



Machine Learning Models in Climate Prediction and Adaptation Planning in Egypt: A Systematic Review

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Abstract

Machine learning (ML) models have gained significant attention for their potential in climate prediction and adaptation planning across various regions. A comprehensive search was conducted using databases including Web of Science, Scopus, and Google Scholar. Studies published between and were reviewed, focusing on ANN applications in Egypt's climate prediction domain. A thematic analysis method was applied to synthesize findings. The review identified a total of 56 studies, with 80% utilising ANN models for climate forecasting. Notably, the proportion of successful predictions ranged from 72% to 91%, indicating moderate reliability in ML model performance. ANNs show promise as effective tools for predicting climatic conditions in Egypt. However, further research is needed to validate these findings and explore potential integration into climate adaptation planning frameworks. Researchers should prioritise validation studies using independent data sets and evaluate the impact of ML models on decision-making processes for climate adaptation strategies in Egypt. Model estimation used $\hat{\theta} = \operatorname{argmin} \{ \theta \} \sum_{i=1}^n \ell(y_i, f_{\theta}(\xi)) + \lambda \operatorname{Vert} \theta \operatorname{Vert}^2$, with performance evaluated using out-of-sample error.

Keywords: *Machine Learning, Climate Change, Adaptation Planning, Africa, Data Mining, Artificial Neural Networks, Predictive Analytics*

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