Journal Publication of International Research for Engineering and Management (JOIREM)
Volume: 04 Issue: 11 | Nov-2026
ISSN (O) 3107-6696

AI-Based Intelligent Crop Selection Using Market and Environmental Analysis

D Sivakumar
dept. of Information Science and Engineering Rajarajeshwari college of engineering Bengaluru, India
dinrrce@gmail.com

Manushree M S
dept. of Information Science and Engineering Rajarajeshwari college of engineering Bengaluru, India
msmanushree1104@gmail.com

Pavithra S
dept. of Information Science and Engineering Rajarajeshwari college of engineering Bengaluru, India
pavithrasatish2104@gmail.com

Vinuthashree G
dept. of Information Science and Engineering Rajarajeshwari college of engineering Bengaluru, India
vinuthashreegvinu02@gmail.com

Yamuna Y N
dept. of Information Science and Engineering Rajarajeshwari college of engineering Bengaluru, India
yamunayn123@gmail.com

Abstract - Agriculture is essential in economic growth and food availability, particularly in India, where a significant percentage of the population depends on farming for their livelihoods. However, agricultural communities encounter various difficulties, such as climate variability, irregular rainfall, soil degradation, water scarcity, and fluctuating market prices. Traditional crop selection methods often depend on traditional knowledge and traditional farming methods, which may may not sufficiently consider variations in environmental factors and market demands. To overcome these limitations, this study introduces an Artificial Intelligence (AI)-based intelligent crop selection system that combines environmental parameters and economic and market indicators to improve farming decisions.

The developed framework examines important environmental variables, including soil nutrient content, temperature, humidity, rainfall, and soil pH, together with financial indicators such as market demand for crops, market price, and expected economic returns. ML-based predictive techniques, including Random Forest, Extreme Gradient Boosting (XGBoost), Support Vector Machine (SVM), and Artificial Neural Networks (ANN), are developed and assessed for crop prediction and recommendation. The system is designed to determine appropriate crop varieties by considering environmental compatibility and economic potential, providing farmers with recommendations based on analytical data rather than relying solely on conventional crop selection techniques. The experimental evaluation compares the predictive performance of the implemented models and identifies an appropriate model for crop recommendation. By integrating environmental suitability with market analysis, the proposed approach seeks to improve crop selection, optimize agricultural resource use, reduce cultivation risks, and improve farmers' financial returns for farmers. The system can also be extended through Internet of Things (IoT) technologies and cloud computing to enable real-time environmental monitoring and scalable agricultural applications. This approach contributes to precision agriculture by combining machine learning-based prediction with environmental and economic analysis to promote sustainable farming practices and informed agricultural decision-making.

I. INTRODUCTION

Agriculture is crucial to the Indian economy, supplying food, raw materials, and job opportunities to a large segment of the population. It is a key sector that sustains rural livelihoods and aids in the nation's economic growth. Nonetheless, various factors such as climate change, unpredictable rainfall, soil erosion, water shortages, shifting weather patterns, and market price volatility affect agricultural productivity. Farmers frequently encounter challenges in choosing the right crops, as traditional methods of crop selection rely heavily on personal experience, historical practices, and seasonal expectations rather than thorough data analysis. Choosing unsuitable crops can lead to decreased productivity, inefficient use of resources, and financial setbacks. The project titled "AI-Based Intelligent Crop Selection Using Market and Environmental Analysis" seeks to create a smart decision-support system that suggests appropriate crops by evaluating environmental conditions alongside market

factors. This system examines key soil characteristics like nitrogen, phosphorus, potassium, and soil pH, in addition to climate variables such as temperature, humidity, and rainfall. Furthermore, it incorporates market data, including crop demand, current market prices, and projected profitability, to facilitate economically sound crop selection. Computational learning techniques, including Random Forest, Extreme Gradient Boosting (XGBoost), Support Vector Machine (SVM), and Artificial Neural Networks (ANN), are applicable for examining the gathered data to forecast appropriate crops. These models can be assessed through relevant performance metrics to evaluate their predictive abilities and determine the most suitable predictive model for crop selection. The system seeks to offer recommendations that integrate both crop suitability and potential economic returns by merging environmental analysis outcomes with economic considerations.

