

“Smartagri – Fertilizer Sales and Inventory Management System”

1.Prof. S. A. Solanke

2. Shreya Nandurkar

3. Khushi Rewtkar

4. Shraddha Bhuyar

5. Swarangi Pokale

6. Vedanti Dhote

7. Sneha Sahu

Department of Computer Science & Engineering

P. R. Pote Patil College of Engineering & Management, Amravati-444602, Maharashtra, India.

ABSTRACT

Fertilizer businesses require effective management of products, inventory, suppliers, customers, purchases, and sales. Manual records can cause data duplication, stock errors, delayed updates, and difficulty in retrieving information. This paper presents SmartAgri – Fertilizer Sales and Inventory Management System, a centralized web-based application designed to organize fertilizer business operations. The system integrates fertilizer, inventory, supplier, customer, purchase, sales, invoice, and reporting functions. It uses a frontend connected to a Spring Boot backend through Representational State Transfer (REST) APIs, with MySQL for centralized data storage. Authentication and controlled access help protect business information. The proposed system reduces dependency on separate manual records and provides organized access to fertilizer-related information. The modular architecture also provides a foundation for future enhancements such as regional language support, demand forecasting, dealer management, delivery tracking, and intelligent agricultural assistance.

Keywords: Smart Agriculture, Fertilizer Management, Inventory Management, Spring Boot, MySQL, REST API.

1. INTRODUCTION

Fertilizer businesses manage products, stock, suppliers, customers, purchases, sales, and transaction records. Maintaining these activities through paper records, spreadsheets, or separate files can result in repeated data entry, inaccurate stock calculations, delayed updates, and difficulty in retrieving information.

Digitalization provides a centralized approach for managing these activities. **SmartAgri** is a web-based Fertilizer Sales and Inventory Management System that integrates fertilizer products, inventory, suppliers, customers, purchases, sales, invoices, and reporting.

The system uses a frontend, Spring Boot backend, REST APIs, and MySQL database. Its main purpose is to provide structured and accessible management of fertilizer business information.

1.1 Existing Challenges

Traditional fertilizer management may involve:

1. Manual maintenance of product and transaction records.
2. Errors in stock calculations.
3. Separate purchase and sales records.
4. Difficulty managing supplier and customer information.
5. Difficulty identifying low-stock products.
6. Additional effort for preparing reports.
7. Repeated data entry and data duplication.

1.2 Proposed SmartAgri System

SmartAgri provides a centralized platform for fertilizer products, inventory, suppliers, customers, purchases, sales, invoices, and reports.

User Login → Dashboard → Module Selection → Data Processing → Database → Result

The frontend provides the interface, Spring Boot processes application requests, REST APIs enable communication, and MySQL stores system data.

2. PROBLEM STATEMENT

Managing fertilizer products, inventory, suppliers, customers, purchases, and sales through manual or disconnected records makes it difficult to maintain accurate and consistent information. Stock differences, scattered customer and supplier information, and time-consuming report preparation can affect business operations.

Therefore, an integrated system is required to centralize fertilizer information, inventory, transactions, invoices, and reporting. SmartAgri addresses this requirement through a web-based management platform.

3. OBJECTIVES

The major objectives of SmartAgri are:

1. To develop a web-based fertilizer sales and inventory management system.
2. To maintain fertilizer information in a centralized database.
3. To manage inventory and stock levels.
4. To organize supplier and customer information.
5. To manage purchase and sales transactions.
6. To provide authentication and controlled access.
7. To provide invoice and reporting functionality.
8. To reduce dependency on manual record keeping.

4. LITERATURE REVIEW

4.1. Background / Basic Concepts

Smart agriculture refers to the use of digital technologies to improve agricultural monitoring, decision-making, resource management, and operational efficiency. Important technologies include Internet of Things (IoT), wireless sensor networks, machine learning, automation, cloud and edge computing, and digital information systems.

