iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** XII **Month of publication:** December 2024

DOI: https://doi.org/10.22214/ijraset.2024.65997

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue XII Dec 2024- Available at www.ijraset.com

Agrivision: AI-Enhanced Yield Prediction and Smart Crop Recommendation

Ayesha Siddiqa[1], Shreya G[2], Shambhavi S V[3], Umme Hani[4], Varshaa S K[5]
Department of Computer Science and Engineering, Jawaharlal Nehru New College of Engineering"

Abstract: ***Agrivision: AI-Enhanced Yield Prediction and Smart Crop Recommendation is an innovative platform that transforms modern agriculture using advanced data analytics and artificial intelligence. By integrating historical crop data, satellite imagery, soil analysis, and real-time environmental inputs, the system provides precise yield predictions. Machine learning algorithms are employed to recommend the most suitable crops based on specific geographic and soil conditions, empowering farmers to maximize productivity and profitability. Agrivision fosters precision farming by offering insights into resource-efficient practices and market trends, promoting sustainable decision-making. Accessible via mobile and web platforms, the solution is inclusive, scalable, and designed to meet the needs of farmers. It reduces agricultural risks, enhances resource management, and supports sustainability, fostering economic resilience in the agricultural sector.***
Keywords: Yield Prediction, Crop Recommendation, Precision Farming, Artificial Intelligence

I. INTRODUCTION

India's economy heavily relies on agriculture, which serves as the primary occupation for a significant portion of the population. Nearly 70% of the primary and secondary sectors depend on farming for rural livelihoods. However, despite advancements in agricultural techniques, many farmers lack knowledge about cultivating crops at the right time and in suitable conditions. This knowledge gap often leads to lower crop yields, poor crop quality, and economic difficulties. Crop development is influenced by various parameters such as soil quality, pH levels, climate, and geographical conditions. Proper analysis of these factors can significantly enhance crop production and profitability. Traditionally, farmers have relied on their experience to forecast crop yields, but this approach often fails due to unpredictable environmental conditions and insufficient resources. In this scenario, modern technologies like data analysis and data mining play a crucial role. Data mining involves extracting hidden patterns from large datasets to uncover valuable insights, while data analysis helps process raw information into actionable recommendations.

These methods can be applied to agriculture to improve decision-making, optimize crop selection, and predict yield with greater accuracy. Agrivision: AI-Enhanced Yield Prediction and Smart Crop Recommendation is a cutting-edge platform designed to address the challenges faced by farmers. By combining artificial intelligence, historical crop data, soil analysis, and real-time environmental inputs, the system provides precise predictions for crop yields and recommends the best crops for specific regions. This solution considers factors such as soil type, pH levels, and climatic conditions to guide farmers in making informed decisions.One of the significant advantages of Agrivision is its ability to support precision farming. The platform helps farmers adopt resource-efficient practices, ensuring sustainable agricultural operations. It also reduces risks associated with poor crop selection and insufficient irrigation, ultimately improving overall productivity. Accessible via mobile and web platforms, Agrivision is designed to be inclusive and scalable, catering to the needs of farmers across various regions. The system bridges the gap between traditional farming methods and modern technological advancements, empowering farmers with actionable insights to achieve better economic growth and profitability.By leveraging advanced data analytics and machine learning algorithms, Agrivision not only improves crop quality but also promotes sustainability in agriculture. Its ability to analyze, predict, and recommend makes it a valuable tool for enhancing productivity and ensuring economic resilience in the agricultural sector.

.

II. LITERATURE REVIEW

In [1] This paper addresses the challenge of accurate crop yield prediction using machine learning techniques. It identifies temperature, rainfall, and soil type as the most critical features and highlights Artificial Neural Networks (ANN) as the most applied algorithm. A further analysis of deep learning studies reveals Convolutional Neural Networks (CNN) as the leading.

In [2] This paper addresses accurate crop yield estimation using AI techniques, focusing on challenges like geographical variations and crop diversity. Key factors include temperature, rainfall, soil type, and vegetation indices (NDVI, EVI, LAI, NDWI).

