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Food Wastage Minimization in Urban Households and Restaurants: A Case Study of Selected Wards of Kolkata

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Abstract:
Food waste is a growing concern in urban areas, contributing to environmental, social and economic challenges. In cities like Kolkata, where population density is high and food consumption is diverse, the problem is especially significant. The study compares food waste generation and management practices in urban households and restaurants within selected wards of Kolkata .The aim is to understand the differences and similarities in food waste patterns between two sectors ,as well as to explore the factors that influence waste generation .The research adopts a qualitative approach , collecting primary data from households and restaurants through interviews ,direct observation , and focus group discussions .The selected wards represent varied socio-economic conditions and food culture diversity. Information is gathered on the types of food wasted, reasons for wastage, storage practices and disposal methods. The study also examines awareness levels regarding food waste impacts and the adoption of waste reduction measures. Findings are expected to reveal that restaurants generally produce larger quantities of food waste due to overproduction, menu variety and customer preference, while households waste smaller but more frequent amounts, often due to improper storage, over – purchasing or cooking in excess. Both sectors face common challenges such as lack of proper waste segregation, limited awareness of composting methods and inadequate municipal waste management facilities. By comparing the two groups, this study aims to highlight gaps in current practices and suggest targeted interventions
for reducing food waste. Recommendations will focus on awareness campaigns, community level composting, improved storage and portion management, and policy measures to encourage sustainable consumption. The results will be useful for policy makers, municipal authorities, restaurant managers and household to work together in creating a more sustainable urban food system in Kolkata.

Keywords: Food waste types, reasons, Purchasing and consumption pattern, environmental implications, management.

INTRODUCTION

In busy cities, a lot of good food is wasted every day in households, shops and restaurants. This happens when people buy more than they need or reject food because it looks imperfect or is close to expiry. According to UNEP (2022), 1.05 billion tonnes of edible food were wasted at households, retail and restaurant level. Food waste not only causes money loss but also harms environment, wasting water, energy, and labour and producing methane in landfills. Simple actions like buying only what is needed, sharing extra food and changing habits can reduce waste and help to create cleaner, fairer cities.

Literature Review

1. **Environmental impact assessment of food waste management using two composting techniques: MaKay, G. (2020)** examines Food waste significantly contributes to greenhouse gas

emissions and global warming. Makay (2020) compared windrow composting and anaerobic digestion (AD) using SimaPro software in Qatar. Results showed AD had lower overall environmental impact, though windrow composting caused more air acidification. Transporting waste accounted for 60% of emissions, while composting itself contributed the remaining 40%.

2. **Food waste management a roadmap to reduced food poverty and food lost with rise in climate change and poverty: Bhattacharya, S. (2021)** examines that Food waste is a major global issue contributing heavily to greenhouse gas emissions. Bhattacharya (2021) highlights losses during production, transport, and consumer levels, with 40% wasted in the U.S. and 50 kg per household annually in India. Overproduction, excessive buying, and underconsumption intensify the problem. Repurposing discarded food into manure, textiles, or biofuels can reduce environmental impact and resource dependency.

3. **Trends and challenges in valorization of food waste in developing economies: A case study of India:** Sinha (2021) explains that food waste is often landfilled or treated with chemicals, causing pollution. India, China, the USA, and Brazil generate the most food waste, with developing nations relying on traditional methods. New research focuses on converting waste into biofuels and eco-friendly chemicals to reduce environmental harm. Countries like India are adopting green technologies to reuse waste instead of discarding it.

4. **Environmental implications of food waste: A study on south-Asian countries:**
De (2023) emphasizes that food waste threatens food security, the environment, and the economy.
If food waste were a country, it would be the third-largest greenhouse gas emitter, per UNEP 2021.
The study found strong links between food waste and GHG emissions in several South Asian nations. It urges governments to cut food waste to meet sustainable development goals and reduce climate impacts.

