



FOODSHARE: AN AI BASED AND URGENCY DRIVEN COORDINATION PLATFORM CONNECTING DONORS, NGOS AND VOLUNTEERS FOR SURPLUS FOOD REDISTRIBUTION

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Abstract : Food wastage and hunger persist as a paradox in urban India, where surplus edible food from restaurants, caterers and institutional kitchens is routinely discarded while a substantial fraction of the population remains undernourished. Existing digital food donation platforms largely rely on proximity or category based donor to NGO notification, provide no mechanism for partial fulfillment of large requirements and treat notification as a single event rather than a process that should adapt as a donation approaches spoilage. This paper presents FoodShare, a coordination platform that connects three actors - donors, NGOs and community shelters and volunteers through a hybrid matching mechanism combining semantic text embeddings with rule based scoring across spatial distance, time-decay urgency and quantity compatibility. The system additionally supports partial fulfillment of large NGO requirements and a bounded, urgency driven escalation policy that widens notification reach only when a donation remains unclaimed, while limiting repeated alerts to reduce recipient fatigue. The system is implemented as a layered service architecture with real time coordination support between matched parties. This work positions its contribution relative to existing food-donation systems in the literature, identifying and addressing specific gaps in matching intelligence, partial fulfillment and time aware escalation.

IndexTerms - Food Redistribution, Surplus Food, Food Donation Platform, Semantic Matching, Sentence Embeddings, Partial Fulfillment, Urgency Based Escalation, NGO, Volunteers.

I. INTRODUCTION

Food loss and food insecurity coexist as two sides of the same unresolved logistical problem. A significant proportion of food produced for human consumption is never eaten, while, simultaneously, a large section of the population does not have reliable access to sufficient food. This paradox is particularly visible in urban settings, where commercial kitchens, event caterers and institutional canteens routinely generate surplus edible food as a byproduct of normal operation over preparation to avoid running short, unpredictable demand and the economics of bulk cooking all contribute to a steady stream of food that would otherwise be discarded.

India illustrates this paradox at national scale. Recent estimates place India as the second largest food-wasting country in the world, with food service establishments alone accounting for a substantial share of this waste, even as a large population remains undernourished and India continues to rank poorly on international hunger indices. The problem is compounded by the fact that, for many food businesses, disposal is not a neutral or cost free action: wasted food represents lost input cost and emerging waste management regulations increasingly impose compliance obligations and penalties on businesses that generate significant waste volumes without demonstrating responsible disposal. Figure 1 situates this problem using recent global data on food-wasting countries and the sectoral origin of food waste.

Connecting surplus food with the people who need it has traditionally depended on manual coordination, such as phone calls, personal networks, and informal arrangements between donors and charitable organizations. This method does not scale well for several reasons. It relies on donors and NGOs already knowing each other. It gives no visibility into who currently has surplus food or who currently needs it. It also offers no structured way to prioritize donations that are close to spoiling. Digital donation platforms have started to tackle parts of this problem, but as reviewed in Section II, most of them stop at simple notification mechanisms. They lack deeper matching intelligence, cannot partially satisfy large requirements, and have no way to adjust notification reach based on how urgent a donation is.

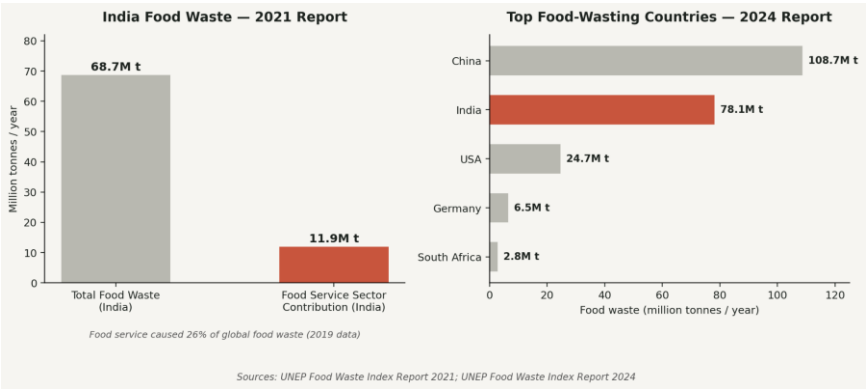


Fig. 1. Food waste by country (2024) and India's food-service-sector contribution (2021), illustrating the scale of the problem this work addresses.

