KrishiConnect: An Intelligent Agriculture Prediction System using AI and ML

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Abstract

Agriculture faces major challenges such as unpredictable weather, soil degradation, and fluctuating market prices. This research proposes KrishiConnect, an intelligent agriculture support system enhanced with Artificial Intelligence (AI) and Machine Learning (ML) models. The system integrates real-time data (weather, soil, and market) and applies predictive algorithms to provide crop recommendations, yield prediction, and price forecasting. The objective is to improve decision-making, increase productivity, and maximize farmers' income.

Keywords: *AI, Machine Learning, Smart Agriculture, Crop Prediction, Price Forecasting, Data Analytics*

1. Introduction

Agriculture is one of the most important sectors in India, as it provides food, employment, and income to a large portion of the population. A majority of farmers still depend on traditional farming methods, which are often based on experience rather than data. Because of this, many challenges affect agricultural productivity and farmers' income.

One of the major problems is uncertain climate conditions. Weather patterns have become unpredictable due to climate change. Sudden rainfall, droughts, or temperature changes can damage crops and reduce yield. Farmers often do not have accurate weather information to make proper decisions.

Another important issue is poor crop planning. Farmers usually select crops based on tradition or local practices instead of analyzing soil conditions, weather, and market demand. This may lead to growing unsuitable crops, which results in low productivity and financial loss.

There is also a lack of market knowledge among farmers. Many farmers do not know the future prices of crops or market demand. As a result, they may sell their produce at low prices or at the wrong time, reducing their profits.

Traditional agricultural systems mainly provide general information but do not use data effectively. They lack advanced tools to analyze large amounts of data such as soil nutrients, weather conditions, and historical market trends.

By using AI and ML technologies, the system helps farmers make smarter decisions, reduce risks, and improve productivity and income. This transformation from traditional farming to smart farming can significantly enhance the agricultural sector.

Traditional systems do not use data effectively.

To overcome these problems, this research introduces an Artificial Intelligence (AI) and Machine Learning (ML)-based extension to the existing system. The proposed system is designed to be predictive rather than just informative. It uses data-driven models to:

- Recommend the most suitable crops
- Predict crop yield in advance
- Forecast market prices

2. Existing System

The existing agricultural system primarily relies on traditional farming practices that lack the integration of advanced technologies such as Artificial Intelligence and Machine Learning. Farmers generally make decisions based on experience, intuition, and limited historical knowledge rather than data-driven insights. There is inadequate utilization of critical factors such as soil parameters, weather conditions, and market trends in a unified manner. As a result, crop selection is often inefficient and not optimized for maximum yield. Additionally, the system does not provide reliable mechanisms for crop yield prediction or future market price forecasting, leading to uncertainty in production and profitability. Farmers also face challenges due to unpredictable climate conditions and fluctuating market prices, with limited access to real-time information. The absence of an integrated platform combining soil, weather, and market data further reduces the effectiveness of decision-making. Overall, the existing system is largely informative rather than predictive, resulting in lower productivity, higher risk, and reduced economic benefits for farmers.

3. Proposed System (Enhanced with AI/ML)

The upgraded system includes:

- Crop Recommendation using ML:

Crop Recommendation uses Machine Learning algorithms to suggest the best crop for a given land. It considers factors like soil nutrients (N, P, K), pH level, temperature, and rainfall. The model is trained on agricultural data to learn patterns between inputs and crops. When new data is given, it predicts the most suitable crop. Algorithms like Decision Tree or Random Forest are commonly used. This helps farmers choose crops scientifically. It improves yield and reduces the risk of crop failure.

- Yield Prediction:

Yield Prediction uses AI and ML to estimate the expected crop production before harvesting. It takes inputs such as rainfall, soil fertility, temperature, and land area. The model is trained using historical data to understand how these factors affect yield. Linear Regression is commonly used for prediction. The system provides output in terms of expected yield (e.g., tons per hectare). This helps farmers plan resources like water and fertilizers. It reduces uncertainty and improves productivity.

