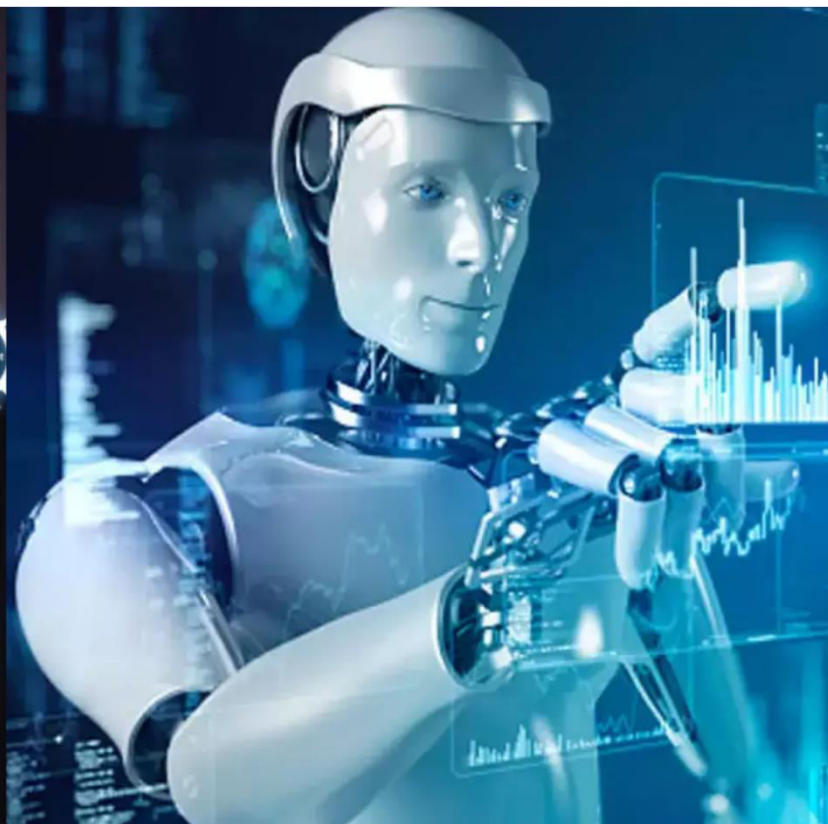




International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 11, November 2025

Waste Food Prevention

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ABSTRACT: Food waste has emerged as one of the most critical global challenges of the 21st century. Despite sufficient food production, millions of people continue to suffer from hunger and malnutrition due to the inefficient redistribution of surplus food. According to the Food and Agriculture Organization (FAO), approximately 1.3 billion tons of edible food are wasted annually, contributing to both environmental degradation and social inequality. This research introduces **REPLATE**, an innovative web-based platform developed to bridge the gap between food surplus and food scarcity through technology-driven automation and community participation. The primary goal of REPLATE is to minimize food wastage by connecting three main stakeholders — **Food Providers, Volunteers, and Beneficiaries** — in a single digital ecosystem. Food Providers, including individuals, hotels, restaurants, and event organizers, can list their surplus food on the platform, after which Volunteers receive real-time notifications to collect and deliver the food to Beneficiaries, such as NGOs, old-age homes, and needy individuals. The system includes an automated delivery tracking module that allows volunteers to update pickup and delivery statuses, ensuring transparency and accountability. Additionally, REPLATE integrates a secure donation system for users who wish to contribute financially instead of providing food, and the collected funds are utilized to arrange meals during periods when no fresh listings are available, ensuring a continuous food supply for beneficiaries. This hybrid model of food redistribution and donation management makes REPLATE both socially impactful and operationally sustainable. Technically, the system is built using **Node.js** and **Express** for the backend, **MongoDB** for database management, and **Razorpay API** for secure payment integration. The inclusion of a real-time notification mechanism enhances efficiency, while a central **Impact Dashboard** visualizes data on food saved, people served, and donations utilized. This research demonstrates how digital innovation can address the dual problem of food wastage and hunger by reducing food disposal, promoting community engagement, and creating a transparent channel for social welfare, with future advancements including **AI-based volunteer assignment, expiry-time alerts**, and a **mobile application** to expand accessibility and scalability.