This paper makes the following contributions. First, we propose a matching mechanism that combines semantic similarity of free text donation and requirement descriptions with rule based scoring of spatial distance, time-remaining urgency and quantity compatibility, rather than relying on category tags or proximity alone. Second, we introduce support for partial fulfillment, allowing a single large NGO requirement to be satisfied incrementally across multiple donations. Third, we propose a two-tier, distance-bounded escalation policy that widens the pool of notified recipients as a donation's remaining safe-consumption window narrows, while limiting repeated notifications to avoid recipient fatigue. Finally, we present an integrated coordination role for volunteers, who are responsible for physical pickup and delivery, alongside donors and NGOs, within a single unified platform. The remainder of this paper reviews related work, describes the proposed system and its methodology, discusses implementation and concludes with a discussion of current limitations and future work.

II. RELATED WORK

Several recent systems address aspects of digital food donation coordination. Table I summarizes the approach taken by each, its principal feature and the specific limitation that motivates the present work.

Table I. Comparison of existing food donation systems and their limitations

System / Source	Approach	Key Feature	Limitation Relative to This Work
Rajvor et al. [1]	Manual-browse web portal with admin approval	Simple donor-to-charity posting and contact	Has no automated matching and no handling of urgency, so every discovery step is done by hand
Shivani and Usha [2]	Location-based donor-NGO notification system	Automated alerts to nearby NGOs	Matching depends only on distance. It cannot fulfill a request partially and sends one notification with no escalation afterward
Swetha and Pavana [3]	Real-time notification platform with analytics dashboard	Tracks live status and provides administrative reports	The authors name machine learning matching and predictive analytics as future work, so neither is implemented yet
Sethi et al. [4] (SEVA)	Multi-parameter NGO matching with image-based verification	Calculates a combined score from proximity, capacity, food type and acceptance history and also coordinates volunteer tasks	Matching works on fixed categories rather than meaning. It does not support partial fulfillment and sends only one round of notifications with no escalation limited by distance

Looking across these systems, three gaps keep appearing. First, matching usually relies on structured attributes such as category or distance instead of the actual meaning of free text descriptions. Second, requirements are treated as all or nothing, so a large need cannot be met through several smaller donations. Third, notification happens only once, and there is no policy for widening the pool of recipients as a donation gets closer to its safe consumption deadline. The system proposed in this paper is built specifically to address all three gaps within a single coordination platform.

III. PROPOSED SYSTEM AND METHODOLOGY

FoodShare is built as a layered service architecture that keeps presentation, application logic, data storage and the matching and escalation processes separate from one another. Three types of users interact with the system through views designed for their roles, all connected to one shared backend. Donors post their surplus food. NGOs and community shelters post what they need and accept donations. Volunteers handle the pickup and delivery. Figure 2 illustrates this architecture.

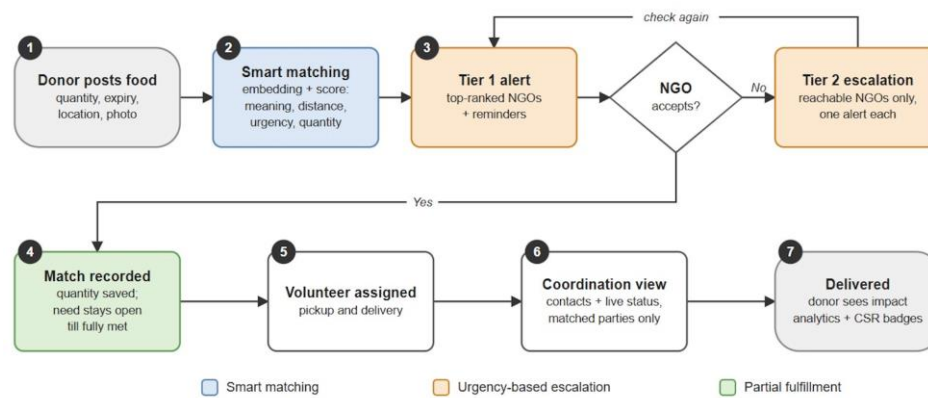


Fig. 2. End to end layered system architecture of the FoodShare platform, illustrating actor channels, application orchestration, the composite matching engine and the MongoDB document store.

