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Machine Learning Driven Agricultural Portal Enhancing Crop Production and Decision-Making

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ABSTRACT- The Agricultural Portal is an innovative platform designed to improve crop production by providing farmers with easy access to agricultural information, resources, and tools. The portal offers a wide range of features including weather forecasts, crop shopping, crop prediction, yield prediction, crop stock and purchase History. This technical paper outlines the development and implementation of the Agricultural Portal, highlighting its features and functionalities. The paper also explores the benefits of the portal for farmers, including increased productivity, improved decision-making, and enhanced profitability. Advanced machine learning models are integrated into the portal to improve its predictive capabilities. The portal is built on a robust technology platform that is scalable and adaptable to the needs of farmers of different sizes and geographies. The Agricultural Portal represents a significant step forward in the use of technology in agriculture. By providing farmers with easy access to information and resources, it has the potential to transform the way they farm and improve crop production across the globe by using different Machine Learning Algorithms. In the existing system There is only one feature but we are trying to add extra features and making into a single portal in the proposed system.

KEYWORDS- Machine Learning Algorithms, Agricultural portal, predicting systems

I. INTRODUCTION

Agriculture is vital to humanity, not only for food but also for employment and the economy. Crops or arable land are relatively “new,” even though people have been eating grains and plants for over 1,00,000 years. Around 11,000 years ago, during the Neolithic era, often referred to as the New Stone Age, people first actively managed the land and its vegetation. In India, agriculture provides a considerable portion of the country’s economic support and the majority of the country’s food needs. Due to India’s The associate editor coordinating the review of this manuscript and rapid population growth and important climatic changes, the demand chain and food supply must be maintained. Several scientific approaches have been included in agriculture to preserve the harmony between the supply and demand offood. The significant climatic variance makes it difficult for farmers to choose how to be more flexible and sustainable . inputs. food security. In India, Agriculture uses 70 percent of the water world wide .

The integration of machine learning and data-driven approaches in agriculture has significantly enhanced crop yield prediction and price forecasting. Research in this domain has focused on leveraging supervised learning models, climate data, and secure cloud storage frameworks to improve agricultural decision-making. Studies such as those by Prameya R. Hegde and Ashok Kumar A. R. emphasize predictive analytics for yield and price forecasting, ensuring informed market strategies. Similarly, E. Manjula and S. Djodiltachoumy explore computational intelligence techniques for accurate yield estimation. Supervised machine learning approaches, as discussed by Dr. Y. Jeevan Nagendra Kumar et al.

agriculture in 2018, which contributed 17%-18% of the area wise output, and rainfall. Recently, machine learning has advanced in various industries, including agriculture. Numerous machine learning approaches, such as decision trees, artificial neural networks, support vector machines, and country's GDP. India's national area held steady at about 3,28,726 thousand hectares between 1971 and 2020 . By 2025, India's agricultural industry is expected to grow to USD 24 billion. With 70 percent of sales coming from retail, India has the world's 6th largest food and grocery market. According to preliminary estimates for the fiscal year 2022-2023, the nation will produce 149.92 million tons of food grains altogether (Kharif alone). India's rapid population growth primarily drives the sector.

Additional evidence favouring these results from increasing income levels in urban and rural locations, boosting the demand for agricultural products across the country. As a result, in addition to the introduction of numerous e-farming applications, the increased utilization of cutting edge technologies is driving sectors such as geographic information systems (GIS), artificial intelligence (AI), blockchain and remote sensing technologies, and drones.

Figure.1 shows the season-wise analysis of crop production for Kharif, Rabi, Summer, Autumn, and Winter seasons and the year. The crop production is maximum in the Kharif season and minimum in winter.

The crop production for India from 1997 to 2020 is shown in Figure.2 From the analysis shown, it can be observed that the majority of the land in the country was planted with wheat and rice, which produced morethan73%ofthenation'sstaple grains.

