

AI-Based Food Waste Pattern Analyzer for College Hostels

1M1B FINAL PROJECT REPORT

Submitted by

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**1M1B – IBM SKILLSBUILD
AI FOR SUSTAINABILITY VIRTUAL INTERNSHIP
JANUARY - 2026**

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my institution, faculty, and mentors for their continuous support and guidance during this project. I thank the 1M1B Foundation, IBM SkillsBuild, and AICTE for providing this valuable opportunity through the AI for Sustainability Virtual Internship.

ABSTRACT

This project focuses on reducing food waste in college hostels using artificial intelligence. Food wastage is a major sustainability issue that leads to loss of resources, financial cost, and environmental damage. The project proposes an AI-based decision-support system that analyzes hostel food preparation and waste data to identify patterns. The system helps in understanding which food items are wasted most, on which days wastage is high, and why students leave food. Based on these insights, AI provides recommendations for better food planning. This project supports Sustainable Development Goal 12 – Responsible Consumption and Production.

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1. INTRODUCTION

Sustainability means using resources in a way that meets our present needs without harming the ability of future generations to meet their own needs. It is about balancing human activities with nature so that the environment, society, and economy can grow together in a healthy way. When we practice sustainability, we try to reduce waste, save energy, protect natural resources, and use things responsibly instead of wasting them.

Food waste is one of the biggest problems affecting sustainability today. Large amounts of food are thrown away every day in homes, hotels, schools, and college hostels. This is not just a waste of food, but also a waste of water, electricity, money, and human effort used to produce it. When food is wasted, it often ends up in landfills where it produces harmful gases that increase pollution and climate change. At the same time, many people in the world still suffer from hunger. This makes food waste not only an environmental issue but also a social and moral problem.

Artificial Intelligence (AI) can play an important role in solving such real-life problems. AI can analyze large amounts of data, find hidden patterns, and help people make better decisions. In the case of food waste, AI can study data about food preparation, consumption, and leftovers to understand why food is being wasted. It can then give suggestions on how to prepare the right quantity of food and improve planning. By using AI in a responsible way, we can reduce waste, save resources, and move closer to a more sustainable future.

2. PROBLEM STATEMENT

Food waste is a common problem in college hostels where large quantities of food are prepared every day to serve many students. Often, a significant amount of this food is left uneaten and thrown away. This happens due to many reasons such as preparing more food than needed, mismatch between menu and student preferences, changes in attendance, exam schedules, or food quality issues. When this food is wasted, it also means that the money, water, electricity, and human effort used to produce it are wasted.

Current methods of managing food in hostels mostly depend on rough estimates and past experience of the mess staff. Decisions about how much food to cook are usually based on assumptions like average attendance or fixed quantity rules. There is no proper system to record and analyze how much food is actually eaten and how much is wasted. Feedback from students is often informal and not properly used for planning. Because of this, the same mistakes are repeated, and food waste continues every day.

To reduce food waste, hostels need a better and smarter way of planning food preparation. This requires collecting data about food preparation, consumption, wastage, day type, and student feedback, and then analyzing it properly. A data-driven approach can help understand real patterns instead of guessing. By using AI to study this data, hostels can make better decisions about menu planning and portion sizes.

How might we use AI to analyze food waste patterns in college hostels so that food preparation becomes more sustainable?

3. OBJECTIVES

The main objective of this project is to understand and reduce food waste in college hostels by using artificial intelligence in a simple and practical way. The project aims to study hostel food-related data so that the real reasons behind food wastage can be clearly understood instead of relying on guesswork.

Another objective is to use AI to identify patterns in food waste, such as which food items are wasted the most, on which days wastage is high, and what common reasons students give for leaving food. By finding these patterns, the project tries to turn raw data into useful knowledge.

The project also aims to provide clear and practical recommendations that hostel management can easily follow. These suggestions may include changing portion sizes, improving menu choices, or adjusting food preparation based on different days and situations.

Finally, this project supports the idea of sustainable food management. By reducing food waste, it helps save resources like water, energy, and money, and also reduces environmental pollution. Through this, the project contributes to building a more responsible and sustainable system of food consumption.