The developed approach also aids in the effective use of agricultural resources by guiding farmers in choosing crops based on soil characteristics, climate compatibility, and market prospects. This strategy can lessen the uncertainty involved in crop selection, decrease the probability of poor cultivation choices, and while encouraging environmentally friendly farming methods. Additionally, the framework can be further improved with IoT-based technologies sensors and cloud computing technologies to facilitate real-time environmental monitoring, ongoing data collection, and better access to agricultural information. The project highlights the potential benefits of merging artificial intelligence, machine learning, and market analysis to enhance decision-making in agriculture. By integrating environmental suitability with economic factors into a single framework, the system seeks to advance precision agriculture, improve resource management, and support the digital transformation of the agricultural industry.

II. LITERATURE REVIEW

AI-based computational methods and data-driven learning techniques are increasingly useful approaches for improving the decision process within the agricultural sector. Researchers have developed frameworks for suggesting suitable crop varieties and predicting farming-related results market patterns soil characteristics, weather patterns, past crop performance, and market trends. Despite this, environmental suitability and economic viability are frequently considered distinct

prediction challenges. This review explores pertinent research and highlights the gap that the proposed system aims to fill.

A. Crop Prediction Through Learning Models

In [1], researchers explored the application of ML techniques to suggest suitable field and garden crops in India, considering soil nutrients and climate factors. The research evaluated multiple predictive models, including Support Vector Machine (SVM), Extreme Gradient Boosting (XGBoost), Random Forest, K-Nearest Neighbors (KNN), and Decision Tree. The The input features considered were nitrogen, phosphorus, potassium, soil pH, temperature, rainfall, and humidity. The results indicated that XGBoost , and analyzing agricultural and horticultural crop categories separately primarily focused on. Nonetheless, the research mainly concentrated on crop suitability considering soil properties and climatic factors, while excluding crop demand and financial returns into optimization of crop selection.

B. Crop Recommendation Using Deep Learning Madhuri et al. [2] introduced an Enhanced Deep Belief Network (IDBN) for recommending crops through a multimodal strategy. Their system integrated specific agricultural characteristics and utilized Gaussian Restricted Boltzmann Machines along with the Ranger Optimizer to enhance the learning process. The authors indicated that the IDBN they proposed surpassed traditional Deep Belief Networks in their assessments. This research highlights the capability of deep learning to model the interactions between agricultural variables. Additionally, a comprehensive decision-making framework that simultaneously considers environmental suitability and market profitability.

C. Energy-Efficient AI for Sustainable Agriculture Elbasi et al. [3] introduced a Green AI framework tailored for smart agriculture, focusing on predictive models that conserve energy and promote sustainable resource management. The research explored the use of lightweight algorithms, model compression, federated learning, edge computing, and clean-energy approaches to minimize the computational and environmental impacts of AI systems in agriculture. Additionally, it pinpointed opportunities for incorporating technologies like the Internet of Things (IoT) and explainable AI.

D. Machine Learning for Agricultural Price Forecasting Nayak et al. [4] investigated deep-learning approaches for forecasting the prices of tomato, onion, and potato in Indian markets. Their study incorporated weather variables, including precipitation and temperature, alongside historical price information. The authors evaluated models such as N-BEATSx and Transformer-based forecasting approaches and compared their performance with statistical and conventional machine-learning methods. Their findings highlighted the potential benefits of incorporating external environmental variables into agricultural price forecasting. However, forecasting the price of a crop does not, by itself, determine whether that crop is suitable for cultivation under the soil, climate, and water conditions of a particular region.

