International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

FarmConnect : Secure Digital Contract Farming Platform

Ratan Kalke
Department of Computer Engineering
Don Bosco Institute of Technology
Mumbai, Maharashtra

Hardik Khare
Department of Computer Engineering
Don Bosco Institute of Technology
Mumbai, Maharashtra

Atharva Khadye
Department of Computer Engineering
Don Bosco Institute of Technology
Mumbai, Maharashtra

Vikas Bhagat
Department of Computer Engineering
Don Bosco Institute of Technology
Mumbai, Maharashtra

***Abstract* - Agricultural supply chains in developing economies suffer from inefficiencies such as information asymmetry, dependence on intermediaries, and lack of contract transparency. This paper presents FarmConnect, a mobile-based digital platform designed to enable end-to-end contract farming through structured negotiation, automated contract generation, and fulfillment tracking. To ensure data integrity, a SHA-256 based cryptographic hashing mechanism is integrated for tamper detection of digital contracts. The system is implemented using Kotlin (Jetpack Compose) and a Node.js backend with secure authentication mechanisms. A pilot evaluation demonstrates improved transparency, reduced negotiation time, and reliable contract verification. The proposed system provides a scalable and secure alternative to traditional contract farming practices.The system also incorporates a trust score mechanism to improve reliability in contract-based transactions.**

Keywords - Contract Farming, Digital Agriculture, SHA-256, Secure Contracts, Supply Chain, Trust Score

I. INTRODUCTION

The agricultural sector plays a vital role in the economies of many developing countries by providing employment, generating income, and ensuring food security for a large population. Despite its importance, agricultural trade suffers from several inefficiencies, including fragmented supply chains, limited market accessibility, lack of transparent pricing mechanisms, and heavy dependence on intermediaries.These challenges often result in income instability for farmers and procurement risks for buyers.

Farmers frequently lack direct access to reliable buyers and are forced to depend on commission agents for price discovery, leading to information asymmetry and reduced bargaining power. On the other hand, buyers face uncertainties in sourcing consistent product quality, monitoring supply timelines, and enforcing contractual agreements. The absence of structured communication and proper documentation further complicates agricultural transactions.

Contract farming has been proposed as a solution to these issues by establishing formal agreements between farmers and buyers. These agreements typically define product specifications, pricing terms, delivery schedules, and payment conditions. However, in practice, contract farming systems remain ineffective due to reliance on manual processes, lack of transparency, and weak contract enforcement mechanisms.

Advancements in digital technologies provide an opportunity to modernize traditional contract farming systems. Mobile-based platforms can enable real-time communication, automate documentation workflows, enhance transaction traceability, and ensure secure data storage. Digitization can significantly improve transparency, accountability, and efficiency within agricultural supply chains.

This study proposes FarmConnect, a digital platform designed to facilitate secure and transparent contract farming transactions. The platform integrates end-to-end functionalities, including negotiation, contract generation, and tracking, thereby addressing the limitations of conventional contract farming systems.

A. BACKGROUND AND PROBLEM CONTEXT

Agricultural markets in developing countries are significantly influenced by the presence of multiple intermediaries, fragmented communication systems, and the lack of reliable information sources. These limitations restrict farmers from directly engaging with buyers, resulting in delayed and often unprofitable trade processes. Traditional contract farming systems attempt to address these challenges through formal agreements; however, they primarily rely on manual documentation, which limits efficiency and transparency.

Manual contract management introduces several issues, including misplaced records, weak enforceability of agreements, lengthy verification procedures, and the absence

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

of real-time monitoring mechanisms. These limitations reduce trust and hinder effective contract execution.

Furthermore, most existing agricultural mobile applications focus on isolated functionalities such as crop advisory services or price prediction. Very few platforms provide a comprehensive, end-to-end solution covering the entire contract farming lifecycle.

These challenges highlight the need for a unified digital platform capable of managing all stages of contract farming in a structured, transparent, and efficient manner.

B. MOTIVATION AND PROBLEM STATEMENT

1) Motivation

The primary motivation of this research is to address the inefficiencies present in agricultural trade systems by leveraging digital technologies to develop a transparent and structured contract farming platform. A unified digital solution can reduce risks, enhance operational efficiency, and ensure proper documentation, thereby improving trust and collaboration between farmers and buyers.