- Market Price Prediction:

Market Price Prediction uses Machine Learning to forecast future crop prices. It analyzes past market price data and identifies patterns over time. Time series models like ARIMA or LSTM are used for prediction. The system considers seasonal trends and market demand. It provides farmers with estimated future prices of crops. This helps them decide the best time to sell. It reduces dependency on middlemen and increases profit.

- Weather-based Decision Support:

This module uses real-time weather data to support farming decisions. It collects data such as temperature, rainfall, and humidity from weather sources. Based on this data, the system gives suggestions for irrigation, fertilization, and harvesting. It helps farmers prepare for adverse weather conditions. The system improves planning and reduces climate-related risks. It ensures efficient use of resources. Overall, it supports smarter and safer farming practices.

5. Methodology

The proposed KrishiConnect system follows a structured methodology to design and implement an intelligent agriculture prediction system using Artificial Intelligence (AI) and Machine Learning (ML). The methodology consists of multiple stages, including data collection, preprocessing, model development, training, and prediction.

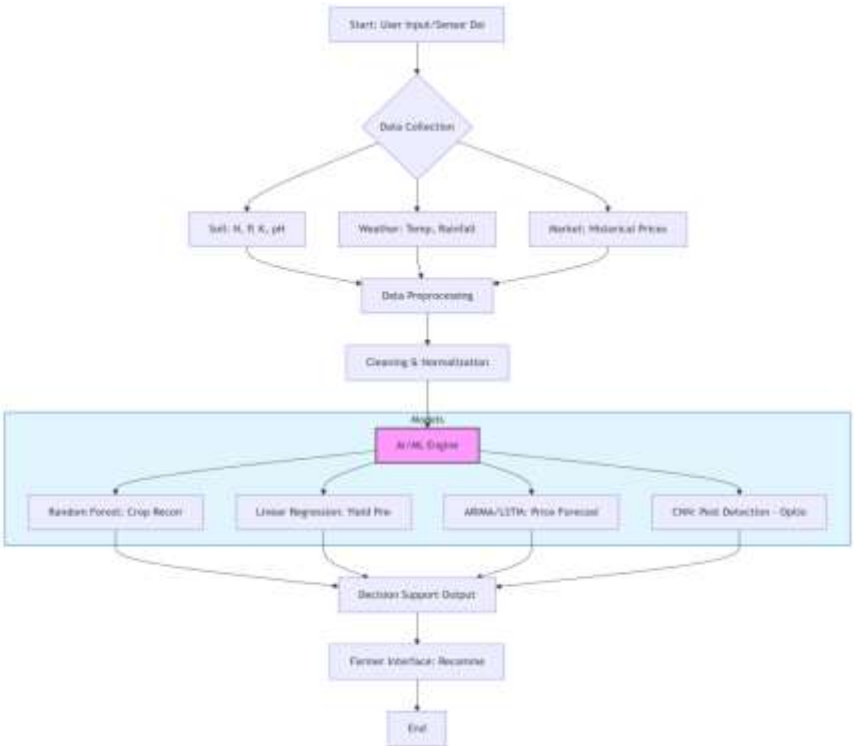

Fig1: Methodology used

4. AI/ML Models Used

- Crop Recommendation Model

The Crop Recommendation Model is a core component of the proposed system that uses Machine Learning techniques to identify the most suitable crop based on soil and environmental conditions. It supports farmers in making data-driven decisions, improving productivity, and reducing risks. The system uses supervised learning algorithms such as Decision Tree and Random Forest, which can handle multiple input parameters and model complex relationships. Random Forest improves accuracy by combining multiple decision trees and reducing overfitting.

The model takes inputs like soil properties (pH, Nitrogen, Phosphorus, Potassium) and weather conditions (temperature, rainfall). These inputs are collected from datasets or APIs and are preprocessed before being used. During training, the model learns patterns between input features and suitable crops. Once trained, it can analyze new data and predict the best crop, sometimes providing multiple options ranked by suitability. Overall, this model enables accurate predictions and transforms traditional farming into a scientific, data-driven approach, helping farmers improve yield and use resources efficiently.

