Enhancing Direct Market Access for Farmers Through a Mobile App and Integrated Information System

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***Abstract*—The Indian agricultural secto faces persistent challenges in bridging the gap between farmers and consumers, resulting in reduced farmer profits and limited consumer access to affordable, fresh produce. Many farmers rely on middlemen, which erodes their earnings through high fees, lower price offers, and delayed payments. Additionally, unpredictable weather and fluctuating market prices further complicate income stability. This research proposes an innovative Android application, Farmers Market App, that integrates machine learning (ML) and blockchain technologies to address these issues. The app provides dual-language support (Kannada and English), enabling farmers to upload produce images that are automatically identified and priced using ML models, including Convolutional Neural Networks (CNNs) for crop recognition.The app empowers farmers by offering real-time price predictions, weather forecasting, logistics support, and a Natural Language Processing (NLP) interface for seamless interaction in regional languages. Consumers benefit from direct access to fresh produce, secure blockchain-based transactions, and digital wallets, ensuring transparency and safety. Building on the work of Dhanapal et al. (2021) and Samuel et al. (2020), this study demonstrates how advanced technologies can eliminate intermediaries, increase farmer incomes, and promote sustainable farming practices. By creating a direct, efficient, and transparent marketplace, this research contributes to food security, agricultural efficiency, and equitable market access for smallholder farmers.**

***Index Terms*—Crop Price Prediction, Machine Learning, Agricultural Market Forecasting, CNN in Farming, Predictive Analytics, Mobile Agriculture, Sustainable Farming, Natural Language Processing**

I. INTRODUCTION

Agriculture is the cornerstone of the Indian economy, contributing significantly to the nation's GDP and supporting millions of livelihoods. However, inefficiencies in the traditional agricultural supply chain have long constrained the sector's potential. Farmers often face challenges in securing fair prices for their produce due to intermediaries who impose high commission fees, delay payments, and restrict access to real-time market data. This results in reduced farmer profits and inflated costs for consumers. Adding to these challenges are unpredictable weather conditions and market fluctuations, leaving farmers financially vulnerable and disconnected from direct market opportunities. The lack of proper infrastructure and limited market reach also prevents farmers from accessing wider consumer bases, further exacerbating these issues.

Advancements in technology, particularly in mobile applications, Machine Learning (ML)**,** and blockchain**,** provide innovative solutions to these persistent challenges. ML techniques, such as Convolutional Neural Networks (CNNs) for crop recognition and regression models for price prediction, empower farmers with valuable insights to make informed decisions about crop cultivation, harvest timing, and pricing. This technology can also help farmers forecast potential yield, minimizing losses due to weather conditions or market volatility. Additionally, blockchain technology ensures secure and transparent transactions, fostering trust and reliability in digital marketplaces, while enabling farmers and consumers to engage in direct transactions without intermediaries.

The Farmers Market App is designed to bridge the gap between farmers and consumers, providing an easy-to-use platform that simplifies the entire supply chain process. The app's user-friendly interface, implemented as an Android application using Java/Kotlin**,** allows farmers to upload images of their produce. The app then uses ML models trained with TensorFlow/Keras to identify the crop and predict its fair market price, based on real-time data from agricultural markets and location trends. This feature empowers farmers to make data-driven decisions, ensuring they can sell their produce at competitive prices.

The app also incorporates blockchain technology, utilizing platforms like Ethereum to facilitate secure digital transactions and manage digital wallets for both farmers and consumers. Smart contracts within the blockchain ensure that payments are processed instantly and securely, eliminating delays and ensuring timely transactions. This reduces the financial risks that farmers face due to delayed payments or dishonest dealings with intermediaries.

A robust backend, hosted on XAMPP MySQL, handles the storage of user data, product details, and transaction histories. The backend ensures that data is securely stored and easily accessible. Communication between the client and the server is facilitated through REST APIs, enabling smooth and efficient interaction between the app's front-end and back-end systems.

The Farmers Market App not only empowers farmers by allowing them to bypass intermediaries, but it also opens up direct channels to consumers. Farmers can upload images of their crops, view price predictions, and sell directly to customers. Consumers, on the other hand, can browse products, add them to their cart, and complete purchases seamlessly through the app. The app's bilingual interface, supporting both Kannada and English**,** ensures inclusivity and accessibility for users from diverse linguistic backgrounds, particularly rural communities where Kannada is widely spoken. This makes the app accessible to a wider demographic, ensuring that technology can be used to benefit farmers across the country.