5. **Food waste in Indian households: status and potential solutions:** Dixit (2023) notes India had the highest number of undernourished people in 2020, worsened by COVID-19. Globally, 931 million tons of food were wasted in 2019, with Indian households wasting 50 kg per person annually. Poor meal planning, lack of food appreciation, and fading traditions drive household food waste. Solutions include new consumption habits and strengthening family food culture to guide policymakers in reducing waste.

6. **Insights into the management of food waste in developing countries: with special reference to India:** Sahoo (2023) notes that one-third of food produced for humans is wasted, causing harm globally. In India, urbanization and population growth make food waste a pressing issue. Poor management threatens both the environment and public health. The study stresses better waste characterization, improved practices, and strong government policies for effective management.

7. **Food Waste Utilization for Reducing Carbon Footprints towards Sustainable and Cleaner Environment: A Review**: Bhatia (2023) highlights that one-third of global food production is wasted, depleting resources and polluting air. Carbon footprint analysis shows food waste's major role in climate change, urging behavioral change. Valorization—turning waste into biofuels, chemicals, and materials—offers sustainable solutions. Advanced biorefineries and new technologies help bridge the gap between food waste generation and disposal.

8. Food Waste Valorization and its Impact on the Environment-A Study:
Bhat (2023) highlights that around 40% of food in India is wasted, causing pollution and emissions.
The study explores composting, biogas, and anaerobic digestion as ways to repurpose waste. Using Life Cycle Assessment, it evaluates energy use, emissions, and environmental impacts of these methods. Food

waste valorization offers both environmental and economic benefits, though challenges remain in implementation.

9. Reducing Food Waste in Indian Households:
Basu (2024) stresses that food waste worsens both hunger and climate change. India faces severe undernourishment, with 14% of its population affected, alongside massive food wastage. This paradox highlights deep socioeconomic inequality in the food system. Wasting food also wastes land, water, labor, and emits greenhouse gases, amplifying environmental harm.

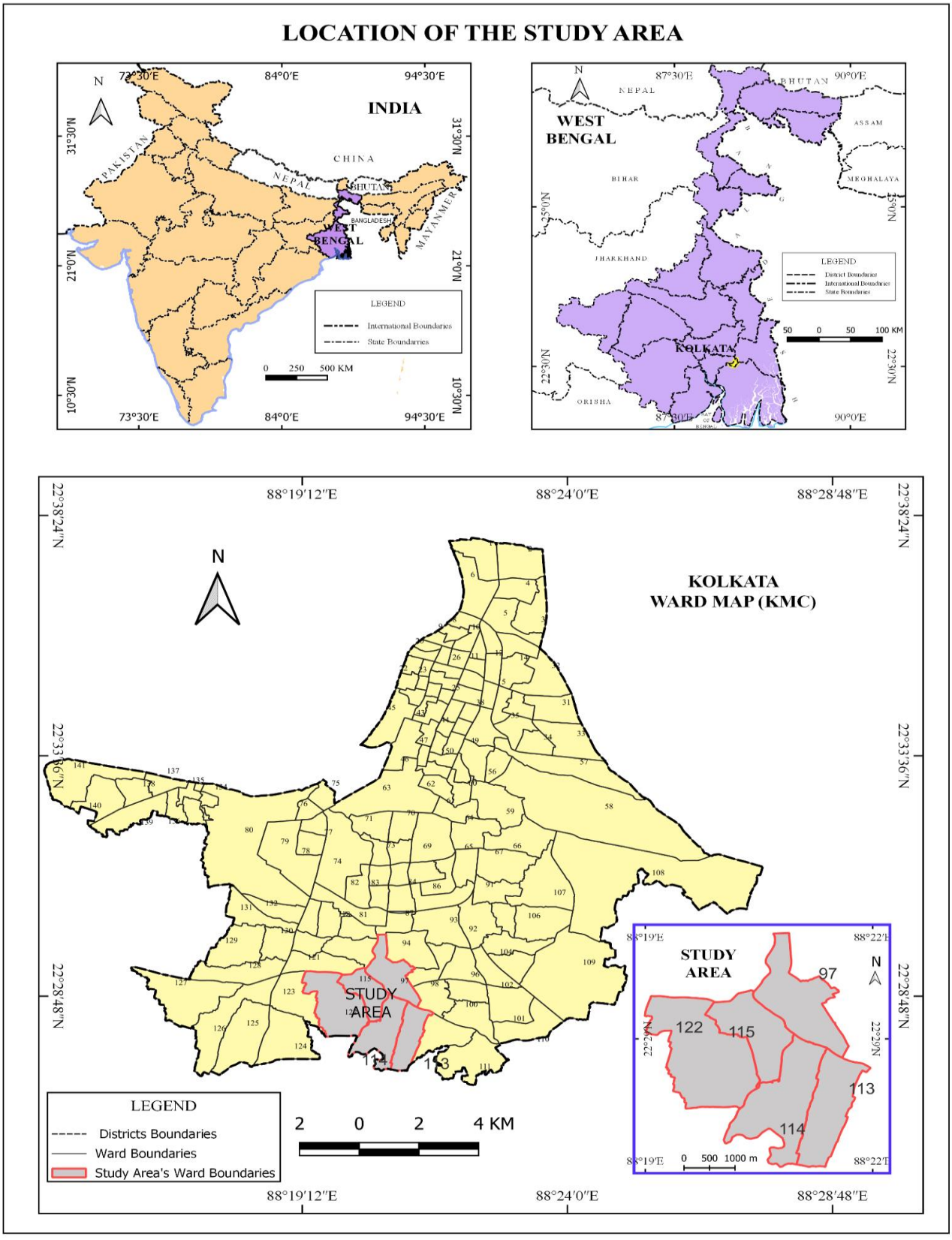
10. **A study on food wastage by restaurants, households and effective strategies for food waste management:** Bontha (2024) highlights that food wastage is a growing but often overlooked issue in India. Globally, one-third of food is wasted, with surveys showing consumers waste due to large portions and refrigeration. Restaurants in Thane and Mulund either share surplus food with staff or discard it carelessly. The study proposes a food waste management model to reduce waste and support the needy.

