International Journal of Engineering Technology and Management Science
Website: ijetms.in Issue: 2 Volume No.9 March - April – 2025
DOI:10.46647/ijetms.2025.v09i02.068 ISSN: 2581-4621

PREDICTION OF UNCERTAIN TRENDS AND PRICES IN AGRICULTURE USING MACHINE LEARNING TECHNIQUES

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ABSTRACT
Agriculture remains the cornerstone of our nation's economy, yet farmers continue to struggle with unpredictable climate patterns, fluctuating crop prices, and limited access to actionable insights. These challenges often result in poor crop selection, misinformed decisions, and significant financial losses. To combat these issues, we introduce AgroSage — an intelligent, AI-powered agricultural assistant designed to empower farmers with data-driven decisions. At its core, AgroSage utilizes the Decision Tree Regression algorithm to accurately predict crop prices based on key factors such as rainfall, wholesale price index, month, and year. By forecasting price trends in advance, the system enables farmers to optimize their crop choices and maximize profitability. AgroSage is more than just a prediction tool. It is a comprehensive ecosystem tailored for modern agriculture. Key modules include real- time weather forecasting, crop and fertilizer recommendations, and an integrated platform featuring a digital marketplace, expert-guided chat portal, and a knowledge base. The system is intuitive, scalable, and built with the end-user in mind — ensuring accessibility even for those with limited technological literacy. With AgroSage, we bridge the gap between traditional farming and modern technology, enabling smarter agricultural practices and contributing to a stronger, more resilient economy.

INTRODUCTION

India being a rural nation, its economy transcendently relies upon agricultural yield development and unified agroindustry items. It is currently quickly advancing towards a specialized turn of events. India now is rapidly progressing towards technical development. Smart farming is changing the face of agriculture in India. Technology can provide a solution to most challenges farmers face. It can help them predict weather more accurately, decrease waste, boost output and increase their profit margins. In the status quo, the farmers and the consumers find it difficult in the real world to determine the accurate prices of crops without having prior knowledge of the fluctuating trend prices or weather conditions. Accordingly, innovation will end up being helpful to agriculture. The paper aims to predict crop prices in advance. This work is based on finding proper regional datasets that help us in achieving high accuracy and better performance. Our system, Agro-Genius, is using Machine Learning to build the Price Predicting Model. In the past few years, a lot of fluctuation in the prices of the crop has been seen. This has increased the rate of crop damage produced each year. The main aim of this prediction system is to ensure that the farmers get a better idea about their yield and deal with the value risk. Weather is also highly unpredictable these days. It also affects the crop production. The proposed system will also forecast the weather helping the farmer make correct decisions regarding field ploughing, field harvesting etc. Similarly, fertilizers play an important role. Fertilizers load the soil with the required nutrients that the crops eliminate from the soil. Crop yields

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and production will be fundamentally decreased if fertilizers are not used.

Research Motivation

Agriculture remains the backbone of India's economy, supporting nearly 60% of the population directly or indirectly. Despite this, Indian farmers face numerous challenges such as fluctuating market prices, unpredictable weather patterns, lack of access to real-time information, and limited knowledge of government schemes. These issues not only affect their income but also demotivate many from pursuing agriculture as a sustainable livelihood. A significant problem observed in the agricultural market is the uncertainty in crop prices. Farmers often have no clue what their harvest will be worth when they finally bring it to market. They sell their produce at lower prices due to the fear of spoilage and lack of proper storage or market access. This pricing volatility, coupled with climatic uncertainties and inadequate planning, results in considerable financial losses and crop wastage.

Moreover, many farmers are unaware of government schemes, subsidies, and support programs specifically designed to help them reduce input costs or get better returns. The gap between policy implementation and ground-level awareness is still very wide, especially in rural and remote areas.

With the rise of technology and data availability, Machine Learning (ML) has emerged as a potential game-changer in the agricultural sector. Predictive analytics using ML can empower farmers with price forecasting, weather predictions, crop recommendations, fertilizer usage, and location-based farming suggestions. This creates a smart farming ecosystem where decisions are based on data rather than assumptions.

