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Addressing Water Resources Regulations under Climate Change Impact through Multi-Objective Modelling in Zeravshan River Basin

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Balancing water demand for the whole basin efficiency is priority task in the world. This is especially true in the arid regions with the limited resources, where water resources is one of main income source. Central Asia is one of such regions with conflicts over water sharing of transboundary river basin in arid climate. There are two groups of countries in here, the first upstream countries being origin and source of the river flow and the second who utilize most of the flow for irrigation. The distribution of the available lands for irrigation and income is high in downstream, while upstream argues to have right over water to generate own benefits. The balanced usage of the water between participators to reach the most outcome from available resources could ease tension and provide a better economic outcomes between argues.

Zeravshan river basin is a transboundary river shared by Tajikistan in upstream and Uzbekistan downstream chosen for the investigation. Today Tajikistan uses only 4% of the river flow, while in Uzbekistan it is a very important water source with full water resource utilization for irrigation. Arguments over increasing water use by upstream to the water demand in downstream and analysis of the possible water resources distribution to achieve positive benefits for both countries under climate change were analyzed. Through optimization framework including multi objectives of the dam operation, irrigation demands, social and urban demands under climate change impact to achieve positive benefit was developed. Through analyzing several future climate projection implications to the water environment and lands in the downstream are discussed. Most of the future projections, show a temperature increase of 3-4°C in CA, accompanied by precipitation decrease in summer and increase in winter. Water availability in summer will become the main issue as well as changes in seasonality of the runoff, higher temperatures in winters and hotter and drier summers.

The framework includes model to analyze available water resources and assessment of the whole basin efficiency including dam operation and irrigation demand, based on this information adaptation measures. Comparison of the increasing irrigation efficiency in downstream to the 10% rate can decrease water requirements on early stages, however there are still large deficiency of the water resources in the peak irrigation season. Dam operation to benefit irrigation has positive impact while can't compensate the needs of energy in winter months. Cooperation of the both sides are required to address such changes in river flow as interest lies on opposite side. Combination of dam operation for energy production and increasing irrigation efficiency additionally by using return waters can provide a beneficial scenario for the region under future climate change. However, it will require strong political will to address energy swap interexchange and social impact on population with decreased water flow. Our main goals were to define optimal solution to achieve nexus on water resources distribution between counterparts and provide optimal adaptation measures on degraded lands.