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An Intensive Analysis And Implementation For Crop And Fertilizer Recommendation

[1] Ajithra. R, [2] Mr. Giriprasath.K S,

[1] M.Sc. Data Science and Business Analysis, [2] Assistant Professor,

[1 2] Department of Computer Science,

[1 2] Rathinam College of Arts and Science, India.

Abstract: Agriculture is a biggest economy and largest work force in India. Farmers are the backbone of our nation and depend on agriculture to fulfil their duties. But in our country farming communityis the only community which faces a bunch of problems which starts immediately after the planning of right crop to cultivate still end ofharvesting. In India it is not easy to cultivate andharvest a specific variety of crop because of soil conditions of the farmland. When we compare our farming technologies with the western one, we can easily understand that how far we areand in whatever technologies we are lacking. Still in India we are following the traditional way of farming with limited technologies. Today in real life Data analysis, artificial intelligence, and machine learning playing a major role in every industry. With the help of that technologies, we can understand the cropping patterns, and fertilizer recommendation of a specific land area. If we see little deeper, we can understand the quality of soil for example nutrients level, phosphorus level, potassium. level, using the sensors we have fixed already. This technology is very much accuratein understanding and deliver the farmers with good recommendations about fertilizers and crop and this will help the farmers to increase theharvest from the farmland which directly income the farmers gross product.

Keywords: Crop and Fertilizer recommendation, Internet of Things, Random Forest, Logistic Regression.

1. INTRODUCTION

India is a diversity nation with different kind of climatic conditions in different areas. And there is other way to say that India is a diversify by means of season because India is a two-season country especially summer andwinter. From ancient period itself farming is not only a business more than that it is part of an Indian culture.In India majority of workforce is still depends on farming but the technological developments we have for farming is still not up to the mark. Punjab is the first state to penetrate the mass production of agriculture products dueto this the other states also slowly penetrated this format. But due to this the farmlands became more Chemical substances added lands. These practices also alter seasonal climate patterns, which threaten essential resources like soil, water, and air and generate food insecurity. Quality of soil is an important factor for yield. Previously the upcoming yield is predicted on the bases of the farmers prior experience but now the soil nutrients conditions playa major role in prediction of the yield. so, technology will help them to understand what variety of crops needs to be cultivated and what crop give more profit. Suggestion to the farmers regarding the proper use of fertilizers will help them for the proper management of crops and farmlands. To raise the caliber and output level of the farmland first we need to understand the previous history of fertilizers and chemical substances used in the land and about the moisturizes and the soil nutrient conditions of the land. All this factors directly and indirectly improve the quality and quantity.

The traditional one-size-fits-all approach to fertilization often leads to inefficient resource utilization, economic losses for farmers, and adverse environmental consequences. Precision agriculture, with its emphasis on data-driven decision-making, offers a solution to these challenges. Byleveraging advanced technologies, such as sensors. In a rapidly changing agricultural landscape, a critical frontierin agricultural innovation is the thorough analysis and implementation of crop and fertilizer recommendations. This approach has the potential to maximize resource utilization, boost crop productivity, and encourage sustainable farming practices. We can obtain current data on crop conditions, nutrient levels, and soil health throughremote sensing and data analytics. To help farmers make educated decisions, maximize yields while minimizing their impact on the environment, and optimize resource utilization, sensors are essential in delivering precise, real-time data. This targeted approach not only maximizesyields but also promotes sustainable farming practices byreducing fertilizer waste and mitigating the risk of nutrient runoff. The intensive analysis and implementation of crop and fertilizer recommendations hold immense potential for revolutionizing agricultural practices. Sensors enable farmers to proactively address emerging challenges suchas pest outbreaks or water stress, thereby safeguarding crop health and resilience. In essence, sensor technology empowers farmers to optimize resource allocation, enhanceproductivity, and promote environmental sustainabilityin agriculture. We can create a future of efficient and sustainable food production, guaranteeing food security for future generations, by utilizing data and technology.

