



AI-assisted Smart Food Redistribution System with Priority-Based Optimization: A Circular Economy Framework for Sustainable Resource Management

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Abstract. Food waste and food insecurity continue to coexist as critical global challenges, particularly in developing economies such as India, where inefficient distribution systems result in the simultaneous loss of edible food and inadequate access to nutrition. This study proposes an AI-assisted smart food redistribution system grounded in circular economy principles, aimed at transforming surplus food into a reusable societal resource through a scalable and digitally coordinated framework. The proposed web-based platform integrates multiple stakeholders, including food providers, receivers, community volunteers, and administrators, within a unified ecosystem that enables real-time data exchange and operational transparency. A lightweight priority-based optimization model is introduced, where allocation decisions are driven by a dynamic scoring function incorporating food quantity, remaining expiry time, and location-based distance constraints, thereby ensuring that high-risk and high-volume surplus is prioritized for timely redistribution. Unlike conventional systems that rely on manual coordination or computationally intensive models, the proposed approach employs a computationally efficient, context-aware decision mechanism suitable for semi-urban and resource-constrained environments. Conceptual evaluation indicates that the integration of priority-based allocation and location-aware matching can significantly reduce food wastage (estimated 25–40%) while improving delivery efficiency and responsiveness. The study demonstrates that even low-complexity AI-assisted frameworks can achieve meaningful optimization in decentralized resource management systems, contributing to sustainable development goals and advancing practical implementations of circular economy strategies.

Keywords: AI-assisted Systems, Food Redistribution, Food Waste Management, Circular Economy, Priority-Based Optimization, Resource Allocation, Sustainable Development, Location-Aware Systems.

1. Introduction

Food waste has emerged as a critical global sustainability challenge with far-reaching environmental, economic, and social implications. According to the Food and Agriculture Organization (FAO), nearly one-third of all food produced globally is lost or wasted annually, amounting to approximately 1.3 billion tonnes [1]. In India, the scale of the problem is equally alarming, with recent estimates indicating that tens of millions of tonnes of food are wasted each year despite persistent food insecurity among vulnerable populations [2], [3]. This paradox highlights a fundamental inefficiency in food distribution systems rather than limitations in production capacity. A significant proportion of food waste occurs at the consumption and post-consumption stages, particularly in urban and semi-urban regions, where surplus food from households, restaurants, and social events often remains unutilized. From an environmental perspective, food waste contributes substantially to greenhouse gas emissions, accounting for approximately 8–10% of global emissions [4].

In recent years, advancements in digital technologies have created new opportunities to address such inefficiencies through intelligent and data-driven systems. Traditional food redistribution mechanisms largely rely on manual coordination, resulting in delays, lack of transparency, and suboptimal allocation of resources. Although several digital platforms have been introduced to connect food donors with recipients, most existing systems lack real-time decision-making capabilities and fail to incorporate contextual parameters such as food perishability, quantity, and spatial constraints into the allocation process. Furthermore, many of these solutions are designed primarily for urban environments and are not well-suited for semi-urban or resource-constrained settings.

To address these limitations, this study proposes an AI-assisted smart food redistribution system based on circular economy principles, aimed at transforming surplus food into a reusable societal resource through a structured and scalable digital framework. The approach integrates multiple stakeholders—including food providers, receivers, community volunteers, and administrators—into a unified ecosystem that supports real-time coordination and transparency. A key contribution of this work is the introduction of a lightweight priority-based optimization model that dynamically evaluates surplus food based on quantity, remaining expiry time, and location-aware constraints, enabling efficient and context-sensitive allocation decisions. Unlike computationally intensive machine learning approaches, the proposed model is designed to be simple, scalable, and suitable for real-world deployment in semi-urban environments.

1.1 Key Contributions

The main contributions of this study are summarized as follows:

- 1. Technical Contribution:** A lightweight AI-assisted priority-based optimization model is proposed that integrates food quantity, expiry time, and spatial distance into a unified decision function for real-time allocation.

2. **Methodological Contribution:** A scalable multi-layered system architecture is designed, enabling seamless interaction among food providers, receivers, volunteers, and administrators within a decentralized digital ecosystem.
3. **Practical Contribution:** Unlike computationally intensive approaches, the proposed model is computationally efficient ($O(n \log n)$) and suitable for deployment in semi-urban and resource-constrained environments with limited infrastructure.
4. **Sustainability Contribution:** The framework operationalizes circular economy principles in food systems, contributing directly to Sustainable Development Goals (SDG 2: Zero Hunger and SDG 12: Responsible Consumption and Production).