A. Technology Stack

Table II. Technology stack of the FoodShare platform

Component	Technology
Frontend	React 19 (Vite build tool)
Backend / API	Python, FastAPI
Database	MongoDB
Matching Model	Sentence-Transformers (all-MiniLM-L6-v2)
Real-Time Communication	WebSockets (FastAPI native)
Task Scheduling	APScheduler
Authentication	JWT (PyJWT) with BCrypt password hashing

B. Matching Mechanism

Every donation and requirement comes with a free text description, which the system converts into a dense vector of fixed length using a pretrained sentence embedding model as soon as the listing is posted. This lets the system compare listings by their meaning instead of relying on exact keywords or matching categories. For example, it can recognize that a description like "leftover vegetarian catering" is closely related to a requirement written as "vegetarian meals needed," even though the two share no common words. The resulting semantic similarity score is then combined with three rule based factors. These are the distance between the donor and the recipient, the urgency based on how much safe consumption time the donation has left, and how closely the donation quantity matches the quantity still required. All four components are merged into one weighted score. This score decides the ranking used for recommendation feeds and also for choosing who is notified first.

C. Partial Fulfillment

Unlike a model where a donation must either cover the whole need or nothing at all, FoodShare lets a single NGO requirement be fulfilled step by step through several donations that come from different sources. Whenever a match is accepted, the system records how much that donation contributes, and the requirement stays open with its remaining quantity reduced until the full need has been covered. This reflects a practical reality. One donor's surplus rarely lines up exactly with a large requirement, and food redistribution becomes more efficient when partial contributions are allowed instead of being turned away.

D. Escalation Mechanism

To ensure that a donation is not lost simply because its best matched recipient is slow to respond, while avoiding indiscriminate notification of the entire recipient pool, FoodShare applies a two tier escalation policy. The highest ranked candidate recipients receive an initial notification and periodic reminders while the donation remains unclaimed. If no response is received within a set interval, the pool of notified recipients is progressively widened to include lower ranked candidates, however, this widening is bounded by the distance that could realistically be travelled within the donation's remaining safe consumption window, so that recipients who could not physically collect the donation in time are not notified. Recipients added through this widening step receive a single notification rather than repeated reminders, limiting the overall volume of alerts sent and reducing the risk that recipients begin to ignore notifications from the platform altogether.

IV. IMPLEMENTATION

The system is implemented as a set of modular backend services covering authentication and role management, donation and requirement posting, a unified community feed supporting both browsing and filtering, match acceptance (including partial fulfillment), volunteer task assignment, and direct coordination between matched parties. Matched or assigned parties are given access to a dedicated coordination view, which is kept separate from the general browsing feed. This ensures that contact and status information is only displayed once a donation has actually been matched or a task assigned, rather than being shown on every listing.

The frontend presents three role-specific portals for donors, NGOs and shelters, and volunteers, alongside the shared community feed. Each portal provides only the actions relevant to that role. For example, a donor's view does not present options meant for an NGO or volunteer, and vice versa. Donations may optionally include a photograph of the food being offered, which is displayed alongside the listing in the feed and in the donor's own donation history.