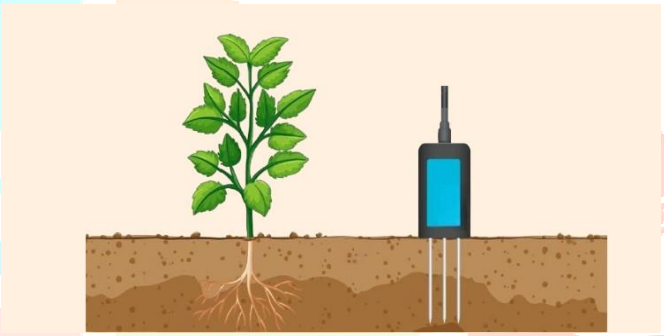

Fig. 1: NPK Sensor

This leads to increase revenue and finally that revenue takes to the economic growth. This project's primary objective is to design and develop an Internet of Things (IoT) system that employs sensors to gather data in real-time about the nutrients present in soil. Through sensor the data will be collected and stored in raspberry pi using machine learning algorithms, it will deliver accurate result. It will suggest the crop and fertilizer through customized application. The main objectives are directly (fig.1) will collect the potassium (K), phosphorus (P), and nitrogen (N) level will be displayed on the application. With the help of the technology, farmers will be able to make knowledgeable decisions about the use of fertilizer by receiving customized recommendations based on their unique fields and crops. The primary goals of this paper are to suggest fertilizer and increase crop productivity.

2. LITERATURE SURVEY

Crop and Fertilizer Recommendation System using Ma- chine Learning. Palaniraj, Balamurugan A, Durga Prasad, Pradeep [1]. Here, data on the weather, temperature, soiltype, soil nutrient value, and rainfall totals have been gathered. Following that, the data will be examined. Thedata was trained using support vector machine algorithmsso that a model and predictions could be made. The system's accuracy over 90.01%.

Crop Prediction and Fertilizer Recommendation Using Machine Learning. Priyanka Rajendra Sonawane, Pooja Nagraj patil [2]. Here they have forecast the soil to predictthe right crop and fertilizer to feed the world's population.Support vector machine algorithms used for classification and regression problems. The data are split 80:20 between training and testing data sets. The system's accuracy over 95%.

Crop Recommendation Using IOT and Machine Learning. Anusha D J, Trupti G, Sunidhi K R, Kiran Kumar K M[3]. Here they have used DHT11 sensor for realtime Temperature and humidity

value and GPS receiver through satellite communication algorithm to find the nearest neighbor's system's accuracy over 85%.

Crop yield prediction based on Indian agriculture using machine learning. Nishant, P. S., Venkat, P. S., Avinash. L., Jabber, B. (2020, June).[4]. Here they have forecastthe crop's yield by entering the State, district, season, andarea. The advanced algorithm techniques used to predict the crop. The system's accuracy over 82%.

Prediction of crop yield and fertilizer recommendation using machine learning algorithms. Bondre, D. A., Maha Gaonkar, S. (2019).[5]. Here by using previous datasystems to forecast crop yield. The algorithms Support Vector Machine and Random Forest are for regression and classification to achieve maximum accuracy. The system's accuracy over 99.47% and 86.35%.

3.EXISTING SYSTEM

3.1 Agri App

Agri App is an Android-based mobile application that provides farmers with a comprehensive set of tools and information to improve their agricultural practices. Crop Advisory get a real-time agro-advisory services from agricultural experts through chat, videos, or images in their local language. Soil Testing services to determine the nutrient status of your soil and receive personalized fertilizer recommendations. Gain access to a comprehensivelibrary of crop practices and guidelines for various crops. Purchase agricultural inputs, including seeds, fertilizers, and pesticides, at competitive prices.

3.2 Agro Bas App

Agro bas is a comprehensive cloud-based agricultural management platform that empowers farmers and agricultural businesses to streamline operations, optimizecrop production, and enhance profitability. It offers a suite of integrated modules that cover all aspects of the agricultural cycle, from crop planning and field management to harvesting and post-harvest processing.It provides comprehensive pest and disease management tools, including pest scouting, disease identification, and targeted treatment. By conducting an in-depth analysisof soil properties, crop requirements, researchers and practitioners can develop robust models capable of providing personalized fertilizer prescriptions. It provides tools for yield estimation, quality control, and inventory.