11. The quantity and composition of household food waste: Implications for policy:
Martianto (2024) studied household food waste in Bogor Regency, Indonesia, comparing urban and rural areas. On average, households wasted 77 kg per capita annually, with 37.7% being edible food. Urban households generated more waste than rural ones, mainly rice, vegetables, and fruits.
Spoilage, short shelf life, overcooking, and leftovers were key drivers, highlighting the need for awareness and behavior change programs.

12. **Tackling Food Waste in Urban Landscapes: A Systematic Review of Household Food Waste in Asian Countries:** Andik (2024) emphasizes that social factors, especially urbanization, drive food waste in Asian cities. The study reviewed 41 sources using PRISMA guidelines to analyze household food waste behavior. Five key influences were identified: household traits, psychological and behavioral factors, situational context, and food-related aspects. Raising awareness and understanding consumer needs can help reduce urban household food waste effectively.

SELECTION OF STUDY AREA
The study was conducted across five selected Wards named 97,114,113,115,122 wards of Kolkata Municipality Corporation area, extends form 88°19'E to 88° 22'E and 22°27'N to 22°29'N. This study was purposively selected to represent a mix of socio-economic profiles of both residential and commercial food establishment. (Fig 1)

Fig No. 1 Source: NATMO



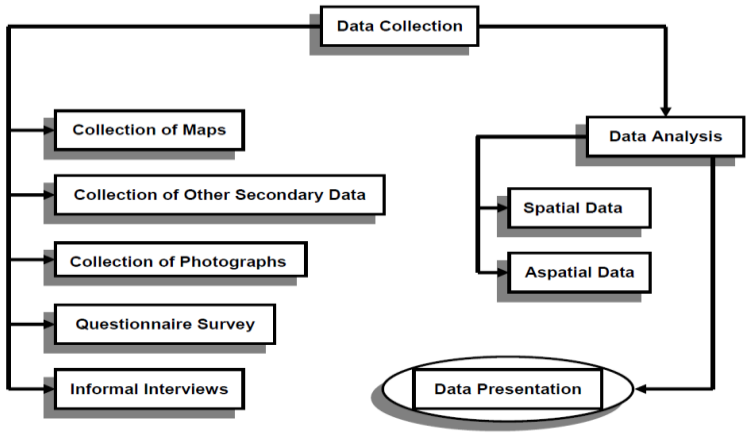
OBJECTIVES

The specific objectives of the study are:

