Intra-annual surface runoff distribution of The Chatkal River in different watery years

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Abstract. In planning water reservoirs, it's significant to understand surface runoff behaviors, especially in medium and small rivers. The article examines water availability results during different watery years of The Chatkal River, which is the biggest left tributary of The Chirchik River. The computation of intra-annual runoff distribution for three different years of watery and for two distinguished periods of watery was carried out. It is derived that independently from the watery of year, 80% of runoff originates in high water period and 20% in the low water period.

1 Introduction

Among the other large tributaries of the Chirchik River, the Chatkal River has a feature of the orographic systems of the Tien Shan Mountains. The relief of the mountainous region of the basin is formed by the Talas Alatau ridge and its southwestern spurs, the configuration, elevation marks, and orientation, which mainly determine the hydrographic network and regime the rivers in the basin. Chatkal has four large and many small tributaries. The average weighted height of the Chatkal river basin is 2605 m. Even though the Chatkal river has a larger catchment area of 6870 km2 and an average long-term discharge Q = 108 m^3/s, the Pskem river is 2840 km2 and Q = 79 m3/s, respectively. Considering the catchment area [1], the difference is insignificant. This is explained by the fact that, in the area close to the confluence of the river into Chirchik, there is a short Kumbel Mountain ridge that is perpendicular to the direction of the Chatkal River. Therefore, it prevents the invasion of moisture-laden air masses. The situation in the case of The Pskem River it is open to moisture air masses, and therefore, it has higher surface runoff [2, 3].

In recent years, Uzbekistan has been paying attention to the design and construction of small reservoirs and mudflow reservoirs to solve the problem of lack of water resources. Moreover, such hydraulic structures also help to provide electricity to small regions. At the moment, dozens of such reservoirs are being built throughout the republic. In the Tashkent region in the basin of the Chirchik River, it is on the Pskem and Chatkal rivers that several are being built [4-7]. When calculating the water content, the intra-annual runoff distribution is of enormous importance.

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2 Materials and Methods

In this article, the method of Hydrometeorological research processing of the data which were got by using of mathematical statistics and comparison of the calculated data with the results of field data was applied. We used the average monthly and average annual water discharge data from 4 hydrological stations of the focusing area for different water content years. The locations of the hydrologic stations are in the study area. The data of annual flow rates are received from the department of water cadaster and meteorological measurements, Centre of Hydrometeorological Service under Cabinet of Ministers of The Republic of Uzbekistan [6, 9].

3 Results and Discussions

It is important to note that, in flatland areas and steppes of Central Asia, for redistribution of water resources, the key role plays human. The reason is, in foothill places river water intensively used for irrigation and as a transporter human manages with water to deliver vast oases of Central Asia. For The Chirchik River itself, information of surface runoff melt water from perennial glaciers and snow cover consists at least 55 % [10,11,14]. And rain runoff is less than 2 %. This content of runoff generation explains the results of the following table.

Table 1. Results of the evaluation of intra-annual surface runoff distribution of The Chatkal River

№	Hydrological station and observations in years	Intra-annual runoff distribution (average in **low watery year** group)		Intra-annual runoff distribution (average in **average watery year** group)		Intra-annual runoff distribution (average in **high watery year** group)	
		high water period, % *(IV-IX)*	low water period, % *(X-III)*	high water period, % *(IV-IX)*	low water period, % *(X-III)*	high water period, % *(IV-IX)*	low water period, % *(X-III)*
1	The Chatkal River at Nayzatukay, 30	76	24	81	19	83	17
2	The Chatkal River at Ters, 38	75	25	79	21	82	18
3	The Chatkal River at Khudoydodsay, 48	77	23	80	20	83	17
4	The Chatkal River at village Charvak,40	77	23	79	21	83	17
Mean by periods:		76	24	80	20	83	17

Table 1 demonstrates that depending on precipitation amount in a year, the intra-annual distribution of the runoff of the Chatkal River for high-water periods (IV-IX months) ranges 76-83%, in low-water periods (X-III months) varies within the range of 17-25% [15,16,17]. This means regardless of the water management year group, for the high water period, about 80% of the runoff formed, and the rest 20% of runoff is formed in the second phase, respectively (see Fig. 1).

