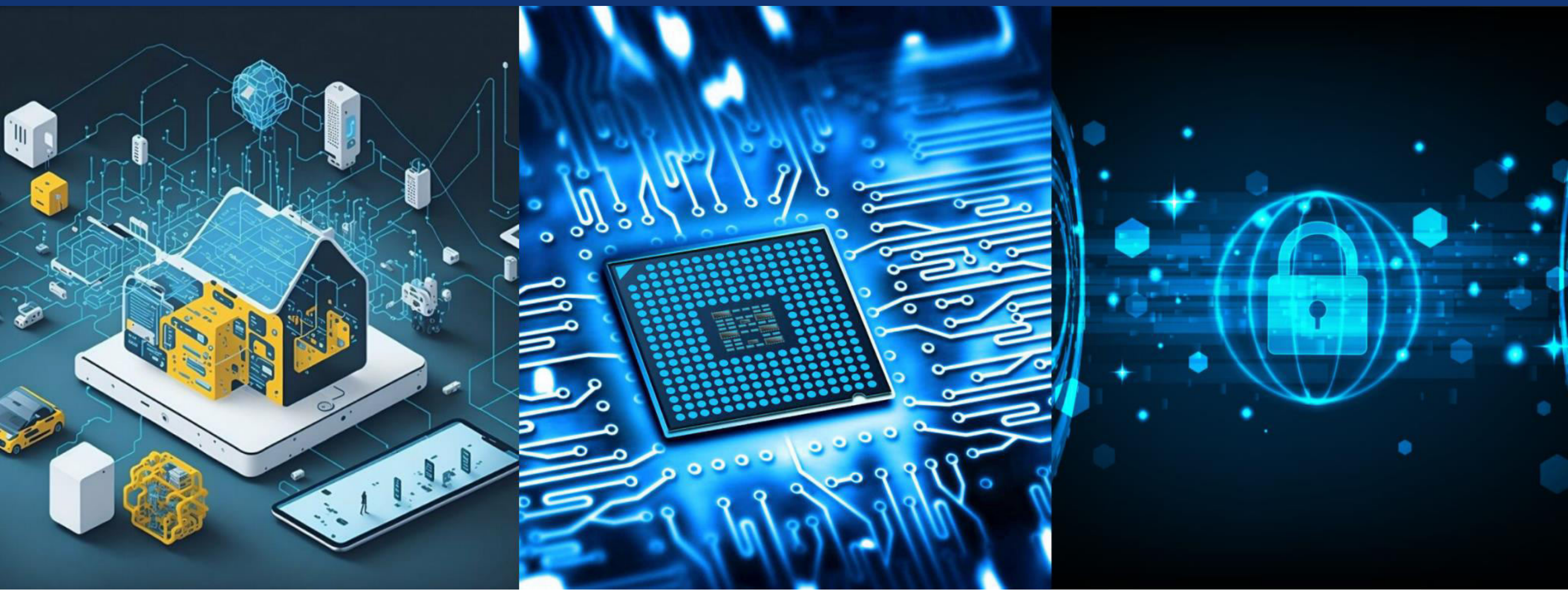
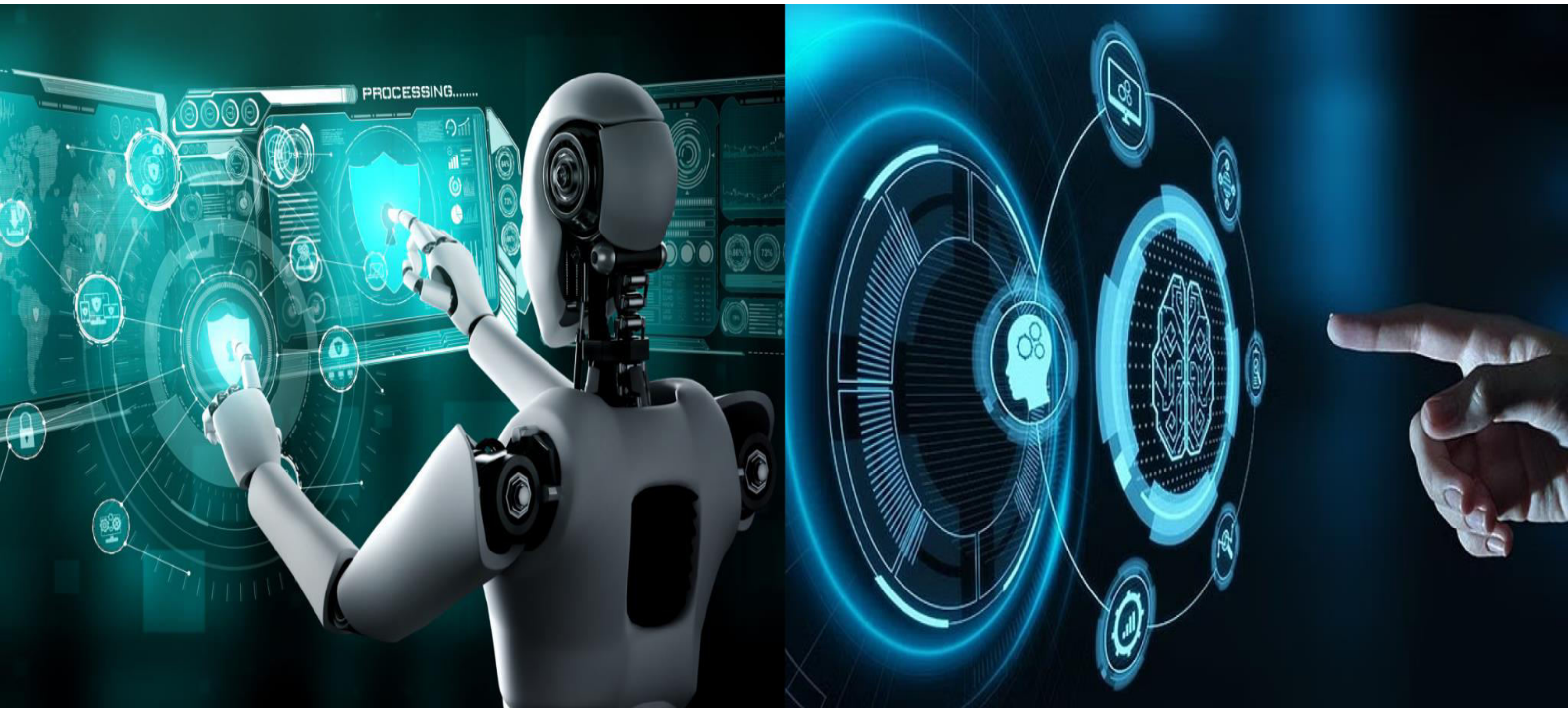
ISSN(O): 2320-9801
ISSN(P): 2320-9798



