INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 08 ISSUE: 08 | AUG - 2024 SJIF RATING: 8.448 ISSN: 2582-3930

ECO-FERTILIZATION USING ML TECHNIQUE

RAPELLI SRIKANTH.[1]
Assistant Professor
Department of computer science and Engineering(Data science)
CMR Engineering College
Hyderabad, India
@gmai.com

A.SHRAVANI[2]
Assistant Professor
Department of computer science and Engineering(Data science)
CMR Engineering College
Hyderabad, India
shravaniannam@gmai.com

Y.BALRAJ [3]
Assistant Professor
Department of computer science and Engineering(Data science)
CMR Engineering College
Hyderabad, India
balaraj@gmai.com

ALURI GOPI[4]
Assistant Professor
Department of Electronics and Communication Engineering
CMR Engineering College
Hyderabad, India
alurigopi@cmrec.ac.in

Abstract— Farmers often have limited control over their use of fertilizers, but they can achieve higher yields and reduce fertilizer loss with expert guidance on the best practices for fertilizer use. Rainfall volume and timing are also crucial factors in nutrient loss, with moderate rainfall at the right moment aiding nutrient penetration and dissolution, while excessive rain can increase runoff and the risk of losing important nutrients like nitrogen, phosphorus, and potassium.

To address these issues, this paper proposed a nutrient recommendation system that employs an updated version of the random forest algorithm, which is based on time-series data to predict the optimal quantity of nutrients needed for various crops based on rainfall patterns and crop fertility. By leveraging this method, farmers can improve soil fertility and reduce the potential for leaching and runoff, providing the optimum conditions for crop growth.

I. INTRODUCTION

The agricultural sector holds a significant position in the national economy as it contributes around 17-18% to India's Gross Domestic Product (GDP). India is also ranked second globally in terms of farm outputs, highlighting the crucial role of agriculture in the country's economic growth. The fertilization of crops and rainfall are closely related as rainfall influences the effectiveness of fertilizers in promoting crop growth. Adequate rainfall after fertilization can help nutrients penetrate the soil and reach the roots of the plants, resulting in better crop yield. Insufficient rainfall can cause fertilizers to remain on the soil surface, leading to their evaporation or being carried away by wind. Heavy rainfall can result in the runoff of fertilizers, leading to nutrient loss and reduced crop productivity. The timing of rainfall is also crucial for the fertilization of crops, as rainfall shortly after fertilization helps dissolve fertilizers and move them into the soil. Excessive rainfall can lead to leaching, where nutrients are carried away from the root zone and lost from the soil. Different crops have varying fertilizer requirements and sensitivity to rainfall, and farmers need to take these factors into account when fertilizing their crops. Overall, fertilization and rainfall are interdependent factors that impact crop growth and productivity, and farmers need to manage them carefully to maximize their agricultural output.

Nitrogen (N), phosphorus (P), and potassium (K) are three of the most important macronutrients required by plants for their growth and development. These nutrients play crucial roles in various physiological processes within the plant, and their availability in the soil can have

a significant impact on crop yield and quality. Nitrogen is essential for the formation of chlorophyll, the green pigment in plants that is responsible for photosynthesis. Phosphorus is involved in energy transfer within the plant, and is also important for root development and water uptake. Potassium is important for the regulation of water balance within the plant. It also helps plants to withstand stress and disease, and can improve the quality of fruits and vegetables.

Predictive analysis is a data analytics technique that involves using machine learning algorithms and statistical methods to analyse historical and current data in order to make predictions about future events or trends. The goal of predictive analysis is to identify patterns and relationships in the data that can be used to make informed decisions about future outcomes. Random forest is a popular machine learning algorithm and predictive analysis that belongs to the category of ensemble methods. The algorithm is based on decision trees, where multiple decision trees are trained on different subsets of the data, and their outputs are combined to make a final prediction. To use the random forest algorithm in this project, we trained the model using historical data on crop nutrient requirements and rainfall amounts. The model was then used to predict the amount of nutrients required for a crop based on the amount of rainfall.

II.EXISTING METHODOLOGY

Previously, farmers relied on their knowledge and assumptions to determine the appropriate fertilizers to use in their crops. However, there are now machine learning models that can predict the necessary amount of nutrients for a specific crop type or location. Additionally, there is an existing system that utilizes a deep learning model, utilizing the Extreme Learning Machine (ELM) algorithm, to predict the required amount of nutrients based on weather conditions.

III. PROPOSED METHODOLOGY

The system being proposed employs the random forest algorithm to analyze user-provided information and generate precise predictions. If nutrients are used excessively or inadequately, it may result in reduced crop yields. This study aims to supply the appropriate amounts of nutrients, such as N, P, and K, based on the weather patterns of a designated location for 7 days.