E. Research Gap and Motivation

Journal Publication of International Research for Engineering and Management (JOIREM)
Volume: 04 Issue: 11 | Nov-2026
ISSN (O) 3107-6696

The studies reviewed highlight considerable advancements in areas such as environmental crop recommendation, agricultural prediction using deep learning, sustainable AI, and forecasting agricultural commodity prices. Despite these developments, each approach tends to focus on separate facets of agricultural decision-making, suggesting a need for their integration into a comprehensive crop-selection framework.

To bridge this gap, the proposed system, named AI-Based Intelligent Crop Selection Using Market and Environmental Analysis, seeks to merge environmental factors like soil nutrients (N, P, K), soil pH, temperature, humidity, rainfall, and water availability with market data, including crop prices, demand, and historical price trends. The aim is to use machine-learning techniques to pinpoint crops that not only meet environmental conditions but also offer favorable economic prospects. In contrast to systems that suggest crops based only on soil and climate factors, the proposed method seeks to include economic factors in the recommendation process. This approach is designing an aid in makes more informed decision about crop selection, enhancing the use of resources, and assist farmers in evaluating potential financial risks. To validate the effective of the proposed system, it is necessary to conduct experimental evaluations using appropriate datasets, compare with baseline models, and employ well-defined performance metrics.

III. METHODOLOGY

The system, titled AI-Based Intelligent Crop Selection Using Market and Environmental Analysis, employs machine learning to suggest appropriate crops by evaluating soil characteristics, weather conditions, water resources, and market trends. The approach involves gathering agricultural data, preprocessing this data, training models, predicting environmental suitability, analyzing market conditions, ranking crops, and generating recommendations, as shown in the Fig . 1.

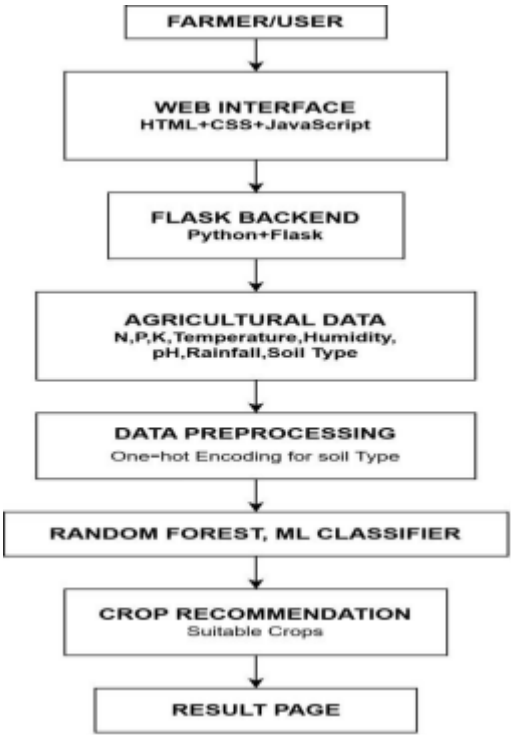


Fig .1. Block Diagram of the AI-Based Intelligent Crop Selection Using Market and Environmental Analysis

A. Data Collection

Initially, agricultural and market data are collected from appropriate datasets and trustworthy sources. The environmental dataset encompasses soil nutrients like Nitrogen (N), Phosphorus (P), and Potassium (K), along with soil pH, Temperature, Humidity, and Rainfall. Additional input parameters may include soil types and water availability. Market related data includes crop prices, market demand and past price trends. These data help to identify crops with greater economic potential. The received data is organized in the dataset for further analysis and processing.

B. Preprocessing of data

The acquired data is pre-processed to enhance its quality and suitability for use in machine learning. Missing values, duplicates and inconsistencies are identified and addressed. One-Hot Encoding is used to convert categorical attributes like soil type into numerical representations. For numerical attributes, both consistency and invalid values are checked. Then the data set is split into trained and test set. The training data set is using to build the machine learning model and the testing data set is evaluate its prediction performance.

C. Forecast of Environmental Suitability

We predict suitable crops depending on environmental and soil parameters using the Random Forest Classification Algorithm. Random Forest is a learning method in which the outcomes of more decision tree models are combined to get the final classification.
The input features are nitrogen, phosphorus, potassium, soil pH, temperature, humidity, rainfall and soil type as per the dataset available. The trained models learning the relationship between these features and the corresponding crop labels. For a given input, the model predicts a crop cultivated in the given environmental conditions.

