

# Web-Based Crop Fatigue Analyser with Ai-Based Crop Disease Detection and Fertilizer Recommendation

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## Abstract

Agricultural productivity in rural regions is facing serious challenges due to soil degradation, late detection of crop diseases, and inefficient nutrient management. Farmers often struggle because they lack access to expert agronomic advice and modern digital tools, especially in areas with poor internet connectivity. As a result, crop yields decline, resources are wasted, and sustainability is threatened. To address these problems, we developed a web-based smart agriculture platform designed specifically for low-connectivity environments. The platform integrates artificial intelligence with rule-based analytics to provide farmers with simple, practical, and timely guidance. It features a farmer dashboard that shows soil health and crop status, an easy-to-use interface for monitoring and decision-making, and built-in tools for nutrient and disease management. Because of its lightweight design, the system can run smoothly on basic devices and deliver insights even in remote areas. Farmers receive localized recommendations that help them act quickly, reduce losses, and improve productivity.

This paper presents the design and development of the smart agriculture platform, explaining its system architecture, technologies used, and core functionalities that make it an accessible solution for sustainable farming in rural communities.

**Keywords:** Agriculture ,Rural Farming, Crop Productivity, Plant Disease Detection, Fertilizer Recommendation, Soil Condition Analysis, Crop Suitability, Sustainable Farming, Smart Agriculture.

## 1. Introduction

The platform is designed to support farmers in three key ways. First, it checks the history of crops grown in a field to identify signs of soil weakness, since repeated cultivation of the same crop can reduce fertility. Based on this, it suggests practical measures such as changing crops, resting the land, or adding the right nutrients to restore soil health [a][b]. Second, it helps farmers detect crop diseases by analyzing leaf images, recognizing issues like fungal infections, bacterial spots, viral damage, or nutrient shortages. This early detection allows farmers to control the spread of disease and reduce losses, which is especially valuable in rural areas where expert guidance is limited [1][3][6][7]. Along with identifying diseases, the system also recommends suitable fertilizers based on crop condition and soil health, ensuring farmers take timely and effective action [2][b]. Finally, the platform provides personalized fertilizer advice that balances nutrient needs with environmental sustainability, helping farmers improve productivity while protecting the land [2][3][c][d][e][f].

### 1.1 Problem Statement :

Farmers often grow the same crop again and again, which slowly makes the soil weak and less fertile. Many don't notice crop diseases early, and they often use the wrong type or amount of fertilizer. These problems lead to lower harvests and less income. Most tools that could help are either too expensive, not available in local languages, or need fast internet things many farmers don't have. That's why there's a need for easy to-use, affordable tools that work in local languages and don't depend on strong internet.

### 1.2 Significance

This study is significant because it helps farmers overcome major challenges like soil degradation, late disease detection, and inefficient fertilizer use. By combining artificial intelligence with rule-based analytics, the platform provides simple, localized, and timely recommendations. It empowers farmers to choose suitable crops, manage nutrients wisely, and act quickly against diseases. The lightweight design ensures accessibility even in low-connectivity rural areas, improving productivity, sustainability, and food security.

### 1.3 Proposed Solution

The proposed solution is a smart agriculture web application that uses artificial intelligence and rule-based analytics to support farmers. It detects plant diseases early, recommends suitable fertilizers, and analyzes soil conditions to suggest the most appropriate crops. With a farmer-friendly dashboard and lightweight design, the system works even in low-connectivity areas, helping farmers make quick, informed decisions that improve productivity and sustainability.

## 2. Literature Review

Farming is very important for rural areas, but farmers face many problems such as poor soil quality, late detection of crop diseases, and wrong use of fertilizers. These issues reduce crop yield, waste resources, and make farming less sustainable [a]. Researchers have shown that artificial intelligence can help by detecting plant diseases early using computer vision and deep learning methods [1][3][6][7]. Studies also explain how AI can be combined with IoT devices, drones, and mobile apps to give farmers real-time support and practical guidance [2][4].

At the same time, research shows that pests and diseases cause huge crop losses every year, especially in India, where losses remain very high compared to global averages [5]. This highlights the need for eco-friendly methods like integrated pest management and biopesticides, which can reduce damage without harming the environment [6][7]. Another important challenge is that many farmers in rural areas do not have access to expert advice or modern digital tools, especially in places with poor internet connectivity [b].

