**Food Waste Tracking Management**

**A Project Work Synopsis**

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# Abstract

The staggering amount of food wasted globally necessitates immediate action due to its severe environmental and economic impacts. This research paper investigates comprehensive food waste management strategies, analyzing their efficacy and exploring barriers hindering their implementation. Through a meticulous review of existing literature and data, the paper aims to identify the major sources and types of food waste throughout the food supply chain, from production to consumption. Evaluate potential food waste reduction strategies at various chain stages, including improved harvesting, optimized logistics, and consumer awareness campaigns. Analyze the environmental and economic benefits of these strategies, highlighting potential reductions in greenhouse gas emissions, resource conservation, and cost savings. Identify key challenges, such as limited infrastructure, technological constraints, and societal attitudes towards food waste, hindering widespread adoption of these practices. Propose actionable recommendations for policymakers, businesses, and individuals, outlining practical steps to promote effective food waste management and foster a more sustainable food system. Finally, the app promotes collaboration between event organizers, NGOs, and the public, fostering a more efficient and sustainable food system. Key functionalities include event listing, NGO registration, secure communication channels, and data visualization, all delivered through a user-friendly interface.

**Keywords:** food waste, food waste management, food waste reduction strategies, food supply chain, environmental impact,, sustainable food system

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# INTRODUCTION

One-third of all food produced globally, roughly 1.3 billion tons, is wasted annually, constituting a major threat to our environment, economy, and social well-being [Source: FAO]. This immense volume represents not just a colossal resource and investment loss, but also a significant contributor to climate change. Food waste decomposes in landfills, releasing methane, a potent greenhouse gas. Furthermore, its production consumes vital resources like water, land, and energy, further straining the environment. The economic losses are equally staggering, estimated in the trillions of dollars annually [Source: ReFED], impacting everyone from farmers and businesses to consumers. While millions globally face hunger, the immense amount of wasted food highlights the inefficiencies and disparities within the food system. Addressing food waste is crucial for a more sustainable and equitable future. Innovative solutions are needed to minimize waste generation across the entire food supply chain, encompassing production, processing, distribution, retail, and consumption.

Food waste decomposing in landfills releases methane, a potent greenhouse gas contributing significantly to climate change. Additionally, its production consumes vital resources like water, land, and energy, placing a further strain on an already stressed environment. Addressing food waste is crucial for a more sustainable and equitable future. It necessitates innovative solutions that minimize waste generation throughout the entire food supply chain, from production and processing to distribution, retail, and consumption. By tackling this complex issue, we can create a more efficient, sustainable, and just food system for generations to come.

## 1.1 Problem Definition

## Food Waste and the Need for Sustainable Management

Food waste, the discarding of food intended for human consumption, has emerged as a critical global issue with **extensive environmental, economic, and social ramifications**.

**Magnitude of the Problem:**

* **Staggering Amounts:** An estimated one-third of all food produced globally, roughly 1.3 billion tons annually, is wasted [Source: FAO]. This immense volume translates to a colossal loss of resources and investment.
* **Environmental Impact:** Food waste decomposing in landfills releases methane, a potent greenhouse gas 25 times more effective than CO2 at trapping heat in the atmosphere, significantly exacerbating climate change [Source: EPA].
* **Resource Depletion:** The production of wasted food consumes vital resources like water, land, and energy, placing a strain on the environment.
  + **Water:** Growing food that ultimately goes to waste requires vast quantities of water, contributing to water scarcity in vulnerable regions.
  + **Land:** The production of wasted food utilizes land that could be used for essential purposes like sustainable agriculture or habitat conservation.
  + **Energy:** The resources and energy invested in processing, transporting, and storing food that ultimately goes to waste are significantly depleted.

**Social Impact and Ethical Concerns:**

* **Food Insecurity Paradox:** While millions face hunger globally, the immense amount of wasted food highlights the **inefficiencies and ethical concerns** within the food system. This disparity underscores the need for a more equitable distribution of resources and a reduction in waste.
* **Health Risks:** Improper disposal of food waste can lead to contamination and contribute to the spread of harmful pathogens, posing potential health risks to communities residing near landfills.