3.3 Soil Kit App

Soil Kit app allow you to test your soil by sending samples to labs. Then they analyze the results and provide information on key nutrients like nitrogen, phosphorus, potassium, and organic matter. Based on the analysis, the apps recommend personalized fertilizer application rates and types to optimize nutrient levels for specific crops and soil types. Helps you to diagnose problems based on plant symptoms.

4. METHODOLOGY

4.1 System Architecture

The primary objective of this project is to design and develop an Internet of Things (IoT) system that employs sensors to gather data in real-time about the nutrients present in soil. Through sensor the data will be collected and stored in raspberry pi. Using machine learning algorithms, it will deliver accurate result. It will suggest the crop and fertilizer through customized application. The key objectives are directly the nitrogen, phosphorus and potassium level will be presented on the application. By obtaining personalized advice based on their fields and crops, farmers would be empowered to make informed decisions regarding the use of fertilizer thanks to technology NPK sensors use various technologies to analyze the nutrient content in the soil, providing farmers and agronomists with valuable information for making informed decisions about fertilization and crop management. These sensors can help optimize fertilizer application, reduce costs, and minimize environmental impact by ensuring that crops receive the right amount ofnutrients.

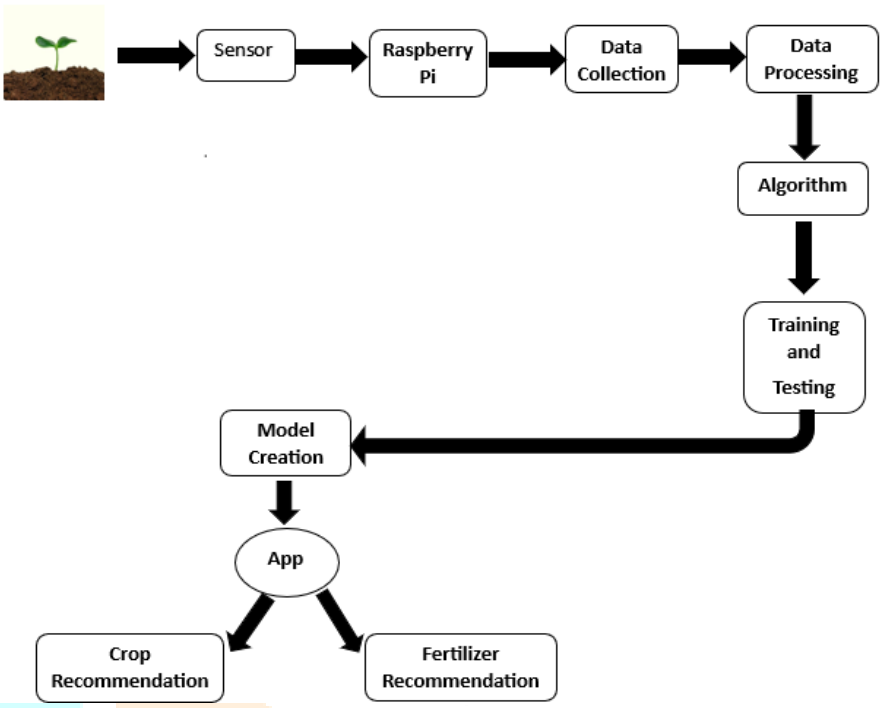

Fig. 2: System Architecture

4.1.1 Implementation

- NPK Sensor Data: Install NPK sensors in the tar-get agricultural area. Regularly collect data from the sensors, determining the soil's concentrations of phosphorus (P), potassium (K), and nitrogen (N).
- Raspberry pi: It will store the collected data then datapreprocessing, algorithm, training, and testing processwill be happened inside the raspberry pi.
- Data Preprocessing: Clean and preprocess the collected sensor data. Handle missing or inaccurate values. Normalize or standardize the data to ensure consistency.
- Integration with IoT Platform: Connect the NPKsensors to an IoT platform for real-time data trans- mission. Ensure secure and reliable communication between the sensors and the central system.
- User Interface: Provide a user interface (UI) that farmers to access the recommendations. The UI should display current soil nutrient levels, recommended fertilizers, and application rates.
- Mobile Application: Consider developing a mobile application for easy access to recommendations and real-time data. The app could also include additional features, such as historical data analysis.