II. PROPOSED WORK

Enhancing Multiple Features Into Single portal: Which save the time and preventing from the high loss by leveraging all this techniques and features into the single portal including machine learning algorithms like KNN , Random forest and gives the high profits for the farmers

Under the prediction option, crop prediction will predict the crop to be grown, yield prediction will predict the yield of the crop, and rainfall prediction will predict the rainfall for that area in millimeters

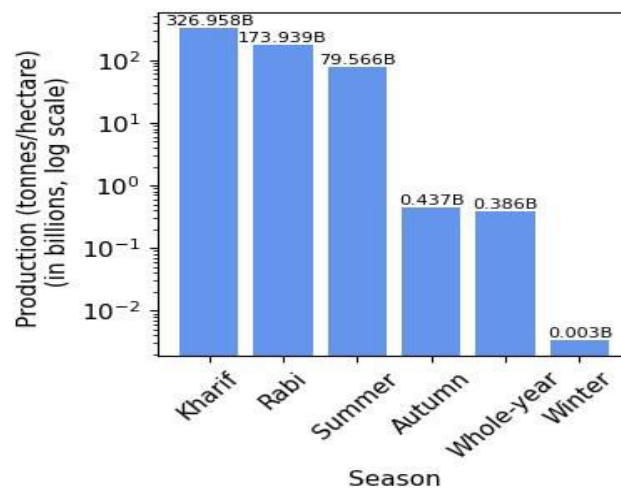


Fig. 1 Year wise Crop Production

country's GDP. India's national area held steady at about 3,28,726 thousand hectares between 1971 and 2020 . By 2025, India's agricultural industry is expected to grow to USD 24 billion. With 70 percent of sales coming from retail, India has the world's 6th largest food and grocery market. According to preliminary estimates for the fiscal year 2022-2023, the nation will produce 149.92 million tons of food grains altogether(Kharif alone).India's rapid population growth primarily drives the sector.

Additional evidence favouring these results from increasing income levels in urban and rural locations, boosting the demand for agricultural products across the country. As a result, in addition to the introduction of numerous e-farming applications, the increased utilization of cutting edge technologies is driving sectors such as geographic information Farmers can boost production under favourable conditions and decrease production loss under unfavourable conditions by using crop yield estimation. Numerous variables, such as farmer practices, choices, pesticides, fertilizers, weather, and market prices, impact crop yield positive forecasts. It is possible to estimate crop yield using statistical information from yields of previous years, together with deep learning , have been applied to calculate agricultural production.

The crop production for India from 1997 to 2020 is shown in Figure.2 From the analysis shown, it can be observed that the majority of the land in the country was planted with wheat and rice, which produced more than 73% of the nation’s staple grains.

India accounts for around 40 percent of global rice (Basmati and Non-Basmati) trade and exports to more than 150 countries. Trade ministry data showed that exports rose 11 percent to 2.16 million tons in the first half of 2022-23. The illustration shows that rice has the highest production and area allocation. The agricultural industry had strong growth

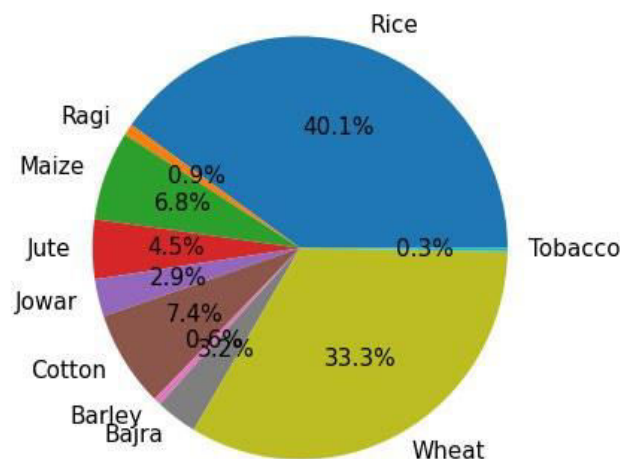


Fig.2 yield productions

terms of exports over the past year. Exports of rice, basmati and non-basmati total ed USD 6.12 billion in FY22 (through December 2021), as represented in Figure3.ing (40%): The image was shift at a specific angle in the counter-clockwise direction. The value was set to 40° in the present study.