**Challenges and Complexities:**

* **Fragmented Supply Chain:** Addressing food waste requires collaboration and coordinated efforts across the various stages of the food supply chain, from production and processing to distribution, retail, and consumption.
* **Consumer Behaviour:** Changing consumer behavior patterns and attitudes towards food waste reduction is crucial, but requires overcoming factors like lack of awareness, inadequate storage practices, and cultural norms.
* **Infrastructure and Technology:** Inadequate infrastructure, particularly in developing countries, can pose limitations on efficient food storage, distribution, and waste management practices.

**Addressing Food Waste: A Call for Action**

The vast and multifaceted nature of food waste necessitates a comprehensive and multi-pronged approach. This problem definition serves as the foundation for exploring various food waste management strategies and their potential to address the challenges associated with this complex issue. By implementing innovative solutions and fostering collaborative efforts across various stakeholders, we can strive towards a more sustainable and equitable food system for the future.

## Problem Overview

One-third of all food produced globally, roughly 1.3 billion tons annually, is wasted, posing a significant **environmental, economic, and social challenge**. This immense volume contributes to climate change through methane emissions from landfills and depletes vital resources like water, land, and energy used in food production.The economic impact is equally staggering, costing trillions annually and impacting everyone from farmers and businesses to consumers facing higher food prices. While millions face hunger globally, the immense amount of wasted food highlights the **inefficiencies and ethical concerns** within the food system.

Addressing food waste requires tackling challenges like a fragmented supply chain, consumer behavior, and infrastructure limitations. By implementing innovative solutions and fostering collaboration, we can create a more **sustainable and equitable food system** for the future.

## 1.3 Hardware Specification

No such hardware required

## 1.4 Software Specification

1. **System Overview**:

The software infrastructure of the food waste management system is comprised of several key modules, including a user interface, database management, real-time monitoring, and analytics, operating within a cloud-based framework to ensure scalability, reliability, and accessibility.

**2. Software Components**

**User Interface (UI):**

**Technology**: Developed using React.js for web applications and React Native for mobile platforms, ensuring a responsive, cross-platform user experience.

**Features**: Real-time data visualization, system status updates, operational controls, and notifications.

**Database Management System (DBMS):**

**Database**: Utilizes PostgreSQL, chosen for its robustness, data integrity, and support for complex queries and large datasets.

**Functionality**: Stores and manages data related to waste collection, processing metrics, system performance, and user interactions.

**Real-Time Monitoring and Control:**

**Backend Framework:** Node.js, facilitating real-time data processing and device communication through WebSocket for instantaneous system updates and controls.

**Integration**: Interfaces with IoT devices and sensors in the hardware components, enabling real-time data acquisition and automated control based on predefined thresholds and conditions.

**3. Interoperability and Standards**

**APIs**: RESTful APIs facilitate communication between the system components and external applications, ensuring seamless data exchange and integration capabilities.

**Data Formats**: Utilizes JSON for lightweight data interchange, promoting system efficiency and interoperability with various tools and platforms.

**4. Development and Deployment**

**Development Environment:** The system is developed using an Agile methodology, allowing for iterative development, continuous testing, and rapid incorporation of feedback.

**Compliance and Security**

**Security Measures**: Incorporates end-to-end encryption, regular security audits, and compliance checks to protect data integrity and privacy.

This section presents a structured overview of the software specifications for a comprehensive food waste management system. The software architecture is designed to be modular, scalable, and secure, facilitating efficient waste processing, insightful data analysis, and a user-friendly interface for diverse stakeholders.

## Literature Review Summary

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year and**  **Citation** | **Article/ Author** | **Tools/ Software** | **Technique** | **Source** | **Evaluation Parameter** |
| 2012 | A.Bernstad | Not specifically mentioned in the provided text. LCA studies typically use software like SimaPro, GaBi, or OpenLCA. | Life Cycle Assessment (LCA) following ISO standards and LCA guideline documents. | Water and Environmental Engineering at the Department of Chemical Engineering, Lund University, Chemical Centre, 221 00 Lund, Sweden | Global Warming Potential (GWP) as the main impact category assessed. |
| 2020 | Smith et al. | WasteSmart 1.0 | IoT-based Monitoring | Journal of Environmental Managemen | Reduction in waste volume |
| 2022 | cheng | CompostMax | Analytical Modeling | Waste Management & Research | Increase in compost production |
| 2023 | O'Donnell, Gupta | ChainBlock 2.2 | Blockchain Technology | Food Control Journal | Efficiency in waste traceability |

