

SMART CONTRACT FARMING SYSTEM

G. Naveen Kumar¹, B. Vaishnavi²,
Ch. Gayathri Bharghavi³, K. Shveni⁴

¹Associate Professor, CSE(AI&ML), Vignan's Institute of Management and Technology for Women, HYD, India.

^{2,3,4}B Tech 4th year Student, CSE(AI&ML), Vignan's Institute of Management and Technology for Women, Hyderabad, India.

Abstract:

The Smart Contract Farming System is a digitalized platform created to connect farmers and buyers more reliably and transparently. Its main goal is to reduce the gap between both buyers and farmers by using secure digitized agreements that clearly define terms and conditions, which helps to build trust and ensures that transactions are fair and well-structured. The platform is developed using Vite and React, through which users can easily register, explore crop listings, view contracts, and interact in real time. On the backend, Node.js and Express.js handle the core application logic, including API services, authentication, contract processing, and transaction management. All data is securely stored and managed using MongoDB, ensuring consistency and reliability. One of the key features of the system is the Price Prediction Module, which works before a contract is finalized. This module uses agricultural datasets collected from IEEE research publications. With the help of Python-based machine learning models, the system predicts crop prices by analyzing historical data, seasonal trends, and market needs and supply. It helps farmers and buyers in making informed decisions and agreeing on fair prices. Once the price is decided, digital contracts are created and accepted by both parties. This system also includes crops based on agricultural seasons such as Kharif, Rabi, and Zaid, which helps in better planning and avoids mismatches between supply and demand. In addition to contract management, the platform involves features like dispute resolution tools and analytical dashboards, which make the overall process more efficient and transparent. Payments are secured through trusted methods such as UPI and escrow systems, ensuring safe and reliable transactions. The feature that makes this application more effective is the Crop Insurance module, which allows farmers to enroll in government-supported insurance schemes. This protects them from unexpected risks like floods, droughts, or pest attacks. Overall, the system is designed to be scalable, efficient, and user-friendly. It strengthens farmers by giving them assured market access while helping buyers get a consistent and trustworthy supply of crops.

Keywords: Smart Contract Farming, Machine Learning, Price Prediction, Digital Contracts, React, Node.js, MongoDB, Crop Insurance, UPI Payments, Demand and Supply, Transparency.

I. INTRODUCTION:

Agriculture is always the backbone of human civilization, lifestyle, employment, and economic stability. Traditional farming was the primary source of living for many small farmers, where they cultivate crops mostly on a seasonal crop cycle, based on local knowledge and available resources. Farmers face extreme difficulty due to middlemen interference, unpredictable market prices, lack of trustworthy buyers, and limited access to modern inputs. On the other hand, buyers face challenges due to inconsistent sources. To

address this gap, this paper proposes a transparent digital contract farming for guaranteed market access and a constant source. Ex-post facto research design using 60 farmers was collected through interviews and analyzed using statistical methods like t-test and averages [1]. Qualitative case study, political economy, and historical analysis were done to highlight the social impacts of contract farming [2]. A descriptive and comparative review of literature, policy analysis, and case references of Punjab, Haryana, and Andhra Pradesh was done, which emphasized the need for group contracts and producer organizations [3]. Conducted a survey of 247 farmers across 14 blocks in Kushinagar District by using random sampling and statistical analysis (SPSS) to assess adoption, awareness, and challenges of contract farming [4]. A study on India's contract farming model using descriptive and analytical methods was done by focusing on tripartite agreements (Farmer-Sponsor-APMC) [5]. A web-based platform using React.js, Firebase, Blockchain Smart Contract, and Tailwind CSS was developed for real-time contract tracking [6]. By eliminating hardware dependency and incorporating transparent contracts, the proposed solution provides a secure, scalable, and trustworthy approach to small farmers and buyers in need.

