IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁒ Peer-reviewed & Refereed journal ⁒ Vol. 14, Issue 5, May 2025

DOI: 10.17148/IJARCCE.2025.14524

SMART AGRO ADVISOR: A Mobile App Solution For Sustainable Farming

R.Priyadharshini[1], S.Rasika [2], Mrs.S.Jancy Sickory Daisy [3]

Student, Department of Computer Science and Engineering, Anand Institute of Higher Technology, Kazhipattur, Chennai[1,2]

Associate Professor, Department of Computer Science and Engineering, Anand Institute of Higher Technology, Kazhipattur, Chennai[3]

Abstract: This project focuses on building a smart and sustainable agricultural system that assists farmers in reducing the overuse of chemical fertilizers and pesticides. Excessive chemical application has long-term negative effects on soil fertility, crop yield, and the surrounding ecosystem. To address these issues, the system utilizes Artificial Intelligence (AI) techniques to provide personalized recommendations for suitable crops, fertilizers, and pesticides based on the specific soil condition and plant health data. The application allows farmers to register using their basic details and input soil data either manually (by entering nutrient values such as Nitrogen, Phosphorus, Potassium, pH level, and moisture) or by uploading images. Based on this information, the AI model predicts the most suitable crop for cultivation. Additionally, the system features a disease detection module where farmers can upload images of infected leaves. Using machine learning and image processing techniques, the system diagnoses the disease and suggests appropriate remedies, including the type and quantity of fertilizers or pesticides required.

Keywords: Artificial Intelligence, Sustainable Agriculture, Crop Recommendation, Soil Analysis, Plant Disease Detection, Machine Learning, Fertilizer Suggestion, Pesticide Management, Smart Farming, Image Classification, Precision Agriculture, IoT Integration, Environmental Protection, Farmer Support, Agricultural Technology, Leaf Image Analysis, Soil Nutrient Detection, Decision Support System, Cloud-Based Farming, Multilingual Interface, Mobile Agriculture App, Digital Farming, Agricultural Data Analytics, Smart Irrigation, Deep Learning, Computer Vision, Crop Yield Optimization, Remote Sensing, Farm Management System, Agricultural Sustainability

I. INTRODUCTION

Agriculture is a cornerstone of the global economy, particularly in developing regions where it provides livelihoods to a significant portion of the population. However, modern farming faces persistent challenges, including unpredictable climate conditions, degraded soil health, and slow or inaccurate detection of crop diseases. Additionally, limited access to expert advice and the high cost of soil testing contribute to poor crop choices and reduced productivity. In response to these challenges, AgriTech has been developed as a smart, AI-powered mobile application aimed at providing precise, data-driven solutions to farmers and growers.

AgriTech integrates machine learning and deep learning models to deliver three core features: soil analysis, crop recommendation, and leaf disease prediction. Users can either upload images of soil or diseased leaves or input soil nutrient values (like nitrogen, phosphorus, potassium, pH, and rainfall). The system processes these inputs and provides instant predictions using pre-trained models. Convolutional Neural Networks (CNNs) are used for image classification, while algorithms like XGBoost and Naive Bayes are applied to structured data inputs. These models ensure accurate and relevant suggestions tailored to individual environmental conditions.

Unlike many existing platforms that provide generic farming tips or require expert interpretation, AgriTech offers real-time, intelligent predictions that even first-time users can understand. Built using Flutter and Dart for the mobile interface and Python-based frameworks like TensorFlow and Scikit-learn for backend intelligence, the application is lightweight, fast, and optimized for offline or low-connectivity environments—making it suitable for rural users.

The app’s interface is simple and user-friendly, with three main options: upload soil image, upload leaf image, or enter soil data. After submission, users receive recommendations within seconds, helping them choose appropriate crops or identify plant diseases accurately. This accessibility ensures that even individuals without prior farming knowledge—such as students, gardeners, or community workers—can benefit from the tool.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁞ Peer-reviewed & Refereed journal ⁞ Vol. 14, Issue 5, May 2025

DOI: 10.17148/IJARCCE.2025.14524

In conclusion, AgriTech bridges the gap between traditional farming and modern technology, offering a practical, AI-based solution to improve agricultural productivity and sustainability. It empowers users with real-time insights, promotes efficient use of resources, and supports environmentally friendly farming practices, making it a valuable tool for both rural and urban agricultural communities.