2) Problem Statement

This research aims to address the following key challenges:

1. Lack of assured market access for farmers
2. Absence of transparent and structured negotiation mechanisms
3. Limited enforcement and monitoring of contractual agreements
4. Inefficient payment tracking and documentation processes
5. Inadequate dispute resolution mechanisms

C. NOVELTY OF THE PROPOSED SYSTEM

The proposed system introduces a Trust Score Mechanism to enhance reliability in contract farming transactions. Each user is assigned a dynamic trust score based on multiple parameters, including successful contract completion rate, dispute history, and transaction consistency.

The trust score is computed as:

$$T = w1 \cdot S + w2 \cdot (1 - D) + w3 \cdot C$$

Where:
T = Trust Score
S = Success rate of completed contracts
D = Dispute ratio
C = Consistency of transactions
w1, w2, w3 = weighting factors

II. RELATED WORK

- Agricultural supply chains in developing countries are often characterized by fragmented communication among stakeholders and limited access to reliable information. Several research studies have explored the role of digital technologies in improving agricultural systems. Existing solutions primarily focus on Management Information Systems (MIS), price forecasting tools, and mobile-based advisory platforms. While these systems provide valuable insights to farmers, they fail to address the inefficiencies associated with contract-based agricultural transactions.
- Research on contract farming highlights its potential to mitigate price risks, improve supply chain coordination, and enhance income stability for farmers. However, existing studies also identify key challenges, including weak contract enforcement, lack of transparency, and power imbalances between farmers and buyers. Manual contract management systems are particularly ineffective due to inadequate monitoring and poor documentation practices.
- Recent advancements in digital supply chain management demonstrate the capability of mobile-based platforms to enhance transparency and accountability in transactional processes. Although blockchain-based technologies have been proposed to ensure data immutability and trust, they often face challenges related to scalability, complexity, and high infrastructure costs.
- Furthermore, existing agricultural marketplace platforms mainly support buyer–seller discovery and product listing. Only a limited number of systems provide integrated functionalities such as negotiation, contract generation, fulfillment tracking, and dispute resolution within a single platform.
- Therefore, there exists a clear research gap in developing a comprehensive digital platform that supports the complete contract farming lifecycle while ensuring data integrity.

Table 1: Comparison with Existing Systems

Feature	Existing Platforms	FarmConnect
Buyer – Seller Matching	Yes	Yes
Negotiation System	Limited	Yes
Contract Generation	Minimal	Yes
Fulfillment Tracking	Limited	Yes
Dispute Resolution	No	Yes
Data Integrity	No	Yes (SHA-256)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

III. PROPOSED SYSTEM

A. RESEARCH CONTRIBUTIONS

The key contributions of this study are as follows:

1. Design and development of an integrated digital platform that supports the complete contract farming lifecycle.

2. Implementation of a structured real-time negotiation system along with automated digital contract generation.

3. Development of a secure client–server architecture using modern mobile and backend technologies.

4. Integration of a SHA-256 based hash integrity mechanism for ensuring contract security and tamper detection.

5. Evaluation of the proposed system through pilot testing with real users to assess performance and usability.

B. SYSTEM OVERVIEW

1. The proposed FarmConnect system is an integrated digital platform designed to manage the complete contract farming transaction lifecycle. It enables structured interaction between key stakeholders, including farmers and buyers, through a mobile application supported by backend services.

2. The primary objective of the system is to eliminate inefficiencies in traditional agricultural trade by providing transparent communication, automated contract management, and secure data handling.

3. The platform incorporates multiple functional modules, including user authentication, crop listing, negotiation management, automated contract generation, fulfillment tracking, and dispute resolution, thereby offering a comprehensive solution for contract farming.

C. MATHEMATICAL MODELING AND DECISION LOGIC

1. Negotiation Decision Model

Let:

Pb = Proposed price by buyer
Pf = Expected price by farmer

A negotiation is considered successful if:

$$|Pb - Pf| \leq \delta$$

Where δ is the acceptable price deviation threshold.

This condition ensures convergence of negotiation towards mutually acceptable pricing.

2. Cost Optimization Model

The total cost of contract execution is defined as:

$$Ctotal = Ctransport + Cstorage + Cdelay$$

The objective is to minimize total cost:

Minimize Ctotal

This model can be extended to optimize logistics and contract execution efficiency.

