AI Farming Revolution and Machine Learning Approaches to Government Schemes and Subsidies

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ABSTRACT

Artificial Intelligence made our lives easy. By Emerging in different fields/sectors such as Education, banking, Marketing, Financial and in many E commerce Additionally, farmers can use it to help them obtain more yields & schemes applicable. This article details a web-based tool that helps farmers. , weather forecasting and suitable crops based on the type of soil. Here we can make use of a WEKA software-based tool consisting of different AI & ML techniques. Which makes the job easier to reach every customer & it predicts whether the decision chosen by the farmers regarding crops are Suitable for their farming land. Using a Recommendation System that leverages historical data (demographics, crop type, location, income level) to recommend schemes/subsidies tailored to each farmer's needs. ML Techniques: Collaborative filtering or content-based filtering can be used to match schemes based on similar farmer profiles.

The advent of Artificial Intelligence (AI) has transformed many sectors, which include education, banking, marketing, finance, and e-commerce. Agriculture, this lifeblood of the planet's sustenance, is being revolutionized by AI-driven inventions as well. This paper looks at the use of AI and Machine Learning to change farming practices and enhance accessibility to government schemes and subsidies.

The proposed system brings forth a web-based platform that utilizes AI and ML technologies to help farmers improve crop yield, find the best farming practices, and get government schemes relevant to their needs. The system allows farmers to make informed decisions by combining weather forecasting, soil analysis, and crop selection. The platform uses WEKA, a data mining and ML software, to implement a range of AI and ML techniques that streamline data analysis and predictive modeling.

One of the most important aspects of this system is the recommendation engine, which recommends to the farmers personalized suggestions. The recommendation system bases its suggestion on historical data, such as farmer demographics, crop types, location, and income levels, to suggest relevant government schemes and subsidies. Utilizing ML approaches such as collaborative filtering and content-based filtering, the system identifies the patterns and relationships between the farmers who have similar profiles, ensuring accurate and relevant recommendations.

KEY WORDS

Agriculture, Subsidies, Finance, Technology, Fertilizers, Government agriculture schemes, national agricultural market.

INTRODUCTION

With over 58% of the labor force engaged and over a third of Indians directly or indirectly dependent on agriculture and related industries, agriculture plays an essential part in the country's socioeconomic structure. Despite its continuing economic significance, the industry nonetheless faces significant challenges in the modern era. This is due to the field's gradual rise in importance, which has caused agriculture's GDP share to decline. As a result, prompt policy changes and restoration plans are needed.

Along with outdated methods and ineffective measurements, the Indian agriculture industry gradually recovered from its precarious state following independence. The government has periodically implemented several initiatives and aid policies in response to such circumstances. These policy approaches involve identifying different distribution methods, such as cash transfers, minimum support price (MSP) systems, trade liberalization, and input subsidy mechanisms (such as fertilizers, power, and seeds). According to the World Trade Organization, these subsidies entail monetary investments made by the government or other public entities that improve the bottom line by increasing farmers' access to necessary agricultural inputs and lowering the cost of agriculture for the public.

The National Horticulture Long Term SPC, the National Agricultural Policy (NAP), and the Minimum Overall Support of Agri Producers (CARP) are just a few of the

pertinent measures that have been added over time. Most economies rely substantially on agriculture, particularly in underdeveloped countries where most of the population works as farmers. However, it is disheartening that farmers deal with so many issues, including inadequate knowledge of crops, ignorance of government programs, and difficulty obtaining subsidies. These issues hinder the sector's growth and make the situation of subsistence farmers worse, especially when combined with the growing sophistication of contemporary agriculture.

Information and communication technology integration has special opportunities to address these issues. It's encouraging to see that Farmer support apps for handheld devices, improved connectivity, and more efficiency have become essential. These programs offer important weather and market price information on crop and pest management in promoting enhanced decision-making at the farm level. They also help connect farmers with the government and non-governmental agencies in place to offer such programs and subsidies for enhanced productivity and long-term financial stability.