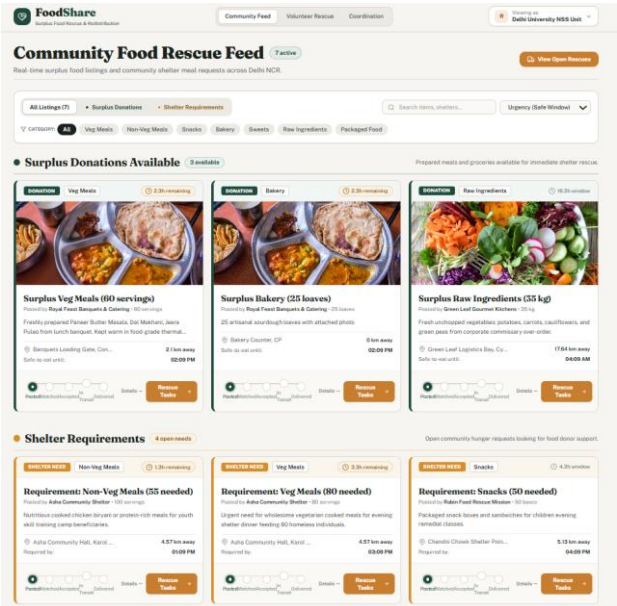


Fig. 3. Community Feed interface showing role appropriate posting actions and category based filtering.

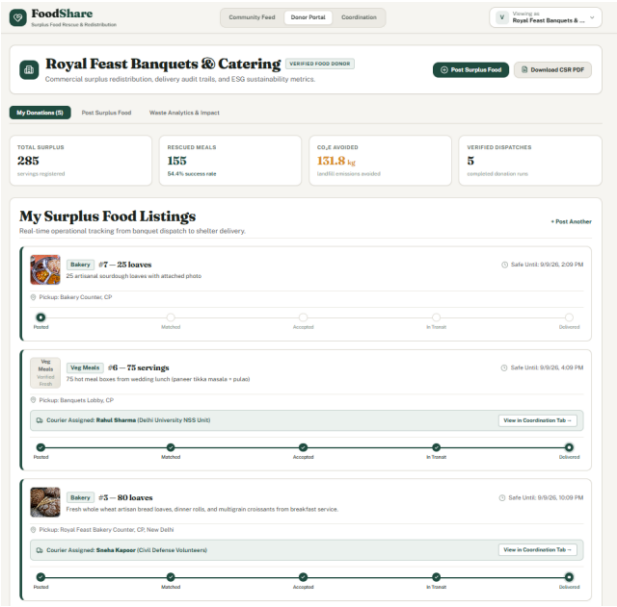


Fig. 4. Donor Portal displaying donation history, impact metrics and assigned courier coordination links.

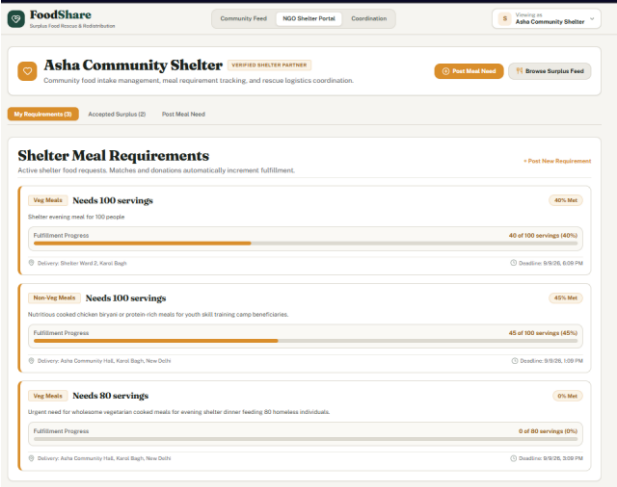


Fig. 5. NGO Shelter Portal showing active requirements with incremental fulfillment progress.

