

Smart Kisan Seva

A Smart Agricultural Support System for Crop Recommendation and Price Prediction

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Abstract - Agriculture is the backbone of the Indian economy; however, the farmers are often in trouble in deciding the right crops and the right time for selling the crops. Uncertainty in soil conditions, changes in climate, and changes in prices are the major factors affecting the profitability and financial stability of the farmers. Smart Kisan Seva is the intelligent web-based agricultural support system proposed in this paper for helping farmers in decision-making in the fields of crop selection and price forecasting. The proposed system is based on the integration of ML models for crop selection and commodity price forecasting, and the farmers can sell their products directly to the traders through the proposed system.

The module for crop recommendation makes use of supervised ML models based on the soil parameters like Nitrogen(N), Phosphorus(P), and Potassium(K), along with temperature, humidity and rainfall. The price prediction module makes use of regression and time series models for the prediction of future prices based on the historical mandi prices. Apart from these, the system has implemented secure authentication features and the use of a chatbot for easy accessibility for the farmers in the rural areas by supporting three languages: English, Telugu, and Hindi.

The system also comprises the farmer trader interaction module, which helps in transparent trade negotiation, trade management, notification, and communication using the integrated chat tool. By doing

this experiment we have got an high accuracy in crop recommendation, and price forecasting module has reliable trend prediction results. The integration of predictive analytics and the digital marketplace allows the Smart Kisan Seva system to enhance agricultural productivity, market transparency, and farmer income through the empowerment of farmers using technology.

Keywords - Smart Agriculture, Crop Recommendation System , Price prediction, Machine Learning, Soil Nutrient Analysis, Farmer-Trader Marketplace.

I. INTRODUCTION

Agriculture is crucial in the Indian economy which helps many people in the country and helps in increasing GDP of the country. Many farmers lack in taking decisions about crop cultivation. Farmers face many challenges in selecting suitable crops and finding the traders and finding best time to sell their crop. This results in low crop yield and financial losses.

Usage of machine learning techniques and data analytics can improve decision making in agriculture. These techniques can analyze the soil nutrients, environmental conditions and historical market data to provide accurate crop recommendation and price prediction. However, many existing agricultural systems focus only on crop recommendation and price prediction but lack in user-friendly interfaces and accessibility for rural farmers. And

they also lack in direct connection between traders and farmers.

To overcome these challenges, this paper proposes Smart Kisan Seva, a web based application that have the features of crop recommendation, price prediction and digital marketplace within this single web application. When user enter the input parameters like N, P, K, humidity and rainfall, the system uses these input parameters in its ML model to recommend the best crop for this input values. And price prediction model uses inputs as crop name, month, season etc.

This system also enables direct interaction between farmers and traders which removes intermediaries which makes more benefits to the farmers. It also includes multilingual support and an AI based chatbot to assist farmers. Finally this system aims in improving agricultural productivity and increase farmers profits.

II. RELATED WORK

In recent years, there have been numerous developments in the machine learning that made scientists to make accurate and effective intelligent farming decision support systems. For example, many researchers have created different models for crop recommendation, yield estimation, and predicting prices using a data-driven approach.

In one of the paper of crop and price prediction, Pandit Samuel (2020) developed three forecasting algorithms: decision trees, linear regression, and XGBoost. These algorithms allowed him to estimate the price of agricultural commodities as they were predicted to occur. This research is noteworthy because it demonstrated the necessity for proper data preprocessing before applying an algorithm to predict future prices. Furthermore, although the results of Pandit Samuel's research demonstrated the superior abilities of the XGBoost algorithm to predict prices compared with the other two algorithms, the research was limited to price prediction without including a crop recommendation or the interaction with traders (farmers).

In other paper by author Jalaja (2024) created an Internet-based crop recommendation and profitability analysis system. In addition to using a combination of classification techniques (KNN, SVC, Gaussian naive bayes, and decision trees) to predict which crops would be suitable for the district, Jalaja employed a stacking ensemble (random forest and XGBoost) as an additional means of forecasting the prices of crops. Although this system provides a combination of crop suitability and profitability analyses, it does not have any direct support for traders or provide industry-specific language support.

