AgriPredict:Enhancing Crop Selection Through Neural Networks For Sustainable Agricultural growth

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***Abstract*- In this paper, we propose Agripredict: a novel framework designed for sustainable agricultural growth through informed crop selection. Recognizing the limited awareness of crop selection by farmers in India, primarily due to educational constraints and the lack of access to precise information, suboptimal crop choices are prevalent, neglecting crucial factors like soil, climate, and environmental conditions. Such decisions contribute to diminished agricultural yields and financial losses for farmers. To address this, we propose the utilization of machine learning algorithms, specifically Neural Networks, to predict optimal crop selections based on environmental and soil parameters. The proposed machine learning model utilizes Neural Networks for predictive modeling, considering critical parameters such as Nitrogen, Phosphorus, Potassium, Temperature, Crop Type, Humidity, Rainfall and pH. The results demonstrate a remarkable accuracy of over 98%, showcasing the effectiveness of AgriPredict in aiding farmers to make informed decisions about crop selection. We are comparing the results with different Machine learning Algorithms like Decision Tree, Support vector Machine. This model not only enhances crop quality, production, and yield but also helps farmers avoid economic losses by cultivating the right crop at the right time.**

Keywords - Machine Learning, Crop Prediction, Agriculture, Deep Learning, Neural Networks.

I. Introduction

In this research paper, we introduce a framework aimed at promoting sustainable agricultural growth through informed crop selection, which we have coined as AgriPredict. The primary motivation behind this framework is to address the need for a systematic and technologically advanced approach to crop selection, considering the pivotal role in the overall development and sustainability in agriculture. AgriPredict is conceptualized as a solution to the challenges posed by uninformed decision-making in crop selection, particularly the lack of consideration for factors such as soil suitability, climatic conditions, and other environmental parameters. Our proposed framework leverages machine learning algorithms, specifically Neural Networks, to analyze and interpret collection of data related to agricultural environment. By integrating environmental and soil parameters, AgriPredict aims to empower farmers with precise and personalized recommendations for optimal crop choices. This not only contributes to enhancing agricultural efficiency but also addresses the broader goal of sustainability by aligning cultivation practices with the specific conditions of the land.

Farmers with the complexities of predicting crops for specific seasons, often resort to random fertilizer application without precise insights into nutrient deficiencies. Additionally, a prevalent tendency persists among farmers to adhere to familiar crops, hindering exploration of new varieties. Understanding the profound impact of environmental and socioeconomic factors on crop yield becomes imperative, fostering a comprehensive comprehension of the agriculture ecosystem.

In India, the agricultural practice is deeply rooted in tradition, yet the challenges faced by farmers persist due to limited access to education and precise information. Many individuals engaged in farming come from generations of families dedicated to the land, inheriting practices passed down through time-honored traditions rather than through formal education. While these traditions hold immense value, they sometimes lack the scientific necessary to optimize crop selection. In the pursuit of sustainable agricultural practices, it is crucial to address the challenges posed by climatic changes and soil fertility issues. The unpredictable nature of these factors underscores the need for informed decision-making among farmers, with precision in crop selection and cultivation practices. This knowledge gap leads to suboptimal choices in crop selection. Farmers might choose crops based on familiarity or market demand rather than considering the suitability of the land. Consequently, they might plant crops ill-suited for their particular soil type or climate conditions, leading to reduced yields or crop failure. This lack of alignment between crop selection and environmental factors significantly impacts the farmers livelihoods, causing

economic losses and perpetuating a cycle of financial instability.Here, the proposed AgriPredict model emerges as a transformative solution, employing machine learning algorithms, specifically Neural Networks, to predict optimal crop choices based on crucial parameters like Nitrogen, Phosphorus, Potassium, Temperature, Crop type, Humidity, rainfall, and pH. The AgriPredict model aims to empower farmers by providing accurate predictions on the most suitable crops for cultivation, considering the diverse environmental and soil conditions. Utilizing Neural Networks for predictive modeling, AgriPredict outshines with an impressive accuracy, as compared to traditional decision tree algorithms. This innovative approach not only enhances crop quality, production, and yield but also equips farmers with the knowledge to make informed decisions, ultimately preventing economic losses. The AgriPredict model stands as a beacon for sustainable farming practices, offering a data-driven approach that aligns with the nation's goals for agricultural prosperity.