4. SDG ALIGNMENT

This project is mainly aligned with Sustainable Development Goal 12: Responsible Consumption and Production. SDG 12 focuses on using resources wisely and reducing waste so that natural resources are not unnecessarily exhausted. It encourages people, organizations, and institutions to change the way they produce and consume goods in order to protect the environment and ensure a better future. One of the key targets of SDG 12 is to reduce food waste at all levels, including households, restaurants, and institutions.

The AI-Based Food Waste Pattern Analyzer directly supports SDG 12 by helping college hostels reduce the amount of food that is wasted every day. By analyzing food preparation and waste data, the system helps mess administrators understand how much food is actually needed and where wastage is happening. The AI-generated insights allow better planning of portions and menus, which leads to less overproduction and more responsible use of food. This means fewer resources like water, electricity, and money are wasted, making food consumption more sustainable.

In addition to SDG 12, this project also supports other Sustainable Development Goals in an indirect way. It supports SDG 13: Climate Action because reducing food waste also reduces the amount of waste sent to landfills, which lowers harmful gas emissions that contribute to climate change. It also relates to SDG 2: Zero Hunger, as reducing waste helps in using food more efficiently and responsibly, which is important in a world where many people still do not get enough to eat. Through these connections, the project contributes to multiple global sustainability goals.

5. LITERATURE REVIEW

Food waste has become a serious global problem. Studies show that a large amount of food produced every year is never eaten. This happens at many levels such as farms, markets, homes, restaurants, and institutions like schools and colleges. Food is wasted due to overproduction, poor storage, lack of planning, and mismatch between demand and supply. This wastage leads to loss of money, natural resources, and increases environmental pollution. Many researchers have highlighted that reducing food waste is one of the easiest ways to improve sustainability and protect the environment.

Technology is widely used today to support sustainability. Digital systems are used to monitor energy usage, manage water supply, track waste, and improve resource efficiency. In food management, technology such as databases, mobile applications, and sensors are used to record consumption patterns and reduce wastage. These tools help organizations make better decisions by using accurate data instead of assumptions. Technology also helps in spreading awareness and encouraging responsible behavior among people.

Artificial Intelligence has recently become an important tool in decision making. AI can analyze large amounts of data, find hidden patterns, and provide useful predictions and suggestions. In areas like healthcare, agriculture, transport, and education, AI is used to support human decision making. In food management, AI can study consumption data, understand preferences, and suggest better planning methods. Many studies show that AI-based systems help organizations reduce waste, save costs, and improve efficiency by making smarter, data-driven decisions.

6. METHODOLOGY

This project follows a simple and clear step-by-step method to analyze food waste and provide useful solutions.

Data Collection

The first step is to collect data related to food preparation and wastage in the hostel mess. This includes information such as date, menu items, quantity of food prepared, quantity wasted, type of day (weekday, weekend, exam day), and feedback from students. This data can be collected manually by the mess staff or recorded in a spreadsheet. Even sample or estimated data can be used for understanding the process.

Data Preparation

After collecting the data, it is cleaned and organized in a proper format. Missing values are checked, spelling mistakes in food names are corrected, and all data is arranged in columns such as date, food item, prepared quantity, wasted quantity, and feedback. This step is important because clean and well-organized data helps AI give more accurate results.

AI Analysis

The prepared data is then given to an AI system using clear prompts. The AI reads the data and analyzes it to understand overall trends. It studies how much food is prepared, how much is wasted, and how this changes on different days. AI is used here as a decision-support tool to process data faster and more effectively than manual analysis.

Pattern Detection

From the AI analysis, patterns are identified. These patterns include which food items are wasted the most, which days have higher wastage, and what common reasons appear in feedback. For example, AI may find that certain dishes are often wasted or that wastage increases during exam days.

Recommendation Generation

Based on the detected patterns, AI generates suggestions to reduce food waste. These recommendations may include reducing portion sizes, changing unpopular menu items, adjusting food quantity on specific days, or improving food quality. These suggestions help hostel management make better, data-driven decisions for sustainable food management.

7. SYSTEM DESIGN

The system is designed as a simple decision-support model that takes food-related data as input, processes it using AI, and provides useful insights as output.