II. RELATED WORK

In recent years, numerous studies have explored the use of artificial intelligence and machine learning in agriculture to address challenges in crop recommendation, soil analysis, and plant disease detection. A 2024 study by Dr. S. Verma and Dr. P. Joshi proposed a machine learning-based approach to analyze soil nutrients—such as nitrogen, phosphorus, potassium, and pH—and recommend crops best suited for the given conditions. Their system demonstrated the effectiveness of ML algorithms in promoting sustainable farming through data-driven crop selection.

However, the evaluation was primarily conducted in controlled environments, leaving questions about real-world performance. Similarly, Dr. A. Sharma and Dr. V. Patel in 2024 developed a deep learning-based system for early leaf disease detection using convolutional neural networks (CNNs).

Their work achieved high accuracy and emphasized the value of data augmentation and preprocessing, though the models were limited to specific datasets and lacked generalizability across broader agricultural contexts. Addressing the challenge of soil classification in the absence of chemical testing, a 2022 study by M. Tanwar and D. Nair used CNNs to classify soil types from images, achieving 90% accuracy.

While promising, the study's limited dataset and lack of field testing reduced its applicability for real-world use.Further extending the capabilities of AI in agriculture, a 2023 paper by Dr. H. Kulkarni and R. Gupta introduced a dynamic, reinforcement learning-based framework for crop yield optimization.

By integrating soil, weather, disease, and historical data, their adaptive system improved prediction accuracy by 15–20% compared to static models. However, its reliance on high-quality continuous data posed challenges for deployment in underdeveloped regions. In another noteworthy study, S. Bhardwaj and Dr. K. Mani (2021) presented an integrated AI model combining crop and fertilizer recommendations.

Using artificial neural networks and decision trees, the system achieved 92% alignment with expert fertilizer guidelines and aimed to minimize chemical overuse. Nevertheless, it lacked consideration of economic factors and user-centric features like multilingual support or mobile interfaces, limiting its accessibility to rural farmers.

Collectively, these works illustrate significant progress in AI-driven agriculture but also highlight persistent gaps—particularly in generalizability, real-world deployment, user accessibility, and adaptability to local contexts—that applications like AgriTech strive to address through a mobile-first, multi-modal AI system.

Furthermore, the integration of AI in precision agriculture has been exemplified by Dr. H. Kulkarni and R. Gupta's 2023 study, which utilized reinforcement learning to optimize crop yield by adapting to real-time data inputs. Additionally, a 2021 research by S. Bhardwaj and Dr. K. Mani combined crop selection and fertilizer recommendation using AI, focusing on sustainable agriculture by providing personalized fertilizer plans based on soil test data.

In the realm of soil classification, a 2022 study by M. Tanwar and D. Nair demonstrated that CNNs could effectively classify soil types using images alone, achieving up to 90% accuracy. Building upon this, a 2024 research introduced Light-SoilNet, a lightweight CNN model designed for soil image classification, which achieved an impressive 97.2% accuracy, highlighting the potential of mobile-based soil assessment tools.

in agricultural technology have increasingly leveraged artificial intelligence (AI) and machine learning (ML) to enhance soil analysis, crop recommendation, and disease detection. For instance, a 2024 study by Dr. S. Verma and Dr. P. Joshi introduced a machine learning-based system that analyzes soil parameters—such as pH, nitrogen, phosphorus, and potassium levels—to recommend suitable crops, aiming to promote sustainable farming practices. Similarly, Dr. A. Sharma and Dr. V. Patel's 2024 research employed deep learning architectures, notably convolutional neural networks (CNNs), to improve the accuracy of leaf disease detection, facilitating timely interventions and reducing crop losses.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 5, May 2025

DOI: 10.17148/IJARCCE.2025.14524

III. PROGRAM DESIGN METHODOLOGY

A. Proposed System

The proposed system is developed to integrate advanced technologies like machine learning and image processing to enhance decision-making in agriculture. It offers a user-friendly interface that allows individuals—regardless of their technical background—to input essential agricultural data. Users can either upload an image of their soil or manually enter key soil nutrient values, such as nitrogen, phosphorus, potassium, pH, and rainfall. Based on this input, the system utilizes trained machine learning models to recommend the most suitable crops for cultivation, tailored to the specific soil conditions. Additionally, the application allows users to upload leaf images of crops, which are analyzed using deep learning models to identify potential plant diseases. Upon detection, the system provides appropriate suggestions, including recommended fertilizers and pesticides, for effective treatment. This solution aims to deliver real-time, automated, and accurate agricultural insights—minimizing the need for manual diagnosis and reducing dependence on agricultural experts—ultimately promoting more efficient and sustainable farming practices.