- To analyze the causes of food waste in urban areas.
- To explore the impact of urban food waste on climate change and environmental degradation.
- To assess urban residents' awareness and behaviour toward food consumption and waste.
- To propose practical and sustainable solutions for reducing food waste in city.

METHODOLOGY:

- A qualitative research design was adopted to explore the behavioral, cultural, and institutional factors influencing food waste in urban households and restaurants.
- Purposive sampling was applied to select participants with relevant experience and knowledge. The study was conducted across five selected wards named 97,114,113,115,122 wards of Kolkata Municipality Corporation area. In each ward, 20 households and 2-3 restaurants were chosen to understand lived experiences, attitudes, practices, challenges, and management related to food waste.
- In-depth interviews were conducted with the members of households and restaurant stakeholders. Interviews were semi-structured where the questions were helped to explore food procurement, preparation habits, leftover management, awareness of food waste issues and perceptions about waste reduction.
- Data analysis



DEMOGRAPHIC SOCIO-ECONOMIC FEATURES INTERLINKED TO FOOD WASTE

Gender distribution is slightly male-dominated in most wards, with Ward 113 having the highest male share (64%). Male-dominated households show little variation in waste quantity, but female-led households often manage food resources more efficiently. (Fig 2) The number of children per household is highest in Wards 97 and 114, and lowest in Wards 113 and 115. Higher numbers of children increase waste from unfinished meals and snack packaging. (Fig 3) Family structures vary, with joint families being more common in Wards 97 and 114, while nuclear families dominate elsewhere. Larger families, especially joint households, generate more waste from bulk cooking and storage losses. (Fig 4)

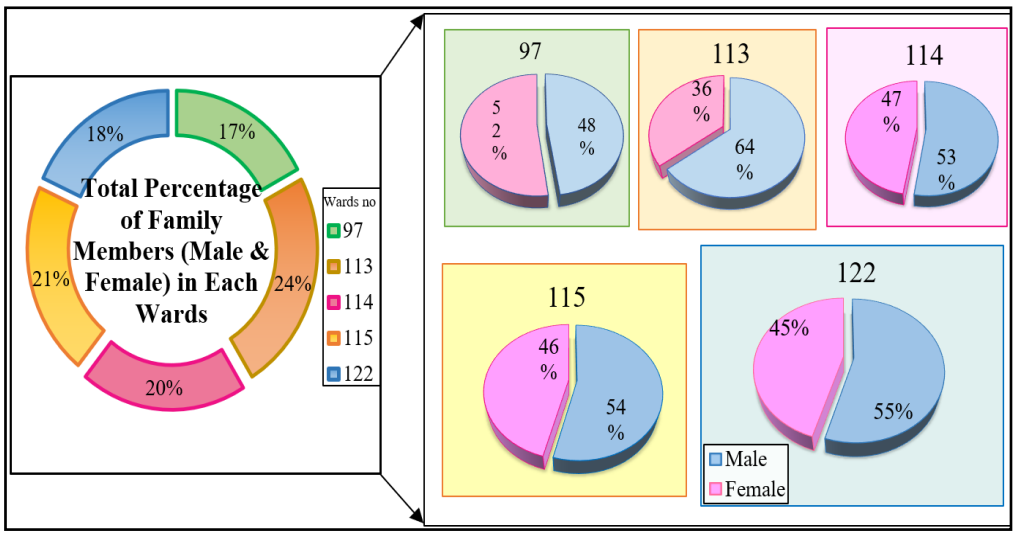
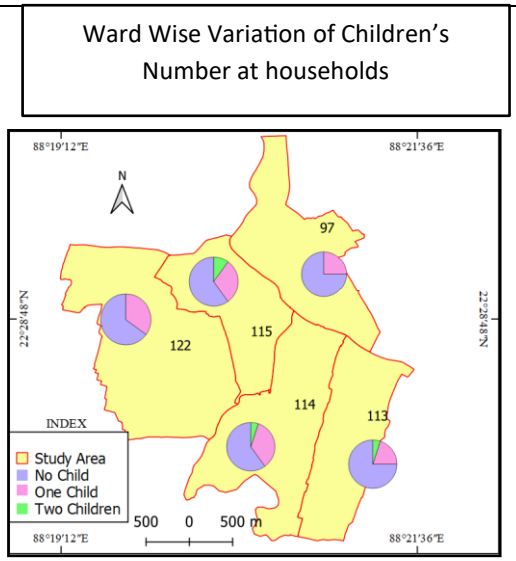