IoT enables the collection and exchange of agricultural information through connected devices and sensors. Machine Learning can support agricultural analysis and decision-making by processing collected data. Wireless sensor networks are used for monitoring agricultural conditions, while automation technologies help improve operational efficiency. Digital platforms can also support fertilizer-related decision-making, inventory management, and supply-chain operations. These technologies provide the foundation for modern smart agriculture and digitally supported fertilizer management systems.

4.2. Existing Methods / Techniques

Digital technologies have been increasingly applied to agricultural monitoring, fertilizer management, automation, and supply-chain operations. IoT-based systems collect agricultural data and support monitoring and decision-making. Machine Learning techniques can be integrated with smart agriculture systems to assist in data analysis and agricultural decision-making [1].

Wireless sensor networks provide monitoring capabilities for smart agriculture applications and support the collection of agricultural information [2]. IoT technologies have also been applied to supply-chain management and logistics, including real-time asset tracking and inventory management [3].

Smart agricultural monitoring and automation systems provide digital support for farm operations [4]. Fertilizer-specific applications have also been investigated, including an IoT-assisted context-aware fertilizer recommendation system [5]. Monitoring and advanced control strategies have been reviewed for smart agriculture applications [6].

Edge, fog, and cloud computing architectures have also been proposed to support IoT-based smart agriculture environments [7]. In addition, IoT-based smart agriculture systems demonstrate the use of connected technologies for agricultural applications [8]. However, most existing studies focus on individual areas such as monitoring, recommendation, automation, or IoT infrastructure rather than providing an integrated fertilizer business management platform.

4.3. Comparison of Existing Studies

Table 1 summarizes representative studies, their methods, applications, key findings, limitations, and research gaps.

Table 1: Comparison of Existing Studies

Ref.	Author(s) & Year	Method / Technique	Application	Key Findings	Limitations	Research Gap
[1]	Anand et al. (2024)	IoT and Machine Learning	Smart agriculture monitoring and decision-making	Demonstrates the use of IoT and Machine Learning for agricultural applications	Focuses mainly on smart agricultural monitoring and decision-making	Integrated fertilizer business and inventory management is not addressed
[2]	Mowla et al. (2023)	IoT and Wireless Sensor Networks	Smart agriculture applications	Reviews the role of IoT and wireless sensor networks in agricultural monitoring and management	Primarily focuses on monitoring and sensor-based applications	Business functions such as fertilizer sales, purchases, suppliers, and invoices are not integrated
[3]	Pethe et al. (2024)	IoT, real-time tracking, and inventory management	Supply-chain management and logistics	Demonstrates applications of IoT in asset tracking and inventory management	Focuses on general supply-chain and logistics operations	Fertilizer-specific products, customers, suppliers, sales, and invoices are not combined
[4]	Banahene et al. (2024)	Smart monitoring and automation	Agricultural farm operations	Provides digital monitoring and	Focuses mainly on farm	Fertilizer business management and transaction

Ref.	Author(s) & Year	Method Technique	Application	Key Findings	Limitations	Research Gap
				automation support for farms	monitoring and automation	processing are not covered

4.4 Research Gap

The reviewed studies demonstrate the application of IoT, Machine Learning, wireless sensor networks, automation, fertilizer recommendation, and computing architectures in smart agriculture [1]–[8]. However, the existing studies primarily focus on agricultural monitoring, recommendation, automation, or technological infrastructure.

There is a need for a focused system that combines fertilizer product management, inventory and stock management, suppliers, customers, purchases, sales, and invoices within a single platform. SmartAgri addresses this gap by providing a centralized web-based fertilizer sales and inventory management system using Spring Boot, REST APIs, and MySQL.

5. PROPOSED METHODOLOGY

5.1 System Architecture

SmartAgri follows a modular architecture:

Users → Frontend → REST APIs → Spring Boot Backend → MySQL Database

The frontend provides the user interface. The Spring Boot backend handles business logic and request processing. REST APIs provide communication between the frontend and backend, while MySQL provides centralized storage.

