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Intelligent Agriculture Decision Support System Using Artificial Intelligence

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Abstract
Our Intelligent Agriculture Decision Support System using AI started as a simple idea: give farmers one place to get clear answers. Not scattered tools. One platform. It now supports the full farming from checking the soil to planning what to grow and when to sell. We built it mainly for new and small farmers who don't always have quick access to experts. The system mixes several AI modules such as soil image classification with CNNs, crop suggestions based on context reasoning, fertilizer planning, pest and disease alerts, weather checks, and plant growth tracking. Everything runs through one backend that handles fast responses and structured decision rules, so the advice feels specific to each user. When a farmer uploads a soil photo, the model reads it and identifies the soil type. Then the system looks at climate, location, and market signals to craft a crop list that actually makes sense for that region. Fertilizer plans and growth timelines come from tuned prompt setups that generate short, farmer friendly messages. The pest and disease feature scans plant images, spots early issues, and pulls treatment steps from expert approved notes. Weather and market modules keep updating in the background, helping the user avoid sudden risks.

Keywords: *Artificial Intelligence, Smart Agriculture, Crop Recommendation, Plant Disease Detection, Decision Support System*

1. Introduction
Agriculture plays a major role in providing food, employment, and economic stability in many countries. A large number of people depend on farming as their primary source of income. However, farmers often face many difficulties while making decisions related to crop selection, soil management, disease control, and irrigation planning[4]. In addition, unpredictable weather conditions and market price fluctuations can further complicate agricultural planning. Traditional farming practices mainly rely on farmers' experience and manual observations. While these methods have been used for generations, they may not always provide accurate results in modern agricultural environments. The rapid growth of technologies such as Artificial Intelligence (AI), Machine Learning (ML), and data analytics has opened new possibilities for improving agricultural productivity. Recent advancements in Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning have opened new opportunities for improving agricultural practices. These technologies allow large amounts of agricultural data to be analyzed efficiently and provide intelligent recommendations to farmers [1].

1.1.Soil Image Classification and Crop Recommendation
Soil quality plays a critical role in agricultural productivity. Different crops require specific soil characteristics such as texture, nutrient content, and moisture level. Identifying soil type accurately can help farmers choose crops that are most suitable for their land. The proposed system uses Convolutional Neural Network (CNN) models to analyze soil images and classify soil types automatically. Based

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on the identified soil characteristics, the system recommends crops that are likely to produce higher yields under those conditions.

1.2.Plant Disease Detection using Deep Learning

Plant diseases can significantly reduce crop yield and quality if not detected at an early stage. Traditional disease identification methods rely on manual inspection by farmers or agricultural experts, which may be time-consuming and inaccurate[6].In the proposed system, deep learning models analyze plant leaf images to identify disease symptoms. Once a disease is detected, the system provides information about possible treatments and preventive measures. Early detection allows farmers to take immediate action and minimize crop damage [2].

2. Method

The proposed Intelligent Agriculture Decision Support System works by integrating multiple AI based modules to assist farmers in making better agricultural decisions. Initially, the farmer uploads soil images and plant leaf images through the system interface[7]. These images are preprocessed to remove noise and improve image quality before being analyzed using deep learning models such as Convolutional Neural Networks (CNN) [5]. Tables and Figures are placed in the middle and as indicated below and referred to in the manuscript shown in Table 1.

Table 1 Dataset Distribution Used in the Proposed System

Category	Count	Percentage
Soil Images	6365	10.5%
Plant Disease Images	54305	89.5%
Total	60670	100%

The architecture of the Intelligent Agriculture Decision Support System using Artificial Intelligence on the high level shown in Figure 1.