4.2 Crop Recommendation

Crop recommendation involves advising farmers on the most suitable crops for their specific agricultural conditions. This process considers factors such as soil level and market demand. Soil analyses, along with modern technologies likeprecision agriculture, help tailor recommendations. Cropdiversity and rotation are encouraged for soil health and risk mitigation. The goal is to optimize yield, economic returns, and resource efficiency while ensuring resilience toenvironmental factors and market dynamics. Analyzes soilnutrients through lab testing and offers detailed reports with nutrient recommendations and insights into soil health.

4.3 Fertilizer Recommendation

Fertilizer recommendation systems utilize various data sources and analytical techniques to provide tailored guidance on fertilizer usage, optimizing crop yields while minimizing environmental impact. These systems typically integrate data on soil properties, crop types, weather conditions, and nutrient requirements. Machine learning algorithms such as decision trees, support vector machines, or neural networks are often employed to analyze these datasets and generate

personalized fertilizer recommendations. By considering factors such as soil nutrient levels, crop nutrient demands at different growth stages, and environmental constraints, these systems can suggest precise fertilization strategies to farmers. Additionally, advancements in remote sensing technologies enable the incorporation of satellite imagery and drones toassess crop health and nutrient status, further enhancing the accuracy of fertilizer recommendations. Overall, fertilizer recommendation systems play a vital role in sustainable agriculture by promoting efficient resource utilization, reducing input costs, and minimizing nutrient runoff into the surrounding environment.

4.4 Algorithms

4.4.1 Naive Bayes

Naive Bayes, a simple yet effective probabilistic classifier, is applied in agriculture for tasks such as crop disease diagnosis, yield prediction, and soil quality assessment. Despite its assumption of feature independence, Naive Bayes demonstrates practical utility in agricultural contexts. In crop disease diagnosis, it analyzes symptoms and environmental factors to classify plants as healthy or diseased, aiding farmers in early detection and management. Moreover, Naive Bayes facilitates yield prediction by considering variables like weather conditions, soilmoisture, and nutrient levels, assisting farmers in optimizing harvest planning and resource allocation. Additionally, it contributes to soil quality assessment by evaluating chemical composition and microbial activity, supporting decisions on fertilizer applicationand land management practices. While simplistic in its approach, Naive Bayes offers computational efficiency and interpretability, making it a valuable tool for agricultural decision making, particularly in scenarios with limited computational resources and straightforward classification tasks.

