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AGRICULTURAL YIELD FORECASTING SYSTEM

DARSHINI R[1], Dr. A. NIRMALA[2]

Student, Dept of Computer Science with Cognitive Systems, Dr.N.G.P.Arts and Science College, Coimbatore,India[1]

Professor & Head, Dept of Computer Science with Cognitive Systems, Dr. N. G. P Arts and Science College, Coimbatore, India[2]

Abstract: Agriculture is the hub of international food security and economic stability. Farmers are, however, faced with unpredictable climatic patterns, soil quality variations, and inadequate access to accurate predictions of yield. The traditional forecasting techniques rely on manual data and complex interpretations and, hence, are less accessible to farmers. This paper suggests an Agricultural Yield Forecasting System with machine learning concepts to provide accurate predictions of yield with fewer input parameters. The system employs Lasso Regression, Elastic Net (ENet), and Kernel Ridge Regression, with stacking procedures to achieve maximum accuracy. Our method demonstrates improved efficiency, accuracy, and accessibility and provides a user-friendly web-based solution, which can be further developed as a mobile app with regional languages.

Keywords: Agricultural Forecasting, Machine Learning, Crop Yield Prediction, Regression Models, Data-Driven Farming

1. INTRODUCTION

Agriculture remains one of the most significant industries in the world, making a positive contribution to the economy and livelihood of millions of individuals. Volatile climatic changes, soil erosion, and pest infestations are, however, some of the critical hazards to crop production. Advanced yield forecasting techniques involve complex climatic and soil factors that are difficult for farmers to interpret. This research proposes a machine learning-based simplified model for forecasting that enables farmers to take decisions based on state, district, crop, and season.

The system applies sophisticated regression models to minimize prediction errors and ensure simplicity of use by non-experts. The ultimate objective is to provide farmers with a simple and effective means of estimating crop yield, thus enabling decision-making in agriculture based on data.

2. RELATED WORK

Some research has looked at crop yield prediction with machine learning:
Hegde et al. (2015) employed linear regression and neuro-fuzzy systems based on rainfall, soil moisture, and biomass for wheat yield prediction.
Sujatha & Isakki (2016) employed climatic and soil features to run classification algorithms (ANN, J48, Naïve Bayes, Random Forest, SVM).
Ramalatha et al. (2018) used a K-means clustering and K-NN classifier hybrid model in their research on Tamil Nadu's major crops.
While such models are very informative, they are mostly defined by high computation cost, reduced accuracy, and high input dependence. Our model addresses all these through stacking-based regression models and feature selection.

3. METHODOLOGY

3.1 System Architecture

The system to be proposed employs a structured machine learning pipeline:
Data Collection: Indian Government Repositories' agricultural datasets.
Preprocessing: Missing values handling, feature selection, and normalization.
Feature Engineering: Choosing appropriate features (State, District, Crop, Season, Year, Area, Production).
Model Selection: Using Lasso, ENet, and Kernel Ridge Regression, with the best performance via stacking.
Prediction & Evaluation: Prediction of yields and accuracy of prediction by Mean Squared Error (MSE) and R-squared measurements.

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User Interface: Providing a web-based application with future plans for a mobile application.

3.2 Machine Learning Models Used

Lasso Regression: Helps in selecting features by penalizing less important features.
Elastic Net (ENet): Merges Lasso and Ridge regression for enhanced stability.
Kernel Ridge Regression: Best for non-linear patterns of farm data.
Stacking: Merges several models to reduce mistakes and make the prediction more accurate.

4. SYSTEM DESIGN

4.1 Data Flow Diagram (DFD)

*The DFD indicates the flow of data through the system:
*It accepts inputs (state, district, crop, season).
*The processing unit uses machine learning models to perform predictions calculations.
*The output module displays forecast yield output to end-users.

4.2 Implementation Details

*Programming Language: Python
*Libraries Used: Pandas, Scikit-learn, NumPy, Matplotlib, Flask
*User Interface: A web application developed on Flask.
*Data Source: Indian farm data from government records.

5. RESULTS AND DISCUSSION

5.1 Dataset and Training

The data set has 2.5 thousand observations categorized by State, District, Crop, Season, Year, Area, and Production. Preprocessing of data provides clean and free-from-noise inputs for training machine learning algorithms.

5.2Advantages of the Proposed System

*Increased accuracy in yield forecasting.
*Less computationally costly than traditional models.
*Easy-to-use interface for farmers.
*Future flexibility for mobile applications and local language integration.