II. RELATED WORK:

Recent research shows that fairer agreements significantly increase the number of contracts made between farmer and buyer. Statistical methods like the t-test and averages are applied by collecting data to identify the benefits that contract farming has [1]. Case studies and historical analysis are done to exploit risks and unequal power between farmers and firms [2]. Policy analysis, descriptive and comparative review of literature was done to highlight the merits of fair agreements [3]. Random sampling and statistical analysis (SPSS) were applied to the survey of 247 farmers to address risks of contract farming [4]. Improved farmer income, ensured price stability, promoted private, and introduced safeguards for fair trade [5]. Enabled digital contracts between farmers and buyers, reduced negotiation time through a web-based platform [6]. However, many existing solutions lack trustworthy agreements, unstable market prices, and less reliable sources for buyers. The proposed system addresses these limitations by providing Python-based price prediction, secure digital contracts, and a crop insurance module to help farmers and buyers in case of any loss.

III. PROPOSED SYSTEM:

A. Overview of Proposed System:

The proposed Smart Contract Farming System (SCFS) is a web-based digital platform designed to connect farmers and buyers in a reliable and transparent way. The system eliminates the risk of unstable market prices by including a price prediction module feature, which uses a machine learning model to predict crop prices based on historical data and market conditions. It is developed with Vite.js, Express.js, and MongoDB; the system supports crop listing, contract management, and secure payments. A key feature is the Crop Insurance module, which enables farmers to claim in case of any natural loss. The system ensures fair pricing, guaranteed market access, and reliable transactions by using digital contracts.

B. System Architecture:

The architecture consists of five core modules:

- Auth & User Management Module
- Contract Management Module
- Payment & Escrow Module
- Insurance Module
- Notification Module

