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CROP PRICE PREDICTION USING MACHINE LEARNING

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Abstract - **India, as the world's most populous country, relies heavily on agriculture as the primary occupation for a significant portion of its populace. However, many farmers adhere to repetitive crop cultivation practices and apply fertilizers without adequate knowledge of their land's requirements. This often leads to diminished crop yields, soil acidification, and top-layer damage. To address these challenges, we have developed a comprehensive smart crop planning system utilizing machine learning algorithms. Our system analyzes land characteristics and weather parameters to recommend the most suitable crop varieties for specific plots. Moreover, it provides detailed insights into the deficient content and required quantity of fertilizers, along with recommendations for the optimal seeds for cultivation. By leveraging our system, farmers can diversify their crop choices, potentially increasing profit margins and mitigating soil pollution. This research paper explores the development and implementation of our smart crop planning system, its impact on agricultural sustainability, and its potential to empower farmers towards more informed decision- making.**

Keywords: **Agricultural sustainability, Smart crop planning, Machine learning, Soil health management, Farmer empowerment, Crop diversification.**

I. INTRODUCTION

Agriculture stands as a cornerstone occupation in India, serving as the backbone of the nation's economy and pivotal to its development. Encompassing the broadest economic sector, agriculture contributes significantly to the country's overall growth. With over 60% of the land dedicated to agricultural activities, it fulfills the essential needs of India's vast population of 1.3 billion people. Therefore, embracing innovative agricultural technologies becomes imperative. This transition not only ensures the sustainability of farming practices but also steers the farmers of our nation towards profitability and prosperity. Traditionally, crop prediction and yield estimation relied heavily on farmers' localized knowledge and experience, often favoring familiar crops or those prevalent in neighboring regions. However, this approach overlooks crucial factors such as soil nutrient content, including nitrogen, phosphorus, and potassium, which significantly impact crop health and productivity.

The lack of crop rotation and indiscriminate application of nutrients can lead to decreased yields, soil pollution (e.g., soil acidification), and surface layer damage. Recognizing these challenges, we have developed a novel system harnessing the power of machine learning to benefit farmers. Machine learning, a subset of artificial intelligence, has revolutionized various sectors, including agriculture. In the agricultural domain, machine learning, combined with big data technologies and high- performance computing, presents unprecedented opportunities for data-driven decision-making. Contrary to misconceptions, machine learning in agriculture is not akin to magic but rather a collection of well-defined models that leverage specific data and algorithms to achieve desired outcomes. Our system integrates machine learning algorithms to analyze soil characteristics, weather patterns, and historical data to provide personalized recommendations tailored to each farmer's land. By leveraging machine learning, farmers can make informed decisions regarding crop selection, nutrient management, and yield optimization, ultimately leading to improved productivity, profitability, and environmental sustainability. Agribusiness stands as a significant pillar of the Indian economy, contributing substantially to its GDP and employing a substantial portion of the workforce. However, recent observations indicate a decline in the sector's contribution, potentially due to the diversion of funds towards industrial expansion. Despite being the largest economic sector in terms of demographics, agriculture remains pivotal in shaping India's socio-economic landscape.

Effective monitoring of crop requirements and accurate assessment of potential yields are critical for agricultural programs to function optimally. Crop yield prediction, which aids decision-makers with crucial insights, serves as the focal point of this study. The research aims to employ various algorithmic approaches to forecast crop yields across different regions. By utilizing aggregate physical production functions and integrating newly developed weather indices alongside technological factors, the study seeks to provide reliable yield estimates for various crops in specific states. The comparison between actual yield data, termed as targets, and prediction models forms the cornerstone of our analysis. In pursuit of a robust evaluation, we have developed a user-friendly interface tailored for farmers. This interface offers comprehensive assessments of rice production based on available data, employing regression analysis, coefficient of determination, and Average Error rate calculations. Through this research, we endeavor to empower farmers with accurate yield forecasts, facilitating informed decision-making and bolstering agricultural productivity in India. The primary aim of agricultural planning in countries dependent on agriculture is to maximize profits despite limited land resources. In the past, farming predictions relied on farmers' experience in specific crop fields. However, with changing conditions, there's a need for more advanced farming methods.