- **Enhancing Multiple Features Into Single portal:** Which save the time and preventing from the high loss by leveraging all this techniques and features into the single portal including machine learning algorithms like KNN , Random forest and gives the high profits for the farmers
- **Direct Farmer-to-Market Access :** Eliminates middlemen, ensuring better profit margins for farmers and Provides a transparent pricing mechanism based on real-time demand and supply.
- **Trading of crops:** The farmer will be able to trade crops, check the crop stocks and see the selling history.
- **Get recommendations for crop and fertilizers:** Under the recommendation option, crop recommendation and fertilizer recommendation will tell which crop to be grown and which fertilizer to be used
- **Get predictions for crop, yield, and rainfall:** Under the prediction option, crop prediction will predict the crop to be grown, yield prediction will predict the yield of the crop, and rainfall prediction will predict the rainfall for that area in millimeters

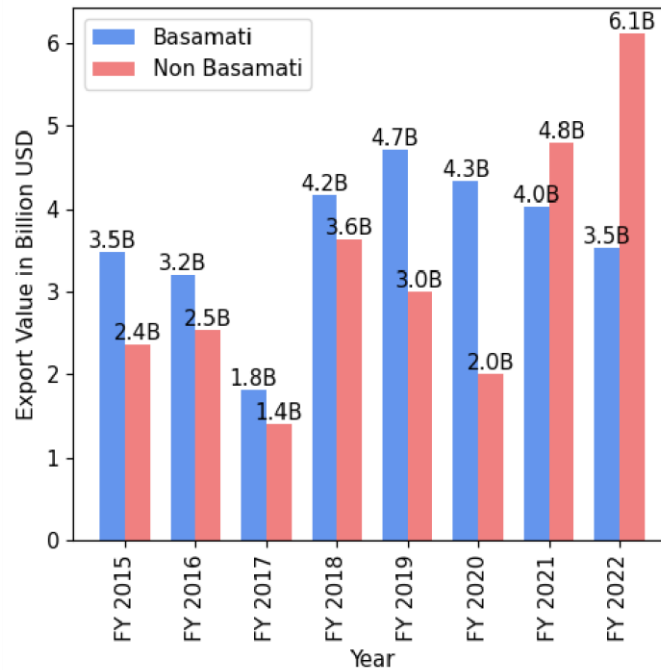


Fig 3 Rice Exports from 2015 to 2022

A.RESEARCH CONTRIBUTIONS

India is a predominantly agrarian nation with around 48.9% of the population is employed in agriculture in some capacity. One of the most pressing issues is farmers' suicides. Farmers are killing themselves, which is a national calamity. According to a report of the Indian National Crime Records Bureau (NCRB), more than 2 lakh Indian farmers committed suicide between 1995 and 2020. This serious issue tends to come from farmers' failure to repay loans typically obtained from banks and private landlords. This is because many losses used to occur due to inadequate knowledge about the crops, such as which crop should be sown in which season. The same insight served as the impetus for this study. By utilizing historical agricultural production statistical data for India, a robust mechanism is needed to estimate yield production at the initial stage. Early foresight can assist farmers to avoid committing suicide, suffering financial losses from their crops, and ultimately affecting the nation's GDP. Forecasting agricultural yields isn't a simple task as several factors like rainfall, wind speed, soil characteristics, climate, humidity, temperature, etc., affect agricultural production, and no single dataset is available for the same.

B.ARTICLE ORGANIZATION

The objective of this study is to predict agriculture yields. For a thorough understanding of the literature, Section.2 looks closely at the theories and related research about crop yield prediction according to the investigation's goals and the research gaps found in the literature. Section.3 describes the study region, data sources, technological perspective, research methodology, and approaches for agriculture yield prediction, along with the relationships among various dataset features. Section.4 shows the model performance of various approaches (i.e., results). Section.5 concludes the entire work and also suggests additional work.