The system contains four major layers:

- **Presentation Layer:** Provides the web interface.
- **Application Layer:** Handles business logic and validation using Spring Boot.
- **REST API Layer:** Enables frontend-backend communication.
- **Database Layer:** Stores application data using MySQL.

5.2 System Modules

The major modules are:

5.2.1 Authentication and User Management

Manages user login and access to system functions.

5.2.2 Fertilizer Management

Maintains fertilizer details such as name, type, brand, category, NPK ratio, prices, stock, supplier, and expiry information.

5.2.3 Inventory Management

Records current stock levels and helps users identify fertilizer items that may need restocking.

5.2.4 Supplier and Customer Management

Stores supplier and customer information and associates them with relevant transactions.

5.2.5 Purchase and Sales Management

Records fertilizer purchases and sales, including products, quantities, prices, suppliers, and customers.

5.2.6 Invoice Management

Maintains invoice information associated with sales transactions.

5.2.7 Dashboard and Reporting

Provides an overview of products, inventory, purchases, sales, and available transaction information.

5.3 Database Design

The MySQL database organizes the main SmartAgri entities and maintains their relationships so that product, supplier, customer, inventory, purchase, sales, and invoice information can be connected and retrieved when required.

Table-2: Major Database Entities

Entity	Purpose
Users	User and authentication information
Fertilizers	Fertilizer product information
Suppliers	Supplier information
Customers	Customer information
Inventory	Stock information
Purchases	Purchase transactions
Sales	Sales transactions
Invoices	Invoice information

The relationships between these entities allow products, suppliers, customers, inventory, purchases, and sales to be managed in an integrated manner.

5.4 System Workflow

The general workflow is:

Login → Dashboard → Select Module → Enter/Update Data → Validate → Process Request → Store/Retrieve Data → Display Result

6. IMPLEMENTATION

6.1 Technology Stack

Table-3: Technologies Used

Component	Technology
Backend	Spring Boot
Programming Language	Java
Frontend	Web-based Frontend
API Communication	REST APIs
Database	MySQL
Build Tool	Maven

6.2 Backend and API Implementation

The backend is developed using Spring Boot and organized into controllers, services, repositories, and entities. REST APIs receive requests from the frontend, process the required operations, communicate with the database, and return responses.

The communication process is:

Frontend → REST Controller → Service → Repository → MySQL → Response

This structure separates the user interface from database operations and supports modular development.

6.3 Authentication and Access Control

Authentication controls access to the application, while authorization can restrict functions according to user responsibilities. This is important because the system handles user, inventory, and transaction information.

7. RESULTS AND DISCUSSION

7.1 Results

The implemented SmartAgri system brings the main fertilizer-business activities into a single application. The completed modules cover fertilizer product records, inventory, supplier and customer information, purchase transactions, sales transactions, invoices, authentication, and dashboard information.

The application uses Spring Boot for backend processing, REST APIs for communication, and MySQL for persistent storage. The integration of these components allows information entered through the application to be processed and stored in a structured manner. Users can therefore access fertilizer and transaction-related records without maintaining separate files for each activity.

7.2 Discussion

The implemented system demonstrates that the selected architecture can be used to organize fertilizer sales and inventory operations within one application. Connecting the product, inventory, supplier, customer, purchase, and sales modules allows related information to be handled through a common database.

The current implementation is focused on core business operations. Features such as demand prediction, IoT-based monitoring, intelligent fertilizer recommendation, and GPS-supported delivery can be considered for future versions of the system.

8. LIMITATIONS

The current development of SmartAgri has certain limitations related to implementation scope, data dependency, security, evaluation, and scalability.

8.1 Data Dependency

The accuracy of inventory, purchase, sales, and reporting information depends on the correctness and completeness of data entered by users. Incorrect or outdated data may affect the reliability of system results.