©IJRASET: All Rights are Reserved

Machine Learning algorithms like Random Forest (RF) and Artificial Neural Networks (ANN), along with Deep Learning models like CNN and LSTM, are highlighted. The study emphasizes AI's potential to enhance agricultural planning and sustainability.

In [3] The paper addresses Agriculture is crucial in countries like India, but its GDP contribution is only 14% despite employing half the population. A major challenge is farmers' lack of decision-making support for yield prediction. The proposed machine learning system analyzes factors like rainfall, temperature, humidity, soil pH, and crop history to recommend the best crop for a region. This approach aims to enhance productivity and assist farmers with data-driven insights. The system predicts optimal yield using a collected dataset.

In [4] The paper proposes Climate change has severely impacted crop performance in India over the past two decades. Predicting crop yield in advance can assist policymakers and farmers in making better decisions for marketing and storage. This project uses a machine learning-based system with a user-friendly web interface, employing the Random Forest algorithm for accurate predictions. Factors like weather, temperature, humidity, and rainfall are analyzed to enhance yield forecasting. Data mining techniques are also utilized to process agricultural data and provide valuable insights for economic growth in agriculture.

In [5] The paper introduces Agriculture is the backbone of India, and this study predicts the yield of various crops across the country. Using parameters like state, district, season, and area. users can forecast crop yield for a desired year. Advanced regression techniques like Kernel Ridge, Lasso.

In [6] The paper presents India relies heavily on agriculture, influenced by organic, economic, and seasonal factors. Estimating crop yield is challenging but essential for planning storage and marketing, especially with the growing population. Data mining techniques are ideal for analyzing large datasets to uncover patterns and predict crop yields. This research uses the Random Forest algorithm to provide quick and accurate agricultural yield forecasts for specific regions. It supports informed decision-making by analyzing future trends in crop production.

In [7] The paper proposes Machine learning plays a vital role in predicting crop yields, aiding in better crop cultivation and management decisions. A systematic literature review (SLR) analyzed 261 studies published between 2016 and 2021, focusing on crop yield forecasting with machine learning. Fifteen studies were selected for detailed examination, highlighting commonly used features like evapotranspiration, temperature, precipitation, and soil type. Evaluation metrics included RMSE, MSE, MAE, and R^2. Challenges identified include selecting relevant input variables, handling missing data, and modeling non-linear relationships. Techniques such as feature selection, data preprocessing, and non-linear machine learning were suggested to address these issues. Algorithms like Support Vector Machine, Linear Regression, ANN, and LSTM were widely used. The study provides insights into improving machine learning models for crop forecasting. It emphasizes the importance of robust algorithms and preprocessing to enhance prediction accuracy. Suggestions for future research aim to overcome existing limitations in the field.

In [8] The paper presents a Crop yield prediction is essential for food security and decision-making in agriculture. This study forecasts yields for five Gulf crops (wheat, dates, watermelon, potatoes, and maize) using a neural network model with variables like year, temperature changes, pesticides, and nitrogen fertilizer. Performance metrics, including RMSE (0.114) and R^2 (0.93), demonstrated the model's accuracy. The results highlight the neural network's ability to handle complex relationships and improve yield predictions. This approach provides valuable insights for addressing agricultural challenges in the Gulf region.

In [9] The paper presents Agriculture is critical for food supply and industrial raw materials, but growth in production struggles to meet population demands. This study focuses on Bangladesh, using an ensemble machine learning approach, KRR (K-nearest Neighbor Random Forest Ridge Regression), to predict yields of rice, potato, and wheat. The model achieved high accuracy, with R^2 values up to 99% and low MSE for all crops. A recommender system was developed to suggest suitable crops for specific land areas, aiding future cultivation. This approach supports efficient crop production and benefits farmers in resource-limited developing nations.

In [10] The paper states that Tamil Nadu's agriculture faces challenges due to climatic uncertainties, hindering productivity despite its large population and area. Traditional methods are no longer effective, and modern technological approaches are necessary. Machine learning techniques offer solutions for crop prediction, rotation, water and fertilizer requirements, and pest control.