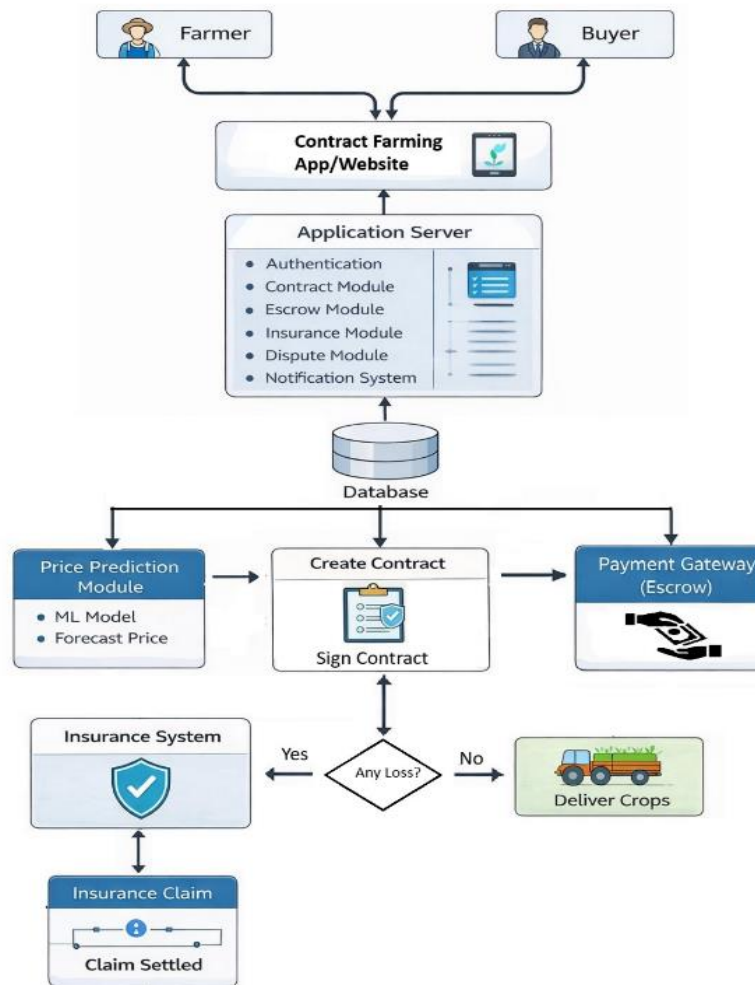


Figure 1: System Architecture for Smart Contract Farming System

- **Auth & User Management Module:** This module manages how users sign up, log in, and access the system based on their roles such as farmer, buyer, or admin. It keeps user accounts secure by using technologies like JWT for login sessions and bcrypt for protecting passwords. All user details are carefully checked and stored safely in the database. The system makes sure that each user only sees and uses features meant for their role, while also tracking activities like logins and profile updates for better security. Built using Node.js, Express.js, and MongoDB, this module ensures a safe and reliable user experience.
- **Contract Management Module:** This module is a key part of the system that handles the creation and tracking of agreements between farmers and buyers. When a buyer selects a crop, the system automatically generates a digital contract with details like price, quantity, quality, and delivery schedule. Built using Node.js and Express.js, it manages contract stages such as draft, approval, active, and completion. Both parties confirm the agreement digitally, and all records are stored securely in MongoDB.

Through a React-based interface, users can easily view and track contracts, while notifications help them stay updated on approvals and deadlines.

- **Payment & Escrow Module:** This module manages secure transactions between farmers and buyers by integrating payment gateways like UPI or Razorpay. When a contract reaches the payment stage, the system calculates the buyer's advance and the farmer's contribution, including insurance. The contract becomes active only after both payments are successfully confirmed. All transaction details are safely stored in the database. Once delivery is verified, the system releases funds from escrow to the appropriate party. It also includes error handling to ensure smooth and reliable payments even if issues occur.
- **Insurance Module:** The Insurance Module helps farmers stay protected from risks like crop loss, natural disasters, or unexpected damage. It allows farmers to enroll in insurance schemes, check policy details, and submit claims when needed. Built using Node.js and Express.js, the system manages registrations and claim processing, while all data is securely stored in MongoDB. Through a simple React interface, farmers can apply for insurance, upload documents, and track their claim status. This module adds a layer of financial security, making the overall farming process safer and more reliable.
- **Notification Module:** The Notification Module keeps users updated about key activities like contract changes, payments, crop updates, deliveries, and disputes. Built with Node.js and Express.js, it sends alerts through push notifications using services like Firebase. The system ensures timely delivery with background processing and allows customizable notification templates. On the frontend, users can view updates through a React-based dashboard. It also records user actions such as logins and transactions, helping maintain transparency and supporting tracking and dispute handling.

IV. IMPLEMENTATION:

A. Development Environment

The Smart Contract Farming System is developed using a full-stack approach. The frontend uses Vite.js with React.js to provide a fast and user-friendly interface. The backend is built with Node.js and Express.js to handle application logic and REST API communication. Data is stored in MongoDB or PostgreSQL for efficient and secure management. Tools like VS Code and Git are used for development and version control. The system is designed to be scalable, efficient, and accessible across devices.

B. User Authentication

User authentication in the system is handled using JWT (JSON Web Tokens) to ensure secure access for all users. Farmers, buyers, and administrators can register by providing their details, which are properly validated before being stored in the database. When a user logs in, their credentials are checked, and a token is generated to allow access to protected features. The system also uses role-based access control, so each user can only access functionalities based on their role. Additionally, passwords are stored securely using encryption methods to protect user data.

C. Price Prediction

The price prediction module is designed to assist farmers in estimating future crop prices using past data. It applies machine learning techniques to study patterns such as seasonal changes, market demand, and historical pricing trends. Based on this analysis, the system provides predicted prices when farmers create listings. This helps them make informed decisions and improves their ability to negotiate better deals with buyers.

D. Data Preprocessing and Storage

Before using machine learning models, the raw agricultural data is first prepared through preprocessing. This step involves handling missing values, scaling or normalizing data, and converting it into a structured format suitable for analysis. Tools like Pandas and NumPy are used to perform these operations efficiently.

Once processed, the cleaned data is stored in the database, making it easy to access for further analysis and model training.