8.2 Limited Evaluation

The current evaluation is mainly focused on the implemented core modules. Comprehensive testing of system performance, usability, security, and end-to-end workflows requires further evaluation with larger datasets and different usage conditions. [2], [6]

8.3 Security Enhancement

Although authentication and controlled access are included, additional security mechanisms may be required for large-scale deployment. Further improvements can include stronger authorization, data protection, and security testing. [2], [6]

8.4 Scalability and Performance

The system has not yet been extensively evaluated with a large number of concurrent users and transactions. As the amount of fertilizer, inventory, purchase, and sales data increases, database optimization and performance testing may be required. [2], [3]

8.5 Limited Advanced Features

The current system focuses on core fertilizer sales and inventory management functions. Advanced capabilities such as demand forecasting, IoT-based monitoring, intelligent fertilizer recommendation, and GPS-based delivery tracking are not included in the present implementation. Related technologies have been explored in existing smart agriculture research. [1], [5], [7], [8]

8.6 Overall Limitation

These limitations reflect the current development scope of SmartAgri. Further testing, security enhancement, database optimization, and integration of advanced agricultural technologies can improve the system's functionality, scalability, and practical applicability.

9. REFERENCES

- [1] N. Anand, H. Pundir, K. Singh, K. Bisht, R. Chauhan, and A. Kapruwan, "Smart Agriculture System Using Internet of Things (IoT) and Machine Learning," in *2024 International Conference on Emerging Smart Computing and Informatics (ESCI)*, 2024, pp. 1–7, doi: 10.1109/ESCI59607.2024.10497311.
- [2] M. N. Mowla, N. Mowla, A. F. M. Shahen Shah, K. M. Rabie, and T. Shongwe, "Internet of Things and Wireless Sensor Networks for Smart Agriculture Applications: A Survey," *IEEE Access*, vol. 11, pp. 145813–145852, 2023, doi: 10.1109/ACCESS.2023.3346299.
- [3] S. Arvindrao Pethe, A. P. Sahu, S. Kodarlikar, and V. Myada, "IoT Research in Supply Chain Management and Logistics: Real-Time Asset Tracking and Inventory Management," in *2024 International Conference on Innovations and Challenges in Emerging Technologies (ICICET)*, 2024, doi:10.1109/ICICET59348.2024.10616272.

- [4] W. O. Banahene, I. A. Aboagye, E. A. Kweku, H. S. Fredrick, O. Gifty, K. Marcellinus, D. M. Stephen, and S. N. Longdon, "Smart Agricultural Monitoring and Automation System for Farms," in *2024 IEEE 9th International Conference on Adaptive Science and Technology (ICAST)*, 2024, doi: 10.1109/ICAST61769.2024.10856461.
- [5] A. A. Khan, M. Faheem, R. N. Bashir, and C. Wechtaisong, "Internet of Things (IoT) Assisted Context Aware Fertilizer Recommendation," *IEEE Access*, vol. 10, pp. 129505–129519, 2022, doi: 10.1109/ACCESS.2022.3228160.
- [6] S. I. Hassan, M. M. Alam, U. Illahi, M. A. Al Ghamdi, S. H. Almotiri, and M. M. Su'ud, "A Systematic Review on Monitoring and Advanced Control Strategies in Smart Agriculture," *IEEE Access*, vol. 9, pp. 32517–32548, 2021, doi: 10.1109/ACCESS.2021.3057865.
- [7] H. A. Alharbi and M. Aldossary, "Energy-Efficient Edge-Fog-Cloud Architecture for IoT-Based Smart Agriculture Environment," *IEEE Access*, vol. 9, pp. 110480–110492, 2021, doi: 10.1109/ACCESS.2021.3101397.
- [8] "Smart Agriculture System using IOT," in *2022 IEEE World Conference on Applied Intelligence and Computing (AIC)*, 2022, doi: 10.1109/AIC55036.2022.9848948.