In her research "Machine Learning Driven Precision Agriculture," Priyanka (2024) applied various models, including random forest, SVR, Voting Regressor, and stacking regressor, to create a Decision Support System that could predict growing degree days(GDD) and evapotranspiration (ET). The results were strong across all models, but Random Forest provided the most accurate outcomes. However, Priyanka mainly focused on irrigation and crop management.

In the research by author Zhang (2020), he combined time series forecasting with an artificial neural network (ANN) model, support vector regression (SVR) model, and feature selection to build an agricultural commodity price forecast model. While the models for predicting agricultural commodity prices were more accurate than previous ones, Zhang did not develop a system for recommending crops based on soil.

In their study of supervised machine learning approach for crop yield prediction by Kumar (2021) compared the effectiveness of Random Forest model with Decision Tree model and Logistic Regression model to predict crop yields based on environmental factors. Out of these three random forest has got more accuracy. However, Kumar's research only focused on yield prediction and did not connect it to market forecasting.

One last study titled "Crop Yield Prediction Using Deep Learning" sought to improve prediction accuracy compared to traditional regression analyses by employing ANN methods. While this study showed some promise with its results, the ANN did not include any financial or trading aspects.

III. PROPOSED SYSTEM

The proposed system Smart Kisan Seva is a web application system that supports farmers in selecting crops and predicting prices of the crop and also connects farmers with the traders. This proposed system is made by integrating machine learning techniques with a digital marketplace that directly connects farmers with the traders.

Architecture

1. User Layer

The User Layer is the component of the system where the users (farmers and traders) interact with the system. This system has two individual interfaces for two users farmer and trader. To login to the system farmer uses mobile number with an OTP authentication and trader uses e-mail authentication which makes secure login for both the users.

After logging in of farmers, they can get crop recommendation by giving input details like soil parameters N, P, K values of soil and temperature, humidity, rainfall and pH. Farmers can also post the crops that are available with them so that traders can see them and make deal with the farmers directly. They also get price prediction based on crop and time of selling. Similarly Traders can view all the crops that farmers posted and can request the required crop which must be accepted by farmers for successful deal.

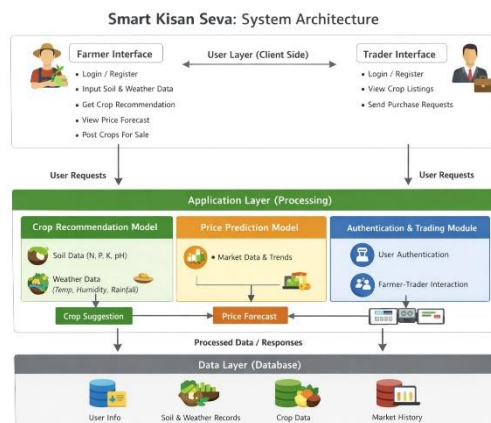


Fig.1 Architecture

2. Application Layer

The application layer is responsible for the system processing and all the core functions. There are three main modules in this layer; they are as follows: Crop Recommendation module; Price Prediction module; Authentication & Trading module.

A. Crop Recommendation Module

The crop recommendation module in this system uses the random forest machine learning algorithm to recommend crops based on the input parameters of soil and environmental parameters. Here we trained an agricultural dataset took from the Kaggle which consists of the attributes of nitrogen, potassium, phosphorus, temperature, humidity, pH and rainfall. Random forest uses multiple decision trees for getting the good outcome which makes it the good choice for crop recommendation. It able accurately predict the best crop based on the input features and got an accuracy of 95%. As soon as the farmer enters the soil information, this information is used by this model to give the recommended crop which will be displayed on the screen.

B. Price Prediction Module

The price prediction module uses the random forest regression algorithm to predict the price of the crop based on the time. We trained historical price dataset took from Kaggle with attributes of crop name, season, month and price. And we got the r^2 score of 0.98 which gives the best price

predictions. When the farmer enters the crop name and other related data the predicted price will be displayed on the screen.

