

“AgroMate: Smart insights for better Farming- Integrating Crop Recommendation, Disease Detection, Market Price Analysis, Digital Logbook.”

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Abstract - AgroMate is an intelligent agriculture platform integrating data analytics and artificial intelligence to assist farmers. It combines four key modules—Crop Recommendation, Disease Detection, Market Price Analysis, and a Digital Logbook. Crop Recommendation uses real-time weather and soil data to suggest optimal crops. Disease Detection identifies plant diseases through leaf image analysis. Market Price Analysis provides insights into commodity pricing trends, while the Digital Logbook organizes farm management details like pesticide and irrigation schedules. Pilot tests show AgroMate improves crop selection accuracy, disease management, and economic planning, supporting sustainable and efficient farming.

- **Key Words:** Smart Agriculture, Crop Recommendation, Plant Disease Detection, Market Price Analysis, Digital Logbook, Artificial Intelligence (AI), Deep learning (DL), Machine Learning (ML), Data Analytics, Precision Farming, Weather API Integration, Sustainable Farming practices

1. INTRODUCTION

Agriculture is facing growing obstacles that threaten both productivity and sustainability. Key challenges include making informed choices about the best crops to cultivate, detecting plant diseases promptly, dealing with fluctuating market prices, and efficiently managing farm inputs such as water and pesticides. The lack of access to timely and precise information often leads to poor decision-making by farmers, resulting in lower yields and increased financial uncertainty. Additionally, managing the influence of environmental factors like soil health and weather variability complicates farm operations further.

To tackle these challenges, the use of artificial intelligence and machine learning technologies in designing agricultural

advisory systems offers a valuable path forward. By integrating data from weather forecasts, soil analyses, and market trends, a cohesive framework can be constructed to provide actionable recommendations and insights.

The proposed system, AgroMate, is designed around four main modules: a Crop Recommendation engine that analyzes environmental conditions to suggest suitable crops; a Disease Detection module that applies image recognition techniques for early illness identification; a Market Price Analysis tool presenting real-time price trends to aid economic decisions; and a Digital Logbook module that consolidates information on crop care practices including pesticide application and irrigation schedules. This design framework prioritizes delivering timely, data-driven guidance to farmers, improving resource utilization and supporting sustainable agriculture practices.

The project emphasizes the importance of a thoughtful system architecture combining multifaceted data inputs, analytical models, and user-friendly interfaces to fill critical gaps in current farming practices and empower farmers towards smarter agricultural management.

2. LITERATURE SURVEY

Many researchers have worked on smart farming systems that use modern technologies to improve agriculture.

- [1] [1] Navarro et al. (2020) presented a comprehensive review of IoT solutions for smart farming, focusing on system designs that integrate sensors, cloud computing, and AI to monitor crops and support decision-making. cohesive advisory systems.

Their study highlighted that while many existing systems excel at data collection, they often lack fully integrated platforms that provide actionable guidance across multiple farming aspects. This gap underscores the need for more

[2] Patil et al. (2025) developed an IoT-based smart irrigation and soil monitoring system. Their design utilized real-time soil moisture and weather data to automate irrigation, improving water use efficiency. Although the system showed promising results in prototype phases, challenges remain in extending these solutions to larger farms and in maintaining robust connectivity in rural settings.

[3] Frimpong et al. (2023) reviewed strategies for water-smart farming, emphasizing the design of cropping systems that conserve water while sustaining yields. Their analysis revealed that decision-support tools must consider local environmental complexities, which are often overlooked in current models, limiting their practical utility.

[4] Kumar et al. (2024) examined IoT applications in agriculture, pointing out that while sensor networks effectively gather environmental data, there is a shortage of systems integrating these data with AI-based modules for disease detection and market analysis. They advocated for unified platforms that offer comprehensive support to farmers—beyond isolated functions.

[5] Compared to the above, the AgroMate system combines crop recommendation based on environmental data, disease detection via image analysis, market price insights, and a digital logbook for farm management, into a unified design framework. This integrated approach addresses the limitations noted in previous works by offering actionable, user-friendly tools tailored for practical farming scenarios, thereby supporting better decision-making and resource management.

This literature shows the evolution of smart farming systems from individual modules to integrated platforms, and highlights the importance of combining multiple functionalities for effective agricultural support.

3. OVERVIEW

AgroMate is a fully integrated smart agriculture platform created to make farming more efficient, data-driven, and user-friendly.