In recent times, the effects of significant natural and economic events have become increasingly evident in the cultivation of agricultural commodities. Specifically, the pronounced escalation of climate-related occurrences, such as droughts stemming from heat waves, directly affects the planting and harvesting conditions of agricultural produce. These abrupt and erratic changes significantly influence the price trends of agricultural commodity derivatives. Early research on price modeling and forecasting of these derivatives has underscored the pivotal role of external factors. These factors encompass a wide array of influences beyond the immediate control of agricultural producers or market participants. The acknowledgment of such external influences highlights the complexity of accurately predicting and modeling price movements in agricultural commodity markets. The continual provision of agricultural commodities. Data provided by the National Horticulture Board indicates that India contributes 57.31% of the total vegetable production and 6.92% of brinjal production (Horticultural Statistics at a Glance 2018). Brinjal, a commonly grown tropical vegetable in India, is highly nutritious, providing 52.0 mg of chlorine, 47.0 mg of phosphorus, 44.0 mg of Sulphur, 6.4 mg of vitamin A, 18.0 mg of calcium, 24 k cal of energy, 1.3 g of fiber, 0.9 mg of iron, 1.4 g of protein, 12.0 mg of vitamin C, and 18.0 mg of oxalic acid, all available from 100g of brinjal.

Odisha ranks 4th nationally in vegetable production. Farming is crucial for economies. It has been practiced for ages and is fundamental to every region. There are numerous ways to enhance crop yield and quality. Predicting crop prices is vital for farmers. Traditionally, farmers relied on past experiences to forecast prices. Accurate information about crop yield history is crucial for price predictions. A new approach suggests using data mining to predict crop prices. Data mining involves analyzing data from different angles to extract useful information. Nowadays, data analytics, using specialized software, helps draw conclusions from data sets.

Unfortunately, many rural farmers aren't aware of new crops and their benefits. To address this, a proposed system utilizes machine learning and prediction algorithms to forecast crop prices. Its goal is to reduce losses caused by lack of knowledge about crop revenue and increase overall profits. The system integrates data from past predictions, current prices, and ideal crop choices, providing farmers with a list of suitable crops for cultivation. Machine learning techniques, such as Decision Tree Regressor, are employed for price predictions, which extend up to twelve months into the future. The system factors in past, current, and future rainfall amounts, as well as previous year's prices, to produce more accurate predictions.

II. LITERATURE SURVEY

The study, "A Survey on Crop Prediction using Machine Learning Approach," centers on the concept of applying methodologies leveraging technical expertise to enhance the agricultural sector's reliability. It aims to empower farmers by enabling them to accurately forecast suitable crops based on machine learning techniques. These techniques consider various factors such as soil quality, weather conditions, and market trends. Additionally, they account for specific conditions like soil pH, nitrogen levels, and nutrient composition. The predictive models employed include Artificial Neural Networks, Information Fuzzy Network, and Data Mining techniques. Ultimately, the research concludes that Artificial Neural Network emerges as the most appropriate technique for the project.

It delves into the core concept that various factors including weather patterns, soil attributes, and historical crop data significantly influence present crop yields. Consequently, it underscores the importance of incorporating these parameters to accurately forecast crop yields. The study employs diverse machine learning algorithms to develop models based on past crop yield data, facilitating predictions for current crop yields.

Specifically, the paper focuses on utilizing the Random Forest algorithm for yield prediction. Real-world data from Tamil Nadu serves as the basis for constructing and testing these models. By enabling farmers to anticipate crop yields before cultivation, the predictions aid in informed decision-making. Notably, the paper emphasizes the effectiveness of Random Forest, a robust and widely used supervised machine learning algorithm, in achieving accurate crop yield predictions.

It proposes a system designed to predict both crop prices and profits accurately. This system involves two key actors: the Administrator, responsible for system maintenance, and the Agricultural Department, tasked with price and profit prediction. For price prediction, factors such as rainfall, maximum trade, minimum support price (MSP), and yield are considered. Profit prediction factors include crop price, yield, cultivation cost, and seed cost. The system utilizes the Naïve Bayes algorithm for price prediction and the K Nearest Neighbor (KNN) algorithm for profit prediction, both belonging to supervised machine learning classification techniques. The Department Head selects the crop and prediction method, providing necessary parameter values. Algorithms run in the background, providing outputs to Department Heads, ultimately benefiting farmers by providing advance knowledge of outcomes, thus enhancing profit rates and contributing to the country's economy.

