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Machine Learning Based Crop Prediction

Kishan B[1], Lakshmi K T[2], Mahalakshmi S[3], Dr. Manjunatha Reddy H S[4]

UG Student, Department of ECE, GAT, Bengaluru, India[1]

UG Student, Department of ECE, GAT, Bengaluru, India[2]

UG Student, Department of ECE, GAT, Bengaluru, India[3]

Professor, Department of ECE, GAT, Bengaluru, India[4]

ABSTRACT: Farmer productivity can be increased with the use of the intelligent instrument known as the Integrated Agricultural Intelligence System (IAIS). To provide customized guidance for various crops, it leverages cutting-edge technology and data analysis. To determine crop health and offer recommendations, IAIS monitors temperature and soil nutrients (NPK levels). In order to assist farmers in understanding the effects ofweather on their crops and modifying their operationsaccordingly, it also makes use of rainfall data. IAIS correctly detects crops using sophisticated algorithms and recommends tactics according to their requirements. Italso assesses the different kinds of fertilizers and suggeststhe best application based on temperature and NPK levels.In order to help farmers use resources more effectively, increase yields, and practice sustainable farming all of which contribute to food security IAIS uses machinelearning to provide timely insights.

Keywords: Integrated Agricultural Intelligence System (IAIS), NPK levels, Soil nutrients, Fertilizers, Sustainable farming, Sophisticated Algorithms.

I. INTRODUCTION

Precision farming, artificial intelligence, and data analysisare all being incorporated into a new crop management system for Udupi that will revolutionize regional agriculture. This strategy supports farmers and improves farming methods while addressing specific issues like limited resources and decreased district investment. By utilizing state-ofthe-art technologies, the system offerstailored approaches to increase productivity and sustainability. It recognizes the need to transition from traditional to data-driven farming in order to address problems like water scarcity and climate change. The technique improves productivity and profitability whileprotecting the environment by placing a strong emphasis on healthy soil and efficient crop management. Given thatthey have access to current information, farmers are able to make informed judgments.

II. LITERATURE SURVEY

[1] D.Jayanarayana Reddy and Dr M. Rudra Kumar, have proposed a project titled "Crop Yield Prediction Using Machine Learning Algorithm". Precise forecastingis essential considering the significance of agriculture in India, particularly considering the hazards associated with climate change and other environmental elements. The initiative examines and creates artificial intelligence-basedcrop yield forecasting techniques. Machine learning algorithms provide more accuracy and efficacy in predicting weather impacts, crop diseases, and growth stages than neural networks, despite the latter's limits in managing non-linear interactions and minimizing prediction mistakes. This raises agricultural output and assists farmers in making wiser decisions.

[2] Pavan Patil, Virendra Panpatil, Prof. Shrikant Kokate haveproposed a project titled "Crop Prediction System using Machine Learning Algorithms". To address problems including low crop yields, recurrent planting, and a lack of information on soil nutrients, machine learning algorithms arebeing developed to enhance agriculture in India. In additionto offering suggestions for fertilizer and seeds, the system evaluates soil and meteorological data to determine which crops would be most suitable for a given plot of land. Furthermore, methods for forecasting crop yields and rainfall are examined. In addition to decreasing soil contaminationand raising farmer profitability, this strategy can improveagriculture as a whole. The technology employed by the system enables farmers to optimize their farming techniques and to make a better judgments in the farming.

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[3] Sapna Jaiswal, Tejaswi Kharade, Nikita Kotambe and Shilpa Shinde have developed a project titled "Collaborative Recommendation System for Agriculture Sector". An agricultural industry collaborative recommendation system that focuses on supporting farmers by providing answers to all of their questions about agricultural practices, creating a profile of their basic needs via an online application, and suggesting government programs currently in place to improve their lot in life. The case study explores the development of collaboration contracts in Indian agriculture. Information and guidance on government initiatives and programs that will help farmersis the goal. Based on the needs of the farmers, the system evaluates their inquiries and provides solutions. Additionally, it keeps farmers updated on the newest methods and trends in agriculture. The KNN method is used in the research to evaluate data and providerecommendations using machine learning techniquesincluding cosine similarity and collaborative filtering.

[4] T.Cyril, P.V.Archana, G.D.Vignesh have developed a project titled "Crop Yield Prediction Using Machine Learning". According to the model, farmer recommendations are predicted using machine learning techniques. Data gathering, data preprocessing, andpredictive models are all included in the process of data processing. In particular, the use of XG Boost (high gradientboosting) regressors to estimate crop yields is highlighted asa crucial aspect of data visualization and technique application in this study. The usage of the Flask framework for the development and deployment of web applications is also covered. In closing, the study emphasizes how machine learning may be used to precisely forecast crop productivity and makes recommendations for future research directions.

