AI Powered Farmer-To-Market Advisory System

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Abstract: *Farmers often lack access to integrated market intelligence combining price trends, weather variability, and logistics costs, leading to suboptimal selling decisions and post-harvest losses. This study proposes an AI driven farmer to market advisory system that integrates computer- vision based crop identification, real time mandi price retrieval, geolocation enabled transport cost estimation, and storage profitability simulation. The framework analyzes multimodal data to recommend optimal selling markets and timing strategies aimed at maximizing net profit. Experimental validation using real time agricultural price datasets demonstrates improved decision support accuracy and reduced spoilage risk. The proposed system highlights the potential of AI enabled decision platforms to enhance agricultural marketing efficiency and support data driven farm level economic planning.*

Keywords: agricultural decision support, profit optimization, multimodal AI, geospatial analytics, and supply chain intelligence

1. Introduction

Farming these days has become quite essential in India. So many people depend on agriculture for their day-to-day income and livelihood. During the whole year, Farmers grow their various crops like vegetables, fruits, and grains. At Present, farmers livelihoods depend on their ability to sell their crops in the market.

Although many farmers are not aware of how to sell, when to sell and where to sell their crops in the market. Farmers do not receive proper guidance and up-to-date information about current market prices, weather conditions, and demands for their crops. Because of this problem, farmers sell their crop through middlemen or local buyers in the market. Middlemen sometimes give lower prices, and farmers lack knowledge about the current market price of their crops. For this reason, they do not get their full income.

Based on these issues related to crop prices and the major impact of weather changes on agriculture, farmers are essential for improved guidance. Sudden changes in weather such as rain, extreme heat, or storms can damage crops and reduce the quality. Farmers do not know about how to predict weather conditions, farmers cannot choose the right time to harvest, store, or sell their crops.

The aim of this project is to solve the above problems by designing a smart farmers guidance system that is available for real time data and current information to farmers. The system combines crop identification, real time market price and weather updates on a single platform. Farmers can use the system to take their own decisions about where and when to sell their crops, which can help improve their profits and reduce losses.

2. Literature Survey

This study explains a digital price information system for farmers. It collects daily mandi prices and shows them to farmers. But it gives only price data and optimal market selection criteria or selling time.[1]

This study related to weather prediction or report systems for farming purposes. Farmers get day-to-day and weekly weather report to choose the best time for irrigation and harvesting activities. But it does not connect weather data with selling decisions or profit estimation.[2]

This study presents an image-based crop recognition system. Farmers upload images for their crop, and the system determines the crop variety. It helps in managing crop effectively, but it does not give the market-related guidance or time to sell.[3]

This research work describes an image analysis technique to detect plant diseases. The system can detect diseases at an early stage and helps farmers in taking preventive actions. But, it does not involve price comparison or market suggestions.[4]

This study mainly concentrates on predicting the crop price using past market data. It studies the past records of the prices to predict the future prices. But, it doesn't take into consideration the current weather and transport costs.[5]

This proposed research work deals with a location-based market comparison system. It compares prices from different mandis and assists farmers in choosing better markets. But, it does not involve identification of the crop and weather information.[6]

This study describes about the use of transport cost analysis in agriculture. This system estimate the travel distance and transportation costs between farms and markets. But, it does not integrate price, weather, and crop data. [7]

This study discusses about the integrated smart farming systems. The different digital tools are combined in this paper to assist farmers. Nevertheless, most of these systems still do not have the complete integration of crop identification, real-time prices, weather updates, and final suggestions in one easy platform.[8]

3. Proposed Solution

The proposed Farmer-to-Market Guidance System will function in a step-by-step process. The main objective of this project mainly focused on collecting information about the crop details and provide a suitable advice to farmers for better decision-making.

1) Crop Image Upload and Identification
The farmers need to upload images of their crops through the application interface. After uploading an computer vision technique to classify the crop shown. The system uses image features such as colour and shape to classify the images.