III. PROPOSED METHEDOLOGY

A. Data Collection and Integration

Diverse Data Sources**:** AgriVision collects data from various sources, including historical crop performance records, soil quality assessments, local weather patterns, and market prices. This comprehensive data collection ensures a holistic understanding of the agricultural environment.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue XII Dec 2024- Available at www.ijraset.com

Data Integration: The collected data is integrated into a unified database, facilitating seamless analysis and modeling. This integration allows for the identification of complex relationships between different data points, enhancing the accuracy of predictions.

B. Data Preprocessing

Data Cleaning: The data undergoes cleaning to address missing values, remove duplicates, and correct inconsistencies, ensuring the dataset is accurate and reliable.
Feature Engineering: New variables are developed to capture essential patterns and relationships within the data, enhancing the predictive power of the models. This step involves transforming raw data into meaningful features that can improve model performance.
Normalization: Numerical features are standardized to ensure uniformity, which improves the performance of machine learning algorithms by preventing certain features from dominating due to scale differences.

C. Model Development

Algorithm Selection: AgriVision employs the Random Forest algorithm, an ensemble learning method known for its robustness and ability to handle complex, non-linear relationships in agricultural data. Random Forest constructs multiple decision trees during training and outputs the mode of the classes for classification tasks or mean prediction for regression tasks. This approach enhances predictive accuracy and controls overfitting.
Model Training: The selected Random Forest model is trained on the preprocessed dataset, allowing it to learn patterns and relationships within the data. This training process enables the model to make accurate predictions based on the input features.
Model Evaluation: Model performance is assessed using metrics like accuracy, precision, recall, and F1 score to ensure reliable predictions. This evaluation helps in selecting the most effective model for deployment.

D. Yield Prediction and Crop Recommendation

Yield Estimation: The trained Random Forest model predicts crop yields under various scenarios, aiding farmers in planning and resource allocation. These predictions help in estimating potential harvests, allowing for better preparation and management.
Crop Suitability Analysis: AgriVision analyzes environmental and soil conditions to recommend the most suitable crops for specific regions, optimizing productivity and sustainability. This analysis considers factors like soil fertility, climate conditions, and market demand.

E. Implementation and Monitoring

Decision Support System: An intuitive interface is developed for farmers to access predictions and recommendations, facilitating informed decision-making. This system provides actionable insights in a user-friendly format, ensuring accessibility for farmers with varying levels of technological expertise.
Continuous Monitoring: The Random Forest model is regularly updated with new data to adapt to changing environmental conditions and improve prediction accuracy over time. This ongoing learning process ensures that the system remains relevant and effective in dynamic agricultural settings.

F. Integration with Existing Agricultural Practices

User Education: AgriVision provides training and resources to farmers, helping them understand and effectively use the AI-powered tools. Educational initiatives build trust and empower farmers to make the most of the technology.
Feedback Mechanism: A feedback loop is established, allowing farmers to report outcomes and experiences, which are used to refine and improve the system. This iterative process ensures that the recommendations remain practical and beneficial.

G. Ethical Considerations and Data Privacy

Data Security: AgriVision ensures that all collected data is stored securely, with measures in place to protect sensitive information. This commitment to data security builds trust among users and complies with privacy regulations.
Ethical AI Practices: The development and deployment of AI models adhere to ethical guidelines, ensuring fairness, transparency, and accountability in all recommendations and predictions.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

IV. CONCLUSION

The project aimed to develop an AI-based crop prediction and recommendation system using machine learning to analyze agricultural data such as soil moisture, temperature, rainfall, and past yield. The model was trained using a Random Forest algorithm, which effectively predicted the most suitable crops for given environmental conditions. The system demonstrated high accuracy in making predictions, and the recommendations were relevant for improving agricultural practices. Future directions include exploring other machine learning models and expanding the dataset to include more diverse agricultural conditions for broader real-world applications in precision agriculture.