[5] Ajay Sudhir Bale, S.Kamalesh, Naveen Ghorpade andtheir associated have developed a project titled "Web Scrapping Approaches and their Performance on Modern Websites". They have made available a hybrid model thatuses machine learning to increase crop-type detectionaccuracy. This model focuses mostly on crop prediction issues and their resolutions utilizing sensor data and machine learning methods. An analysis was conducted on several classification algorithms and theireffectiveness in classifying products. Along with examining how algorithms affect various crop forecasting applications, the system makesrecommendations for enhancements to boost response times and accuracy. There's also a new method proposed for detecting product types. Businesses and organizationsinterested in using drone photography for precision agriculture, crop planning, and monitoring can find valuable information in this article.

III. SYSTEM ARCHITECTURE

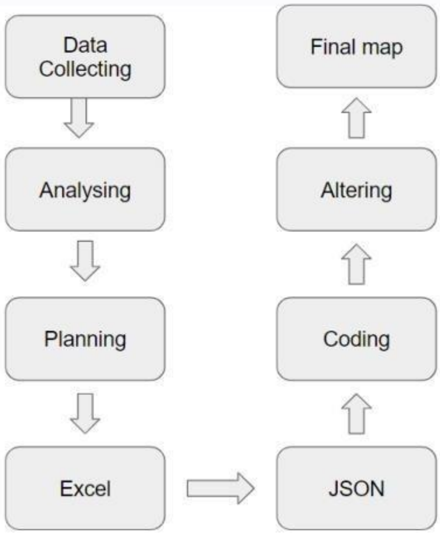

Figure 1. Soil Mapping Model

Data collection: Gather and document all soil data such as soil surveys, statistical information, and field measurements that arepertinent to the research area. To augment data from the ground, use remote sensingdata. **Analysing:** Determine and characterize the precise area that must be demarcated in order to provide a distinct border for theactivity

Planning: Sorting and organizing the collected data to get rid of mistakes, contradictions, and negativity. Data should be digitalized, and a model should besupplied for additional research.

Mapping selection: To select an appropriate tool, take into account the given data and chart. Machine learning algorithms, regression-based models, and geostatistical techniques are some of the techniques used.

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Making a soil map: To make a soil map that accurately depicts the research area's soil conditions and changes, use certain mappingprocedures.
Map verification: Check soil maps for accuracyby contrasting them with field measurementsand additional soil data. Find discrepancies and make the necessary adjustments to the chart to increase accuracy.
Result interpretation: Comprehend theinformation from soil maps and effectively convey it to relevant parties, includingpolicymakers, farmers, and land managers.Make better decisions and manage land better by using maps.

III. IMPLEMENTAION

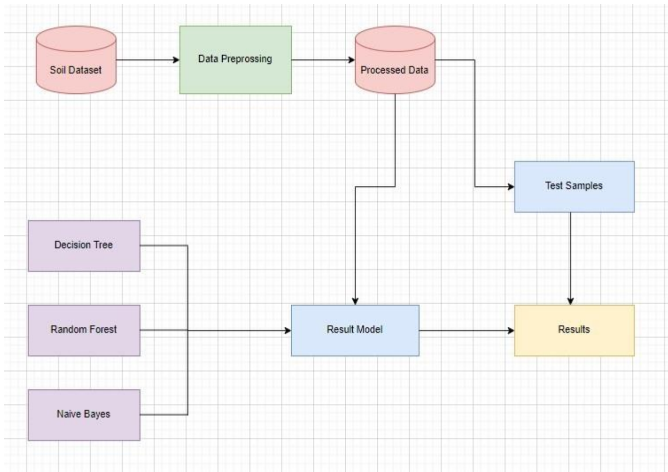

Figure 2. Crop Suggestion Model

The first step in this process is gathering detailed soil data. Strict measures are performed to clean the data, correcting problems like missing values and outliers, before it is ready for analysis. After it is prepared, the data is divided into testing and training groups. First, decision trees are employed to identify trends in the soil data. Next, to increaseprediction accuracy, a more sophisticated random forest model is used, which incorporates several decision trees. To guarantee this model's dependability in soil analysis, its performance is meticulously measured.
The Naive Bayes algorithm is investigated by the technique as an additional classification tool. This strategy seeks to maximize the capabilities of these models for efficient analysis of soil data by utilizing a variety of machine learning approaches. The final objective is to improve productivity and sustainability by establishing a transparent decision-making process for land management and agricultural operations. This all-inclusive strategy aidsfarmers in decision-making, maximizes soil utilization, and improves agricultural results. **Confusion-Matrix for NPK**

