Is Rogun a Silver Bullet for Water Scarcity in Central Asia?

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Paper prepared for presentation at the Young Researchers' Forum of the International Conference-Natural Resource Use in Central Asia: Institutional Challenges and the Contribution of Capacity Building

September 30 to October 1, 2013
JLU, Giessen, Germany

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Background and motivation

Intersectoral and interstate conflicts over the use of limited water and energy resources are aggravating in all arid regions throughout the world, and particularly in the Aral Sea basin of Central Asia. Tremendous expansion of the irrigated areas to produce cotton starting from the 1960s led to a heavy dependence of the economies on irrigated agriculture. Irrigation development reduced environmental flows in the basin and caused a gradual desiccation of the Aral Sea, once the fourth largest lake in the world. The emergence of the five independent Central Asian states in the current territory of the Aral Sea Basin, after the dissolution of the Soviet Union in 1991, added new challenges for sharing basin resources.

The resume of construction of Rogun dam, with a height of more than 300 m and active storage of over 10 km^3, by Tajikistan in 2008 in the Vakhsh tributary of the Amu Darya River in upstream of Nurek reservoir led to fierce intergovernmental debates. Tajikistan intends to increase its national energy security and to gradually grow export revenues from electricity generation through this project with a maximum electricity generation capacity of 3600 MW. The country argues that the construction of the dam also increases water availability to downstream regions. In contrast, downstream Uzbekistan and Turkmenistan are concerned that inappropriate operation of the reservoirs by the upstream country may substantially harm irrigation benefits that are essential for the livelihoods of the majority of the population in these two countries.

Despite many debates and controversial arguments by both parties over the results of the construction of the dam its impact of Rogun Dam on agricultural production and livelihoods in the downstream regions has not been assessed in detail. This study uses an integrated hydro-economic model to address the potential impact of Rogun Dam on downstream water availability and irrigation benefits.

Method

Datasets used in the model are based on different sources, including national statistical reports and the databases of the previous studies. Particularly, data on river flows, regional water uses, cropland areas, and crop yields are based on the CAREWIB database (SIC-ICWC 2011). Reservoir topological parameters and their production and storage volume parameters are based on the databases of previously developed models, such as ASBOM (SIC-ICWC 2003) and EPIC (McKinney and Savitsky 2001). Crop production data were derived from reports by governmental organizations (SIC-ICWC 2008).

River simulation and crop production optimization models are combined using an integrated hydro-economic model following previous integrated river basin models for the Maipo (Cai et al. 2006) and Mekong River basins (Ringler 2004). The model allows analyzing water allocation among different sectors and regions over different seasons and is based on optimization of overall gains from irrigation, power production, and environmental systems across the Amu Darya basin. Flow data that reflected a normal water year are used for the base simulations. Based on data availability, all prices are estimated at the levels of 2006.

Results

According to our results, the construction of Rogun Dam has negligible impacts on water releases to downstream areas if all riparian countries strive for optimal basinwide benefits (Fig. 1). Water releases from the Nurek reservoir to downstream irrigation needs may decrease slightly but without considerable impact on irrigation water availability. This result holds after construction is completed and the reservoir is filled and under various levels of natural water supply (river runoff). The construction of Rogun Dam irrigation may slightly decrease benefits under normal water supply and inconsiderably increase in drier years (Fig. 2). Specifically, irrigation benefits across the Amu Darya basin are expected to be about US$ 1759 million without the Dam and US$ 1744 million with the Dam under long-term average water supply. Under reduced water supply (80% of normal), irrigation benefits are anticipated to be US$ 1474 million without the Rogun Dam and US$ 1507 million with the dam.

Figure 1. Downstream monthly water releases from the Nurek reservoir in the Amu Darya River under various levels of water availability

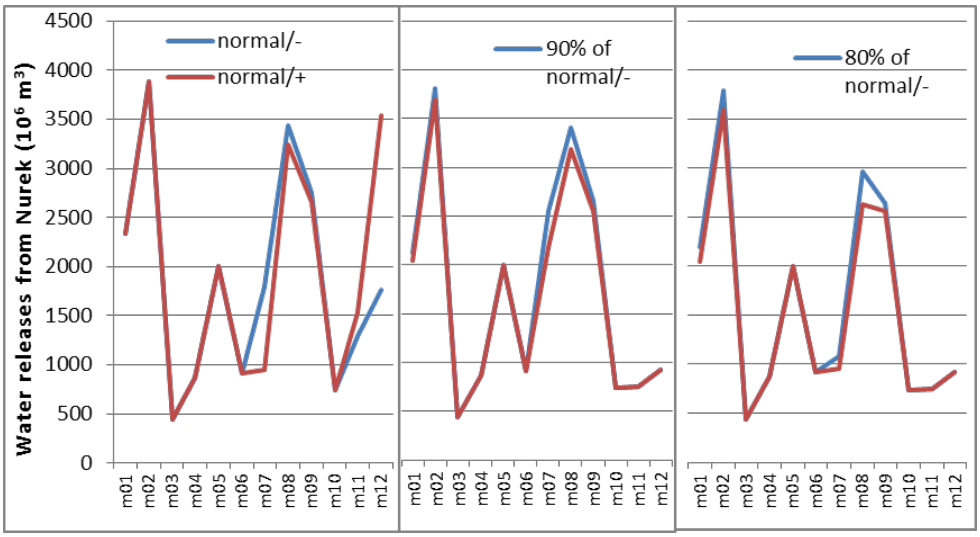
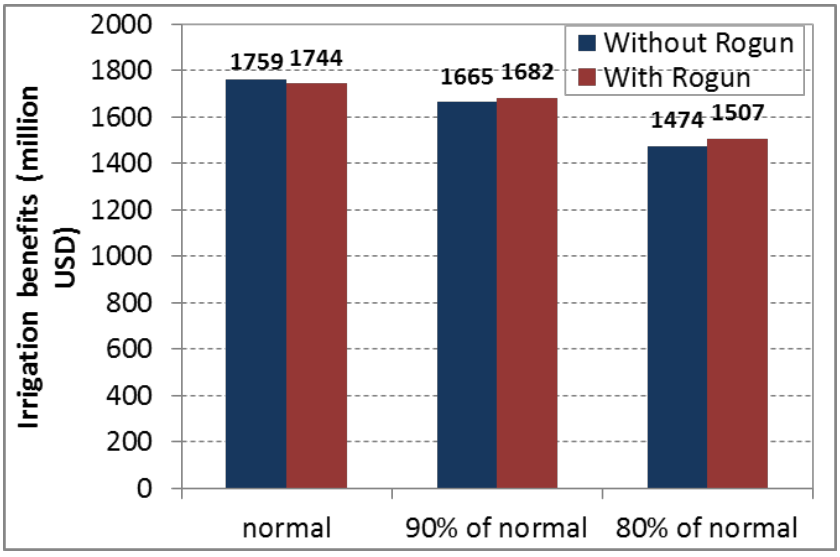