2) Farmer Input Details
Farmers are required for additional data include their location and the quantity of crop. This information is useful in ensuring that the system is able to make accurate analysis and recommendations. The system uses the farmer's location information to find the nearby markets, mandis as well as transportation cost. The quantity information is useful in estimating the profit and demand of the market.

3) Real-Time Data Collection
The system gathers the real-time data including market prices, weather information, and transport costs through APIs. Market price data help farmers to select profitable markets. Weather conditions help in organizing the storage and transport. It helps determine the final cost of selling including transportation details.

4) AI Analysis and Recommendation
The gathered information is analyzed through an AI module to support smart decisions. It compares and analyses prices in the market, weather forecasts, transportation cost to calculate which is the best market to sell crops. The system gets recommendations based on this analysis – best market, profit expected and storage suggestions to reduce spoilage while getting better income for the farmers.

5) User-Friendly Output
The system presents results to the farmers in a clear and simple format. This easily understandable system allows them to easily see the recommendations, estimates on profit, and advice on storage easily and without complexity. This platform provides a simple interface that allow users without technical knowledge can access the system on a daily basis and take smart decisions.

4. Methodology

The proposed AI Farmer Advisory system is an integrated decision-support platform that will integrate Computer Vision, real-time government market data for vegetable prices according to geolocation info, GPS-based routing choices for vehicular transit and Market pricing comparison via Transport Cost-Rating-Optimizing Agent System (TCROA) and storage profitability analysis module. It takes farmer inputs, checks market opportunities and calculates profits before generating the most optimized decision of selling or storing to maximize agricultural revenue in an efficient way.
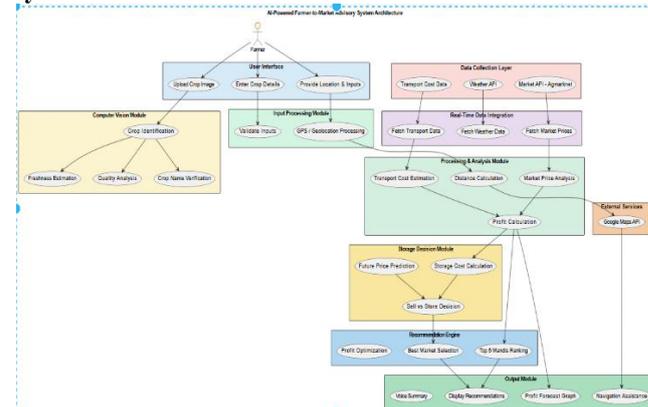
System Architecture

Figure 1: System Architecture of AI-Powered Farmer-to-Market Advisory System

4.1 User Input and Location tracking

The system begins with farmer interaction through a web-based interface.
- Crop name
- Location/Area (Village/City)
- State
- Available Stock
- Farming expense
- Days after harvesting
- Crop image(optional)

In the first stage of operation, the system uses your exact location coordinates obtained via browser-based GPS for accurate distances. If GPS is not available, it resorts to IP-based geolocation or geocoding of the location entered. We take the captured latitude and longitude as an origin point for route calculation and estimating transport costs.

4.2 Computer Vision and Crop Verification

When a crop image is uploaded, visual analysis on the crop image is performed by the Computer Vision module. These modules are performed to three primary functions:

4.2.1 Freshness Estimation
The system evaluate the spoilage of visual pattern and number of days since harvest. It helps farmers to determine whether it is better to sell now or store.

4.2.2 Quality Analysis
Evaluating the crop appearance to see if it satisfies market standards.

4.2.3 Crop Name Verification
The system compares the crop image the user uploads with the crop name provided by the user. If the information does not match, the user is politely notified not to pull the wrong price from the market API. This feature enhances the reliability of the system by reducing the chances of input errors and wrong commodity queries.

4.3 Real-Time Market Data Integration

The AI Farmer-to-market Advisory system gets real-time agricultural price data from Agmarknet Government of India.

This system integrates with live mandi price data gathered from wholesale markets across various states. This API is government-certified and such integration guarantees that all price recommendations displayed are based on real-time data.