Fig No.2 Source: Primary Survey



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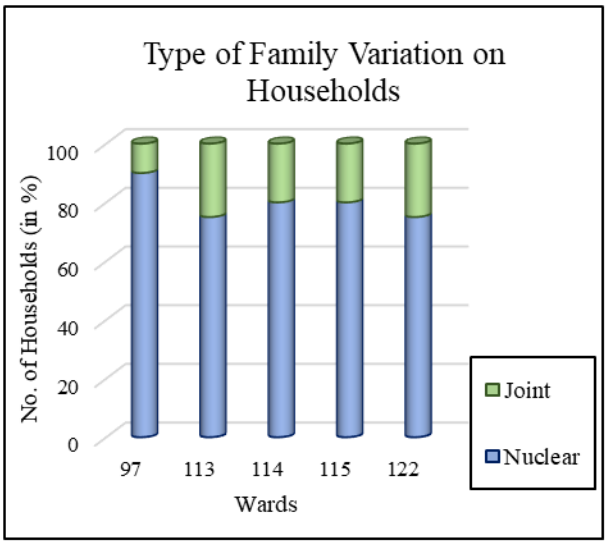


Fig No.4 Source: Primary Survey

Housing types are diverse: slums (17%), apartments (24%), independent houses (60%), housing complexes (21%). Apartments and housing complexes tend to generate more packaged and leftover waste. Slums generate less waste but face higher food insecurity. (Fig 5) Wards 113 and 115, with higher incomes, show greater waste of perishable and processed foods, while lower-income wards waste less but suffer from limited food access. By using Regression and T test shows that there is no significant relation between two variables. If monthly income is increase then the quantity of food wasted generation may not be increase. (Fig 6)

Independent variable	Dependent variable	R value	T value	Significance
Monthly Income (Rs.)	Quantity of Food wasted (gm.)	0.0005	- 9.8995	Insignificant

