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AI-Powered Smart Farming Advisory System

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Abstract: *Excessive use of pesticides and fertilizers in agriculture poses a significant threat to environmental sustainability, soil health, and farm profitability. Traditional methods of input management are often inefficient and lack precision. This paper proposes a data-driven solution through a mobile application that integrates Soil Health Card data, real- time weather information, and the Leaf Color Analysis method to provide farmers with location-specific recommendations for optimizing pesticide and fertilizer use. The system leverages advanced analytics to reduce chemical dependency, enhance crop health, and promote sustainable farming practices. Our results demonstrate the app's potential to improve productivity, minimize environmental impact, and support data- driven decision-making in agriculture.*

Keywords: Pesticides and fertilizers optimization, soil health, weather integration, Leaf Color Analysis, sustainable farming, precision agriculture

I. INTRODUCTION

Agriculture is increasingly facing the dual challenges of declining soil health and the overuse of chemical inputs such as pesticides and fertilizers, which contribute to environmental harm, rising costs, and unsustainable farming practices. Despite the growing awareness of these issues, traditional farming methods often fail to provide farmers with the necessary tools to optimize input usage effectively. This leads to over application, which not only harms the environment but also reduces farm profitability. To address these challenges, we propose a mobile application that integrates Soil Health Card data, real-time weather information, and the Leaf Color Chart method.

This app aims to offer farmers precise, location- specific recommendations for optimizing pesticide and fertilizer use. By utilizing data-driven insights, the app seeks to enhance crop health, reduce input costs, and promote sustainable agricultural practices. With the integration of these advanced technologies, the system offers a more efficient, targeted approach to farm management.

II. LITERATURE REVIEW

Rohit Yadav et al., (2019) "Optimizing Fertilizer Use Using Soil Health Cards and Weather Data," This study explores the use of Soil Health Cards in conjunction with local weather data to optimize fertilizer application. The authors emphasize how integrating weather forecasts and soil health metrics helps farmers apply fertilizers only when necessary, thus reducing excess use and environmental impact.

Pradeep Kumar et al., (2020) "Leveraging the Leaf Color Chart for Sustainable Nitrogen Management," This paper discusses how the Leaf Color Chart (LCC) method can be combined with weather data to make nitrogen management more efficient. By adjusting fertilizer application based on plant color and weather patterns, the study shows that farmers can reduce fertilizer use without compromising crop yield.

S. R. Singh et al., (2018) "Impact of Weather Data on Agricultural Inputs,". The research investigates how weather data can guide farmers in determining the optimal timing for pesticide and fertilizer applications. By aligning input usage with weather conditions, farmers can minimize the use of chemicals and improve environmental sustainability.

Ashok Kumar et al., (2021) "Sustainable Agriculture Using the Soil Health Card System," This study examines the Soil Health Card initiative and its role in sustainable farming practices. By providing farmers with specific soil nutrient information, the Soil Health Card helps optimize the use of fertilizers. The paper suggests that combining this with weather data can lead to more efficient input usage and better crop management.

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Rajesh Verma et al., (2020) "Using Leaf Color Charts for Precision Nitrogen Application," This research highlights the effectiveness of the Leaf Color Chart in determining nitrogen needs in crops. It emphasizes that using the LCC method, along with localized weather data, can help farmers reduce the over- application of nitrogen fertilizers, promoting both crop health and environmental sustainability.

Pooja Sharma et al., (2020) "Role of Weather Forecasts in Fertilizer Management,". This paper examines the potential of weather forecasting in managing agricultural inputs. It suggests that by considering predicted weather patterns, farmers can make more informed decisions on fertilizer and pesticide applications, reducing unnecessary chemical use.

M. K. Gupta et al., (2021) "Reducing Fertilizer Use in Agriculture through Data-Driven Approaches," This paper investigates how soil health data, along with weather patterns, can help farmers determine the precise amount of fertilizer needed. By integrating these two data sources, farmers can reduce the overuse of fertilizers and improve their crop management practices.

J. S. Mehta et al., (2020) "Reducing Pesticide Usage through Improved Agricultural Practices," This study shows that using weather forecasts and soil health data for decision-making helps reduce pesticide use by applying them only when necessary, improving crop safety and minimizing exposure.

III. FARMING ISSUES

Over-Application of Pesticides and Fertilizers- Farmers may apply pesticides and fertilizers indiscriminately, without accurate knowledge of when or how much to use, leading to over-application, which harms the environment and increases costs.