D. INTELLIGENT TRUST SCORING AND DECISION SUPPORT MODEL

To enhance reliability and decision-making in contract farming transactions, the proposed system incorporates a Trust Scoring Model for evaluating user credibility.

Each participant (farmer or buyer) is assigned a dynamic trust score based on historical interactions and transaction outcomes.

The trust score is computed as:

$$T = w1 \cdot S + w2 \cdot (1 - D) + w3 \cdot C$$

Where:

T = Trust Score
S = Success rate of completed contracts
D = Dispute ratio
C = Transaction consistency
w1, w2, w3 = weighting factors (w1 + w2 + w3 = 1)

This model enables users to assess the reliability of counterparties before entering into agreements, thereby reducing risks associated with unreliable transactions.

Additionally, the system incorporates a basic predictive mechanism that analyzes past transaction data to assist users in decision-making, such as selecting reliable partners and identifying stable pricing patterns.

This integration of trust-based evaluation and data-driven decision support enhances transparency and promotes efficient contract farming operations.

IV. SYSTEM ARCHITECTURE

The platform adopts a client-server architecture that guarantees modularity, scalability, and secure handling of information.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

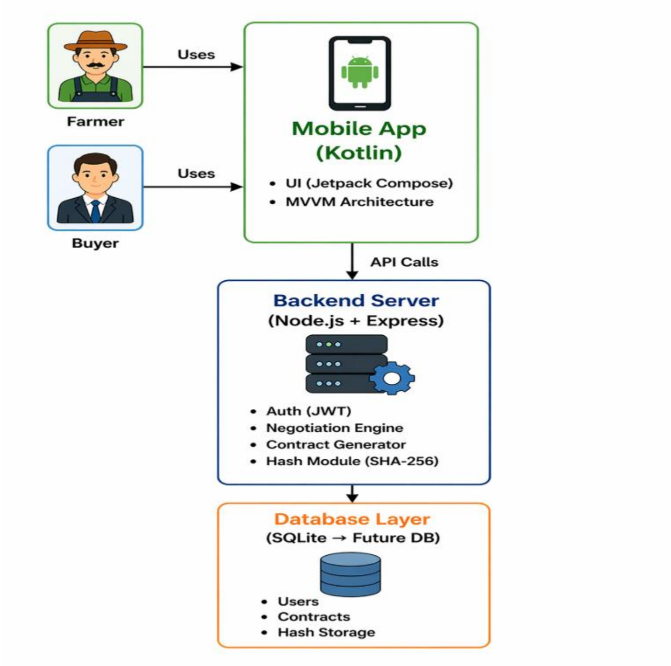

Fig.1.System Architecture of FarmConnect

The system architecture is divided into three main layers:

A. PRESENTATION LAYER (CLIENT SIDE)

The presentation layer consists of an Android mobile application developed using Kotlin and modern UI technologies. This layer is responsible for user interaction, data visualization, and communication with backend services. Key components include:

- Jetpack Compose-based user interface
- MVVM architecture for state management
- Secure API communication using Retrofit
- Local data storage using Room database
- Push notifications

Modern Android architecture components ensure efficient memory management and smooth data flow, enhancing overall application performance.

B. APPLICATION LAYER (BACKEND SERVICES)

The application layer handles core business logic and transaction processing. It is implemented using Node.js and Express.js with TypeScript.
Key functionalities include:

- Authentication and authorization management
- Crop listing processing
- Negotiation workflow handling
- Contract generation and verification
- Payment record management
- Dispute resolution

Security mechanisms such as JWT authentication, bcrypt password hashing, API rate limiting, and secure HTTP headers are implemented to ensure protection against unauthorized access.

C. DATA LAYER

The data layer is responsible for storing and retrieving system data using a structured database system. The current implementation uses SQLite as a lightweight database solution.

The database includes relational tables for:

- User profiles
- Crop listings
- Negotiation records
- Contract details
- Payment transactions

ACID properties, indexing, and foreign key constraints ensure data consistency and reliability.

The current prototype uses SQLite; however, future deployment will utilize scalable databases such as MongoDB or PostgreSQL to support large-scale operations.