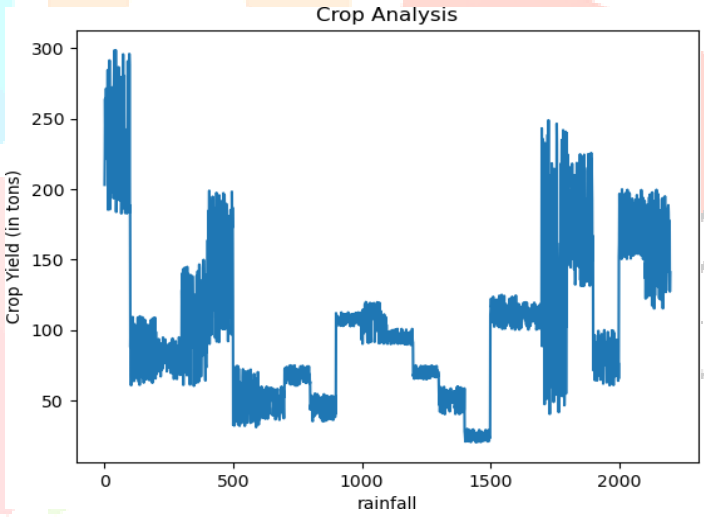

Fig. 3: Crop Analysis

4.4.2 Random Forest

Random Forest, a popular ensemble learning algorithm, finds extensive application in agriculture due to its versatility and robustness. By aggregating predictions from multiple decision trees, Random Forest provides accurate and reliable results for various agricultural tasks. In crop classification, it analyzes diverse features such as spectral data from satellite imagery, soil characteristics, and climate conditions to classify crops accurately. Moreover, Random Forest assists in yield predictionby leveraging historical data, weather patterns, and soil fertility metrics, aiding farmers in making informed decisions about planting strategies and resource allocation. Additionally, it plays a crucial role in disease detection and pest management by identifying patterns indicative of crop diseases or pestinfestations, enabling timely interventions to mitigate losses. With its ability to handle high-dimensional data, nonlinear relationships, and provide insights into feature importance, Random Forest emerges as a valuable tool for optimizing agricultural practices, enhancing productivity, and ensuring sustainable food production.

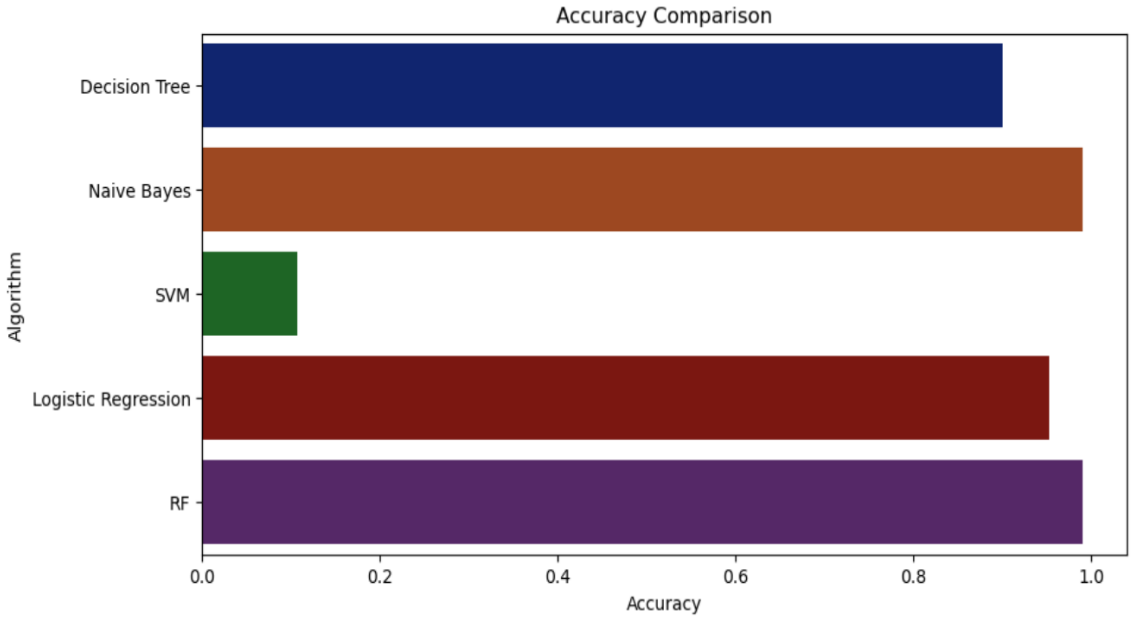

Fig. 4: Comparison algorithms for crop recommendation

4.4.3 Logistic Regression

Logistic Regression finds application in agriculture forvarious tasks, including crop disease prediction, yieldestimation, and soil quality assessment. By analyzingfactors such as weather data, soil characteristics, and crop features, Logistic Regression models can predict the likelihood of disease outbreaks or estimate crop yields. Farmers in making knowledgeable choices for effective fertilizer use and maximized crop production. Logistic Regression is favored for its simplicity, interpretability, and efficiency, particularly when the relationship between features and the outcome is expected to be approximately linear. Compare to other all algorithm logistic regression gives the accuracy high for fertilizer recommendation.