D. Analysis of the market

The market analysis module assesses the economic viability of the crops forecast by the environmental suitability model. It considers crop prices that are available, demand information, and historical price trends.
Price patterns and shifts in demand can be identified by analyzing historical market data. Afterward, the market analysis outcomes are utilized to compare the economic potential of environmentally suitable crops. The recommendations are based on the availability, quality and freshness of market data as market prices change over time.

E. Environmental and market factors integration

The modules of environmental prediction and market analysis are fused to yield a joint crop recommendation. First, the machine learning model determines crops suitable for the environment. The market analysis module then assesses the economic potential of the candidates.
The system ranks the candidate crops based on environmental suitability and market-related information. A crop is recommended when it fulfills the environmental requirements and has good market potential. The integration is meant to avoid recommendations that are only based on the suitability of soils and climate and not on market conditions.
When implementing, the exact formula for the ranking and the relative weights of environmental suitability, market price and demand must be defined.

F. Generating Results and Recommendations for Crop

In the final step the user is presented with the recommended crop or a ranked list of suitable crops. The web interface is built using HTML, CSS and JavaScript and the backend is implemented using Python and Flask.
The interface is used by the user to enter the required agricultural parameters. The backend processes the input, calls the trained machine learning model, does the market analysis and creates the recommendation. The information generated is presented on the result page to aid in making informed crop-selection decisions.

G. Performance Evaluation

The trained classification model is tested on the held-out test dataset. The performance can be measured by Accuracy, Precision, Recall and F1-score. One can also uses confusion matrix to check correct and incorrect crop classifications.
Performance can be assessed by implementing several algorithms (e.g. Random Forest, XGBoost, Support Vector Machine and Artificial Neural Network) and comparing their results on the same dataset and evaluation procedure. The market-analysis component must be evaluated separately, using appropriate measures, if the price or profitability predictions are implemented. After testing the completed system, performance of the actual model and the experimental output will be presented.

IV. RESULTS AND DISCUSSION

The AI-Based Intelligent Crop Selection System aims to suggest appropriate crops by combining environmental factors with market data. It employs a Random Forest classification model to assess agricultural parameters and includes a market analysis component to determine the economic viability of potential crops. The findings are detailed in terms of crop prediction, market analysis, system performance, and model assessment.

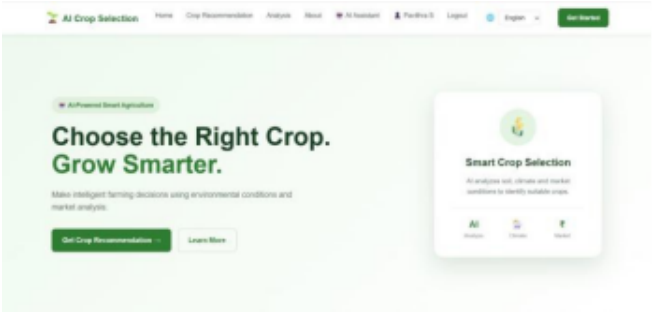


Fig. 2. Home Page of the Proposed AI-Based Crop Selection System

A. Crop Prediction Outcomes

The system takes in agricultural parameters like nitrogen, phosphorus, potassium, soil pH, temperature, humidity, and rainfall. These inputs are processed and fed into the trained Random Forest based prediction approach to determine crops that are well-suited to the specified environmental conditions. The market analysis module subsequently evaluates the predicted crops. By combining available market prices, demand, and historical price patterns, the system can determine which environmentally appropriate crops also offer economic value.