D. ARCHITECTURAL DESIGN CONSIDERATIONS

The FarmConnect system is designed using a modular client–server architecture to ensure scalability, maintainability, and efficient resource utilization. The backend follows a monolithic architecture in the current implementation for simplicity and ease of deployment. However, the system is designed to be extendable into a microservices-based architecture, where individual services such as authentication, contract management, and negotiation can be independently deployed and scaled.

The system supports concurrent user interactions through asynchronous request handling using Node.js, enabling efficient processing of multiple transactions simultaneously.

Basic fault tolerance is achieved through input validation, error handling mechanisms, and secure API communication. Future enhancements will include distributed deployment, load balancing, and redundancy mechanisms to ensure high availability.

E. API DESIGN AND COMMUNICATION

The system follows RESTful API principles for communication between the mobile application and backend services. The APIs are designed to be stateless and secure using JWT-based authentication.

Key API endpoints include:

- POST /login – user authentication
- POST /signup – user registration
- GET /crops – retrieve crop listings
- POST /proposal – submit negotiation proposal
- POST /contract – generate contract
- GET /verify – verify contract integrity

This structured API design ensures efficient and secure data exchange between system components.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

F. SCALABILITY AND LOAD HANDLING

The system is designed to handle increasing user load through modular backend architecture and asynchronous processing. Node.js enables non-blocking I/O operations, allowing multiple concurrent requests to be processed efficiently.

Future improvements include integration of load balancers and cloud-based deployment to support large-scale user interactions.

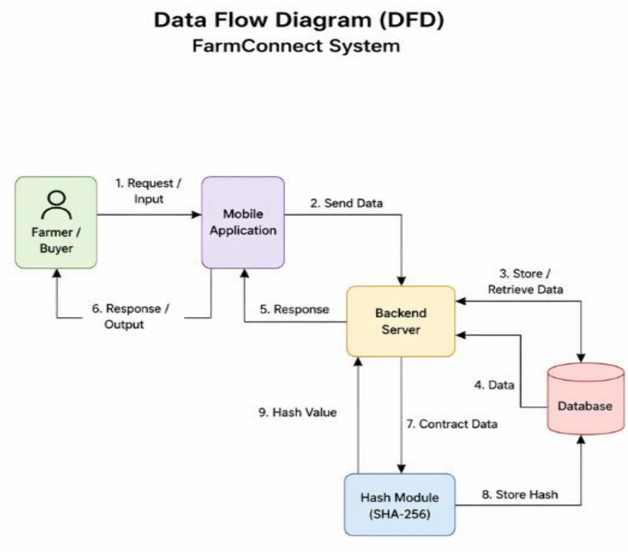

Fig. 2 Data Flow Diagram

The data flow diagram represents the movement of data between users, mobile application, backend services, and database. It also includes the SHA-256 hashing module for ensuring contract integrity and tamper detection.

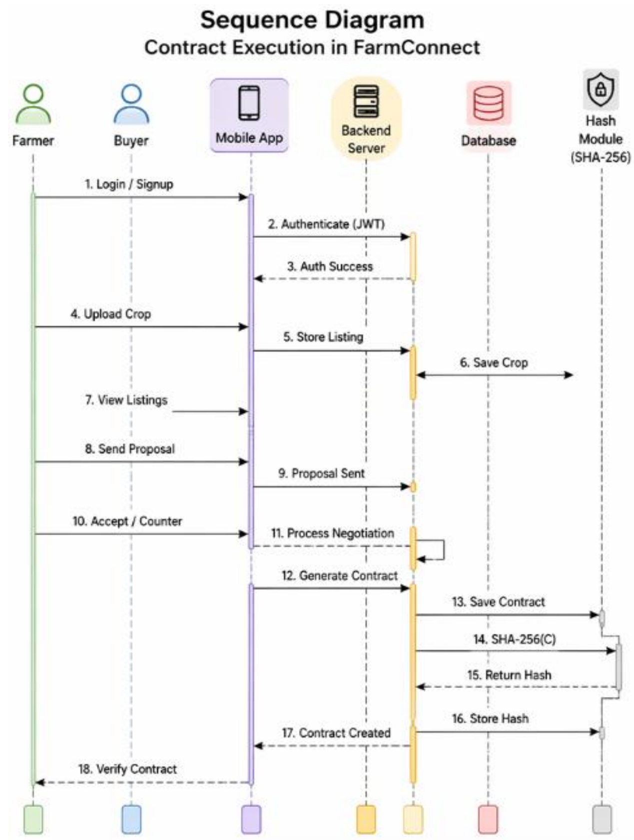

Fig. 3 Sequence Diagram of Contract Execution in FarmConnect

The sequence diagram illustrates the interaction between farmers, buyers, mobile application, backend services, and database during contract execution. It includes authentication, crop listing, negotiation, contract generation, and SHA-256 based integrity verification.

