ANNA-CHAIN

Transforming Food Waste into Value through Digital Circular Economy

1. Project Title

Anna-Chain: Smart Food Waste Redistribution Platform

2. Problem Statement

Food waste is a growing urban challenge in developing countries like Nepal. Restaurants, hotels, and food outlets generate large amounts of leftover food daily, most of which ends up in landfills. This creates multiple interconnected problems affecting the environment, economy, and governance.

Key Challenges

- **Excessive Food Waste:** Restaurants pay disposal fees to dump food waste, increasing operational costs.
- **Environmental Impact:** Organic waste in landfills produces methane gas, a major contributor to climate change.
- **Lack of Waste Segregation:** Most food waste is mixed and untracked, making recycling or reuse difficult.
- **High Cost of Animal Feed:** Farmers rely on expensive commercial feed despite the availability of reusable food waste.
- **Poor Monitoring:** Municipalities lack real-time data to track waste generation, diversion, and compliance.

Existing waste management systems focus mainly on disposal rather than reuse and circular economy, resulting in economic loss and environmental damage.

3. Proposed Solution

Anna-Chain is a digital platform that connects restaurants generating food waste with nearby farmers who need affordable animal feed, while providing municipalities with real-time waste diversion and environmental impact data.

In Anna-Chain, food waste is matched to animals based on their dietary suitability to ensure safe reuse. Omnivorous animals such as pigs can consume a wide range of food

waste including leftover rice, cooked vegetables, bread, and mixed food scraps after safety verification. In contrast, herbivorous animals like cows are only suitable for plant-based waste such as vegetable scraps and grain residues. The platform uses safety scoring and waste-type classification to ensure that each type of food waste is distributed only to appropriate animals, preventing health risks and promoting responsible reuse.

The system ensures that only safe and suitable food waste is redistributed through AI-assisted verification and a controlled transaction workflow.

System Workflow

- **Waste Upload:** Restaurants upload images and details of their food waste through a web application, including basic information such as food type and preparation style.
- **AI-Based Classification & Safety Filtering:** Computer vision analyzes the uploaded waste and classifies it into feed-suitable or restricted categories. Food waste showing signs of heavy processing is marked unsafe and not allowed for listing.
- **Safety Scoring:** Only approved feed-suitable waste is assigned a safety score.
- **Marketplace Access:** Farmers view nearby available waste with price, quantity, distance, and safety score. Restricted or unsafe waste is not visible to farmers.
- **Secure Transaction:** Farmers purchase approved food waste using an escrow-based payment system to ensure transaction safety.
- **Pickup & Confirmation:** Farmers collect the waste directly from the restaurant and confirm pickup with photo proof.
- **Payment Release:** Funds are released to the restaurant after pickup confirmation.
- **Carbon Tracking:** The system estimates CO_2 emissions avoided by diverting safe food waste from landfills.
- **Priority Listing:** Restaurants that consistently divert safe waste and achieve higher carbon impact scores receive higher priority in marketplace listings.
- **Municipality Monitoring:** Authorities access a dashboard to track waste diversion, rejected unsafe waste categories, environmental impact, and compliance.

4. Illustrative Example

If a restaurant uploads 20 kg of vegetable waste, the system verifies it as safe and lists it on the platform. A nearby farmer purchases the waste and collects it directly from the restaurant. The platform records approximately 50 kg of CO_2 emissions avoided, contributing to environmental sustainability.

5. Tech Stack

Frontend

Technology	Purpose
React / Next.js	Web dashboard for restaurants, farmers, and municipalities
Tailwind CSS	Styling and responsive UI design

Backend

Technology	Purpose
Firebase Functions / Node.js API	Core backend logic and API endpoints
Firebase Authentication	Secure user login and access control
Firebase Firestore	Real-time database for uploads, marketplace, and dashboard

AI & Data Processing

Technology	Purpose
OpenCV	Image preprocessing (resize, crop, clean images)
Pre-trained Vision Model (YOLO / ResNet50)	Food waste classification and safety scoring
Rule-based Safety Scoring	Determines suitability of waste for redistribution
Carbon Estimation Formula	Calculates CO_2 savings and assigns carbon points

6. Restaurant Reputation System

Anna-Chain incorporates a reputation system where farmers rate waste quality after each transaction. Restaurants with ratings below 3.5 stars face reduced visibility and higher fees, while high-reputation restaurants (4.5+ stars) receive featured placement and lower transaction fees. This creates strong incentives for maintaining waste quality standards.

Rating	Impact
Below 3.5 stars	Reduced visibility, higher listing fees, quality audits required
4.5+ stars	Featured placement, lower fees, priority farmer access, sustainability badges

7. Carbon Credit System & Incentives

Anna-Chain incorporates a carbon credit system that quantifies and rewards sustainability efforts. Restaurants earn carbon credits based on food waste weight diverted from landfills, with credits automatically awarded upon confirmed waste pickup.

Carbon Credit Applications

Stakeholder	Benefit
Food Delivery Apps	Rank restaurants by carbon credits, display green badges, attract eco-conscious customers
Government	Grant tax benefits and subsidies to high-performing restaurants, track compliance reporting
Restaurants	Improve brand reputation, unlock financial incentives, enhance delivery app visibility

Restaurants access a dashboard showing cumulative carbon credits, monthly trends, environmental impact (CO_2 equivalent in kg), and peer benchmarking. Credits can be traded in a regulated marketplace or redeemed for government grants and tax deductions.

8. Impact

- **Restaurants:** Reduce disposal costs and earn revenue, gain sustainability reputation, unlock tax benefits and grants, improve food delivery app rankings
- **Farmers:** Access cheaper, local feed, reduce dependency on commercial feed
- **Environment:** Reduce methane emissions and landfill waste, achieve quantifiable climate action goals
- **Government:** Real-time insights for waste management and climate reporting, implement targeted incentive programs
- **Food Delivery Platforms:** Promote sustainable restaurants and attract environmentally conscious consumers