International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.625

Volume 13, Issue 1, January 2025

www.ijircce.com | ijircce@gmail.com | +91-9940572462 | +91 63819 07438

© 2025 IJIRCCE | Volume 13, Issue 1, January 2025| DOI: 10.15680/IJIRCCE.2025.1301048

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Integrated Crop Protection Management

Madhumita R Aradhya[1], Pranay Srinivas[2], Elluri Bhavya Sree[3],

Mr. Sheik Jamil Ahmed[4]

Final Year B. Tech Student, School of CSE, Presidency University, Bangalore, India[1],[2],[3]

Assistant Professor, School of CSE, Presidency University, Bangalore, India[4]

ABSTRACT: This study offers a comprehensive strategy to tackle the difficulties farmers encounter when choosing crops and forecasting production. Our suggested approach provides predictive insights into crop production results and tailored crop recommendations by utilizing machine learning techniques and extensive agricultural information. The system includes a crop recommendation algorithm that analyzes soil properties, farmer preferences, and environmental parameters using a neural network. A crop production prediction model also projects crop yields according to agronomic practices, rainfall, season, crop type, and soil quality. To maximize their agricultural operations, farmers can access decision-support tools and actionable insights via an easy-to-use interface. Our suggested system seeks to improve farming communities' economic prosperity, sustainability, and productivity by bridging the gap between data science and agriculture.

