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AGRICULTURE CROP PRICE PREDICTION USING MACHINE LEARNING

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Abstract - The accurate forecast of crop prices is of considerable importance to farmers, policymakers, and stakeholders to enable informed decisions and ensure economic stability in the agricultural sector. The traditional forecasting methods are largely ineffective when it comes to accurate forecasting, due to the complex and dynamic nature of the agricultural market. This study proposes a machine learning-based solution to effectively forecast crop prices. Various machine learning models such as regression, decision trees, and neural networks were used to analyze and forecast crop prices using historical data, weather patterns, market trends, and other relevant factors. The focus is on increasing prediction accuracy, reducing uncertainty, and helping sustainable agricultural usage of resources. The results show that machine learning models perform better than traditional means of forecasting in general and have a higher adaptability toward dynamic market conditions. The findings of this study point to the immense potential machine learning has in transforming agricultural price forecasting, which ultimately shall allow better resource allocation and better decision-making processes. The research adds to the existing body of knowledge regarding the applications of machine learning in agriculture, and it offers scalable and efficient solutions for crop price forecasting. In the concluding lines, the study said that the participation of machine learning in agricultural forecasting can drastically benefit farmers and stakeholders by promoting economic stability and sustainability in this care.

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Keywords: Crop Price Prediction, Machine Learning, Agricultural Forecasting, Regression Models, Neural Networks, Decision Trees, Sustainable Agriculture.

1.INTRODUCTION

Accurate prediction of crop prices is very important to farmers, policymakers, and stakeholders for evidence-based decisions and to maintain economic stability within the agricultural sector. The traditional forecasting solutions are usually not very effective in case of the complex and volatile nature of agricultural markets. This research proposes an ML framework to perform this task with higher efficacy. Historical weather data, market trends, and other relevant factors will be investigated using regression, decision trees, and neural networks to analyze and predict crop prices from such data sets. The objective of the research is to increase the accuracy of prediction, reduce uncertainty, and sustain agriculture. It has been reported that the machine-learning models surpassed the conventional methods when compared for their precision adaptability against dynamic market conditions. This identification suggests an opportunity for machine learning to transform agricultural price forecasting, facilitating improved resource allocation and decision-making approaches. This new investigation serves as a valuable contribution to mounting knowledge on ML utilization in agriculture, promising scalability and efficiency in realizing crop price prediction. Finally, the researches conclude that the adoption of machine learning in agricultural forecasting will benefit the farmers and stakeholders alike by economic stability and sustainability in the sector.

Agriculture is a critical sector in many countries' economies, providing food, raw materials, and employment to millions of people. However, the prices of agricultural crops are highly volatile due to various factors such as weather conditions, crop yields, market demand, and governmental policies. Price fluctuations can severely affect the incomes of farmers and the stability of agricultural markets. With the advancement of machine learning (ML), it has become possible to analyze complex datasets and predict the future trends of agricultural prices more accurately. ML algorithms can process a large number of variables, such as climate data, historical prices, soil conditions, and geopolitical factors, to generate insights that were previously difficult to obtain. By developing predictive models, stakeholders in the agricultural sector can make informed decisions, optimize crop production strategies, and reduce risks associated with price instability. This study aims to explore the potential of using machine learning techniques, particularly supervised learning models, to predict the prices of agricultural crops. The use of these models can enable stakeholders to gain a competitive edge and make more data-

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driven decisions, ultimately leading to more sustainable agricultural practices.

2.METHODOLOGY

In the methodology section of this research, the methods and analyses performed, focusing on **Agriculture Crop Price Prediction**, are described. A structured approach is presented for developing and evaluating predictive models for crop prices. Historical data on crop prices, weather patterns, market trends, and other relevant factors were collected from reliable sources. The dataset was preprocessed to address issues such as irregularities, missing data, and normalization, ensuring a high-quality dataset for analysis.

2.1 Crop Price Prediction based Decision tree regressor

This research focuses on predicting crop prices, aim to provide accurate and reliable estimates for farmers and stakeholders. The study uses the **decision tree algorithm**, which has proven to be highly effective and well-suited for this type of analysis. The process begins with collecting relevant data, which is then carefully analyzed and cleaned to ensure its quality. This cleaned data is used to train the model and predict crop prices. Below, Figure 1 illustrates the architecture of the proposed crop price prediction system, showcasing the step-by-step approach used in this research.