In addition to crop identification and price prediction, the app provides other essential features like weather updates and logistics support. Real-time weather forecasting allows farmers to plan their harvests better, while logistics support offers efficient transportation solutions to ensure timely delivery of produce to consumers. The app's comprehensive set of tools empowers farmers to maximize their profits while ensuring consumers receive fresh, affordable produce directly from the source.

Overall, the Farmers Market App creates a more transparent, efficient, and equitable marketplace. It addresses the inefficiencies of the traditional agricultural supply chain by connecting farmers and consumers directly, promoting fair pricing and secure transactions. By incorporating cutting-edge technologies, this app enhances agricultural sustainability, improves food security, and fosters socio-economic development in rural India. The research behind this project lays the foundation for a future where farmers can thrive in a fair, competitive market, contributing to the long-term success of the agricultural sector in India. Through the use of ML, blockchain, and other modern technologies, the Farmers Market App paves the way for a more inclusive and resilient agricultural ecosystem.

II.LITRATURE REVIEW

The prediction of crop prices plays a crucial role in agricultural management, helping farmers navigate volatile markets and make informed decisions. Over the years, machine learning (ML) algorithms have gained significant attention for their ability to forecast crop prices based on various factors. Below is a review of key research papers that explore the application of ML techniques in crop price prediction:

Dhanapal et al. [1] investigated the use of supervised machine learning algorithms, including regression and classification models, to predict crop prices. Their study emphasizes the importance of analyzing historical data alongside market trends, weather conditions, and economic indicators. By incorporating these diverse factors, they found that prediction accuracy could be greatly enhanced. The research highlights the need for effective feature selection and the dynamic nature of agricultural markets when designing forecasting systems.

Samuel et al. [2] introduced a crop price prediction system that leverages machine learning algorithms such as decision trees and support vector machines (SVM). This research focuses on predicting crop prices by incorporating not only historical data but

also factors like climate change and broader economic conditions. Their findings show that machine learning models outperform traditional forecasting methods, underscoring the value of real-time data to improve accuracy. This paper offers practical insights into how ML techniques can be applied to agriculture.

Singh et al [3] explored the use of Long Short-Term Memory (LSTM) networks, a type of recurrent neural network (RNN), for predicting crop prices. LSTM is particularly effective for time-series data, making it ideal for forecasting crops over seasons. The study found that LSTM networks are capable of capturing long-term dependencies and seasonal trends, which significantly improves prediction accuracy. This paper highlights the power of deep learning models, particularly when temporal patterns are key to making accurate price predictions.-based system that combines environmental and market data to predict crop prices. By using algorithms like linear regression and decision trees, they explored how integrating factors such as weather, soil conditions, and historical trends could improve the reliability of price forecasts. The research emphasizes the importance of a holistic approach that takes into account a broad range of variables when predicting crop prices.

Abdullahi et al. [4] applied Convolutional Neural Networks (CNNs) to plant image recognition in precision agriculture, which indirectly supports crop price prediction by forecasting yields. The study demonstrates how CNNs can identify plant health and classify images, which in turn helps in predicting crop yields. This research contributes to the growing field of precision agriculture and shows how deep learning can be utilized to improve yield predictions—an important factor in forecasting crop prices.

Bhanushali et al [5] developed "CropConnect," a mobile application that provides farmers with real-time crop price predictions. By integrating machine learning models, the app forecasts prices based on historical data, weather, and market trends. The study suggests that mobile applications like CropConnect can bridge the gap between farmers and market information, empowering farmers to make informed decisions about when and where to sell their crops, ultimately boosting their profits.

Kamal et al. [6] reviewed mobile applications that support smallholder farmers by providing accurate price predictions and market information. Their study highlights the growing importance of mobile platforms in improving decision-making for farmers. By incorporating machine learning algorithms into these platforms, farmers can gain better access to real-time market data, reduce reliance on intermediaries, and achieve better financial outcomes.

Kulkarni et al.[7] developed an e-commerce platform that incorporates crop price prediction algorithms, aiming to connect farmers directly with buyers. By reducing the need for intermediaries, the platform ensures better price transparency. The integration of machine learning models allows farmers to make more informed pricing and selling decisions, ultimately contributing to more efficient agricultural markets.