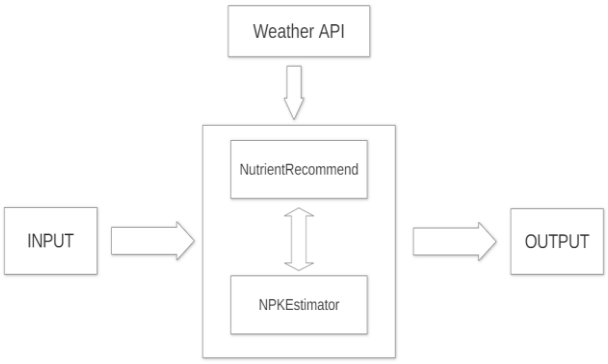


Fig: Block diagram of proposed system

3.1 Data Preprocessing

To prepare the data for our system, we perform data pre-processing by selecting and extracting only the pertinent information from the acquired dataset. This typically involves identifying and including data on the crop type, the required N, P, K values for that crop, and relevant weather conditions like temperature and rainfall. Any extraneous data is excluded, resulting in a streamlined and useful dataset that can be effectively utilized by our system.

3.1.1 Weather Forecast

To implement the proposed system, we need to retrieve the current weather forecast for the specified location. To accomplish this, we will connect our system to a weather API and retrieve only the essential data, such as temperature, rainfall, and humidity.

3.2 Train and Test data

To train the model, we need to apply the random forest algorithm on the training dataset, specifying the number of decision trees to be used. After training, we can evaluate the performance of the model by testing it on the test dataset.

3.3 Random Forest Algorithm

Random forest algorithm is a powerful machine learning algorithm that can handle a large amount of data and is capable of making accurate predictions. It has several advantages over other algorithms. One of the main advantages of the random forest algorithm is that it is capable of handling large datasets with a high number of input variables. It constructs numerous decision trees and

combines their outputs to generate predictions. Each decision tree is developed using a random subset of the training data and features. This process minimizes the risk of overfitting and enhances the model's ability to generalize to new data.

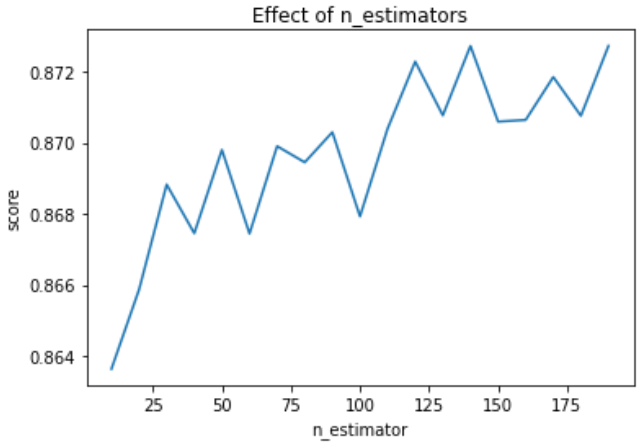
In this paper, the algorithm calculates the average of the predictions from all the decision trees. This approach of combining multiple models improves the model's robustness and accuracy.

When constructing the decision trees, we first choose a feature to divide the dataset based on its impurity, with the feature having the lowest impurity or Gini index being selected as the root node.

$$Gini\ Index = 1 - \sum_{i=1}^{n} (P_i)^2$$
$$= 1 - [(P_+)^2 + (P_-)^2]$$

For training our random forest regression model, we will be utilizing the sklearn module, specifically the RandomForestRegressor function. This function has several important parameters that need to be considered, such as:

- n_estimators: determines the number of decision trees that will be used in the model.



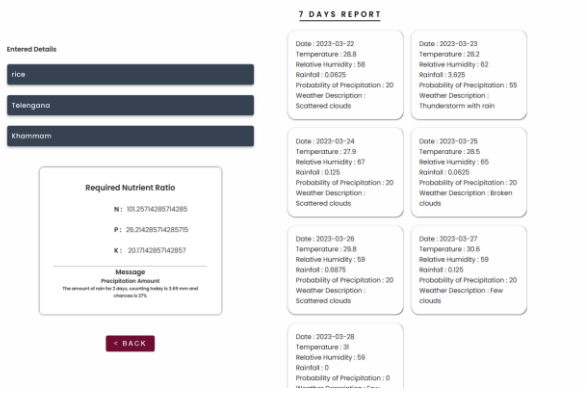
- criterion: allows us to select the loss function that the model will use to determine its outcomes. We are using mean squared error (MSE) as the loss function Our objective is to minimize the MSE as much as possible.