C. Authentication and Trading Module

This module is responsible for secure login of the users. There are two different authentication methods available for two users farmer and trader:

- (i) Farmers can authenticate using an One Time Password-based login
- (ii) Traders can authenticate via either email login or Google OAuth login.

Once logged into the system, farmer can add a new crop to the list of crops with crop name, quantity and selling price. Farmer can also get crop recommendation and price prediction of the crop he need to sell.

Whereas traders can view the crops listed by farmers and can place orders by sending purchase request to the farmer. When a trader sends a purchase request to the farmer, the farmer will receive the request and he can accept or decline that request. Once the request got accepted they get connected through a chat feature to complete this deal.

3. Data Layer

The data layer is responsible for storing different types of data. Here we used SQLite for data storage which acts as a database. The data stored includes the follows:

- User Information (Farmer and Trader)
- Soil and weather data records
- Crop recommendation dataset
- Crop listing data
- Historical market price data

This data storage helps in machine learning models for crop recommendation and price predictions.

Technologies used

Next.js, React, TypeScript, and Tailwind CSS are all technologies used to build the user interface of our system. FastAPI and Python have been used to build the backend and to allow for seamless API communication between the front end and machine learning models. Uvicorn is the ASGI server running the FastAPI application.

Additional Features

This system has many additional features that help in usability and accessibility for its users. These include an AI-based chatbot to assist farmers in agricultural related questions and the system also provides dashboards to easily review their stats in crop listing, trade requests and market insights.

In addition to this the platform has multi language support for its users which help local rural farmers to use this system easily. This increases the use of this platform.

IV. RESULTS

This system was developed as a web-based system and it was evaluated based on the crop recommendation and price prediction model performance with functionalities of web application modules.

The Crop recommendation model used the random forest classification which classifies the crops based on the input features. This module successfully giving the recommendations based on input parameters nitrogen, phosphorus, potassium, temperature, humidity, rainfall, and pH, which directly influence crop growth.

The random forest algorithm is advantageous because it utilizes multiple decision trees to give accurate predictions without overfitting the dataset. The accuracy we achieved was approximately 95% which gives best results.

When the farmer inputs the soil and weather data in this system, the crop recommendation module processes the data through the models to recommend the best crop which gives high yields to the farmer.

Figure 2 shows the crop recommendation interface the farmer will utilize to input the soil parameters to receive the crop recommendations suggested through the Random Forest model.

Fig 2 Crop recommendation

Along with the crop recommendation, we also integrated a predictive pricing module that estimates price of a crop using past pricing data collected from Kaggle. Here it uses random forest classifier algorithm where we achieved r^2 score of 0.98 which give best price results.

When the farmer want to predict price of a certain crop, he gives the inputs such as crop name, month, season etc. to get the predicted price. The model takes these input features and processes the data to display the result on the screen.

With this feature, producers can forecast what they can expect at market price levels and find the best time to sell crops in order to maximize profit margins.

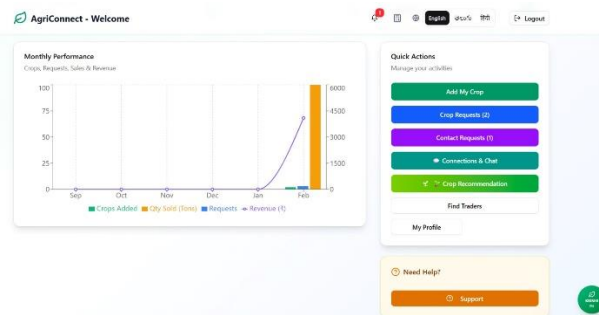


Fig 3 Farmer Dashboard

Both the users farmer and trader has their own dedicated interfaces where they can login. Farmer can login through mobile number with OTP and access multiple features including crop recommendation, price prediction and connection with the traders.