V. SYSTEM WORKFLOW

The FarmConnect system follows a structured workflow that supports the complete contract farming lifecycle.

The operational workflow of the system is illustrated Fig.4.

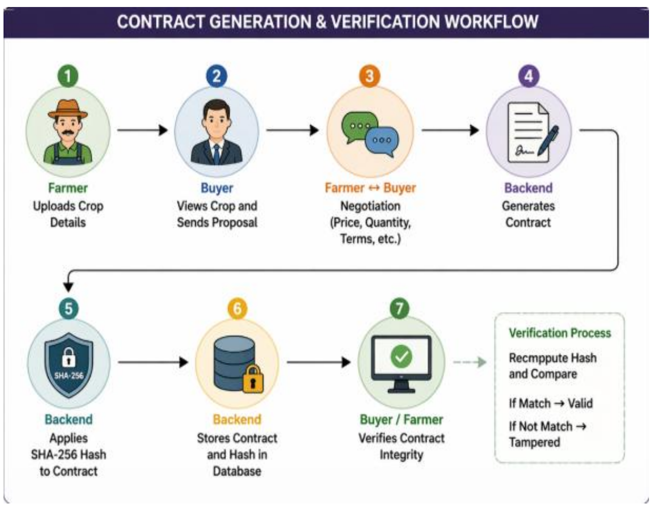

Fig. 4. Contract Generation and Verification Workflow

A. CROP LISTING WORKFLOW

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

1. Farmers upload crop details, including quantity, expected price, and product images
2. The data is validated and securely stored in the database.
3. The listings are made available to registered buyers for viewing.

B. NEGOTIATION WORKFLOW

The negotiation module enables structured communication between farmers and buyers.

1. The buyer selects a crop listing.
2. The buyer submits a purchase proposal.
3. The farmer reviews the proposal and either accepts it or provides a counter-offer.
4. The negotiation continues until both parties reach mutual agreement.
5. Once finalized, the system proceeds to contract generation.

This structured negotiation process improves transparency and ensures traceability of all interactions.

C. CONTRACT GENERATION WORKFLOW

After successful negotiation:

1. Contract details are automatically generated based on agreed terms.
2. A digital contract document is created in PDF format.
3. Both parties confirm the contract through the application interface.
4. The contract is activated for execution and tracking.

D. FULFILLMENT TRACKING WORKFLOW

The fulfillment module monitors contract execution progress.

1. Farmers upload proof of milestone completion (e.g., crop readiness images).
2. Buyers verify the fulfillment status.
3. The system updates contract progress indicators in real time.
4. Completion is recorded upon successful delivery confirmation.

E. DISPUTE RESOLUTION WORKFLOW

In case of disputes:

1. Either party can initiate a dispute request.
2. Supporting evidence (documents or images) can be uploaded.
3. The dispute data is securely stored for review.
4. The system tracks and updates the dispute resolution status.

This structured workflow enhances accountability and reduces delays in conflict resolution.

VI. SECURITY MECHANISM

Security is a critical component of the FarmConnect system, as it handles sensitive data related to user identities and digital contracts. The system incorporates multiple security mechanisms to ensure data protection, secure communication, and prevention of unauthorized access.

Potential threats include replay attacks, unauthorized access, and data tampering. These threats are mitigated using JWT-based authentication, encrypted password storage, and hash-based integrity verification.

A. AUTHENTICATION AND AUTHORIZATION

The system employs JSON Web Token (JWT)-based authentication to manage user sessions securely. Upon successful login, a token is generated and used for subsequent API requests, ensuring stateless and secure session management.

User passwords are securely stored using bcrypt hashing, which protects against unauthorized access and password-related attacks such as brute-force attempts.

