Comparative Machine Learning Models for Monthly Reservoir Water Volume at Mae Ngat Dam

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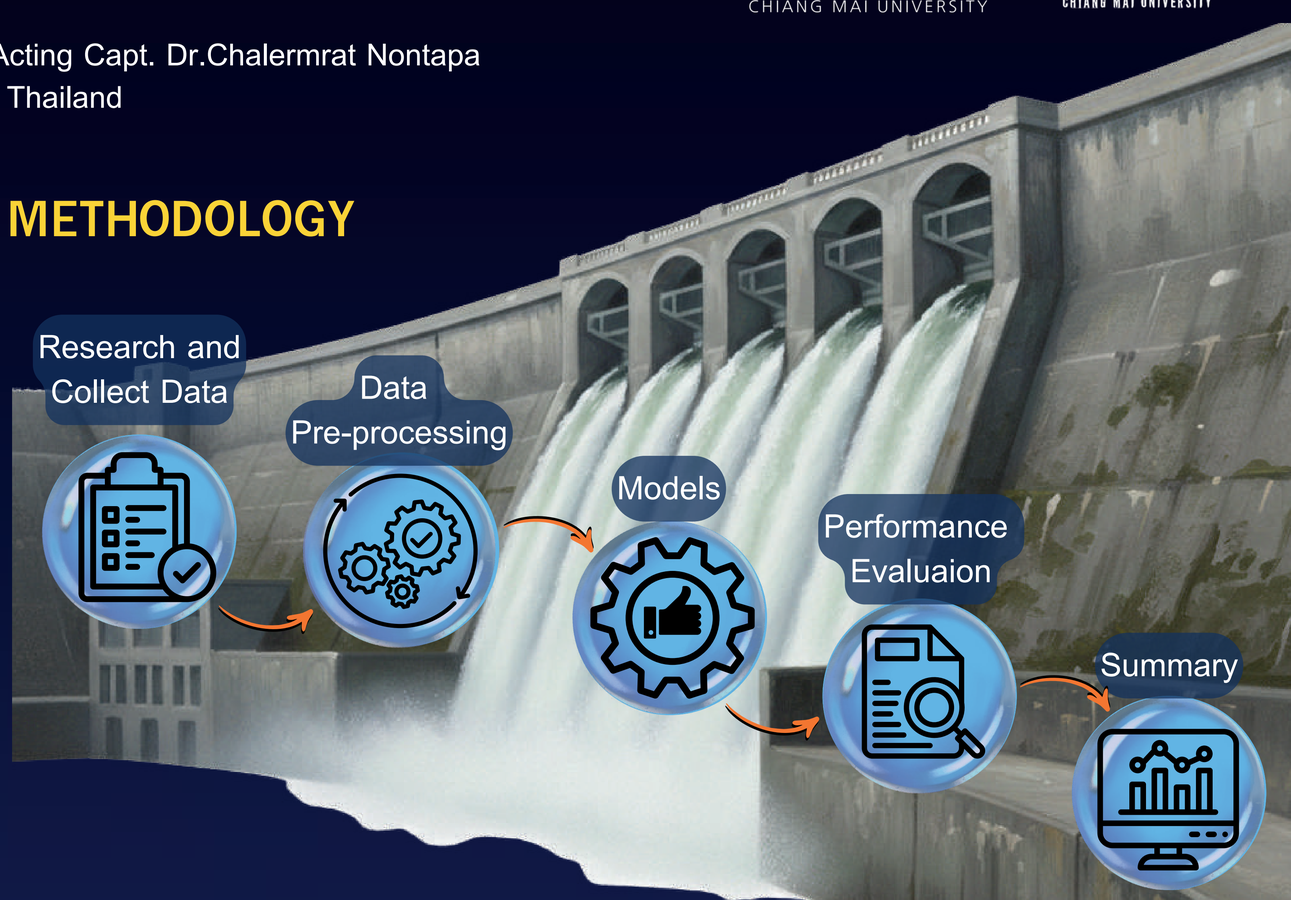
ABSTRACT

This study evaluated five machine learning models to forecast the monthly water volume of the Mae Ngat Somboon Chol Dam. Results indicated that the Decomposition with Multiplicative XGBoost model is the most effective providing the highest accuracy with an R-Squared of 96.10% and a testing error (MAPE) of only 3.2852%.

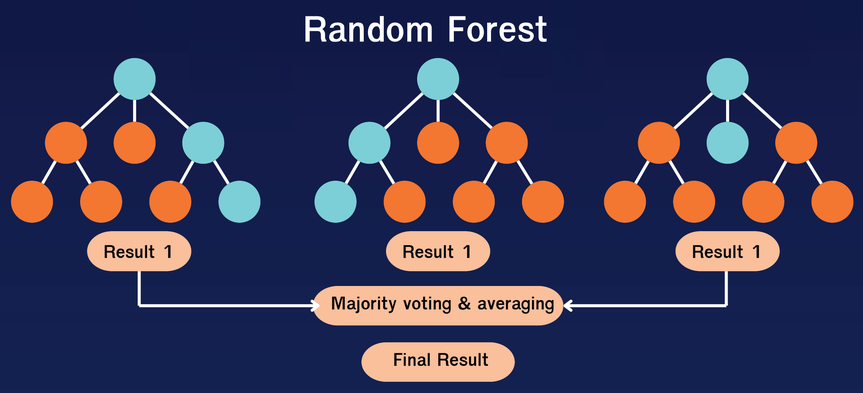
INTRODUCTION

Climate change-induced water fluctuations pose a significant threat to agriculture and food security in Chiang Mai. This study utilizes statistical and time-series techniques to develop high-precision monthly inflow forecasting models for the Mae Ngat Somboon Chol Dam. The goal is to provide a robust decision-support tool for optimized water management, flood and drought mitigation, and sustainable resource administration in the Upper Ping River Basin.