II. LITERATURE SURVEY

Dr Latha Banda, Aarushi Rai, Ankit Kansal, and Animesh Kumar Vashisth in [12], They have presented an engaging and user-friendly chatbot created especially for farmers in this study. This chatbot uses web scraping to obtain real-time data and makes use of machine learning algorithms for Naïve Bayes classification. By doing so, it can predict the most suitable crops for cultivation based on current conditions.

Shilpa Mangesh Pande, Dr Prem Kumar Ramesh, Anamol, Dr Aishwarya, Karuna Rohilla and Kumar Shaurya [7], the authors collected a dataset specifically for Karnataka and Maharashtra regions. The paper introduces an inbuilt recommender system that enables users to explore various crop options and their expected yields to make informed decisions. To analyze the dataset, the authors implemented several machines learning algorithms, including Random Forest, k-Nearest Neighbors (KNN), Multiple Linear Regression (MLR), Support Vector Machines (SVM), and Artificial Neural Networks (ANN). One of these algorithms is, Random Forest regression yielded the highest accuracy and proved to be the most effective for this specific task.

Aruvansh Nigam, Saksham Garg, Archit Agrawal and Parul Agrawal [8]. The authors of this study provided a number of machine learning techniques for forecasting crop production depending on temperature, precipitation, season, and region. On datasets from the Indian government, experiments were carried out, and They used the Random Forest classifier, XGBoost classifier, KNN classifier, and logistic regression as machine learning approaches in their investigation. The Random Forest regression model consistently showed the highest accuracy in predicting crop yields, according to the authors' experiments.

M. Kandan, Garapati Sravani Niharika, Mallula Jhansi Lakshmi, Kallakuri Manikanta, and Korlepara Bhavith [11], the authors put forth a system aimed at exploring the potential of machine learning algorithms in predicting crop yields based on climatic conditions. This system takes into consideration various climatic and agricultural parameters, with the objective of assisting farmers in selecting the most suitable food crops for cultivation. Decision trees and random forests were two of the machine learning methods used in this study; the random forest algorithm showed the best accuracy in crop yield prediction.

Somasundaram R S, Nagamani K, Lilly Florence M and Swamydoss D [1], This article concludes that machine learning algorithms, by supplying features such as crop, rainfall rate, soil moisture, fertilizers utilized, etc., help farmers anticipate the crop production rate. Using three different algorithms, this study found that SVM and RF produced results that were comparable to MVR. Lasso, Kernel Ridge, and Elastic-Net Regression designs are examples of contemporary regression approaches used in agricultural production.

Akash Mondal and Saikat Banerjee[10], This research paper proposes and implements a model to predict crop yield from available data. The proposed model for crop prediction is developed using Feedforward Neural networks rectified linear activation unit, backward and forward propagation techniques. The main objective is to predict maximum yield of crop.

III.METHODOLOGY

The proposed method will forecast an appropriate crop based on soil composition and meteorological factors including temperature, humidity, rainfall, and soil pH. Our suggested system's primary goal is to minimize the challenges farmers have while selecting the best crop and to increase production in order to avoid financial losses. Neural networks were used in the implementation of the suggested Model.

A. Data Collection

In data collection, the most effective technique to gather and evaluate information from several sources such as official websites, agricultural dataset and internet resources is possible. We obtained the dataset from Kaggle.com for our model. The datasets undergo preprocessing and cleaning. The following characteristics must be present in an estimated dataset that the system receives. The following factors will be taken into account for crop prediction: i) NPK values ii) soil PH iii) temperature iv) humidity v) rainfall vii) crop name.

B. Data Preprocessing

To train the model, the dataset must first be preprocessed and refined after being gathered from sources. Data cleaning is a step in the data processing process that removes unwanted attributes from the dataset to enable accurate crop forecast.
We then apply label encoding for the independent and dependent variable. Label encoding is the technique used to convert labels into numerical value to convert them into machine understandable format. Following dataset cleaning, the data is divided into training and testing sets, with 70% of the data used for model training and 30% for model testing. The division of data is done using sklearn.