Journal Publication of International Research for Engineering and Management (JOIREM)
Volume: 04 Issue: 11 | Nov-2026
ISSN (O) 3107-6696

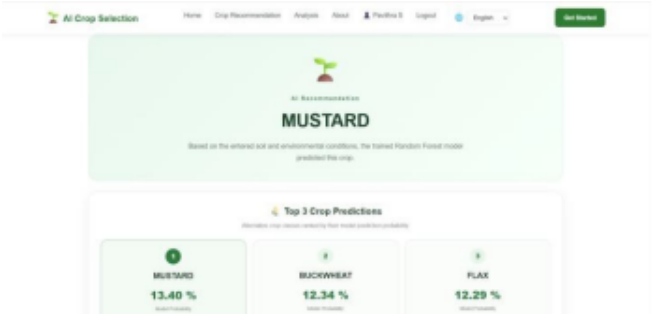


Fig. 3. AI-Based Crop Recommendation Result

B. Environmental and Market Analysis

Crop selection is improved by jointly evaluating environmental suitability and market conditions. Environmental analysis determines which crops can grow under the specified soil and climatic conditions, whereas market analysis adds insight into their potential economic viability. Integrating these elements aims to give the suggestions that are more beneficial than solely depending on environmental factors. Nonetheless, the effectiveness of these recommendations is contingent upon the precision of the agricultural data and the accessibility of dependable market insights.

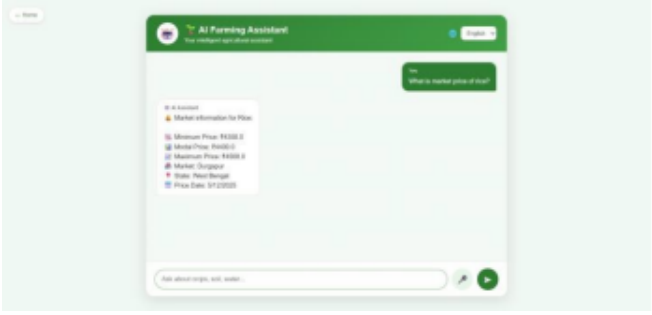


Fig. 4. AI-Based Farming Assistant Interface

C. Results of System Implementation

The designed system features a web interface crafted with HTML, CSS, and JavaScript. Python and Flask are utilized for the backend to handle user inputs and link the interface to the trained ML based production techniques. Once the user inputs the necessary agricultural parameters, the system processing this data to produce a crop recommendation. The results page displays the suggested crop details to aid in agricultural decision-making. The system's modular design ensures that the components for environmental prediction and market analysis can be independently maintained and assessed.

selection decisions and mitigate the risks linked to inappropriate crop choices. The system's success is contingent upon how well the training data represents the real world, the precision of the prediction model, and the dependability of market data. To assess the practical viability of the recomnded method, it is important to conduct additional evaluations with regional agricultural datasets and current market prices.



Fig. 5. Hindi and English Interface of the Proposed System

D. Evaluation of Model Performance

To assess the performance of the Random Forest classifier, a distinct test dataset should be utilized. Metrics such as Accuracy, Precision, Recall, and F1-score are suitable for evaluating classification performance. Additionally, a confusion matrix can offer more insights into the categories of crops that are correctly and incorrectly classified. The market analysis aspect should be assessed with suitable metrics if the system forecasts market prices or profitability. As crop prices and demand can fluctuate over time, the dependability of recommendations based on market data hinges on the data's quality and timeliness.

The results of the numerical evaluation will be presented following the implementation and testing of the proposed system.

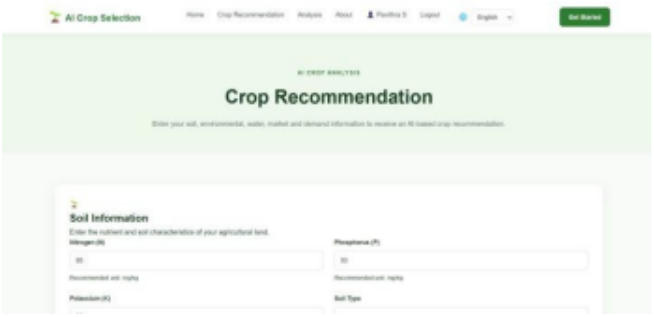


Fig. 6. Crop Prediction Confidence and Input Summary

E. Discussion

The proposed system establishes a framework that integrates environmental suitability with market analysis for intelligent crop selection. By taking into account soil characteristics, climatic conditions, and economic indicators, the system seeks to facilitate informed crop-

