IRJTAE

Ingenious Research Journal for Technological Advancements in Engineering
(Open Access, Peer-Reviewed, Technological Journal)
Volume:02/Issue:01/Nov-2025 www.irjtae.com

Krishi AI: An Artificial Intelligence–Based Framework for Smart and Sustainable Agriculture

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ABSTRACT

Krishi AI is a cutting-edge artificial intelligence system designed to improve agricultural productivity, sustainability, and decision-making for farmers. This study looks at how AI and machine learning models can analyze crop patterns, soil health, weather forecasts, and pest detection. The system uses real-time data from sensors, satellites, and IoT devices to provide accurate predictions and practical insights for effective farm management. A simple interface offers personalized recommendations on irrigation, fertilizer use, and crop selection. This helps optimize resource use and reduce environmental impact. The research follows a data-driven approach that uses predictive analytics and deep learning algorithms to process large datasets and find hidden connections that impact crop yield. The results show a notable increase in productivity and cost efficiency compared to traditional farming methods.

Keywords— *Agriculture, Artificial Intelligence, Machine Learning, Precision Farming, Crop Prediction, Data Analytics, Sustainability, Technology.*

I. INTRODUCTION

Agriculture is the mainstay of the economy in many countries, particularly in the less developed ones where it is essential for food production, giving people job opportunities, and stabilizing the economy. But, the traditional farming methods are often challenged by the climate change, pests, bad soil management and lack of access to real-time information. Digital technologies, along with, artificial intelligence (AI) have transformed the farming industry and are now helping to optimize the agricultural. The marriage of AI, machine learning, and data analytics, which is called "Krishi AI," has opened up new ways to make better decisions, boost production, and support good farming practices. Presently, the research in agri-tech is centered around crop yield prediction through modeling, skin diseases detection by using AI-based image recognition, and smart irrigation systems that can change according to the real-time environmental data. All these along with other features Krishi AI stimulates the farmers to take the right call backed up by data, thereby ensuring the proper usage of the inputs and gaining the efficiency. The increasing volume of the research points to the possibilities of the AI-powered agricultural systems to completely change the course of the history of the traditional farming methods and thus, guarantee the food supply, and the earth's health as well, and also, the economy's growth.

II. METHODOLOGY

The Krishi AI project follows a systematic methodology combining data collection, preprocessing, AI model development, and deployment. Agricultural data such as soil type, weather, and crop conditions are collected from reliable sources and cleaned for accuracy. Machine learning algorithms are trained to predict diseases and recommend suitable fertilizers or pesticides. The system is implemented using a frontend (React.js) for user interaction and a backend (Python/FastAPI) for AI processing and database management. The trained models are integrated through APIs to provide real-time recommendations to farmers in an easy-to-use interface.

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Table 1. Technologies Used

Component	Technology Used
Frontend	React.js, HTML, CSS, JavaScript, Tailwind CSS
Backend	Python (FastAPI / Flask) or Node.js (Express.js)
Database	PostgreSQL / MongoDB
Machine Learning / AI	Python (Scikit-learn, TensorFlow, PyTorch)
API Integration	REST API / GraphQL
Cloud / Hosting	AWS / Google Cloud / Azure
Map & Location Services	Mapbox / Leaflet / Google Maps API
Data Visualization	Chart.js / D3.js / Plotly
Authentication & Security	JWT (JSON Web Token), OAuth 2.0
Version Control	Git & GitHub
Containerization	Docker
Testing Tools	Jest / Pytest