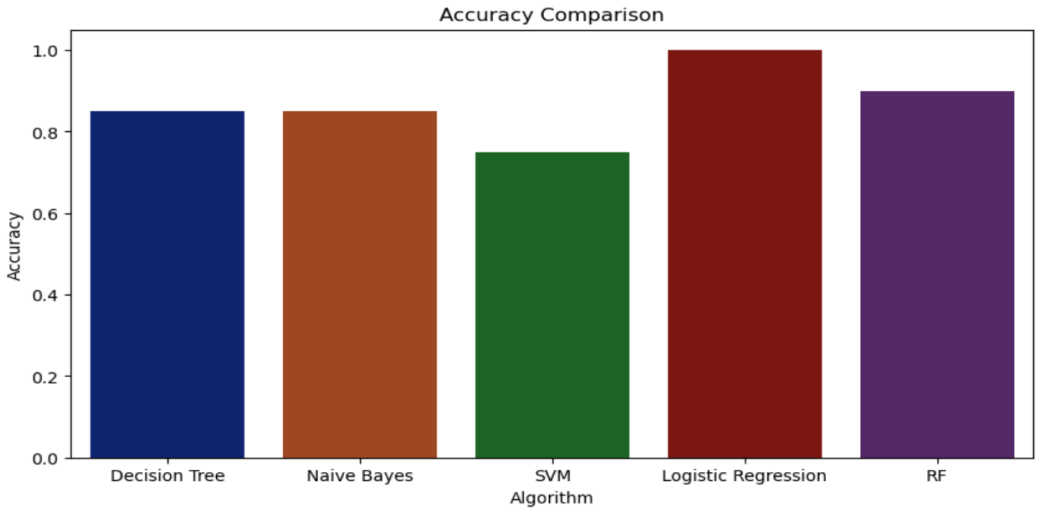

Fig. 5: Comparison algorithms for fertilizer recommendation

4.4.4 Support Vector Machines (SVM)

Support Vector Machine (SVM) is a versatile supervised learning algorithm widely employed in variousdomains, including agriculture. In agriculture, SVM aids in tasks like crop classification, disease detection, and precision farming. By analyzing data from satellite imagery, sensors, and genomic information, SVM models assist farmers in optimizing resource allocation, monitoring crop health, and predicting yields. Furthermore, SVM contributes to early pest and disease detection, enabling timely interventions to mitigate crop losses. With its ability to handle high-dimensional data and generalize well, SVM emerges as a valuabletool in modern agriculture, facilitating sustainable practices and enhancing productivity. SVM can transfer the input data into a higher dimensional space separable dataset that divides classes.

5. CONCLUSION

To conclude this study about An Intensive Analysis and Implementation for Crop and Fertilizer Recommendation using machine learning will make a very big differencein the agricultural industry to understand the soil and deliver the required crop and fertilizer to the farmland. The dataset consisting of soil nutrient level, crop, and fertilizer recommendation. The quality of the soil will be integrated from sensors and send the value to raspberry pi and after training and testing data it will recommend the crop and fertilizer in application. For crop recommendation Random Forest is good with accuracy 99%. For fertilizer recommendation Logistic Regression is good with accuracy98%. Additionally, this technique will assist newcomers in selecting a crop that will thrive in their region and yield a profit. And in many areas the crops will be more damaged due to precipitation so through this system it is easy to understand, and they can take the proper remedies. And due to less profit, most of the peoples are not gets attracted towards farming even if they have interest. But this study will make things change and attract more peoples because of the descent profit. And finally, this study taught me many insights about the farmers and farming lands and their problems.

6. REFERENCES

[1] Palaniraj, A., Balamurugan, A. S., Prasad, R. D., & Pradeep, P. (2021). Crop and fertilizer recommendation system using machine learning. IRJET, 8.

[2] Somwanshi, K., Sonawane, P. R., Lohar, T. S., & Jadhav, M. S. Crop Prediction and Fertilizer Recommendation Using Machine Learning.

[3] Anusha K, Anusha D J, Sunidhi K R, Trupti G, Kiran Kumar K M, 2023, Crop Recommendation Using Iot And Machine Learning, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 11, Issue 05 (ICEI – 2023),

[4] Nishant, P. S., Venkat, P. S., Avinash, B. L., & Jabber, B. (2020, June). Crop yield prediction based on Indian agriculture using machine learning. In 2020 International Conference for Emerging Technology (INCET) (pp. 1-4). IEEE.

