



# Crop Yield and Price Prediction System Using Deep Learning

Dr. Neelam Kumar<sup>1</sup>, Bhogawade Pallavi<sup>2</sup>, Jagadale Rutuja<sup>3</sup>, Jagdale Nisha<sup>4</sup>, Punde Pranjal<sup>5</sup>

<sup>1</sup>Professor, SRCOE, Department of Computer Engineering, Pune, Maharashtra, India.

<sup>2,3,4,5</sup> Student, SRCOE, Department of Computer Engineering, Pune, Maharashtra, India.

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**Abstract:** Agriculture is the primary source of livelihood for a massive population in India, particularly in states like Maharashtra. However, farmers face mounting challenges including unpredictable climate conditions, soil degradation, and increasing instances of crop diseases. To combat these issues, this research proposes an AI-Powered Crop Yield Prediction and Agricultural Diagnostic System that integrates Machine Learning and Computer Vision technologies into a unified platform. The system utilizes a Random Forest regression model to predict crop yield based on rainfall, temperature, soil nutrients (NPK), crop type, and seasonal data, achieving a high predictive accuracy of 91.64%. Furthermore, a Convolutional Neural Network (CNN) model is incorporated for early plant disease detection and treatment recommendation. The system is designed with a multi-layered architecture accessible via web and mobile interfaces, providing farmers with actionable insights to optimize resource management and agricultural productivity.

**Key Words:** Artificial Intelligence, Crop Yield Prediction, Plant Disease Detection, Precision Agriculture, Smart Farming, Computer Vision, Soil and Climate Analysis.

## I. INTRODUCTION

Agriculture plays a vital role in the economy of many developing countries, especially India, where a large portion of the population depends directly or indirectly on farming for their livelihood. In states such as Maharashtra, agriculture is not only an economic activity but also a major contributor to food security and rural development. However, modern agriculture faces several serious challenges including unpredictable climate conditions, irregular rainfall patterns, soil fertility degradation, pest infestations, and the increasing occurrence of crop diseases. These issues significantly affect crop productivity and often result in financial losses for farmers. Traditional farming decisions are generally based on experience and historical knowledge, which may not always be reliable in the context of changing environmental conditions.

With the rapid advancement of information technology, Artificial Intelligence (AI) and Machine Learning (ML) have emerged as powerful tools that can transform traditional agriculture into a more efficient and data-driven system. These technologies can analyze large volumes of environmental, climatic, and agricultural data to generate meaningful insights that assist farmers in making better decisions. Predicting crop yield in advance helps farmers plan their resources, manage finances, and optimize crop selection according to soil and weather conditions. The proposed AI-Powered Crop Yield Prediction and Agricultural Diagnostic System aims to address these agricultural challenges by integrating machine learning algorithms, computer vision techniques, and modern software technologies into a unified platform.

The platform is designed with a multi-layer architecture consisting of a Node.js and Express-based backend, a Python-based machine learning engine, and a MongoDB database for efficient data storage and management. The system is accessible through both a web-based dashboard developed using React and a mobile application designed for Android devices, ensuring usability for farmers in both field and office environments. By combining predictive analytics, automated disease diagnosis, and crop recommendation features, the system provides farmers with actionable insights that support smarter agricultural practices. Ultimately, this research demonstrates how artificial intelligence can be applied to improve crop productivity, reduce risks associated with farming, and contribute to the development of sustainable and technology-driven agriculture.

## II. PROBLEM STATEMENT

To Implement Crop Yield and Price Prediction System using Deep Learning.

## III. OBJECTIVES

- To forecast crop prices based on historical market data and trends.
- To analyze the impact of factors such as weather conditions, soil quality, and rainfall on agricultural output.
- To design an integrated system that provides both yield and price prediction in a single platform.

- To improve decision-making for farmers by providing reliable and data-driven insights.
- To develop a model using Deep Learning techniques for accurate prediction of crop yield.