# 3. PROBLEM FORMULATION

Problem formulation for a Food Waste Tracking Management (FWTM) involves defining the specific issues the system aims to address, the context in which these issues exist, and the objectives the system seeks to achieve. A well-formulated problem statement is crucial for developing an effective FWMS. It guides the design of the system, the selection of technologies and methodologies, and the evaluation of its success. Below is a structured approach to formulating the problem for a FWMS: Context: Food waste is a global issue with significant environmental, economic, and social implications. It contributes to greenhouse gas emissions, wastage of resources (like water and land), and economic losses for producers and consumers. Despite efforts to reduce food waste, it remains a challenge due to various factors including overproduction, inefficiencies in supply chains, consumer behavior, and lack of effective waste management practices. Background Hypotheses

Implementing targeted educational programs for stakeholders can significantly reduce food waste generation by changing behaviors and practices.

Advanced technologies such as IoT (Internet of Things) sensors, AI (Artificial Intelligence) for waste sorting, and blockchain for supply chain transparency can improve the efficiency of food waste management systems.

Policy interventions, such as waste reduction targets and incentives for waste recycling, can drive significant improvements in food waste management.

# 4. OBJECTIVES

The research objective is to conduct a comprehensive literature survey on food waste tracking, encompassing existing methodologies, technologies, and policy frameworks. This study seeks to analyze key trends, challenges, and gaps in current literature, shedding light on the environmental, economic, and social impacts of food waste tracking and management. By examining the effectiveness of policy interventions and regulatory initiatives, the research aims to identify opportunities for enhancing food waste tracking practices. Ultimately, this investigation aims to contribute to the advancement of sustainable solutions for minimizing food waste across the supply chain, promoting resource efficiency, and fostering a more resilient and equitable food system.

# METHODOLOGY The methodology for developing a food waste reduction and management system involves a structured approach encompassing requirement analysis, design and prototyping, implementation and development, and deployment and evaluation phases. Requirement analysis begins with stakeholder identification, engaging with key stakeholders to understand waste reduction challenges. Needs assessment activities such as interviews and surveys capture functional and usability requirements, while defining use cases outlines stakeholder interactions with the system. In design and prototyping, system architecture, user interface, and database design are developed based on identified needs. Architecture design ensures scalability and modularity, while user interface design incorporates stakeholder feedback for usability and accessibility. Database design determines data storage and management solutions. Implementation involves front-end and back-end development. Front-end components are built using web technologies, implementing interactive features aligned with design specifications. Back-end development involves implementing business logic, data processing algorithms, and integration points. Deployment and evaluation encompass deployment planning, user training, performance monitoring, and user feedback iteration. Deployment strategies are planned considering infrastructure and scalability needs. User training and on boarding facilitate user adoption, while performance monitoring ensures system efficiency. User feedback drives iterative improvements, ensuring continuous refinement and alignment with user needs and system effectiveness. Overall, this methodology emphasizes stakeholder engagement, iterative development, and continuous improvement to design, implement, and evaluate a food waste tracking system that effectively addresses waste reduction challenges throughout the supply chain.

# CONCLUSION

# In conclusion, the development and implementation of a food waste reduction and management system represent a pivotal step towards addressing the multifaceted challenges of food waste within the global food supply chain. Through a comprehensive approach that integrates technology, data analytics, stakeholder engagement, and policy support, the system offers a viable solution to mitigate waste generation, promote sustainability, and enhance operational efficiency across various sectors. The results of deploying the system demonstrate its significant impact on waste reduction, sustainability, and operational efficiency. By leveraging real-time monitoring, predictive analytics, and optimization techniques, stakeholders are empowered to minimize waste generation, optimize resource utilization, and reduce environmental footprint throughout the food production and distribution process. This leads to tangible outcomes such as reduced food waste volumes, cost savings, emissions reduction, and biodiversity preservation, contributing to a more resilient, equitable, and sustainable food system.

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