[5] Bondre, D. A., & Maha Gaonkar, S. (2019). Prediction of crop yield and fertilizer recommendation using machine learning algorithms. International Journal of Engineering Applied Sciences and Technology, 4(5), 371-376.

[6] Vivek, M. V. R., Harsha, D. S., & Maran, P. S. (2019). A survey on crop recommendation using machine learning. Int. J. Recent Technol. Eng, 120-125.

[7] Parikh, D. P., Jain, J., Gupta, T., & Dabhade, R. H. (2021). Machine learning based crop recommendation system. Int J Adv Res Sci Commun Technol, 6(1), 891-897.

[8] Medar, R., Rajpurohit, V. S., & Shweta, S. (2019, March). Crop yield prediction using machine learning techniques. In 2019 IEEE 5th international conference for convergence in technology (I2CT) (pp. 1-5). IEEE.

[9] Gosai, D., Raval, C., Nayak, R., Jayswal, H., & Patel, A. (2021). Crop recommendation system using machine learning. International Journal of Scientific Research in Computer Science, Engineering and Information Technology, 7(3), 558-569.

[10] Gandhi, N., Armstrong, L. J., & Petkar, O. (2016, July). Pro- posed decision support system (DSS) for Indian rice crop yield prediction. In 2016 IEEE Technological Innovations in ICT for Agriculture and Rural Development (TIAR) (pp. 13-18). IEEE.

[11] Nishant, P. S., Venkat, P. S., Avinash, B. L., & Jabber, B. (2020, June). Crop yield prediction based on Indian agriculture using machine learning. In 2020 International Conference for Emerging Technology (INCET) (pp. 1-4). IEEE.

[12] Anbananthen, K. S. M., Subbiah, S., Chelliah, D., Sivakumar, P., Somasundaram, V., Velshankar, K. H., & Khan, M. A. (2021). An intelligent decision support system for crop yield prediction using hybrid machine learning algorithms. F1000Research, 10.

[13] Bandara, P., Weerasooriya, T., Ruchirawya, T., Nanayakkara, W., Dimantha, M., & Pabasara, M. (2020). Crop recommendation system. International Journal of Computer Applications, 975, 8887.

[14] Shah, A., Dubey, A., Hemani, V., Gala, D., & Kalbande,D. R. (2018). Smart farming system: Crop yield prediction using regression techniques. In Proceedings of International Conference on Wireless Communication: ICWiCom 2017 (pp. 49-56). Springer Singapore.

[15] Bhanumathi, S., Vineeth, M., & Rohit, N. (2019, April). Crop yield prediction and efficient use of fertilizers. In 2019 Inter- national Conference on Communication and Signal Processing (ICCSP) (pp. 0769-0773). IEEE.

[16] Senapaty, M. K., Ray, A., & Padhy, N. (2023). IoT-Enabled Soil Nutrient Analysis and Crop Recommendation Model for Precision Agriculture. Computers, 12(3), 61.

[17] Archana, K., & Saranya, K. G. (2020). Crop yield prediction, forecasting and fertilizer recommendation using voting-based ensemble classifier. SSRG Int. J. Comput. Sci. Eng, 7, 1-4.

[18] Schut, A. G., & Giller, K. E. (2020). Soil-based, field-specific fertilizer recommendations are a pipedream. Geoderma, 380, 114680.

[19] Bodake, K., Ghate, R., Doshi, H., Jadhav, P., & Tarle, B. (2018). Soil based fertilizer recommendation system using Internet of Things. MVP Journal of Engineering Sciences, 1(1), 13-19.

[20] Padmanabhuni, S. S., Narayana, J. L., Bhavani, K. H. L., Venkata Krishna sai Poojitha, V., Rupa, B., & Jaya, C. (2023, February). IOT-Based Fertilizer Recommendation System Using a Hybrid Boosting Algorithm. In International Conference on Intelligent Sustainable Systems (pp. 137-156). Singapore: Springer Nature Singapore.