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Smart and Automated Fertilizer Comparison System

Beena Sheril, Akarsha Sajjan B, Ankitha J, Bhavanashree S, Chaitra B

Associate Professor, Department of Computer Science & Engineering, SJM Institute of Technology, Chitradurga,
Karnataka, India

B.E. Student, Department of Computer Science & Engineering, SJM Institute of Technology, Chitradurga,
Karnataka, India

B.E. Student, Department of Computer Science & Engineering, SJM Institute of Technology, Chitradurga,
Karnataka, India

B.E. Student, Department of Computer Science & Engineering, SJM Institute of Technology, Chitradurga,
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B.E. Student, Department of Computer Science & Engineering, SJM Institute of Technology, Chitradurga,
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ABSTRACT: Farmers often struggle to find fertilizers at affordable prices because rates, discounts, brands and availability differ across online platforms, and checking each website separately is slow and confusing. This paper presents the Smart Fertilizer Marketplace, a mobile and web-based application that collects fertilizer information such as price, brand, composition, availability, ratings and delivery options from multiple online marketplaces using web scraping and APIs, and presents it through a single, user-friendly interface. Farmers can search by fertilizer name, brand, crop type or nutrient composition, compare products on cost, quality and suitability, read product details and reviews, receive notifications about price drops and offers, and are redirected to the chosen seller to complete the purchase. The system is built with Python, Flask, HTML/CSS/JavaScript and a MySQL or MongoDB database, with optional cloud and mobile support. By increasing price transparency and reducing the effort of finding quality fertilizers, the platform helps farmers save money and time, avoid counterfeit products and make informed purchasing decisions, supporting digital agriculture.

KEYWORDS: Fertilizer comparison, Price comparison, Agricultural e-commerce, Web scraping, Digital agriculture, AgriTech.

I. INTRODUCTION

Agriculture supports the economy and the livelihood of millions of farmers, and fertilizers are among its most important inputs because they supply the nutrients that improve soil fertility and crop yield. However, buying fertilizers has become difficult: prices, brands, discounts and delivery options vary widely across markets and online platforms, and farmers, especially in rural areas, have limited information about product quality. Visiting several websites individually is time-consuming and often leads to higher prices or unsuitable purchases.

Existing e-commerce websites mainly focus on selling products and do not offer a dedicated, farmer-friendly way to compare fertilizer prices across sellers. This paper addresses that gap by proposing the Smart Fertilizer Marketplace, a centralized platform that (i) collects fertilizer data from multiple online sources, (ii) compares products on price, ratings, offers and availability, (iii) presents detailed product information such as nutrient composition, usage instructions and reviews, and (iv) redirects users to trusted seller websites to complete the purchase through an interface usable by farmers with basic technical knowledge.

The project falls in the domain of Agricultural Technology (AgriTech) and E-commerce Systems. Its scope covers data collection, user registration and login, search, comparison, product details, notifications and purchase redirection; payment, delivery and inventory management are handled by the external sellers. The remainder of the paper is organized as follows. Section II reviews related work. Section III describes the proposed methodology, architecture and modules. Section IV lists the system requirements. Section V concludes the paper and outlines future work.

II. LITERATURE SURVEY

Several studies on agricultural e-commerce, online marketplaces and price comparison systems informed this work. Agricultural e-commerce platforms let farmers buy fertilizers, seeds and pesticides online with product information, secure transactions and order tracking [1]. Price comparison systems based on web scraping and APIs gather prices, ratings, discounts and availability from many websites and save users time [2]. Mobile applications bring fertilizer recommendations, weather information and purchasing to farmers, with cloud services and regional language support improving rural adoption [3], while recommendation systems use crop type, ratings and preferences to suggest suitable products [4]. Smart marketplace solutions combine product comparison, online purchasing and real-time updates to reduce dependence on traditional markets [5].

Table I summarizes the studies reviewed.

Study / Year	Focus	Method	Key Finding
Kumar et al. (2021)	Agricultural e-commerce platform	Mobile app, database, cloud	Improves market accessibility and buyer–seller transparency
Patel & Mehta (2020)	Online price comparison	Web scraping, APIs	Saves time and improves purchasing efficiency
Reddy & Rao (2022)	Smart farming via mobile	Android, cloud, real-time data	Mobile apps and regional language support aid rural adoption
Ali & Singh (2021)	Agricultural product recommendation	Machine learning recommender	Personalized suggestions reduce user confusion
Babu & Devi (2023)	Smart marketplace solutions	Cloud, APIs, mobile apps	Centralized marketplaces improve farmers' decisions

TABLE I STUDIES REVIEWED ON AGRICULTURAL E-COMMERCE AND PRICE COMPARISON

Across these studies, three patterns emerge. First, centralized marketplaces improve transparency and reduce farmers' effort. Second, web scraping and APIs are the practical means of collecting real-time product data. Third, mobile access and regional language support are important for rural users. The studies also point to AI-based recommendations and multilingual support as future enhancements. However, few of them provide a farmer-focused platform dedicated to fertilizer price comparison with purchase redirection, which this paper addresses.