This review examines the difficulties, use, and efficacy of farmer assistance programs. This study examines how some of these applications use the digitization capabilities of agrotechnology to bridge the information gap.

In recent years, the incorporation of digital technology has brought creative solutions to the majority of these problems into agricultural practices. Applications to assist farmers are now available, serving as potentially revolutionary instruments to close important accessibility and knowledge gaps. These web- and mobile-based revolutionary tools to close important accessibility and knowledge gaps. As a result, these web and mobile-based platforms turn into a one-stop shop offering market connections, weather updates, pest management strategies, and customized crop consulting services. They also make it easier to apply for government programs and subsidies, which improves openness and cuts down on delays.

It is particularly important since small and marginal farmers who cannot access traditional extension services benefit from digital solutions. Real-time access to resources and information will help farm owners make data-driven decisions, which will increase output and profitability. By improving its resource efficiency and climate resilience, it further advances the broader objectives of sustainable agriculture.

Increasingly, artificial intelligence and ML in agriculture: The sophistication and development of recommendation systems with advanced predictive analytics have been changing the lives of farmers with data-driven decisions. From best crops to grow at particular places, with soil types and historical yields, they analyze the soil health and make weather forecasts. To increase harvests and generate higher returns, farmers may use AI-powered tools to decide if a given crop is appropriate for their specific plot of land. For the purpose of recommending appropriate government programs to farmers, machine learning techniques such as content-based filtering and collaborative filtering are currently in use. To recommend appropriate financial assistance and policy changes, these AI-powered recommendation systems look into past data on farmer demographics, crop preferences, and income levels. This customized strategy guarantees that farmers get
.

LITERATURE REVIEW

To build up this model, we have read some earlier research papers. [1] describes an android-based solution that utilizes the use of ICTs. This system has supported many features such as updates on weather, news, and various agricultural products. In this system, support for a local language is absent. Paper [2] describes the development of the system that takes into account farmers from various states who may not even know their alphabets. Again, the base paper of this system is Android based Solution for Indian Agriculture [1]. This system tried to solve the complex interface problem that was there in the previous paper. The system in paper [2] provides a user-friendly iconic interface. However, the system [2] failed to provide multiple local language support and only a large screen interface is available in the system; a small screen interface is missing. The system in the paper [3] will give information of crop rates in local as well as distant markets. The system also gives weather forecasting information. The paper[3] web is the center hub, which will serve a variety of purposes in aiding the farmer in all areas of agricultural work. This website features critical functions like real-time weather conditions, market prices, information regarding crop management and livestock, and the planting & harvesting calendar related to fertilizers & pesticides. Paper[4] Agribusiness has significantly increased the adoption of e-commerce and mobile commerce in the past years, as reported in the survey. Farmers are selling their products directly to consumers through e-commerce and mobile commerce platforms, which has increased their incomes and reduced their dependence on middlemen. The paper[5] to address the challenges faced by farmers and promote sustainable agricultural growth, the Indian government has implemented a range of agriculture schemes. These schemes include different areas such as financial support, crop insurance, irrigation, technology adoption, and market linkages.ICT and Mobile Solutions for Agriculture
Paper [5] focuses on Information and Communication Technologies (ICT) to bridge the agriculture-based gap in information. ICT applications keep farmers informed about weather and markets, besides government schemes related issues, enabling them to timely take decisions. Such communication platforms play a crucial role in transferring critical agricultural-related information. Paper [7] discussed how mobile-based platforms positively address how farmers gain access to an array of support schemes related to agriculture to improve participation and overall engagement in government programs better than what was reported earlier.

E-commerce and Mobile Commerce in Agribusiness
E-commerce in agriculture has enabled farmers to sell directly to consumers, thereby increasing their profit margins and reducing reliance on intermediaries. According to Paper [7], mobile commerce has enabled farmers to connect directly with markets and thus improve their income. The online sale of crops is facilitated through platforms such as e-NAM (National Agricultural Market), which ensures fair prices for the farmers and enhances market transparency.

