

Integrated Flood and Sediment Management In River Basins for Sustainable Development: The Case of Cagayan River Basin

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Introduction

Vietnam and the Philippines are two of the countries most affected by climate change and fluctuation. Extreme floods and droughts are anticipated to become more powerful and frequent as a result of climate change.

Due to climate change, deforestation combined with heavy rainfall during the flood season accelerates reservoir sedimentation, resulting in reservoir storage capacity decreases. As a result, downstream populations in the Vu Gia-Thu Bon and Cagayan River basins are anticipated to be vulnerable to severe floods and droughts, inflicting serious damage to agriculture, aquaculture, and people's asset. Water shortages in the dry season are also exacerbated by land use changes and irrigation expansion, particularly in El Nino years.

An "integrated flood and sediment management" approach is required for sustainable development in a river basin, in which all water-related issues must be addressed and managed appropriately in a coordinated manner throughout the basin.

This collaborative research initiative between the Philippines, Vietnam, and Japan aimed to create new flood, sediment, and water resource management ideas and methodologies for sustainable development in ASEAN river basins. In conjunction with academics from Japan, Vietnam, and the Philippines, the project's outputs aimed to assist minimize disasters caused by floods and droughts linked to climate change consequences. The project aimed to create cutting-edge technology for dam restoration, reservoir operation, and water resource asset management, which will be

conveyed to the Vietnamese and Philippine industrial sectors and governments.

Approach and methods

This Isabela State University has forged an alliance with Kyoto University and Thuyloi University in to help address issues in integrated flood and sediment management in river basins in both the Philippines and Vietnam. The whole project was divided into four (4) components following the integrated approach for river basin management. This paper highlights the assessment of the impacts of climate change and the optimization of a rainfall-runoff-inundation model for the Cagayan River Basin to be used as a decision support tool for flood inundation forecast and upgrade dam discharge protocol during extreme rainfall events. It also highlights the conduct of a bathymetric survey in the Magat Dam reservoir to assess the sedimentation rate and recommend an intervention to address sedimentation problems.

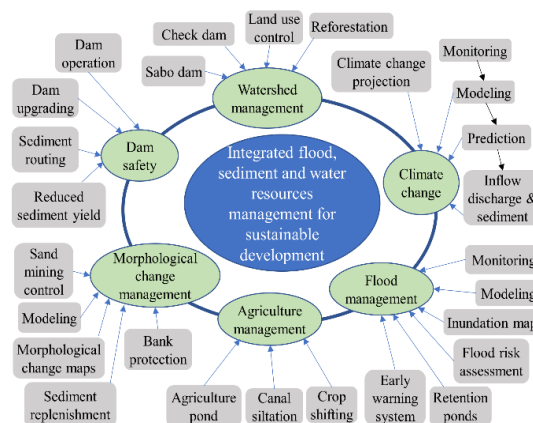


Figure 1. Schematic Framework for Integrated flood, sediment, and water resources management for sustainable development in river basins.

Results and discussions

Based on the initial results, interventions to increase the live storage of the dam are necessary. The result of the bathymetric survey was used to strengthen the proposal to conduct dredging in the reservoir and construct Sabo dams in the Magat Dam watersheds.

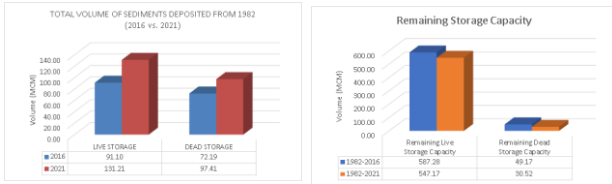


Fig. 3 Total volume of sediments deposited in Magat Dam and its remaining storage capacity.

This study predicted a significant increase and decrease of monthly inflow in mid and by the end of the 21st century under RCP 4.5 and RCP 8.5 climate change scenarios.

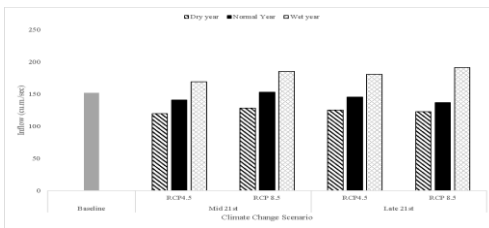


Fig. 4 Projected inflow of Magat Reservoir under the effect of Climate Change during the Mid and Late 21st Century.

The RRI Model was calibrated and validated to be used as a decision support tool for flood inundation forecasts.

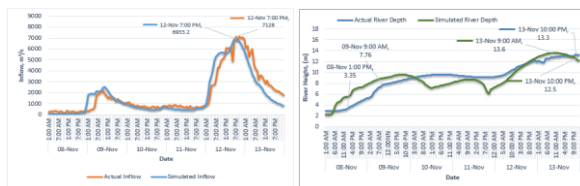


Fig 5. Actual vs Simulated inflow and flood height of the RRI model.

The model was able to determine flood inundations in the basin during Typhoon Ulysses.

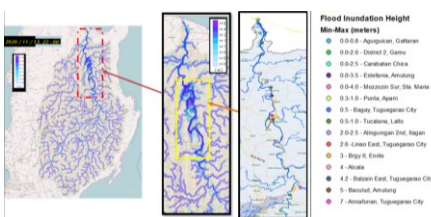


Fig 6. Flood Height Map Along Cagayan River Basin.

Rainfall forecast will utilize an ensemble technique to be provided by Japan Water Agency (JWA); the Rainfall-Runoff-Inundation model will be used as the tool for dam inflow forecast and for flood forecast in Cagayan River Basin.

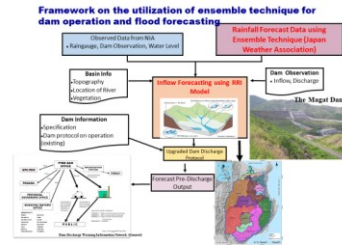


Fig 7. Proposed framework of ensemble technique for dam operation and flood forecasting in CRB.

This study paved the way for training and seminars led by Kyoto University. Scholarships will also be given to Master and Doctoral Students. Moreover, the creation of the International Association on Climate Change Adaptation and Disaster Risk Reduction Management (IO-CCA/DRRM) will strengthen integration of climate change adaptation and disaster risk reduction management, environmental awareness, and mitigation.

Conclusion

The tri-lateral collaboration between the Isabela State University in the Philippines, Kyoto University in Japan, and Thui-Loi University in Vietnam has been bringing productive research in Region 2 as the international research project under this partnership has already been used to strengthen the management interventions in the Magat Dam reservoir of the NIA-MARIIS.

References

[1] Principe, J.A. 2012 Exploring climate change effects on watershed sediment yield and land cover-based mitigation measures using SWAT model, RS and GIS: case of Cagayan River basin, Philippines, *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XXXIX-B8, Australia, 193-198,