### IV. LITERATURE REVIEW

Menon et al., in the paper “*Deep Learning Based Farm-Level Crop Yield Prediction*” (2025), proposed a model combining remote sensing data with weather and soil parameters. The study highlights that integrating satellite data improves prediction precision at a large scale. The authors concluded that multimodal deep learning models provide more accurate and scalable agricultural predictions. [1]

Shawon et al., in the paper “*Crop Yield Prediction Using Machine Learning: An Extensive Review*” (2025), analyzed various machine learning and hybrid models for yield prediction. The study highlights that ensemble and hybrid techniques improve robustness and performance. The authors concluded that hybrid AI approaches outperform traditional prediction models. [2]

Hernández et al., in the paper “*Predictive Models Based on Artificial Intelligence for Crop Yield Estimation*” (2025), proposed AI-based models integrating environmental and agricultural data. The study highlights the importance of sustainability and efficient resource usage. The authors concluded that AI-driven systems enhance agricultural productivity and support food security. [3]

Lionel et al., in the paper “*Comparative Study of Machine Learning Models in Crop Yield Prediction*” (2025), compared multiple models such as Random Forest, CNN, and Gradient Boosting. The study highlights that ensemble models achieve higher accuracy than individual models. The authors concluded that combining algorithms leads to better prediction performance. [4]

Nikhil et al., in the paper “*Machine Learning-Based Crop Yield Prediction in South India*” (2024), developed prediction models using regional climate and soil datasets. The study highlights that machine learning captures complex relationships between environmental factors and yield. The authors concluded that localized models improve prediction accuracy for specific regions. [5]

Yuan et al., in the paper “*Crop Yield Prediction Using UAV Remote Sensing and Machine Learning*” (2024), proposed a system using drone-based imagery and machine learning techniques. The study highlights that remote sensing provides detailed spatial information for prediction. The authors concluded that UAV-based systems enhance precision agriculture practices. [6]

Gopi et al., in the paper “*Crop Recommendation and Yield Prediction Using Hybrid Optimization Models*” (2023), proposed a hybrid system combining optimization algorithms with machine learning models. The study highlights that hybrid techniques improve both recommendation and prediction accuracy. The authors concluded that integrated systems provide better support for farmers. [7]

Benos et al., in the paper “*Machine Learning in Agriculture: A Comprehensive Updated Review*” (2021), provided insights into recent advancements in agricultural AI systems. The study highlights the integration of IoT, big data, and AI in farming. The authors concluded that smart agriculture systems improve efficiency and decision-making. [8]

Russello et al., in the paper “*Fertilizer Recommendation System Using Machine Learning*” (2020), developed a system that suggests fertilizers based on soil nutrients and crop type. The study highlights that proper fertilizer usage improves crop productivity and reduces environmental impact. The authors concluded that intelligent recommendation systems enhance sustainable agriculture. [9]

Shahhosseini et al., in the paper “*Forecasting Crop Prices Using Machine Learning Models*” (2020), proposed predictive models using time-series data and regression techniques. The study highlights that accurate price prediction helps farmers maximize profit. The authors concluded that ML-based forecasting systems can reduce market uncertainty. [10]

### V. SOFTWARE/HARDWARE REQUIREMENTS

#### Software Requirements

- Operating System: Windows / Linux / macOS
- Programming Language: Python
- Libraries & Frameworks: TensorFlow, Keras, NumPy, Pandas, Scikit-learn, Matplotlib
- Development Environment: Jupyter Notebook / Google Colab / VS Code
- Database: MySQL / MongoDB (optional)
- Tools: Excel (for data preprocessing), Git (for version control)

#### APIs & External Services

- Weather API (for real-time weather data)
- Market Price API (for crop price prediction)

#### Tools & IDEs

- Visual Studio Code Code development
- Git Version control
- GitHub Project repository

#### Hardware Requirements

- RAM: Minimum 8 GB (16 GB recommended)
- Storage: 256 GB or more

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- GPU: Optional (NVIDIA GPU recommended for faster deep learning training)
- Internet Connection: Required for data collection and cloud-based tools

## VI. SYSTEM ARCHITECTURE/DATA FLOW DIAGRAM

### System Architecture

The system follows a modular and layered architecture, integrating artificial intelligence, real-time data, and user interaction into a single platform. This approach enhances decision-making for farmers by providing accurate predictions, actionable insights, and practical recommendations.