Input Data

The input to the system is hostel mess data collected on a daily basis. This includes details such as the date, menu item, quantity of food prepared, quantity of food wasted, type of day (weekday, weekend, exam day), and student feedback. This data is usually stored in a spreadsheet or CSV file. The purpose of this input data is to give the AI a clear picture of how food is being prepared and consumed in the hostel.

AI Processing

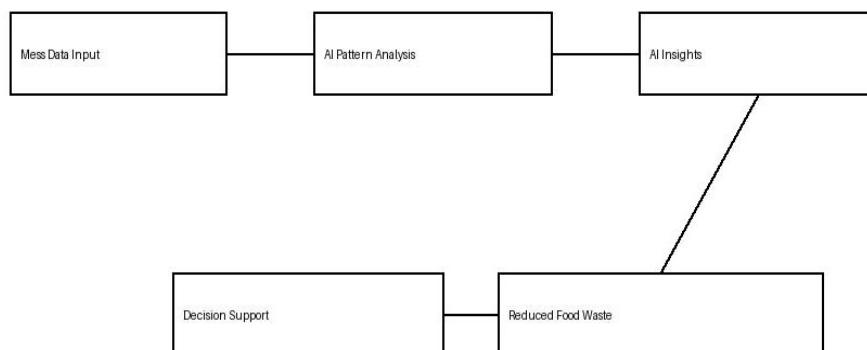
The input data is given to the AI system through well-designed prompts. The AI reads and analyzes the data to understand trends and relationships. It compares prepared quantity with wasted quantity, checks how waste changes on different days, and studies feedback to understand student preferences. During this stage, AI acts as an intelligent analyzer that processes large amounts of data quickly and accurately.

Output Insights

After processing the data, the AI produces useful insights. These include identifying the most wasted food items, the days with the highest wastage, and the common reasons for waste. The AI also generates recommendations such as reducing quantity of certain items, changing menu options, or adjusting preparation on special days. These outputs help hostel management make better decisions.

Flow Diagram Explanation

The flow diagram shows the working of the system in a simple way. First, food-related data is collected and entered into the system. This data is then sent to the AI for analysis. The AI processes the data and finds patterns. Based on these patterns, AI generates insights and recommendations. Finally, these suggestions are given to hostel administrators who use them to improve food planning and reduce waste. The flow moves from data input to AI analysis, then to insights, and finally to action for sustainability.



8. AI TOOLS AND TECHNOLOGIES

This project uses simple but powerful AI tools and methods to analyze food waste and support better decision making.

Prompt Engineering

Prompt engineering means giving clear and well-structured instructions to the AI so that it understands exactly what is required. In this project, prompts are designed to ask the AI to analyze food waste data, find patterns, and give suggestions. For example, the prompt may ask the AI to identify the most wasted food items or to explain reasons for waste based on feedback. Good prompts help the AI give accurate and useful results.

Large Language Models (LLMs)

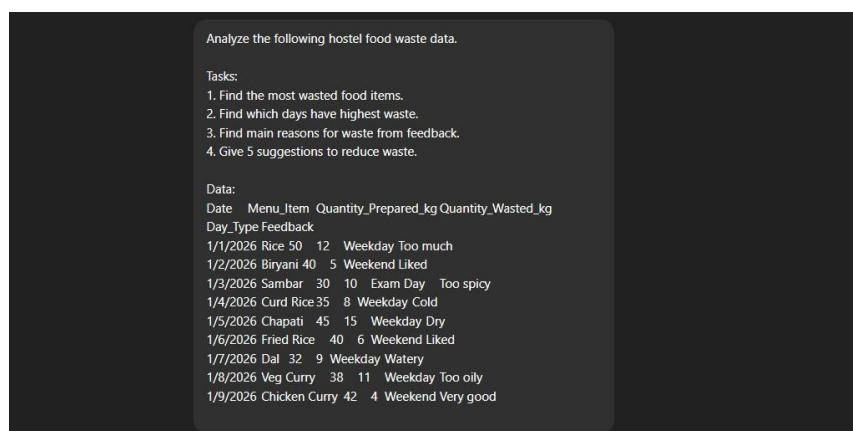
Large Language Models are AI systems that understand and generate human-like text. They can read data, understand instructions, and give meaningful explanations. In this project, LLMs are used to analyze the food waste data and convert numbers into easy-to-understand insights. They also help in summarizing patterns and generating recommendations in simple language that hostel administrators can easily follow.