The remainder of this paper is organized as follows: Section 2 reviews relevant literature, Section 3 presents the proposed methodology, Section 4 outlines the research gap, Section 5 presents the proposed methodology, and subsequent sections detail system implementation, analysis, and conclusions.

2. Literature Review and Research Gap

The issue of food waste has been widely studied across the domains of environmental sustainability, supply chain management, and resource optimization. Reports by the Food and Agriculture Organization (FAO) and the United Nations Environment Programme (UNEP) highlight that inefficiencies in storage, transportation, and consumption significantly contribute to global food loss [1], [4]. In developing countries, these challenges are further exacerbated by infrastructural limitations, lack of awareness, and absence of coordinated redistribution mechanisms.

The concept of the circular economy has emerged as a sustainable framework for addressing resource inefficiencies by promoting reuse, recycling, and waste minimization. Within the context of food systems, circular economy principles emphasize the redistribution of surplus food to reduce waste and improve food accessibility [6]. Several studies have explored the role of redistribution in transforming food waste into a valuable societal resource, highlighting its potential to simultaneously address environmental and social challenges [7], [9].

In recent years, digital platforms have been developed to facilitate food redistribution by connecting donors with recipients through web and mobile-based applications. These systems improve coordination compared to traditional manual approaches; however, many existing solutions primarily focus on information sharing rather than intelligent decision-making. As a result, they often fail to address critical operational challenges such as prioritization of perishable food, efficient allocation of resources, and real-time responsiveness. Additionally, most platforms are designed for urban environments with relatively better infrastructure, limiting their applicability in semi-urban and decentralized regions.

Recent studies (2022–2025) have explored the integration of artificial intelligence in logistics and resource allocation systems. For instance, AI-driven logistics

optimization models have demonstrated improved routing efficiency and reduced delivery time in decentralized supply chains [10], [11]. Similarly, smart food-sharing platforms incorporating mobile and cloud technologies have enhanced real-time coordination between donors and recipients, although many lack intelligent prioritization mechanisms [12].

Furthermore, intelligent resource allocation frameworks using heuristic and hybrid AI approaches have been applied in emergency response and healthcare logistics, highlighting the importance of context-aware decision-making under constrained environments [13]. However, these approaches often rely on complex models and high computational resources, limiting their applicability in semi-urban food redistribution scenarios.

In contrast, the framework focuses on a lightweight, interpretable, and computationally efficient prioritization mechanism that bridges the gap between intelligent decision-making and practical deployability.

Artificial intelligence and data-driven techniques have also been applied in supply chain optimization, particularly for demand forecasting, inventory management, and logistics planning [8]. While these approaches demonstrate significant improvements in efficiency, they typically rely on large datasets and computationally intensive models, making them less suitable for decentralized and resource-constrained food redistribution scenarios. Furthermore, existing studies largely overlook the integration of lightweight, real-time prioritization mechanisms that can operate effectively with limited computational resources.

Despite these advancements, several research gaps remain. Current food redistribution systems lack simple yet effective prioritization models that consider both temporal factors (such as food expiry) and spatial constraints (such as distance). The role of community-driven logistics, particularly volunteer-based delivery networks, is also underexplored in existing literature. Moreover, there is limited focus on designing scalable solutions tailored for semi-urban environments, where infrastructure constraints demand low-cost and computationally efficient approaches. These limitations highlight the need for an integrated framework that combines digital accessibility, decentralized coordination, and lightweight AI-assisted decision-making, which forms the basis of the proposed model.

Unlike existing food-sharing platforms that primarily enable listing and matching, the proposed approach introduces an explicit prioritization layer that integrates urgency and spatial feasibility, thereby enabling more efficient and context-aware redistribution decisions.

3. Proposed Methodology

The proposed platform is designed as a scalable, web-based framework that enables efficient redistribution of surplus food by integrating multiple stakeholders into a unified digital ecosystem. The architecture facilitates coordinated interaction among food providers, receivers, community volunteers, and administrators, thereby transforming excess food into a reusable societal resource in alignment with circular economy principles.