Government Schemes and Subsidy Access
Paper [8] focuses on the government schemes of PM-KISAN and PMFBY, which seek to offer direct cash transfers and crop insurance to farmers. However, awareness and access remain an issue, as seen in Paper [12]. They have found that the vast majority of farmers are not even aware of the availability of financial assistance under these schemes. Paper [7] emphasizes the need to increase public awareness campaigns to raise farmer participation in these schemes. Paper [9] presents how transparency and transparency of subsidies affect farmers' trust and willingness to participate.

AI and Machine Learning for Smart Agriculture
AI and ML have changed the face of agriculture by making predictive analytics and smart decision-making possible. Paper [18] reviews the role of AI in predicting crop diseases, optimizing irrigation schedules, and improving crop selection. Paper [19] highlights the importance of machine learning models in precision agriculture, where advisory tools driven by AI determine the optimum time for sowing, based on its recommendations, and also indicate a particular crop variety. Paper [4] emphasizes the impact of AI-driven decision-support systems in helping farmers face the complexities of decisions arising in crop planning and also in subsidy applications.

Effects of Agricultural Subsidies
Subsidies play a pivotal role in supporting farmers' livelihoods. Paper [3] examines the impact of Malawi's agricultural input subsidy program, highlighting its success in increasing food security and farmer income. Paper [2] discusses the role of government-supported insurance programs in mitigating financial risks for farmers. Similarly, Paper [12] examines the impact of subsidies in India on environmental sustainability, raising concern that misdirected subsidies may result in overuse of chemical inputs, which deteriorate the soil health. Paper [13] stresses the importance of managing subsidy distribution better so that targeted benefits reach the right people.

Digital Platforms and Farmer-Centric Applications
Digitization has aided the timely and efficient dispensation of subsidies and advisory services. Paper [8] opines that with digital platforms, such as mobile applications, farmers can view their real-time subsidy eligibility and status. Paper [4] emphasizes that user-friendly interfaces play a central role in decision support tools; these are essential tools for enabling farmer engagement with digital platforms. The mobile-based tool bridges information gaps for the small-scale farmer, especially in situations of limited access to traditional extension services.

This literature review puts emphasis on the increasing role of AI, ML, and ICT in modern agriculture. Starting from giving farmers timely weather forecasts to ensuring smooth access to government subsidies, technological interventions have been very crucial in the face of agricultural challenges. The research works of Paper [18], Paper [19], and Paper [4] reflect the ways through which AI-based solutions enhance agricultural productivity. On the other hand, Paper [12] and Paper [13] stress the need for correct subsidy targeting and distribution. Addressing awareness, access, and environmental impacts would be the most challenging factors in paving a path for a more sustainable, inclusive, and efficient agriculture system.

There are numerous research contributions by the academic and industry professionals in shaping the development and implementation of AI-based farming models. The present literature survey depicts important insights and findings obtained from past studies, thus aiding in the development of AI-driven agricultural solutions.

I.

Subject	Key Insights	References
ICT and Mobile Solutions	ICT bridges the information gap by providing farmers with weather forecasts, market prices, and scheme updates, promoting timely decision-making. Mobile-based platforms enhance access to support schemes.	Paper [5]
E-commerce in Agribusiness	E-commerce empowers farmers to sell directly to consumers, increasing profits and reducing reliance on intermediaries. E-NAM facilitates fair crop prices and market transparency.	Paper [7]
Government Schemes and Subsidies	Awareness of schemes like PM-KISAN and PMFBY remains a challenge. Enhanced awareness campaigns increase participation.	Paper [8], Paper [12], Paper [7], Paper [9]