Table :1

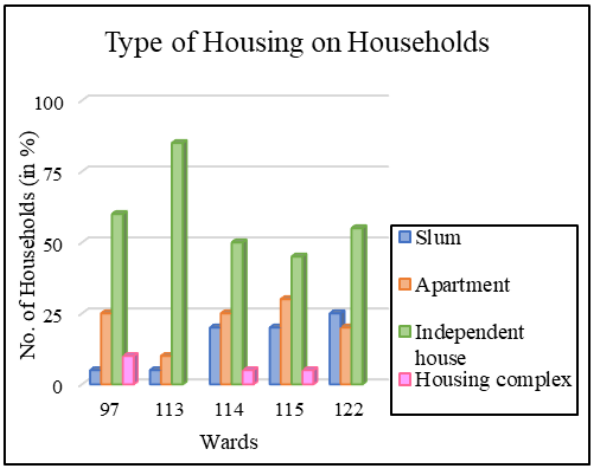


Fig 5 Source: Primary Survey

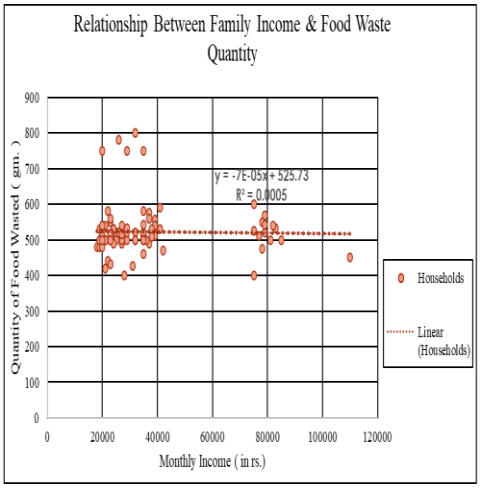


Fig 6 Source: Primary Survey

FOOD CONSUMPTION & PURCHASING BEHAVIOURS OF HOUSEHOLD RESPONDENT'S

Weekly buying dominates in Wards 97 & 114, reducing bulk storage needs but potentially increasing packaging waste. Monthly buying in Wards 113 & 115 can cause higher risk of spoilage due to bulk storage (Fig. 8). Local markets preferred in most wards; supermarkets and online shopping more common in Wards 115 & 122, which can lead to more packaged waste (Fig. 7). Family size and previous consumption dominate; sales promotions in Wards 113 & 115 encourage bulk buying, increasing risk of waste. Bulk buying without proper preservation leads to higher spoilage rates. Packaging-heavy purchases from supermarkets and online stores contribute to non-biodegradable waste. Wards 97 & 113 check food before buying, reducing duplicate purchases; Ward 122 checks least, causing more overbuying and spoilage. (Fig. 9) Low checking habits and bulk buying without awareness increase both organic and packaging food waste in dense urban wards. Wards 97 & 113 regularly check expiry dates before buying, minimizing spoilage risk. (Fig. 10) Regular checking reduces waste by avoiding overbuying and preventing consumption of expired goods. (Fig. 11) Overbuying Frequency – More common in Wards 114 & 122, increasing risk of unused food spoilage; Ward 97 rarely overbuys. Refrigeration common in Wards 114, 115 & 122; traditional preservation used more in Wards 97 & 113.Wards 97 & 113 consume perishables same day, reducing spoilage; Wards 114 & 115 store for 2–5 days; Ward 122 stores beyond 5 days, raising spoilage risks. (Fig. 12) Longer storage without proper preservation leads to higher organic waste; over-reliance on refrigeration can encourage overbuying. Promoting balanced storage practices and right-quantity buying habits can significantly reduce perishable waste in high-density wards. (Fig. 13) Food purchasing type differ where the fresh produce and dry goods dominate; packaged foods are more popular in Wards 113 & 115, adding to packaging waste. (Fig. 14) Wards 113 & 115 are highly influenced by discounts, leading to bulk purchases; Ward 97 shows minimal effect. Discount-driven bulk buying and packaged food preference directly raise the amount of expired goods and non-biodegradable waste in urban households.