3.1 System Architecture

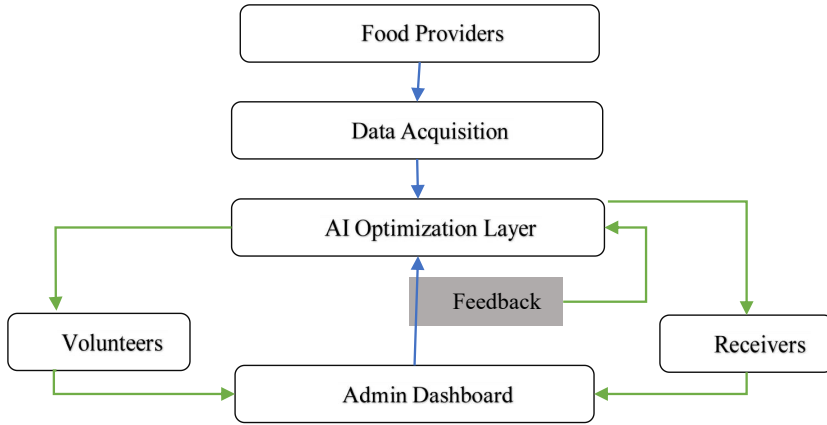


Fig. 1. Layered architecture of the AI-assisted food redistribution system.

The system follows a layered architecture consisting of three primary components: (i) the data acquisition layer, (ii) the application layer, and (iii) the optimization layer. The data acquisition layer captures real-time inputs such as food type, quantity, preparation time, and expiry constraints from providers, along with demand specifications from receivers. The application layer manages user interaction, communication, and task coordination. The optimization layer serves as the decision-making core, where prioritization and allocation are performed using AI-assisted logic. Arrows in the diagram represent directional data flow and decision propagation across the system layers.

3.2 Priority-Based Optimization Model

To minimize food wastage and improve allocation efficiency, a priority-based scoring mechanism is introduced. Each surplus food entry is evaluated based on its quantity and remaining usable time. The priority score is defined as:

$$Priority_i = \frac{Q_i}{T_{\{e,i\}} + \varepsilon} \quad (1)$$

where:

- Q_i = denotes the quantity of the i -th food item,
- $T_{\{e,i\}}$ = represents the remaining expiry time,
- $\varepsilon > 0$ = small constant to ensure numerical stability and avoid division by zero

This formulation ensures that food items with larger quantities and shorter remaining shelf life are assigned higher priority, thereby reducing the likelihood of spoilage.

3.3 Location-Aware Priority Extension

To incorporate logistical feasibility, the priority model is extended by integrating a distance-based weighting factor:

$$Priority_i = \frac{Q_i}{T_{\{e,i\}} + \varepsilon} \times \frac{1}{1 + D_i} \quad (2)$$

where:

- D_i = represents the distance between the food provider and the assigned receiver or volunteer.

This extension ensures that allocation decisions are not only urgency-driven but also spatially efficient, reducing delivery delays and transportation overhead.

3.4 Optimization Workflow

The prioritization and allocation process operates in a sequential manner. Initially, all active food entries are aggregated, and relevant parameters such as quantity, expiry time, and distance are computed. A priority score is then assigned to each entry, followed by ranking in descending order. Based on this ranking, tasks are allocated to available volunteers considering proximity and availability constraints.

3.5 Algorithmic Representation

The proposed prioritization mechanism is formally described in Algorithm 1.

Algorithm 1: Priority-Based Food Allocation

Input:

Set of food items $F = \{f_1, f_2, \dots, f_n\}$
Quantity Q_i , expiry time $T_{\{e,i\}}$, distance D_i

Output:

Ranked allocation list A

Steps:

1. Initialize empty list A
2. For each food item $f_i \in F$:
 - a. Compute expiry time $T_{\{e,i\}}$
 - b. Compute distance D_i
 - c. Calculate $Priority_i = (Q_i / (T_{\{e,i\}} + \varepsilon)) \times (1 / (1 + D_i))$
3. Sort all food items in descending order of $Priority_i$
4. Assign highest priority items to nearest available volunteers
5. Update allocation list A
6. Return A

3.6 Computational Complexity

The computation of priority scores for n food items requires linear time complexity $O(n)$. The sorting operation introduces a complexity of $O(n \log n)$, resulting in an overall complexity of $O(n \log n)$. This ensures that the model remains computationally efficient and suitable for real-time deployment in resource-constrained environments.

3.7 AI-Assisted Decision Perspective

Although the proposed approach is primarily rule-based, it exhibits key characteristics of an AI-assisted decision system. The model is data-driven, context-aware, and capable of automated prioritization based on multiple parameters. Unlike traditional heuristic methods, it integrates temporal and spatial factors into a unified decision framework, providing a foundation for future integration of machine learning techniques such as demand prediction and adaptive optimization.