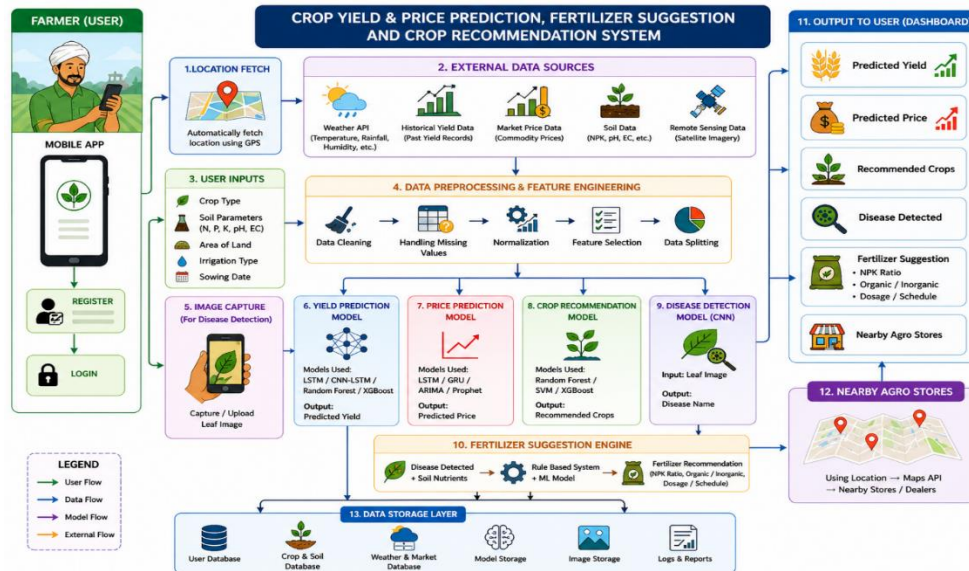


Fig.1. Crop Yield and Price Prediction System Architecture

### User Inputs:

- Crop type
- Soil parameters (Nitrogen, Phosphorus, Potassium, pH)
- Area of land
- Irrigation type
- Sowing date

### External Data Sources:

- Weather data (temperature, rainfall, humidity)
- Historical crop yield records
- Market price data

## VII. UML DIAGRAM

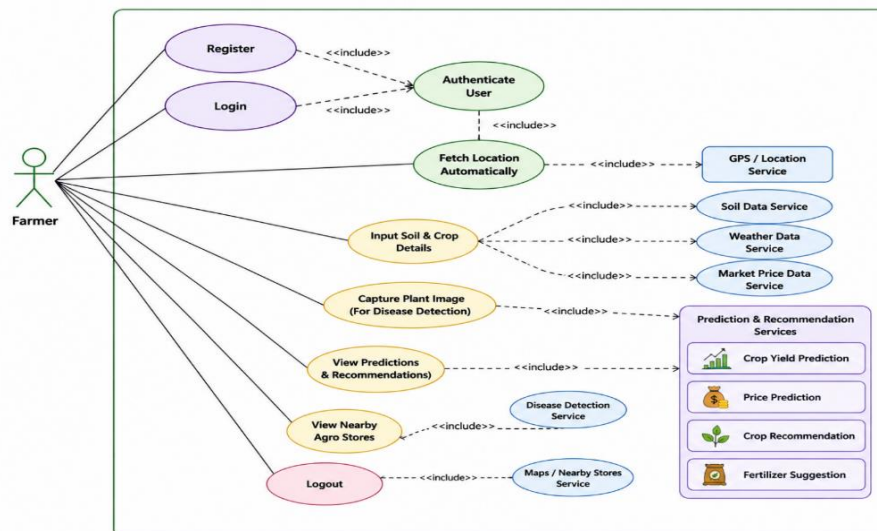


Fig 2. UML Diagram

The UML Use Case Diagram represents the functional behavior of the system and shows how the farmer interacts with different features of the application. It provides a high-level view of the system’s operations and external integrations. The use case diagram of the proposed system illustrates how a farmer interacts with the application to access various agricultural services.

The farmer acts as the primary user who can register and log in, where both actions involve user authentication for secure access. Once logged in, the system automatically fetches the user’s location using GPS, which is essential for retrieving region-specific data such as weather, soil conditions, and nearby agro stores. The farmer then provides input details like soil parameters and crop information, which are processed with the help of external services such as weather and market data APIs. Additionally, the farmer can capture or upload a plant image, which is analyzed by the system to detect diseases using deep learning models.

Based on the collected data, the system provides multiple outputs including crop yield prediction, price prediction, crop recommendation, and fertilizer suggestions. The farmer can also view nearby agro stores through map-based services for purchasing agricultural inputs. Finally, the user can securely log out of the system. Overall, the use case diagram represents a complete interaction flow, showing how different functionalities are integrated to support intelligent decision-making in agriculture.

