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Farmer Logistics Connector For Truck Sharing And Route Matched Load Optimization

Edla Srilekha, P. Mahipal Reddy*
Vaagdevi Engineering College, Warangal, 506005, Telangana, India.
*Correspondence: P. Mahipal Reddy

ABSTRACT

Agricultural transportation plays a vital role in connecting farmers with markets, but conventional logistics management often suffers from poor coordination, inefficient vehicle utilization, and increased transportation costs. Manual communication methods such as phone calls and local agents frequently result in delayed deliveries, empty return trips, and limited visibility of available transport resources. To address these challenges, this research proposes the Farmer Logistics Connector for Truck Sharing and Route Matched Load Optimization (FLCTS), a web-based platform that digitally coordinates truck sharing among farmers and truck owners. The system is developed using React.js for the frontend, Django Representational State Transfer (REST) Framework for backend services, and My Structured Query Language (MySQL) for centralized data storage. It provides secure user registration, administrator approval, role-based access control, truck posting, route-based transport matching, and transport request management through Application Programming Interfaces (APIs). The centralized database enables efficient storage and retrieval of user, truck, and request information while ensuring transparency and data consistency. The proposed system minimizes empty vehicle trips, improves truck capacity utilization, reduces fuel consumption, and decreases transportation delays through structured digital coordination. Additionally, it enhances communication between stakeholders, supports secure information sharing, and provides real-time visibility of transport availability. Experimental implementation demonstrates that the platform improves operational efficiency, strengthens agricultural supply chain coordination, and offers a scalable, reliable, and cost-effective solution for rural transportation management. The proposed framework contributes to sustainable agricultural logistics by replacing traditional manual processes with an intelligent, transparent, and technology-driven

Key words: Agricultural Logistics, Truck Sharing, Route Matching, Load Optimization, Logistics Management, React.js, Django REST Framework, MySQL, Web-Based Platform, Transportation Coordination.

1.INTRODUCTION

The global food supply system enables consumers to access a wide variety of food products throughout the year, regardless of seasonal or geographical limitations. However, there has been a significant increase in consumer preference for regionally produced food due to its perceived freshness, quality, affordability, and environmental benefits. In 2015, regionally produced food generated $8.7 billion in sales from U.S. farms [1]. While some of these products are sold directly through farmers' markets, the majority are distributed through retail stores, with studies showing that nearly 87% of consumers prefer supermarkets that offer locally produced food [2]. Consumers are increasingly motivated by factors such as better food quality, improved nutritional value, reduced dependence on long-distance transportation, lower fossil fuel consumption, and support for local economies [3]. Additionally, direct interaction between farmers and consumers strengthens trust, transparency, and long-term

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relationships within the regional food supply chain [4].

The growing demand for regional food presents substantial opportunities for small-scale farms, which represent nearly 85% of regional food producers and benefit from direct-to-consumer sales that allow higher pricing and better market access [5]. Consequently, government agencies and policymakers have introduced various initiatives to encourage regional food production and strengthen rural economies [6]. Despite these efforts, many farmers continue to face challenges related to high transportation costs, limited marketing opportunities, and the difficulty of reaching multiple markets efficiently [7]. To overcome these limitations, regional food systems require well-organized logistics infrastructure that supports larger-scale distribution through retail stores, educational institutions, healthcare facilities, and other commercial channels. The emergence of regional food hubs has significantly improved logistics coordination by providing centralized facilities for aggregation, storage, processing, distribution, and marketing of locally produced agricultural products, thereby enhancing supply chain efficiency and expanding market opportunities for farmers [8].