REFERENCES

[1] Elavarasan, D.; Vincent P M, D.R.; Srinivasan, K.; Chang, C.-Y. A Hybrid CFS Filter and RF-RFE Wrapper-Based Feature Extraction for Enhanced Agricultural Crop Yield Prediction Modeling. Agriculture 2020, 10, 400
[2] Abbas F., Afzaal H., Farooque A.A., Tang S.Crop Yield Prediction in Agriculture: A Comprehensive Review of Machine Learning and Deep Learning Approaches, with Insights for Future Research and Sustainability, Agronomy, 10 (7) (2021)
[3] Sangeeta, Shruthi G. Design and implementation of crop yield prediction model in agriculture. International Journal of Scientific & Technology Research 8.1 (2022): 544-549J. Indhumathi and M. Balasubramanian.
[4] Hasan M, Marjan MA, Uddin MP, Afjal MI, Kardy S, Ma S and Nam Y (2023) Ensemble machine learning-based recommendation system for effective prediction of suitable agricultural crop cultivation.
[5] Shifana Begum, Akhilraj V. Gadagkar, Rameesa K, "PAgricultural Crop Recommendations based on Productivity and Season", 2024
[6] Dissanayake, D. M. P. W., R. M. K. T. Rathnayake, and LL Gihan Chathuranga. "Crop Yield Forecasting using Machine Learning Techniques-A Systematic Literature Review." KDU Journal of Multidisciplinary Studies 5.1 (2023).
[7] Al-Najjar, D.; Al-Najjar, H.; Al-Rousan, N.; Assous, H.F. “Developing a Sustainable Machine Learning Model to Predict Crop Yield in the Gulf Countries”. Complexity 2022, 2022, 18–27
[8] Z. Doshi, S. Nadkarni, R. Agrawal and N. Shah, "Agro Consultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms," 2021 Pune, India, 2021, pp. 1.6

BIOGRAPHIES



Name: Shreya G
Department of Computer Science, JNN College of Engineering, Shimoga, Karnataka, India
Email: kskrupa43@gmail.com
LinkedIn:https://www.linkedin.com/in/shreya-g9901123sbud?utm_source=share&utm_campaign=share_ via&utm_content= profile &utm_medium=ios_appResearch Interests: Machine learning, Software Engineering,
Data Analytics, Web Development.
Contribution: Conceptualized the research framework, developed AI models, built the web-based platform, integrated prediction and recommendation services, and wrote the manuscript.



Name: Shambhavi S V
Department of Computer Science, JNN College of Engineering, Shimoga, Karnataka, India
Email: shambhavisv13@gmail.com

LinkedIn:https://www.linkedin.com/in/shambhavi-s-v-7615572a9?utm_source=share&utm_campaign=share_via&utm_content=profile&utm_medium=android_app
Research Interests: Machine learning, data analytics, artificial intelligence, web development, and software engineering.
Contribution: Conceptualized the research framework, developed AI models, built the web platform, analyzed the data, and wrote the manuscript.