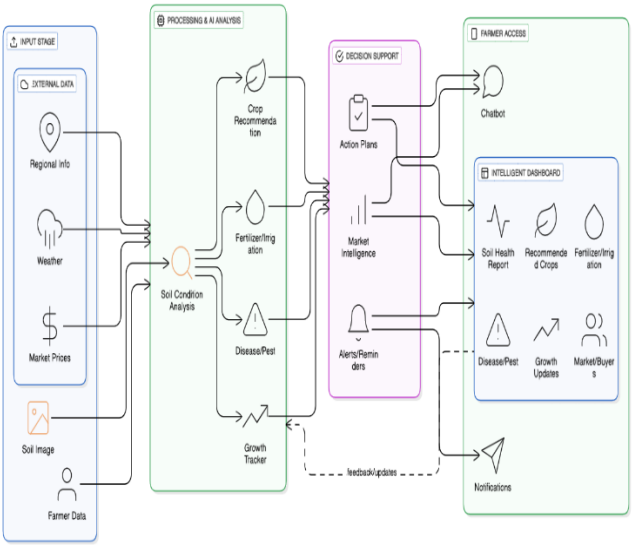

Figure 1. Overall System Architecture.

3. Results And Discussion

3.1.Results

These modules include soil classification, disease detection, crop recommendation, fertilizer advisory, weather forecasting, and market price analysis shown in Table 2.

Table 2 Soil Classification Model Performance

Metric	Value
Accuracy	95.3%
Precision	94.4%
Recall	95.0%
F1-score	94.8%

Table 3. Plant Disease Detection Model Performance

Metric	Value
Accuracy	96.8%
Precision	96.2%
Recall	97.1%
F1-score	96.6%

3.2..Discussion

The results demonstrate that integrating artificial intelligence techniques in agriculture can significantly improve decision-making for farmers. The soil classification and disease detection modules

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help farmers identify problems at an early stage and take appropriate actions[8]. The crop recommendation system assists farmers in selecting crops that are suitable for their soil and environmental conditions. By combining weather forecasting and market insights, the system provides a comprehensive platform that supports farmers throughout the farming cycle. Overall, the proposed system has the potential to increase crop productivity[3], reduce agricultural risks, and promote sustainable farming practices. Additionally, the system improves farming efficiency by providing real-time recommendations based on available data. Farmers can easily access important information such as crop suitability, disease prevention methods, and fertilizer usage through a simple interface. This reduces dependency on manual observation and traditional farming methods. The integration of multiple intelligent modules makes the system more effective in supporting modern agricultural practices shown in Figure 2.

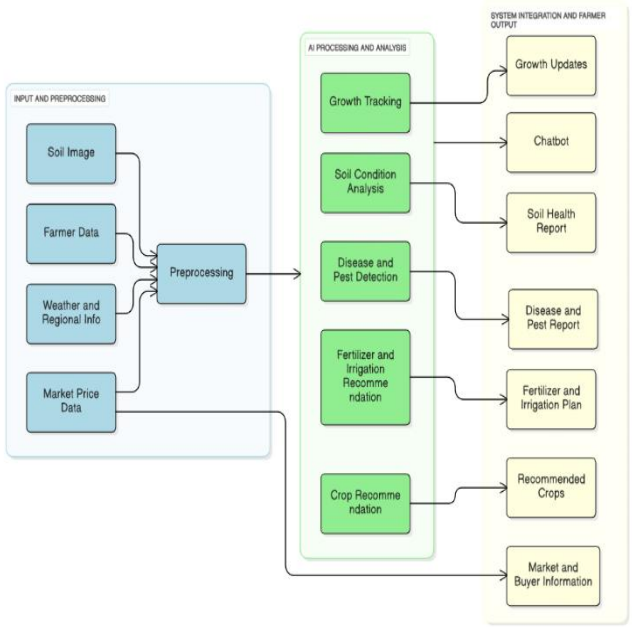

Figure 2. Intelligent Agriculture Decision Support System using Artificial Intelligence diagram of the workflow.

Conclusion

This study presented an AI-based Intelligent Agriculture Decision Support System that helps farmers make better agricultural decisions. The system combines several important modules such as soil analysis, plant disease detection, crop recommendation, fertilizer guidance, weather forecasting, and market information. By integrating these features into a single platform, the system provides useful insights that support farmers in planning and managing their farming activities more effectively.

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