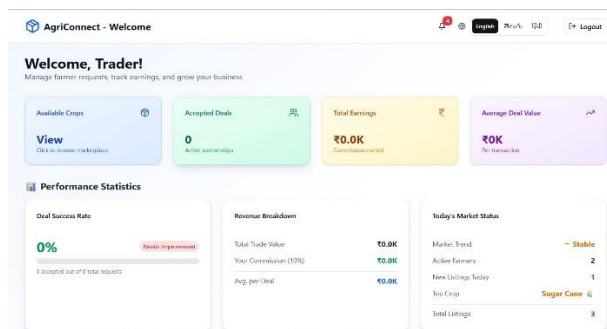


Fig 4 Trader Dashboard

Whereas trader can login using their e-mail and upon successful login traders can search crops that farmers have posted and they can submit purchase request.

After the trader request, farmer can view these requests and they have options to accept or decline this deal. Once if this deal was accepted then the traders and farmer can able to use chat feature provided by the system to complete this deal.

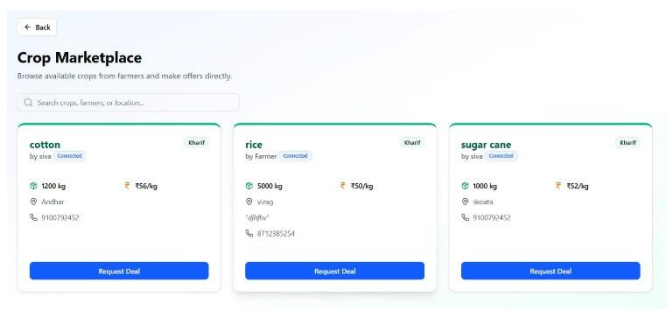


Fig 5 Crop marketplace

This system has number of new features including AI chatbot, dashboard analytics and multi-language support which enables user-friendly usage of this system.

V. CONCLUSION

This research presented Smart Kisan Seva a web-based system that combines machine learning algorithms with a user-friendly digital marketplace which makes farmers to select and trade the crops easily. This system was built using a random forest algorithm which gave a good accuracy of 95% which established a reliable crop prediction capability.

In addition to this a random forest regression based price prediction module was developed which gave a R2 score of 0.98 indicating a very high accuracy for price prediction. It also allows for direct interaction between farmers and traders through a request based system which includes chat functionality.

It also includes several other features including AI chatbot support and dashboard analytics which shows the information like success rate of trading etc. This system also includes secured user authentication using OTP and e-mail. It also enable multi-language support (English, Telugu and Hindi). By utilizing the power of machine learning and a user-friendly digital marketplace, Smart Kisan Seva is an effective means for improving decision-making in agriculture, promoting transparency in agriculture, and increasing farmer profitability. Future enhancements may include adding real-time data sources to the program and enabling the system for larger-scale agricultural use.

VI. REFERENCES

- [1] T. Jalaja et al., "Empowering Agriculture: A Machine Learning-Based Decision Support System for Crop Selection and Profitability Analysis," International Journal of Intelligent Systems and Applications in Engineering, 2024.
- [2] B. Priyanka et al., "Machine Learning Driven Precision Agriculture: Enhancing Farm Management through Predictive Insights," International Journal of Intelligent Systems and Applications in Engineering, 2024.
- [3] Z. Zhang et al., "Forecasting Agricultural Commodity Prices Using Model Selection Framework With Time Series Features and Forecast Horizons," IEEE Access, vol. 8, pp. 28197–28209, 2020.
- [4] R. Rohith et al., "Crop Recommendation System Using Machine Learning Techniques," Proceedings of NCRTC Conference, 2023.
- [5] Y. J. N. Kumar et al., "Supervised Machine Learning Approach for Crop Yield Prediction in Agriculture Sector," International Journal of Engineering Research & Technology, 2021.
- [6] P. Samuel et al., "Crop Price Prediction System Using Machine Learning Algorithms," Journal of Software Engineering and Simulation, 2020.
- [7] P. K. et al., "Crop Yield Prediction Using Deep Learning Algorithm," International Journal of Advanced Computer Science and Applications, 2022.