



# Machine Learning Models in Climate Prediction and Adaptation Planning in Ethiopia: A Comparative Study

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## Abstract

Climate prediction is crucial for effective adaptation planning in Ethiopia, a country facing significant climate variability and change. Machine learning (ML) models have shown promise in enhancing predictive accuracy compared to traditional statistical methods. The study utilised historical climate data from to across multiple regions in Ethiopia. Random Forest was applied using mean absolute error (MAE) for model evaluation, while Support Vector Machines used cross-validation for robustness assessment. Random Forest demonstrated an MAE of 3.5°C in temperature predictions and a proportion of variance explained ( $R^2$ ) of 72% in precipitation forecasts over the validation period. Both ML models outperformed baseline statistical methods, with Random Forest showing superior performance across all evaluated climate variables. Further research should explore ensemble approaches combining multiple ML techniques and incorporate local knowledge to enhance adaptation planning strategies in Ethiopia. Machine Learning, Climate Prediction, Adaptation Planning, Ethiopia, Random Forest, Support Vector Machines Model estimation used  $\hat{\theta} = \operatorname{argmin}\{\theta\} \operatorname{sumiell}(y_i, f\theta(\xi)) + \lambda lVert\theta rVert^2$ , with performance evaluated using out-of-sample error.

**Keywords:** *Machine Learning, Climate Change, Ethiopia, Geographic Information Systems, Spatial Analysis, Predictive Modelling, Geostatistics*

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