KEYWORDS: precision agriculture, agricultural sustainability, machine learning, artificial neural networks, crop recommendation, crop production prediction, and decision support system

The following are acronyms: Crop Recommendation System (CRS), Artificial Neural Networks (ANNs), Machine Learning (ML), and Crop Production Prediction Model (CPPM).

I. INTRODUCTION

Using cutting-edge technologies has become essential in modern agriculture to boost output, maximize resource use, and guarantee sustainable farming methods. Artificial neural networks (ANNs) and machine learning (ML) are two of these technologies that have shown great promise in tackling important issues in agriculture, especially in crop recommendation and production forecasting. Crop Recommendation System (CRS) and forecast crop yield based on a variety of criteria, this paper presents an extensive study that incorporates machine learning approaches.

Through the analysis of numerous soil and climate characteristics, such as pH, temperature, humidity, rainfall, phosphorus (P), potassium (K), nitrogen (N), and rainfall, the CRS seeks to help farmers make well-informed judgments about crop selection. The system optimizes agricultural production and resource efficiency by using machine learning (ML) methods, such as artificial neural networks (ANNs), to deliver customized crop suggestions suited to particular soil and meteorological circumstances.

Additionally, the study includes crop production forecasting, which is essential for maintaining food security and financial stability in rural areas. The method will recommend the ideal crop for a given plot of land based on weather and content parameters.

Additionally, by examining past crop yield data in conjunction with environmental factors, the predictive model provides information about potential future trends in agricultural productivity. This gives farmers, decision-makers, and other agricultural stakeholders the capacity to foresee and lessen possible difficulties, such as soil nutrient depletion and climate variability.

This research is important because it has the potential to transform farming processes and promote the shift to sustainable and data-driven farming practices. Farmers can enhance crop choices, reduce risks, and increase profitability while encouraging environmental stewardship by utilizing ML and ANNs. Additionally, proactive planning and resource allocation are made possible by the insights gained from crop production prediction, which enhances the resilience and prosperity of farming communities.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

All things considered, this study emphasizes how ML-driven methods are revolutionizing the agricultural industry and stresses the significance of using technology to solve the intricate problems the sector faces. We clear the path for a more resilient, fruitful, and sustainable future in agriculture by creating and deploying cutting-edge technologies like the CRS and crop production prediction models.

II. LITERATURE REVIEW

Maaz Patel and Anagha Rane. 2023. Crop Suggestion Framework [1]. By forecasting which crops are compatible with the elements that affect crop growth, such as soil nutrients, soil pH, humidity, and rainfall, their research aims to assist farmers in selecting the optimum crops for their circumstances and surroundings. They employ a variety of machine learning models, including Gaussian Naïve Bayes (GNB), Logistic Regression (LR), Support Vector Machine (SVM), and Decision Tree (DT).

Archontoulis Sotirios V., Khaki Saeed, and Wang Lizhi. A CNN-RNN Framework for Crop Yield Prediction [2].Using historical data, the proposed CNN-RNN model and other well-liked techniques like random forest (RF), deep fully connected neural networks (DFNN), and LASSO were used to forecast corn and soybean yield for the years 2016, 2017, and 2018 throughout the entire Corn Belt (including 13 states) in the United States.

Mahendra [3] (2020). Machine Learning Methods for Crop Prediction. Journal of Engineering Research International.To increase the dataset's richness and prediction capacity, numerous engineering techniques were applied in the project to extract new characteristics or modify preexisting ones. It offers details on the amount and composition of fertilizers and seeds needed for growing. Therefore, farmers can grow a new crop type, perhaps boost their profit margin, and prevent soil contamination by using the method.

Parvathi, R., and S. Bangaru (2021). A system that uses artificial neural networks to recommend crops. 3.rs-874525/v1 [4] 10.21203/rs.It facilitates the farmers' decision-making. A recommendation system is constructed based on three factors: the crop, the crop type, and the districts. A classification model is constructed by taking into account the agroclimatic parameters of a crop, such as temperature, relative humidity, soil type, soil pH, and crop duration. The new method of district prediction involves marking the crop patterns of Tamilnadu's 33 districts and creating a classification model based on those patterns.