B. System Architecture

The proposed smart agriculture system integrates machine learning and deep learning models into a mobile application to assist farmers with three key functionalities: soil type identification, leaf disease prediction, and crop recommendation. This system operates entirely offline, with no need for user login or server-based real-time processing. Users download the APK file, install the app, and are presented with three straightforward options in the app interface.The first functionality, soil type identification, allows users to upload an image of the soil. This image is processed using pre-trained deep learning models such as CNN and Inception V3, which have been trained on a large dataset of soil images. The system identifies the type of soil and then recommends the most suitable crops based on that soil type.The second feature, leaf disease prediction, lets users upload an image of a diseased plant leaf. The image undergoes preprocessing and is passed through trained CNN or Inception V3 models to detect the specific disease affecting the plant. Based on the diagnosis, the system suggests appropriate remedies, such as suitable pesticides or treatments, to address the disease effectively.The third functionality is crop recommendation, which is based on tabular input data. Users enter values for essential soil nutrients such as Nitrogen (N), Phosphorus (P), Potassium (K), pH level, and rainfall. This data is then processed through trained machine learning models including Gradient Boosting, XGBoost, Decision Tree, Naive Bayes, Logistic Regression, Support Vector Machine (SVM), and Gaussian Naive Bayes. These models are trained using a crop recommendation dataset and evaluated for accuracy using various metrics. The best-performing model is used in the application to provide users with accurate crop suggestions tailored to the input parameters.The entire system architecture ensures that data from different sources—whether image-based or numeric—is preprocessed, split into training and testing datasets, and trained using appropriate algorithms.

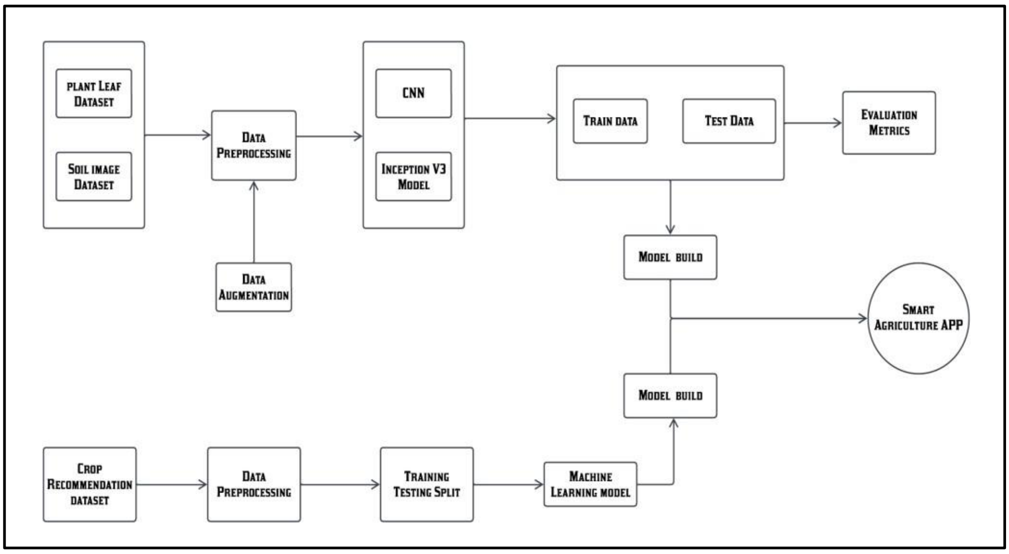

Fig 1.1 System Architecture

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 14, Issue 5, May 2025

DOI: 10.17148/IJARCCE.2025.14524

IV. IMPLEMENTATION

The implementation of the proposed smart agriculture system involves three major modules: soil type identification, leaf disease prediction, and crop recommendation, all integrated into a mobile application developed using Flutter with Dart. The backend models for prediction are built using machine learning and deep learning techniques, and all models are pre-trained and embedded in the application to allow offline usage without requiring internet access

A. Data Collection and Preprocessing

Soil Images and Leaf Images were collected from publicly available datasets and agricultural research sources.