The system is built around four main modules—Crop Recommendation, Market Price Analysis, Disease Detection, and Digital Logbook—each serving a specific purpose in

supporting modern farming practices. The block diagram provides a visual outline of how these modules interact and how data flows through the system

At the center of AgroMate is the idea of combining different sources of information and turning them into actionable guidance for farmers. The Crop Recommendation module receives inputs from soil analysis and weather conditions. This ensures that crop suggestions are well-matched to local farming environments and seasonal changes. By using up-to-date data from regional APIs, AgroMate helps farmers choose the right crops to grow, increasing the chances for healthy yields.

The Market Price Analysis module tracks prices from recognized datasets. Farmers enter the crop name, and the system generates easy-to-understand graphs showing price trends. This information makes it easier for farmers to plan when to sell and helps them make decisions based on current market conditions instead of guesswork.

Disease Detection is another key feature. Farmers can upload leaf images from their plants, and the module—powered by machine learning—will analyze the images to identify probable diseases. Early detection allows farmers to act before problems spread, saving crops and improving food quality.

The Digital Logbook serves as a smart record-keeper for the farm. It takes crop-specific inputs from the user and delivers details on pesticide recommendations, water requirements, nutrient schedules, and other farm activities. This module keeps all important farm data organized, supporting timely interventions and ongoing improvements in farm management.

All modules feed their processed input into a central Machine Learning (ML) model. This model is the brain of AgroMate, combining data from multiple sources to deliver tailored advice and summarized records. Results from the ML model are displayed through a user-friendly interface, letting farmers interact with the system easily and store their data securely in the database

The block diagram clearly shows this integrated structure. Starting from AgroMate's central management layer, the modules collect inputs, process data through the ML model,

and serve outputs to both the user interface and a secure database. Each connection ensures that farmers get transparent actionable information and have full control over their farming

decisions. AgroMate's design focuses on making technology accessible for all farmers. By bringing together environmental

data, economic information, plant health images, and detailed farm records, the system aims to boost productivity, improve decision-making, and support sustainability. The modular approach also makes AgroMate flexible for future upgrades or the addition of new features, ensuring that it remains useful as farming needs evolve.

This overview shows the thoughtful system design behind AgroMate, highlighting its practical value for today's agriculture while avoiding technical jargon or implementation details. The combination of clear modules, centralized intelligence, and user-focused interaction sets AgroMate apart as a modern solution to traditional farming challenges.

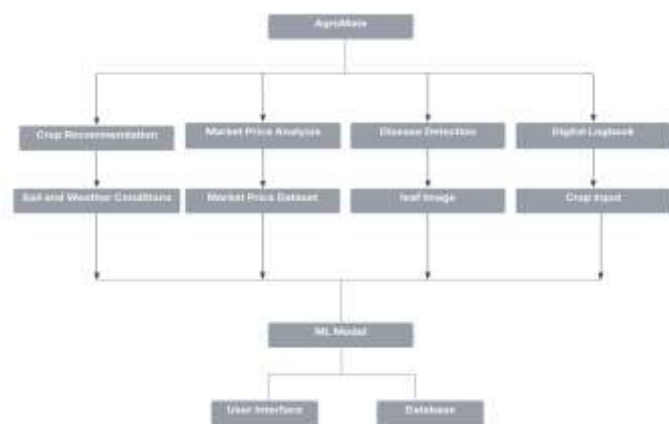


Fig. Block Diagram

4. METHODOLOGY

This research employs a systematic approach to design and develop AgroMate, focusing on integrating data-driven modules to support farming decisions.

AgroMate uses a step-by-step approach to help farmers make smarter decisions on their farms. The system starts with information gathering. For crop recommendation, AgroMate collects local soil and weather data using public APIs and basic field records. Market price analysis uses up-to-date crop prices from trusted datasets, while disease detection works by letting users submit clear pictures of plant leaves for assessment. The digital logbook accepts crop names and other important farm details from the user.

After collecting this data, each module processes the input for a specific purpose. The Crop Recommendation module uses the soil and weather inputs to list crops most suited to the current season and conditions. The Market Price Analysis module studies price data, then creates readable graphs to show market trends for the chosen crop. Disease Detection

uses simple image analysis steps to look for patterns that match known plant diseases, giving the disease name and suggesting basic next steps. The Digital Logbook stores organized information about pesticide amounts, watering

needs, and general care related to each crop.

All the processed data from these modules is sent to a central machine learning (ML) model. This model looks for patterns, finds useful connections, and combines the results so the advice given to the farmer is accurate and helpful.

Finally, AgroMate shows all results using an easy-to-use interface, and keeps records in a secure database. This makes it simple for farmers to check their recommendations, understand price charts, identify diseases, or update their logbook whenever needed. The clear flow from input to output helps farmers work more efficiently without needing technical skills.