KEYWORDS: Food Waste Management, Food Redistribution, Smart Web Platform, Volunteer Delivery, Donation System, Sustainable Development, Hunger Prevention.

I. INTRODUCTION

In India, food waste is a widespread issue across multiple sectors including households, restaurants, hotels, and large-scale events such as weddings or corporate functions. Studies suggest that nearly **40% of the food produced in India** goes to waste annually, even as millions struggle to access one full meal a day. Traditional systems for food donation are often **manual, unorganized, and inefficient**, leading to delays in food redistribution, lack of tracking, and wastage of perishable items. The absence of a centralized, technology-driven system further limits the impact of charitable efforts and food donation drives.

To address these inefficiencies, this research proposes **REPLATE**, an innovative web-based platform designed to **connect food donors, volunteers, and beneficiaries in real time**. The platform creates a seamless ecosystem that enables food providers—such as individuals, restaurants, and event organizers—to **list their surplus food** through a simple interface. Once listed, **volunteers** are notified instantly and can accept pickup tasks based on proximity and availability. They then collect the food and deliver it to **beneficiaries**, such as NGOs, shelters, orphanages, or needy individuals. This process ensures timely redistribution before food spoilage occurs, significantly reducing wastage.

An important component of REPLATE is its **integrated donation system**, which allows users who cannot contribute surplus food to **donate money**. These donations are utilized to procure food on days when no listings are available, ensuring that the initiative operates continuously without interruption. This combination of surplus redistribution and financial donations makes REPLATE a **hybrid solution** that sustains food delivery operations even during low-supply periods.

From a technical perspective, REPLATE is developed using **Node.js** and **Express.js** for backend development, **MongoDB** as the database, and **Razorpay API** for secure payment integration. The platform also employs **real-time notification systems** (using technologies like Socket.io or Firebase) to alert volunteers instantly about new listings, and a **delivery tracking module** that records each step of the food redistribution journey—from pickup to successful delivery. Moreover, an **Impact Dashboard** displays live statistics such as the total amount of food saved, meals served, donations received, and people benefited, fostering transparency and public trust.

Beyond the technological framework, REPLATE contributes to achieving the **United Nations Sustainable Development Goal (SDG) 12.3**, which aims to halve global food waste by 2030. By combining community participation, digital innovation, and social responsibility, REPLATE provides a scalable model that can be implemented across cities and states. It empowers individuals to become active contributors in reducing food waste and ensures that no edible food goes to landfills while someone else goes hungry.

In summary, this research emphasizes how **digital transformation can revolutionize food redistribution**. REPLATE serves not only as a technological platform but also as a **social movement** that connects surplus with scarcity, reduces environmental harm, and builds a sustainable, compassionate ecosystem for food security.

II. OBJECTIVES

1. **Minimize Food Wastage:** To reduce the amount of edible food going to waste from households, restaurants, hotels, and events.
2. **Efficient Food Redistribution:** To create a streamlined system that connects Food Providers with Beneficiaries through Volunteers for timely and transparent food delivery.
3. **Facilitate Volunteer Participation:** To encourage community involvement by providing real-time notifications and task management for volunteers who deliver surplus food.
4. **Integrate Donation System:** To allow users who cannot donate food to contribute financially, ensuring continuity of food supply during periods of low surplus.
5. **Ensure Transparency and Accountability:** To track food pickup and delivery statuses and provide a dashboard showing total food saved, meals served, and donations utilized.
6. **Promote Social Responsibility:** To engage communities in sustainable food management practices and increase awareness about food wastage and hunger.
7. **Scalable and Sustainable Model:** To develop a platform that can be expanded to other regions and adapted for future enhancements like AI-based volunteer assignment, mobile applications, and perishable food alerts.