2. LITERATURE SURVEY

Zhu et al. [9] builds a mathematical model with the goal of minimizing the total distribution cost. A hybrid ant colony optimization is designed to solve the problem, and the effectiveness of the model and algorithm are verified through two sets of comparative experiments. To determine which products should be invested in freshness-keeping cost to reduce the total distribution cost, they perform numerical analysis on the relevant parameters in the model. Results provide decision-making references for cold chain logistics distribution enterprises in the design of distribution routes. Fikar [10] developed a decision support system which combined agent-based simulation and dynamic routing procedures to investigate e-groceries inventory and delivery operations. The quality functions of 48 agricultural products they incorporated into the model to simulate food decay processes. His findings contributed to the sustainable supply of food. Gasset et al. [11] addresses the open vehicle routing problem (OVRP), a major logistical challenge in route optimization for a fleet of vehicles serving geographically dispersed customers. Using a heuristic approach, they explore the complexities of OVRP, comparing the results with advanced optimization methods. This study not only highlights the effectiveness of mathematical modeling, but also explores the practicality of heuristic algorithms such as Greedy, Nearest Neighbor and 2-opt to provide quality solutions. The findings highlight the nuanced interplay between solution quality and computational efficiency, providing valuable insights for addressing real-world logistics challenges. Recommendations delve into optimization opportunities and the integration of emerging technologies, ensuring adaptable solutions to the intricate problem of open vehicle routing.

Wu et al. [12] with the crowd-shipping problem and split deliveries, respectively. In synthesis, these studies have improved computational efficiency and flexibility in route planning. Implementing these approaches in open vehicle routing optimization (OVRP) provides efficient and adaptable solutions to complex logistics challenges. Considering the type of techniques or tools to address the solution of optimization problems in VRP and OVRP environments, which allow for finding high-quality solutions in a reasonable time, heuristic approaches are among them and have been applied in the works of Peng. Huang et al. [13] assume that at any time during the delivery phase, each vehicle could

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have a chance to be disrupted. When a disruption happens, vehicles will be unable to continue their journeys and supplies will be unable to be delivered. They model the occurrence of disruption as a given probability and consider the multi-period expected delivery. Their objective is to either minimize the total travel cost or maximize the demand fulfillment, depending on the supply quantity. This problem is denoted as the multi-period vehicle routing problem with disruption (VRPMD). VRPMD does not deal with disruptions in real-time and is more focused on the long-term performance of a single routing plan. They first prove that the proposed VRPMD problems are NP-hard. They then present some analytical properties related to the optimal solutions to these problems. They show that Dror and Trudeau's property do not apply in their problem setting. Nevertheless, a generalization of Dror and Trudeau's property holds.

Hadi et al. [14] explores various elements that affect the logistics distribution system in rural areas, including road infrastructure, storage facilities, transportation technology, and distribution mechanisms. This study uses a systematic literature review approach to analyze data related to this topic. The analyzed articles are limited to articles published in the period between 2013 and 2024. The focus areas of global and Indonesian show a difference in research focus, with global scholars placing more emphasis on technological innovation and management practices, while research in Indonesia is more focused on supply chain analysis and distribution strategies. The main challenges of rural logistics in Indonesia include poor road infrastructure, inadequate storage, and price inequality due to intermediaries. Moazzeni et al. [15] delivers a structured synthesis that connects collaboration mechanisms, digital enablers, and rural logistics characteristics, moving beyond fragmented treatments in prior reviews. A comprehensive search and rigorous screening of 73 studies revealed literature spanning three interconnected domains: collaborative logistics, digital technologies, and rural logistics. Based on this analysis, they identify three logistics modes that shape interactions between production firms and customers in rural areas: rural-to-rural, rural-to-urban, and urban-to-rural. The review findings are consolidated into an integrated framework that links collaboration practices with enabling technologies.

3. PROPOSED METHODOLOGY

The system is designed as a web-based agricultural logistics platform developed to simplify and streamline transportation coordination among farmers and truck owners. As shown as fig. 1 The system replaces manual and informal logistics practices with a centralized digital interface that improves visibility of available transportation resources. It allows users to post truck details such as route, date, and available load capacity, enabling efficient sharing of transportation services. The platform supports role-based access, ensuring secure interaction between users and administrators. By enabling route-based matching and controlled request handling, the system reduces transportation delays and improves operational efficiency. In this research enhances transparency, accountability, and utilization of logistics resources within agricultural supply chains.

User Interface (Web Browser – React.js): Farmers, truck owners, and administrators interact with the system through a browser-based user interface developed using React.js. The interface enables smooth navigation for user registration, login, dashboard access, truck posting, and viewing available transport routes. User actions such as adding trucks or requesting transport are converted into secure Hypertext Transfer Protocol (HTTP) requests and sent to the backend server.

