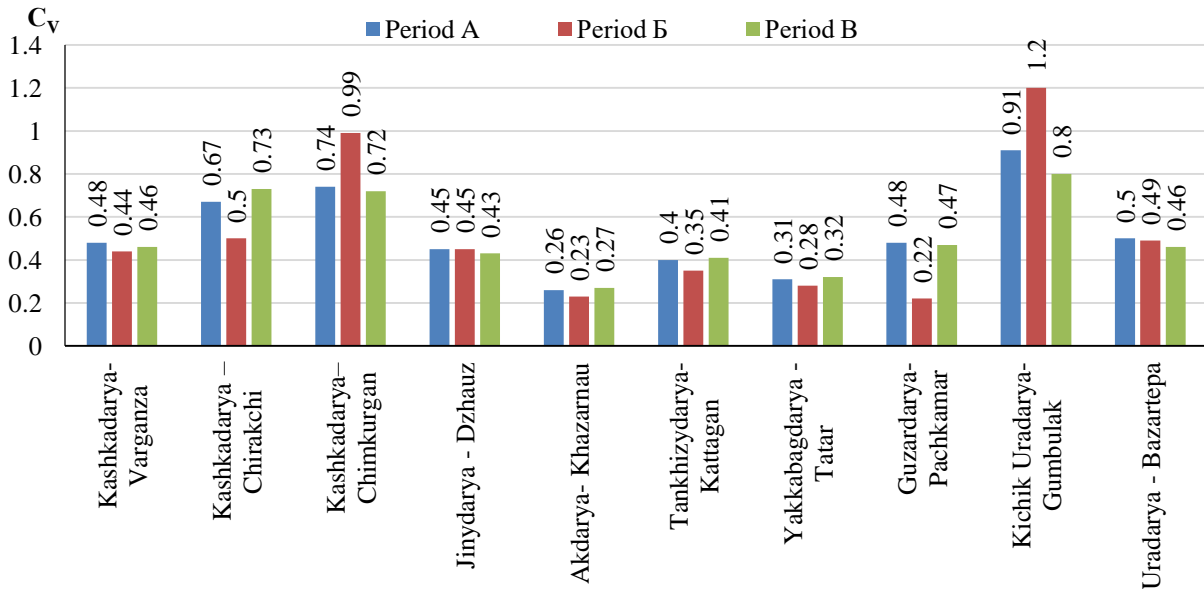
Fig. 1. Values of variation coefficients calculated for different calculation periods
A – period covering all years of observations; Б –period till 1970;
B –period from 1971and subsequent years; n – number of years with data processing

On the base of materials obtained at 10 hydrological points of observations the mean annual discharge values (Q_{av}) and volume of the annual river flow (W_{an}) were calculated were calculated for specified calculation periods. Afterwards the difference of flow volume (ΔW) calculated by the mean annual discharge values for each of the two calculation periods was determined (fig.2).
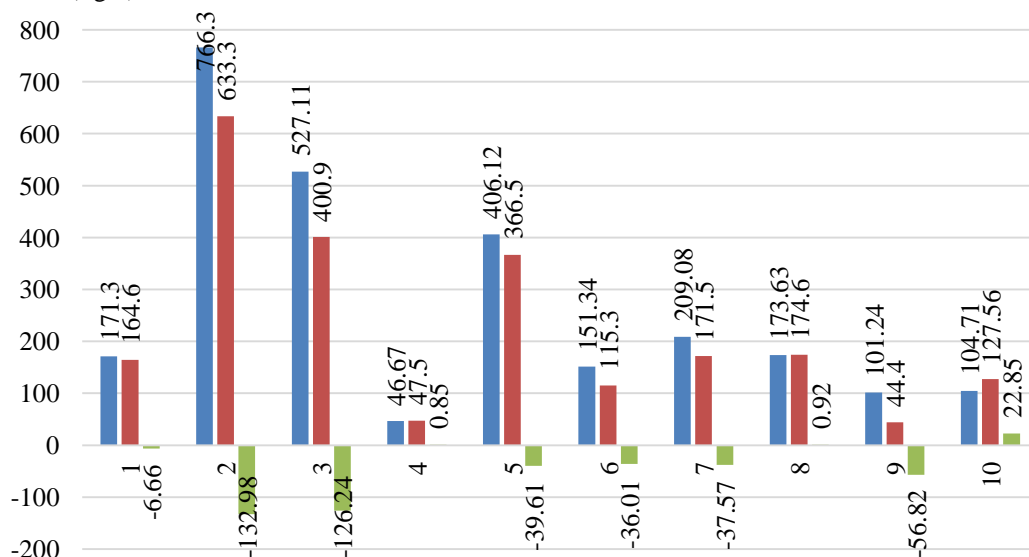

Fig. 2. Quantitative changes of flow of rivers of Kashkadarya basin
1- Kashkadarya – Varganza; 2 - Kashkadarya – Chirakchi; 3 - Kashkadarya – Chimkurgan; 4-Jinydarya – Dzhauz; 5-Akdarya–Khazarnau; 6 -Tankhizydarya – Kattagan; 7-Yakkabagdarya – Tatar; 8 - Guzardarya–Pachkamar; 9-Kichik Uradarya–Gumbulak; 10- Uradarya–Bazartepa

Analysis of calculated values of difference of flow volume has shown that in majority of cases the flow decrease was recorded in the second calculation period: its minimum value ($\Delta W = 4,05\%$) accords with the one for Kashkadarya river (Varganza), while maximum value - 58,2 % was recorded at Kichik Uradarya river. Only in one case

(Jinydarya) the difference has positive sign. In average the change of flow for all rivers was -22,8%. The reason of it was extensive water intake higher hydrologic in the second calculation period.

II. CONCLUSION

Summarizing the results of study the following conclusions can be drawn:

The values of the mean long-term characteristics of river flow almost coincide with the results of V.E.Chub;

The values of variation coefficients in the upper part of the basin are similar for three calculation periods;

For all rivers, besides Guzadarya (Pachkamar) and Uradarya (Bazartepa) the values of variation coefficients were higher to a certain extent in the last calculation period;

The accounted water resources of Kashkadarya river basin, in the area of their formation are characterized by following values: total flow of surface water varies in the range of 600 mln.m^3 - 1,9 billion m^3 a year, total mean long-term discharge of rivers is 32,5 m^3/s, while mean annual flow volume is 1,023 km^3.

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