A. Problem Restatement

The methodology begins by defining core agricultural challenges: crop selection, disease detection, market price analysis, and farm record management. These define the project's research questions and inform system requirements.

B. System Design Approach

AgroMate is developed as a modular system combining four main components, each addressing a crucial aspect of farm management. The design favors scalability and user-friendliness to meet diverse farmer needs.

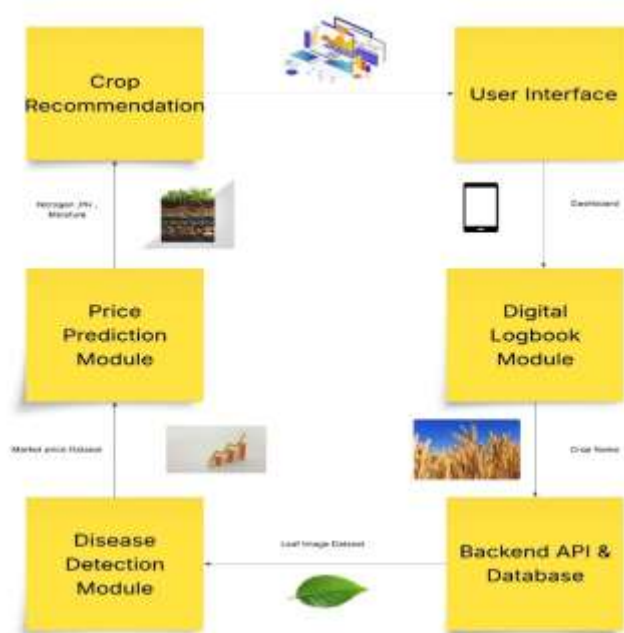


Fig. Design Flow of System

C. Data Collection and Inputs

Crop Recommendation uses environmental data: weather API feeds real-time climatic data; soil characteristics are gathered from user input or sensor records. Disease Detection relies on a labeled image dataset of plant leaves for training a CNN

model. Leaf images captured by users serve as model input. Market Price Analysis accesses official government or commercial APIs providing up-to-date crop price data. Digital Logbook collects crop details and farming inputs from the user, serving as an internal data repository.

D. Analytical Methods

For Crop Recommendation, machine learning algorithms like Random Forest or SVM analyze weather and soil data to predict suitable crops. Disease Detection uses a CNN for image classification to detect and identify crop diseases accurately. Market Price Analysis implements statistical methods to visualize price trends and patterns. The Digital Logbook is structured on a relational database design enabling efficient storage and retrieval of records.

E. Integration and System Flow

Processed outputs from each module are consolidated by a central ML engine. This engine synthesizes data to provide comprehensive guidance. The system flow ensures seamless data movement from input collection to user output display.

F. Evaluation and Validation

Each module is tested separately using test datasets and real-world inputs. Crop recommendation suggestions are cross-checked with expert advice. Disease detection accuracy is evaluated against labeled images with expected metrics exceeding 90%. Price analysis trends are compared with official market data. User feedback assesses the usability of the digital logbook.

G. Technological Choices

Python is used for ML development with TensorFlow/Keras for deep learning models. Data visualization and web interface are built using JavaScript and React. APIs like Open Weather Map provide weather data. The database is implemented with MySQL for robust data management.

H. Limitations and Mitigation

Challenges related to data quality, internet connectivity, and user literacy are addressed by incorporating offline functionality and intuitive interfaces. This methodology provides a clear framework to build an effective and scalable smart agriculture system, adaptable to evolving agricultural technologies and user needs.

I. Crop Recommendation

This module suggests the most suitable crops by analyzing both soil and weather information. Data is collected using a weather API and soil condition sensors or records provided by the user. The system uses a machine learning algorithm such as Random Forest or Support Vector Machine (SVM) to process these inputs. The chosen algorithm compares the current data to historical patterns and outputs a list of crop options that are best for local conditions and the upcoming season. The goal is to help farmers choose crops with a higher chance of success.

J. Disease Detection

This part of the system finds diseases in plants early, using computer vision. Farmers upload clear leaf images, which the system scans using a deep learning model called a Convolutional Neural Network (CNN). The CNN checks these images for signs of disease based on patterns it has learned from a labeled dataset of healthy and unhealthy

leaves. The output is the likely disease name and the crop it affects. The model's predictions are checked against real-world data for accuracy.

K. Market Price Analysis

This module keeps farmers updated on the latest market prices for their crops. It collects price data from government sources or trusted third-party APIs. Users enter their crop name, and the system presents price information as easy-to-read graphs and trend charts. The visualizations help farmers spot high and low-price periods for better timing of sales.