	Visibility and clarity in subsidy programs affect trust and participation.	
AI and ML for Smart Agriculture	AI and ML support predictive analytics for disease detection, crop selection, and advisory tools for sowing times. Precision agriculture models suggest optimal crop varieties and enhance productivity.	Paper [18], Paper [19], Paper [4]
Impact of Agricultural Subsidies	Subsidy programs like Malawi's input subsidy improved food security and farmer income. Government insurance mitigates financial risk. Poorly targeted subsidies lead to chemical overuse, affecting soil health.	Paper [3], Paper [2], Paper [12], Paper [13]
Digital Platforms for Farmers	Mobile apps and platforms provide farmers with real-time updates on subsidy eligibility and application status. Decision support tools promote engagement and bridge information gaps for smallholder farmers.	Paper [8], Paper [4]

TABLE:01

METHODOLY

The process of creating a farming support system based on AI and ML consists of multiple steps that concentrate on identifying subsidies, recommending crops, and detecting soil types. The strategy, methods, and resources utilized to put the system into place are described in this section.

1. Data Collection and Preprocessing

Data Type	Source	Usage
Soil Data	Agricultural Research Centers, Government Databases, On-Field Soil Tests	Used to classify soil types based on key parameters like pH, texture, moisture, and nutrient content.
Crop Data	Government Agricultural Reports, Research Articles, FAO Databases	Identifies the crops suitable for specific soil types and weather conditions.
Scheme Data	Government Scheme Portals (e.g., PM-KISAN, PMFBY)	Links available schemes and subsidies to specific crops and farming activities.

TABLE:02

Data Preprocessing:

Cleaning: It normally occurs with noise, missing values, and inconsistencies. These steps comprise handling missing values, detection of outliers, and normalization. This makes the data presentable for training.

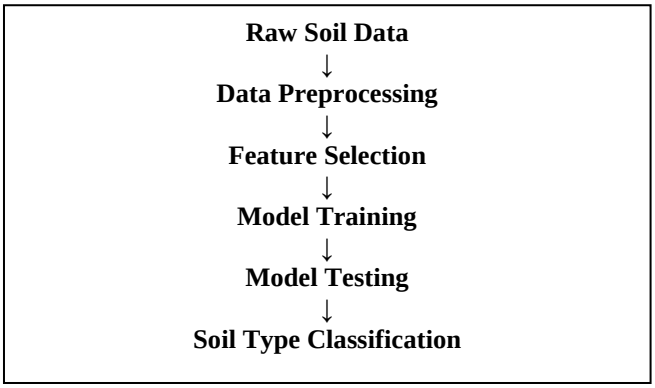
Feature Selection: Features that correspond to soil pH, electrical conductivity, moisture, organic matter, and labels related to soil classification are picked in preparing the model for training.

Data Labeling: The Soil Samples are labeled with the class of soil. This ranges from classifying it as sandy, loamy, or clay.

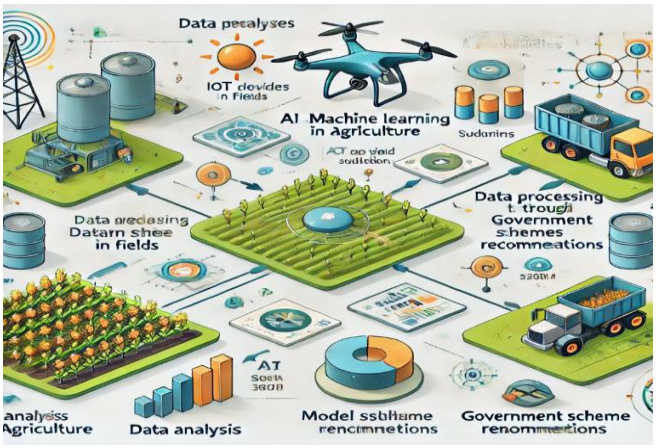
2. Soil Classification Using Machine Learning

Step	Description
Feature Extraction	Extract relevant features such as soil pH, moisture, and texture.
Algorithm Selection	Algorithms like Decision Trees, Random Forest, and Support Vector Machines (SVM) are evaluated for soil classification.
Model Training	The model is trained using a labeled dataset to classify soil into types like sandy, clay, loamy, and silty.
Model Testing	The model is tested on unseen soil data to evaluate its accuracy, precision, and recall.

