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TELANGANA RICE CROP YIELD PREDICTION USING MACHINE LEARNING

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ABSTRACT
Accurate rice yield prediction is essential for effective agricultural planning and resource management in Telangana. This study applies machine learning techniques to develop a predictive model using key agro-climatic and fertilizer consumption attributes, including district code, year, rice cultivation area, production volume, temperature variations, precipitation, annual rainfall, and nitrogen, phosphate, and potash consumption. Multiple models, including Linear Regression, Lasso Regression, and Decision Tree, were evaluated, with Linear Regression achieving the highest accuracy (0.889 score). Data preprocessing, such as feature selection and standardization, was implemented to enhance model performance.
This machine learning-based approach provides a reliable and interpretable solution for crop yield forecasting, assisting farmers and policymakers in making data-driven agricultural decisions. The model can be integrated into a web-based application for real-time predictions, contributing to improved food security and resource allocation.

Keywords:
Rice Yield Prediction, Machine Learning, Linear Regression, Lasso Regression, Decision Tree, Agro-Climatic Data, Fertilizer Consumption

INTRODUCTION

Rice is one of the most important staple crops in Telangana, contributing significantly to the state's agricultural economy. Accurately predicting rice crop yield is essential for effective farm planning, resource allocation, and policymaking. Traditional methods of yield estimation rely on historical trends, climatic observations, and expert analysis, which often require extensive data collection and third-party assessments. This process can be complex and time-consuming, making it difficult for farmers to access timely and accurate predictions.
To bridge this gap, machine learning (ML) techniques offer a data-driven approach to predict crop yield more efficiently. This study focuses on developing an ML-based rice yield prediction model using agro-climatic and fertilizer consumption data specific to Telangana. The dataset, sourced from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), includes key attributes such as district code, year, rice cultivation area, production volume, temperature variations, precipitation, annual rainfall, and fertilizer consumption (nitrogen, phosphate, potash, and total consumption).The dataset for this research has been obtained from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) database (http://data.icrisat.org/dld/).
The study evaluates multiple ML models, including Linear Regression, Lasso Regression, and Decision Trees, identifying Linear Regression as the best-performing model with an accuracy score of 0.889. To improve prediction reliability, techniques such as feature selection and data standardization were applied.
This research aims to develop a farmer-friendly, real-time crop yield prediction system, enabling better decision-making, efficient resource utilization, and improved agricultural productivity. The findings can be further extended into a web-based application to make predictions accessible to farmers and policymakers, enhancing food security and sustainability in Telangana.

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OBJECTIVES

The objective of this study is to develop an accurate machine learning model for predicting rice crop yield in Telangana using agro-climatic and fertilizer data. It aims to analyze key factors, evaluate ML models (Linear Regression, Lasso, Decision Tree), optimize performance through feature selection and tuning, and create a user-friendly web application for real-time predictions. The goal is to assist farmers and policymakers in making data-driven decisions for better agricultural planning and resource management.

METHODOLOGY

The Telangana Rice Crop Yield Prediction model follows a structured machine learning pipeline:

1. **Data Collection:** Sourced from the ICRISAT database, including attributes like district, year, rice area, production, temperature, rainfall, and fertilizer consumption.
2. **Data Preprocessing:** Missing values handled, Lasso-based feature selection, label encoding for categorical data, and standardization applied for consistency.
3. **Model Selection & Training:** Implemented Linear Regression, Lasso Regression, and Decision Tree, with hyperparameter tuning (GridSearchCV) for optimization.
4. **Model Evaluation:** Performance compared using R^2 score, MAE, and RMSE, where Linear Regression achieved the highest accuracy (0.889 R^2 score).

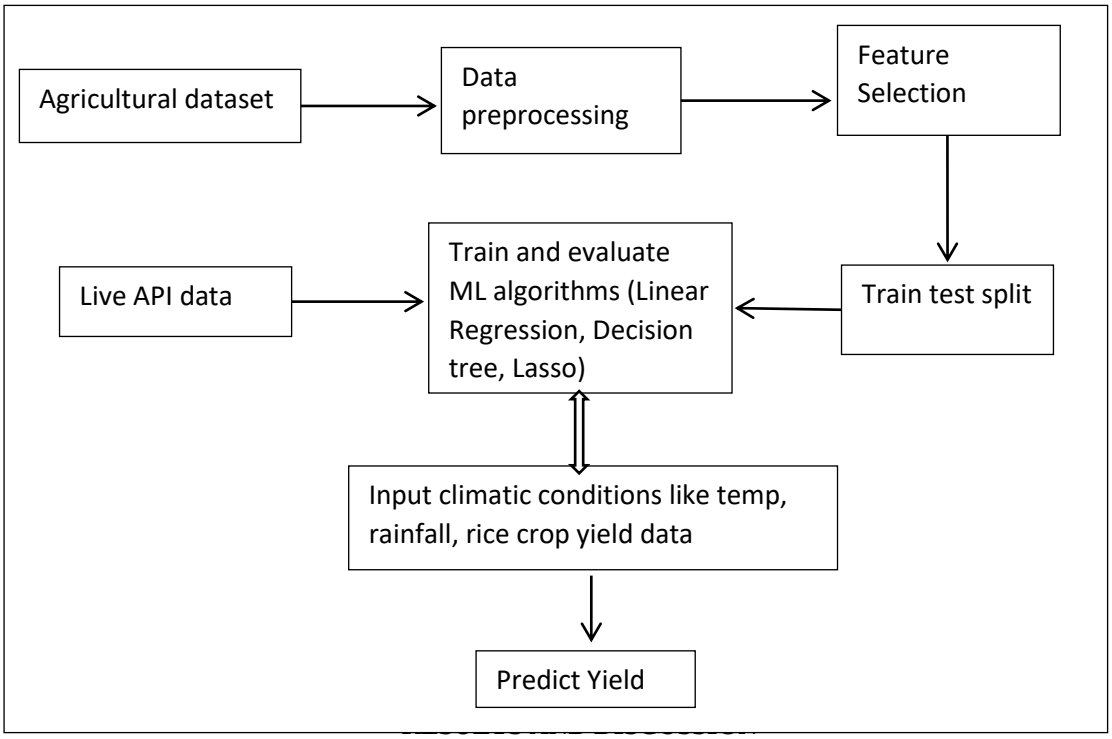

Figure 1: System Architecture for Rice crop yield prediction

Model	R^2 score
Linear Regression	0.889385
Lasso	0.879335
Decision Tree	0.820410

Table 1: Performance Metrics of linear regression, Lasso, Decision tree Regression models

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Linear Regression model achieved an R^2 score of 0.889, indicating that 88.9% of the variance in rice crop yield is explained by the input features. This suggests that Linear Regression is a strong predictor for yield estimation, capturing key relationships between soil properties, weather conditions, and agricultural inputs with reasonable accuracy.

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CONCLUSION

Applying Linear Regression, the model effectively captured yield patterns from weather, and agricultural inputs, ensuring reliable predictions with minimal complexity. Currently a web application, our future work includes integrating soil related data, developing a mobile app for real-time farmer input, integrating satellite and IoT data for better accuracy, and translating it into regional languages for wider accessibility.

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