➢ Crop Yield Prediction

Crop Yield Prediction is an important component of the proposed system that uses Machine Learning to estimate crop output before harvesting. It helps farmers plan resources, manage risks, and improve productivity. The system uses Linear Regression, a supervised learning algorithm, to model the relationship between input variables and yield. It is suitable because it predicts continuous values such as yield in tons per hectare.

The model takes inputs like rainfall, soil nutrients (N, P, K), and land area, which directly affect crop growth. This data is collected from historical records and preprocessed for accuracy. During training, the model learns how these factors influence yield. Once trained, it can predict expected yield for new inputs. For example, an increase in rainfall within an optimal range may increase yield, while excessive rainfall may reduce it. Overall, this module provides accurate, data-driven yield estimation, helping farmers optimize resources and improve agricultural productivity.

➢ Market Price Prediction

Market Price Prediction is a key module that uses Machine Learning to forecast future crop prices. It helps farmers decide the best time to sell their produce and maximize profit. The system uses time series algorithms such as ARIMA and LSTM, which analyze data over time and capture trends, seasonal patterns, and price fluctuations.

The model takes historical market price data as input, which is preprocessed and used for training. During training, it learns how prices change based on time, demand, and seasonal factors. Once trained, the model predicts future crop prices for upcoming periods. For example, if prices usually increase in a certain season, the model will predict a similar trend.

Overall, this module supports data-driven decisions, reduces dependency on middlemen, and helps farmers increase their income.

➢ Pest Detection (Optional Advanced Model)

Pest Detection is an optional advanced module that uses Deep Learning to identify plant diseases at an early stage. It helps farmers take timely action to prevent crop damage and improve productivity. The system uses a Convolutional Neural Network (CNN), which is effective for image processing and pattern recognition. It can extract features like color, texture, and shape from leaf images. The model takes leaf images as input, captured through mobile cameras or uploaded by farmers. These images are preprocessed and analyzed by the trained CNN model. During training, the model learns to distinguish between healthy and diseased leaves using labeled datasets. Once trained, it can classify diseases and identify plant health. Overall, this module supports early detection, reduces crop losses, minimizes pesticide use, and improves crop management.

5. System Architecture (AI Integrated)

The proposed system architecture integrates Artificial Intelligence and Machine Learning models to provide intelligent agricultural solutions. In this system, the user (farmer) inputs essential data such as soil parameters (pH, nutrients) and basic crop-related information into the system through an interface. This data acts as the primary input for analysis. Once the data is entered, it is processed by multiple Machine Learning models designed for specific tasks. The crop recommendation model analyzes soil and weather conditions to suggest the most suitable crop. Simultaneously, the yield prediction model estimates the expected production, and the market price prediction model forecasts future crop prices. After processing, the system generates outputs in the form of best crop suggestions, expected yield, and predicted market prices. This integrated approach ensures that farmers receive complete decision support from a single platform. Overall, the architecture enables a data-driven, automated, and intelligent farming system.

➢ Data Collection

Data collection is a crucial step in building an effective Machine Learning-based agricultural system. The proposed system gathers data from multiple reliable sources to ensure accuracy and relevance. Soil data is collected from government datasets or agricultural databases, which include parameters like pH level and nutrient content (N, P, K). Weather data is obtained through APIs that provide real-time and historical information such as temperature, rainfall, and humidity. Additionally, market price data is collected from agricultural markets and online platforms, which include past and current crop prices. This diverse data is combined to create a comprehensive dataset that supports training and prediction. Proper data collection ensures that the system produces accurate and reliable results.