III. PROPOSED METHODOLOGY

1. System Architecture

The architecture is designed for scalability, flexibility and user-friendliness and has six components. The User Interface provides web and mobile access for registration, login, search, comparison and purchase links. The Data Collection Module gathers prices, ratings, discounts, availability and seller details using web scraping and APIs. The Product Comparison Module compares products on price, ratings, offers and availability and supports filtering and sorting. The Database Management Module stores user details, fertilizer information, search history and notifications. The Application Logic Module processes requests, handles authentication and coordinates the front end, database and external platforms. The External Interfaces connect the system to e-commerce websites and redirect users to the selected seller for purchase, payment and delivery.

2. Data Flow

Fig. 1 illustrates the data flow. The farmer sends login, search and other requests to the application server, which stores and retrieves fertilizer details, prices, offers, ratings and user data in the Product Database and collects product data from e-commerce and seller websites through APIs or web scraping. The Comparison Engine analyses the collected data and the results (best prices, offers, ratings and availability) are shown to the farmer, who selects a product and is redirected to the seller for purchase.

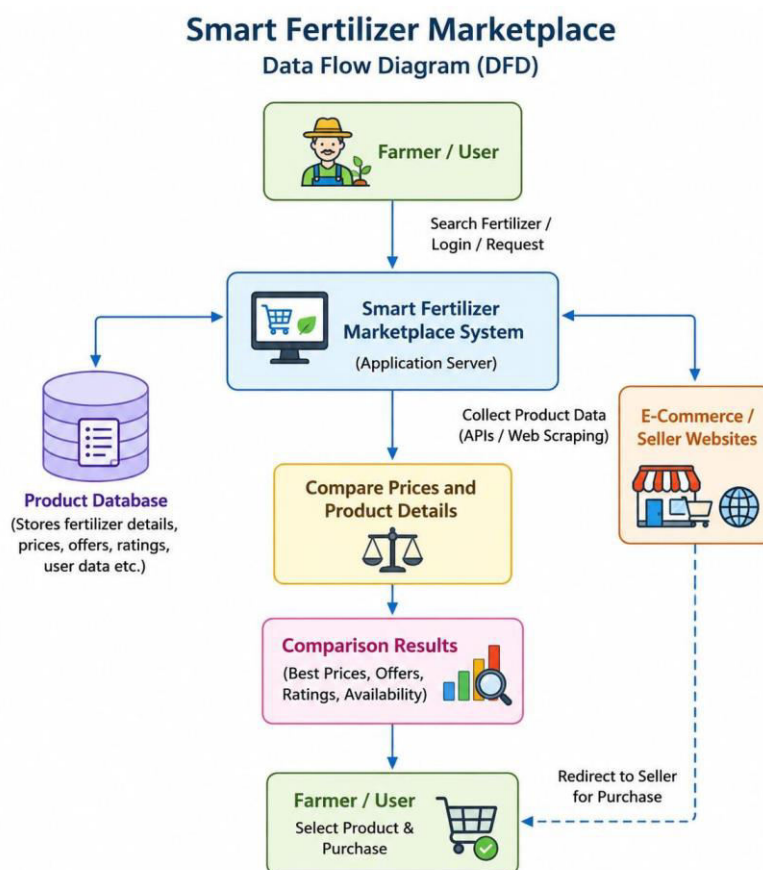


Fig.1. Data flow diagram of the Smart Fertilizer Marketplace

3. Working Mechanism and Interfaces

The farmer registers or logs in and searches by fertilizer name, brand, crop type or nutrient composition. The server collects and keeps updated the matching product data, compares it, and shows structured results with description, nutrient composition, usage instructions, reviews and delivery information. As shown in Fig. 2, the interface flow runs from Login/Registration to the Home Dashboard (Search Product, View Offers, Notifications), then to the Fertilizer Comparison Interface, Product Details and Seller Information, and finally the Redirect to Seller Website screen, where the seller handles payment, confirmation and delivery. Alerts about price drops, offers and availability are sent throughout.

Smart Fertilizer Marketplace Interface Diagram



Fig.2. Interface diagram of the Smart Fertilizer Marketplace

4. Modules

The system is divided into the following modules:

- User Authentication — registration, login/logout, password recovery and profile management.
- Fertilizer Search — search and filtering by name, brand, crop type, nutrient composition and category.
- Data Collection — extraction of prices, ratings, offers and seller information through APIs and web scraping, with real-time updates.
- Product Comparison — comparison of prices, offers, discounts, ratings and reviews to display the best options.
- Product Details — specifications, nutrient details, usage instructions, seller information and customer reviews.
- Notification — price drop alerts, offer notifications, availability updates and new product announcements.
- Database Management — secure storage of user data, fertilizer information, search history and comparison records.
- Purchase Redirection — links to external e-commerce platforms for completing the purchase.
- Admin — management of users, product data, system updates and maintenance.