IV. GAP ANALYSIS

Traditionally, farmers have used a fixed amount of fertilizers for a specific type of crop, which can result in excessive use of fertilizers and water pollution. Although there are existing models related to soil fertility for certain types of crops or specific regions, their accuracy may be limited. However, by utilizing the Random Forest algorithm, we can potentially improve the accuracy of these models. Our project aims to cover a wide range of crops present in India, unlike existing models which only focus on specific crops or regions.

V. RESULTS AND DISCUSSIONS

To obtain the required information, the user must input the relevant details such as the type of crop, the name of the state, and the name of the city. Once the page is submitted, the system processes the information and displays the results. The results will include the optimal amount of nutrients required for the specified crop based on the temperature and rainfall in that location. Additionally, a weather report for the next seven days will be provided. With an accuracy rate of 90%, the system will display the results in the following format.



V. CONCLUSION AND FUTURE SCOPE

By utilizing the Random Forest algorithm, this study demonstrates the ability to anticipate the optimal nutrient levels necessary for crop growth and yield improvement. Such advancements are invaluable for our agricultural community. This research takes into account the current weather conditions and the type of crop in order to provide more accurate nutrient recommendations. Enhancements to this system include creating a user

interface in the native language, which would make it easier for non-English speaking individuals to utilize the system. Additionally, speech recognition capabilities can be integrated to accommodate illiterate users. By utilizing IOT technology, data regarding soil composition can be directly extracted, further aiding in fertilizer predictions.

REFERENCES

[1] Krutika Hampannavar, Vijay Bhajantri, Shashikumar G,[25 April 2019] Prediction of Crop Fertilizer Consumption,IEEE, DOI: 10.1109/ICCUBEA.2018.8697827

[2] G. Prabakarana, D. Vaithiyanathanb, Madhavi Ganesanc, [2018]"Fuzzy decision support system for improving the crop productivity and efficient use of fertilizers," Computers and Electronics in Agriculture Volume 150, July 2018

[3] Usman Ahmed , Jerry Chun-weilin,Gautam Srivastava,Youcef Djenouri,[2021] "A nutrient recommendation system for soil fertilization based on evolutionary computation," https://doi.org/10.1016/j.compag.2021.106407

[4] Zonlehoua Coulibali1, Athyna Nancy Cambouris ,Serge-Étienne Parent, [2020 Aug 7] "Site-specific machine learning predictive fertilization models for potato crops in Eastern Canada," doi: 10.1371/journal.pone.0230888

[5] Umm E Farwaa, Ahsan Ur Rehmanb, Saad Qasim Khanc, Muhammad Khurramd, [April 2020]" Prediction of Soil Macronutrients Using Machine Learning Algorithm," International Journal of Computer (IJC), 38(1), 1–14. Retrieved from https://ijcjournal.org/index.php/InternationalJournalOfComputer/article/view/1527.

[6] LIUJianab*ZUOQiangc*ZHAILi-meiaLUOChun-yanaLIUHong-binaWANGHong-yuanaLIUShenaZOUGuo-yuancRENTian-zhi,[2016] " Phosphorus losses via surface runoff in rice-wheat cropping systems as impacted by rainfall regimes and fertilizer applications,", IEEE, https://doi.org/10.1016/S2095-3119(15)61087-5.

[7] Nusrat Jahan, Rezvi Shahariar., [DEC 20220]"Predicting fertilizer treatment of maize using decision tree algorithm," DOI: http://doi.org/10.11591/ijeecs.v20.i3.pp1427-1434.

[8] T. Blesslin Sheeba,1L. D. Vijay Anand,2Gunaselvi Manohar,3Saravana Selvan,4C. Bazil Wilfred,5K. Muthukumar,6S. Padmavathy,7P. Ramesh Kumar,8and Belete Tessema Asfaw, [19 Apr 2022] "Machine Learning Algorithm for Soil Analysis and Classification of Micronutrients in IoT-Enabled Automated Farms,"

[9] U. Naseem, I. Razzak, and P. W. Eklund, "A survey of preprocessing techniques to improve short-text quality: A case study on hate speech detection on Twitter," in Multimedia Tools and Applications. Springer, Nov. 2020, pp. 1–28. [Online]. Available: https://link. springer.com/article/10.1007/s11042-020-10082-6

[10] Kaggle, " https://www.kaggle.com/datasets/atharvaingle/crop-recommendation-dataset ".

[11] Z Senthil Kumar Swami Durai, Mary Divya Shamili, "Smart farming using Machine Learning and Deep Learning techniques," Decision Analytics Journal, vol-2, 2022, PP. 1-30

[12] Akash Manish Lad, K. Mani Bharathi, B. Akash Saravanan, R. Karthik, "Factors affecting agriculture and estimation of crop yield using supervised learning algorithms," https://doi.org/10.1016/j.matpr.2022.03.080.