It focusing on price prediction based on World Supply and Demand Estimate (WSDE) data, the authors employ machine learning (ML) algorithms to process and predict crop prices. Unlike traditional statistical methods, ML techniques do not assume a specific data model, making them ideal for modeling complex, nonlinear behaviors such as crop yield prediction. Various ML algorithms including Logistic Regression, Decision Trees, XGBoost, and Neural Networks are applied to accurately predict prices. Results are reliable and accurate compared to traditional methods. The study involves feeding data into ML algorithms, training them using training data, and evaluating them with test data sets, resulting in improved price prediction capabilities.

III. PROPOSED SYSTEM

The envisioned system aims to forecast the optimal crop for specific land plots by analyzing soil composition and weather variables like temperature, humidity, soil pH, and rainfall.

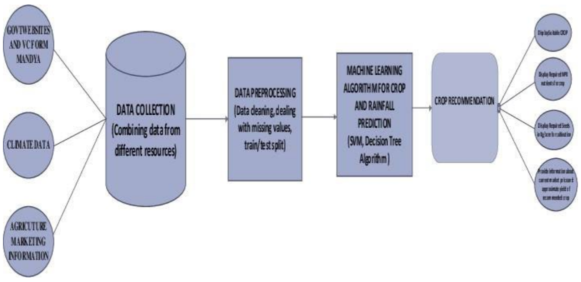

Fig 1: Architecture of the Purposed System

1. **Data Collection:** The most effective approach for gathering and assessing data from various sources such as government websites, VC Form Mandya, and APMC websites is data collection. This process involves assembling a comprehensive dataset for the system, which must encompass the following attributes: soil pH, temperature, humidity, rainfall, crop data, and NPK values. These parameters are essential for crop prediction. Additionally, for annual rainfall prediction, historical rainfall data from previous years is collected.

2. **Data Pre-processing:** Data preprocessing is a critical step in machine learning for crop price prediction. It involves preparing the raw data collected from various sources to make it suitable for analysis and model training. This process includes cleaning the data to remove errors and inconsistencies, handling missing values, scaling or normalizing numerical features, encoding categorical variables, and splitting the dataset into training and testing sets. By performing data preprocessing, we ensure that the data is in a format that machine learning algorithms can effectively learn from, leading to more accurate and reliable predictions.

3. **Machine Learning Algorithm for Prediction:** Predictive algorithms in machine learning are finely tuned models designed to forecast probable outcomes based on learned patterns from past data. Predictive analytics harnesses data, statistical methodologies, and machine learning techniques to gauge the probability of forthcoming events grounded on historical data. The objective transcends mere comprehension of past occurrences to furnish an optimal evaluation of future occurrences.

Within our system, we've employed supervised machine learning algorithms, which encompass classifications and regressions as subcategories. Among these, classification algorithms emerge as the most fitting for our system's needs.

- Rainfall prediction: -SVM algorithm.
- Crop prediction: - Decision tree algorithm

Rainfall Prediction:

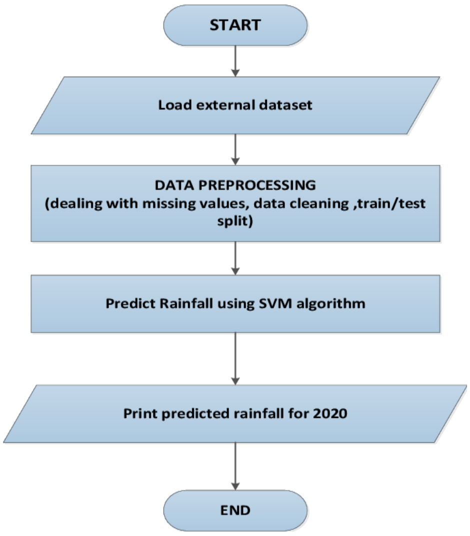

Fig 2: Flow chart for Rainfall Prediction

Predicting rainfall for crop price prediction using machine learning entails developing a model that estimates future precipitation based on historical data and relevant features. One approach to this prediction involves utilizing regression algorithms, which analyze relationships between input

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variables (such as historical rainfall, temperature, humidity, etc.) and the target variable (future rainfall).
A simple linear regression equation could be represented as:
$$Rainfall=\beta0+\beta1\times Historical\ Rainfall+\beta2\times Temperature+\beta3\times Humidity+\epsilon$$
Where:
*Rainfall represents the predicted rainfall.
*$\beta0, \beta1, \beta2, \beta3$ are coefficients to be estimated.