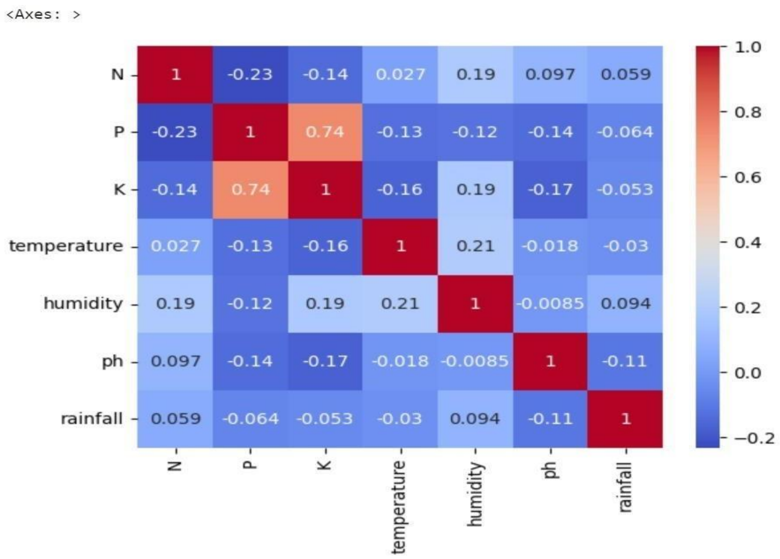

Figure 3. Confusion-Matrix for NPK

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A correlation matrix illustrates the relationships between many variables, such as temperature, humidity, pH, rainfall, phosphorus (P), potassium (K), nitrogen (N), andso on. Humidity and rainfall have a mild negative association, with a correlation value of -0.2 indicatingthat there is a slight decrease in rainfall when humidity rises and vice versa. In other words, if a correlation is approaching -1, it indicates that the variables move in the opposite direction from one another. No association between the variables is shown by a correlation near 0.

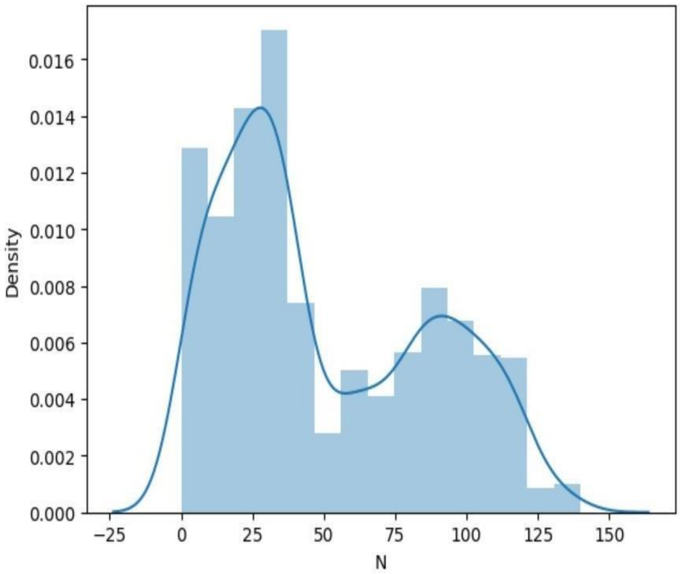

Figure 4. Distribution graph for Nitrogen (N)

The graph also shows that the formulation at the 30th point contains the most nitrogen per unit among different NPK formulations, which helps estimate the nitrogen concentration for formulating as shown on the graph.

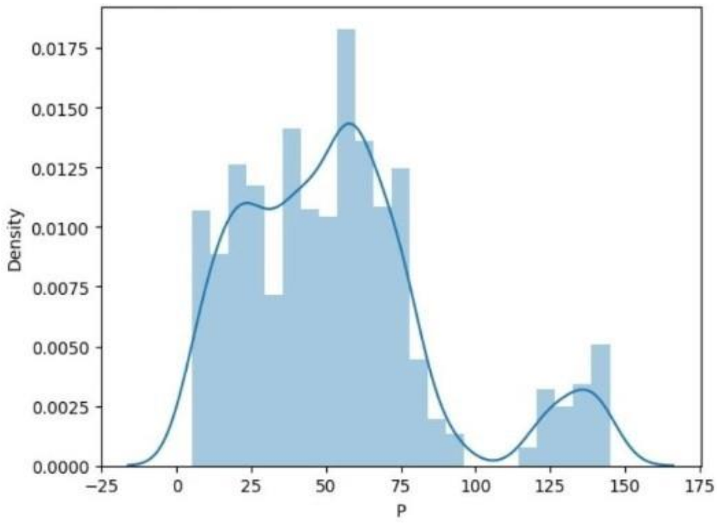

Figure 5. Distribution graph for Phosphorous (P)