4.3.1 Commodity Price Retrieval

Accessing Real-time commodity price is done through the Agmarknet government API where crop name and respective state are passed as primary parameters It had to pull multiple values such as the minimum price, maximum price, modal price and arrival date for different mandis in the state from the API. Out of these, modal price is used to calculate revenue and profit because it is the price which comes for the maximum times in a mandi.

4.3.2 Market-Wise Modal Price Extraction

But in contrast to an aggregated value, the system can pull out modal prices for each mandi.

This enables:
- Analysis of different markets
- Days with Maximum Prices: Analysis of mandis
- Comparison of market prices within a single state
- Granularity at the market level enables profit computation per mandi after adjustment for transport.

4.3.3 Arrival Date Handling

Every record specifies the arrival date when commodity arrived at the mandi. Current market pricing information is maintained by the system processing the most recent records. So, whenever the specific date did not return anything for data, it was fetching newest records to be able to making decisions.

4.3.4 State-Based Filtering

State records are essential as prices differ greatly depending on the region and impact the estimation of profits as well as the modeling of transportation.

4.4 Locating Mandis and Distance Calculation

An important component of profit optimization is the Mandi Identification and Distance Computation module, which uses geographic intelligence to augment real-time market pricing. Correct distance evaluation plays a crucial role to providing high-quality guidance, as transportation expenses for the main contributors to net profit margins.

4.5 AI-Supported Transportation Cost Assessment

The system replaces fixed transport charges, the system determines a variable cost through an AI-based model. Final fee per kilometer is also based upon crop type, quantity, and nature of load.

Transportation charges is calculated as:
Transport Cost $= $ Distance $\times$ Rate AI

By not using fixed assumptions, this dynamic methodology gives realistic cost estimation as well as enhances the precision of global profit calculation.

4.6 Calculate the profitable model Profit Estimation:

Revenue $= $ Market $\times$ Quality
Net profit:
Net Profit $= $ Revenue-Cultivation Cost-Transport Cost
Total mandis is ranking based on overall net profit.
The system is available for top 5 profitable markets are displayed.

4.7 Cold Storage Profitability Simulation

The system analyse the future price prediction trends and make comparisons:

Immediate selling profit vs stored profit.
Storage cost:
Storage cost $= $ Daily Rate $\times$ Days $\times$ Crop Value
Stored profit:
Stored profit $= $ Future Revenue – Transport – Cultivation - Storage
Decision rule:
The system recommends storage when stored profit exceeds immediate profit

4.8 Profit Forecast Visualization

The utility of the system is three-fold: it generates a profit roadmap that shows what your projected profit will be over time, how much cost you have accumulated for storage, and how that compares with selling for immediate profit. They analyze recent market movements to calculate future income. Farmers can float different sale dates down into the interactive slider, allowing them to make data-driven decisions. the market farmers.

4.9 Cold Storage Facility Recommendation

If it is more profitable to store, the system detects cold storage around and shows what its name and distance with contact information and link for navigation. Geographic location coordinates are used for distance computation, making storage engineering decisions more actionable and implementable.

4.10 Advisory Report Generation

The final output includes:
- Best strategy (Sell or Store)
- Best mandi
- Expected net profit
- Transport breakdown
- Storage recommendation
- Suggested selling date
- Navigation assistance
- Voice summary

5. Results and Discussion

The AI Farmer Advisory System was tested with real-time inputs and government market data to provide recommendations based on accurate profits. The solution computed crop information, location, financial cost and shelf life to give a comprehensive advisory output.

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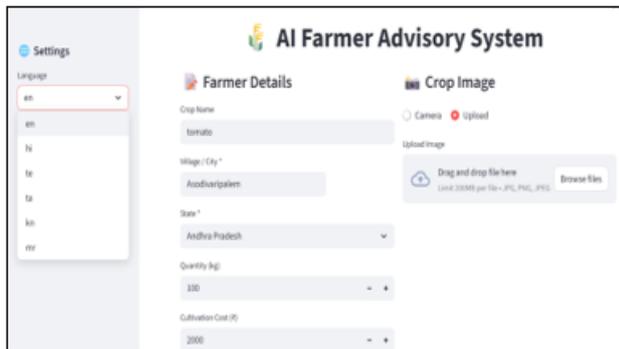
5.1 Market Price Retrieval

Figure 2: User Interface of AI Farmer Advisory System

It fetched the real-time commodity prices from the agmarknet database and extracted market-wise modal prices. Hence, by filtering and validating the data temporally filtered based on states we could maintain accurate data for computing profit.