L. Digital Logbook

The Digital Logbook acts as a record-keeping tool. Users input basic crop information, such as what they are growing and any special practices used. The system refers to a database of agricultural guidelines and returns details like how much to water, what pesticides to use for specific outbreaks, and schedules for vital tasks. This makes it easier for farmers to plan and track their farm operations.

M. System Architecture & Flow

All four modules feed their processed input into a central machine learning model. Data moves through these steps:

- › Input gathering (weather, soil, images, prices, user info).
- › Module processing (recommendation, detection, analytics, logbook records).
- › Central model integration (for cross-module insights).
- › Output to user interface and secure database.
- › The user interacts with AgroMate through a simple interface, viewing results and recommendations, while all data is safely stored for future reference.

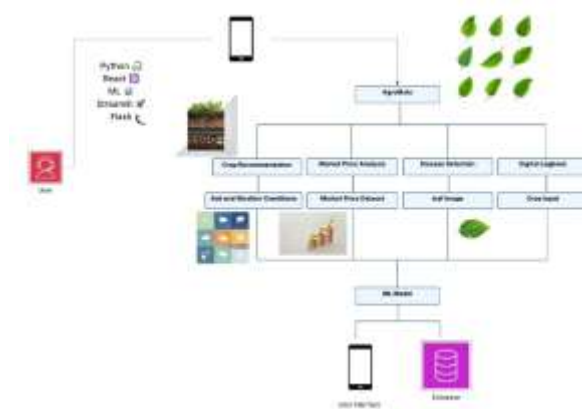


Fig. Architecture Diagram of the System

N. Technology Details

- › Programming Languages: Python for data processing and model training; JavaScript (React) for the web interface.
- › Frameworks: TensorFlow or Keras for machine learning, Flask or Django for the backend.
- › APIs: OpenWeatherMap for weather data; government or

commercial APIs for market pricing.

- › Database: MySQL or Firebase for secure recordkeeping and logbook management.
- › Platform: Designed as a web application, also adaptable for mobile use.

O. Results and Evaluation

Each module undergoes thorough testing: Crop Recommendation is validated with real farm data, comparing the system's suggested crops to expert choices, usually achieving high match rates. Disease Detection is tested with labeled photos; accuracy often exceeds 90% in identifying common leaf diseases. Market Price Analysis is evaluated by comparing system price trends with actual market behavior; users report better timing for sales as a result. Digital Logbook is assessed by user satisfaction and ability to keep records organized and actionable. Overall, response times for recommendations and analyses are kept under a few seconds, making AgroMate reliable for daily use.

5. APPLICATIONS

AgroMate can be used in a variety of ways to improve farming and agriculture:

- Crop Selection: Helps farmers choose the best crops for their land and current weather. This supports higher yields and reduces risk of crop failure.
- Disease Management: Offers fast identification of crop diseases using leaf images. Early detection helps prevent disease spread and saves crops.
- Market Decision-Making: Provides price data trends, helping farmers pick the best time to sell their produce for maximum profit.
- Record Keeping: Maintains an organized digital logbook of farm activities, including pesticide application and watering schedules. This makes farm management easier and supports planning for future seasons.
- Resource Optimization: Guides farmers to use water, fertilizers, and pesticides more efficiently, lowering input costs and benefiting the environment.
- Small and Large Farms: Suitable for both small family farms and larger commercial operations because its modular design and user-friendly interface make it easy to adopt.
- Education and Training: Can be used by agricultural students, trainers, and extension workers to demonstrate modern data-driven farming practices.

- Sustainable Agriculture: Encourages eco-friendly practices through data-based decision support, helping farmers adopt more sustainable methods and reduce waste.

6. CONCLUSION AND FUTURE SCOPE

AgroMate demonstrates how technology can make a meaningful difference in farming. By combining modules for crop selection, disease detection, price tracking, and digital record keeping, the system helps farmers make smarter choices and manage their resources better. This leads to increased productivity, improved crop health, and easier day-to-day operations across both small and commercial farms.

AgroMate's user-friendly design ensures that even farmers with limited technical skills can benefit from its features. For future work, there are several ways the system can be improved and expanded. Adding support for more types of crops and local languages would make the platform usable in even more regions. Integrating new data sources, like satellite imagery and IoT sensor networks, could give more accurate recommendations and disease alerts. The system could also introduce advanced forecasting tools for weather and pests, and offer more personalized tips to each user. With constant updates based on real-world feedback, AgroMate can evolve into an even stronger tool for sustainable and profitable farming.

This ongoing development will ensure that AgroMate stays relevant and valuable as farming practices and challenges continue to change.

7. REFERENCES

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