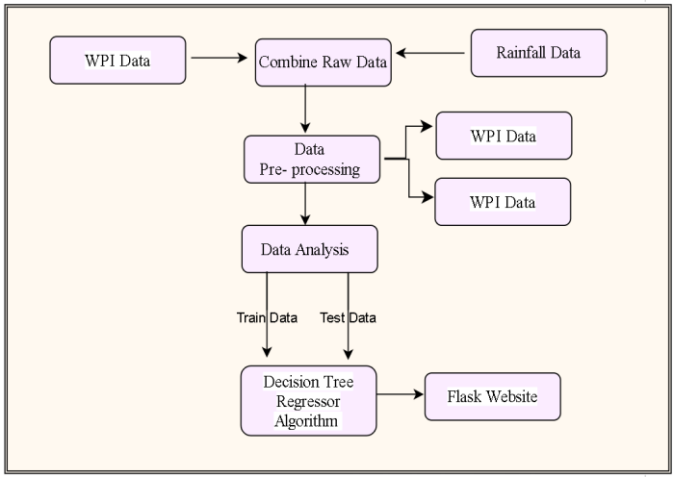

Figure 1. Crop price prediction system architecture

2.2 Modules of Architecture

The implementation is divided into the following modules.

1) Data Gathering

2) Data Cleaning

3) Data Exploration

4) Prediction using Machine learning

5) Web application

1) Data Gathering

Dataset is prepared by collecting the crop and rainfall data from the Indian government data repository (data.gov.in). There are a lot of datasets that contain data. We need to obtain the data which contains the details of the whole price index and rainfall of the individual crops per month. The datasets are available on below links:

https://www.data.gov.in/resource/year-wise-minimum-support-price-according-crop-year-2017-18-2021-22

https://www.data.gov.in/resource/wholesale-price-index-base-year-2011-12-till-last-financial-year

```
Month,Year,Rainfall,WPI
1,2017,19,159
2,2017,22.6,157.9
3,2017,27.8,156.5
4,2017,37.9,154.5
5,2017,62.4,148.1
6,2017,168.1,145.4
7,2017,289.3,143.5
8,2017,256.2,142.6
9,2017,171.5,142.9
10,2017,76.3,138.9
11,2017,29.9,141.4
12,2017,15,144.8
1,2018,19.2,143.4
2,2018,20.1,141.9
3,2018,27.1,137.7
4,2018,40.2,134.4
5,2018,62.7,133.9
6,2018,165,136.6
7,2018,286.3,138.5
8,2018,254.3,140.3
9,2018,171.9,141.1
10,2018,77.2,141.8
11,2018,28.1,139.5
12,2018,14.1,140.2
```

Figure 2. Combined dataset of Cotton

2) Data Cleaning

One of the most significant steps in any machine learning project is data cleaning. There are several different methods of statistical analysis and data visualization techniques in the

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dataset that you can use to explore the data to identify the appropriate data cleaning operations to be conducted. There are some very simple data cleaning operations before jumping to the advanced methods that we can conduct in a machine learning project on every single dataset. They are so important that models can break or report excessively optimistic outcomes of success if missed. In our dataset, we need to clean all the null values and check whether all the data types are valid.

3) Data Exploration

Also known as E.D.A, exploratory data analysis is a very important phase in researching and investigating various data sets and summarizing their significant characteristics, often using different methods of data visualization. It allows it simpler for a data analyst to obtain repeated trends, spot anomalies, test theories, and conclusions to decide the best way to monitor data sources to get the results with greater precision. 10

4) Prediction using Machine Learning

Decision Tree Regressor

5) Web Application

The Predicted WPI data is displayed in a visually understandable web application created using the Flask framework. Flask is one of the popular, extensible web micro-framework for building beautiful web applications with Python. An index page will be created and from there we can navigate to 20 different crops and see their forecast in detail