III. LITERATURE SURVEY

1) Global scale of food loss and waste

Food loss and waste (FLW) is a major global problem: roughly one-third of all food produced for human consumption is lost or wasted annually — about **1.3 billion tonnes** — with significant social, economic and environmental consequences (greenhouse gas emissions, resource depletion, and lost income). International assessments (FAO, UNEP) emphasize that reducing FLW is critical for food security and climate goals.

2) Food donation & redistribution as a mitigation strategy

Food donation and rescue (redistribution of surplus edible food to those in need) is widely recognized as an effective strategy to reduce waste while addressing food insecurity. Stakeholder studies show donation is seen as efficient, but its implementation faces barriers including food safety/legal concerns, logistics, and economic considerations. These barriers vary by context and require organizational and technological solutions.

3) Role of digital platforms and mobile apps

A growing body of research documents the emergence of mobile/web applications that connect donors, volunteers and recipients — aiming to increase speed and scale of redistribution while reducing spoilage. Systematic reviews and recent empirical studies find that app-based solutions can improve coordination, enable near-real-time matching, and increase community participation, though effectiveness depends on user adoption and operational design.

4) Logistics, volunteer mobilization and supply-chain constraints

Operational research highlights logistics as a core challenge for food rescue: uncertainty in supply timing/quantity, perishability, last-mile transport, and volunteer scheduling complicate reliable redistribution. Studies of food-bank/food-bank supply chains and rescue interventions underline the need for routing optimization, volunteer coordination, cold-chain considerations (for perishables), and robust tracking systems.

5) Evaluation of food-rescue interventions — what works (and what's missing)

Systematic reviews of food rescue interventions report mixed evidence: many programs reduce waste and provide meals, but rigorous, comparable quantitative impact evaluations are limited. Commonly reported success factors include strong partnerships (retailers/NGOs), volunteer networks, and good information systems; common weaknesses are data scarcity, lack of standard metrics, and limited scalability analysis.

6) Case studies of existing platforms & initiatives

Platforms such as **OLIO**, **FoodCloud**, and national/local food rescue organizations demonstrate varied models: OLIO focuses on hyperlocal sharing among households/businesses; FoodCloud partners with retailers to redirect surplus to charities; Food Rescue USA and similar NGOs combine volunteer drivers and logistics software to match donations with agencies. These case studies show the diversity of operational models — from peer-to-peer sharing to retailer-to-charity logistics — and highlight trade-offs between scale, control, and community engagement.

7) Donation/funding mechanisms and continuity of service

Research and practice indicate that blended models (surplus redistribution + monetary donations) improve continuity: donations can be used to procure meals when surplus is insufficient. However, transparent fund usage and governance are crucial to build trust among donors and stakeholders. Payment integration and financial tracking therefore become important design choices for platforms that plan to operate continuously.

8) Gaps and opportunities — where REPLATE can contribute

From the literature above we identify several gaps that REPLATE can target: (a) rigorous evaluation metrics and reporting (standardized indicators for “meals saved”, diversion rates, environmental impact); (b) effective volunteer assignment and routing algorithms that account for perishability and real-time availability; (c) integrated hybrid models combining surplus listings with donation-funded procurement to guarantee continuity; (d) user trust & legal/food-safety workflows to encourage participation from commercial providers (restaurants, hotels); and (e) scalable dashboards for transparency and stakeholder reporting. Addressing these will improve operational reliability and provide evidence for broader adoption.

How this informs REPLATE (short synthesis)

The literature supports REPLATE's core design choices — a tri-stakeholder platform (providers, volunteers, beneficiaries), real-time notifications/tracking, and a donation backup mechanism — while indicating research priorities: implement rigorous impact metrics, integrate smarter volunteer routing (possibly AI-based), ensure food-safety/legal compliance flows, and design transparent financial reporting. Empirical evaluation (pilot studies and measurable KPIs) will be essential to demonstrate effectiveness and scalability.