"Supervised Machine learning Approach for Crop Yield Prediction in Agriculture Sector," presented by Y. J. N. Kumar, V.

Spandana, V. S. Vaishnavi, K. Neha, and V. G. R. R. Devi at the 5th International Conference on Communication and Electronics Systems (ICCES) in Coimbatore, India, 2020 [5].Random Forest is a machine learning method that can make these predictions. It will achieve the highest level of accuracy in the crop prediction.By taking into account the fewest number of models, the random forest method provides the optimal crop yield model. In the agricultural industry, forecasting crop yield is particularly helpful.

III. PROPOSED SYSTEM

The suggested system integrates cutting-edge machine learning techniques with extensive agricultural datasets to provide a fresh solution to farmers' problems with crop selection and production prediction.Based on a variety of environmental and agronomic criteria, the system seeks to give farmers precise and tailored crop selection suggestions as well as predictive insights into crop production outcomes.

© 2025 IJIRCCE | Volume 13, Issue 1, January 2025| DOI: 10.15680/IJIRCCE.2025.1301048

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

(A) Crop Recommendation System:

Feature	Description	Benefit
Pest and Disease Prediction	Predicts potential pest and disease outbreaks	Helps farmers take preventive actions to reduce crop losses
Crop Recommendation	Suggests suitable crops based on soil, climate, etc.	Maximizes yield and ensures resource optimization
Fertilizer Prediction	Recommends optimal fertilizer usage based on soil and crop type	Ensures efficient fertilizer use and improves crop productivity
Warehouse Locator	Identifies nearest storage facilities	Reduces post-harvest losses and improves supply chain efficiency

Fig 1. Table for System Features and Benefits

A dataset that includes a broad range of agricultural information, such as weather, soil properties, historical yield data, crop kinds, and farmer preferences, is used by the crop recommendation system.
The system evaluates the dataset using machine learning methods, specifically the Random Forest model, to produce recommendations for farmers that are relevant to their needs, the environment, and historical performance.
The method seeks to help farmers make well-informed decisions to optimize yields and profitability by taking into account variables including crop compatibility, climate adaptability, and soil fertility.

(B) Crop Production Prediction Model:
A crop production prediction model built within the system predicts the anticipated yield for a few chosen crops based on input variables like soil quality, weather trends, and agronomic techniques.
The technology offers insights into future crop performance by combining historical yield data with predictive modeling approaches. This helps farmers foresee possible obstacles and
allocate resources as efficiently as possible.
The system's data-driven methodology enables farmers to oversee their farming operations, reduce crop failure risks, and improve overall sustainability and productivity.

(C) User Interface and Accessibility:
The suggested system has an easy-to-use interface that farmers with different degrees of technological proficiency can employ.
Farmers may easily receive crop suggestions, productivity forecasts, and useful information at any time and from any location by interacting with the system online.
The tips and decision-support features offered by the user interface help farmers make better decisions and have a better overall experience.

© 2025 IJIRCCE | Volume 13, Issue 1, January 2025| DOI: 10.15680/IJIRCCE.2025.1301048

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

IV. METHODOLOGY

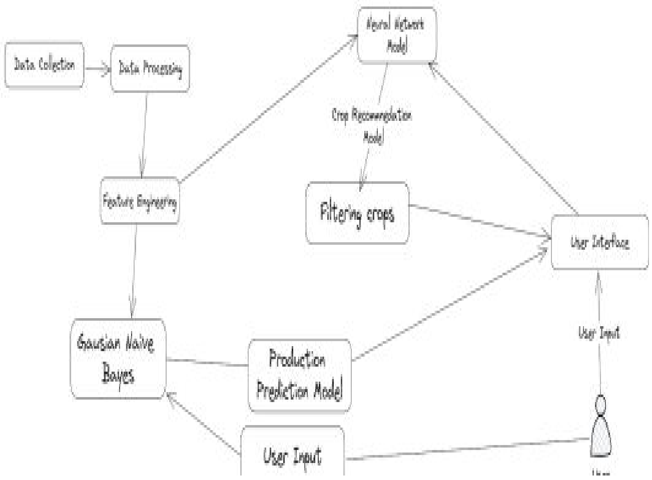


Fig 2. Block Diagram of methodology

In order to create two interrelated components—a crop recommendation system and a crop production forecast model—this research project takes a comprehensive approach. While concentrating on a shared collection of 20 crops, each component makes use of distinct datasets. Below is an outline of the process for both components:

(A) **Crop Recommendation System: Dataset Selection and Preprocessing:**A dataset tailored to crop recommendations was gathered for the crop recommendation system. The model's performance and efficacy in predicting crop production were evaluated using this dataset's accuracy, precision, recall, and F1-score.
Model Selection and Implementation: Because neural networks can capture intricate correlations in the data, they were chosen as the main model architecture for the crop recommendation system.To improve the model's capacity for generalization and prediction accuracy, extensive parameter tuning and optimization were carried out.
Training and Validation: To train and assess the model, the dataset was divided into training, validation, and test sets. Cross-validation methods were used to accurately evaluate model performance and avoid overfitting. A different test dataset was used to validate the trained model, guaranteeing its resilience and dependability.
Integration: With an emphasis on the common set of 20 crops, the crop recommendation system offers farmers tailored recommendations depending on variables like soil quality and weather patterns.

(B) **Crop Production Prediction Model: Preprocessing and Dataset Selection:** A distinct dataset tailored to crop production prediction was gathered for the crop production prediction model.
This dataset includes pertinent data about the variables affecting agricultural yield. To guarantee data cleanliness and machine learning algorithm compatibility, preprocessing approaches were used.
Model Selection and Implementation: Because of its strong performance across a variety of datasets, the Gaussian Naive Bayes model was selected as the main model for crop production prediction.
To improve the model's forecast accuracy, extensive parameter adjustment and optimization were carried out, much like with the crop recommendation system.
Validation and Training: The dataset was divided and put through training and validation processes to avoid overfitting and maximize model performance.
Integration: Using the common set of 20 crops as its focus, the crop production prediction model sought to anticipate crop yields based on variables like soil quality, weather trends, and historical data.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

V. RESULTS

Crop Recommendation System:

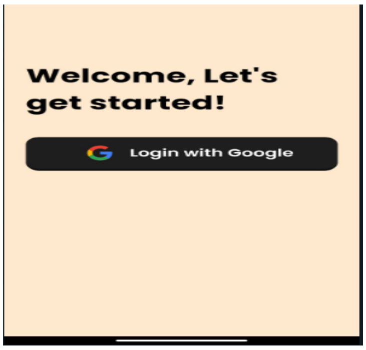


Figure 3: Login Page

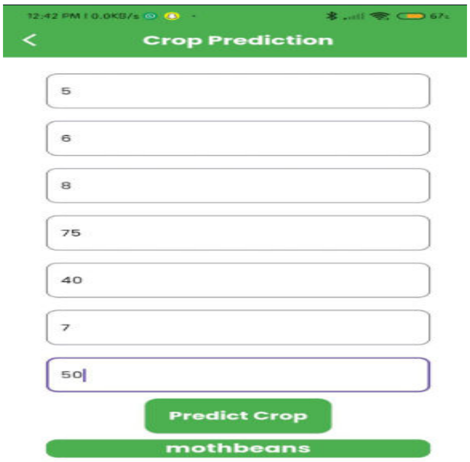


Figure 3. Crop Prediction

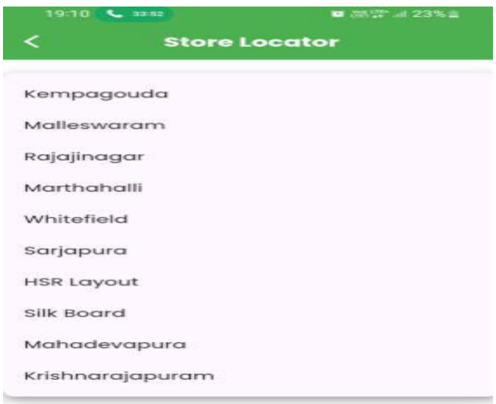


Figure 4. Store Locator

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Figure 5. Pest Disease Detection