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Backend Server (Django REST Framework): The Django Representational State Transfer (REST) Framework backend handles all incoming requests from the frontend and executes core business logic. It manages user authentication, role verification, admin approval processes, truck management, and transport request handling. This layer acts as the control unit, ensuring secure and structured communication between users and the database.

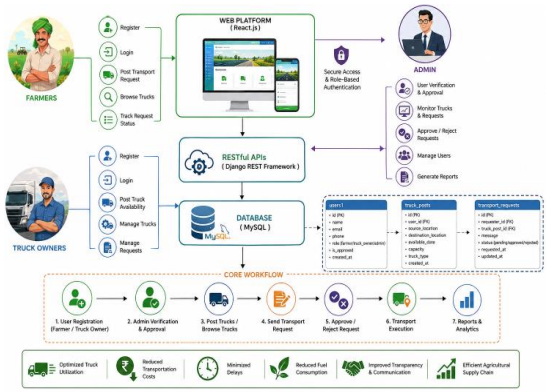


Fig. 1: Proposed system architecture for FLCTS.

Database Layer (MySQL): The My Structured Query Language (MySQL) database stores all system data in a structured relational format. It maintains user profiles, approval status, roles, truck postings, routes, available load capacity, and transport request records. Optimized SQL queries ensure efficient data retrieval, updates, and consistency across the platform.

User Registration and Approval Flow: Users submit registration details which are validated and stored with a pending approval status. This mechanism prevents unauthorized access to the platform. The administrator verifies and approves valid users before granting login permissions, ensuring secure and trusted participation in the system.

Administrator Management Module: Administrators manage user accounts and monitor transportation activities through secured administrative controls. They approve or reject user registrations and view all transport requests across the system. This ensures transparency, system reliability, and controlled platform usage.

Truck Posting and Management Module: Approved users can add truck details including route, date, truck number, and available load capacity. These details are stored in the database and made visible to other users for browsing. This module supports efficient truck sharing and better utilization of transportation resources.

Transport Request and Approval Module: Users can browse available trucks and send transport requests based on route compatibility. Truck owners receive requests and can approve or reject them. Contact details are shared only after approval, ensuring secure and controlled communication.

End-to-End Operational Flow: The system follows a structured flow from the React-based user interface to the Django backend and MySQL database. Every request is authenticated, validated, processed, and securely stored. Role-based access control and centralized data management ensure system reliability, transparency, and efficient agricultural logistics coordination.

Workflow

The system follows a structured workflow the step-by-step interaction between users, administrators, and the system. The process begins with user registration and verification, ensuring that only approved users gain access to the platform. Once authenticated, users can perform logistics-related activities such as posting truck availability or browsing transport options. All user actions are processed through the backend server, where validations and business rules are applied before data is stored in the database. The system supports request-based interactions, allowing controlled communication between farmers and truck owners. This structured workflow ensures secure operations, efficient truck sharing, and transparent logistics

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coordination across the platform illustrated in fig. 2.

User Access and Interface Interaction: The workflow begins when a farmer, truck owner, or administrator accesses the system through a web browser using a React.js-based interface. The interface provides facilities for user registration, login, dashboard access, truck posting, and request viewing. React.js enables dynamic page rendering, ensuring smooth navigation without page reloads. Every user interaction is translated into secure HTTP requests. These requests are forwarded to the backend server for further processing.

User Registration Process: New users submit registration details such as username, email address, mobile number, and address through the registration module. The backend validates the submitted data to ensure correctness and uniqueness. Upon successful validation, the user details are stored in the database with a pending approval status. This mechanism prevents unauthorized access to the platform. Users are notified that login access is granted only after administrator approval.

Administrator Approval Workflow: The administrator logs into the system and views the list of newly registered users awaiting approval. User details are reviewed to ensure authenticity and legitimacy. Once approved, the user's account status is updated in the database. This workflow ensures that only verified users are allowed to participate in truck sharing and logistics activities. It also enhances platform security and trust.

Login and Role Validation: Approved users log into the system using valid credentials. The backend authenticates the credentials and determines the role of the user as administrator or farmer. Based on the identified role, users are redirected to their respective dashboards. Unauthorized or unapproved login attempts are blocked by the system. This role-based validation ensures controlled access to system functionalities.

