A STUDY ON CLIMATE CHANGE ADAPTATION AND RESILIENCE STRATEGIES FOR OPTIMIZING BENEFITS OF THE MAHAWELI RIVER BASIN IN SRI LANKA

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SUMMARY

Climate change, disasters, and multiple non-climatic drivers affect the social system, the quality of life, the natural and built environment, and the food-water-energy nexus. Impacts due to climate change and subsequent disasters have to be strategically handled by connecting natural science and technology for policymaking to implement adaptation and resilience strategies. Therefore, this research focused on developing a standard method to understand water-related disaster risks and proposing strategies for policymaking in terms of disaster risk reduction and water resources management. To understand water-related disaster risks, this research developed an integrated approach for assessing climate change impacts by utilizing the Data Integration and Analysis System of Japan for handing, manipulating, and downscaling big-data of General Circulation Models and the Water-Energy Budget-based Rainfall-Runoff-Inundation model for reproducing various long-term hydrological variables more accurately. This approach was applied to the Mahaweli River Basin in Sri Lanka to understand climate change impacts on rainfall, inundation, floods and droughts. The results showed that a) this river basin will yield sufficient water resources for future usage in various sectors, b) meteorological and hydrological floods will also increase in the future climate, and c) the downstream region of the basin is vulnerable to future droughts during the North-East monsoon period and the Intermediate Monsoon-2 period. But these future changes only depict the information regarding average changes over a 20-year period. Still, the onset and withdrawal of these events are uncertain based on the available information. Therefore, it is necessary to use seasonal forecasting and short-term weather prediction for flood and drought management. Hence, to utilize future water resources and manage flood and drought disasters to ensure food, water, and energy security, two adaptation strategies that the Mahaweli Authority of Sri Lanka can use were developed by utilizing information from seasonal forecast-based short-term weather prediction. The results indicated that by utilizing seasonal forecasts, optimization tools, and reservoir operation rules, we can achieve flood and drought risk reduction by saving enough water for an upcoming agriculture season and enhance energy generation by pre-releasing a future flood through a power turbine. Moreover, the results of the short-term operation showed that the expected flood inflow could be utilized for power generation by pre-releasing the forecasted inflow and keeping the reservoir elevation at a low level to receive a future flood, thus preventing the reservoir from spilling.

Keywords: Disaster risk reduction, Climate change impact assessment, General Circulation Models, Water Energy Budget Rainfall Runoff Inundation Model, Decision making, Reservoir optimization, Seasonal forecast, Weather forecast.