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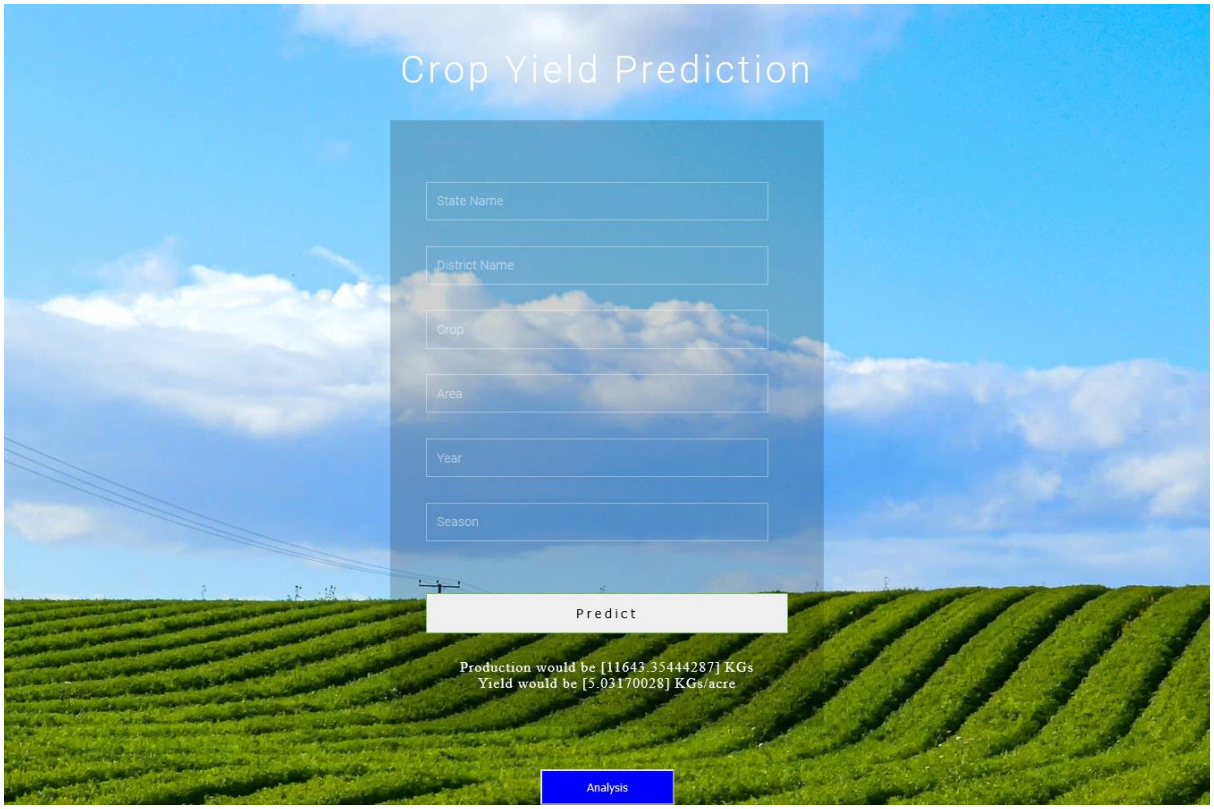
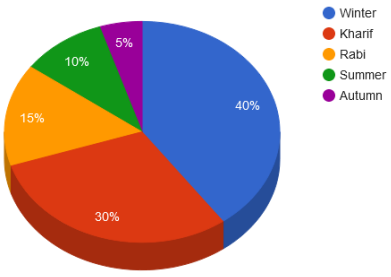


Crop Yield Prediction(pie chart analysis)



Future

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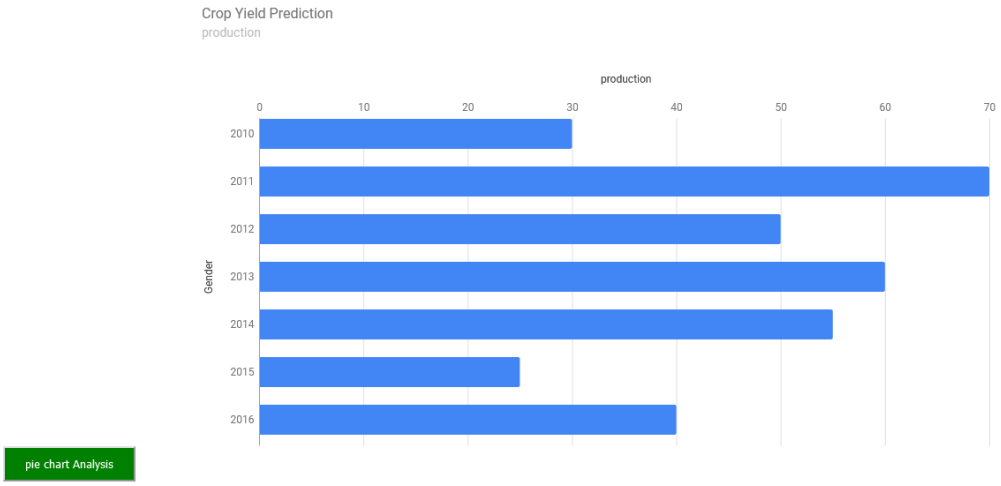

6. CONCLUSION

The present paper introduces an agricultural yield forecast system based on machine learning, which enhances predictive accuracy using stacked regression models. The system reduces farmer decision-making complexity through accurate yield forecasts based on limited inputs.

6.1 Future Work

*Developing a mobile app for easier access.
*Including local languages to enable it to reach more farmers.
*Integration of ground and real-time weather data for further precision improvements.

Using machine learning and data-driven methods, the platform aims to provide farmers with predictive data to improve agricultural productivity.

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