Pattern Analysis

Pattern analysis is the process of finding repeated trends or behaviors in data. In this project, AI looks for patterns such as which food items are wasted frequently, which days have higher waste, and what type of feedback is common. By finding these patterns, the system can understand the real reasons behind food wastage instead of making guesses.

Decision Support AI

Decision Support AI does not replace humans but helps them make better decisions. In this project, AI supports hostel administrators by giving clear suggestions based on data analysis. It does not automatically change menus or quantities, but provides guidance so that humans can decide the best actions. This ensures responsible use of AI while improving food planning and reducing waste.



9. RESULTS AND DISCUSSION

After the food waste data was analyzed using AI, several useful insights were obtained. The AI was able to study the quantities of food prepared and wasted, along with day types and feedback, and convert this information into clear results. It showed which food items were wasted the most, on which days wastage was higher, and what reasons were commonly given by students for leaving food.

Some clear patterns were identified from the analysis. For example, the AI found that certain items like plain rice, curd rice, and some vegetable dishes were wasted more compared to other items. It also observed that food wastage was higher on regular weekdays than on weekends, and increased on exam days when student attendance and eating habits changed. From the feedback data, common reasons for wastage included “too much quantity,” “not tasty,” “too spicy,” “too oily,” and “cold food.” These patterns helped in understanding that both portion size and food quality played an important role in food wastage.

Based on these patterns, the AI generated useful suggestions. It recommended reducing the quantity of food prepared for items that were frequently wasted. It also suggested changing or improving recipes of unpopular dishes. For special days like exam days, AI advised preparing smaller quantities to match lower attendance. Other suggestions included improving food temperature and taste, and collecting regular feedback to update the menu. These recommendations show how AI can support better food planning and reduce waste in a practical way.

1) Most Wasted Food Items (by Quantity_Wasted_kg)	
Item	Wasted (kg)
Chapati	15 -- Highest
Rice	12
Veg Curry	11
Sambar	10
Dal	9
Curd Rice	8
Fried Rice	6
Biryani	5
Chicken Curry	4

Most wasted item: Chapati (15 kg)
Next major wastes: Rice, Veg Curry, Sambar

2) Days with Highest Waste	
By Individual Date	
• 1/5/2026 (Weekday – Chapati): 15 kg → Highest single-day waste	
• 1/1/2026: 12 kg	
• 1/8/2026: 11 kg	
By Day Type (Total Waste)	
Day Type	Total Waste (kg)
Weekday	55 -- Highest
Exam Day	10
Weekend	15
Conclusion:	
• Waste is highest on Weekdays	
• Exam day also shows notable waste	
• Weekends have lowest waste	

3) Main Reasons for Waste (from Feedback)	
Negative feedback patterns:	
Feedback	Issue Type
Too much	Over-preparation
Too spicy	Taste problem
Cold	Temperature issue
Dry	Texture issue
Watery	Texture issue
Too oily	Taste/health issue
Main Causes:	
1. Over-preparation	
2. Taste problems (too spicy, too oily)	
3. Poor texture (dry, watery)	
4. Serving temperature issues (cold food)	

4) Five Suggestions to Reduce Waste	
1. Prepare food based on past demand	Use previous weekday/weekend data to estimate correct quantity.
2. Improve taste testing before serving	Check spice, oil, salt, and consistency before mass cooking.
3. Keep food hot till serving time	Use hot boxes or insulated containers.
4. Get daily student feedback	Short form or suggestion box to adjust next day's menu.
5. Offer smaller first servings	Allow refills instead of giving large portions initially.
Final Insight	
• Biggest waste comes from Chapati and Rice	
• Waste is highest on Weekdays	
• Main reasons: over-cooking, bad taste, bad texture, cold food	
• Simple planning + feedback + quality control can reduce waste a lot.	