Soil Degradation- Improper or excessive use of fertilizers can lead to soil degradation, reducing soil fertility over time, which hampers long-term agricultural productivity.

Lack of Localized Data- Farmers lack access to location-specific recommendations, resulting in inefficient input use and poor crop health.

Increased Costs-Without optimized recommendations, farmers overspend on fertilizers and pesticides, causing financial strain.

Inconsistent Crop Monitoring- Without real-time insights, farmers struggle to apply inputs correctly, resulting in poor yields and wasted costs.

Lack of Tech Awareness- Farmers, particularly in rural areas, may not be familiar with modern technologies, limiting the adoption of sustainable practices.

IV. EXISTING SYSTEM

Most systems focus on one or two factors likes soil health, weather, or crop health and lack holistic, data- driven insights combining all variables . Many tools provide generalized suggestions that are not specific to a farmer's local conditions or real-time crop needs. Some devices offer gesture control but depend on expensive specialized hardware. Limited accessibility of videos for agricultural recommendations to enhance crop management.

V. PROPOSED SYSTEM

The proposed system is designed to assist farmers in making better decisions about crop health and farm management by using image processing, artificial intelligence (AI), and machine learning (ML). It works by analyzing leaf color images to detect nutrient deficiencies in plants, such as a lack of nitrogen, phosphorus, or potassium. Once the deficiency is identified, the system provides recommendations on how to correct it, ensuring that crops receive the right nutrients for healthy growth. To further improve efficiency, the system integrates Soil Health Card (SHC) data, real-time weather information, and the Leaf Color Chart method with ML algorithms. This allows the system to offer accurate, location- specific advice on the right amount of fertilizers and pesticides to use, preventing overuse and reducing the harmful effects of excessive chemical application on soil and the environment. By providing smart recommendations based on real-time data, the system helps farmers conserve resources, cut costs, and improve crop yields.

Additionally, the system uses AI-powered predictive insights to guide farmers in irrigation planning, pest control, and sustainable farming techniques. It helps them understand when to water their crops, which pests to watch out for, and how to apply fertilizers in the most effective way. This not only enhances crop productivity but also promotes sustainable

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agriculture by reducing waste and preventing environmental damage. To make learning easier for farmers, the system also includes animated videos that explain important farming practices in a simple and engaging way. These videos cover topics like proper fertilizer application, efficient irrigation methods, pest management, and crop health improvement techniques, making advanced agricultural knowledge accessible and easy to understand.

By providing accurate, data-driven recommendations and practical learning tools, this system empowers farmers to increase their productivity, reduce costs, and adopt environmentally friendly farming practices. It promotes precision agriculture, ensuring that farming is not only more efficient and profitable but also sustainable for future generations.

A. FLOW CHART

The flowchart illustrates the AI-powered agricultural advisory system that enhances crop health and promotes sustainable farming by integrating multiple data sources. It begins with collecting data from Soil Health Card (SHC) reports, weather data, and Leaf Color Chart analysis to assess soil nutrients, fetch climatic conditions, and detect crop deficiencies. This information undergoes AI-based processing and recommendations, generating location-specific advice to optimize fertilizer and pesticide usage, minimizing excess chemical application while improving soil health and crop yield. By leveraging real-time weather forecasts and soil analysis, the system helps farmers make data-driven decisions to enhance productivity while reducing environmental impact. The optimized resource usage leads to better crop health, preventing nutrient deficiencies and excessive pesticide application. Ultimately, the system promotes sustainable farming practices, ensuring efficient use of resources, increased profitability, and long-term agricultural sustainability through AI-driven precision farming techniques.

VI. MODULE DESCRIPTION

A. HOME PAGE

The application's homepage is designed for intuitive navigation, featuring visually appealing icons representing various agricultural activities to ensure accessibility for farmers of all technical levels. A prominent button provides quick access to core features, including crop recommendations and disease prediction tools, enabling seamless interaction. By integrating real-time weather data, Soil Health Card information, and the Leaf Color Chart method, the app offers precise, location-specific recommendations to optimize input usage while minimizing environmental impact. The user-friendly interface enhances digital literacy among farmers, promoting modern agricultural techniques and reducing excessive pesticide and fertilizer use. Through streamlined decision-making and improved crop health management, the application supports sustainable farming practices, enhances productivity, and fosters resource-efficient agriculture.