Along with these studies, I carried out my own observations specifically in my hometown, Khopi Shirgoan, Khed, Ratnagiri, where farmers struggle with soil degradation, lack of disease detection, and limited guidance on fertilizer use. I noticed that many farmers rely on traditional practices and guesswork, which often leads to lower productivity and financial losses. These firsthand insights confirm the urgent need for a simple, web-based smart agriculture platform that can provide disease alerts, fertilizer suggestions, and crop recommendations based on soil condition. Because of its lightweight design, such a system can run on basic devices and work even in low-connectivity areas, helping farmers make better decisions, improve yields, and move towards sustainable farming [2][3][c][d][e][f].

### 3. Methodology (Development Process)

#### 3.1 Design of Research

To build a structured approach for analyzing and implementing a technology-based solution for farmers in rural areas, this research follows a design and development methodology. The focus is on iterative improvement of a smart agriculture web application by combining insights from existing studies [1][2][3][4], best practices in AI-based crop management [6][7], and advancements in web development technologies [c][d][e][f]. Through systematic designing, developing, and testing of the application, the research aims to create a scalable and farmer-friendly platform that supports disease detection, fertilizer recommendation, and soil-based crop suitability, while addressing the challenges observed in rural communities such as Khopi Shirgoan, Khed, Ratnagiri [a][b].

#### 3.2 Information Gathering

**Secondary Data** A critical review of scholarly journals, research papers, and agricultural reports was conducted. These studies provided insights into crop disease detection methods [1][3][6][7], fertilizer usage patterns [2][b], and the impact of soil conditions on crop productivity [a]. They also highlighted challenges such as lack of timely expert advice, poor infrastructure, and high crop losses due to pests and diseases [5].

**Technical Research** A detailed study of existing AI-based agricultural platforms [2][3][4][6][7] and e-commerce systems was undertaken to identify suitable technologies, security models, and user experience (UX) practices [c][d][e][f]. This investigation guided the selection of frameworks for scalability, API development, and database performance, ensuring the platform could serve farmers effectively even in low-connectivity rural areas [b].

#### 3.3 Architecture of the System

The system architecture is divided into four main components: frontend, backend, database, and AI/NLP modules.

**Frontend:** Built using HTML, CSS, JavaScript, to provide a responsive and user-friendly interface for image upload, symptom entry, and viewing results [c].

**Backend:** Developed with Python (Flask) to handle routing, API endpoints, and server logic. REST APIs enable communication between the frontend and AI modules, while authentication ensures secure login and session management [d][e].

**Database:** Implemented using SQLite or MySQL to store user data, image metadata, disease records, fertilizer mappings, and optional symptom logs [b].

**AI Module:** Uses TensorFlow/Keras for training convolutional neural networks (CNNs) on labeled crop disease datasets [1][2][3][6][7][d]. OpenCV and NumPy are applied for image preprocessing and feature extraction [f].

**NLP Module (Optional):** Employs spaCy for keyword extraction from farmer-entered symptom descriptions, refining diagnosis and improving recommendations [e].

### 4. Design and Implementation

- **Frontend:** HTML, CSS (Responsive Web Interface)
- **Backend:** Python (Flask Framework)

- **Database:** MySQL
- **Machine Learning:** Image Processing & Disease Detection Models (Python libraries such as TensorFlow/Keras, OpenCV, Scikit-learn)
- **Authentication & APIs:** Flask-based REST APIs
- **Deployment/Hosting (optional):** Local Server

**System workflow**

**Step 1: User Authentication:**

Farmers log in to the system through the frontend interface (HTML/CSS). This ensures secure access and allows only registered users to use disease detection and fertilizer recommendation features.

**Step 2: Image Upload :**

Farmers upload crop images through the web interface for analysis. The system accepts these images and forwards them to the Flask backend for processing.

**Step 3: Disease Detection :**

The Flask backend uses machine learning models to analyze the uploaded crop images. It identifies possible diseases affecting the plant and prepares results for further recommendation.

**Step 4: Recommendation :**

Generation Based on the detected disease, crop type, and soil condition, the backend generates fertilizer suggestions. These recommendations are tailored to improve crop health and yield.