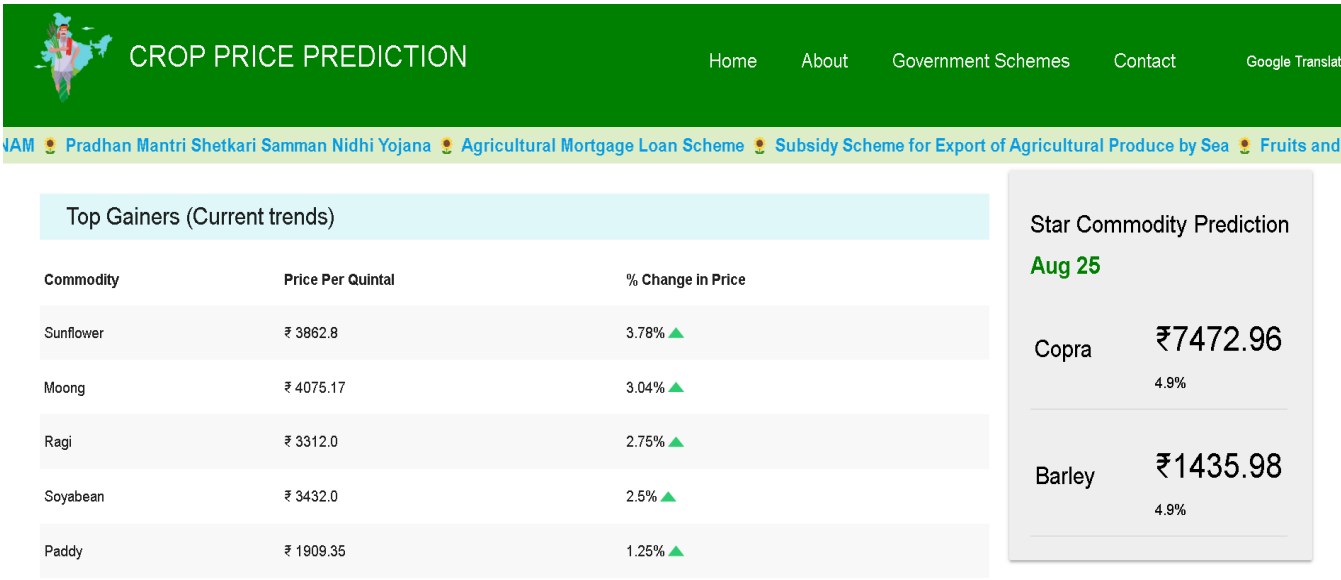

Figure 4. Index Page

```
clf = DecisionTreeRegressor()
clf.fit(X_train, y_train)
print("DecisionTreeRegressor")
y_pred = clf.predict(X_test)
df = pd.DataFrame({'Actual': y_test, 'Predicted': y_pred})
df
print('Mean Absolute Error:', metrics.mean_absolute_error(y_test, y_pred))
print('Mean Squared Error:', metrics.mean_squared_error(y_test, y_pred))
print('Root Mean Squared Error:', np.sqrt(metrics.mean_squared_error(y_test, y_pred)))
```

```
DecisionTreeRegressor
Mean Absolute Error: 2.4294117647058804
Mean Squared Error: 15.142941176470595
Root Mean Squared Error: 3.8913932179195916
```

Fig 3 Root mean square of Decision tree regressor

A Decision Tree is one of the most commonly used algorithms for supervised learning. In the form of a tree structure, a decision tree generally generates regression models or classification models. It Breaks down a dataset into smaller subsets and, based on the subsets, a decision tree is created. A tree containing decision nodes and leaf nodes is the final product. There are mostly two or more branches of a decision node, each representing values for the checked attribute. An option for the final numerical goal is represented by the Leaf node. The topmost node in the tree corresponds to the root node, which is the best node. Both continuous and categorical data can be processed by decision trees. Machine learning prediction has the following steps:

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Step 1: Initialize a dataset containing information on rainfall and wholesale price index.

Step 2: From the dataset select all the independent variables.

Step 3: From the dataset select all the dependent variables.

Step 4: Fit the x and y variables with a decision tree regression.

Step 5: Update the UI with predicted values.