Figure 6. Fertilizer Prediction

VI. CONCLUSIONS

In conclusion, our research presents a comprehensive framework for enhancing agricultural practices through advanced machine learning techniques. We have shown the ability to maximize crop choices and boost yields by combining neural network-based crop recommendation and production prediction models. The use of a variety of datasets, careful preprocessing, and exacting model validation highlight how reliable our methodology is.Additionally, the smooth incorporation of crop production prediction improves our system's usefulness and efficiency. To meet changing agricultural difficulties and guarantee the long-term viability of farming methods, constant improvement and adaptation will be necessary as we forward. Our work is to provide farmers with practical insights, ultimately promoting agricultural profitability and global food security.

VII. FUTURE WORK

We intend to improve our system in a number of ways for upcoming projects. First, in order to facilitate more thorough decision-making, we want to enhance the system with characteristics beyond environmental considerations.
Including an automated answer for feedback. This would allow for real-time, farmer-specific adjustments to water levels, humidity, and other parameters.
In addition, we intend to grow our dataset library by moving from official datasets with restrictions to large, detailed datasets. This change will increase our understanding and make our suggestions more accurate.

We also hope to incorporate a multilingual chatbot interface, providing farmers with an easy-to-use platform for in-depth conversations. By enabling smooth communication and enabling farmers to submit inputs and receive outputs in the language of their choice, this chatbot will improve usability and accessibility. These upcoming advancements hold the potential to considerably improve our agricultural recommendation system's usefulness and efficacy, empowering farmers and promoting sustainable farming methods.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