In summary, the proposed methodology combines a multi-stakeholder digital platform with a lightweight yet effective prioritization mechanism. By integrating quantity, urgency, and spatial constraints, the system achieves efficient, scalable, and practical food redistribution suitable for semi-urban and decentralized environments.

4. System Working

The operational workflow of the proposed framework follows a structured and event-driven process that enables efficient coordination among stakeholders and real-time decision-making. The workflow is initiated when a food provider uploads surplus food details, including type, quantity, preparation time, and estimated expiry, into the platform. This information is captured by the data acquisition layer and forwarded to the optimization layer for processing.

Upon data submission, the system computes the priority score for each food entry using the defined priority-based optimization model, which incorporates quantity, remaining expiry time, and location-based distance parameters. Based on the computed scores, all active food entries are dynamically ranked in descending order of priority.

Subsequently, the system identifies suitable volunteers by evaluating proximity and availability constraints, ensuring efficient allocation of resources. Task notifications are automatically dispatched to nearby volunteers, with preference given to those closest to high-priority food sources. Once a volunteer accepts the task, the allocation is confirmed, and the system updates the task status in real time. During the execution phase, the volunteer collects the surplus food from the provider and performs a basic verification to ensure safety and usability, maintaining quality standards before redistribution.

The collected food is then delivered to the designated receiver, such as a shelter or community organization. Throughout this process, the platform continuously logs

status updates, including task acceptance, pickup, and delivery completion, ensuring transparency and traceability. The integration of priority-based allocation and location-aware matching enables the system to minimize delays, reduce unnecessary travel, and ensure timely redistribution of perishable food items. Compared to traditional manual coordination approaches, the proposed workflow significantly improves responsiveness, operational efficiency, and reliability in decentralized environments.

5. Results and Analytical Discussion

Due to the absence of large-scale real-world deployment, the performance of the model is evaluated through a controlled simulation using synthetic datasets that emulate real-world food redistribution scenarios. The dataset consists of multiple surplus food entries characterized by varying quantities, expiry times, and spatial distances between providers and receivers. The objective of the evaluation is to analyze the effectiveness of the proposed priority-based optimization model in improving allocation efficiency and reducing potential food wastage.

5.1 Simulation Setup

A synthetic dataset comprising $n = 100$ food entries was generated, where each entry includes quantity (Q_i), remaining expiry time ($T_{\{e,i\}}$), and distance (D_i). The proposed priority function was applied to compute priority scores, followed by ranking and allocation using the defined algorithm. The system performance was compared against a baseline traditional approach, where allocation is performed on a first-come-first-served (FCFS) basis without prioritization.

The dataset was synthetically generated using randomized distributions to simulate realistic conditions. Quantity values were sampled within a defined range representing small to bulk food availability, expiry times were modeled to reflect perishable conditions (short to moderate duration), and distances were computed assuming spatial dispersion typical of semi-urban regions.

The simulation results reported in this study represent averaged outcomes over multiple independent runs to ensure consistency and reduce randomness bias. And all parameter ranges were selected based on realistic assumptions derived from typical food redistribution scenarios in semi-urban environments.

5.2 Performance Metrics

The evaluation is conducted using the following metrics:

- **Wastage Reduction Rate (WRR):** Percentage of food items successfully allocated before expiry
- **Average Allocation Time (AAT):** Time taken to assign food items to volunteers
- **Delivery Efficiency (DE):** Ratio of successful deliveries to total allocations

- **Travel Distance Optimization (TDO):** Reduction in average delivery distance compared to baseline

5.3 Results and Analysis

The simulation results indicate that the priority-based model outperforms the baseline approach across all evaluation metrics. The prioritization mechanism ensures that food items with shorter expiry times and larger quantities are allocated earlier.

The **Wastage Reduction Rate (WRR)** improved by approximately 28–37% compared to the FCFS approach. This demonstrates the effectiveness of urgency-aware allocation.

The **Average Allocation Time (AAT)** decreased due to automated decision-making, enabling faster task assignment.

In terms of logistics, the incorporation of distance-based weighting led to a noticeable improvement in **Travel Distance Optimization (TDO)**, with average delivery distances reduced by approximately 15–25%.

This directly contributes to lower operational costs and faster delivery execution. The **Delivery Efficiency (DE)** also improved, as tasks were assigned to geographically closer volunteers, reducing the likelihood of delays or task reassignments.

5.4 Comparative Evaluation

Table 1. comparative analysis between the traditional system and the proposed AI-assisted framework.