E. LSTM and Gaussian Regression

Advanced techniques like LSTM (Long Short-Term Memory) and Gaussian Regression are applied to improve the accuracy of price prediction. LSTM is mainly used for analyzing time-based data such as past crop prices and seasonal patterns, while Gaussian Regression helps in understanding uncertainty and variations in pricing trends. Together, these models provide more accurate predictions and help users make better decisions based on reliable insights.

F. Insurance Module

The insurance module is designed to offer financial security to farmers in case of crop loss or failure. Farmers can enroll in insurance policies while creating contracts within the system. All policy-related information is stored securely, and users can raise claims whenever needed. The backend processes these claims by checking predefined conditions and updates their status accordingly. This feature builds trust and minimizes financial risks for farmers.

V. ALGORITHM:

```
BEGIN
INITIALIZE system
INITIALIZE dataset, model, user, listing, payment

// USER LOGIN
INPUT email, password
IF user exists AND password is correct THEN
    GENERATE token
ELSE
    DISPLAY "Invalid login"
END IF
// DATA PROCESSING
LOAD dataset
CLEAN dataset
CREATE features (lag, rolling, encoded)
// MODEL TRAINING
TRAIN model using dataset
// PRICE PREDICTION
INPUT crop details
PREDICT future_price
// FARMER DECISION
INPUT current_price
IF future_price > current_price THEN
    decision ← "HOLD"
ELSE
    decision ← "SELL"
END IF
// LISTING CREATION
INPUT user_price
```

```
IF user_price is empty THEN
  listing_price ← future_price
ELSE
  listing_price ← user_price
END IF
SAVE listing

// BUYER ACTION
INPUT buyer_offer
IF buyer_offer >= 0.9 * future_price THEN
  contract ← "ACCEPTED"
ELSE
  contract ← "NEGOTIATE"
END IF
// PAYMENT
IF contract = "ACCEPTED" THEN
  PROCESS payment
  SAVE payment details
END IF
DISPLAY results
END
```

VI. RESULTS:

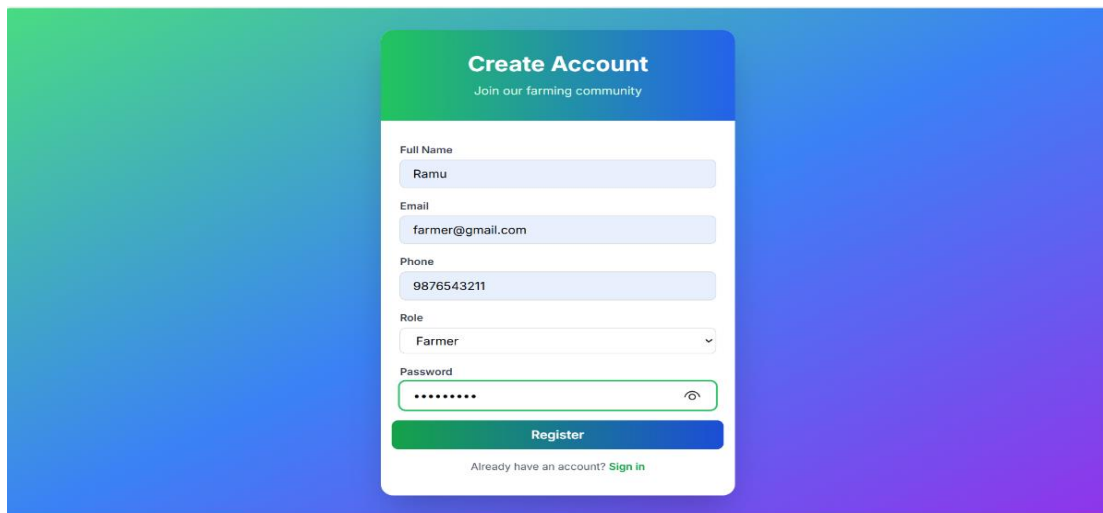
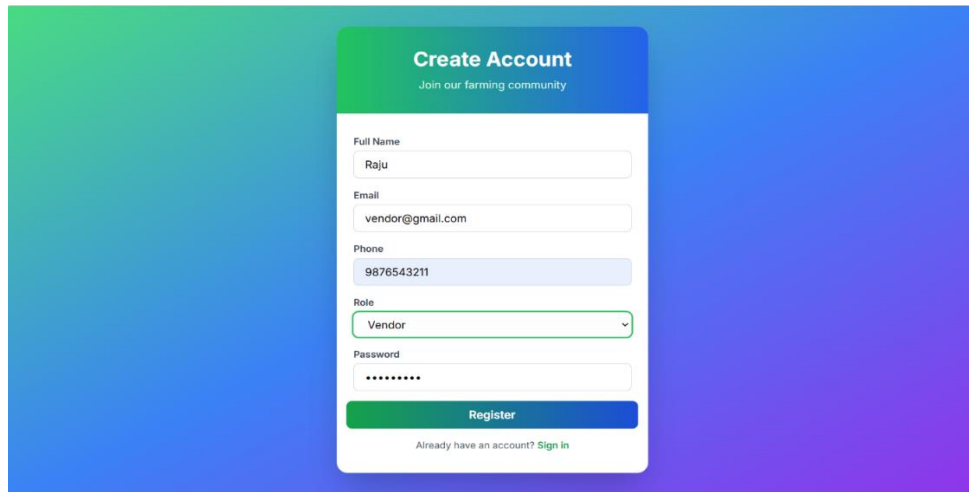