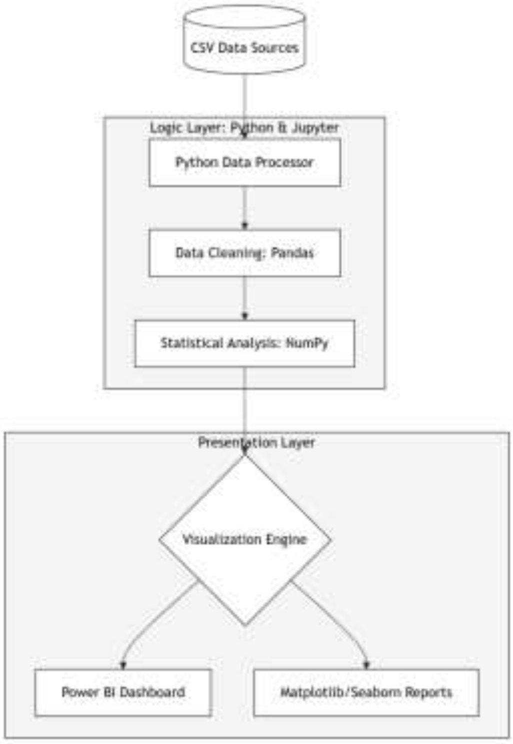

Fig2: System Architecture and Modeling

➢ Model Training Process

The model training process involves several important steps to build an accurate and efficient Machine Learning model. Initially, data collection is performed from various sources such as soil, weather, and market datasets. Next, the collected data undergoes data cleaning, where missing values, noise, and inconsistencies are removed to improve data quality. After cleaning, feature selection is performed to identify the most important parameters (e.g., rainfall, soil nutrients) that influence predictions. The processed data is then used for model training, where Machine Learning algorithms learn patterns and relationships between inputs and outputs. Finally, the model is evaluated through testing and accuracy measurement to ensure reliable performance. This systematic training process ensures that the models provide accurate predictions and effective decision support for farmers.

8. Results and Predictions

Model	Accuracy	Output
Crop Recommendation	85–95%	Best crop
Yield Prediction	80–90%	Expected production
Price Prediction	75–85%	Future prices