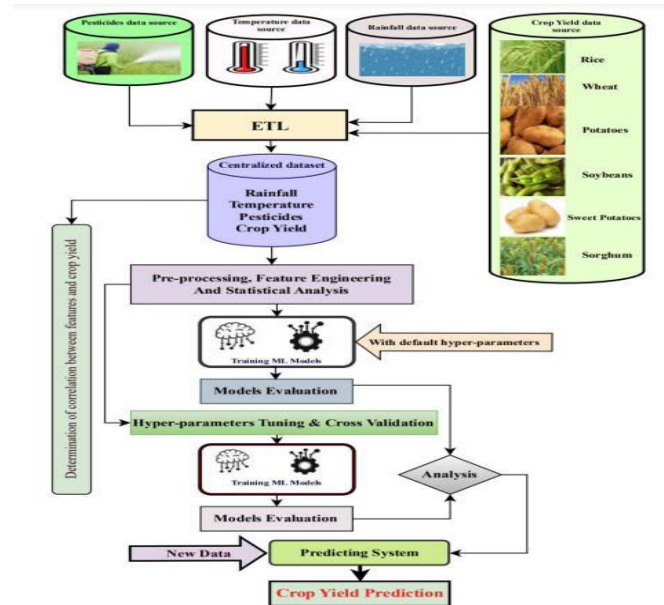


Fig. 4. System Architecture of Agriculture Portal

The crop yield prediction system architecture is designed to intelligently forecast crop production using integrated environmental and agricultural data. It begins by gathering information from multiple data sources, including pesticides usage, temperature records, rainfall statistics, and historical crop yield data for crops like rice, wheat, potatoes, soybeans, sweet potatoes, and sorghum. These diverse datasets are processed through an ETL (Extract, Transform, Load) system to create a centralized and standardized dataset. This consolidated data undergoes pre-processing, feature engineering, and statistical analysis to determine the correlation between climatic factors, pesticide application, and crop yield. Machine learning models are then initially trained using default hyperparameters, followed by evaluation to assess their baseline performance. To enhance accuracy, hyperparameter tuning and cross-validation are performed, leading to the final model training with optimized parameters. The models are further evaluated to ensure reliability and precision. The predictive system uses these refined models to analyze new input data and generate accurate crop yield predictions, supporting data-driven decision-making for agricultural planning and resource management.

III. RANDOM FOREST

An uncorrelated forest of decision trees is built by amalgamating the bagging approach and feature randomness, i.e., the bagging approach's extension is RF. Low correlation across decision trees is ensured via feature bagging or feature randomization, or the random subspace technique, which provides a random selection of features. RF only chooses a portion of the feature splits that decision trees can take into account. Each decision tree in the ensemble is built using the bootstrap sample, a data sample obtained from a training set. The rest 1/3rd of the training sample is used as test data.

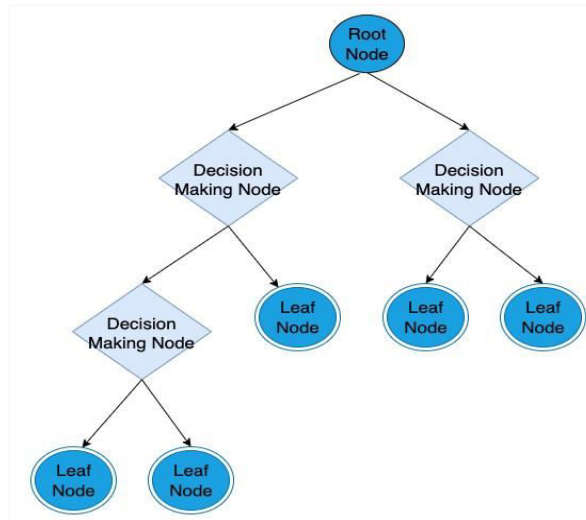


Fig 5. Decision Tree

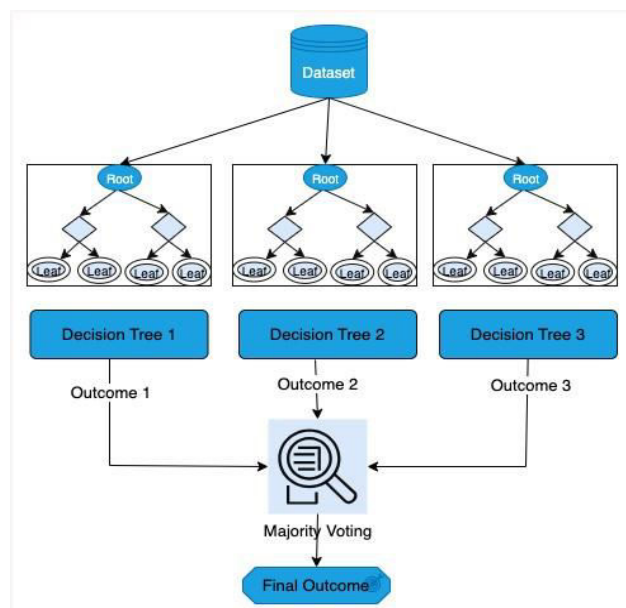


Fig 6. Random Forest

IV. RESULT AND ANALYSIS

The features of the dataset are related to one another. The authors identified the crop as a significant feature and plotted the link. Figure5 shows the production count for each of the 10 crops taken consideration in the study. Figure6 shows the historical correlations between Area and Crop Type. It can be observed that the maximum area is allotted to wheat, followed by Rice.