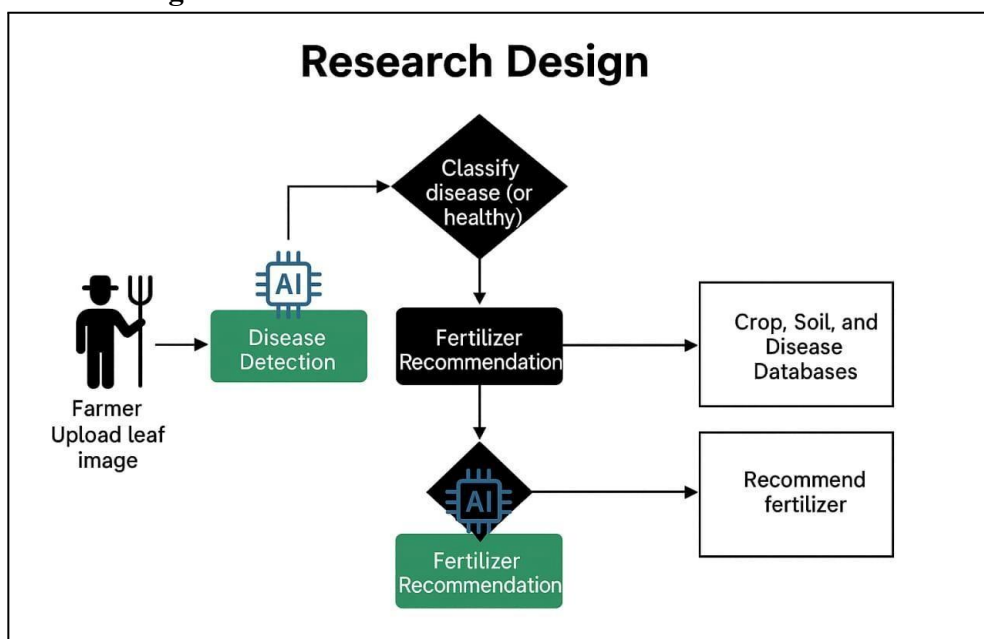
**Step 5: Database :**

Update The MySQL database stores disease detection results and fertilizer recommendations. This ensures that historical data is preserved for future reference and continuous improvement.

**Step 6: Report:**

Delivery Farmers receive a clear, farmer-friendly report through the frontend interface. The report contains disease detection results along with fertilizer recommendations for immediate action.

**System Architecture Diagram**



**Figure 1: System Architecture**

## 4.2 Technologies Used

Sr.no	Process	Technology Used
1	Image Upload through app or web interface	HTML/CSS, JavaScript, Python (Flask)
2	Image sent to CNN model for processing	Python, TensorFlow / Keras (CNN Model)
3	Model matches image with trained dataset to detect disease	Convolutional Neural Network (CNN), NumPy, OpenCV
4	Detected disease is displayed to the user	Python, Web Framework, Bootstrap for UI
5	Fertilizer recommendation is generated based on disease and soil data	Rule-Based System using Python (if-else logic / simple ML model)

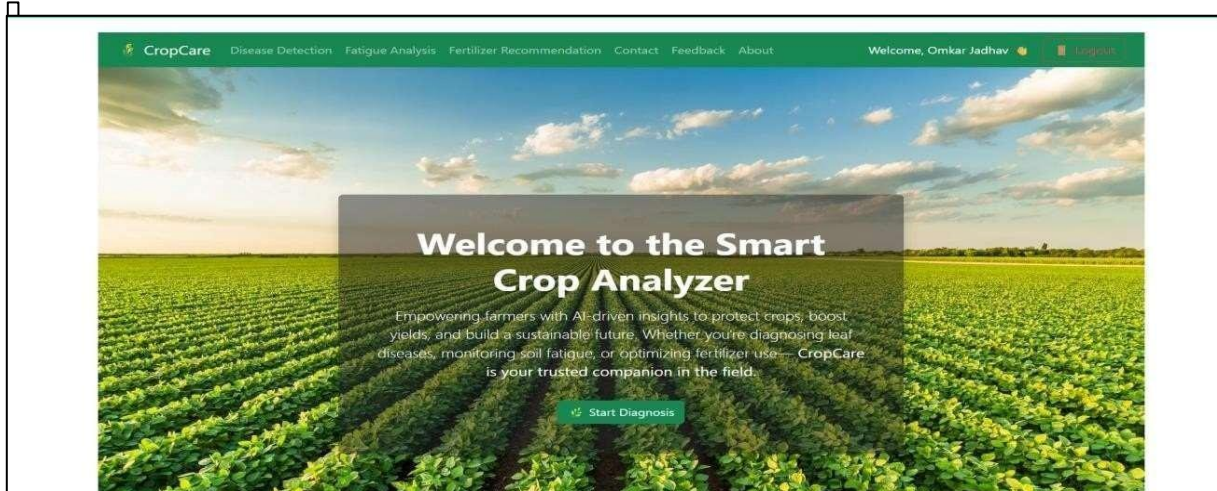
## 4.3 User Interface (UI) & Screenshots

