IJARETY

International Journal of Advanced Research in Education and TechnologY (IJARETY)

Volume 11, Issue 4, July-August 2024

Impact Factor: 7.394

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

International Journal of Advanced Research in Education and TechnologY(IJARETY)

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Referred Journal |

|| Volume 11, Issue 4, July-August 2024 ||

DOI:10.15680/IJARETY.2024.1104041

Predicting Suitable Crops using Machine Learning

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ABSTRACT: To ensure sustainable farming methods and maximize agricultural production, careful crop selection is essential. This study explores the application of machine learning algorithms to forecast the best crops to grow given soil and climatic parameters. We provide a model that combines regression and classification techniques to identify the ideal crops by incorporating variables including temperature, rainfall, soil moisture, humidity, and pH levels. To forecast eligible crops and suggested fertilizer quantities, the system analyzes historical data using Logistic Regression and Support Vector Machines (SVM). The findings show that farmers may choose crops that are more productive and sustainable by using machine learning to help them choose crops that are in line with climate conditions.

KEYWORDS: Crop Prediction, Logistic Regression Support Vector Machines (SVM)**,** Soil Moisture, Meteorological Data, Machine Learning, Agricultural Yield

I.INTRODUCTION

The foundation of India's economy, agriculture is essential to both food security and means of subsistence. Due to the unpredictability of meteorological factors like temperature swings and irregular rainfall, conventional crop selection techniques based on past performance are becoming less and less effective. This research provides a machine learning-based method that uses soil and meteorological data to predict viable crops. This system intends to support farmers in making decisions that will increase production and promote sustainability by utilizing cutting-edge data analysis tools. In order to give farmers relevant insights, the main problem in crop prediction is integrating multiple data sources, such as weather forecasts and soil properties. Large datasets are difficult for traditional methods to process and analyze, which emphasizes the need for machine learning approaches that can handle complex conditions. This study aims to develop a machine learning model that predicts which crops are best suited for a given set of climatic and soil conditions. Secondly, it compares the efficacy of Logistic Regression and Support Vector Machines (SVM) in crop suitability prediction. Lastly, it suggests the best amounts of fertilizer based on predicted crop types.

II. RELATED WORKS

Machine learning advances recently have demonstrated potential in agricultural forecasting. A method that combines soil and meteorological data to suggest crops and fertilizers has been proposed by Nischitha et al. (2020) in an effort to increase yield and decrease soil pollution [1]. Using the Kohonen Self-Organizing Map and Back Propagation Network, Ghadge et al. (2018) accurately predicted agricultural yields and soil quality using both supervised and unsupervised learning techniques [2]. Farmers can benefit from the practical insights that Narendiran et al. (2018) provided by using a modified Support Vector Machine (SVM) for real-time crop prediction based on soil variables [3]. Girish et al. (2019) evaluated several machine learning algorithms, such as KNN, SVM, and decision trees, to forecast agricultural output and rainfall. They found that SVM was the most successful [4]. An extensive review of machine learning methods for raising crop yield, including ensemble-based models, neural networks, and other algorithms, was provided by Patil et al. (2017) [5].

III. DESIGN OF THE SYSTEM

3.1 Data Collection: The meteorological and soil attribute data, among other sources, were used to compile the data for this investigation. The most important variables were the yearly rainfall, temperature, humidity, pH levels, and soil moisture content. The collection, which comes from meteorological and agricultural sources, covers five years and contains both historical and real-time measurements.

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	temp	hum	soilmoisture	rain	ph
0	29	85	78	No Rain	7
1	30	85	81	No Rain	7
2	29	85	83	No Rain	7
3	29	85	81	No Rain	7
4	29	84	82	No Rain	7
5	29	84	79	No Rain	7
6	29	84	80	No Rain	7
7	30	84	79	No Rain	7
8	30	84	79	No Rain	7
9	29	84	81	No Rain	7
10	29	84	80	No Rain	7
11	29	85	83	No Rain	7
12	29	85	82	No Rain	7

Table 1: Example Dataset considered for study

3.2 Data Preprocessing: Preparing the data for machine learning models required a number of steps in the data pretreatment procedure. These procedures included decoding categorical variables into numerical values, normalizing features to assure consistency, and cleaning the data by eliminating duplicates and addressing missing values.

3.3 Model Architecture

3.3.1 Logistic Regression: We used Logistic Regression to calculate the likelihood that a crop would be appropriate. P(Y=1∢X)=11+e−(β0+β1X1+β2X2+⋯+βnXn)P(Y=1|X) = \frac{1}{1 + e^ is the logistic function that is utilized.{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n)}}P(Y=1∣X)=1+e−(β0+β1X1+β2X2+⋯+βnXn)1, where β\betaβ is the model coefficient and P(Y=1∣X)P(Y=1|X)P(Y=1∣X) is the probability of crop suitability.

