The multidisciplinary approach necessity at planning of use water and Hydropower resources of the Transboundary rivers of Central Asia

La nécessité d'approche multidisciplinaire lors de la planification d'eau d'utilisation et des ressources d'Hydroélectricité des fleuves Transfrontiers de l'Asie Centrale

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RÉSUMÉ

Ce travail est centré sur les conséquences de la construction de réservoirs en zone de piémont sur les caractéristiques microclimatiques et les changements météorologiques. Ces réservoirs induisent des modifications des températures de l'eau influençant la qualité des sols et leur efficacité agricoles. Les influences de ces changements climatiques sur les ressources agroclimatiques ont été analysées dans trois districts à fortes activités agricoles (Dangara, Fayzabad et Yavan) localisés en bordure du réservoir de Nurek. Les données utilisées proviennent de stations hydrométéorologiques (HMS) proches ; dynamique de la température, de l'humidité relative de l'air et des précipitations sur plusieurs décennies (1968-1988). L'évaporation et le coefficient d'humidité ont été estimés par calcul. Les résultats de ces calculs ont démontré que sur le long terme (1968-2000), la température annuelle moyenne s'est élevée de 1.0-1.5°C ce qui a conduit à une diminution de l'humidité relative de 3-6 %, à augmenter l'évaporation de 10-26 % annuellement et de 12-30 % entre mai et septembre. Cependant dans le district d'Yavan du fait de la température de l'air, l'évaporation a diminué de 0.5 et 7.2 %, l'humidité relative de 7.2 % et le facteur d'humidification de 10 %.

ABSTRACT

The efficiency of reservoirs construction in foothill districts and the essential influence on the formation of a microclimate and change of meteorological parameters of district is shown. The influence of reservoir and temperatures of water on change humus and the efficiency of the agricultural grounds are observed. For establishment influences of the climate change on possible changes of agroclimatic resources were spent the analysis of climatic parameters of three districts with developed agricultural branches (Dangara, Fayzabad and Yavan) adjoined to the Nurek reservoir. For this purpose data of Hydrometeorological stations (HMS) located in these areas have been used. Data on dynamics of temperature and relative humidity of air and atmospheric precipitations for 1968-1988 years were used. The evaporation and humidity coefficient were defined by calculation. Results of calculations are demonstrated that for 20 years (1968-2000) the average annual temperature has raised on 1.0-1.5^{o}C that has led to decrease of the relative humidity on 3-6 % and to increase evaporation on 10-26 % in an annual cut and 12-30 % in period May- September. However in Yavan district the temperature of air, evaporation decreases accordingly on 0.5 and 7.2 % and relative humidity and factor of humidifying raise on 7.2 % and 10 % accordingly.

KEYWORDS

Humidity, hydropower station, irrigation, microclimate, reservoir

INTRODUCTION

In the Aral Sea Basin on the territory which is located five states, water resources are used basically for irrigation and water-power engineering. These water users demand different modes of regulation of a river drain. In interests of water-power engineering – the greatest development of the electric power and accordingly use larges parts of an annual drain of the rivers in winter the cold period of year. For irrigation the greatest volume of water is required in the summer during the vegetative period. Regulation of a river drain is thus carried out by the large reservoirs. Thus all largest hydroelectric power stations are constructed in the countries of a zone of the drain formation - in upstream the rivers Amu Darya and Sir-Darya – in Kyrgyzstan and Tajikistan and the main areas of the irrigated lands are located in states of the down stream of the rivers – Kazakhstan, Turkmenistan and Uzbekistan. Tajikistan is rich of water resources. The total account of rivers in republic contains more then 25000, total length of about 90000 km. 6 per cent of all territory of republic is occupied by more than 8492 glaciers. Total annual volume of hydropower production in Tajikistan contains 527 bln. kWt · h. After lead – in to act of hydropower station of Rogun (3600 MWt) and Sangtuda (670MWt) annual plenty of hydropower in Tajikistan reaches 20 bln. kWt·h. For example, the energy potential only the Zeravshan River Basin is makes – 11.8 bln. kWt·h. The intensive grows of the Tajikistan population, presence of the large file of the fertile but not mastered lands suspended to upstream of the Zeravshan river demands principal processing of economic use of the Zeravshan rivers scheme. The mutual combination of interests of upstream and downstream countries of the Zeravshan River is quite achievable by building of the cascade of Hydropower station (HPS) with regulation of the river drain.

1 ECOLOGICAL, IRRIGATION AND ENERGETIC CRITERIA OF THE RESERVOIRS CONSTRUCTION

At present for definition of efficiency criteria of the Hydropower station (HPS) with reservoirs is widely applied method based on the analysis of key parameters HPS construction such as capacity and out-put electricity by HPS in dependence of area territory occupied for building of HPS. As index of ecology-economic efficiency of Hydropower station is used relation of capacity and out-put electricity to the one hectares of the territory used for construction of HPS.

Table 1 Ecology-economical efficiency of HPS with reservoirs construction

Ecology-economical Index efficiency of HPS	On capacity references to the area for building HPS (MWt / ha)	On power output references to the area for building HPS (TWt / ha)
Annual for HPS with area of ground less 100 th. ha	0. 123	0.406

By used of data presented on the Table 1 we made estimation efficiency now current Nurek HPS and planed in the near future construction of the Rogun HPS with reservoirs (Table 2).