B. API SECURITY MECHANISMS

The system implements additional security measures to protect backend services:

• Rate limiting is applied to prevent denial-of-service (DoS) and brute-force attacks

• Secure HTTP headers are configured using Helmet middleware to mitigate common web vulnerabilities

• Cross-Origin Resource Sharing (CORS) policies are enforced to control access from external domains

These mechanisms collectively enhance the security of the system and ensure safe communication between the client and server.

C. DATA INTEGRITY USING SHA-256 HASHING MECHANISM

To ensure the integrity of contract data, the system employs a SHA-256 based cryptographic hashing mechanism. Each contract is converted into a unique hash value that acts as a digital fingerprint.

Let C represent the contract data:
13
$H = SHA256(C)$

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

Where:
H is the generated hash value
C is the contract content

The generated hash is stored securely in the database. During verification, the hash is recomputed and compared with the stored value.

If H = H', the contract remains unchanged.
If H ≠ H', the contract has been tampered.

This mechanism provides strong data integrity, tamper detection, and ensures trust between stakeholders without requiring complex blockchain infrastructure.

Algorithm : Contract Verification

Input: Contract data C
Output: Verification result
1. Compute hash H = SHA256(C)
2. Retrieve stored hash Hs
3. Compare H with Hs
4. If H = Hs
Return "Valid"
Else
Return "Tampered"

D. SECURITY ANALYSIS AND THREAT MITIGATION

The FarmConnect system incorporates multiple security mechanisms to protect against potential threats in digital contract farming environments.

1) Threat Model

The system considers the following potential threats:

• Unauthorized access – attackers attempting to gain access to user accounts
• Data tampering – modification of contract data
• Replay attacks – reuse of valid requests to manipulate transactions
• Injection attacks – malicious input affecting backend processing

2) Attack Mitigation Strategies

The system implements the following countermeasures:

• JWT-based authentication ensures secure and stateless session management
• bcrypt hashing protects user credentials against brute-force attacks
• SHA-256 hashing ensures integrity and tamper detection of contract data
• Input validation prevents injection-based attacks
• Rate limiting protects against denial-of-service (DoS) attempts

3) Security Evaluation

Simulated attack scenarios were conducted to validate system security. The hashing mechanism successfully detected all instances of contract modification, achieving 100% integrity verification accuracy.

These measures collectively ensure secure communication, data protection, and trust in the contract farming system.

Table 2: Security Threats and Mitigation

Threat Type	Mitigation Technique
Unauthorized Access	JWT Authentication
Password Attacks	bcrypt Hashing
Data Tampering	SHA-256 Hashing
Injection Attacks	Input Validation
DoS Attacks	Rate Limiting

VII. IMPLEMENTATION

A. DEVELOPMENT METHODOLOGY

The FarmConnect system was developed using an iterative software development approach to ensure flexibility, continuous improvement, and efficient integration of system components.

The development process consisted of the following phases:

1) Requirement analysis and stakeholder identification
2) System architecture design
3) Database schema modeling
4) Backend API development
5) Mobile application development
6) Security integration
7) Testing and validation

This structured methodology enabled systematic development and validation of the system. The complete development lifecycle was executed over a period of approximately 3 to 3.5 months.

B. MOBILE APPLICATION IMPLEMENTATION

The Android mobile application was developed using modern frameworks and architectural patterns to ensure scalability, maintainability, and efficient performance.

The implementation incorporates the following technologies:

1) Kotlin (v1.9.20)
2) Jetpack Compose with Material Design 3
3) MVVM architecture following Clean Architecture principles
4) Hilt (Dagger 2.48) for dependency injection
5) Retrofit and OkHttp for RESTful API communication
6) Room database for local data storage

7) Firebase Cloud Messaging for push notifications

The MVVM architecture ensures a clear separation of concerns between the user interface, business logic, and data layers. Additionally, Kotlin Coroutines and Flow are utilized for asynchronous operations and reactive data handling, improving application responsiveness and performance.

C. BACKEND IMPLEMENTATION

The backend of the FarmConnect system was developed using modern server-side technologies to ensure scalability, performance, and secure data processing. The implementation utilizes the following technologies:

1) Node.js (≥ 18.0.0)
2) Express.js (v4.18.2)
3) TypeScript (v5.3.3)

To ensure system security, the following mechanisms are implemented:

• JSON Web Token (JWT) for authentication and session management
• bcrypt for secure password hashing
• Rate limiting middleware to prevent abuse and brute-force attacks
• Helmet middleware for secure HTTP headers
• Input validation using express-validator

Additionally, PDFKit is used for automated generation of digital contract documents, enabling efficient and structured contract creation.