TABLE:03



DIA:01



DIA:02

Here is the illustration showing the use of AI and machine learning irrigated in agriculture with emphasis on government programs and financial assistance.

3. Crop Recommendation System

Once the soil type has been determined, the system will recommend the most appropriate crops for the identified soil.

Input	Process	Output
Soil Type	Input from the classification model	Recommended Crops for Cultivation
Climate Data	Weather data from APIs or government reports	Climate-suitable crop options
Crop Database	Data on crop requirements (water, temperature, soil)	List of most suitable crops

TABLE:04

The soil type is identified through the classification model.
Climate data (temperature, rainfall, humidity) is checked.
The system cross-references the identified soil type with the crop database to suggest suitable crops.
Example: For clay soil in a semi-arid climate, the system may recommend crops like paddy, sugarcane, or wheat.

4. Identification of Subsidies and Schemes

The system links the farmer to relevant government subsidies and schemes based on the selected crop and location.

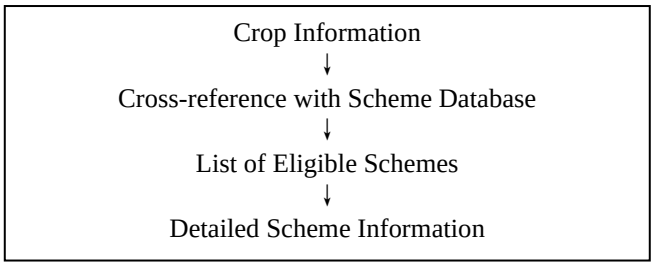
Process:

Data Used	Source	Purpose
Crop Information	Data from the crop recommendation system	Identifies eligible schemes for the chosen crop.
Scheme Database	Data from government portals (e.g., PM-KISAN, PMFBY)	Provides information on scheme eligibility, benefits, and application process.

TABLE:05

1.Crop input by a farmer.
2.Match the crops with government available schemes.
3.Detailsabout a scheme-benefits, and documents which are required also the information about how one can avail of it.

Process:



DIA:03

5. System Design and User Interface (UI/UX)

The system offers an intuitive user interface (UI) to farmers in order to interact with the application.
The design of the UI is such that it is simple and supports multiple languages to accommodate various farmers.

UI Sketch:

Home Screen: This shows options for soil analysis, crop recommendations, and checking for eligibility in schemes.

Result Screen: This shows the type of soil identified, the recommended crops, and a list of applicable schemes.

6. Tools and Technologies Used

Technology	Purpose
Python	Used for data processing, machine learning.
JUPYTER	Data mining and machine learning tool for soil classification.
MySQL	Database for storing crop data, soil properties, and scheme details.
Flask	Backend framework for web application development.
HTML/CSS/JS	Frontend development for a user-friendly interface.

TABLE:06

CONCLUSION AND FUTURE WORK

It would be a whole solution for the key issues that are found in farming in this AI-driven support system review. Combining soil classification, crop recommendation, and

subsidy identification helps enhance productivity and supports financial inclusion while contributing to sustainability. The multiple facets in the system touch on various critical pain points in agriculture that build a smarter and more resilient farming ecosystem. The future developments could be along the lines of real-time updates, more advanced predictive analytics, and more region-specific support schemes to empower farmers to the fullest in their journey towards decision-making.