**VIII. ENTITY RELATIONSHIP DIAGRAM**

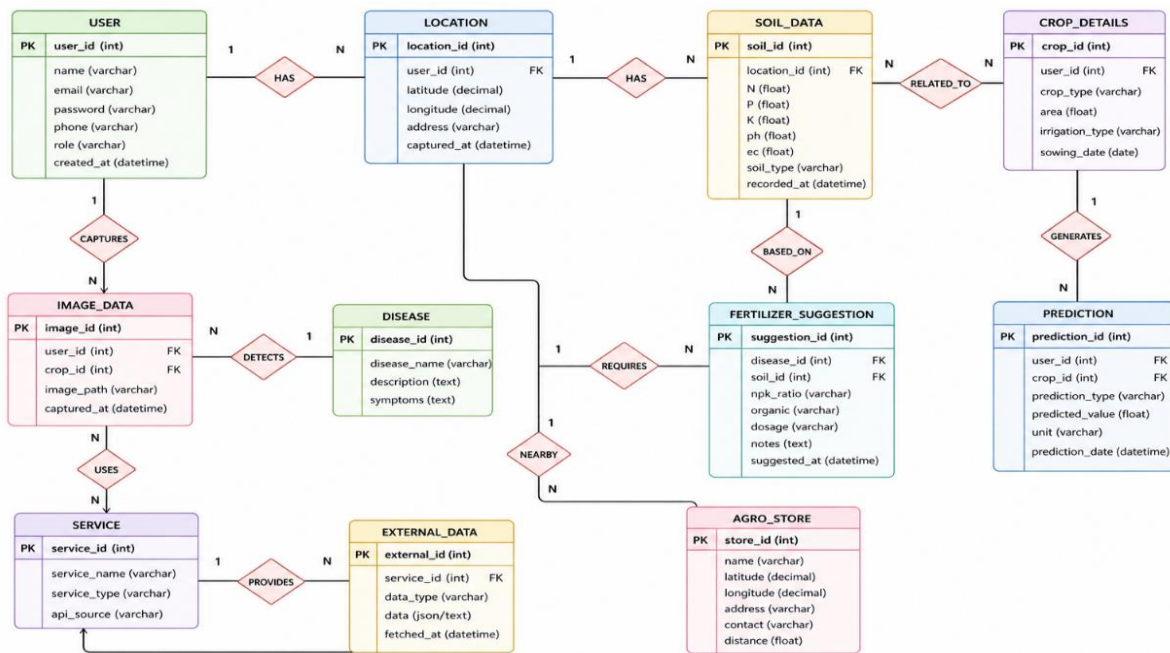


Fig 3. Entity Relationship Diagram

**1. User**

The User entity represents the farmer who uses the system. It stores basic information such as user ID, name, email, password, phone number, and role.

**Purpose:**

- Handles authentication (login/register)
- Links all other data (soil, crop, prediction, images) to a specific farmer

**2. Location**

The Location entity stores geographical information of the user such as latitude, longitude, and address.

**Purpose:**

- Used to fetch weather and soil data
- Helps in showing nearby agro stores
- Enables location-based predictions

**3. Soil Data**

The Soil Data entity contains soil-related parameters like:

- Nitrogen (N)
- Phosphorus (P)

**Purpose:**

- Used as input for yield prediction
- Helps in fertilizer recommendation
- Improves accuracy of crop suggestion

### IX. RESULTS

The AI-Powered Crop Yield Prediction and Agricultural Diagnostic System was successfully implemented using a robust technology stack consisting of Node.js, Python, MongoDB, React, and Android SDK.

The implementation highlights include a secure Node.js backend, a high-performance Python Flask ML engine, and a feature-rich Android application for real-time field diagnostics.