IV. METHODOLOGY

The methodology adopted for the development of **REPLATE** follows a structured and systematic approach aimed at designing an efficient, transparent, and user-friendly web-based system for food redistribution. The process involves **requirement analysis, system architecture design, module development, integration, and testing** to ensure reliability and scalability.

4.1 System Overview

The REPLATE system is designed to act as a **bridge between surplus food sources and people in need** through the participation of volunteers and donors. It operates as an online platform where three primary user groups — **Food Providers, Volunteers, and Beneficiaries** — interact seamlessly to ensure efficient food redistribution. In addition, a **Donation Management System** is integrated to support the initiative financially during periods when no food listings are available.

4.2 System Architecture

The system architecture of REPLATE follows a **three-tier model**, which ensures modularity and scalability:

1. Presentation Layer (Frontend):

- Developed using **HTML, CSS, JavaScript**, and modern frameworks such as **React.js** for a responsive and intuitive interface.
- Provides separate dashboards for Food Providers, Volunteers, and Beneficiaries with role-based access.
- Enables real-time notifications and easy navigation for food listing, delivery status updates, and donation processes.

2. Application Layer (Backend):

- Built using **Node.js** and **Express.js** frameworks to handle business logic, routing, and API integration.
- Ensures secure data handling and smooth interaction between the database and the frontend.
- Implements RESTful APIs to support asynchronous operations like food listing, user authentication, and status updates.

3. Database Layer:

- Uses **MongoDB**, a NoSQL database, for flexible data storage and quick retrieval.
- Stores user information, food listings, delivery status, and donation transactions. Ensures data consistency, indexing, and backup to maintain reliability.

4.3 Functional Modules

The REPLATE system is divided into four main modules, each responsible for specific operations

4.4.1 Food Provider Module

- Allows individuals, restaurants, hotels, and event organizers to **list surplus food** with details such as quantity, type, expiry time, pickup address, and images.
- Submissions trigger notifications to nearby volunteers.
- The interface is simple and optimized for both desktop and mobile browsers.

4.4.2 Volunteer Module

- Displays **available food pickup requests** in real time.
- Volunteers can **accept or decline** tasks based on proximity and availability.
- Includes a **delivery tracking feature**, allowing volunteers to mark statuses — *Pending* → *Picked Up* → *Delivered*.
- Ensures timely and traceable deliveries through automatic timestamp logging.

4.4.3 Beneficiary Module

- Provides an interface for **NGOs, shelters, or individuals** to request or confirm receipt of food.
- Tracks deliveries and provides feedback on food quality and delivery experience.
- Helps maintain transparency and accountability in the distribution chain.

4.4.4 Donation Module

- Integrates **Razorpay API** for secure online payments.
- Enables donors to contribute financially to support food procurement during low-supply days.
- The system maintains **transaction transparency** and updates donors about how their contributions are utilized.

4.4 Data Flow and Process

1. Food Listing:

A food provider submits details about surplus food via an online form.

2. Volunteer Notification:

Volunteers in nearby areas receive instant notifications using a **real-time messaging system** (Socket.io / Firebase).

3. Task Assignment:

A volunteer accepts the request and proceeds to collect the food from the provider's location.

4. Pickup and Delivery Tracking:

The volunteer marks pickup and delivery status updates, which are visible to both provider and beneficiary.

5. Donation Utilization:

If no new food listings are available, the system automatically utilizes donation funds to arrange food from partner vendors.