The maximum phosphorus concentration in the tested NPK formulations is displayed by the peak at the 55th position on the x-axis. In order to maximize crop phosphorus uptake, this aids in fertilizer selection. Gaining knowledge of these phosphorus levels facilitates the optimization of fertilizers to match the demands of certain crops, hence increasingagricultural output. Phosphorus is essential for the growth anddevelopment of plants, and this peak shows the maximum concentration that may be achieved within the tested range.

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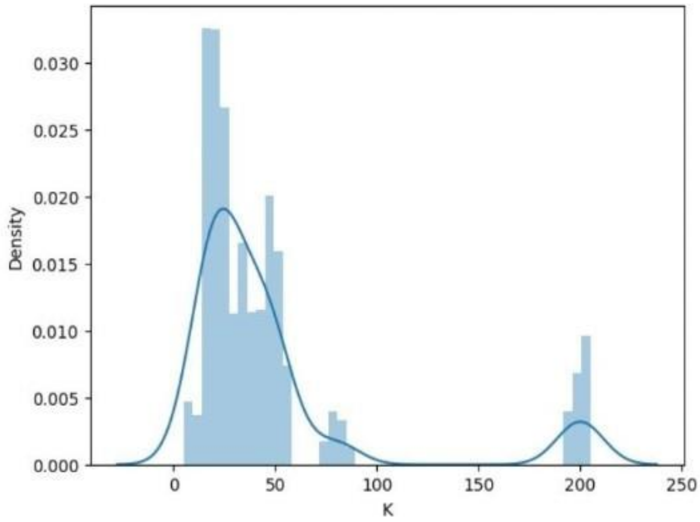

Figure 6. Distribution graph for Potassium (K)

The graph indicates that the y-axis peaks at 0.030 between thex- and y-axes' positions 0 and 50. This indicates that of all the formulations examined, the ones in this range have the highest potassium concentration. Finding the optimalpotassium-rich fertilizer for crops is made easier by the peak value, which shows that the 0–50 range in NPK formulations has the highest potassium content per unit.

Machine Learning Algorithms

Farmers can benefit from the Machine Learning Based Crop Prediction System, which eliminates uncertainty in selecting the optimal crops to plant. It examines the nitrogen (N), phosphorus (P), and potassium (K) content of soil and compares the results to a big database of crops that have the right amounts of each component. This technology offers customized guidance based on a number of variables, making it unique to the circumstances of each farmer. It helps farmerschoose crops with the best odds of a successful harvest by providing the best crop selections in an understandable and straightforward style using an intuitive interface.

Machine Learning Alogrithms	**Accuracy**
Random Forest Classifier	99.81%
Decision Tree Classifier	94.54%i
Gaussian Naive Bayes Algorithm	75.27%
Logistic Regression	71.09%

V. RESULTS

With the use of machine learning, the suggested approach assists farmers in managing nutrients and maximizing crop productivity. It has robust validation, simple input processing,and explicit suggestions. Strategic feedback is used topromote continuous improvement, and the system is made to be both effective and scalable. In the end, extensive testing increases agricultural output and sustainability by ensuringaccuracy and dependability. The goal of this approach is to increase farmers productivity and farming efficiency.

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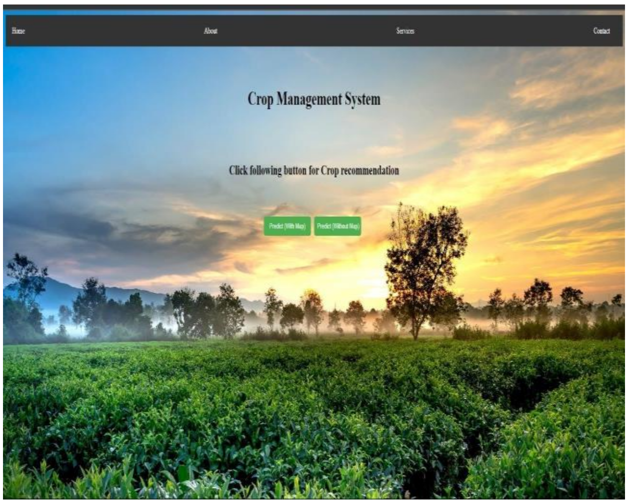