5.2 Computation of Profits and Position in the Market

Revenue and net profit for each mandi was computed after adding transport costs. The markets were ranked based on net profit to select best selling locations.

5.3 Cold Storage Analysis

Figure 3: Cold Storage Profit Analysis Module

The storage module evaluated the predicted profit from storing the product against with expected profits from immediate sale. The system generated recommendations based on profitability comparison.
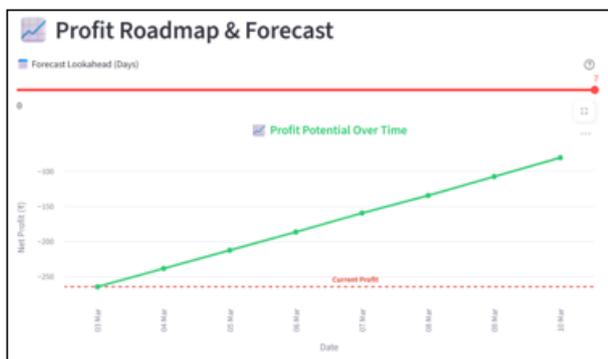
5.4 Profit Forecast Visualization

Figure 4: Profit Roadmap & Forecast

A roadmap shows the outlines of the profit growth trends over time, contrasting to selling the product right away. The responsiveness slider allowed the system to simulation of future selling dates.

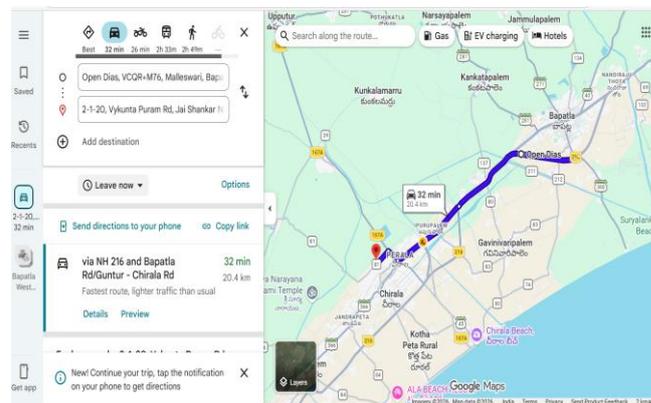### 5.5 Route and Navigation Integration

Figure 5: Market Transportation Cost and Route Visualization

The distance from the mandi was computed (geographically) and navigation links were created for every recommendation to make sure that the recommendations provided meet the user location criteria.

5.6 Overall Performance

The findings indicate that the system successfully integrates day-to-day update price data, transport charges, storage planning, profit estimation and navigation tools to deliver provide data-based agricultural advisory advice.

6. Future Scope

The future work can include the system integrating demand forecasting models for more precise prediction in markets and deployment as a mobile app to increase accessibility to rural areas. Rich supply-chain visibility can be obtained through blockchain integration, while government procurement schemes can also be connected to increase options for selling. The usability and price prediction accuracy can be further streamlined by the support of multiple regional languages and usage of advanced deep learning models.

7. Conclusion

This study presents an AI enabled farmer to market advisory framework integrating crop recognition, real time price intelligence, geospatial transport optimization, and storage profitability modelling. Experimental deployment demonstrates the feasibility of unified multimodal decision support in improving profit estimation and reducing post-harvest losses. While the proposed architecture advances integrated agricultural analytics, future work should focus on large scale validation, predictive accuracy benchmarking, and mobile deployment for rural accessibility. The findings reinforce the potential of AI driven economic advisory systems in strengthening data informed agricultural supply chain decision making.

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