Figures5 and 6 show the historical correlations between the dataset’s features, such as Crop type, Area, and Production. presents the forecast outcomes. The study concludes that Random Forest outperforms other machine learning algorithms regarding accuracy.

Using statistical data, Random Forest produces India’s most accurate crop production estimation

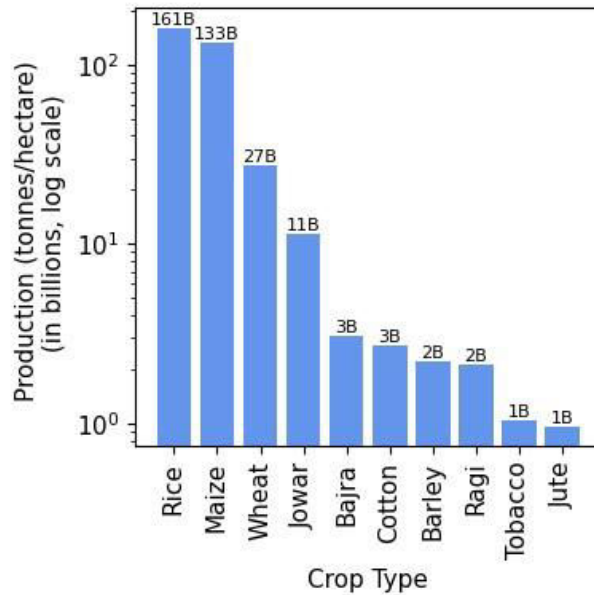


Fig 7. Relationship between crop and Production.

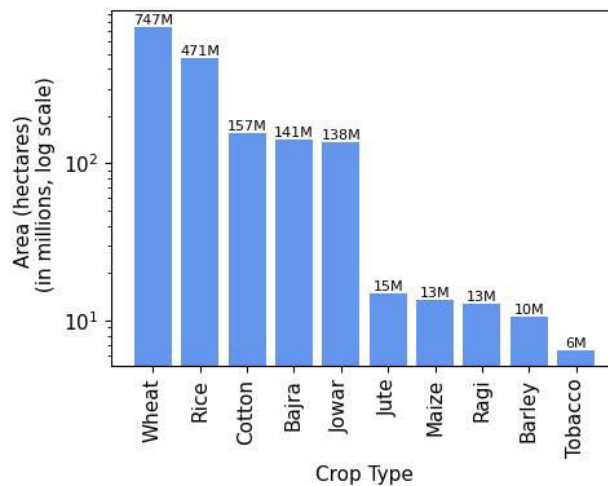


Fig 8 Area allotted to crops

The bar chart presents crop production (in tonnes per hectare) on a logarithmic scale, highlighting the production levels of various crops. Rice leads with the highest production at 161 billion tonnes per hectare, followed by maize at 133 billion. Wheat ranks third with 27 billion, while Jowar follows at 11 billion. Bajra and cotton have similar production levels of 3 billion each, whereas barley, ragi, tobacco, and jute exhibit lower outputs, ranging between 1 and 2 billion. The log scale effectively emphasizes the vast differences in production between crops, with rice and maize significantly outperforming others.

The testing data set, the performance of the system is better compared to the other experiment. In deep learning the over fitting problem may occurs due to the small size of the data set. Therefore, 5 fold cross validation was applied on the data set. The Adam optimizer performs better in all the performed experiments.

Comparison of the proposed method with other methods

The demand and supply for food have grown more difficult to manage as the population grows. To assist farmers, experts have worked hard over the past few years to anticipate agricultural yield production. In order to forecast India's crop yield, this study uses various machine learning and deep learning approaches. The study underlines the advantages of cutting-edge procedures. It is beneficial for small-scale ranchers, as they may use the predictions to estimate crop

V. CONCLUSION

This The Machine Learning-Driven Agricultural Portal provides a comprehensive solution to modern farming challenges by integrating advanced technologies into a single platform.

The system enhances crop production and decision-making through ML-based recommendations and predictions for crops, fertilizers, yield, and rainfall. By offering direct farmer-to-market access, it eliminates middlemen, ensuring better profit margins for farmers and transparent pricing mechanisms based on real-time supply and demand.

Additionally, the trading module enables farmers to manage crop stocks, view selling history, and conduct seamless transactions, fostering a more efficient and profitable agricultural ecosystem. The portal ensures data-driven decision-making and resource optimization, improving agricultural productivity while reducing losses

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