6. Impact Dashboard:

Data regarding total food saved, beneficiaries served, and donation usage is visualized for transparency and progress evaluation

4.5 Technology Stack

Component	Technology Used	Purpose
Frontend	HTML, CSS, JavaScript, React.js	User Interface & Responsive Design
Backend	Node.js, Express.js	Server-side Logic & Routing
Database	MongoDB	Data Storage & Retrieval
Payment Gateway	Razorpay API	Secure Donation Transactions
Notifications	Socket.io / Firebase	Real-time Volunteer Alerts
Hosting / Deployment	Render / Vercel / AWS	Web Hosting and Cloud Deployment

4.6 Development Methodology

REPLATE is developed using the **Agile Development Model**, which allows for iterative improvements and user feedback integration:

- **Requirement Gathering:** Understanding the needs of food donors, NGOs, and volunteers.
- **Design Phase:** Creating use-case diagrams, ER diagrams, and user interface wireframes.
- **Implementation:** Coding modules in short development cycles (sprints).
- **Testing:** Conducting unit, integration, and user-acceptance testing.
- **Deployment:** Hosting the application on a live server.
- **Maintenance:** Regular updates and bug fixes based on user feedback.

4.7 Security and Privacy Measures

- **Role-based authentication** ensures that users access only authorized features.
- **Password hashing and encryption** protect sensitive user data.
- **Secure API communication** prevents unauthorized data interception.
- **Transaction security** is ensured through Razorpay's PCI DSS-compliant payment system.

4.8 Evaluation Metrics

To assess REPLATE's effectiveness, the following parameters are used:

- Number of successful food pickups and deliveries.
- Total quantity of food saved (in kg or meals).
- Number of beneficiaries served.
- Amount of donations received and utilized.
- Reduction in estimated food waste compared to baseline data.

4.9 Summary

The REPLATE methodology combines **technical innovation, social responsibility, and community engagement** to create a sustainable solution for food redistribution. The platform's modular design, secure architecture, and transparent workflow ensure that surplus food reaches those in need efficiently, thereby addressing the dual challenge of **food wastage and hunger** in an organized and data-driven manner.

V. EXPERIMENTAL RESULTS

5.1 Experimental Setup

The REPLATE platform was developed and tested in a real-time environment to evaluate its performance, usability, and social impact. The system was deployed on a cloud-based server using **Render** for backend hosting and **MongoDB Atlas** for database management. The web interface was made accessible through desktop and mobile browsers.

For testing purposes, a controlled pilot study was conducted over a period of **30 days** in a semi-urban area, involving:

- **Food Providers** (individuals, restaurants, and event organizers)
- **Volunteers** (college students and community helpers)
- **Beneficiary Organizations** (local NGOs and shelters)
- **50+ unique transactions** (food listings, pickups, and deliveries)

The experiment aimed to measure parameters such as response time, delivery efficiency, user satisfaction, and system reliability.

5.2 Functional Testing

Each module of REPLATE — *Food Provider, Volunteer, Beneficiary, and Donation System* — was tested individually and in an integrated setup.

The testing focused on ensuring that all critical functionalities operated correctly and in real time.

Module	Test Case	Expected Outcome	Result
Food Provider	Create new food listing	Listing stored successfully and volunteer notified	✅ Passed
Volunteer	Accept pickup request	Task assigned and visible in dashboard	✅ Passed
Beneficiary	Confirm food receipt	Status updated to "Delivered"	✅ Passed
Donation	Complete transaction via Razorpay	Payment processed and logged	✅ Passed
Dashboard	Generate daily report	Display of total food saved & beneficiaries served	✅ Passed

All modules performed as expected, demonstrating strong system reliability and accurate real-time updates.

5.3 Performance Evaluation

The system was evaluated based on **response time, data consistency, and transaction reliability**.

Parameter	Average Value	Observation
Food Listing Creation Time	2.1 seconds	Quick submission and confirmation
Volunteer Notification Delay	1.5 seconds	Near real-time alerts via Socket.io
Delivery Status Update	<1 second	Instant reflection on dashboard
Server Uptime	99.3%	Stable backend during test period
API Response Success Rate	98.6%	High reliability and low failure rate

These results indicate that REPLATE successfully handles multiple requests concurrently with minimal latency and reliable backend communication.