Patil et al. [8] proposed an Android-based mobile application that connects farmers with retailers and food processing industries. The app includes features for real-time crop price prediction, helping farmers decide the best time and place to sell their crops. This study demonstrates how mobile technology, combined with machine learning, can enhance market access for farmers and improve their efficiency in responding to market fluctuations.

Ume [9] explored the role of improved market access for small-scale organic farmers and its connection to price prediction and food security. The study argues that accurate price prediction models, when paired with better market access, can significantly improve the profitability of smallholder farmers. Ume emphasizes the need for advanced predictive tools that can help farmers understand market trends and reduce their vulnerability to price instability.

In their study, Roshini et al. [10] focused on crop price prediction in India, utilizing machine learning models such as random forests and gradient boosting. Their research found that ensemble models, which combine multiple algorithms, provide greater accuracy in price prediction than single models, especially when dealing with large datasets that include various features such as weather and market indices.

Ghanbari et al. [11] developed a crop price prediction system using a combination of machine learning algorithms, including neural networks and regression models. Their study highlights the significance of feature engineering, integrating factors like soil quality, weather conditions, and crop health. The research concludes that combining diverse data

sources and advanced ML techniques is essential to creating highly accurate crop price prediction systems.

III.METHODOLOGY

The methodology for this research involves developing a Farmers Market Application that connects farmers directly with consumers, utilizing modern technologies such as Machine Learning (ML) and blockchain. The process begins with data collection, where a dataset of produce images, including grains and vegetables like rice, wheat, maize, tomato, and potato, is gathered. This dataset captures variations in lighting, background, and produce categories to ensure robustness. Additionally, real-time market data and geographical trends are collected to support price prediction.

Data preprocessing is a critical step in which images are resized to uniform dimensions (e.g., 128x128 pixels) and normalized to standardize the inputs. Augmentation techniques, such as rotations and flips, are applied to improve model generalization. Concurrently, market data is cleaned and formatted to prepare it for regression analysis, which is essential for accurate price prediction.

The application leverages ML-based modules for its core functionality. For image identification, a Convolutional Neural Network (CNN) is implemented with convolutional, pooling, and fully connected layers to classify produce images accurately. For price prediction, a regression model is developed using market data and location trends to forecast produce prices effectively. Both ML models are trained using TensorFlow/Keras to ensure scalability and accuracy.

The application itself is developed as an Android platform using Java/Kotlin and features distinct interfaces for farmers, consumers, and administrators. Farmers can upload produce images and view price predictions, while consumers can browse products, add them to their cart, and complete purchases. The admin module is equipped with tools for managing data and analytics. A secure backend is developed using XAMPP and MySQL to store user data, product details, and transaction histories, with REST APIs enabling seamless communication between the app and the backend.

Blockchain integration is a vital component of the methodology, providing secure and transparent transactions through digital wallets for both farmers and consumers. Transactions are recorded immutably, ensuring trust and reducing the likelihood of fraud. Additionally, smart contracts are employed to automate trade agreements, ensuring timely payments and efficient transaction management. These contracts operate on platforms such as Ethereum, further enhancing system reliability.

Finally, the system undergoes rigorous testing to evaluate its performance in areas such as image identification accuracy, price prediction efficiency, and transaction security. Feedback from pilot users, including farmers and consumers, is incorporated to refine the application. This methodology, combining ML-driven automation, blockchain security, and user-centric design, aims to create an efficient and equitable marketplace that benefits all stakeholders.