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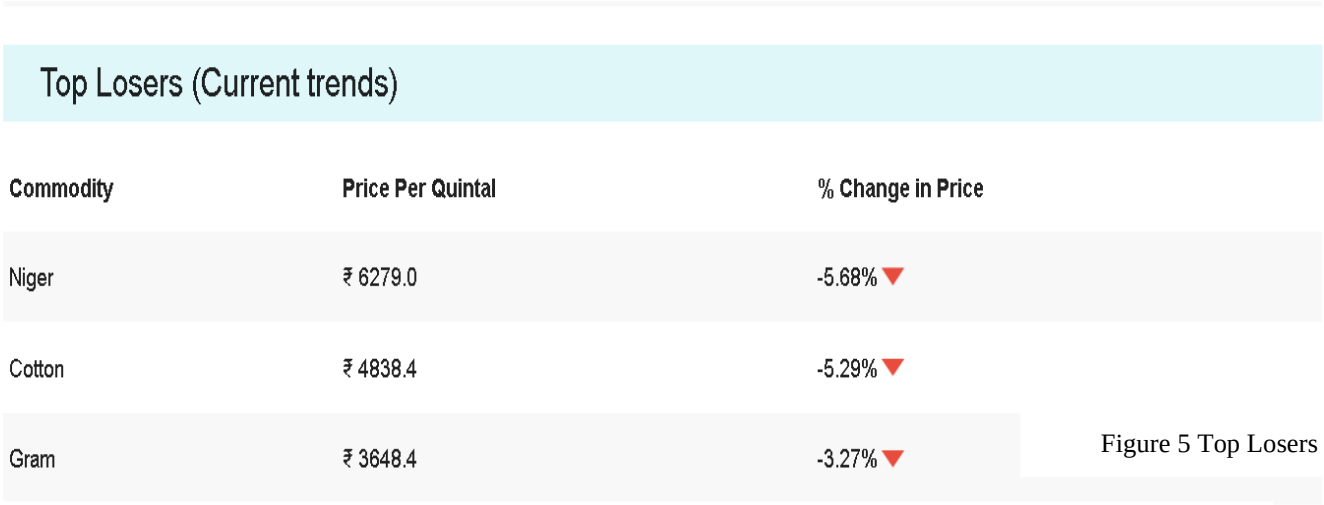
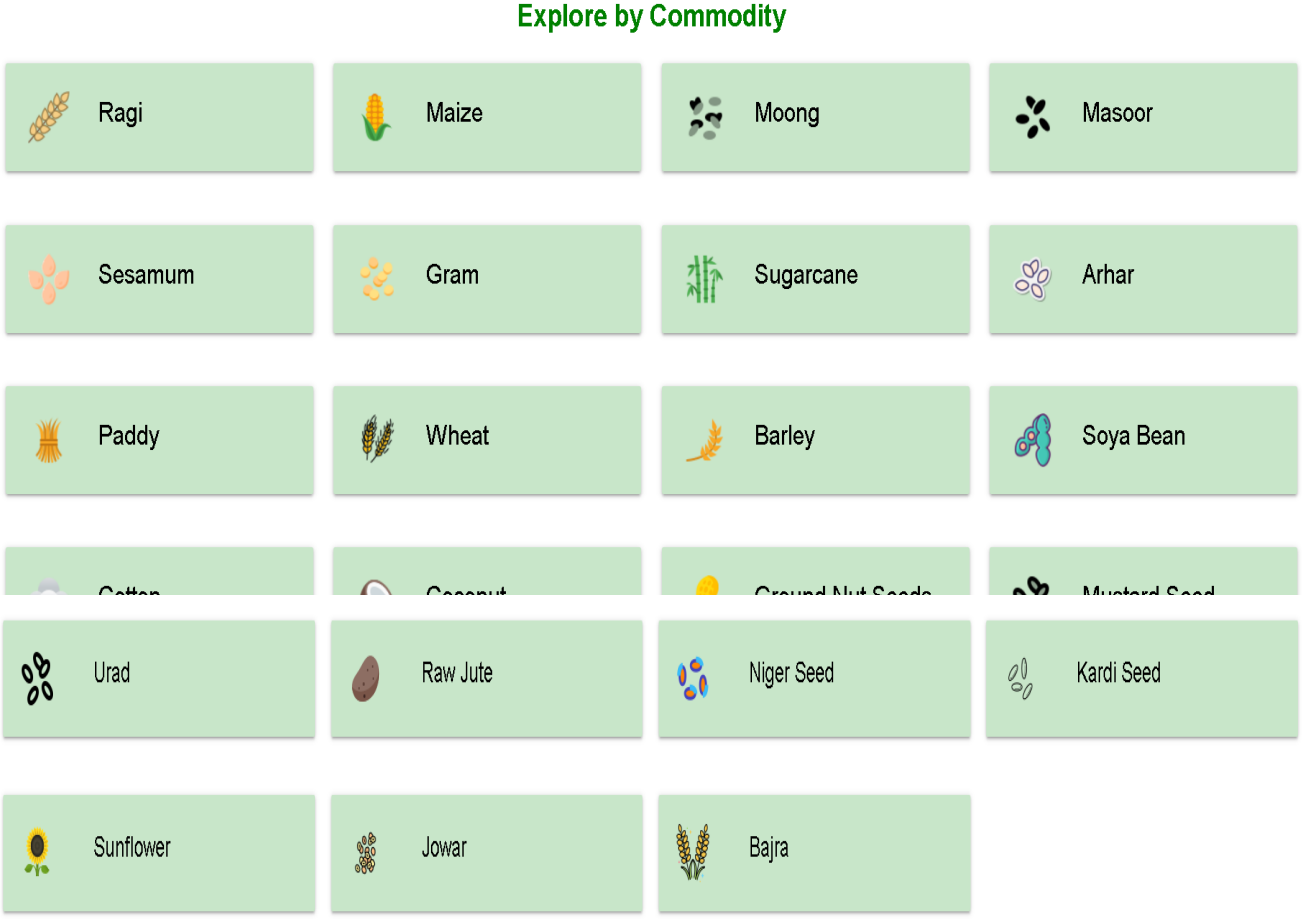