C. Machine Learning Algorithm

Based on trained data, the optimized estimation of the machine learning algorithm's expected outcome is required. An appropriate algorithm, data analysis, and machine learning techniques are utilized to determine the outcome based on historical data, which is the algorithm employed for our neural network model. Through an increase in agricultural yield, the integration of ML techniques with

agriculture will contribute to the overall improvement in this industry.

D. Agri Predict – Crop Prediction Model

"Neural networks, also known as artificial neural networks (ANNs), is a subset of machine learning and are at the heart of deep learning algorithms. Their name and structure are inspired by the human brain, mimicking the way that biological neurons signal to one another."

A deep learning method that takes input and outputs is called a neural network. We have trained our neural network in our suggested model using back propagation, and eight hidden layers are employed to determine the overall cost. Using the fewest possible hidden layers may not provide the highest level of accuracy due to the size of the dataset. The RELU activation function is used in the hidden layer, enabling ANN to behave as a nonlinear classifier. A SoftMax activation function is used in the output layer to transform any input into a probability distribution. Eighty epochs are performed for training in order to achieve more accurate findings. We determined the loss at each period.

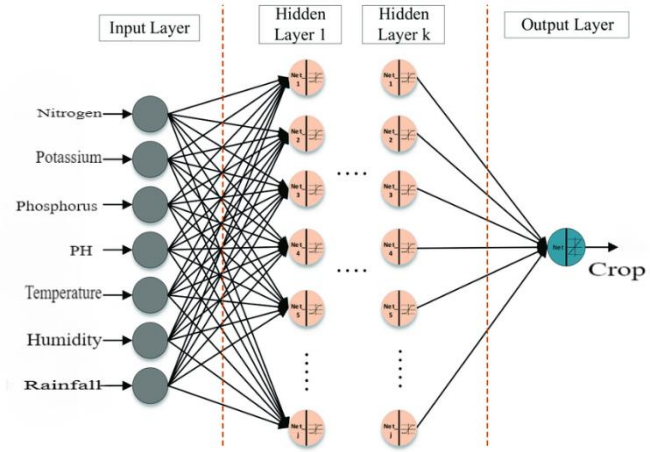

Fig. 1. Proposed Neural Network Model

Figure 1 illustrates how the input layer considers seven parameters, including temperature, humidity, rainfall, PH, phosphorus, nitrogen, and potassium. Additionally, eight hidden layers are being used to train the model. The crop name is the result. Our model suggests a good crop for the farmer who supplies input features.

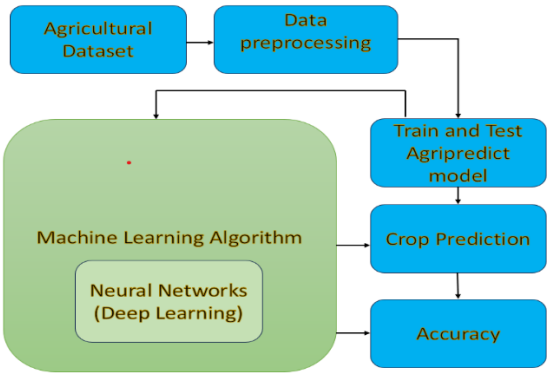

Fig. 2. Proposed Implementation Approach

Fig 2 shows the how the implementation flows in our model. Firstly, we have to load dataset, next In data preprocessing part we are Normalizing the dataset and final preprocessed data is to be splitted into training and testing. Finaly we are providing the training data to the neural network model Then the model is trained. Finally, the results are obtained and performance metrics is calculated.

Table.1 Some samples of Crop Dataset

SL. No	N	P	K	Temp	Humidity	Ph	Rainfall	Crop
1	90	42	43	20.8797	82.0027	6.5029	202.935	rice
2	85	58	41	21.7704	80.3196	7.0380	226.655	rice
3	60	55	44	23.0044	82.3207	7.8402	263.964	rice
4	74	35	40	26.4911	80.1583	6.9804	242.864	rice
5	78	42	42	20.1301	81.6048	7.6284	262.717	rice
6	69	37	42	23.0580	83.3701	7.0734	251.055	rice
7	69	55	38	22.7088	82.6394	5.7008	271.324	rice
8	94	53	40	20.2777	82.8940	5.7186	241.974	rice
9	89	54	38	24.5158	83.5352	6.6853	230.446	rice
10	68	58	38	23.2239	83.0332	6.3362	221.209	rice
11	91	53	40	26.5272	81.4175	5.3861	264.614	rice

The data set in use, before pre-processing, is depicted in Table.1. It includes information on temperature, humidity, Ph, nitrogen, potassium, phosphorus, rainfall, and label.