3.3.2 Support Vector Machine (SVM): Crops were classified using Support Vector Machines (SVM) by identifying a hyperplane that maximizes the margin between groups. For SVM, the decision function is f(x)=sgn(wTx+b).w^T x + b = \text{sgn} f(x)f(x) is equal to sgn(wTx+b). where the bias term is bbb and the weight vector is www. To effectively handle non-linear classification problems, the kernel trick is utilized.

3.4 Model Training and Evaluation: To guarantee robustness, the models were trained using a stratified 10-fold cross-validation. F1-Score, recall, accuracy, and precision were among the evaluation metrics. These metrics, which include the harmonic mean of precision and recall, the ratio of true positives to the sum of true and false positives, and the percentage of properly predicted instances, offer a thorough evaluation of the performance of the model.

IV. EXPERIMENTAL RESULT

After a dataset of 10,000 instances was used to assess the suggested models, the following performance metrics were obtained:

4.1 Logical regression : With precision of 74.8%, recall of 77.2%, and an F1-Score of 75.9%, the Logistic Regression model yielded an accuracy of 76.3%.

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Figure 1 shows the evaluation of SVM algorithm.

4.2 SVM, or support vector machine: With a precision of 78.4%, recall of 80.1%, and an F1-Score of 79.2%, the SVM model showed a superior accuracy of 79.5%.

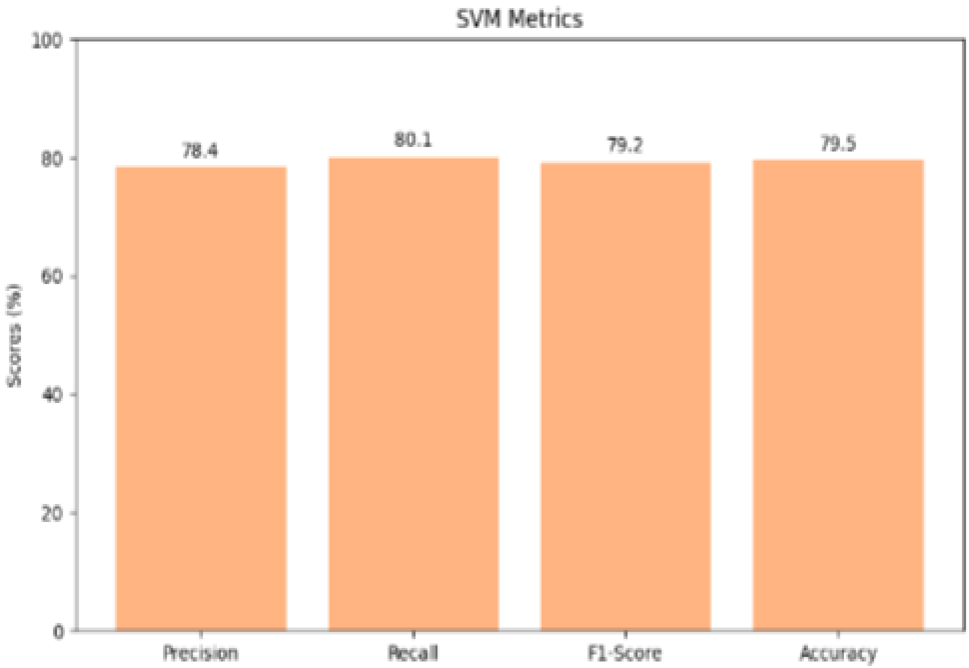

Figure 2 shows the evaluation of SVM algorithm.

4.3 Important Results : According to the results, the SVM model predicts crop suitability better than Logistic Regression. Both models were successful in predicting the right crops depending on soil and weather conditions. On the basis of anticipated crop kinds, the system additionally offered suggestions for the application of NPK fertilizer.

V.CONCLUSION

This study demonstrates how machine learning methods may be used to forecast appropriate crops using soil and meteorological data. The SVM model was the better option for crop prediction because it performed better than Logistic Regression. The suggested system provides useful advice on fertilizer application and crop selection, which

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can raise agricultural sustainability and productivity. In the future, the dataset will be expanded to include more environmental variables, and the models will be improved to attain even higher accuracy.

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IJARETY

International Journal of Advanced Research in Education and Technology

ISSN: 2394-2975 Impact Factor: 7.394

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