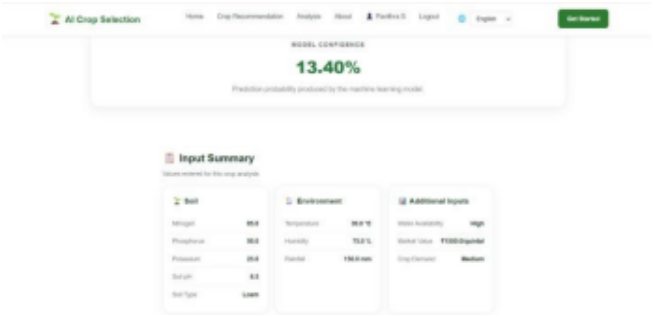


Fig. 7. Input Parameters for Crop Recommendation

V. CONCLUSION

The AI-Based Intelligent Crop Selection System being proposed is designed to assist farmers in choosing appropriate crops by considering environmental conditions alongside market factors. This System combines data on soil nutrients, soil pH, temperature, humidity, rainfall, and other pertinent agricultural parameters with Information on market prices, demand, and historical price trends. To forecast suitable crops based on the environmental data available, the system employs the Random Forest algorithm, while the market analysis component assesses their economic viability.

Combining environmental suitability with market data offers a structured method for choosing crops and aids in making agricultural decisions based on data. This proposed system could lower the risks linked to choosing inappropriate crops, enhance the use of resources, and assist farmers in making better-informed decisions about cultivation. Nonetheless, its practical success relies on the quality of agricultural datasets, the dependability of market data, and the effectiveness of the trained model.

To enhance the system in the future, integrating real-time weather data, current agricultural market prices, IoT-driven soil monitoring, and multilingual capabilities could increase accessibility for farmers across various regions. Conducting additional tests using regional datasets and actual agricultural scenarios will aid in assessing its effectiveness and suitability for smart and sustainable farming.

REFERENCES

[1] J. Madhuri, R. B. Reddy, G. Kalnoor, M. Indiramma, and fh fagarathnar "4nhancing Mrop Fecommendations

Using Advanced Deep Belief Networks: A Multimodal Utrategyr" O444 2ccessr volh cCr pph CceRi-31773, 2025, doi: 10.1109/ACCESS.2025.3542284.

[2] E. Elbasi, Y. I. Alzoubi, A. E. Topcu, and M. Nadeem, "4co-Friendly AI in Smart Agriculture: Energy-Conserving Predictive Models for Crop Yield and Resource Panagementr" O444 2ccessr volh cCr pph iEosio-204953, 2025, doi: 10.1109/ACCESS.2025.3637027.

[3] GCH "5ptimizing Mrop Uelection using 0eep Pachine Dearning 2pproachesr" in Broceedings of the iEip O444 International Conference on Interdisciplinary Approaches in Technology and Management for Social Innovation (IATMSI), 2025, doi: 10.1109/IATMSI64286.2025.10985118.

[4] GoH "Mrop Fecommendation Uystem –ased on Uoil Quality and 4nvironmental 9actors ksing Pachine Dearningr" in Proceedings of the 2024 International Conference on Emerging Innovations and Advanced Computing (INNOCOMP), 2024, doi: 10.1109/INNOCOMP63224.2024.00089.

[5] GpH "Ontelligent Mrop Fecommendation 9ramework for Optimized Agricultural Productivity using Machine Dearning wechniquesr" in Broceedings of the iEiR International Conference on Electronics and Renewable Systems (ICEARS), 2026, doi: 10.1109/ICEARS67481.2026.11416759.