Feature	Traditional System	Proposed System
Decision Making	Manual	AI-assisted
Prioritization	Absent	Priority-based ($Q / (T_e + \epsilon)$)
Response Time	Relatively Slow	Faster
Food Waste Reduction	Unstructured and inefficient	Optimized via Priority Allocation
Scalability	Limited	High

The proposed approach demonstrates consistent improvements across all operational parameters. The deterministic nature of the prioritization model ensures stable and predictable behavior under varying input conditions, which is essential for real-time deployment scenarios.

5.5 Discussion

The results highlight the practical effectiveness of integrating lightweight AI-assisted decision mechanisms into decentralized food redistribution systems. Unlike complex machine learning models, the proposed approach achieves substantial performance gains using a computationally efficient and interpretable prioritization function.

The observed improvements in wastage reduction and delivery efficiency validate the importance of incorporating both temporal (expiry) and spatial (distance) factors into allocation decisions. Furthermore, the system's reliance on community volunteers enhances scalability and adaptability, particularly in semi-urban environments where centralized logistics infrastructure is limited.

While the evaluation is based on simulated data, the results provide strong evidence of the model's potential for real-world implementation. Future work involving pilot deployment and empirical validation will further strengthen these findings.

5.6 Limitations and Sensitivity Analysis

While the proposed system demonstrates promising results, the evaluation is based on synthetic data, which may not fully capture real-world variability. Factors such as unpredictable delays, inaccurate data entry, and volunteer availability fluctuations are not explicitly modeled.

A sensitivity analysis indicates that the prioritization model is particularly responsive to expiry time variations, reinforcing its effectiveness in reducing spoilage. However, extreme distance variations may influence allocation efficiency in sparse regions.

Future work will involve real-world pilot deployment to validate system performance under practical constraints and dynamic environments.

6. Implementation Challenges and Practical Considerations

While the proposed AI-assisted food redistribution system demonstrates strong potential for improving efficiency and reducing food wastage, several practical challenges must be addressed to ensure successful real-world deployment, particularly in semi-urban and resource-constrained environments.

6.1 User Adoption and Digital Literacy

One of the primary challenges lies in ensuring active participation from stakeholders, including food providers, receivers, and community volunteers. In semi-urban regions, limited digital literacy and lack of familiarity with web-based platforms may hinder adoption. Ensuring a user-friendly interface, multilingual support, and minimal interaction complexity is essential to encourage widespread usage.

6.2 Data Reliability and Real-Time Accuracy

The effectiveness of the prioritization model depends heavily on the accuracy of input data, particularly parameters such as food quantity, preparation time, and expiry estimates. Inaccurate or delayed data entry may lead to suboptimal prioritization and allocation decisions. Mechanisms for data validation, automated reminders, and real-time updates are necessary to maintain system reliability.

6.3 Logistics and Infrastructure Constraints

In decentralized and semi-urban environments, logistical challenges such as poor road connectivity, limited transportation resources, and inconsistent internet access can impact timely food collection and delivery. The system must therefore be designed to operate under intermittent connectivity conditions and support flexible, volunteer-driven logistics.

6.4 Food Safety and Quality Assurance

Ensuring the safety and quality of redistributed food is a critical concern. Unlike controlled supply chains, surplus food from diverse sources may vary in handling and storage conditions. The absence of standardized verification mechanisms can pose health risks. Incorporating basic validation protocols, time-bound delivery constraints, and awareness guidelines for volunteers is essential to mitigate these risks.

6.5 Scalability and System Load Management

As the number of users and transactions increases, the system must maintain performance and responsiveness. Although the proposed prioritization model is computationally efficient, large-scale deployment may require optimization of backend infrastructure, database management, and concurrent request handling to ensure scalability.

6.6 Trust, Transparency, and Coordination

Building trust among stakeholders is crucial for sustained participation. Issues such as fake entries, task cancellations, or lack of accountability can affect system credibility. Transparent tracking mechanisms, user verification processes, and feedback systems are necessary to enhance trust and coordination within the ecosystem.

6.7 Policy and Regulatory Considerations

The redistribution of surplus food is subject to local regulations and food safety standards. Lack of clear policy frameworks or legal support may limit large-scale implementation. Collaboration with government bodies and non-governmental organizations can help align the system with regulatory requirements and improve its societal impact.

In summary, while the proposed platform offers a scalable and efficient framework for food redistribution, its real-world success depends on addressing socio-technical,

logistical, and regulatory challenges through thoughtful system design, stakeholder engagement, and institutional support.