The motivation behind this research is to:

- Reduce the uncertainty that farmers face in crop prices by leveraging machine learning-based prediction models.
- Enable better decision-making by providing timely and region-specific insights on crops, fertilizers, and farming methods.
- Bridge the information gap by offering multilingual support and a farmer-friendly interface with maps and guides.
- Empower farmers with awareness about government schemes and allow easy access to seeds, fertilizers, and market linkages.
- Create a collaborative and inclusive platform for farmers to ask questions, share experiences, and receive expert advice via a chat-based interface.

Ultimately, the goal is to increase profitability and sustainability in farming practices, reduce waste, and improve the overall quality of life for Indian farmers by making agriculture smarter, data-driven, and more predictable.

Problem Statement

In recent years, the agricultural sector in India has encountered various challenges due to the increasing unpredictability of crop prices, fluctuating weather patterns, and limited access to reliable information. Farmers often make critical decisions based on assumptions or outdated knowledge, which leads to reduced productivity, financial instability, and post-harvest losses. These challenges are compounded by the lack of awareness about government schemes and support programs designed to assist farmers in improving their yield and income.

There is a noticeable gap between technological advancements and their implementation in rural agricultural practices. Farmers do not have access to predictive tools that could help them anticipate market conditions or select the most suitable crops for cultivation based on real-time data. In addition, the regional diversity and language barriers in India make it difficult to implement a uniform digital solution that caters to the needs of farmers from different states and backgrounds.

This project addresses the need for a system that utilizes machine learning techniques to forecast crop prices, recommend suitable crops based on region and season, provide weather predictions, and suggest relevant government schemes. The aim is to reduce uncertainty in agricultural planning

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and to promote a more informed, data- driven approach to farming.

APPLICATION

Predicts future crop prices using machine learning algorithms, enabling farmers to make informed decisions about what and when to sell for maximum profit.

1. Provides accurate and region-specific weather forecasts to help farmers plan sowing, irrigation, and harvesting activities effectively.
2. Suggests relevant government schemes based on crop type, location, and season, ensuring farmers can access available benefits and subsidies.
3. Recommends the best-suited crops for cultivation based on the user's location, month, and historical data, helping to improve yield and resource efficiency.
4. Offers irrigation and agricultural land maps to assist farmers in selecting suitable land and understanding regional farming conditions**.**

PROPOSED SYSTEM

The proposed system, Agro-Genius, is a web-based application designed to assist farmers in making informed agricultural decisions by leveraging machine learning techniques. The system integrates various modules to provide accurate predictions, recommendations, and essential information in a simple and user-friendly format. The primary goal of the system is to reduce uncertainty in agriculture by offering key insights on crop prices, weather conditions, suitable crops, and available government schemes based on location and season. The application is accessible in multiple languages to ensure ease of use for farmers across different regions.

The system consists of the following core components:

1. Utilizes historical market data and machine learning algorithms such as Naive Bayes, Decision Trees, and K-Nearest Neighbour to forecast future prices of various crops, enabling farmers to plan harvest and sales more effectively.
2. Provides short-term and long-term weather predictions based on the farmer’s location. This helps in planning farming activities such as sowing, irrigation, and harvesting, thereby minimizing the risk of weather-related crop damage.
3. Analyzes regional climatic and soil conditions along with the current season to recommend the most suitable crops for cultivation. This feature ensures efficient use of land and resources for maximum yield
4. Identifies and displays relevant central and state government schemes available for the farmer’s selected crop and region, promoting awareness and helping farmers access financial and resource-based support.
5. Provides two types of maps: irrigation maps and agricultural land view maps. These maps assist farmers in identifying suitable land for farming, understanding irrigation patterns, and analyzing the potential of nearby non-agricultural land.

Goals of the Proposed System

The primary goal of the proposed system is to empower farmers with reliable, data-driven insights that aid in effective agricultural decision-making. The system aims to reduce the uncertainty associated with traditional farming practices by introducing predictive analytics into the agricultural workflow. One of the core objectives is to forecast crop prices in advance using machine learning algorithms, allowing farmers to plan their sales strategically and avoid losses due to sudden market fluctuations.