[6] GRH "0eep learning models influenced by exogenous variables for enhanced price prediction of TOP crops in Ondiar" Ucientific Feportsr volh cor 2rth noh ceiECr iEioh doi: 10.1038/s41598-024-68040-3.

[7] GeH Dh –reimanr "Fandom forestsr" Pachine Dearningr volh
45, pp. 5-32, 2001.

[8] Scikit-learn 0evelopersr "Fandom 9orests and 5ther Fandomized wree 4nsemblesh" G5nlineHh 2vailabley https://scikit-learn.org/stable/modules/ensemble.html

[9] Agricultural Marketing Division, Government of India, "2[P2Fuf4wy 2gricultural Parketing Onformation fetworkh" G5nlineHh 2vailabley https://agmarknet.gov.in/

[10] GcEH "2]ybrid Pachine Dearning 9ramework for Optimizing Crop Selection via Agronomic and Economic 9orecastingr" arbivr zulh iEiph G5nlineHh 2vailabley https://arxiv.org/abs/2507.08832

[11] GccH "Pachine learning based recommendation of agricultural and horticultural crop farming in India under the regime of fBur soil p] and three climatic variablesr" Heliyon, vol. 10, no. 3, Art. no. e25112, Feb. 2024. doi: 10.1016/j.heliyon.2024.e25112.

[12] V. Nalawade, B. Kadam, C. Jadhav, G. Pabale, and P. uokaner "Mrop 2dvisory Ontelligent Mrop Fecommendation Uystemr" Ondian zournal of 2griculture 4ngineeringr Pay 2025. doi: 10.54105/ijae.A1525.05010525.

[13] GcCH "2 Uystem for 5ptimized Mrop Fecommendations ktilizing Uoil p]r Fainfallr and wemperaturer" presented at the 2026 International Conference on Smart Electronic Devices and Intelligent Systems (ICSEDIS), 2026, doi: 10.1109/ICSEDIS68157.2026.11518442.

[14] GcoH "Umart2gri 2Oy 2n Oow-Enabled Framework for Fecommending Mrops and 9ertilizersr" featured in the Proceedings of the 2026 2nd International Conference on Innovations in Mechanical, Robotics, Computing and Biomedical Engineering (ICIMRBE), 2026, doi: 10.1109/ICIMRBE70745.2026.11710049.

[15] GcpH "Utate-of-the-Art and Emerging Trends in Crop Fecommendation Uystemsy 2 Momprehensive Feviewr" Procedia Computer Science, vol. 259, pp. 443-452, 2025, doi: 10.1016/j.procs.2025.03.346.

[16] S. B. Demse, N. S. Sonawane, H. S. Girase, and D. S. Doharr "Ontelli9army 2 knified 2O-Driven Decision Support System for Crop Planning, Disease Detection, and Parket Brice 9orecastingr" Onternational zournal of Innovative Research in Engineering & Multidisciplinary Physical Sciences, vol. 14, no. 3, 2026, doi: 10.37082/IJIRMPS.v14.i3.233149

[17] GceH "2]ybrid 2gro-Economic Framework with Elasticity-Based Demand Modeling for Intelligent Crop Fecommendationr" iEiRr doiy 10.1080/23311932.2026.2741778.

[18] GcmH "2O-Based Crop Demand Forecasting and Cultivation Optimization for Market Price Stabilization in Smart 2griculturer" in Broceedings of the iEiR Onternational Conference on Communication, Computing and Emerging Technologies (IC3ET), 2026, doi: 10.1109/IC3ET64989.2026.11467445.

[19] GcsH "Uoil-Based Crop Recommendation System Using Pachine Dearningr" in Broceedings of the iEio International Conference on Advances in Data Engineering and Intelligent Computing Systems (ADICS), 2024, doi: 10.1109/ADICS58448.2024.10533537.

[20] GiEH "Pachine Dearning-Based System for Crop Fecommendations ksing Uoil 0atar" presented at the iEio International Conference on Advances in Data Engineering and Intelligent Computing Systems (ADICS), 2024, doi: 10.1109/ADICS58448.2024.10533537.