The label (Crop name) consists of 21 different crops such as rice, maize, jute, cotton, coconut, papaya, orange, apple, muskmelon, watermelon, grapes, mango, banana, pomegranate, lentil, blackgram, mungbean, mothbeans, pigeonpeas, kidneybeans, chickpea and coffee. Additional training, testing, splitting, and other operations are performed on this pre-processed data set.

IV. Results and Discussions

the user gives input as seven features from the keyboard, including N, P, K, temperature, humidity, Ph, and rainfall. Next, based on the inputs provided, the algorithm suggests to the user the appropriate crop.

A learning model's efficiency can be assessed using different execution metrics, or performance can be tracked using different evaluation metrics. The model is validated for the planned work in terms of:

- Estimating performance
- Comparing different other algorithms based on:
  - Metrics for evaluation

Using The Neural Network algorithm, we have obtained the accuracy as 97.5%. For each class (crop), the model achieved perfect precision, recall, and F1-score, all equal to 1.00. This

indicates that the model made no errors in classifying instances for any crop in the training set.

Table.2 Illustrating the results of different models for a dataset and highest accuracy is represented in bold

Methods	**Precision**	**Recall**	**Accuracy**	**F1-score**
Decision Tree	0.95	0.95	94.54%	0.95
Support Vector Machine	0.97	0.96	96.36%	0.96
Neural Networks	**0.99**	**0.99**	**97.57%**	**0.99**

In the evaluation of classification models, precision, recall, accuracy, and F1-score serve as critical performance metrics. In the provided results, the Decision Tree model demonstrates a commendable precision and recall of 0.95, suggesting a balanced ability to correctly identify positive instances while minimizing false positives and negatives. The overall accuracy of 94.54% showcases the model's proficiency in making correct predictions across all classes. Moving on to the Support Vector Machine, it boasts an impressive precision of 0.97 and recall of 0.96, indicating a high precision in correctly identifying positive instances and an effective ability to capture true positives. The SVM achieves an outstanding accuracy of 96.36%, reinforcing its robust performance in classifying instances. In contrast, the Neural Networks model stands out with perfect precision, recall, and accuracy scores of 0.99, reflecting an exceptional ability to accurately classify instances across all classes, highlighting its superior performance in the given task. Overall, these metrics provide a comprehensive evaluation of the models, offering insights into their precision, recall, accuracy, and F1-score, crucial for understanding their efficacy in differentiating between classes.

The Neural Networks model consistently outperforms the Decision Tree and Support Vector Machine models, achieving perfect precision, recall, and accuracy scores. Its superior performance across multiple metrics positions the Neural Networks model as the most effective and accurate classifier among the evaluated models.

V. Conclusions

Based on the influencing factors, the suggested method demonstrated the likely application of deep learning algorithms in forecasting the appropriate agricultural production. In comparison to the Naive Bayes classification, the suggested technique is simple to use and has a prediction accuracy of more than 97% for identifying the correct crop. Farmers can grow the healthiest food crops by following the recommendations of the climate and agricultural parameters, which take into account factors like pH, temperature, humidity, rainfall, crop type, nitrogen, phosphorus, and potassium. As a result, our technique suggests forecasting crop production prior to field cultivation. The farmer will assess the crop's yield in accordance with requirements.

AgriPredict is currently revolutionizing the agricultural landscape by introducing an innovative approach to crop selection. Utilizing advanced Neural Networks, our model is providing farmers with accurate predictions for optimal crop choices based on crucial environmental and soil parameters. By addressing the prevalent issue of uninformed decisions in crop cultivation, AgriPredict is empowering farmers to make informed choices, ultimately improving agricultural efficiency and output. The model's exceptional accuracy, exceeding 97%, underscores its efficacy in aiding farmers. Furthermore, AgriPredict is not only enhancing crop quality and yield but also contributing to sustainable agricultural practices by aligning cultivation decisions with environmental factors. In doing so, AgriPredict is emerging as a transformative tool, fostering a more resilient and productive agricultural sector.

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