Another important goal is to recommend crops that are most suitable for cultivation based on the geographical location, soil condition, and the current season. This ensures that farmers make optimal use of their land and resources, resulting in higher crop yield and profitability. In addition to this, the system seeks to provide accurate, location- specific weather forecasts to help farmers

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schedule critical activities such as sowing, irrigation, and harvesting.
The system also aims to enhance farmer awareness regarding various government schemes and subsidies. By suggesting relevant schemes based on the selected crop and region, it ensures that farmers do not miss out on opportunities for financial and institutional support. Moreover, the platform is designed to provide agricultural and irrigation maps, enabling users to analyze land suitability and make informed decisions about where and when to cultivate. All these objectives work together to promote sustainable, smart, and efficient farming practices among rural communities.

ADVANTAGES OF THE PROPOSED SYSTEM

1. The proposed system offers several advantages that directly address the prevailing issues faced by farmers in the agricultural sector. By integrating machine learning algorithms, the system provides predictive insights into crop prices, which enables farmers to make informed decisions regarding the sale of their produce.
2. This reduces their dependency on middlemen and minimizes the risks associated with market price fluctuations. Accurate price predictions empower farmers to plan better and increase their profit margins.
3. Furthermore, the system improves overall agricultural productivity by recommending the most suitable crops based on the farmer's geographical location, soil conditions, and seasonal factors. This leads to more efficient land use and promotes sustainable farming practices.
4. The inclusion of localized weather forecasting ensures that farmers are better prepared for climatic changes, reducing the chances of crop damage due to unexpected weather events.
5. Another major advantage of the system is its ability to inform farmers about government schemes that are relevant to their crops and region. Many farmers remain unaware of the financial and resource-based support available to them due to a lack of access or information.
6. By providing this data in a structured and accessible manner, the system helps bridge this gap and enables farmers to benefit from various subsidy and welfare programs.
7. Additionally, the integration of agricultural and irrigation maps aids farmers in analyzing land suitability before cultivation. This is particularly useful for those who are new to farming or are looking to begin agricultural activities in a new region.
8. By combining these features into a single, user- friendly platform with multilingual support, the system ensures accessibility and usability for farmers from diverse linguistic and regional backgrounds, thereby promoting the adoption of smart farming practices across the country.

SYSTEM ARCHITECTURE

The system architecture of the proposed platform is structured to ensure smooth integration of its various components and efficient functioning across different modules. It adopts a layered design that supports the implementation of machine learning models, data processing, and a user-friendly interface for farmers.
At the foundational level, the data acquisition layer is responsible for collecting and managing all relevant input data. This includes historical crop price datasets, weather information, soil and crop data, and records of government schemes. These datasets are obtained from publicly available sources or agricultural databases.
The next component is the machine learning layer, which performs data analysis and prediction tasks. It applies algorithms such as Naive Bayes, Decision Trees, and K- Nearest Neighbour to process input data and generate outputs such as crop price forecasts and crop suitability recommendations. The models are trained and tested to identify the best-performing algorithm for different types of predictions.
The application logic layer acts as the central processing unit of the system. It coordinates between the user input, the machine learning models, and the database. This layer processes the user's

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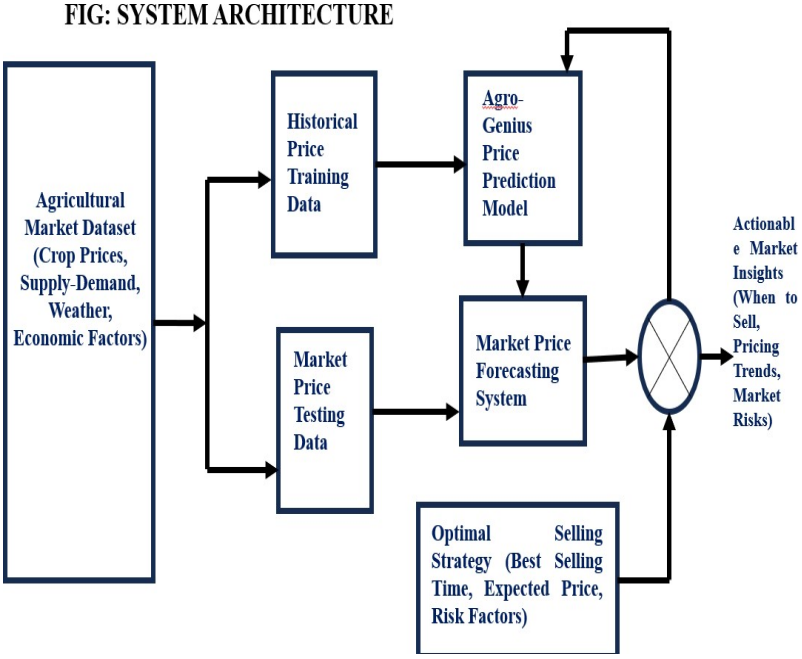
queries, applies the appropriate prediction logic, and compiles the results to be displayed to the user.
The user interface layer is responsible for presenting information to the user. It is designed as a web-based application that allows farmers to interact with the system using simple input fields and visual outputs. It supports multiple languages and provides access to crop suggestions, weather updates, government scheme recommendations, and agricultural maps.
Finally, the database layer manages the storage of all data within the system. It stores user data, model outputs, historical records, and real-time updates securely and allows quick retrieval as required by the application logic. Each layer in the architecture plays a specific role and communicates with the others to form a cohesive and efficient system aimed at supporting modern agricultural practices through predictive analytics.