Truck Posting by Users: Approved users can post truck availability details such as market date, truck number, route origin, destination, and available load capacity. The backend validates the submitted information and stores it securely in the database. These truck details become visible to other users for browsing and request generation. This step enables efficient sharing of transportation resources.

Truck Browsing and Transport Request Generation: Users browse available trucks based on route and date information displayed on the dashboard. Interested users send transport requests for suitable trucks through the interface. Each request is recorded in the system with a pending status. The request details are routed to the respective truck owner for further action.

Request Approval and Contact Sharing: Truck owners review incoming transport requests and decide to approve or reject them. Upon approval, the request status is updated in the database. The system then shares contact details of the truck owner with the requesting user. Rejected requests are marked accordingly, ensuring clear communication and transparency.

Data Storage and System Synchronization: All user information, truck postings, and transport requests are stored securely in the MySQL database. Django REST Application Programming Interface (APIs) manage data retrieval, updates, and synchronization between components. The React frontend dynamically updates dashboards based on backend responses. This end-to-end workflow ensures reliable data handling, system transparency, and efficient agricultural logistics coordination.

4. RESULTS AND DISCUSSION

The system is implemented using a web-based application that integrates a responsive frontend

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with a robust backend to support efficient agricultural transportation coordination. The frontend is developed using React.js to provide an interactive interface for farmers, truck owners, and administrators. The backend is implemented using the Django REST Framework, which manages authentication, role verification, approval workflows, truck sharing logic, and business rule execution. MySQL is used as the relational database to securely store user information, truck availability data, and transport request records. RESTful APIs facilitate seamless communication between the frontend and backend components.

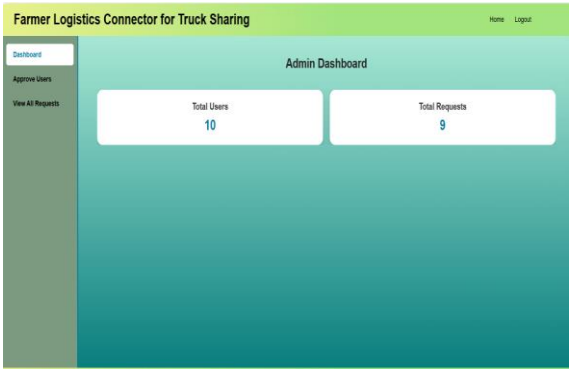


Fig. 2: Admin dashboard page.

Fig. 2 provides administrators with a centralized overview of system activity in this research. It displays key metrics such as the total number of registered users and total transport requests, enabling quick monitoring of platform usage. The sidebar allows easy navigation to user approval and request management sections. This page helps administrators efficiently supervise system operations and maintain control over user access. It supports transparent administration and effective logistics coordination.

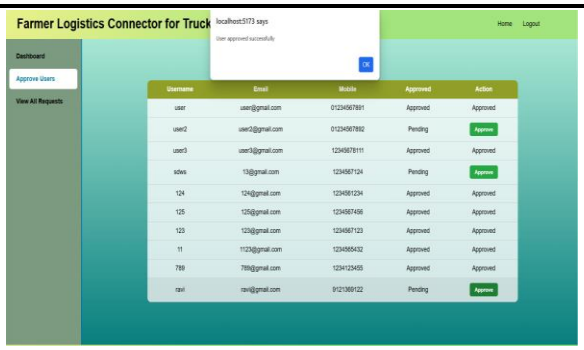


Fig. 3: Admin – User approval page.

Fig. 3 allows the administrator to manage and verify newly registered users in this research. It displays a detailed list of users along with their email addresses, mobile numbers, and approval status. Pending users can be approved instantly using the approve action, and confirmation messages are shown upon successful approval. This page ensures that only verified and trusted users gain access to the platform. It plays a critical role in maintaining system security and controlled participation.

Fig. 4 provides administrators with a consolidated view of all transport requests made within this research. It displays key details such as the requester, truck owner, route information, date of travel, and current request status. This page enables administrators to monitor logistics interactions and ensure transparency across the platform. By presenting request data in a clear tabular format, it supports effective system supervision and operational oversight.

