Crop Price Prediction Using Machine Learning

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Abstract. Ensuring agricultural profitability is a vital issue in developing countries like India, where over a third of the population earns their income directly or indirectly through agriculture. Estimating and evaluating crop yields is done globally to achieve high yields and appropriate pricing. However, there is no accurate procedure in place to provide farmers with insights on which crops should be grown. This project aims to predict crop prices by analysing historical data, such as precipitation, temperature, market prices, land area, and crop yield, using supervised machine learning models. We have focused on crops from the Rabi and Kharif seasons and applied models like Decision Trees, Random Forest, and Support Vector Regression to develop a robust system for predicting crop prices, providing farmers with data-driven insights for decision-making.

Keywords. Machine Learning, Supervised Learning, Agriculture, Crop Price Prediction.

1. INTRODUCTION

In agriculture-driven economies, accurate crop yield and price predictions are essential for farmers to make informed choices about which crops to cultivate. The current process lacks a precise method to provide this crucial information, resulting in uncertainty. This project leverages machine learning algorithms to analyse historical agricultural data to predict crop prices. By utilizing a variety of input factors like meteorological conditions, market data, and soil quality, we aim to develop a model that can help farmers optimize their agricultural strategies.

2. RESEARCH METHODOLOGY

The research methodology follows several stages:

Data Collection: Historical data on various crop parameters, including meteorological data, market prices, soil types, and irrigation methods, were collected.

Data Preprocessing: Non-categorical values were mapped to numerical codes for processing. Features such as 'Location', 'Soil', 'Irrigation', and 'Crop' were encoded as categorical variables.

Modelling: Different machine learning models such as Linear Regression, Decision Tree, Random Forest, and Support Vector Regression were trained using the preprocessed data.

Evaluation: The models' performance was assessed using metrics like R^2 score to determine their accuracy in predicting crop prices

3. THEORY AND CALCULATION

This research establishes a framework for predicting crop prices through machine learning and agricultural data analysis. It assumes that crop prices are influenced by factors such as environmental conditions, historical yield data, and market dynamics. The process begins with collecting and preprocessing historical data on variables like temperature, rainfall, and soil characteristics. Various machine learning models analyse the relationships between these features and crop prices, learning from historical patterns to make predictions based

on new inputs. Feature selection is essential for enhancing prediction accuracy, while external factors like market demand and governmental policies are acknowledged for their potential impact. Ultimately, this theoretical approach aims to provide a data-driven methodology for predicting crop prices, equipping farmers with actionable insights for better decision-making in agriculture.

4. RESULTS AND DISCUSSION

The study reveals that machine learning models, especially Random Forest and Support Vector Regression (SVR), effectively capture the relationships between agricultural and meteorological factors affecting crop prices. The Random Forest model achieved an R^2 score of approximately 0.85, indicating its strong predictive capability, while SVR also performed well with non-linear datasets. Significant features influencing crop prices included temperature and rainfall, consistent with recent findings emphasizing environmental impacts on agriculture.

Evaluation metrics such as Mean Absolute Error (MAE) and Mean Squared Error (MSE) confirm the models' reliability in predicting crop prices, allowing farmers to anticipate market fluctuations. This research enhances the existing literature by integrating a broader range of variables, including soil type and historical yield data, improving prediction accuracy compared to traditional methods.

5. CONCLUSIONS

The machine learning-based system developed in this project effectively predicts crop prices, offering significant improvements over traditional methods. Models like Decision Tree, Random Forest, and Support Vector Regression provided accurate price forecasts by analysing historical agricultural data, enabling farmers to make data-driven decisions regarding crop sales and planning. This approach empowers farmers to optimize profits and enhances agricultural productivity. The system's scalability allows it to be applied across different regions and crop types, offering flexibility in various agricultural settings. However, the model's accuracy depends on the availability of high-quality data, and future improvements may be needed to address region-specific factors and external market influences. Additionally, integrating factors such as government policies or international market trends could further enhance the system's predictive capabilities. In conclusion, this project demonstrates a robust and scalable solution for crop price prediction, contributing to better decision-making in agriculture and addressing key challenges faced by farmers.

6. DECLARATIONS

1.1 Study Limitations

1. Data Availability and Quality

The model's accuracy depends heavily on the availability of reliable and comprehensive historical data. Incomplete or low-quality data can lead to inaccurate predictions.

2. Model Performance on Unseen Data

Machine learning models may perform well on historical data but struggle with real-world data that includes unseen variables, such as sudden changes in market demand or extreme weather events.

3. External Factors Not Considered

Factors like government policies, subsidies, or international market fluctuations may significantly impact crop prices but are not accounted for in the current model.

1.2 Acknowledgements

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1.3 Funding source

None.

1.4 Competing Interests

The authors declare that no potential conflicts of interest exist in this publication. There are no financial, professional relationships, personal that could be perceived as influencing the research or the interpretation of the results presented in this manuscript.

7. HUMAN AND ANIMAL RELATED STUDY

1.5 Ethical Approval

This study did not require ethical approval, as it did not involve human or animal subjects. An ethical exemption letter has been obtained, indicating that ethical review is not required for this research. A scanned copy of the exemption letter is available and can be provided upon request.

1.6 Informed Consent

Informed consent was not applicable for this study, as it did not involve direct interaction with human subjects. However, the application was designed to ensure user privacy and anonymity, allowing users to opt-in voluntarily without any obligation. If needed, a statement regarding user consent for the use of anonymized data can be provided.

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