#### Visual Representation of Implementation

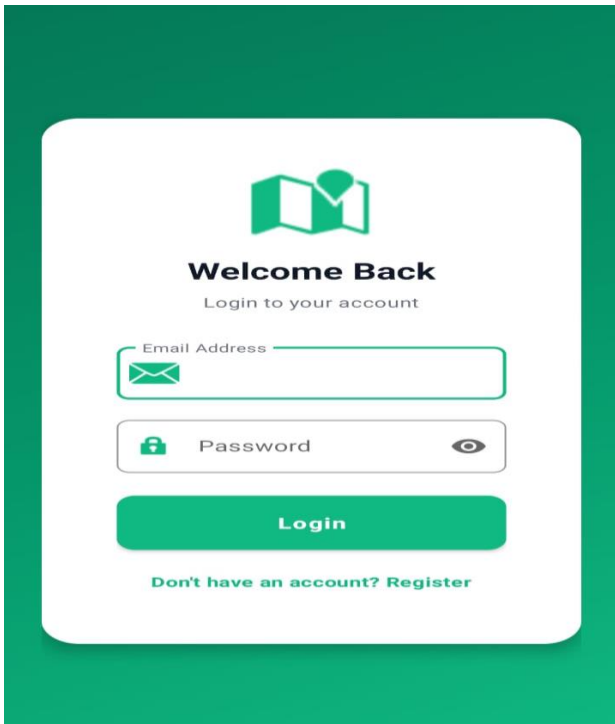


Fig 9.1 Login Page

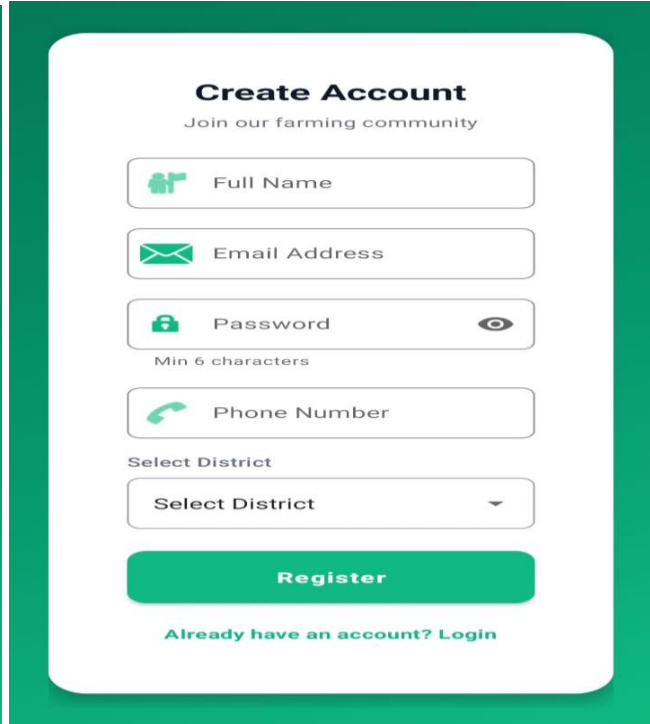


Fig 9.2 Registration Page

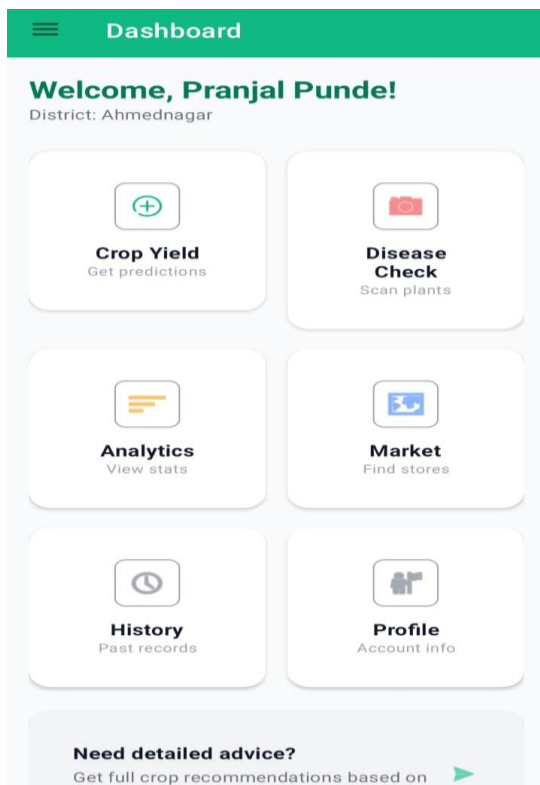


Fig 9.3 Farmer Dashboard

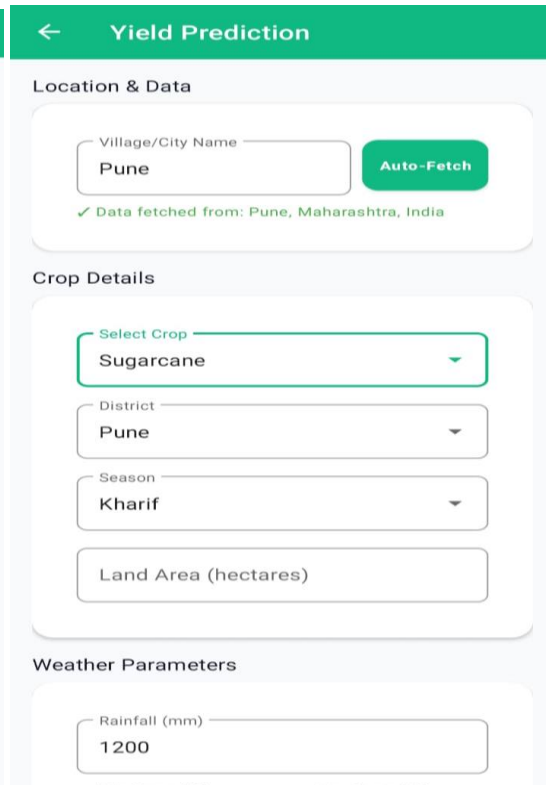


Fig 9.4 Input Page for Crop and Yield Prediction

## Prediction Result

Crop: Sugarcane

**Predicted Yield**  
83.32 tons/hectare

Total Production  
83.32 tons  
(for 1.00 hectares)