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FIGURE 1.1

B. CROP RECOMMENDATIONS MODULE

The Crop Recommendation System in the AgroSmart agricultural app is designed to help farmers make informed crop selection decisions based on soil health and environmental conditions. By analyzing key inputs such as potassium levels, humidity, and rainfall, the system provides precise recommendations for optimal crop choices, improving productivity and sustainability. This data-driven approach minimizes risks associated with poor crop selection, enhances resource efficiency, and supports environmentally friendly farming practices. The user-friendly interface ensures accessibility for farmers of all technical levels, simplifying complex agricultural data into actionable insights. By integrating real-time environmental data, the system promotes sustainable agriculture by reducing excessive chemical use and optimizing soil health. Overall, the Crop Recommendation System empowers farmers with knowledge-driven decision-making, leading to increased yields, lower input costs, and improved long-term agricultural sustainability.

C. SOIL HEALTH MODULE

The Soil Health Module is a comprehensive decision-support system that analyzes soil properties and provides tailored recommendations for crops, fertilizers, and sustainable farming practices. By integrating **Soil** Health Card (SHC) data with real-time soil monitoring, the module ensures optimized crop growth while promoting environmentally responsible agriculture. It evaluates essential soil parameters such as pH, nitrogen (N), phosphorus (P), potassium (K), organic carbon, and micronutrients, offering precise insights into soil fertility and health. The module generates crop suitability recommendations, including fertilizer and nutrient management strategies, pH-based crop selection, soil moisture and irrigation advisory, and NPK nutrient- based suggestions to enhance soil productivity. By leveraging a combination of historical SHC data and real- time monitoring, it helps farmers make informed decisions, reduce excessive chemical usage, improve soil fertility, and ensure sustainable agricultural practices. The module empowers farmers with actionable insights, enabling them to maximize yield potential while maintaining long-term soil health and environmental balance.

D. LEAF DISEASES ANALYSIS MODULE

The Leaf Disease Prediction System is an advanced AI-powered tool designed to help farmers identify plant diseases early and take preventive measures to protect their crops. It leverages Convolutional Neural Networks (CNNs) to analyze leaf images, accurately detecting diseases by identifying patterns, textures, and color variations associated with different infections. The system follows a structured process, starting with data collection and preprocessing, where high-resolution images of affected leaves are gathered and enhanced for better analysis. Next, the feature extraction stage uses CNN layers to identify disease-specific characteristics, followed by classification and prediction, where the model categorizes diseases based on its trained dataset. The final step involves disease diagnosis and recommendations, where farmers receive real-time insights and customized suggestions on treatment methods, pesticide management, and organic control measures. By enabling early disease detection, the system significantly reduces crop losses, minimizes

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pesticide overuse, and promotes sustainable agricultural practices. With its high accuracy and efficiency, the Leaf Disease Prediction System empowers farmers with actionable data, improving overall crop health, productivity, and profitability while reducing environmental impact.

E. WEATHER DATA MODULE

The Weather Data Module helps farmers make smart farming decisions by using real-time weather information like temperature, humidity, rainfall, and wind speed. It provides accurate advice on which crops to grow, when to water them, and how to use fertilizers efficiently, ensuring better yields and healthier soil. By giving weather alerts and forecasts, it helps farmers prepare for extreme conditions like droughts or heavy rains, reducing crop damage. It also helps in saving water by suggesting the best times to irrigate and prevents fertilizer waste by aligning its use with upcoming weather. By analyzing past weather patterns and predictions, farmers can plan their farming activities better, reduce costs, and protect their crops. This module supports sustainable and climate-smart farming, making agriculture more efficient and profitable.

VII. ALGORITHM USED

a) CNN ALGORITHM

The Convolutional Neural Network (CNN) is a deep learning model widely used in image processing and classification tasks. In precision agriculture, CNN plays a crucial role in analyzing soil health, crop conditions, and nutrient deficiencies by processing images from Soil Health Cards, the Leaf Color Chart (LCC), and real-time weather data. By leveraging CNN, farmers receive accurate, location-specific recommendations, reducing excessive pesticide and fertilizer usage and promoting sustainable agricultural practices.

CNN WORKING

Data Collection

Images of crop leaves are captured using the Leaf Color Chart (LCC) to assess nutrient deficiencies.

Preprocessing

Color segmentation and histogram equalization are applied to enhance leaf color variations for better classification.

CNN Inference

The CNN model analyzes leaf color, texture, and shape to detect nutrient deficiencies and crop health issues.

