FLOW REGULATION BY WATER RESERVOIR FOR IRRIGATION USE

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Abstract The research is dedicated flow regulation by water reservoir for rice plantations in conditions of dry years. Simulation of water reservoir control is carried out with help of stochastic programming methods.

Keywords: water reservoir; irrigation, stochastic modeling.

Methods

Algorithm for water reservoir control of "fair concessions" (Voropaev et.al., 2003) and the corresponded PC program "IT balans" (Ismaiilov et al., 2014) were used for the search of effective rules of runoff regulation by water reservoir. The mathematical record of the task represented by minimizing the following functional:

$$\Phi\left(V^{\rho}, U^{\rho}, t\right) = \min \max \left| \frac{\sum_{t=1}^{t=T} U^{\rho} - U^{\rho}_{opt}}{U^{\rho}_{opt}} \right|$$

and the next conditions must be made:

$$\vec{V} = A\vec{W} + B\vec{U}; \vec{V} \le \vec{V} \le \bar{\vec{V}}; \vec{U} \ge 0; \vec{V} \ge 0$$

for $t = 0, \vec{V} = \vec{V}_0$, where $\vec{V}$– vector of the water reservoir storage (or level vector); $\vec{V} = \bar{\vec{V}}$, accordingly low limit – Dead storage and the upper limit - Full water reservoir storage; $\vec{U}$– vector of the plan drafts from water reservoir; $\vec{U}_t$ – vector of the real drafts at the moment t, which involves all water supply requirements of downstream (main - supply rise irrigation) and ecological water discharge; $\vec{U}_{opt}$ – optimum draft values; $\vec{W}$ - vector of runoff to the water reservoir; t – time during the year (in our variant – numbers of pentads, maximum T=72); A and B - matrix system conditions.

The Krasnodar water reservoir was chocen for the research. The reservoir is situated on the Cuban river, its catchment is located in the foothills of the North Caucasus and has water regime of torrential floods during vegetation period, however, there is significant probability of long-time dry period.

Main water user is rice irrigation. The data about the object contained dependence between level and the storage volumes of the water reservoir and its main parametersare: Dead storage capacity196 mln m^3 and corresponding Dead storage level (DSL) 25.85 m; Full storage capacity 1798 mln m3 and corresponding Normal level (NL) 32.75 m. Data about runoff to the reservoir contain daily discharges with begining 1994 year. Simulative model for the reservoir control have been made for the years of low water, in particularly for 1994 year (fig.1). According to the simulative model (Ismaiilov et al., 2014) of water reservoir were determined: graphs of water reservoir levels and water consumptions and water drafts during year (graph of fig.1); then the year sum of deficits, most pentad deficit (for 5 days), , amount of the deficit pentads were calculated. Same characteristics were determined with help of traditional water reservoir control according to dispatcher graph realized by PC program (Veliev, 2019). Results are represented table 1.

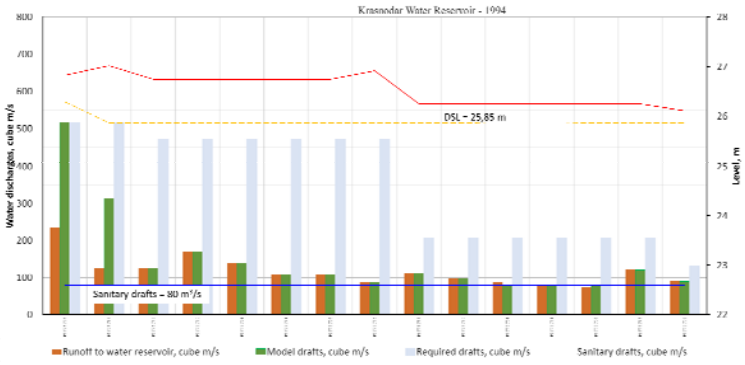

Figure 1: Examples of different rainfall scenarios

Results

The results of comparison represent in table 1.

Table 1: Results 1994 year

Models	The year sum of deficits, mln m^3	Most deficit, mln m^3	Quantity of deficit pentads during year
Old model	3579,2	442	33
New model	1474	198	21

Conclusions

The results of research have showed that the new model is much more profitable than the old model, but it works according to the well-known runoff hydrograph to the water reservoir. Therefore, the new model may be useful for the decision maker in the presence of short-term and long-term forecasts of runoff.

Bibliography

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