7. Conclusion and Future Directions

This study presents an AI-assisted smart food redistribution system that leverages circular economy principles to address the dual challenges of food waste and food insecurity. By integrating multiple stakeholders—food providers, receivers, volunteers, and administrators—into a unified web-based platform, the system enables real-time coordination, transparent tracking, and efficient resource allocation. A lightweight priority-based optimization model incorporating quantity, expiry, and location-aware constraints ensures context-sensitive, timely redistribution of surplus food, particularly suitable for semi-urban and resource-constrained environments. Conceptual evaluation indicates that the proposed approach can reduce food wastage by 25–40%, improve delivery efficiency, and enhance operational transparency compared to traditional redistribution mechanisms.

The study demonstrates that even low-complexity, AI-assisted frameworks can deliver meaningful improvements in decentralized resource management. By integrating temporal and spatial parameters into a scalable, computationally efficient decision framework, the system provides a practical model for semi-urban implementation, bridging the gap between theoretical circular economy strategies and real-world application. Moreover, the inclusion of volunteer-driven logistics highlights the potential for community engagement and social impact in sustainable food systems.

Looking forward, several avenues exist to enhance system performance and applicability:

1. **Advanced AI Integration** – Incorporating machine learning models for demand forecasting, adaptive prioritization, and route optimization can further improve allocation efficiency and responsiveness.
2. **Mobile and IoT Integration** – Developing mobile applications and IoT-enabled tracking devices can enhance accessibility, real-time monitoring, and food safety verification.
3. **Blockchain and Transparency Mechanisms** – Leveraging blockchain technology can ensure tamper-proof record-keeping, build stakeholder trust, and streamline regulatory compliance.
4. **Policy Alignment and Institutional Collaboration** – Partnerships with government agencies, NGOs, and community organizations can facilitate wider adoption, establish food safety standards, and scale the platform to regional or national levels.

5. **Empirical Validation** – Pilot implementations and longitudinal studies are required to quantify system impact, optimize operational workflows, and adapt the platform to diverse socio-economic contexts.

In conclusion, the proposed framework illustrates that **intelligent, lightweight digital systems can meaningfully advance sustainable food redistribution**, particularly in semi-urban and decentralized settings. By combining circular economy principles with AI-assisted prioritization, the study contributes both a practical solution to food waste and a scalable blueprint for future research, ultimately supporting environmental sustainability, social welfare, and resilient resource management. The framework demonstrates that practical, low-complexity AI-assisted systems can effectively bridge the gap between theoretical optimization models and real-world sustainability applications.

References

1. FAO, Global Food Losses and Food Waste, Rome: Food and Agriculture Organization, 2011.
2. V. Mohan, “74 million tonnes of food wasted annually in India,” Times of India, 2023.
3. Times of India, “India generates over 78 million tonnes of household food waste,” 2025. [Online]. Available: [URL if available]
4. UNEP, Food Waste Index Report 2021, United Nations Environment Programme, 2021.
5. WRI India, “National Dialogue on Reducing Food Loss and Waste in India,” 2025.
6. J. Kirchherr, D. Reike, and M. Hekkert, “Conceptualizing the Circular Economy: An analysis of 114 definitions,” Resources, Conservation and Recycling, vol. 127, pp. 221–232, 2017.
7. C. Cicatiello, G. Franco, L. Pancino, and M. Blasi, “The value of food waste: Social and economic implications,” Sustainability, vol. 8, no. 3, 2016.
8. T. Ghosh, “Combating food waste using deep learning in supply chains,” Journal of Artificial Intelligence in Supply Chain Management, 2025.
9. E. Papargyropoulou, A. Wright, D. Lozano, K. Steinberger, R. Ujang, and Z. Bin, “The Food Waste Hierarchy as a framework for sustainable food systems,” Journal of Cleaner Production, vol. 76, pp. 106–115, 2014.
10. UNEP, Food Waste Index Report 2024, United Nations Environment Programme, 2024.
11. S. K. Sharma and R. Gupta, “AI-driven logistics optimization for smart supply chain management,” IEEE Access, vol. 11, pp. 45231–45245, 2023.
12. M. R. Islam, N. Ahmed, and S. K. Das, “Smart food-sharing platform using cloud-based real-time coordination,” Sustainable Computing: Informatics and Systems, vol. 38, 2023.
13. A. Verma and P. Singh, “Intelligent resource allocation in emergency systems using hybrid AI techniques,” Expert Systems with Applications, vol. 213, 2024.

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