Figure1: Farmer Sign in Page



Create Account
 Join our farming community

Full Name

Email

Phone

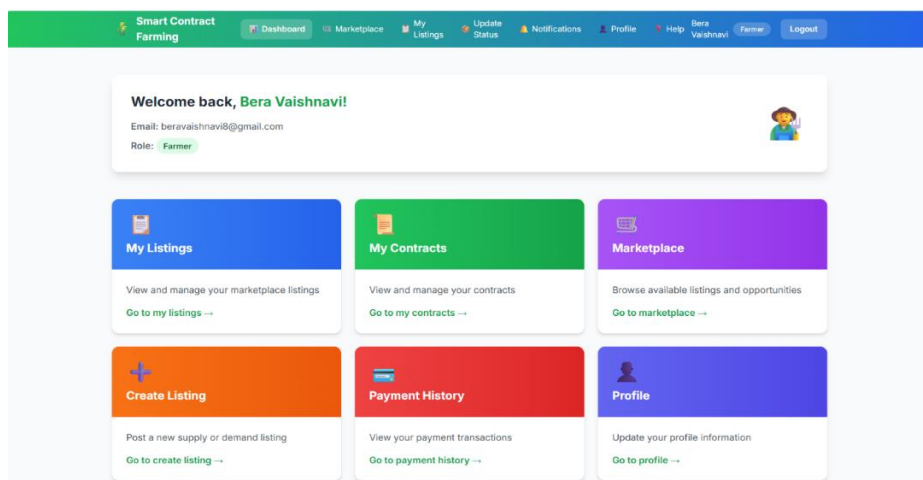
Role

Password

[Register](#)

Already have an account? [Sign In](#)