*ϵ represents the error term.
This equation describes how the predicted rainfall is influenced by historical rainfall, temperature, humidity, and potentially other relevant factors. By training this model on historical data and optimizing the coefficients, the machine learning algorithm can make accurate predictions of future rainfall, which in turn can inform crop price predictions.

Crop Prediction:
The crop prediction procedure commences by loading external crop datasets. Subsequently, the dataset undergoes several stages of pre-processing, as detailed in the Data Pre-processing section. Following pre-processing, the models are trained using the Decision Tree Classifier on the training set. For crop prediction, various factors including temperature, humidity, soil pH, and forecasted rainfall are considered. These factors serve as input parameters for the system, which can either be manually entered or obtained from sensors. The system appends the predicted rainfall and input parameter values into a list. Utilizing the Decision Tree algorithm, the system predicts the crop based on the data stored in the list.

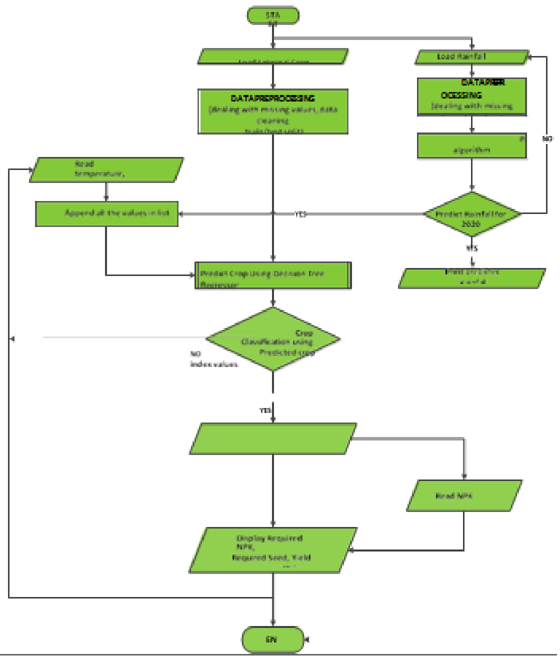

Fig 3: Purposed System Flowchart

Crop Recommendation:
Utilizing forecasted rainfall, soil composition, and weather parameters, the system offers recommendations on the optimal crop for cultivation. Additionally, it provides fertilizer requirements such as Nitrogen (N), Phosphorus (P), and Potassium (K) in kilograms per hectare, along with the necessary seed quantity in kilograms per acre for the recommended crop. Furthermore, the system displays current market prices and estimated yields in quintals per acre for the suggested crop. These comprehensive details assist farmers in selecting the most profitable crop option.

IV. EXPERIMENTAL OUTPUT

The proposed system suggests the most appropriate crop for specific land based on parameters such as annual rainfall, temperature, humidity, and soil pH. Among these, the system autonomously predicts annual rainfall using SVM algorithm, while users input the remaining parameters. In the output, the system presents the recommended crop, necessary seeds per acre, market price, and estimated yield of the suggested crop. Additionally, the system considers NPK values provided in the input section to determine the required NPK for the recommended crop.

The output with Graphical User Interface is shown in figure 4

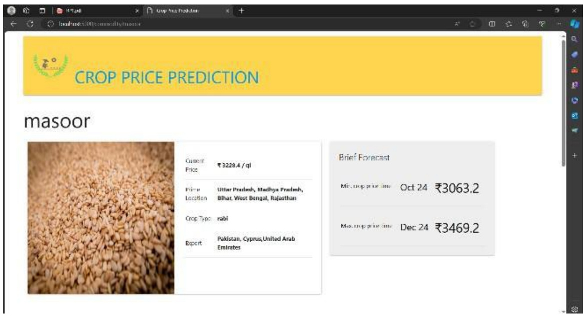

Fig 4: Overall Output with GUI

The system underwent testing using diverse datasets obtained from various farmers, reflecting the varying conditions of their lands. These conditions encompassed differences in pH levels, humidity, and NPK values. Notably, the predicted annual rainfall remained constant throughout the testing period, specifically for the year 2023