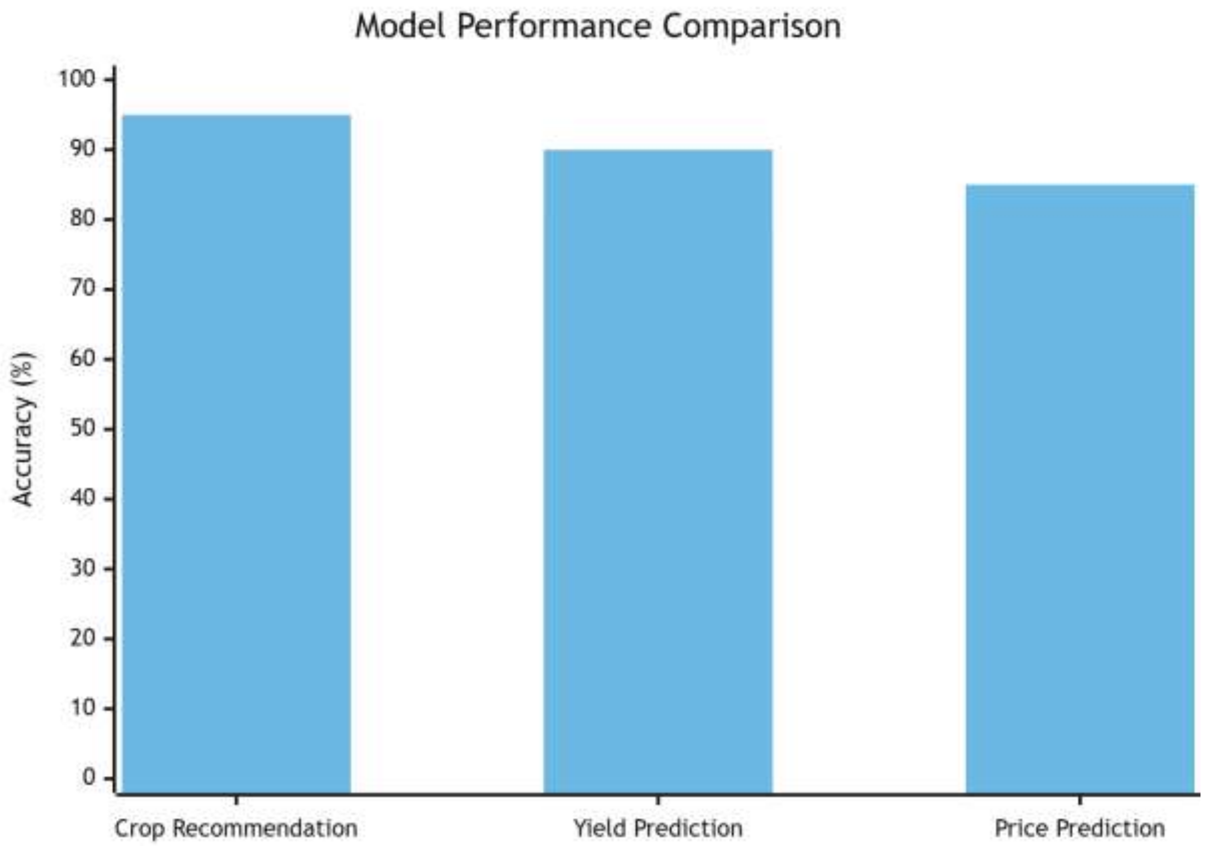

Fig3: Predictions (Crop, Yield, Price)

This graph shows the performance comparison of different models used in the system. It represents the accuracy range (minimum to maximum) for Crop Recommendation, Yield Prediction, and Price Prediction. Crop Recommendation has the highest accuracy (85–95%), followed by Yield Prediction (80–90%), while Price Prediction has slightly lower accuracy (75–85%). The graph helps to understand how well each model performs. It shows that all models provide reliable results for decision-making.