D. DATABASE DESIGN

The FarmConnect system utilizes a scalable database architecture to support multi-user interactions and concurrent transactions. For production deployment, the system is designed to integrate with cloud-ready database solutions such as MongoDB and PostgreSQL.

MongoDB provides a flexible NoSQL document-based structure suitable for handling dynamic contract data, while PostgreSQL ensures strong consistency and relational integrity for structured data such as user profiles and transactions.

The database supports the following core entities:

• User profiles
• Crop listings
• Negotiation records
• Contract data
• Payment transactions
• Dispute records

Indexing mechanisms and optimized query structures are employed to ensure efficient data retrieval. The system architecture is designed to support horizontal scaling and cloud deployment for large-scale usage.

This transition from SQLite to a scalable database system ensures improved performance, reliability, and support for concurrent access in real-world deployment scenarios.

The system can be deployed on cloud platforms such as AWS or Firebase to enable distributed access, automatic scaling, and high availability.

VIII. RESULTS AND EVALUATION

A. PILOT TESTING SETUP

The proposed FarmConnect system was evaluated through a controlled pilot testing phase to assess its functionality, usability, and performance under simulated real-world conditions.

The testing environment included:

• A controlled group of users comprising core developers and external participants
• Simulated contract farming scenarios representing real-world interactions

The evaluation was conducted over a period of two weeks under a controlled simulated environment. During this period, multiple transaction workflows were executed to validate system performance.

The testing setup was designed to simulate practical contract farming scenarios, enabling evaluation of system behavior under realistic operational conditions.

B. EVALUATION METRICS

The performance of the proposed system was evaluated using the following metrics:

1) Negotiation completion time – measures the time required to complete the negotiation process between stakeholders.

2) Contract generation time – evaluates the time taken to generate a digital contract after agreement.

3) System response time – indicates the time taken by the system to respond to user requests.

4) User workflow success rate – represents the percentage of successfully completed user operations.

5) Hash verification accuracy – measures the correctness of the SHA-256 based integrity verification mechanism.

These metrics provide a quantitative assessment of system efficiency, responsiveness, and reliability under simulated workload conditions.

C. LIMITATIONS OF CURRENT EVALUATION

The current evaluation is limited to a small-scale pilot study involving a restricted number of users and transactions. Although the results demonstrate functional correctness, they are not sufficient for establishing statistical significance or large-scale system validation.

Future work will focus on the following improvements:

• Deployment with a larger and more diverse user base
• Performance benchmarking under high-load conditions
• Validation using real-world agricultural datasets

These limitations highlight the need for further evaluation to ensure scalability, robustness, and real-world applicability of the system.

D. PERFORMANCE ANALYSIS

Table 3: Performance Metrics

Metric	Value
Contract Generation Time	< 2 sec
System Response Time	< 500 ms
Negotiation Success Rate	85%
Hash Verification Accuracy	100%

These results indicate that the system performs efficiently and reliably under controlled simulated deployment conditions. The low response time and high verification accuracy demonstrate the effectiveness of the implemented architecture and security mechanisms.

The system demonstrates low latency and high reliability, indicating its suitability for real-time contract management applications.

E. SYSTEM PERFORMANCE METRICS

To enhance the rigor of evaluation, additional performance indicators were analyzed:

• Throughput – number of transactions processed per second
• Latency distribution – response time variability (p95, p99)
• Failure rate – percentage of unsuccessful operations

The system achieved an approximate throughput of 5–8 transactions per second under simulated load conditions, indicating stable processing capability.

F. LATENCY ANALYSIS

The system response time was analyzed using latency distribution metrics. The average latency was observed to be less than 500 ms, while the 95th percentile (p95) latency remained below 800 ms.

These results indicate consistent and stable performance under moderate workload conditions.

G. SECURITY VALIDATION

Security testing was conducted to evaluate the effectiveness of the SHA-256 based integrity verification mechanism. Simulated tampering attempts were introduced into the contract data.

The system successfully detected all instances of data modification, achieving 100% hash verification accuracy. This demonstrates the robustness of the implemented integrity mechanism in ensuring secure and tamper-proof contract management.

