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THE EMERGING ROLE OF ECONOMIC ANALYSIS IN DECISION SUPPORT FOR THE OPERATION OF OFFLINE FLOOD STORAGE RESERVOIRS

■ *An example based on the case of the Tiszaroff reservoir*

The construction of a series of flood peak reservoirs along the River Tisza was the result of a change in flood defense strategy triggered by the experiences of the Millennium floods and a Hungarian national budget constraint. The Tiszaroff flood detention reservoir was the first large scale off-line flood storage facility along the river and the only one that was in use to mitigate the Tisza flood-wave of 2010.

The integration of the flood storage facility into the flood defense protocol raised new questions. Beyond hydraulic effectiveness, the question about the optimal use of the facility emerged. How can the deliberate inundation of the reservoir be economically assessed? How can the damage cost in the reservoir be compared to the incremental risk mitigation along the river? The economic module created

by REKK.AQUA integrates this aspect into the facility's operation protocol.

The decision support module is an economic tool that calculates the net economic effect of opening the reservoir. It incorporates information about specific points of the decision sphere that the head of the flood-defense operation faces, including uncertainty over the timing of flood forecasts and the projected peak level of the approaching flood wave.

The economic decision support module of the Tiszaroff flood detention reservoir relies on research provided by the domestic implementation of the Flood Directive and data on local flood defense activities, archived by the regional water directorate since 2006.

The Monte Carlo approach of the module helps decipher between differing decision scenarios presented by a complex and uncertain situation. In Hungary a comprehensive, experience based probability function for catastrophe driven by water levels has never been developed. The module makes up for this absence by testing the hydrological effect of opening the reservoir against different “assumed as critical water level” scenarios. This “assumed critical levels” approach allows the head of the defense operation to integrate an assessment of the circumstances of the given flood defense situation into the operation of the module.

With the module at hand, the hypothetical effects of reservoir use for previous flood-waves were examined - there were severe floods on the river Tisza in 2000 and 2006, but the Tiszaroff flood detention reservoir was not yet available. In addition, an ex-post analysis of the 2010 flood was also carried out. In 2010 the Tiszaroff flood detention reservoir was actually inundated.

The results show that even a small percentage decrease in the probability of a flood catastrophe (when peak levels approach the “one in a hundred year flood”) economically validates the use of the flood detention reservoir. Employing the reservoirs during the 2000 and 2006 floods would have halved the risk of catastrophe for the impacted stretch of the river.

An analysis of the use of the flood detention reservoir in 2010 revealed that the decision yielded only a slightly positive economic gain. This is a positive result from the module’s perspective because the ex-post evaluation matches the actual flood defense operation experience. In 2010 the necessity to open the reservoir (from the water level’s point of view) was a borderline decision, but some atypical features of the given flood-wave eventually gave way to the floodgate’s opening.

Conclusions

The results show that the economic evaluation of the use of flood detention reservoirs contributes to cost efficient defense operations. Meanwhile there are at least two ways in which further development can improve the overall cost effectiveness:

1. The changes in flood risk due to the reservoir’s mitigation effect provide a rational frame for the regulation of damage exposure inside the reservoirs. It can provide a sound economic basis for agreements between the reservoir operator and the land owners/users targeting damage exposure reduction that can further increase flood safety in cost effective ways.
2. The development of a pre-optimized operation scheme of the main flood-detention reservoirs of the catchment during the preparation phase of the flood defense activity can result in substantial cost savings in terms of damage compensation payments to land users within the reservoirs during future flood events.

The module strictly focuses on the defense related issues of the flood events but at the same time the calculations show the “interfaces” where there are sound economic platforms for the integration of several water policy issues that can be attached to the different uses of a reservoir territory.

Authors



Gábor Ungvári is senior water economist at AQUA.REKK the water economics unit of REKK. He received his MSc in economics in the Budapest University of Economic Sciences.

His main professional interest is applying economics for the advanced use of water related ecosystem services in solving current water policy problems. He worked in a series of water-resource focused, interdisciplinary research and landscape rehabilitation programs. His analytical work in water economics targets (among many) flood risk management, the problem of water logging and waterway development issues on the Danube. These experiences were used in the Economic Expert Group that contributed to the first National River Basin Management Plan of the WFD and in the Ex-ante economic analysis in the current second round of the plan’s supervision.

An other field of activity is research and consultancy work on water utility management. As part of the AQUA.REKK team he participated in the creation and run of the Benchmarking organization of the Hungarian Water Utility Association.