Investigation of Mountain Reservoirs' Sedimentation with the Natural Experiments

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Sedimentation process of reservoirs starts with the rivers' blocking and continues as long as the river on the surface of reservoir accumulated sediments, i.e. silting prisms (SP), forms the equilibrium hydrographic curve (EHC). This process is faster in the mountain reservoirs by which the river is able to transport a full range of sediment to downstream. There is no certified method of SP and EHC parameters forecasting up to nowadays; the risks caused by high floods are ignored. The systematic collection of information on the reservoirs is too protracted, therefore it was necessary to study it using the natural experiments.

With the purpose of SP formation process studying and EHC forecasting, field situ experiments on the small mountain rivers of Georgia (Rutskali, Ruchu, Vere) have been carried out. The three streams were blocked by dams of a meter height. Instrumental observations over the SP have been conducted by the program corresponding to their hydro regimes. On the River, where the reservoir volume was less than the sediment annual runoff, approximately for a year SP reached its limited size and EHC was formed.

On the other rivers, processes have been evolved with different intensity. A full-scale field study has shown that EHC is formed much higher than channel' initial position and due to this, while the flood, it creates a significant threat of catastrophic inundation. After the EHC formation, the reservoir completely loses its function and SP' surface is represented by inclined to dam parabolic, plane, the area of which surpasses of the reservoir mirror at 30%.

In tributaries SP forms the sediment plumes that extended till the boundary of top water level propagation created by the reservoir. Length of plumes (L) is a function of the maximum water flow discharge (Q_m), solid runoff (R), bottom sediment diameter (d) and the riverbed stream initial inclination (I): $L=f(Q_m,R,d,I)$.

The number of flood risk increases proportionally to the SP growth and of the river bed height. This is explained by the fact that the probability of catastrophic flooding is increased simultaneously with the sediment plume volume increment in the river bed.

In the approximation form the EHC has a parabola shape that is extended from the dam up to the point of the river bed cross section, above of which it retains the natural transport mode of solid flow during the reservoir operation.

References:

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