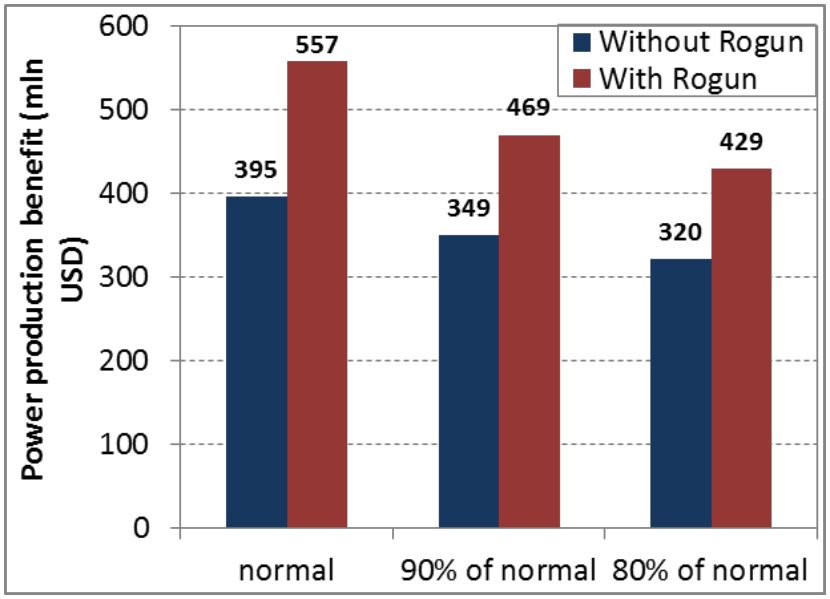
Figure 2. Irrigation benefits with and without Rogun Dam under various levels of water availability



While the construction of Rogun Dam does not impact irrigation considerably, it substantially improves power production levels and benefits (Figure 3). Power

production benefits in the Amu Darya basin may increase from US$ 395 million to US$ 557 million under average water flows. Under 80% of normal water supply, power generation benefits are lower but the construction and operation of the dam increases the benefits from US$ 320 to US$ 429 million.

Figure 3. Power production with and without Rogun Dam under various levels of water availability



Conclusion

The construction of Rogun Dam has negligible impact on downstream irrigation if the reservoir is operated to maximize basinwide benefits. At the same time, the new reservoir can significantly improve energy security and somewhat ameliorate adverse impacts from low flows in dry years. As such, the construction of Rogun Dam is not a silver bullet for water scarcity but can significantly alleviate the energy deficit in the Amu Darya basin. A comprehensive assessment of the advantages and disadvantages of the construction of the Dam requires additional, long-term impact analyses, which would assess alternative dam filling options, as well as operation rules that only maximize hydropower production to the possible detriment of downstream irrigation benefits in the basin. Under such consideration, Rogun Dam might turn out to be considered rather more explosive than

any silver bullet might have indicated.

References

Cai X., C. Ringler, and M.W. Rosegrant, 2006. Modeling Water Resources Management at the Basin Level: Methodology and Application to the Maipo River Basin. IFPRI Research Report 146. IFPRI, Washington DC, US

McKinney D.C., and A.G. Savitsky, 2001a. EPIC Modeling System Guided Water, Salt and Energy Management Problems. Available from: http://www.ce.utexas.edu/prof/mckinney/papers/aral/EPIC/EPICmodel.html.

Ringler, C., Huy, N.V., 2004. Water Allocation Policies for the Dong Nai River Basin in Vietnam: An Integrated Perspective. EPTD Discussion Paper No. 127. International Food Policy Research Institute, Washington DC.

SIC-ICWC, 2003. The database of the Aral Sea Basin Optimization Model (ASBOM). Excel file. Tashkent, Uzbekistan.

SIC-ICWC, 2008. Crop production costs and revenues across the regions of Uzbekistan in 2006. Unpublished database. Tashkent, Uzbekistan.

SIC-ICWC, 2011. CAREWIB (Central Asian Regional Water Information Base) database. SIC-ICWC, Tashkent, Uzbekistan.