9. Findings

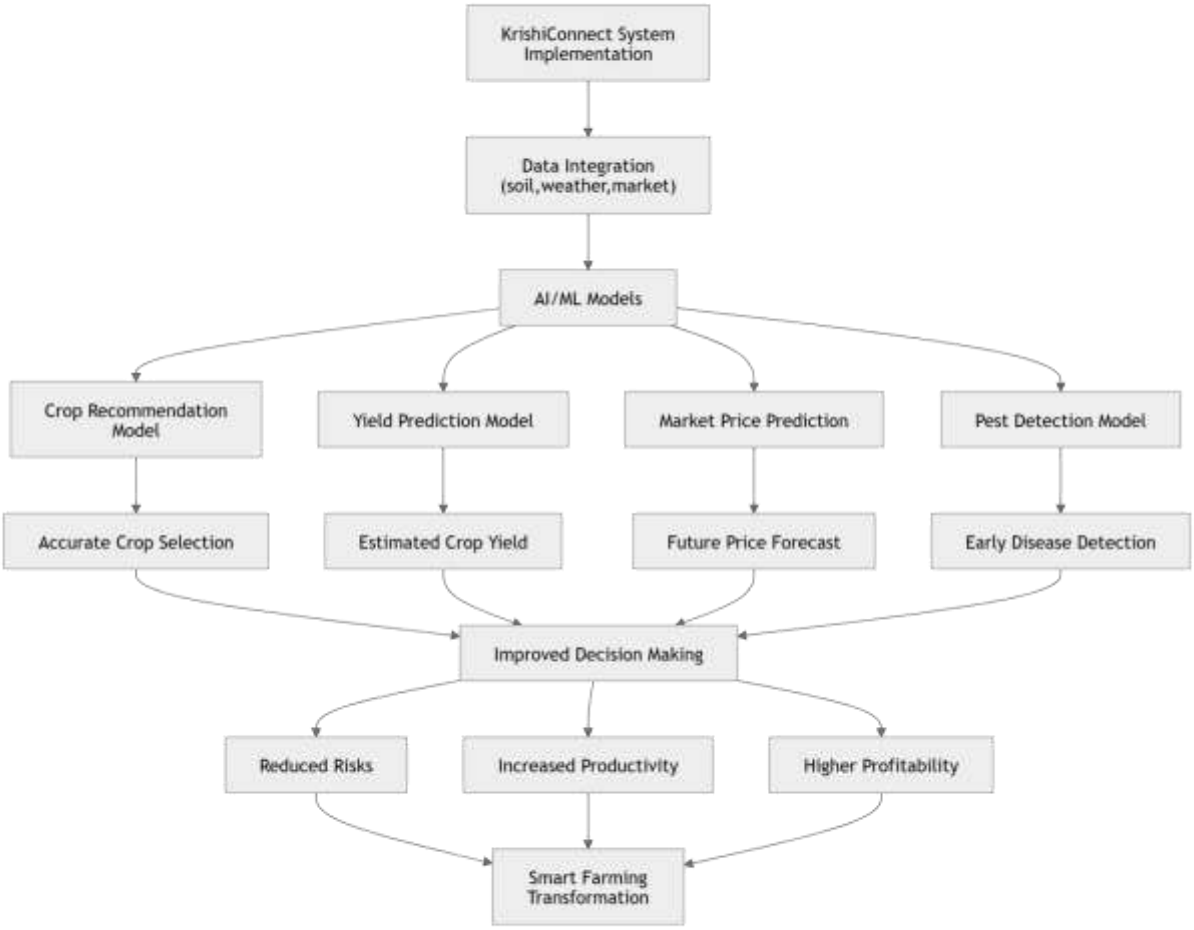

Fig4: Findings

The implementation of the KrishiConnect system using AI and Machine Learning models has produced significant insights in the field of smart agriculture. The study shows that integrating data from soil, weather, and market sources leads to more accurate and reliable agricultural predictions. The Crop Recommendation Model demonstrated high effectiveness in suggesting suitable crops based on soil nutrients and environmental conditions, helping improve crop selection. The Yield Prediction model provided reasonably accurate estimates of crop production, enabling better planning of resources such as water and fertilizers.

The Market Price Prediction model successfully identified patterns in historical price data and provided useful forecasts, allowing farmers to make informed selling decisions. Additionally, the optional Pest Detection module showed the ability to identify plant diseases at an early stage, reducing potential crop losses.

Overall, the findings indicate that AI and ML-based systems can significantly enhance decision-making in agriculture, reduce risks, and improve productivity and profitability. The results confirm that adopting a data-driven approach can transform traditional farming into a more efficient and intelligent system.

10. Advantages of AI Integration

The integration of Artificial Intelligence (AI) and Machine Learning (ML) in agriculture offers significant benefits by transforming traditional practices into data-driven processes. One of the key advantages is data-driven farming, where decisions are made based on analyzed data rather than assumptions or experience. This leads to more accurate and reliable outcomes. AI also helps in reducing losses by predicting unfavorable conditions such as poor weather or low yield in advance, allowing farmers to take preventive measures. It enables better profit decisions through market price prediction, helping farmers choose the right time to sell their crops. Additionally, AI supports smart irrigation and fertilizer usage by analyzing soil and weather conditions, ensuring optimal use of resources. This not only improves crop productivity but also reduces wastage and environmental impact.

11. Challenges

Despite its advantages, the implementation of AI in agriculture faces several challenges. One major issue is data availability, as accurate and large datasets are required to train effective models. In many rural areas, such data may be limited or incomplete. Another challenge is internet access in rural regions, which can restrict the use of real-time data and online systems. Since many AI-based applications depend on cloud services and APIs, lack of connectivity can affect system performance. Furthermore, model accuracy depends on data quality. If the data used for training is noisy, outdated, or incorrect, the predictions generated by the system may not be reliable. Therefore, maintaining high-quality data is essential for successful implementation.

12. Conclusion

This research enhances the existing KrishiConnect system by integrating Artificial Intelligence and Machine Learning models for predictive analysis. The system shifts agriculture from traditional methods to smart farming by providing intelligent and automated solutions. It offers accurate crop recommendations, yield predictions, and market price forecasts, enabling farmers to make informed decisions. The inclusion of real-time insights further improves planning and resource management. Overall, the proposed system improves productivity, reduces risks, and increases profitability, making agriculture more efficient and sustainable.

13. Future Scope

The proposed system can be further improved by incorporating advanced features and technologies. One potential enhancement is the development of a mobile application with an AI assistant, making the system more accessible to farmers. The addition of voice support in local languages can improve usability, especially for farmers who are not familiar with digital interfaces. Future systems may also include drone-based crop monitoring, which can provide real-time field analysis and detect issues more efficiently. Another promising area is the use of blockchain technology for supply chain management, ensuring transparency, traceability, and fair pricing in agricultural markets. These advancements can further strengthen the system and contribute to the development of a fully digital and intelligent agricultural ecosystem.