Figure 2: Vendor Sign in Page

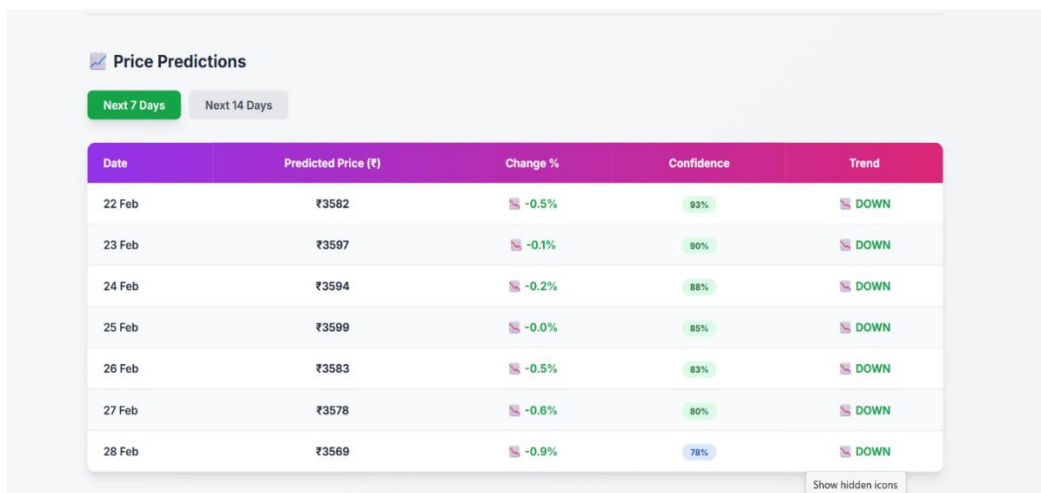


Smart Contract Farming | Dashboard | Marketplace | My Listings | Update Status | Notifications | Profile | Help | Bera Vaishnavi | Farmer | Logout

Welcome back, Bera Vaishnavi!
 Email: beraVaishnavi@gmail.com
 Role: Farmer

- My Listings**
View and manage your marketplace listings
[Go to my listings](#)
- My Contracts**
View and manage your contracts
[Go to my contracts](#)
- Marketplace**
Browse available listings and opportunities
[Go to marketplace](#)
- Create Listing**
Post a new supply or demand listing
[Go to create listing](#)
- Payment History**
View your payment transactions
[Go to payment history](#)
- Profile**
Update your profile information
[Go to profile](#)

Figure 3: Dashboard of the Smart Contract Farming system



Price Predictions

Next 7 Days | Next 14 Days

Date	Predicted Price (₹)	Change %	Confidence	Trend
22 Feb	₹3582	-0.5%	83%	DOWN
23 Feb	₹3597	-0.1%	90%	DOWN
24 Feb	₹3594	-0.2%	88%	DOWN
25 Feb	₹3599	-0.0%	85%	DOWN
26 Feb	₹3583	-0.5%	83%	DOWN
27 Feb	₹3578	-0.6%	80%	DOWN
28 Feb	₹3569	-0.9%	78%	DOWN