- **Home Page:** Welcomes users with an overview of the system and easy navigation to key features.
- **Login and Registration Page:** Allows farmers to securely sign in or create a new account to access personalized services.
- **Fatigue Analysis Page:** Displays fatigue detection results based on crop condition or farmer input, with supportive suggestions.
- **Fertilizer Recommendation Page:** Provides tailored fertilizer advice based on crop type, soil condition, and detected disease.
- **Feedback Page:** Enables users to share their experience, suggestions, or issues to improve the system.
- **Contact Page:** Lists contact details and support options for farmers needing assistance or more information.
- **About Us Page:** Describes the purpose, mission, and team behind the system to build trust and transparency.

### 4.3.2 UI Screenshots The following figures illustrates the key UI screens

Figure No	Description
Figure 2	Homepage displaying an overview of the site including features, register/login options.
Figure 3	Allows farmers to upload crop images and get instant disease identification results.
Figure 4	Provides tailored fertilizer suggestions based on crop type and detected disease.
Figure 5	Displays crop health or fatigue analysis to guide better farming practices.
Figure 6	Enables users to share experiences, suggestions, or issues for system improvement.

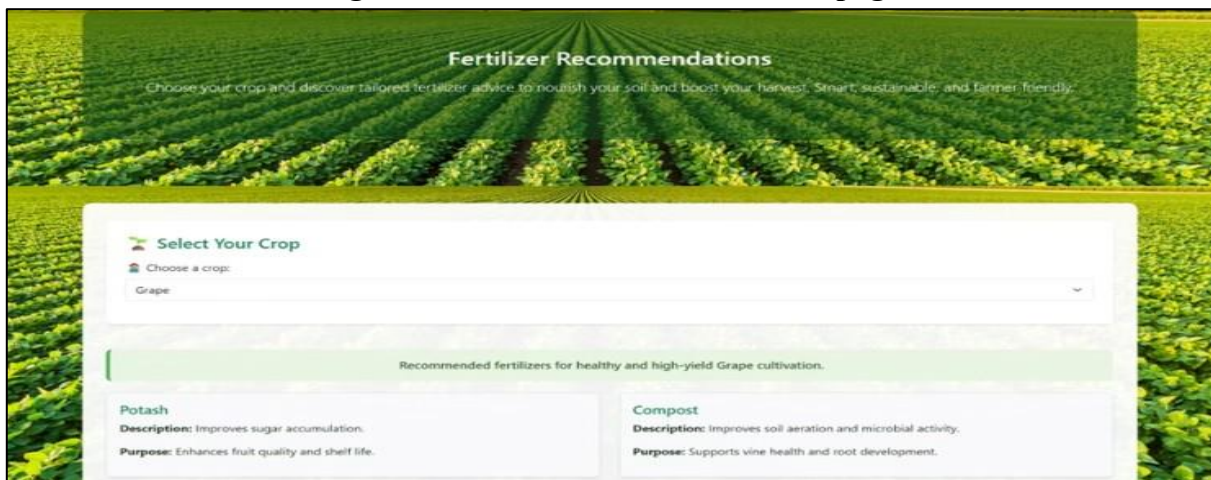
**Figure 2: Home Page**



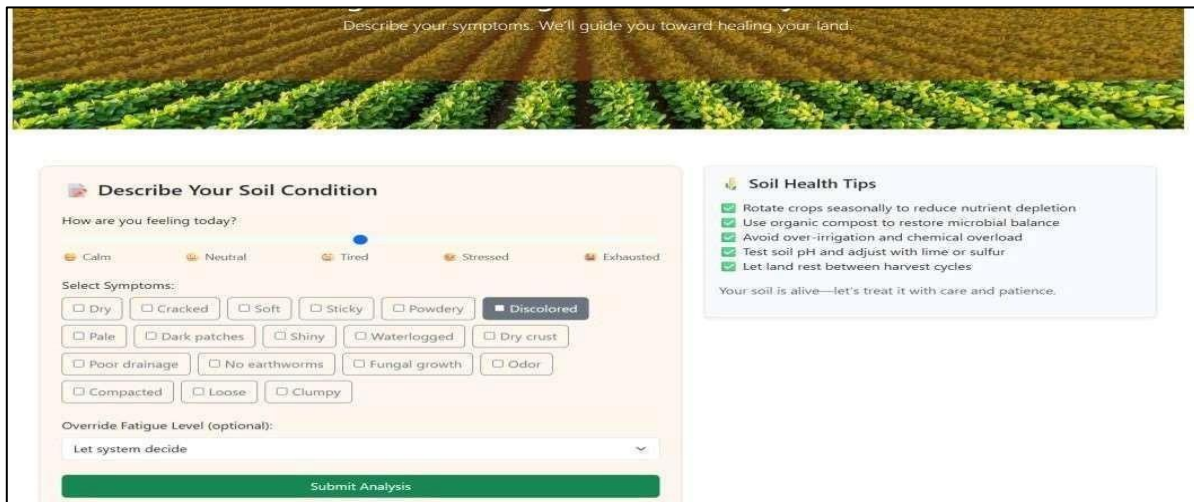
**Figure 3: Disease Detection page**



**Figure 4: Fertilizer Recommendation page**



**Figure 5: Fatigue analysis page**



## 6. Discussion

### 6.1 Strengths of the System

- **Farmer-Friendly Interface:** Simple HTML/CSS frontend makes it easy for farmers to use without technical expertise.
- **Disease Detection:** Machine learning models (TensorFlow/Keras, OpenCV, Scikit-learn) provide reliable crop disease identification.
- **Personalized Fertilizer Recommendations:** Tailored suggestions improve crop health and yield based on detected disease and crop type.
- **Secure and Scalable Backend:** Flask framework ensures smooth API handling, authentication, and scalability for future expansion.
- **Efficient Data Management:** MySQL database securely stores user details, disease results, and fertilizer records for long-term analysis.
- **Automation and Speed:** Reduces manual effort by automating disease detection and fertilizer advice, saving farmers time.
- **Continuous Improvement:** Historical data stored in the database can be used to refine models and improve accuracy over time.
- **Multilingual Support:** The system supports Hindi, English, and Marathi, ensuring accessibility for farmers across diverse regions.