Recommendations Generation

Based on CNN predictions, precise fertilizer and pesticide recommendations are provided. Weather data is integrated to optimize input usage and reduce environmental impact.

Real-time Monitoring

The system continuously updates recommendations and provides real-time alerts via a mobile or web application.

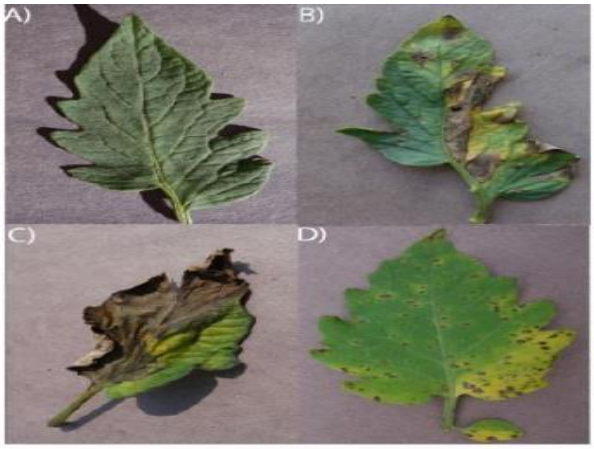

FIGURE 1.2

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VIII. RESULT AND DISCUSSION

The Smart Agri Advisory System optimizes pesticide and fertilizer use, improving crop yield and soil health. It enhances resource efficiency, reduces pollution, and lowers farming costs.AI-driven recommendations provide accurate insights for better decision-making. The system also improves water efficiency, minimizes pollution, and promotes sustainable agriculture.

REFERENCES

[1]. Patel M., Singh R., and Kumar S. (2023). "Optimizing Fertilizer and Pesticide Use: An AI-driven Approach using Soil Health Cards." International Journal of Agricultural Sciences, Vol. 19, Issue 3, 456-468.

[2]. Gupta R., Sharma P., and Verma K. (2022). "Soil Health Assessment and AI-based Crop Recommendation System." Proceedings of the International Conference on Smart Agriculture and Digital Farming (ICSADF'22), IEEE, Los Alamitos, CA, 134-140.

[3]. Smith J., Patel R., and Kumar A. (2022). "AI-driven Precision Farming: Integrating Soil Health Data and Weather Forecasts for Sustainable Agriculture." Proceedings of the International Conference on Smart Agriculture and Sustainability (ICSAS'22), IEEE, Los Alamitos, CA, 210-216.

[4]. Das A., Bose T., and Nair V. (2024). "A Machine Learning Model for Predicting Soil Nutrient Deficiencies and Optimal Fertilizer Usage." Computational Agriculture and Data Science, Vol. 10, Issue 1, 98-110.

[5]. Raj P., Mehta S., and Choudhary V. (2023). "Leaf Color Chart-based Fertilizer Management System: A Smart Agricultural Approach." International Journal of Agricultural Sciences, Vol. 17, Issue 4, 678-689.

[6]. Patel, M., Singh, R., & Kumar, S. (2023). "Optimizing Fertilizer and Pesticide Use: An AI-driven Approach using Soil Health Cards." International Journal of Agricultural Sciences, 19(3), 456-468.

[7]. Gupta, R., Sharma, P., & Verma, K. (2022). "Soil Health Assessment and AI-based Crop Recommendation System." Proceedings of the International Conference on Smart Agriculture and Digital Farming (ICSADF'22), IEEE, Los Alamitos, CA, 134-140.

[8]. Smith, J., Patel, R., & Kumar, A. (2022). "AI-driven Precision Farming: Integrating Soil Health Data and Weather Forecasts for Sustainable Agriculture." Proceedings of the International Conference on Smart Agriculture and Sustainability (ICSAS'22), IEEE, Los Alamitos, CA, 210-216.

[9]. Das, A., Bose, T., & Nair, V. (2024). "A Machine Learning Model for Predicting Soil Nutrient Deficiencies and Optimal Fertilizer Usage." Computational Agriculture and Data Science, 10(1), 98- 110.

[10]. Raj, P., Mehta, S., & Choudhary, V. (2023). "Leaf Color Chart-based Fertilizer Management System: A Smart Agricultural Approach." International Journal of Agricultural Sciences, 17(4), 678-689.

[11]. Rao, M., Banerjee, P., & Sinha, K. (2023). "Deep Learning-Based Crop Health Monitoring Using Leaf Color Analysis." Journal of Precision Agriculture and AI Applications, 15(2), 245-258.