Required parameter for crop prediction			Predicted Crop	Entered Soil nutrients(Kg/ha)			Required nutrients for Crop (Kg/ha)			Required seed for cultivation (Kg/acre)	Approximated yield (quintal/acre)	Market price (Rs /quintal)
pH (0-14)	Temperature (^{0}c)	Humidity (%)		N	P	K	N	P	K			
6.6	28	88	GROUNDNUT	00	16	173	40	24	-113	45	3 - 4	4000 - 5000
7.96	27	79	WATERMELON	00	16.95	613.0	200	83.5	-513	0.3	180-200	800-1200
7.6	23	80	SUGARCANE	00	4.5	245.0	200	145.5	-95	1000-1500	400-600	2000-2500
7.04	25	89	ONION	00	56.5	442.0	60	3.5	-412	350	80-100	800-1200
9	29	82	GREEN GRAM	316.68	22.2	163	-291.32	27.5	-138	6-8	2-3	700-1000

.Fig 5: Tested Output Results

V. CONCLUSION AND FUTURE SCOPE

CONCLUSION:

Currently, our farmers lack efficient utilization of technology and analysis, increasing the risk of choosing the wrong crop for cultivation, leading to reduced income. To mitigate such losses, we have devised a user-friendly system with a graphical user interface (GUI). This system predicts the most suitable crop for specific land and furnishes information on necessary nutrients, required seeds, anticipated yield, and market prices. By enabling farmers to make informed decisions regarding crop selection, this innovation contributes to the advancement of the agricultural sector.

FUTURE SCOPE:

We aim to gather all necessary data by inputting GPS coordinates of a land and accessing the rain forecasting system provided by the government. With this approach, crop prediction becomes feasible simply by inputting GPS coordinates. Furthermore, we can develop models to prevent both food shortages and surpluses, ensuring optimal food distribution and resource management.

VI. REFERENCES

[1]. Rahul Katarya, Ashutosh Raturi, Abhinav Mehndiratta, Abhinav Thapper “Impact of Machine Learning Techniques in Precision Agriculture”.

[2]. Ahamed, A.T.M.S., Mahmood, N.T., Hossain, N.,

[3]. Kabir, M.T., Das, K., Rahman, F., Rahman, R.M., 2015. Applying data mining techniques to predict annual yield of major crops and recommend planting different crops in different districts in Bangladesh. In: 2015 IEEE/ACIS 16th International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing, SNPD 2015-Proceedings,https://doi.org/10.1109/SNPD.2015.7176185

[4]. M. Kavita and P. Mathur, "Crop Yield Estimation in India Using Machine Learning," 2020 IEEE 5th International Conference on Computing Communication and Automation (ICCCA), 2020, pp. 220-224, doi: 10.1109/ICCCA49541.2020.9250915.

[5]. Fafchamps M, Minten B. Impact of SMS-based agricultural information on Indian farmers. The World Bank Economic Review, 2012; 26(3): 383–414.

[6]. Yung-Hsing Peng, Chin-Shun Hs and Po-Chuang Huang,“Developing Crop Price Forecasting Service Using Open Data from Taiwan Markets,”IEEE 2017.

[7]. Abdullah Na, “An IoT based system for crop monitoring”, 2016 International Conference of Information Technology.

[8]. Pooja More, Sachi Nene, “Crop Yield prediction using advanced neural networks and machine learning algorithms”, RTDE ,2017.

[9]. A Survey on Crop Prediction using Machine Learning Approach

[10]. Predicting Yield of the Crop Using Machine Learning Algorithm

[11]. Crop Price Forecasting System Using Supervised Machine Learning Algorithms

[12]. www.kaggle.com for datasets

[13]. S.Veenadhari, Dr. Bharat Misra, Dr. CD Singh.2019. Machine learning approach for forecasting crop yield based on climatic parameters .978-1-4799-2352- 6/14/$31.00 ©2014 IEEE

[14]. Takeshi Yoshida Noriyuki Murakami and Hiroyuki Tauiji.2017. Hybrid Machine Learning Approach to Automatic Plant Phenotyping in Smart Agriculture. 978- 1- 5090-5888-4/16/$31.00 @IEEE 2016.