### 6.2 Challenges and Limitations

- **Data Quality and Availability:** The accuracy of disease detection depends heavily on the quality of crop images and availability of diverse datasets. Poor or unclear images may reduce detection performance.
- **Model Accuracy:** Machine learning models may misclassify diseases if trained on limited or biased datasets, leading to incorrect recommendations.
- **Maintenance and Updates:** Continuous retraining of ML models and updating fertilizer recommendations are required to keep the system relevant and accurate.

### 6.3 Future Scope

- **Integration of Real-Time Data:** Incorporating live soil, weather, and climate data to improve accuracy of recommendations.

- **Mobile Application Support:** Developing Android/iOS apps to make the system more accessible to farmers in rural areas.
- **Advanced Machine Learning Models:** Using deep learning techniques for higher accuracy in disease detection and fertilizer prediction.
- **IoT Integration:** Connecting sensors for soil moisture, pH, and temperature to provide real-time monitoring and automated recommendations.
- **Data Analytics Dashboard:** Providing insights and trends to farmers and agricultural experts for long-term planning.

## 7. Conclusion

This smart agriculture platform is a transformative solution designed to empower farmers in rural and underserved regions by bringing expert-level agronomic support directly to their fingertips without requiring costly infrastructure or advanced technical training [a][b].

It integrates artificial intelligence with rule-based analytics to deliver three core capabilities: soil fatigue detection, AI-powered crop disease identification, and personalized fertilizer recommendations [1][2][3][6][7]. Together, these features provide real-time, actionable insights that help farmers maintain crop health and maximize yields [2][3]. The platform is lightweight, browser-friendly, and optimized for low-bandwidth environments, ensuring accessibility even on basic mobile devices [c][d][e][f].

Its intuitive and supportive interface lowers barriers for users with varying levels of digital literacy, making advanced agricultural intelligence truly inclusive [b]. Beyond technical innovation, the platform promotes sustainability and resilience by enabling proactive farming practices, reducing crop loss, preserving soil health, and fostering long-term productivity [5][6][7].

In doing so, it bridges the gap between modern agricultural technology and grassroots farming needs, democratizing access to knowledge, strengthening food security, and supporting the socioeconomic fabric of rural communities [a][b]. At a time when climate change and population growth are intensifying pressures on global food systems, such solutions are not just beneficial—they are essential [a][5][6].

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