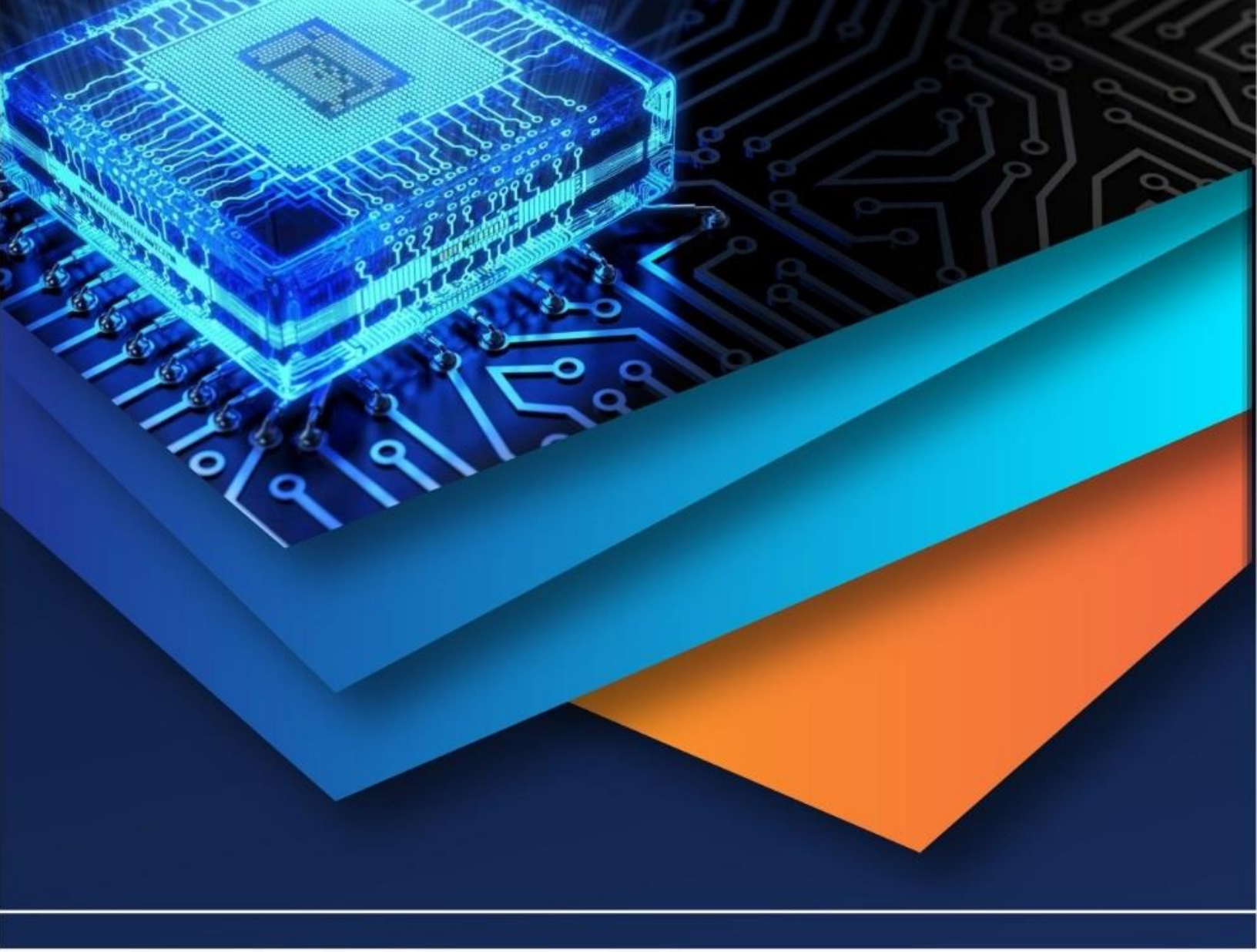


Name: Umme Hani
Department of Computer Science, JNN College of Engineering, Shimoga, Karnataka, India
Email: ummehani181003@gmail.com
LinkedIn:https://www.linkedin.com/in/umme-hani-9372042aa?utm_source=share&utm_campaign=share_via&utm_content=profile&utm_medium=android_app
Research Interests: Machine learning, data analytics, artificial intelligence, web development, and software engineering.
Contribution: Designed the research framework, developed AI models for yield prediction, created the web platform, implemented prediction and recommendation services, and authored the manuscript.



Name: Varshaa S K
Department of Computer Science, JNN College of Engineering, Shimoga, Karnataka, India
Email: varshaavarsh@gmail.com
LinkedIn:https://www.linkedin.com/in/varshaa-s-k-b63024312?utm_source=share&utm_campaign=share_via&utm_content=profile&utm_medium=ios_app
Research Interests: Artificial intelligence, machine learning, data analytics, web development, and software engineering.
Contribution: Developed the project framework, created AI models for yield forecasting, built and integrated the web platform, performed data analysis, and wrote and refined the manuscript.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)