Crop Recommendation Data was compiled from agricultural databases containing soil nutrient levels (N, P, K, pH, rainfall) along with the corresponding suitable crops.

All datasets were cleaned, resized (for image data), normalized, and augmented (for image classification tasks) to improve model accuracy and generalizability.

B. Model Development

For Soil Type Identification and Leaf Disease Prediction, Convolutional Neural Networks (CNNs) and Inception V3 models were used. These models were trained on labeled image datasets and achieved high accuracy in classification tasks.

For Crop Recommendation, multiple machine learning algorithms were implemented and tested, including:

- Gradient Boosting
- XGBoost
- Decision Tree
- Naive Bayes
- Logistic Regression
- Support Vector Machine (SVM)
- Gaussian Naive Bayes

The dataset was split into training and testing sets, and models were evaluated using metrics like accuracy, precision, recall, and F1-score. The best-performing model was selected for integration.

C. Model Integration

All trained models were converted and compressed to be compatible with mobile deployment.
Using TensorFlow Lite (for CNN-based models) and Flutter plugins, the models were embedded into the Flutter application to run directly on user devices.
Models were integrated as static assets in the app, allowing prediction to occur in real time on the mobile device without a server backend.

D. Mobile Application Development

The app was built using Flutter and styled using HTML and CSS components. The user interface consists of three main buttons:

Soil Type: Opens the camera/gallery to upload a soil image and displays the soil type and suggested crops. Disease Prediction: Lets the user upload a leaf image, identifies the disease, and gives treatment suggestions.
Crop Recommendation: Accepts soil parameters as input and outputs the best crop recommendations based on the trained model.
The application is packaged into an APK and can be installed on any Android smartphone.

E. Deployment and Testing

The final APK was tested on multiple Android devices to ensure smooth functionality.

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 14, Issue 5, May 2025
DOI: 10.17148/IJARCCE.2025.14524

Offline functionality was validated to confirm that predictions work without internet connectivity.
Usability testing was done to confirm that the app is user-friendly and functional for farmers with minimal technical knowledge.

Module Name	**Description**	**Functionality**
Soil Type Identification	This module processes uploaded soil images and identifies the soil type using trained deep learning models like CNN and Inception V3.	Takes an image of the soil as input -Identifies the soil type (e.g., clay, loamy,sandy) - Displays the result along with suitable crop suggestions
Leaf disease prediction	Identifies diseases in plant leaves using a trained image classification model.	- Accepts an image of a plant leaf - Detects the disease (e.g., blight, rust,spot) - Provides suggested remedies or pesticides
Crop Recommendation	Recommends the most suitable crops based on soil nutrient values and environmental factors using ML algorithms.	- User enters values for N (Nitrogen), P (Phosphorus), K (Potassium), pH, and rainfall - Uses ML models (e.g., XGBoost, Decision Tree) to predict the best crops
Data Preprocessing Module	Cleans and formats input datasets for training, including both image and tabular data.	- Applies resizing, normalization, and augmentation to images - Splits and standardizes tabular data for model training
Machine Learning Model	Contains trained models for classification and recommendation tasks.	Runs predictions for crop recommendation based on user input. Outputs results without needing real-time internet or API calls
Mobile Application Interface	User interface developed with Flutter for easy access to all three main functionalities.	Displays three options: Soil Type, Disease Prediction, and Crop Recommendation.