**Estimated Price**  
₹3,443.94 / ton  
(Stable)

**Expected Revenue**  
₹286,933.97


Confidence: 70%

**NEW PREDICTION**

Fig 9.5 Result Page

## Disease Detection

Upload Plant Image



Tap buttons below to add image

Camera Gallery

**Analyze Plant**

### Analysis Results

Disease Detected: **Strawberry - Leaf scorch**

Confidence: Confidence: 100.0%

Severity: **Severe (49.6% affected)**

Fig 9.6 Disease Detection Page

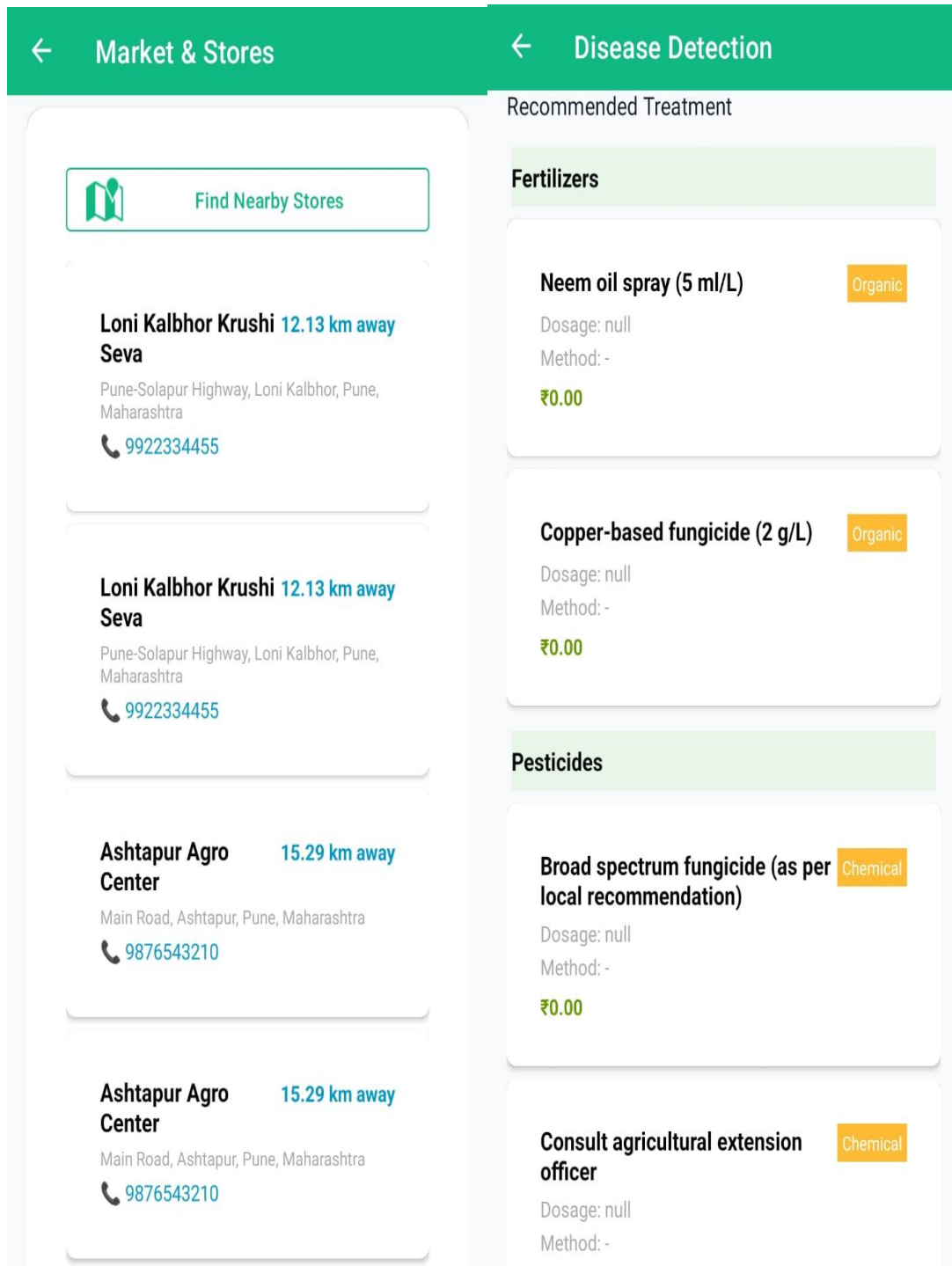


Fig 9.7 Market and stores Page

Fig 9.8 Fertilization Suggestion Page

### X. ADVANTAGES

- Provides more accurate predictions using Deep Learning techniques.
- Helps farmers make better decisions about crop selection and selling time.
- Reduces financial risk by forecasting yield and market prices.
- Handles large and complex datasets (weather, soil, market trends).
- Improves agricultural productivity and profitability.
- Saves time compared to manual estimation methods.

### XI. DISADVANTAGES

- Predictions may be affected by sudden environmental changes (e.g., extreme weather).
- Dependency on internet and digital infrastructure.
- Market price can be affected by unexpected economic or political factor beyond the model scope.

### XII. APPLICATION

- Used in smart farming systems to improve agricultural planning and management.
- Helps farmers in India choose the right crop and decide the best time to sell.
- Can be integrated into mobile or web applications for real-time advisory services to farmers.
- Supports agricultural research by analyzing large datasets using Deep Learning.
- Helps financial institutions in crop insurance and loan risk assessment.