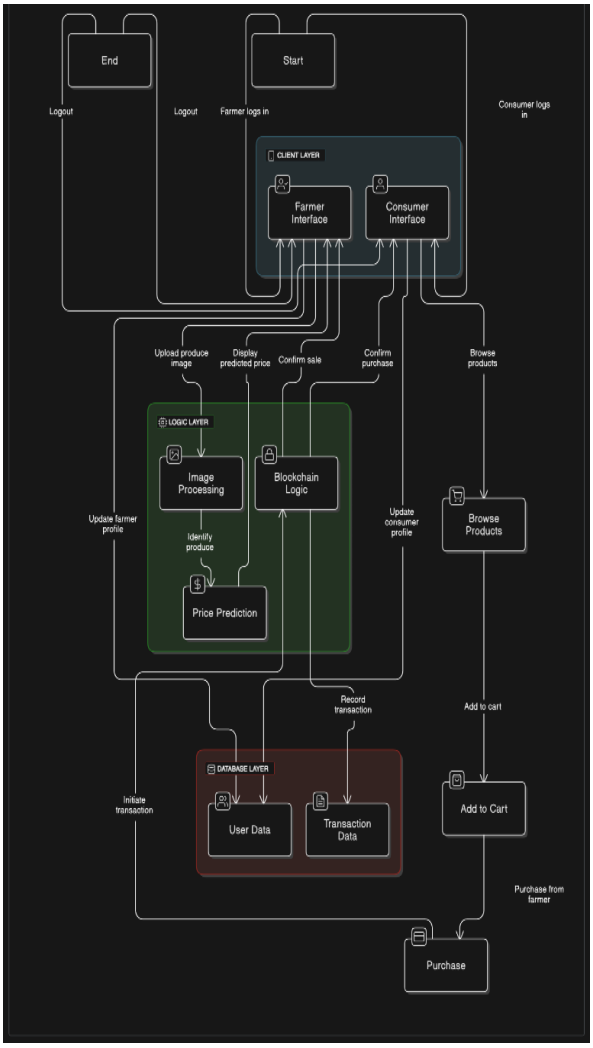
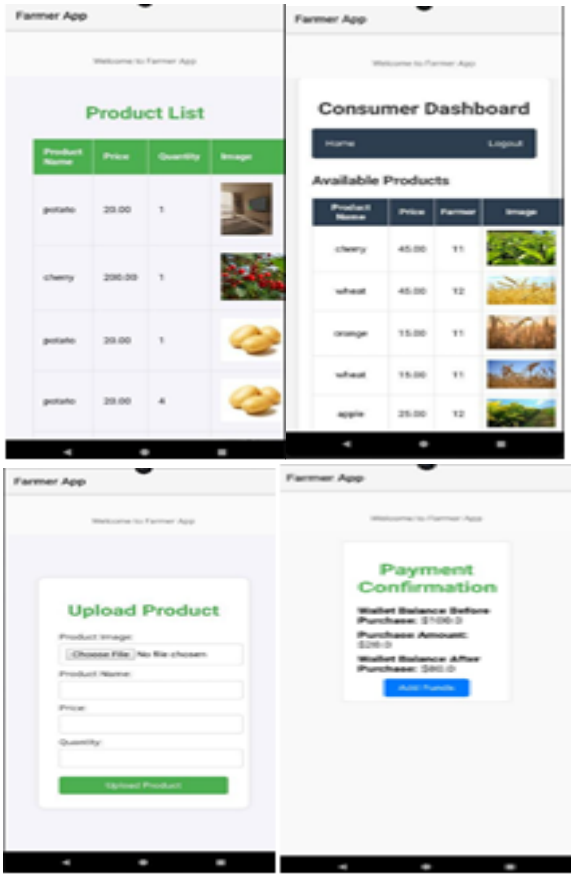


Fig.1 System Architecture of Mobile App

IV.OUTPUTS



V.CONCLUTION

The Farmers Market App provides a fresh and effective solution to the many difficulties faced by farmers in India, such as dependence on middlemen, fluctuating prices, and limited access to markets. By integrating Machine Learning (ML) and blockchain technologies, the app allows farmers to connect directly with consumers, cutting out intermediaries. Using **CNNs** for crop identification and regression models for price forecasting, the app helps farmers make smarter decisions to boost their profits. Blockchain technology ensures secure, transparent transactions, while smart contracts automate payments and agreements, simplifying trade.

Beyond that, the app empowers farmers with real-time information, including market prices, weather forecasts, and logistical support. It also offers consumers an easy way to access fresh produce directly from the source, promoting fairer trade. With its bilingual interface, the app ensures that farmers from diverse linguistic backgrounds can use it, fostering inclusivity. In essence, the app creates a more transparent, efficient, and fair marketplace, supporting sustainable farming practices and improving food security for smallholder farmers and rural communities. This research lays the foundation for a future where farmers can thrive in a fair, competitive environment, contributing to a more sustainable agricultural system.

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