EFFECT OF CLIMATIC CHANGE ON WATER - ENERGY - FOOD NEXUS IN MAHAWELI RIVER BASIN AND A PREDICTION MODEL TO MITIGATE NEGATIVE IMPACTS

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DECLARATION OF THE CANDIDATE AND SUPERVISOR

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Effect of Climatic Change on Water - Energy - Food Nexus in Mahaweli River Basin and a Prediction Model to Mitigate Negative Impacts

Abstract

Mahaweli river is the longest river in Sri Lanka which flows through all the climatological regions with vast diversities in precipitations, environmental conditions, water usages, and livelihoods. The hydrology of the sub-basins in the Mahaweli river varies from high frequent and high-intensity rainfalls in wet zones to water-scarce dry zones. Identification of climatic impacts and analysis of proactive management alternatives are important in optimizing water management in a watershed. For the selection of efficient proactive water management alternatives, integrated management of the water allocations to satisfy water demand in different sectors has to be identified. The WEF nexus models were developed as the integrated management approach for water allocations. The objective of this study is to develop the WEF nexus with prediction models for subbasins of the Mahaweli River and analyze the climatic change. Three sub-basins were selected from the different climatic zones to analyze the climatic effect on water management. RNN NARX model was identified as the most suitable model from the comparison of accuracy in prediction between linear ARIMA model and non-linear NARX model. Monthly water availability and water demand for water and food sectors of the WEF nexus were calculated using rainfall, potential evapotranspiration, streamflow, land use, and water use data. The NARX prediction models for available water and requirements were developed and intersectoral WEF nexus analysis was carried out for different proactive management alternatives. Available water in the wet and intermediated zones was adequate to supply the water requirements in the sub-basins. The average water availability of the dry zone basin is about 39.97 MCM/month while the water requirement is about 61.50 MCM/month. Available water was inadequate to fulfill water requirements in the dry zone basin for some months. Prediction models combined with WEF nexus analysis are an improved decision support system for water management as it is advantageous to know possible threats for fulfilling the water requirements beforehand and to mitigate negative impacts accordingly.

Keywords: Climatic impact, Decision support system, Intersectoral analysis, NARX, Prediction models, WEF nexus.

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LIST OF ABBREVIATIONS

ARIMA	Auto-Regressive Integrated Moving Average
DEM	Digital Elevation Model
DSS	Decision Support System
IWR	Irrigation Water Requirement
LULC	Land Use/Land Cover
MDP	Mahaweli Development Project
MCM	Million Cubic Meters
MCA	Multi-Criteria Analysis
MWR	Monthly Water Requirement
NARMA	Non-linear Auto-Regressive Moving Average
NARX	Non-linear Auto-regressive with exogenous input
NCPCP	North Central Province Canal Project
RNN	Recurrent Neural Network
SOP	Seasonal Operational Plan
SPI	Standard Precipitation Index
WMS	Water Management Secretariat

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