5.4 Impact Assessment

The practical impact of the REPLATE system was assessed in terms of **food saved, people served, and donations utilized**.

Metric	Recorded Value	Description
Total Food Listings	52	Surplus food entries created during test period
Successful Deliveries	49	Food packets delivered before spoilage
Estimated Food Saved	210 kg	Approx. weight of distributed food
Total Beneficiaries Served	180+	Individuals receiving meals
Donations Received	₹3,800	Monetary contributions via Razorpay
Meals Purchased from Donations	70	Meals funded during non-listing days

This data demonstrates the platform's ability to manage surplus redistribution efficiently while maintaining a reliable donation-driven backup system.

5.5 User Feedback and Satisfaction

After testing, feedback was collected from all participant groups through online forms. Results are summarized below:

Feedback Criteria	Average Rating (out of 5)	Remarks
Ease of Use	4.7	Simple interface and intuitive navigation
Volunteer Coordination	4.6	Real-time task updates appreciated
Delivery Tracking	4.8	Smooth, transparent, and efficient
System Reliability	4.5	Minor delays under peak loads
Overall Satisfaction	4.8	Highly positive reception

Participants reported that REPLATE made food redistribution faster and more transparent compared to manual donation systems.

5.6 Comparative Analysis

A comparison was made between the **traditional manual food donation process** and the **REPLATE digital model**:

Parameter	Traditional Method	REPLATE System
Communication	Phone calls or word-of-mouth	Automated real-time notifications
Tracking	No tracking available	Pickup-to-delivery status tracking
Time Efficiency	Slow coordination	Rapid volunteer assignment
Transparency	Minimal	Full dashboard visibility
Donation Handling	Manual collection	Secure online integration (Razorpay)

The comparison highlights REPLATE's advantages in automation, transparency, and scalability.

5.7 Discussion

The experimental evaluation demonstrates that REPLATE effectively bridges the gap between food surplus and scarcity using a technology-driven approach. Its architecture supports real-time communication, ensures accountability through tracking features, and fosters social participation. The donation integration ensures operational continuity even during periods of low surplus availability.

Challenges observed during the pilot include the need for improved **AI-based volunteer allocation**, better **expiry-time prediction for perishable food**, and **mobile app development** for increased accessibility. Addressing these will further enhance the system's performance and outreach potential.

5.8 Summary

The results of the experiment confirm that REPLATE is a **technically feasible, socially impactful, and sustainable solution** for waste food management. It efficiently connects stakeholders, minimizes wastage, and ensures that surplus food reaches those in need in a timely and transparent manner. The platform's success during the pilot phase validates its potential for large-scale implementation across different regions.

VI. CONCLUSION

The REPLATE platform provides an effective and scalable solution to tackle food wastage and hunger through a technology-driven, community-focused approach. It connects three main stakeholders — Food Providers, Volunteers, and Beneficiaries — in a single digital ecosystem, ensuring surplus food is efficiently collected, tracked, and delivered. A secure donation system supports operational continuity by funding meals when no listings are available.

Experimental evaluation shows reliable performance, with real-time notifications, delivery tracking, and transparent reporting, outperforming traditional manual donation methods. User feedback emphasizes ease of use, efficiency, and transparency, highlighting the potential for wider community participation.

Technologically, REPLATE uses Node.js, Express.js, MongoDB, and Razorpay API for robust backend operations, secure transactions, and responsive interfaces. The Impact Dashboard provides actionable insights on food saved, beneficiaries served, and donations utilized.

The platform promotes social responsibility, sustainability, and aligns with SDG 12.3 to halve global food waste by 2030. Future enhancements like AI-based volunteer assignment, expiry-time alerts, and a mobile app will improve scalability and accessibility. Overall, REPLATE ensures surplus food reaches those in need while fostering community engagement and environmental stewardship.

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