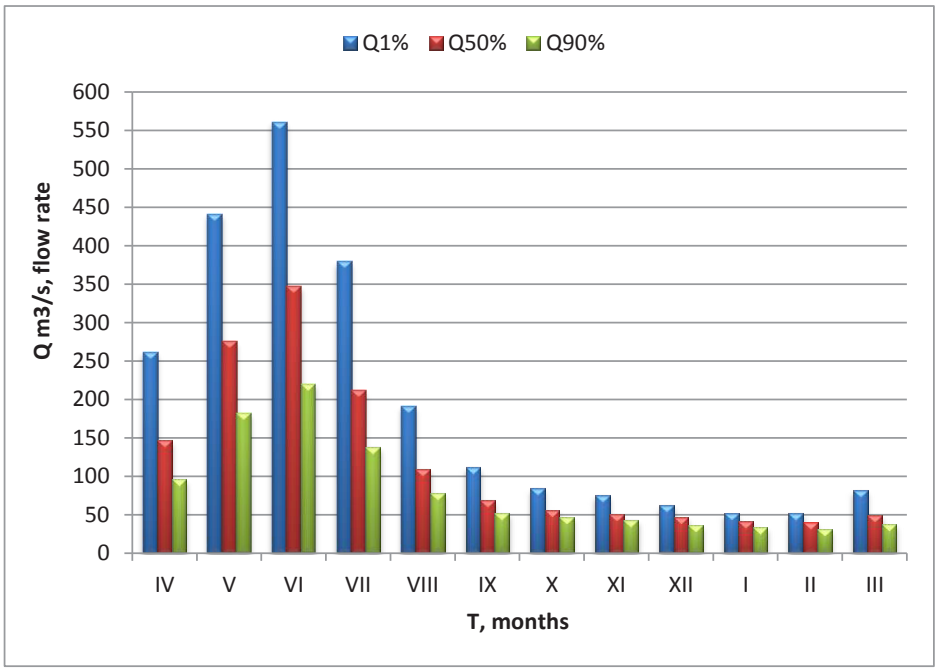

Fig.1. Histogram intra-annual runoff distribution of The Chatkal River at Khudoydodsay station, with 1%, 50%, and 90% exceedance probability, Pearson 3 type family.

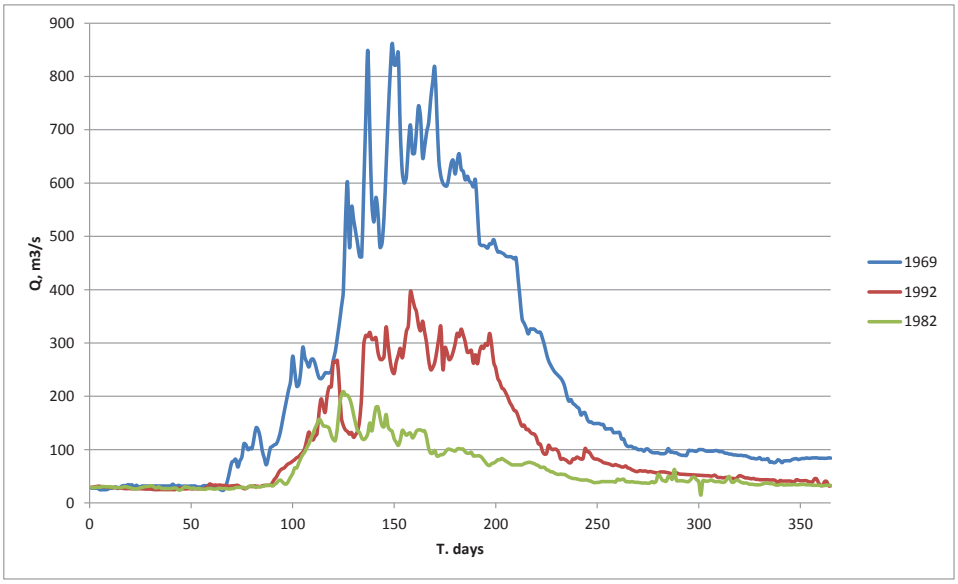

Fig. 2. Hydrograph of The Chatkal River at Khudoydodsay station, in three different years of watery.

In a modern hydrometeorological observation, 1969 was the most watery year. In the figure above (Fig. 2), three no identical years were taken to analyze water content for the study area. These three examples represent high water, average watery, and low watery years, respectively. For a focusing 85 years of observation, in high watery periods, surface runoff fluctuation is similar: melt of perennial snow cover starts and ends almost

simultaneously; however, in the low watery period, the situation is different. Perennial snow cover and mountain glaciers are not melting. The only elements for the generation of surface runoff are basic flow (groundwater discharge) and seasonal snow cover. This can be explained by low precipitation and air temperature during a given year.

4 Conclusions

As Figure 1 shows, for a given 1% of the exceedance probability in the high-water group for The River Chatkal at Khudoydodsay hydrological station, the highest average annual flow of water in June 561 m3/s, the smallest average annual flow is 52 m^3/s in January-February. For a given 90% exceedance probability in the low-water group, these values are equal to 220 m^3/s in June. And 31.5 m^3/s in January-February respectively. The computation of intra-annual runoff distribution for three different years of watery and for two distinguished periods of watery was carried out. It is understood that regardless of the watery of year, 80% of runoff originates in the high water period and 20% in the low water period. For a focusing 85 years of observation, in high watery periods, surface runoff fluctuation of the hydrograph is alike: melt of perennial snow cover starts and ends almost simultaneously; however, in the low watery period, the situation is different.

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