10. RESPONSIBLE AI CONSIDERATIONS

Responsible use of AI is very important in this project because the goal is to help people, not harm them. The system is designed to follow basic principles of responsible and ethical AI.

Fairness

Fairness means that the AI should treat everyone equally and should not be biased. In this project, the system does not use personal details of any student such as name, gender, or background. It only uses general food-related data like quantity prepared, quantity wasted, and feedback about food. Because no personal identity is involved, the system avoids discrimination and works fairly for all students.

Transparency

Transparency means that the working of the AI should be understandable. The AI in this project gives clear explanations along with its suggestions. For example, it does not just say “reduce food quantity,” but also explains why, such as “this item is frequently wasted” or “waste is high on this day.” This helps hostel administrators trust the system and understand how decisions are being supported.

Ethics

Ethics means using AI in a way that is morally right and helpful. This project uses AI only for positive purposes, such as reducing waste, saving resources, and supporting sustainability. It does not try to control people’s choices or force them to eat certain food. The final decisions are always made by humans, and AI only acts as a guide.

Privacy

Privacy is protected by not collecting any personal or sensitive data. The system only uses overall meal-level data and general feedback. No individual student is tracked or identified. All data is used only for analysis and improvement of food planning, ensuring that personal privacy is fully respected.

11. EXPECTED IMPACT

Environmental Impact

This project is expected to reduce the amount of food that is thrown away in college hostels. When food waste is reduced, less waste goes to landfills, which means fewer harmful gases are released into the air. This helps in reducing pollution and controlling climate change. Saving food also means saving the water, electricity, and fuel that are used to grow, transport, and cook it. By using resources more carefully, the project supports environmental protection and sustainability.

Economic Impact

Reducing food waste also helps in saving money. When hostels prepare only the required amount of food, they spend less on raw materials, gas, electricity, and labor. These savings can be used for improving food quality or other student facilities. Better planning also avoids unnecessary expenses caused by overproduction. Thus, the project helps hostel management use their budget more efficiently.

Social Impact

Food waste is not just an environmental problem but also a social issue. While food is wasted in many places, many people still suffer from hunger. By reducing waste, this project encourages responsible behavior and respect for food. It also improves food planning, which can lead to better quality and satisfaction among students. The project creates awareness about sustainability and teaches students and staff to value food and resources more responsibly.

12. CONCLUSION

Food waste in college hostels is a serious problem that leads to loss of food, money, natural resources, and causes environmental pollution. This waste mainly happens due to poor planning, fixed quantity preparation, and lack of proper analysis of food consumption and student preferences. Without understanding real patterns of food usage, the same mistakes are repeated every day, and wastage continues.

This project proposed an AI-based decision-support system to solve this problem. The system uses food preparation and waste data to analyze trends, identify waste patterns, and understand reasons for wastage. By using artificial intelligence, the project turns raw data into meaningful insights and provides clear recommendations such as adjusting portion sizes, improving menu choices, and planning better for different days.

The expected impact of this solution is reduction in food waste, saving of resources, lower costs for hostels, and protection of the environment. It also creates awareness about responsible consumption among students and staff. Overall, this project shows how AI can be used in a simple and responsible way to support sustainability and create positive change.

13. FUTURE SCOPE

This project can be improved further in many ways in the future.

In the future, sensors can be used in the hostel mess to automatically measure how much food is taken and how much is left over. For example, smart weighing machines or bin sensors can record food waste without manual entry. This will make data collection more accurate and faster.

Real-time data can also be added to the system. Instead of analyzing data only after the day ends, the system can track food usage during serving time. This will help mess staff adjust food preparation even on the same day if they notice too much food is being wasted.

A mobile application can be developed for this system. Mess staff can easily enter data through the app, and administrators can see AI insights and suggestions on their phones. Students can also give feedback about food quality using the app, which will help in better planning.

The system can also be trained using larger datasets from many hostels or colleges. With more data, AI will give more accurate patterns and better recommendations. This will allow the system to be used on a larger scale, such as in universities, hotels, or public food programs, to reduce food waste everywhere.

14. REFERENCES

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