### XIII. LIMITATIONS

- **Data Dependency:** Deep learning models require large amounts of high-quality data. In agriculture, data (weather, soil, crop history) is often incomplete, noisy, or unavailable.
- **High Computational Cost :** Training deep learning models needs powerful hardware (GPU/TPU), which increases cost and makes it difficult for small-scale users or farmers.
- **Dynamic Nature of Agriculture:** Crop yield and prices depend on unpredictable factors like weather changes, pests, diseases, and government policies, which are difficult to model accurately.
- **Limited Real-Time Application :**Real-time prediction is difficult due to delays in data collection and processing.
- **Generalization Problem:** Models trained in one region may not work well in another region due to differences in climate, soil, and farming practices.

### XIV. CONCLUSION

The research demonstrates the immense potential of AI in transforming traditional agriculture into a data-driven enterprise. The 91.64% accuracy of the Random Forest model and the effective CNN-based disease detection provide a comprehensive decision-support system. Future enhancements will integrate real-time weather analytics and expand geographic coverage.

### XV. FUTURE SCOPE

- Integration of real-time data from IoT sensors (soil moisture, temperature, humidity) to improve prediction accuracy.
- Use of advanced models in Deep Learning for better performance and faster results.
- Development of a mobile application to provide real-time predictions and recommendations to farmers.
- Inclusion of satellite and remote sensing data for large-scale crop monitoring.
- Expansion of the system to support multiple crops and different geographical regions beyond India.