Additionally, the evaluation confirms that any unauthorized alteration in contract data results in a mismatch of hash values, enabling immediate detection of integrity violations. This ensures a high level of trust and reliability in digital contract transactions within the system.

IX. DISCUSSION

The proposed FarmConnect system demonstrates improved transparency, efficiency, and reliability in contract farming workflows. The integration of a SHA-256 based hashing mechanism ensures data integrity and enables effective tamper detection, thereby enhancing trust among stakeholders. Additionally, the structured workflow and modular architecture contribute to improved system organization and operational consistency.

The results obtained from pilot testing indicate that the system performs efficiently in handling contract generation, negotiation, and verification processes. However, the current implementation is limited to a small-scale environment, and scalability remains a key area for future enhancement. Future work will focus on large-scale deployment, performance optimization under high user load, and integration with real-world agricultural datasets. Further improvements may also include advanced analytics and intelligent decision-support features to enhance system capabilities.

X. CONCLUSION

This paper presented FarmConnect, a secure and integrated digital platform designed to enhance contract farming processes. The system addresses key challenges in agricultural trade, including lack of transparency, inefficient communication, and weak contract enforcement, by providing a structured and technology-driven solution.

The implementation of end-to-end workflows, including crop listing, negotiation, contract generation, and fulfillment

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 04 , April - 2026

tracking, improves operational efficiency and stakeholder coordination. Additionally, the integration of a SHA-256 based hashing mechanism ensures data integrity and enables reliable tamper detection of digital contracts.

Experimental results from pilot testing demonstrate that the system is efficient, responsive, and reliable under small-scale deployment conditions. Although the current evaluation is limited, the results validate the feasibility of the proposed approach.

Future work will focus on large-scale deployment, performance optimization, and integration with real-world agricultural datasets. Further enhancements may include intelligent decision-support systems and cloud-based scalability to improve system capabilities.

Overall, the proposed system provides a practical and scalable solution for modernizing contract farming and promoting transparency, trust, and efficiency in agricultural supply chains.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to Dr. Amey Kumar Tripathy, faculty member at Don Bosco Institute of Technology, for his invaluable guidance, continuous support, and insightful suggestions throughout the development of this project. His expertise and mentorship played a crucial role in shaping the direction and successful completion of this research work.

The authors would also like to thank the Department of Computer Engineering, Don Bosco Institute of Technology, for providing the necessary academic environment, resources, and infrastructure required for the implementation of this project.

Furthermore, we extend our appreciation to all participants involved in the pilot testing phase for their valuable feedback, which contributed significantly to improving the system's functionality and usability.

Finally, the authors acknowledge the support of peers and well-wishers who provided encouragement and constructive input during various stages of this work.

REFERENCES

[1] Food and Agriculture Organization (FAO), “Contract Farming and Market Access,” FAO, 2020.
[2] World Bank, “Digital Agriculture: Opportunities for Growth,” World Bank, 2021.
[3] A. Kamilaris, A. Fonts, and F. X. Prenafeta-Boldú, “The rise of blockchain technology in agriculture and food supply chains,” Computers and Electronics in Agriculture, vol. 162, pp. 95–113, 2019.
[4] G. Lv et al., “Blockchain-based traceability for agricultural products: A review,” Agriculture, vol. 13, no. 9, 2023.
[5] A. El Mane, K. Tatane, and Y. Chihab, “Transforming agricultural supply chains using blockchain and smart contracts,” ICT Express, 2024.
[6] M. Daraghmi et al., “Smart contracts for managing the agricultural supply chain: A practical case study,” IEEE Access, 2024.
[7] S. Nakamoto, “Bitcoin: A Peer-to-Peer Electronic Cash System,” 2008.
[8] W. Stallings, Cryptography and Network Security: Principles and Practice, 7th ed. Pearson, 2017.
[9] T. H. Pranto et al., “Blockchain and smart contract for IoT-enabled smart agriculture,” IEEE Access, 2021.
[10] P. Eachempati, P. R. Srivastava, and J. Zhang, “Blockchain technology in agriculture and supply chain management: A survey,” Enterprise Information Systems, 2021.
[11] S. N., “A framework for agricultural food supply chain using blockchain,” arXiv preprint arXiv:2401.09476, 2024.