DEVELOPING AN INTEGRATED APPROACH FOR OPTIMIZING THE CLIMATE CHANGE IMPACT ON WATER AND AGRICULTURE NEXUS IN THE PHILIPPINES: THE CASE OF PASIG-MARIKINA RIVER AND LAGUNA LAKE BASIN

A Dissertation

Submitted to the National Graduate Institute for Policy Studies (GRIPS)

and

International Centre for Water Hazard and Risk Management (ICHARM),

Public Works Research Institute (PWRI)

in Partial Fulfillment of the Requirements for the Degree of

Ph.D. in Disaster Management

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September 2024

ABSTRACT

Climate change is increasingly recognized as a critical factor affecting water resources and agricultural productivity globally. In the Philippines, a nation highly vulnerable to climatic shifts due to its geographical location, the impacts are particularly pronounced. The Pasig-Marikina River and Laguna Lake Basin, a vital area for both water supply and agriculture, faces significant challenges as a result of changing climate patterns. The interconnectedness of water resources and agriculture necessitates a comprehensive approach to manage and mitigate these impacts effectively. This study aims to develop an integrated approach to optimize the impact of climate change on the water and agriculture nexus under projected climate change scenarios in the Pasig-Marikina River and Laguna Lake Basin by employing high-resolution climate models, hydrological simulations, and agricultural simulation and productivity assessments.

The dynamically downscaled and bias-corrected MRI-AGCM 3.2S super high-resolution Global Climate Model (GCM) was utilized and input-forced into the Water and Energy Budget-based Rainfall-Runoff-Inundation (WEB-RRI) hydrological model. The GCM simulations were performed for both past (1979–2003) and future (2075–2099) climate RCP 8.5 scenario (a severe or business-as-usual scenario) to analyze the projected shifts in discharge and lake levels within the basin. The results indicate an impending climate shift characterized by several key findings, including an increase in maximum daily discharge, earlier attainment of maximum mean monthly discharge by a month, significant rises in mean monthly discharge in four specific months, and elevated maximum daily lake levels. Additionally, there is nearly tripled flood frequency, prolonged maximum inundation duration, and substantial increases in both maximum

flood extent and depth, particularly affecting low-lying areas within the basin, especially the rice fields.

In linking these generated past and future climate scenarios to agricultural production, the calibrated Crop Growth Simulation Model (SIMRIW) was coupled with the WEB-RRI model. Results show that rice production will be significantly affected, with a potential decline in yields if no countermeasures are implemented such as changing the planting date in order to obtain harvest before flood occurs or improve the yield by reducing water stress during dry periods. Moreover, the use of open-source satellite data and UAV image data has proven beneficial in improving the estimation of rice crop damage from flooding events, thereby enhancing the agricultural monitoring system.

Integrating these different models (Global Climate Model, WEB-RRI Model, and SIMRIW Model) and the results of satellite data for crop monitoring, the impact of climate change on the water and agriculture nexus can be optimized. Policy suggestions such as construction of river control structures, use of pump stations, adaptive cropping strategies, comprehensive climate policies, and training programs for capacity building will be beneficial to the Pasig-Marikina River and Laguna Lake Basin. This holds crucial implications for policymakers, water resource managers, stakeholders, and researchers in developing climate-resilient strategies amidst evolving hydrological conditions.