DATA FLOW DIAGRAM

FIG: SYSTEM ARCHITECTURE



The system architecture represents the operational flow of the Agro-Genius price prediction model, focusing on transforming agricultural data into meaningful insights for farmers. The architecture begins with the agricultural market dataset, which consists of information related to crop prices, supply and demand conditions, weather patterns, and economic indicators. This dataset forms the foundation for the system's predictive capabilities.
The collected data is divided into two parts: historical price training data and market price testing data. The training data is used to develop the price prediction model. Machine learning algorithms analyze this data to understand the relationships and trends that affect crop pricing. The testing data is reserved to evaluate the model's accuracy and reliability on new, unseen data.

CONCLUSION

The proposed system aims to bridge the gap between traditional agricultural practices and modern technological advancements by providing an intelligent, data-driven solution for crop price prediction. By utilizing machine learning techniques on region-specific datasets, the Agro- Genius platform enables farmers to make informed decisions regarding the sale of their crops, thereby reducing uncertainty and financial risk.
The integration of historical data analysis with predictive modeling ensures that the system can offer reliable forecasts, helping users to understand market trends and optimal selling strategies. The system also supports farmers with insights on market risks and expected pricing, empowering them

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to plan their agricultural activities more efficiently.
In addition, the platform enhances accessibility through a user-friendly web interface and multilingual support, making it suitable for farmers from diverse regions and backgrounds. The inclusion of agricultural maps and scheme recommendations adds further value by guiding farmers in choosing suitable land and accessing relevant government support.
Overall, the Agro-Genius system contributes towards the digital transformation of agriculture in India, promoting smarter farming decisions and improved economic outcomes for farmers through the power of machine learning and data analytics.

FUTURE SCOPE

The Agriculture Price Prediction System is grounded in a multidisciplinary theoretical framework that integrates principles from economics, data science, and environmental studies. At its core, the system operates on the economic theory of supply and demand, where the prices of agricultural products fluctuate based on their availability in the market and the level of consumer demand. Price prediction relies heavily on the analysis of historical data using time series models, which help identify trends, seasonality, and patterns in crop prices over time. Advanced statistical methods such as ARIMA and machine learning algorithms like regression models, neural networks, and decision trees are employed to process large datasets and generate accurate forecasts.
Additionally, the incorporation of real-time data through technologies like IoT sensors, satellite imaging, and weather monitoring enhances the system's ability to reflect current market conditions and environmental factors. Climate variability and government policies, such as subsidies and trade regulations, are also factored into the prediction model, as they play a crucial role in influencing agricultural output and pricing. The system may use behavioral economics to account for irrational market behaviors and sentiment analysis to capture the psychological influence of consumer preferences and media trends on pricing.
Furthermore, the integration of supply chain dynamics and logistics theory allows the system to consider externalities like transportation costs, storage, and distribution efficiency, which can affect the final market prices. By leveraging big data analytics and artificial intelligence, the Agriculture Price Prediction System becomes more adaptive and resilient, offering a robust tool for farmers, traders, and policymakers to make informed decisions. This holistic approach not only improves price accuracy but also supports sustainable agricultural practices and enhances food security in the long run.

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