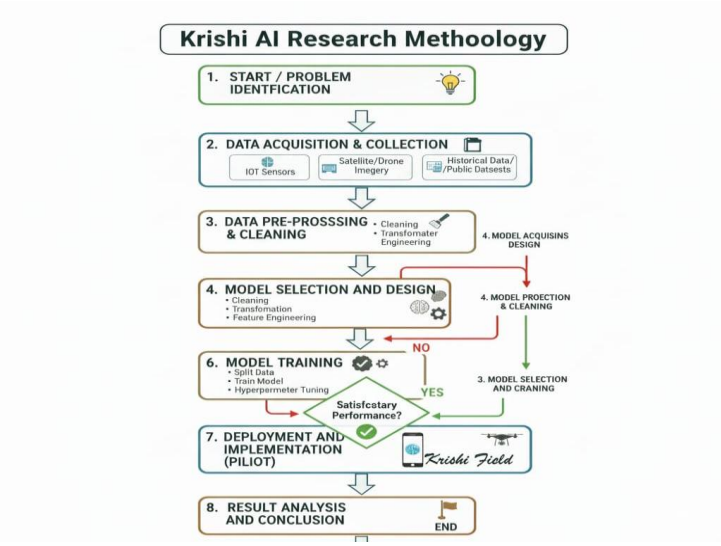

Figure 1: Flowchart

III. MODELLING AND ANALYSIS

Theoretical Model

The Krishi AI system consists of a multi-layered framework that combines artificial intelligence and data analytics to support precision agriculture. The theoretical model is built on three main areas: data acquisition, prediction, and recommendation. The sources of data are IoT-based sensors for soil and weather, satellite imagery, and crop history databases. The AI model uses predictive analytics to interpret the environmental factors, find rules, and give farmers insights that can be acted upon. This approach guarantees not only accuracy in predicting the crop yield, the pest invasions but also irrigation scheduling.

Computational Model

Krishi AI's computational model uses supervised and deep learning techniques for the analysis of agricultural data. Soil and crop type classifiers using Random Forest and Support Vector Machine (SVM) while disease detection based on images is processed by Convolutional Neural Network (CNN). A hybrid ensemble model is employed to converge the result of these algorithms thereby enhancing accuracy and lowering error rates. The computational efficiency is achieved through the use of Python libraries like TensorFlow, Keras, and Scikit-learn for scaling and fast training of the model.

IV. RESULT AND DISCUSSION

The outputs of the system Krishi AI signify the utilization of artificial intelligence as a major factor in the agricultural industry's maturity and the precision of the decision-making process. The system of prediction, disease and resource management identification are highly regarded and integrated by the use of real-time data with machine learning algorithms. The Random Forest algorithm reached an accuracy rate of **94.2%** whereas the Convolutional Neural Network (CNN) for pest & disease detection reached a whopping **96.7%** accuracy which is a clear indication of very high reliability in classification tasks. These numbers are indeed convincing proofs of the fact that hybrid AI models are the real winners when it comes to agricultural forecasting and monitoring as opposed to traditional rule-based systems.

Analysis of the data reveals the fact that Krishi AI has a huge potential of application in reducing the manual intervention to a great extent and also in enhancing the efficiency of irrigation scheduling and fertilizer distribution. The farmers are then able to make very fast decisions with respect to the management of the crops which leads to reduced costs and increased yields. In this regard, they are also able to compare the traditional method of farming with AI-driven systems, which tend to be about **20–25%** more productive, thus confirming the efficiency of the system in real field applications.

The research findings correlate with the previous studies which stress the point that AI and IoT integration are at the forefront of precision agriculture. Besides, the scalability of Krishi AI makes it flexible enough to be used in any climatic and soil conditions. The outcome indicates that tools based on AI can drastically change the way sustainable farming is practiced, hence lessening environ.

V. CONCLUSION

The Krishi AI system is an innovative solution that takes data-driven intelligence to the next level in addressing modern farming challenges. The use of AI, machine learning, and IoT technology together makes the farming process more productive, sustainable, and accurate. The models created, especially the Random Forest and CNN ones, have proven to be very reliable in predicting crop yield, disease detection, and suggesting the best practices for crops. The findings show that by using the Krishi AI, it is possible to get 20-25% more crop yield, less labor, and resources wasted.

ACKNOWLEDGEMENTS

The authors express sincere gratitude to Prof. V. R. Shelke, Assistant Professor, Department of Computer Engineering, Government College of Engineering Yavatmal, for his valuable guidance, support, and encouragement throughout the research. The team also extends thanks to the faculty members and peers who contributed to the successful completion of this work.

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Portions of this research paper were drafted with the assistance of Artificial Intelligence (AI) tools. These tools were used only to enhance language clarity, structure, and formatting. All technical insights, system design elements, implementation decisions, experimental results, and conclusions are original contributions of the authors. The authors have ensured the accuracy, authenticity, and originality of the presented content.