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Impact of Climate Change Adaptation Options on Stream Flow

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Climate change, now, is taken as a reality with distressing effects on natural resources. It is an established fact that the negative impacts of climate change on freshwater will be greater with increased precipitation variability and seasonal runoff shifts on water supply and consequent impacts on water quantity and quality. Therefore, this sector necessitates identification of possible long term adaptation to changing climate and their impacts on regional water availability and demand. We assessed three stakeholder-identified adaptation options namely- construction of traditional ponds (TP), construction of check dams (CD) and increased forest cover (IFC) in Kangsabati reservoir catchment and command area, in India using the Water Evaluation And Planning (WEAP) model. Four high resolution (∼25km) regional climate model outputs and their ensemble for the period 2021-2050 provide a range of future climate (2021-2050) scenarios to force the WEAP model.

Calibrated (1991-2000) and validated (2001-2010) WEAP model with reasonable NSE, R2 and PBIAS statistics has been used to test the effects of identified adaptation options on unmet demand of water, runoff generation and peak stream flow. Applying one traditional ponds for every 1 km2 area reduced unmet irrigation water demand by ∼4.5 x 109 m3 with reduced peak water demand from ∼0.78 x 109 m3 to ∼ 0.7 x 109 m3 compared to non-adaptation scenario. Increasing forest cover reduces runoff by ∼1000 times more than check dams and reduces monsoon season peak runoff rate as well. IFC demonstrates greater ability to meet the adaptation requirement by reducing high flows by upto 8 m3/s during monsoon season and increasing reservoir inflow by upto 0.5 m3/s during the lean season. While there is uncertainty in the magnitude of change of streamflow due to the effect of adaptation options, there is greater certainty in the sign of change. Results indicate that check dams and increasing forest cover as adaptation strategies have a similar type of impact, i.e. reducing streamflow. However, the timing and magnitude of change differs considerably and increasing forest cover may be a more suitable option than check dams or traditional pond for streamflow reduction as the criteria.