Table 2 Estimation of the Nurek and Rogun HPS with reservoirs

Name	*P* MWt	W(10^2) TWt·h	*S* Th. ha	*A* Th. ha	*M* Th.pers.	Index of efficiency			
						P/S (MWt/ha)	*W/S* (TWt/ha)	*P/A* (MWt/ha)	*W/A* (TWt/ha)
Bratsk	4400	22.6	547.0	357.3	70.0	0.008	0.041	0.012	0.063
Charvak	600	20.0	4.6	2.7	9.18	0.13	0.436	0.225	0.750
Togtogul	1200	41.0	31.9	-	29.3	0.038	0.128	-	-
Nurek	2700	112	21.5	0.2	1.50	0.126	0.522	13.50	56.000
Rogun	3600	133	17.0	6.800	16.0	0.212	0.782	0.529	1.956

P- capacity of HPS; W- power output; S- area for building of HPS; A-area of wood vegetation; M- migration of population.

In the Central Asia Region with its inherent climatic conditions choice of place and the geographical location for building of the reservoirs is one of actual problems. Estimation of the influence degree of reservoirs in Arid zones on surrounding environment it is possible by use of coefficient $K_{sur.env.}$

Apparently, the degree of influence of reservoirs on an adjoining land decreases at reduction of their sizes and volume and at the same time return influences of the adjoining land increases to the

reservoir. This feature should be considered at creation of new reservoirs in the Tajikistan and also at development of schemes of building of coasts by recreation establishments, creation of zones of rest with a greater set of recreation services. For an estimation of the role of the reservoirs as local climate formation factor it is possible to use the next attitude $\Delta P/\sigma_{sp.dif.}$, where ΔP – influence indicator, $\sigma_{sp.dif.}$ – Middle square deviation differences of the deposition one of indicator by two station located on the distance 10-20 km. At $\Delta P/ \sigma_{sp.dif.} \geq 1$- influences of the reservoir on formation of the concrete meteorological condition is essential. These criteria we are used at estimation role of the reservoirs as factor of formation of the local meteorological condition and agro climatic parameters of the coastal zone and coasts and also thermics of the rivers in down beefs. Up to filling Nurek reservoir by water temperature of the Vakhsh River water in створе Nurek HPS dams (kishlak Tutkaul) practically not differences from its values on distance up to 17 km below the dam (kishlak Sariguzar). With filling of the bowl Nurek reservoir (1972 year) in spring (February-May) were observed drop temperatures of water and rising in summer - autumn - winter time (July-January) in comparison with natural conditions. The last explain partly by the fact that water take away from the top horizon of the reservoir at its unachieved filling up to High surface level (HSL) which has occurred only in 1980 years. Since this year began influence of the Nurek reservoir on change of a thermal mode of the Vakhsh River water which to be traced most precisely on 17 km of the river downwards from Nurek HPS dams up to hydrological post Sariguzar. The greatest difference of average monthly temperature of water before and after a construction of the reservoir on the hydrological post Sariguzar (4.2 ^{o}C) is observed in November-December. In process of removal from a dam, this difference decreases up to 1.2 ^{o}C. The analysis of changes of the water temperature on length of the rivers under influence of reservoirs shows that they are most significant at large reservoirs: distinction in daily and decade sizes of temperature of water reaches 8-12^{o}C. The greatest difference of average monthly temperatures of water in down beefs before and after a construction of reservoirs to come for November-January and for the Vakhsh River is equal 4.2-3.4^{o}C. The influence of hot temperature of waters dumped from large reservoirs proceeds 8 months in a year but cooling influences of water four (February-May) months. Thus influence of hot temperature on length of the large rivers is traced on distance in 1.74 times greater (209 km), than at dump of the cooled waters (120 km). Hence change of a course of annual distribution of average monthly values of water temperature below large reservoirs for a considered time interval not connected by change of annual means of temperature of air but is influence of reservoirs of the cascade. The influence small channels reservoirs on change of temperature of water on length of the river are traced on in significant distance. For establishment influences of the climate change on possible changes of agroclimatic resources we were spent the analysis of climatic parameters of three districts with developed agricultural branches (Dangara, Fayzabad and Yavan) adjoined to the Nurek reservoir. For this purpose data of Hydrometeorological stations (HMS) located in these areas have been used. The result of investigation demonstrated that for 20 years (1968-2000) the average annual temperature has raised on 1.0-1.5^{o}C that has led to decrease of the relative humidity on 3-6 % and to increase evaporation on 10-26 % in an annual cut and 12-30 % in period May- September. However in Yavan district dynamics of changes of the listed parameters has the opposite tendency: the temperature of air, evaporation decreases accordingly on 0.5 and 7.2 % and relative humidity and factor of humidifying raise on 7.2 % and 10 % accordingly. Reduction of the evaporation in the vegetative period in Yavan district reaches 12.2 %. In view of climatic changes it is necessary to bring corresponding corrective amendments in planning of the water use in agriculture. At development of regime of the irrigation it is usually considered parameters of meteocondition for all period of supervision. But it conducts to essential errors. On the old irrigated and perspective irrigation files due to ignoring the process of global climate warming irrigation regime do not consider growing needs for water. On the contrary, on the Yavan valley files recommended regimes of the irrigation are connected with over expenditure of water resources. For example, last specifications on regimes of the irrigation Yavan valley on annual average means of humidity coefficient (0.35) to the category of droughty areas. But for last 20 years evaporation in a valley has decreased almost on 300 mm (17 %) and the quantity of precipitation has risen on 70 mm (11 %) and humidity coefficient up to 0.45.Hence present irrigating norms for cultivation of the middle-fibrous cotton in Yavan valley is 1100m^3/ha and 3000 m^3/ha for Lucerne are overestimated. Calculations show, that unproductive losses of water only on two valleys are made more 60 mln.m^3. The analysis of the result of researches of the filtration characteristics at irrigation by the clean water and water with the weighed sediments shows that up to building of the Nurek reservoirs in each m^3 of Vakhsh River water contains up to 10 kg sediments and Annually more 100 t sediments rich with minerals inflows to the agricultural fields.