Figure 5 Top Losers

Implementation and result:



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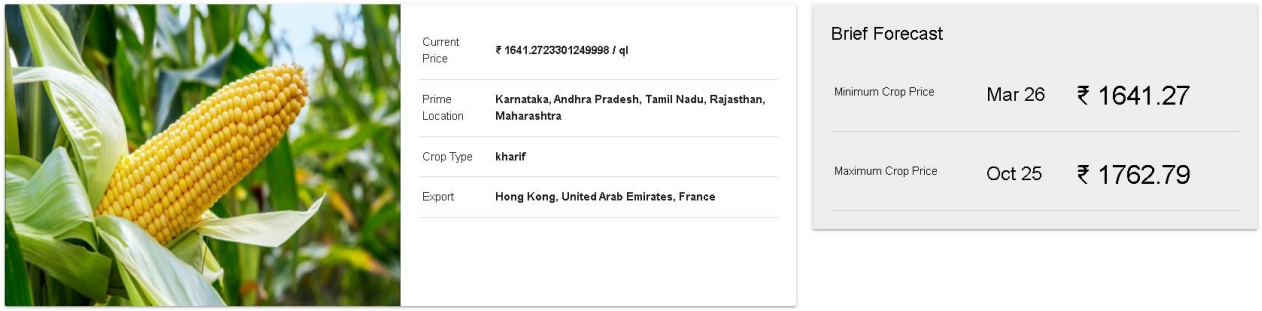

Fig.7 Maize Future Price Pediction

national crop requirements , export demand, and profit optimization, overcoming the common issue export demand, and profit

Forecast Trends

Month	Price (per Qtl.)	Change
Apr 25	₹1641.27	0.0% ▲
May 25	₹1708.87	4.12% ▲
Jun 25	₹1732.43	5.55% ▲
Jul 25	₹1724.81	5.09% ▲
Aug 25	₹1721.71	4.9% ▲
Sep 25	₹1731.96	5.53% ▲
Oct 25	₹1762.79	7.4% ▲
Nov 25	₹1759.6	7.21% ▲
Dec 25	₹1762.67	7.4% ▲
Jan 26	₹1645.66	0.27% ▲
Feb 26	₹1665.31	1.46% ▲
Mar 26	₹1641.27	0.0% ▲

Figure 8. Forecast Trends

3. CONCLUSION

In this paper, is relatively presents a comprehensive decision support framework aimed at optimizing national crop production planning. It addresses key gaps in agricultural policymaking by incorporating the roles of various stakeholders and utilizing historical crop production data across different land sectors. The framework aims to balance optimization, overcoming the common issue where crops are produced based on farmers' preferences or past prices, rather than meeting national demand. This often leads to overproduction of certain crops and shortages of others. A decision-aiding tool is proposed to guide farmers in making crop production decisions that align with national needs and maximize earnings.

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