Figure 7. Home Page for Crop Management System

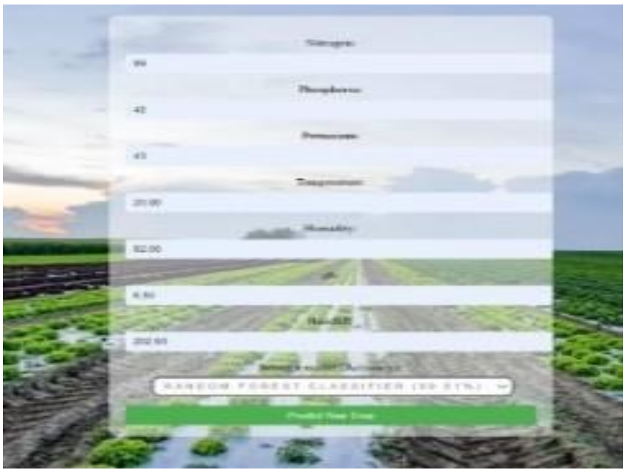

Figure 8. User Input Without Mapping

The user have to manually specify the values of NPK ofthe tested soil, and have to specify the temperature, humidity and precipitation.

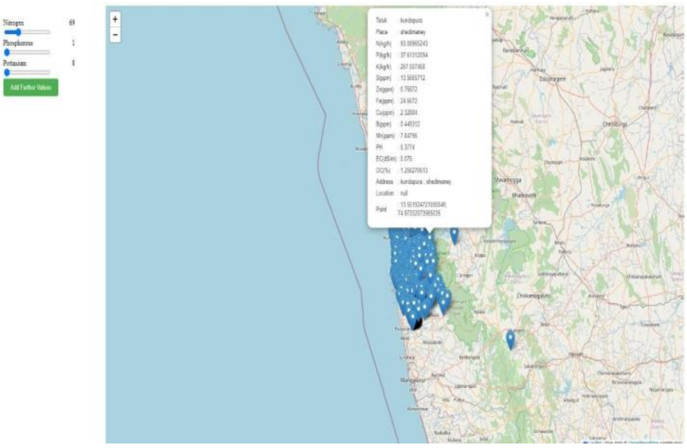

Figure 9. NPK Selection From Map

The user have to select the region to predict the crop by varying the NPK values. On selecting a region it displays the default information of the region.

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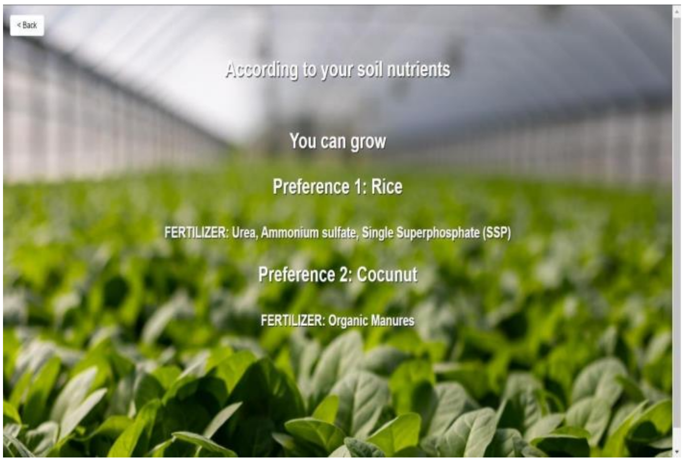

Figure 10. Displaying the result of prefered crop and fertilizer

Displays the crops and the fertilizers to be used for the predicted crops based on the nutrients present in the soil.

VI. CONCLUSION

Technology for farming has advanced significantly with the addition of sensors for monitoring soil health to crop management systems. In order to help farmers make timely adjustments to their methods, these sensors provide real time data on soil moisture, pH, and organic matter. Farmers may use resources like water, fertilizer, and insecticides more economical and environmentally friendly by customizing recommendations for each area. By identifying problems before they get worse, these sensors also aid in managing crop health and soil quality. In general, they suggest that by enhancing crop management techniques, they will raise agricultural sustainability and productivity. In doing so, they lessen the environmental effect of agriculture by streamlining farming chores and managing resources. With the optimization of water use, reduction of fertilizer application, and enhancement of soil health, integrated soil health management safeguards water quality, enhances biodiversity, and conservation.

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