METHODOLOGY



MODELS

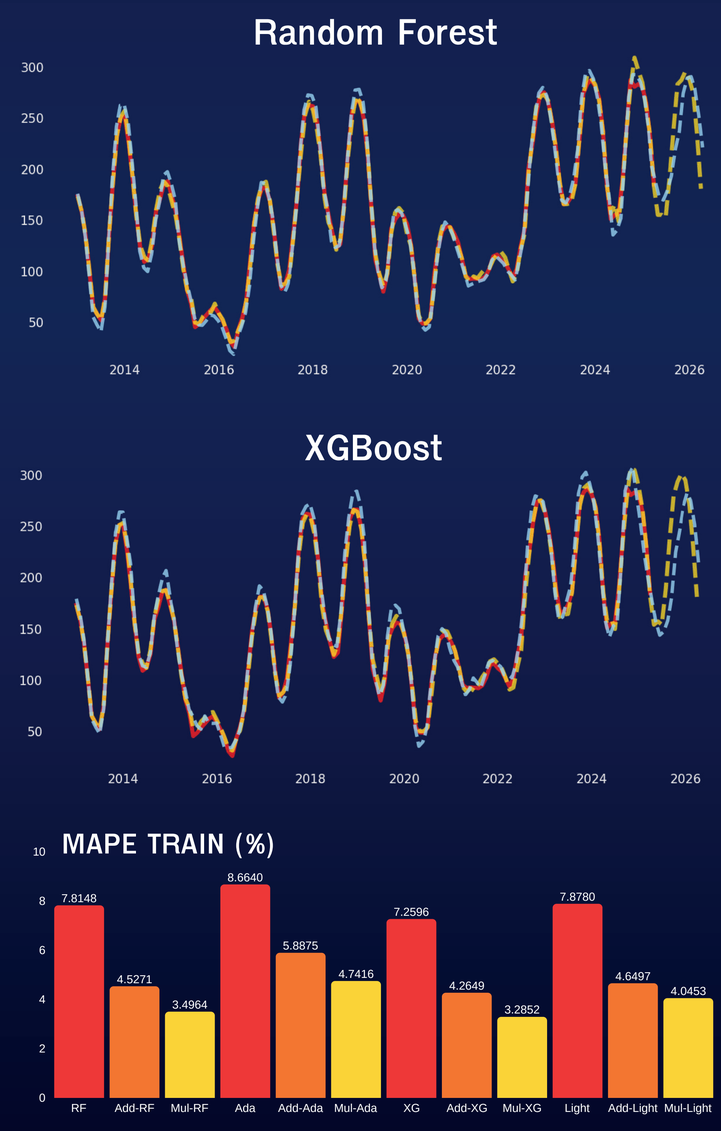


OBJECTIVES

1 To develop and compare the efficiency of predictive models for forecasting the water volume of the Mae Ngat Somboon Chol Dam in Chiang Mai, Thailand.

2 To forecast future trends of water volume in the Mae Ngat Somboon Chol Dam to support water management planning.

RESULT



The Multiplicative Decomposition-XGBoost model demonstrates the highest efficiency in forecasting monthly water volumes for the Mae Ngat Somboon Chol Dam, achieving superior precision with a Testing MAPE of 3.2852% and an R-Squared of 96.10%

EVALUATION CRITERIA

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{Y_t - \overset{\Lambda}{Y}_t}{Y_t}\right| \times 100$$

$$R^2 = \left(1 - \frac{\sum_{t=1}^{n}(Y_t - \overset{\Lambda}{Y}_t)^2}{\sum_{t=1}^{n}(Y_t - \overset{\Lambda}{Y}_t)^2}\right) \times 100$$

CONCLUSION & DISCUSSION

The high efficiency is attributed to its ability to handle complex non-linear relationships and seasonal fluctuations, aligning with the concepts of Cleveland et al. (1990) and Chen & Guestrin (2016). These findings confirm that data decomposition significantly enhances machine learning performance, providing a robust tool for sustainable water management and disaster risk mitigation in Chiang Mai

BENEFITS

The strategic shift from reactive water management to a data-driven, proactive framework enables authorities to leverage high-precision predictive insights for optimizing annual water allocation across the agricultural, domestic, and tourism sectors; simultaneously, this approach significantly mitigates the socio-economic risks associated with seasonal flooding and prolonged droughts through strategic planning, while providing a scalable foundation to adapt this forecasting model to other reservoirs with similar seasonal characteristics, ultimately fostering regional climate resilience and long-term water security through evidence-based policy and sustainable resource stewardship

REFERENCES

[1] Fongngoen, W. (2018). Dam Water Volume Forecasting Using Data Mining Techniques. Journal of Technology Management, Rajabhat Maha Sarakham University, 4(1), 27–33. https://ph02.tci-thaijo.org/index.php/itm-journal/article/view/115233
[2] Saeying, J., Minsan, W., & Taninpong, P. (2023). Forecasting Model for the Amount of Water Flowing into the Reservoirs of the Electricity Generating Authority of Thailand (EGAT). Recent Science and Technology, 15(2), 494–510. https://li01.tci-thaijo.org/index.php/rmutsvrj/article/view/252100