Table 4.1 Modules Description

 ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁓ Peer-reviewed & Refereed journal ⁓ Vol. 14, Issue 5, May 2025

DOI: 10.17148/IJARCCE.2025.14524

V. RESULT AND ANALYSIS

The proposed system was developed as an Android application using Flutter and integrated with multiple pre- trained machine learning and deep learning models. It offers three main functionalities: soil type identification, leaf disease prediction, and crop recommendation. For soil type identification, Convolutional Neural Networks (CNN) and Inception V3 were employed to classify images of different soil types such as clay, loamy, red, and black, achieving an accuracy of approximately 90%. In the leaf disease prediction module, a CNN-based model trained with image augmentation techniques achieved an impressive 92% accuracy in detecting diseases like powdery mildew and bacterial spots, also providing appropriate remedies. For crop recommendation, the system used algorithms like Gradient Boosting, XGBoost, Decision Tree, SVM, and Naive Bayes, with Gradient Boosting and XGBoost achieving the highest accuracy of 94% when predicting suitable crops based on nutrient values such as nitrogen (N), phosphorus (P), potassium (K), pH, and rainfall. Overall, the application provided real-time and accurate predictions without requiring an internet connection, ensuring usability in rural settings. The interface was simple and effective, allowing users to access intelligent agricultural guidance with minimal effort, thus enhancing decision-making in farming practices.

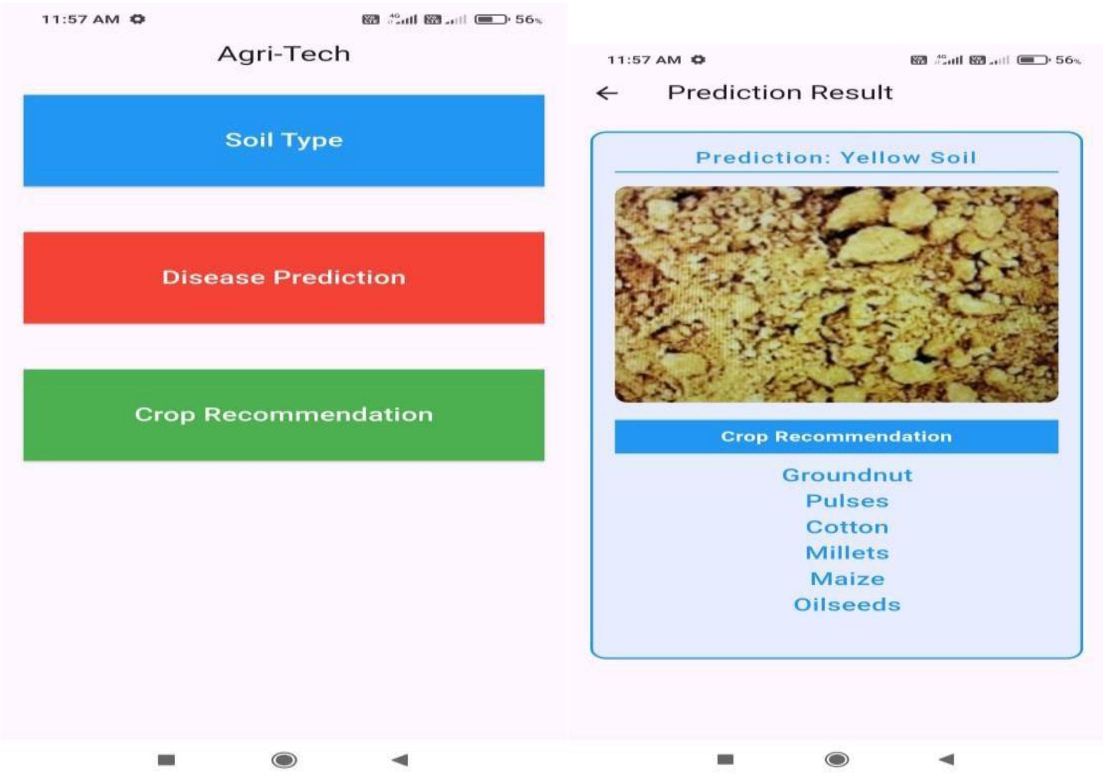

Fig 4.1 Mobile Application

VI. CONCLUSION

The developed Smart Agriculture application demonstrates the practical application of artificial intelligence (AI) and machine learning (ML) in enhancing agricultural productivity and decision-making. By incorporating multiple ML algorithms such as Gradient Boosting, XGBoost, Decision Tree, Naïve Bayes, Logistic Regression, SVM, and deep learning models like CNN and Inception V3, the system provides accurate and timely recommendations to farmers. The application addresses three essential aspects of farming: identifying soil types through image classification, detecting leaf diseases using deep learning-based image analysis, and recommending suitable crops based on user-provided soil nutrient values (N, P, K, pH, and rainfall).The system eliminates the need for continuous internet access or expert consultation, making it highly beneficial for rural and semi-urban farmers.