Show hidden icons

Figure 4: Price prediction for selected crop

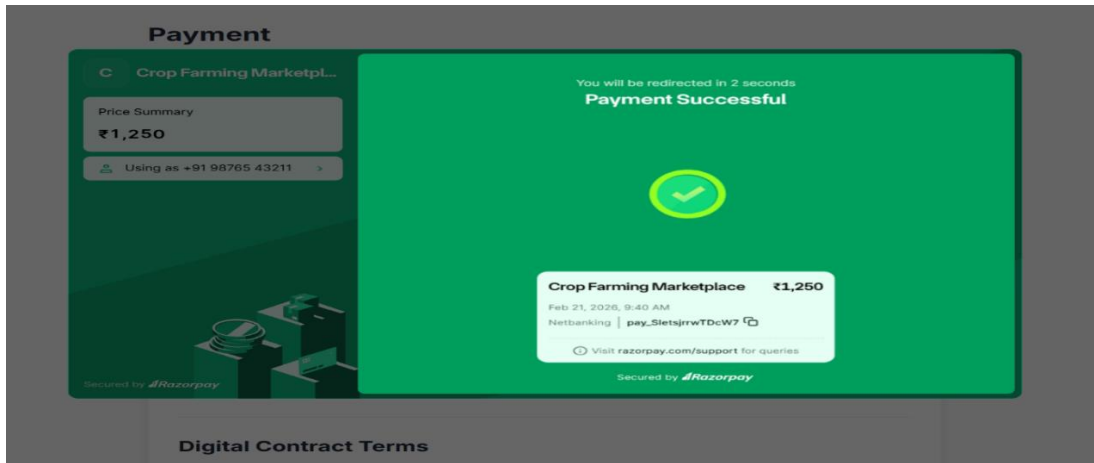


Figure 5: Successful Advance Payment Confirmation via Razorpay

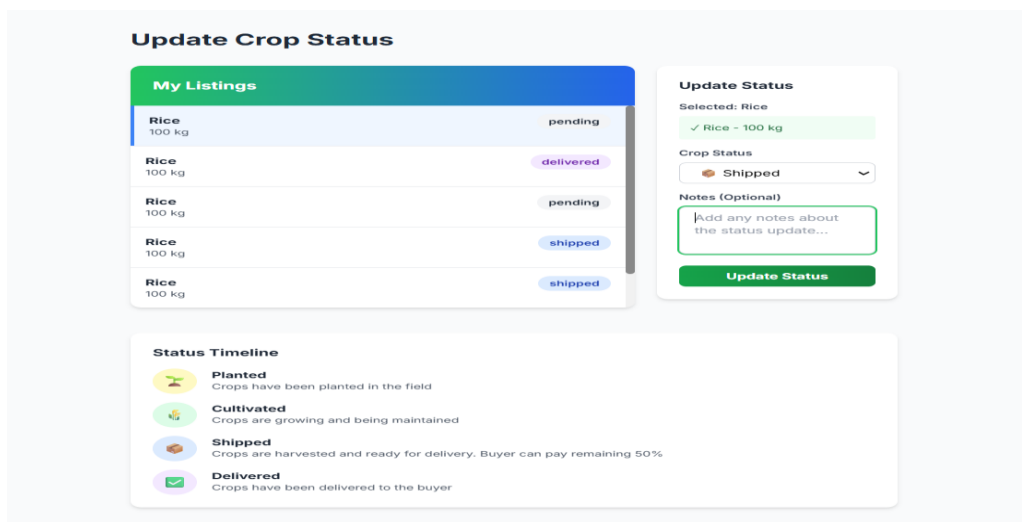


Figure 6: Shipment updated by farmer

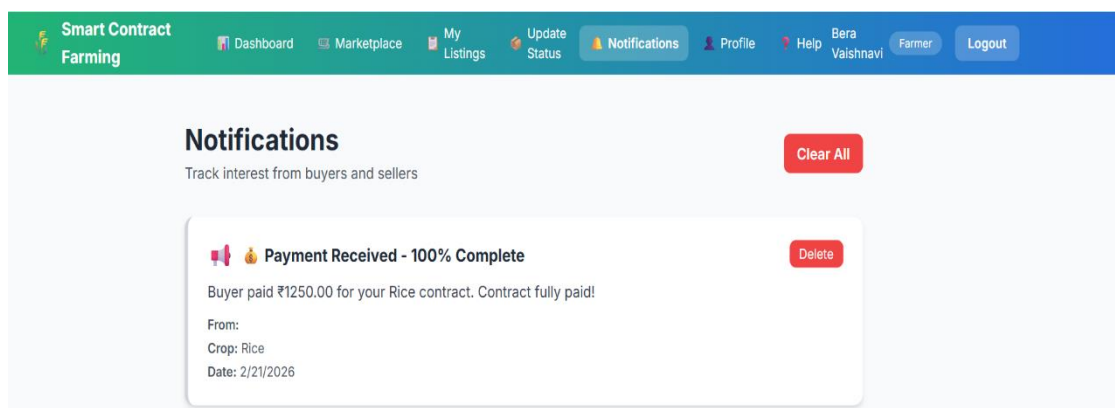


Figure 7: Buyer Payment Completed – Contract successfully closed

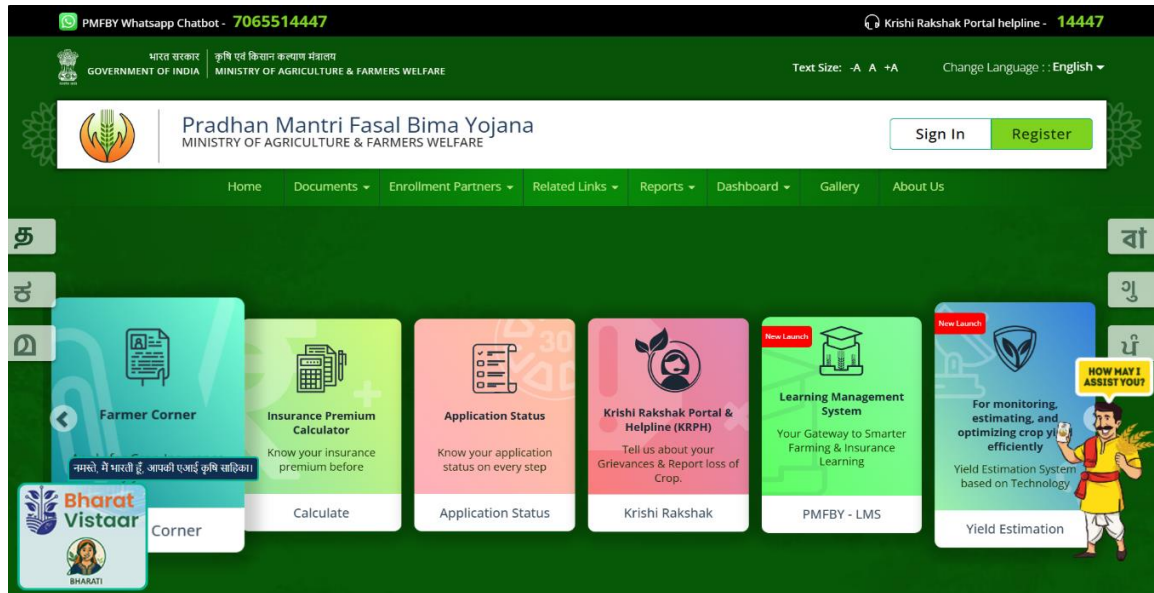


Figure 8: PMFBY dashboard

VII. CONCLUSION:

This research presents an intelligent, secure, transparent, reliable, and digital platform that enables farmers to connect with buyers to make successful contracts. By integrating the Python-based Price Prediction module, farmers face less trouble with price issues. The main feature, “Insurance module,” highlights and protects farmers and buyers from unpredictable natural losses. This framework promotes sustainability, trustworthiness, and resource efficiency while being beneficial to both farmers and buyers.

REFERENCES:

- [1] Kharumnuid, Pynbianglang & Sarkar, Sujit & Singh, Premlata & Priya, Satya & Tomar, B.S. & Singh, Dhiraj & Pandey, Nitin, “An assessment of contract farming system for potato seed production in Punjab-A case study”, Indian Journal of Horticulture, 2017.
