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Machine Learning for Crop Price Prediction: A Study of Agricultural Forecasting and Market Analysis Applications

AJMAL M [1], ANAS A [2]

Under the Guidance of Dr.P. JAYASHEELAN, MCA., Ph.D., Assistant Professor

Department of Data Science, Sri Krishna Adithya Arts and Science College.

Abstract- Agriculture plays a crucial role in the global economy, and accurate crop price prediction is essential for farmers and stakeholders to make informed decisions. Traditional price analysis methods are often manual, unstructured, and lack predictive capabilities, leading to financial risks and inefficient planning. In recent years, machine learning (ML) techniques have gained significant attention due to their ability to analyze large datasets and uncover hidden patterns. This study presents AgriPulse, a machine learning-based web application designed for crop price prediction and market analysis. The system utilizes historical crop price data, rainfall information, and Wholesale Price Index (WPI) values to train a Decision Tree Regression model. It provides six-month and twelve-month forecasts, along with features such as trend visualization, top gaining and losing commodities, and crop profiling. The application is developed using Python and Flask for backend processing, with Pandas, NumPy, and Scikit-learn for data handling and machine learning, while the frontend uses HTML, CSS, JavaScript, and Chart.js for visualization. The proposed system transforms raw agricultural data into actionable insights, helping users optimize decision-making and reduce risks. The study highlights the effectiveness of integrating machine learning with web technologies to enhance agricultural forecasting systems.

Keywords— Crop price prediction, agriculture analytics, machine learning (ML), decision tree regression, AgriPulse, historical price data, rainfall data, wholesale price index (WPI), predictive modeling, market forecasting, data analysis, trend visualization, web application, Flask, Python, Pandas, NumPy, Scikit-learn, Chart.js, risk reduction, decision support system.

I. INTRODUCTION

Agriculture is one of the most important sectors contributing to economic growth and food security. However, one of the major challenges faced by farmers is the unpredictability of crop prices. Farmers often rely on traditional methods such as historical observations, market rumors, and manual analysis, which are inefficient and unreliable. This lack of accurate forecasting leads to poor decision-making, financial losses, and market instability.

With the advancement of data science and machine learning, it has become possible to analyze large volumes of agricultural data and generate accurate predictions. Machine learning models can identify patterns in historical data and provide insights into future price trends. These techniques are increasingly being applied in smart agriculture to improve productivity and profitability.

This paper introduces AgriPulse, a machine learning-based crop price prediction system that provides accurate forecasts and market insights. The system integrates historical data, environmental factors, and economic indicators to generate predictions and assist farmers, traders, and policymakers in making informed decisions.

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II. OVERVIEW OF SYSTEM ARCHITECTURE

The AgriPulse system follows a modular and web-based architecture consisting of three main layers: the presentation layer, application layer, and data layer.

The presentation layer provides a user-friendly interface developed using HTML, CSS, and JavaScript, allowing users to interact with the system and visualize predictions through charts and dashboards. The application layer handles the backend logic, implemented using Python and Flask, where machine learning models process input data and generate predictions. The data layer consists of structured CSV datasets containing historical crop prices, rainfall data, and WPI values.

The system processes user requests, applies machine learning algorithms, and returns predicted values along with graphical insights, ensuring efficient and real-time performance.

III. MACHINE LEARNING MODEL FOR PRICE PREDICTION

The core component of the system is the machine learning model used for predicting crop prices. The study utilizes the Decision Tree Regression algorithm, which is effective for handling non-linear relationships and structured datasets.

The model is trained using historical data that includes features such as month, year, rainfall, and WPI. These features help the model understand seasonal patterns and environmental influences on crop prices. Once trained, the model generates predictions for future months.

Machine learning enables the system to automatically learn from past data and improve prediction accuracy. The model provides reliable forecasts, helping users identify trends and make better decisions regarding crop selling and storage.

IV. APPLICATIONS OF CROP PRICE PREDICTION

Machine learning-based crop price prediction systems have several important applications in the agricultural sector.

- Farmer Decision Support: Helps farmers decide the best time to sell crops based on predicted prices.
- Market Analysis: Assists traders in understanding market trends and planning investments.
- Risk Reduction: Minimizes financial losses caused by sudden price fluctuations.
- Policy Making: Supports government agencies in planning agricultural policies and price regulations.
- Smart Agriculture: Promotes data-driven farming practices for improved productivity.
- These applications demonstrate the significance of integrating machine learning into agricultural systems.

V. ADVANTAGES AND LIMITATIONS

Advantages

- Provides accurate crop price predictions
- Supports data-driven decision making
- Reduces financial risks for farmers
- Easy to use web-based interface
- Scalable and adaptable system

Limitations

- Depends on quality of historical data
- Limited to selected crops and datasets
- Model accuracy may vary with changing market conditions
- Requires regular dataset updates

VI. CONCLUSION

This study presents a machine learning-based crop price prediction system, AgriPulse, which addresses the challenges of traditional agricultural price analysis. By utilizing Decision Tree Regression and

historical datasets, the system provides accurate forecasts and valuable insights into market trends.

The integration of machine learning with a web-based platform enhances accessibility and usability for farmers and stakeholders. The system demonstrates the potential of data-driven technologies in transforming agriculture and improving decision-making processes.

Future enhancements may include the use of advanced deep learning models such as LSTM, integration of real-time market data APIs, and development of mobile applications to increase accessibility. Overall, AgriPulse contributes to the advancement of smart agriculture by enabling predictive and intelligent farming solutions.