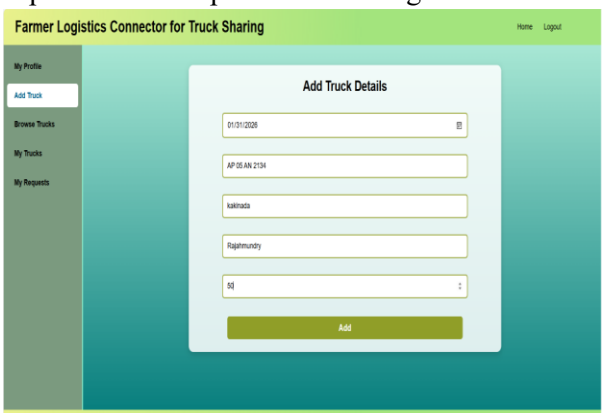


Fig. 4: User add truck details page.

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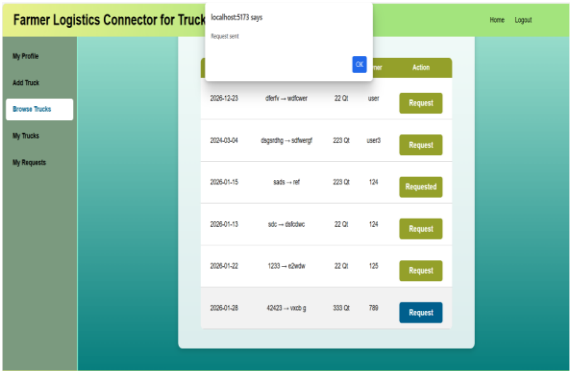


Fig. 5: User browse trucks page.

Fig. 5 allows approved users to view a list of available trucks posted by other users in this research. It displays important details such as travel date, route information, available load capacity, and truck owner name. Users can send transport requests directly from this page using the request option. Confirmation messages are shown after a request is successfully submitted. This page enables efficient discovery of suitable transport options and supports route-matched load sharing.

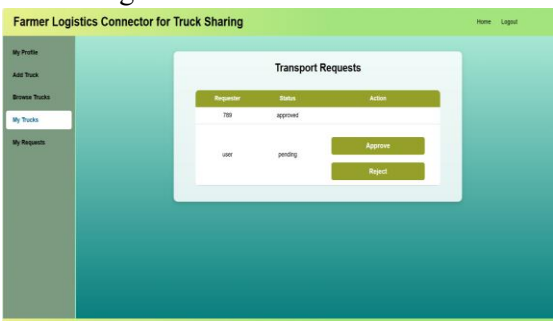


Fig. 6: User my trucks page.

Fig. 6 allows truck owners to manage incoming transport requests for the trucks they have posted in this research. It displays the requester name along with the current request status in a clear table format. Pending requests can be approved or rejected using the provided action buttons. This page ensures controlled communication between users and truck owners. It plays a key role in confirming transport arrangements and maintaining transparency in request handling.



Fig. 7: User my requests page.

Fig. 7 allows users to track the status of transport requests they have sent in this research. It displays details such as request date, truck owner, current request status, and contact information when approved. Pending requests show restricted contact access, ensuring privacy and security. Once approved, contact details become available for coordination. This page helps users monitor request progress and plan transportation effectively.

CONCLUSION AND FUTURE SCOPE

The system successfully demonstrates the application of modern web technologies to address real-world challenges in agricultural transportation. By replacing manual coordination with a centralized digital platform, the system significantly improves the efficiency of logistics operations among farmers and truck owners. The implementation of React.js ensures a responsive and user-friendly interface, while the Django REST Framework provides secure backend processing and structured business logic execution. MySQL enables reliable and consistent storage of user data, truck details, and transport requests. Performance improvements are observed in faster truck discovery, reduced coordination delays, and improved utilization of available load capacity. Role-based access control and admin approval workflows enhance system security and reliability. Efficient API communication and optimized database queries reduce response time and support multiple

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concurrent users. The system minimizes empty return trips and supports transparent request tracking, resulting in cost savings and improved operational efficiency. In this research delivers a scalable and dependable solution that strengthens agricultural logistics coordination and supports sustainable transportation practices.

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