ZeroWasteChef

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1. Relevance to Project Title

Project Title: ZeroWasteChef – Ingredient-Based Recipe Recommendation System for Household Food Waste Reduction

Core Problem: 1.3 billion tonnes of food wasted annually; 30% of household food discarded due to poor ingredient utilization.

Relevance: Directly addresses waste by matching pantry items to recipes, suggesting substitutions, and promoting flexible cooking.

Alignment: Combines sustainable cooking (zero-waste goal) with practical technology (web-based recommendation system).

Impact: Helps users cook what they have, reduces unnecessary purchases, and tracks environmental savings (CO2, water, money).

2. Literature Review

Year	Reference	Summary & relevance
2020	Food Waste Management with Technological Platforms: Evidence from Indian Food Supply Chains (Chauhan Y., *Sustainability*, 2020) MDPI	Examines food waste in Indian supply chains and how technological platforms can help manage it. Good for background on the waste side of your project (even though not recipe-recommendation specific).
2021	Identifying Ingredient Substitutions Using a Knowledge Graph of Food (Shirai S.S. et al., *Frontiers in Artificial Intelligence*, 2021) PMC +1	Focuses on modelling ingredient substitutions via a food knowledge graph — closely relevant to "use what you have" or "substitute leftover/available ingredients" in your zero-waste chef project.
2022	Recipe Recommendation System Using TF-IDF (Chhipa S. et al., *ITM Web Conf.*, 2022) itm-conferences...	Introduces a recipe-recommendation system based on available ingredients and TF-IDF + cosine similarity for Indian cuisine. Relevant for "ingredient → recipe" logic.
2023	Recipe Recommendation System Using IoT-Based Food Inventory Management of Perishables for Household Food Waste Reduction (Vol. 106, *Chemical Engineering Transactions*, 2023) CET Journal +1	A very direct match: combines IoT (inventory, camera load cell) + recipe recommendation to reduce household food waste (~30% reduction). Strong relevance for your waste-minimizing chef project.
2024	Recipe-fusion: Multimodal Food Recipe Recommendation System (Nair K.A. et al., *Journal of Artificial Intelligence Research & Advances*, 2024) STM Journals	Presents a multimodal system (image + text + ingredients) for recipe recommendation based on the input ingredients. Matches your "user gives ingredients → recipe" scenario.

3. Critical Analysis & Synthesis

Ingredient Matching (Teng 2012): Pioneered ingredient-based search but weak with synonyms/missing items → *Our system adds substitution layer and flexible matching.*

Recommender Systems (Freyne 2010): General food recommenders lack zero-waste focus → *We prioritize waste reduction explicitly.*

Vision-Only Approaches (Salvador 2017): Image recognition (~83% accuracy) unreliable for pantry inventory → *We use text-based ingredient input for accuracy.*

Smart Kitchen (Wang 2021): Waste tracking but no recipe suggestions → *We combine tracking + actionable recipe recommendations.*

Weather Integration (Liu 2020): Suggests weather-aware recipes but no implementation → *We integrate weather API for seasonal/comfort suggestions.*

Synthesis: Existing systems address parts of the problem; none combine ingredient matching, substitutions, expiring-first logic, and impact tracking in a single user-facing app.

Gaps Identified:

No holistic waste-to-recipe pipeline: Most systems either track waste *or* recommend recipes, not both.

Weak substitution support: Lack of intelligent ingredient swaps when items are missing.

No expiring-first prioritization: Existing systems don't rank recipes by ingredient urgency.

Limited user feedback loop: No gamification or impact dashboards to sustain engagement.

Scalability concerns: NoSQL proposals lack relational integrity for complex queries (recipes ↔ ingredients ↔ users).

Weather integration incomplete: Mentioned in research but rarely deployed.

Existing Systems

Author/Year	**Focus**	**Limitation**	**Relevance**
Teng et al., 2012	Ingredients for recipe matching	Weak with synonyms/missing items	Supports ingredient search idea
Freyne & Berkovsky, 2010	Food recommender systems	Not focused on zero-waste	Gives base for recommendation
Salvador et al., 2017	Image-based food recognition	Accuracy ~83%, not reliable	Explains why we avoid vision-only
Wang et al., 2021	Smart kitchen waste mgmt.	No recipe suggestions	Motivates zero-waste goal
Liu et al., 2020	Weather & food patterns	No system implementation	Supports weather feature

Our Advantage: Combines ingredient matching + substitution + impact tracking + weather API in one integrated system.

Components And Their Roles

User Ingredients

- The list of food items the user currently has at home.
- Input to the system that drives recipe suggestions to minimize waste.

Recipe Database

- A collection of recipes categorized by ingredients, cuisine, and dietary preferences.
- Enables matching user ingredients to suitable meals.

Ingredient Matching Engine

- The component that interprets user input, including handling synonyms and missing items.
- Ensures accurate and flexible recipe recommendations.

Weather API

- Provides real-time local weather data such as temperature and conditions.
- Allows the system to adapt recipe suggestions based on current weather.

Recommendation System

- Combines ingredient data and weather information to generate tailored recipe suggestions.
- Focuses on zero-waste cooking and user satisfaction.

User Interface

Web app where users input ingredients and receive recipe suggestions.

Designed for ease of use and engagement to promote consistent use.

Framework

Context-aware recommendation system personalizing suggestions using multiple data points (ingredients, weather, user preferences).

Database: PostgreSQL (relational) for structured recipe/ingredient/user data; JSON fields for flexible preferences.

Backend: Node.js + Express (REST APIs), Prisma ORM (type-safe DB access).

Frontend: React + TypeScript, Tailwind CSS, Vite.

Intelligence: Algorithmic matching + substitution logic; future: ML for ranking.

APIs: Weather API integration for seasonal suggestions.

Architecture: Client → API Layer → Business Logic (matching/substitution) → Database.

Conclusion:

Research Validated: Literature confirms ingredient-based recommendation + substitution + waste tracking is valuable but underexplored.

Gaps Addressed: Our system fills critical gaps by combining matching, substitutions, expiring-first logic, and impact feedback in one platform.

Technical Feasibility: Tools (React, Node.js, PostgreSQL, Prisma) are proven and scalable.

Next Steps (Review 3): Build core modules (auth, ingredient search, substitution engine), design UI mockups, and implement MVP with 200+ recipes.

Readiness: Research complete; ready to transition to development phase.

Thank You