5. Implementation

The back end is developed in Python using Flask (or Django) for routing, request handling and authentication, with BeautifulSoup, Selenium and REST APIs for scraping and data collection. The front end uses HTML, CSS and JavaScript, and React Native or Flutter can provide Android support. User, product, comparison and notification data

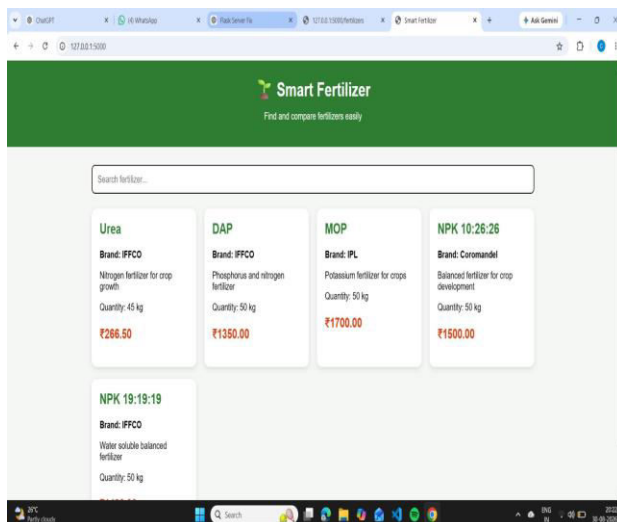
are stored in MySQL or MongoDB, while Firebase or AWS can provide hosting, storage and real-time synchronization. Passwords are stored encrypted and database connections are secured.

IV. SYSTEM REQUIREMENTS

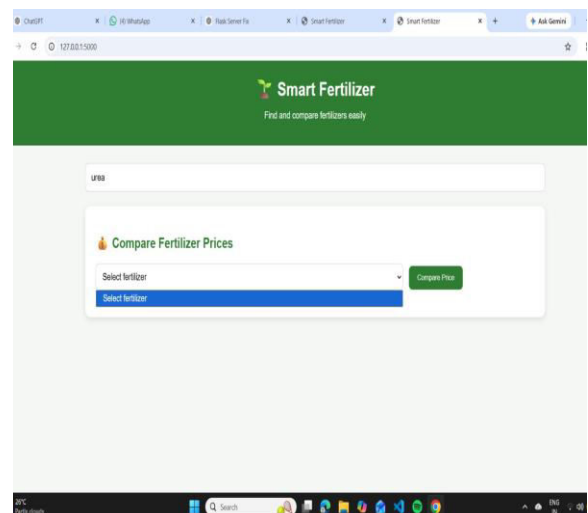
Functionally, the system must provide secure authentication for farmers and administrators, search by name, brand, crop type or nutrient composition, collection of price, rating, discount, availability and seller data from multiple websites, product comparison, database management of product, user and search records, notifications about price drops and offers, and a feedback mechanism for reviews and reporting incorrect information. Non-functionally, it must be fast under many concurrent users, reliable with minimal downtime, secure, scalable, easy to use and maintain, and compatible with different browsers, Android devices and operating systems.

The minimum hardware is a 1.5 GHz processor, 4 GB RAM (recommended), 10 GB of free storage and a stable internet connection. The software stack is Windows, Linux or Android; Python, JavaScript, HTML and CSS; Flask, Django, React Native or Flutter; MySQL or MongoDB; BeautifulSoup and Selenium; Firebase or AWS; and browsers such as Chrome, Firefox and Edge. A high-speed connection is needed to reach external websites and APIs, sensitive data should be encrypted with access limited to authorized users, and scalability can be supported through cloud integration, caching and load balancing.

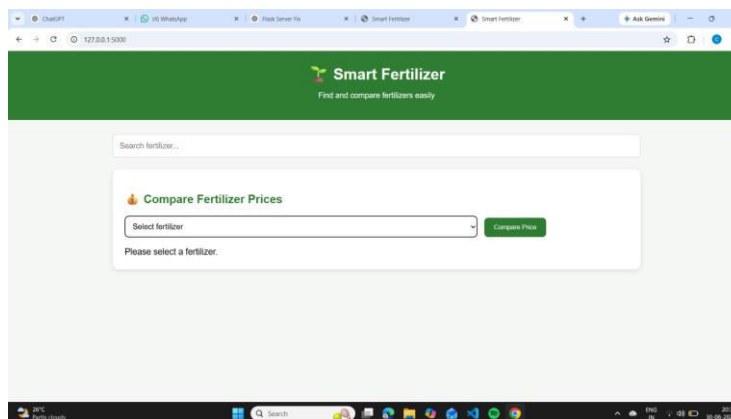
V. RESULT



(a)



(b)



(c)

Fig.3: (a) Displays fertilizer products with names, brands, nutrient composition, quantities, and prices.(b) Enables users to compare fertilizer prices from different sellers using a dropdown menu. (c) Provides a simple interface to search fertilizer prices and view comparison options.

VI. CONCLUSION

The Smart Fertilizer Marketplace gives farmers a single platform to search, compare and purchase fertilizers from multiple online sources, improving price transparency and saving time and money, particularly for rural users. Future improvements include AI-based fertilizer recommendations, multilingual support, soil analysis integration, weather-based suggestions and in-app purchasing.

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