REFERENCES

[1] Patel, Maaz & Rane, Anagha. (2023). Crop Recommendation System.
[2] Khaki Saeed , Wang Lizhi , Archontoulis Sotirios V. A CNN-RNN Framework for Crop Yield Prediction.
[3]N, Mahendra. (2020). Crop Prediction using Machine Learning Approaches. International Journal of Engineering Research and V9. 10.17577/IJERTV9IS080029.
[4] S, Bangaru & Parvathi, R.. (2021). Crop Recommendation System by Artificial Neural Network. 10.21203/rs.3.rs-874525/v1.
[5] Y. J. N. Kumar, V. Spandana, V. S. Vaishnavi, K. Neha and V. G. R. R. Devi, "Supervised Machine learning Approach for Crop Yield Prediction in Agriculture Sector," 2020 5th International Conference on Communication and Electronics Systems (ICCES), Coimbatore, India, 2020.
[6] Dr.G.Suresh, Dr.A.Senthil Kumar, Dr.S.Lekashri, Dr.R.Manikandan, "Efficient Crop Yield Recommendation System Using Machine Learning For Digital Farming", IJMA, vol. 10, no. 1, pp. 906 - 914, Mar. 2021.
[7] Dataset for Recommendation System:- https://www.kaggle.com/datasets/atharvaingle/crop-rec ommendation-dataset.
[8] Database for Crop Production Prediction:- https://www.kaggle.com/datasets/atharvaingle/crop-rec ommendation-dataset.
[9] Agri-Tech and AI in Agriculture A. Smith, B. Thomas, and C. Lee, *"Artificial Intelligence in Agriculture: Applications and Future Directions,"* Journal of Agricultural Technology, vol. 12, no. 3, pp. 25-45, 2023.
[10] Machine Learning Frameworks TensorFlow, *TensorFlow Documentation*, 2023. [Online] Available: https://www.tensorflow.org Keras, *Keras Documentation*, 2023. [Online] Available: https://keras.io
[11] Weather Prediction Models B. Patel, P. Sharma, and S. Gupta, *"Predicting Monsoon Patterns Using Historical Data," International Journal of Meteorology*, vol. 45, no. 2, pp. 58-70, 2022.
[12] Crop Recommendation Systems R. Kumar, J. Agarwal, and M. Verma, *"A Review of Crop Recommendation Systems: Techniques and Models," Journal of Agricultural Informatics*, vol. 18, no. 4, pp. 101-112, 2021.
[13] Pest and Disease Prediction A. Singh, P. Kumar, and M. Raj, *"Deep Learning Techniques for Pest and Disease Prediction in Crops," Computational Biology in Agriculture*, vol. 13, no. 6, pp. 150-164, 2023.
[14]AI in Precision Agriculture D. R. Anderson, S. Harris, and K. White, *"Precision Agriculture and the Role of Artificial Intelligence," International Journal of AI and Agriculture*, vol. 9, pp. 88-99, 2022.
[15] Mobile App Development Frameworks React Native, *React Native Documentation*, 2023. [Online] Available: https://reactnative.dev Flask, *Flask Documentation*, 2023. [Online] Available: https://flask.palletsprojects.com Django, *Django Documentation*, 2023. [Online] Available: https://www.djangoproject.com
[16] Geolocation and Mapping Services Google Maps API, *Google Maps API Documentation*, 2023. [Online] Available: https://developers.google.com/maps
[17] Sustainable Agriculture United Nations, *"Sustainable Development Goals (SDGs),"* 2023. [Online] Available: https://www.un.org/sustainabledevelopment P. Rao, *"Sustainability in Agriculture and its Future," Agricultural Sustainability Journal*, vol. 12, pp. 210-220, 2022.
[18] Agricultural Extension Services A. Sharma, *"The Role of Technology in Agricultural Extension," Journal of Extension Education*, vol. 30, no. 2, pp. 100-110, 2021.
[19]https://www.kaggle.com/datasets/vbookshelf/rice-leaf-diseases/data
[20] S. Patra, "A Review on Impact of Mobile Apps in Agriculture," University of Burdwan, Dec. 2023.
[21] H. P. Patel and D. Patel, "Survey of Android Apps for Agriculture Sector," *International Journal of Information Sciences and Techniques*, vol. 6, no. 1/2, pp. 61–67, Mar. 2016, doi: 10.5121/ijist.2016.6207.
[22] G. B. Adesiji, J. Y. Adelowo, S. E. Komolafe, and T. T. Adesiji, "Farmers' perceived rating and usability attributes of agricultural mobile phone apps," *Smart Agricultural Technology*, vol. 8, p. 100501, Aug. 2024. doi: 10.1016/j.atech.2024.100501.
[23] R. N. Athirah, C. Y. N. Norasma, and M. R. Ismail, "Development of an Android Application for Smart Farming in Crop Management," in *IOP Conference Series: Earth and Environmental Science*, vol. 540, 10th IGRSM International Conference and Exhibition on Geospatial & Remote Sensing, Kuala Lumpur, Malaysia, Oct. 2020, p. 012074. doi: 10.1088/1755-1315/540/1/012074.
[24] N. Mittal and A. Kumar, "App Based Implementation of Modern Agriculture Utilities for Farmers," presented at [Conference Name or Published Source, if available], published by IEEE. [Year of publication].
[25] Mittal, S., Gandhi, S., & Tripathi, G. (2010) ―Socio-economic impact of mobile phones on Indian agriculture‖, New Delhi: Indian Council for Research on International Economic Relations, (p. 53).

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.625| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

[26] Santosh Reddy, Abhijeet Pawar, Sumit Rasane, Suraj Kadam (2015) ―A Survey on Crop Disease Detection and Prevention using Android Application‖, International Journal of Innovative Science, Engineering & Technology, Vol. 2, Issue 4

[27] Rachana P. Koli1 , V. D. Jadhav2 (2015), ― Agriculture Decision Support System As Android Application‖, International Journal of Science and Research, Vol. 4 Issue 4

[28] Mr. Vimal B. Patel, Dr. Rahul G. Thakkar, Mr. Hardikkumar V. Desai (2014) ‖An Android Application for Farmers for Kharif and Rabi Crop Diseases Information‖, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 10.

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

Scan to save the contact details

www.ijircce.com