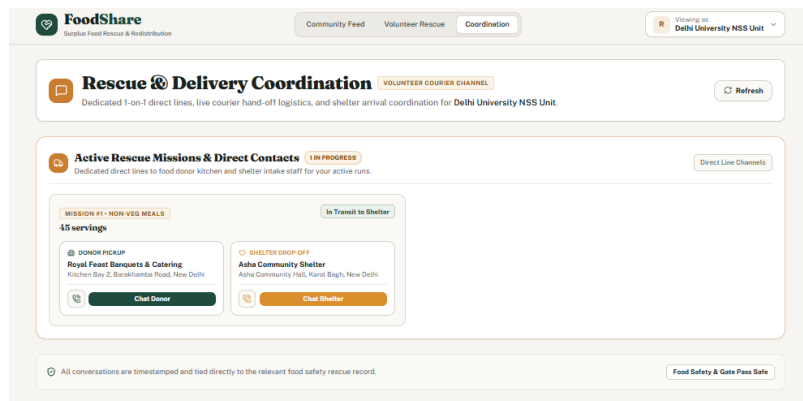


Fig. 6. Dedicated Coordination view surfacing contact details only for matched/assigned parties.

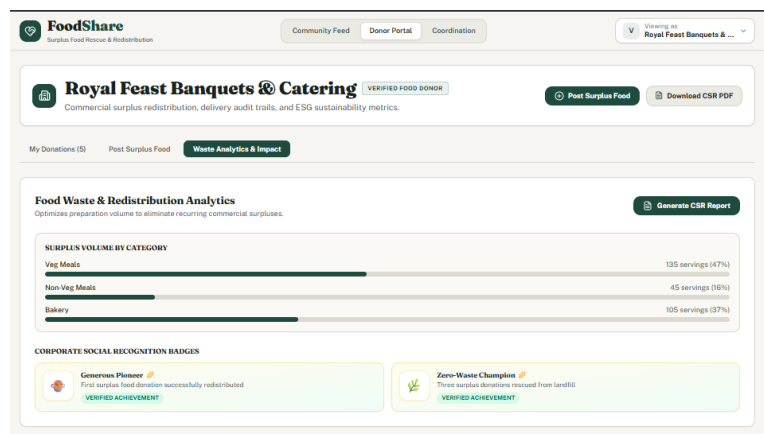


Fig. 7. Donor side waste analytics and CSR recognition badges.

V. RESULTS AND DISCUSSION

As this work presents a system design and prototype implementation rather than a controlled field deployment, this section discusses the qualitative behavior of the system rather than quantitative performance figures. Manual testing across representative scenarios varying the number of nearby recipients, the remaining safe consumption time of a donation, and the size of a requirement relative to available donations confirmed that the core mechanisms behave as intended. Semantically related but lexically dissimilar descriptions are correctly ranked as strong matches. Large requirements can be satisfied incrementally across multiple smaller donations without requiring an exact quantity match. The notification pool widens only when a donation remains unclaimed, while respecting the distance time bound intended to prevent notifying recipients who could not feasibly collect the donation in time.

These observations suggest that the proposed approach is functionally capable of addressing the three gaps identified in Section II: semantic matching, partial fulfillment and bounded urgency based escalation, within a single coordinating platform. A more rigorous, quantitative evaluation, including comparison against baseline matching strategies and measurement of response and redistribution outcomes under realistic donor and recipient behavior, is identified as future work in Section VII.

VI. CONCLUSION

This paper presented FoodShare, a coordination platform for surplus food redistribution that connects donors, NGOs and volunteers through a matching mechanism combining semantic similarity with distance, urgency and quantity based scoring. In contrast to existing donation platforms reviewed in this paper, FoodShare additionally supports partial fulfillment of large requirements and a distance-bounded, fatigue-aware escalation policy that adapts notification reach to a donation's remaining safe consumption window. The system is implemented as a layered service architecture with real time coordination between matched parties, and its design directly addresses gaps identified across recent related work in this domain.

VII. FUTURE WORK

Future improvements will focus on testing the system with actual donors and NGOs instead of relying on sample data created for demonstration purposes. The matching and escalation mechanisms can also be evaluated quantitatively and compared with simpler approaches to determine how effectively they perform. In addition, the platform could be developed into a native mobile application to make it more accessible and convenient for users. Another possible improvement is to introduce adaptive escalation thresholds based on historical recipient response patterns, replacing the fixed time intervals currently used by the system.

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