- [2] Vicol, M., Fold, N., Hambloch, C., Narayanan, S., & Pérez Niño, H, “ Twenty-five years of Living Under Contract: Contract farming and agrarian change in the developing world”, Journal of Agrarian Change, 2022.
- [3] Amarpreet Kaur, Jenny Kapngaihlian, Shruti Chopra, Anurag Chaudhary, “Contract farming in India: Issues and concerns under changing policy environment”, Pharma Innovation, 2022.
- [4] Ajay Kumar Rai, Ashok Rai, Shamsheer Singh, Rajneesh Srivastava, Shruti V Singh and Anjali Sahu, “Contract farming in vegetables: Status and role in Kushinagar District of Uttar Pradesh”, The Pharma Innovation Journal, 2023.
- [5] Badgujar, R., Zagade, G., Suryavanshi, S. K., & Dubey, S, “ Assured contract farming system for stable market access”, International Journal of Creative Research Thoughts (IJCRT), 2024.
- [6] Meghana, Dugasani & Meghana, Venkata & Sunil, G & Reddy, Kumar & Reddy, Hrushikesh & Vijayalakshmi, Y & Vijaya, Kandra & Sasidhar, Babu & Suvanam, & Sasidhar Babu, “Assured Contract Farming System for Stable Market Access”, 2025.