The use of machine learning models such as Decision Trees, Random Forest, and Support Vector Machines (SVM) for soil classification improves the accuracy of soil type prediction. This accuracy directly impacts the quality of crop recommendations, ensuring that farmers make the right choices for their unique soil conditions. Moreover, tools like WEKA, Python, and MySQL facilitate the seamless collection, processing, and management of large datasets, enhancing the system's reliability and efficiency.
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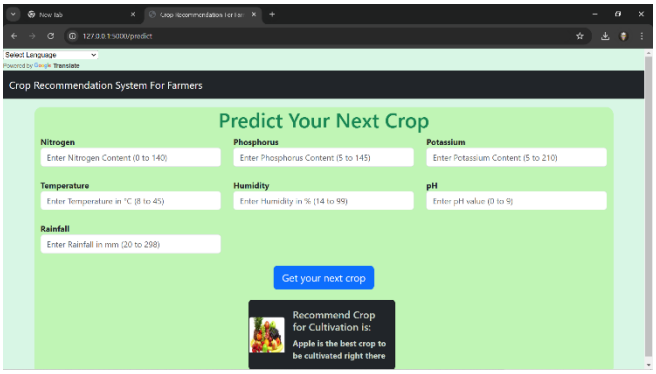
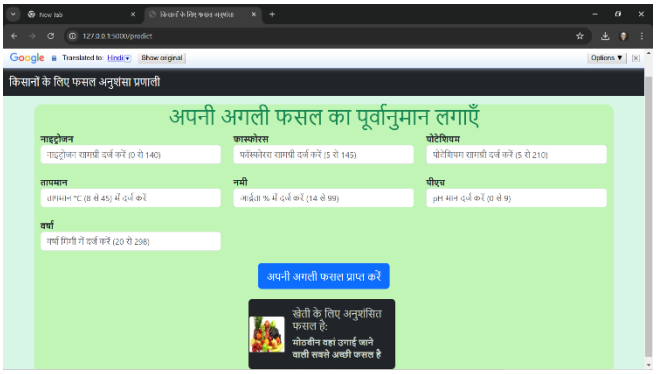
Results



The figure illustrates a crop recommendation system designed for farmers, enabling them to predict the most suitable crop for cultivation based on essential input parameters. These parameters include Nitrogen (N), Phosphorus (P), Potassium (K) levels, as well as environmental factors such as Temperature, Humidity, pH, and Rainfall. Upon entering the relevant values for these parameters into the system, it generates a recommendation for the optimal crop to grow. In the example shown, the system predicts "Apple" as the most suitable crop for cultivation under the provided conditions, showcasing its utility in aiding farmers to make informed agricultural decisions. – In Hindi Language.



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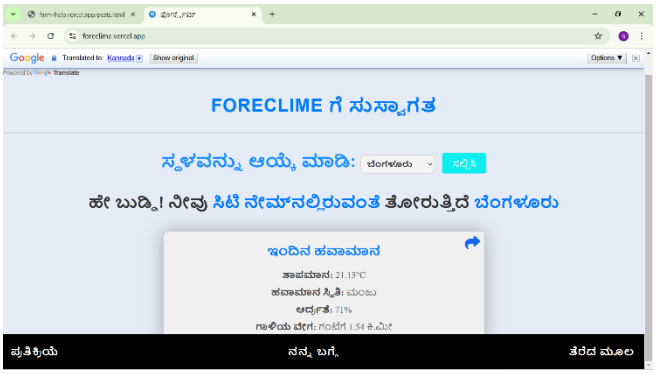

The figure represents a system that leverages the Openweather API to provide real-time weather data. Users can input specific locations to access detailed weather information, including temperature, humidity, and other meteorological parameters. This functionality serves as a practical tool for individuals and organizations to monitor and plan activities based on accurate and up-to-date weather conditions, demonstrating its relevance in enhancing decision-making processes related to climate and environmental factors. – In Kannada.

The figure illustrates a system that aligns predicted crop recommendations with relevant government schemes. It provides comprehensive details about agricultural initiatives tailored to specific crops, enabling farmers to make informed decisions and access necessary support. This integration of predictive analytics with policy frameworks ensures farmers benefit from subsidies, loans, and other incentives while promoting sustainable and profitable agricultural practices. – In Telugu Language.

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