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# TOWARD LOCALIZED DENGUE CONTROL: UNPACKING CLIMATE DETERMINANTS IN PALU CITY, INDONESIA

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## ABSTRACT

Dengue has shifted from a seasonal nuisance to a persistent global health threat, exacerbated by climate change. Since the life cycle of Aedes mosquitoes is strongly controlled by environmental conditions, climate variability offers a crucial early warning signal to anticipate outbreaks. This is particularly relevant for tropical regions like Palu City, Indonesia, which possesses an ideal climate for vector survival. Nevertheless, translating complex climate data into proactive public health actions remains a challenge, as "one-size-fits-all" management policies often fail to accommodate local climate dynamics. This study aims to develop and compare machine learning architectures to accurately predict Dengue Hemorrhagic Fever (DHF) cases in Palu City using climate variables and historical case data. The modeling was evaluated through two approaches: (1) a Random Forest (RF) model, and (2) a hybrid model integrating a linear Autoregressive (AR) algorithm with RF. The AR component captures historical case patterns, while the RF algorithm models the non-linear behavior of climate predictors. The hybrid approach substantially outperformed the single RF model, reducing the Root Mean Square Error (RMSE) by 19.45% and Mean Absolute Error (MAE) by 19.14%. Feature Importance analysis revealed that 1-month lag temperature is a crucial predictor of dengue risk (53.77%), followed by the seasonal effect of the Month variable (25.38%) and 2-month lag relative humidity (20.86%). The model successfully identified critical climate thresholds, indicating that DHF transmission risk increases when the average temperature in the preceding month crosses 26.8°C and humidity two months prior exceeds 87%, particularly during the first-quarter seasonal transition. In conclusion, separating historical components and non-linear climate influences into a combined architecture yields more robust and precise predictions. This model offers a reliable scientific instrument for formulating locally specific vector control policies and supporting a more adaptive DHF early warning system in Palu City.

***Keywords*** Dengue · Random Forest · Autoregressive · Early Warning System · Climate · Palu City.

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