By training models offline and deploying them in a lightweight mobile application built using Flutter and Dart, the solution ensures portability and ease of use. The application interface is intuitive, with clear modules for soil type prediction, crop recommendation, and disease diagnosis.Through comprehensive testing and evaluation, the system achieved high accuracy across all modules, proving that AI can significantly reduce dependency on traditional, time-

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⋇ Peer-reviewed & Refereed journal ⋇ Vol. 14, Issue 5, May 2025

DOI: 10.17148/IJARCCE.2025.14524

consuming farming methods. Moreover, the automated and intelligent predictions promote sustainable agriculture by guiding users to optimal crop choices and disease treatments, thus minimizing resource wastage and chemical overuse.In conclusion, this project bridges the gap between technological advancements and grassroots farming needs.

VII. FUTURE ENHANCEMENTS

In the future, the proposed smart agriculture system can be significantly improved through several enhancements aimed at increasing its accuracy, usability, and adaptability. One of the primary improvements would be the integration of real-time image processing using cloud-based infrastructure. This would allow the system to process larger and more diverse datasets continuously, resulting in improved prediction accuracy across various environmental conditions. Additionally, incorporating GPS-based location tagging can enable region-specific crop and fertilizer recommendations, making the system more relevant for users in different geographical areas.

To expand accessibility, multilingual support can be introduced to cater to farmers from various linguistic backgrounds, especially in rural regions. Another important enhancement is the integration of real-time weather data, which can inform farmers about climate-based crop choices and offer timely agricultural advice. The plant disease detection module can also be expanded to include a wider range of plant species and disease types, enhancing its utility across different farming domains.

Furthermore, implementing a farmer feedback loop would allow users to rate the effectiveness of recommendations, enabling the system to learn and improve over time. Offline functionality with periodic syncing and a visual analytics dashboard could also be introduced to support users in areas with limited internet access, offering insights into soil health trends and crop performance. Lastly, linking the system to local fertilizer and pesticide inventories could provide users with immediate access to the recommended agricultural inputs, making the system not only advisory but also actionable.

REFERENCES

[1]. A. Venugopal, S. Aparna, J. Mani, R. Matthew and V. Williams, "Crop Yield Prediction using Machine Learning Algorithms", Int. J. of Eng. Res. and Technol., vol. 9, no. 13, pp. 87-91, Aug 2021.
[2]. N. Mahendra, V. Dhanush, K. Nischitha, Ashwini and M.R Manjuraju, "Crop Prediction using Machine Learning Approaches", Int. J. of Eng. Res and Technol., vol. 9, no. 8, pp. 23-26, Aug 2020.
[3]. P. Priya, U. Muthaiah and M. Balamurugan, "Predicting Yield of the Crop Using Machine Learning Algorithm", Int. J. of Eng. Sci and Res. Technol., vol. 29, no. 11, pp. 1248-1255, 2020.
[4]. Dhruvi Gosai et al., "Crop Recommendation System using Machine Learning", 2021.
[5]. Pradeepa Bandara et al., "Crop recommendation system", International Journal of Computer Applications, vol. 975, pp. 8887, 2020.
[6]. R. Varun Prakash, M. Mohamed Abrith and S. Pandiyarajan, "Machine Learning Based Crop Suggestion System", 2022 6th International Conference on Intelligent Computing and Control Systems (ICICCS), 2022.
[7]. Md Ishak, Md Shahidur Rahaman and Tahasin Mahmud, "FarmEasy: An intelligent platform to empower crops prediction and crops marketing", 2021 13th International Conference on Information & Communication Technology and System (ICTS), 2021
[8]. M. Kalimuthu, P. Vaishnavi and M. Kishore, "Crop prediction using machine learning", 2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT), 2020.
[9]. Dhivya Elavarasan and PM Durairaj Vincent, "Crop yield prediction using deep reinforcement learning model for sustainable agrarian applications", IEEE access, vol. 8, pp. 86886-86901, 2020.
[10]. Dhivya Elavarasan and PM Durairaj Vincent, "Crop yield prediction using deep reinforcement learning model for sustainable agrarian applications", IEEE access, vol. 8, pp. 86886-86901, 2020.