### REFERENCES

1. M. Sari, S. Duran and H. Kutlu, "Various optimized machine learning techniques to predict agricultural commodity prices," *Neural Comput. & Applic.*, vol. 36, pp. 11439–11459, Apr. 2024.
2. R. L. Manogna, V. Dharmaji and S. Sarang, "A novel hybrid neural network-based volatility forecasting of agricultural commodity prices: empirical evidence from India," *J. Big Data*, vol. 12, Art. no. 85, Apr. 2025.
3. T. Zhang and Z. Tang, "Agricultural commodity futures prices prediction based on a new hybrid forecasting model combining quadratic decomposition technology and LSTM model," *Front. Sustain. Food Syst.*, vol. 8, Feb. 2024.
4. .G. Avinash, G. H. Harish Nayak, M. Baishya, B. Samuel Naik and K. V. C., "Enhancing agricultural commodity price forecasting using generative models: a deep learning approach," *J. Sci. Res. & Reports*, vol. 30, no. 10, pp. 1-11, Sept. 2024.
5. A. Thaker, L. H. Chan and D. Sonner, "Forecasting agriculture commodity futures prices with convolutional neural networks with application to wheat futures," *J. Risk Fin. Manag.*, vol. 17, no. 4, Art. 143, Apr. 2024.
6. M. Saberironaghi, J. Ren and A. Saberironaghi, "Stock Market Prediction Using Machine Learning and Deep Learning Techniques: A Review," *AppliedMath*, vol. 5, no. 3, Art. 76, June 2025.
7. .M. Barua, T. Kumar, K. Raj and A. M. Roy, "Comparative Analysis of Deep Learning Models for Stock Price Prediction in the Indian Market," *FinTech*, vol. 3, no. 4, pp. 551-568, Nov. 2024.
8. O. Okoyeigbo, "A Comparative Analysis of Machine Learning and Deep Learning Techniques for Accurate Market Price Forecasting," *Analytics*, vol. 4, no. 1, Art. 5, Feb. 2025.
9. H. Gupta, R. Aafrein, R. Kumari, S. Rajput and N. Puri, "Forecasting Commodity Prices using Machine Learning," *Int. J. Scientific Res. in Sci. & Technol.*, vol. 11, no. 1, pp. 81-89, Jan-Feb. 2024.
10. H. Saranya, S. Vijayashaarathi, N. Sasirekha, K. Raksha Lohith and S. others, "Stock Market Price Prediction Using Machine Learning," *J. Popul. Therapeutics Clin. Pharmacol.*, vol. 30, no. 12, pp. 130-136, 2023.
11. Neelam LabhadeKumar, Mangala S Biradar, Ashvini Narayan Pawale, "Reinforcement Learning-Based Deep FEFM for Blockchain Consensus Mechanism Optimization with Non-Linear Analysis" *Journal of Computational Analysis and Applications*, Vol. 33 No. 05 (2024)
12. Neelam Labhade-Kumar "Shot Boundary Detection Using Artificial Neural Network", *Advances in Signal and Data Processing. Lecture Notes in Electrical Engineering*, Springer, Vol 703. PP-44-55 Jan-2021 .
13. Neelam Labhade-Kumar Optimizing Cluster Head Selection in Wireless Sensor Networks Using Mathematical Modeling and Statistical Analysis of The Hybrid Energy-Efficient Distributed (HEED) Algorithm, *Communications on Applied Nonlinear Analysis*, ISSN: 1074-133X Vol 31 No. 6s (2024), PP-602-617 August 2024.
14. Neelam Labhade-Kumar "Experimental Design of Electricity Theft Detection and Alert System Using Arduino Assisted Controller and Smart Sensors" *7th International Conference on Inventive Computation Technologies*, IEEE Xplore Part Number : CFP24F70-ART ; ISBN : 979-8-3503-5929-9, 2024, PP-1961-1968 .
15. Dr. Neelam Labhade-Kumar "Novel Management Trends Using IOT in Indian Automotive Spares Manufacturing Industries", *Journal of Pharmaceutical Negative Results* , Vol. 13 ISSUE 09, PP 4887-4899, Nov-2022.
16. Dr. Neelam Labhade-Kumar "Adaptive Hybrid Bird Swarm Optimization Based Efficient Transmission In WSN", *Journal of Pharmaceutical Negative Results*, Vol. 14 ISSUE 02, PP-480-484, Jan-2023.
17. Neelam Labhade-Kumar "Combining Hand-crafted Features and Deep Learning for Automatic Classification of Lung Cancer on CT Scans",

Journal of Artificial Intelligence and Technology, 2023.

18. Neelam Labhade-Kumar “Enhancing Crop Yield Prediction in Precision Agriculture through Sustainable Big Data Analytics and Deep Learning Techniques”, Carpathian Journal of Food Science and Technology,2023, Special Issue, 1-18.
19. Neelam Labhade-Kumar “Accident prevention and management system in urban VANET for improving slippery roads ride after rain” Journal of environmental protection and ecology, ISSN:1311-5065 Issue 2 volume 25,PP 586–599,2024.
20. Prof. Dr. Neelam Labhade-Kumar, An image processing method for kidney stone segmentation in CT scan images based on CNN-regularized extreme learning machine approach, Hybrid and Advanced Technologies, PP- 217-222,202.