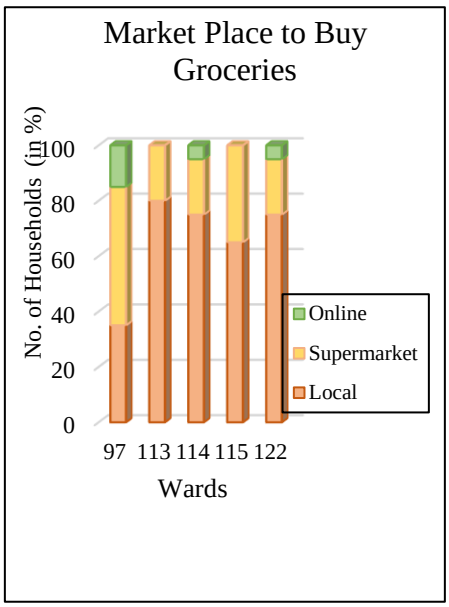


Fig 7 Source: Primary Survey

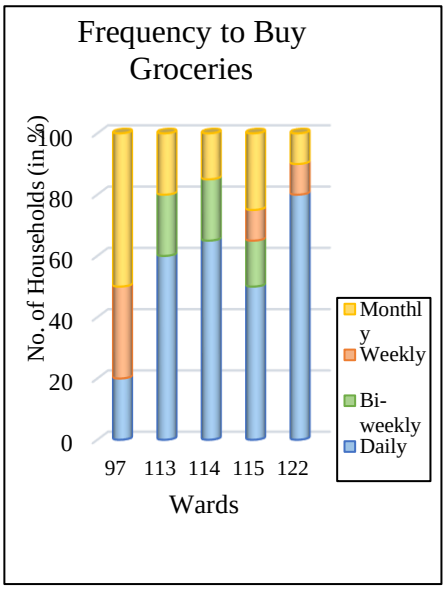


Fig 8 Source: Primary Survey

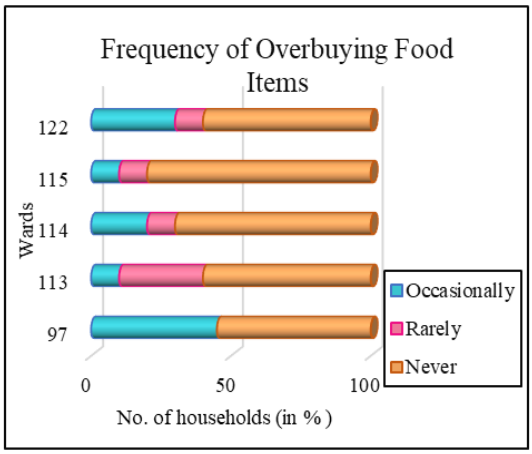


Fig 9 Source: Primary Survey

Ward Wise Variation on The Expiry Date Checking of Packaged Food

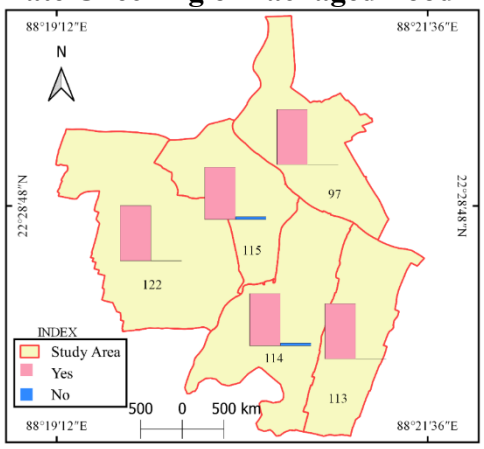
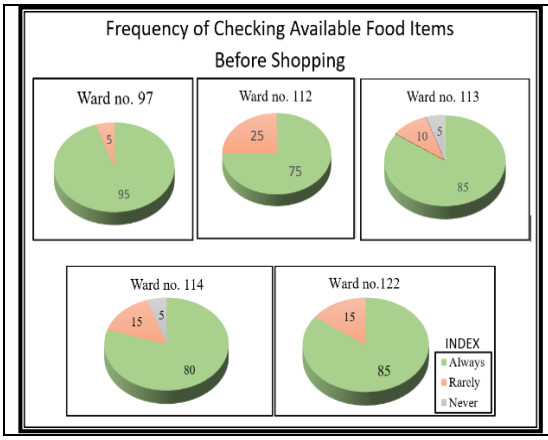


Fig 10 Source: Primary Survey



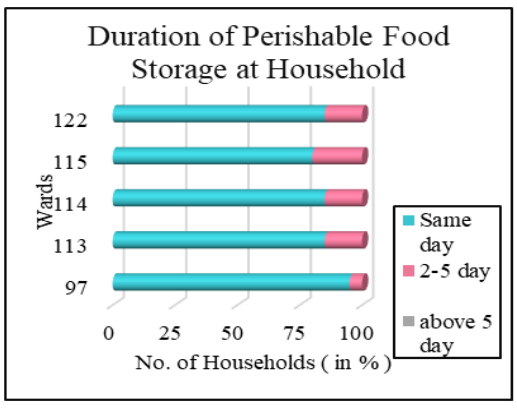
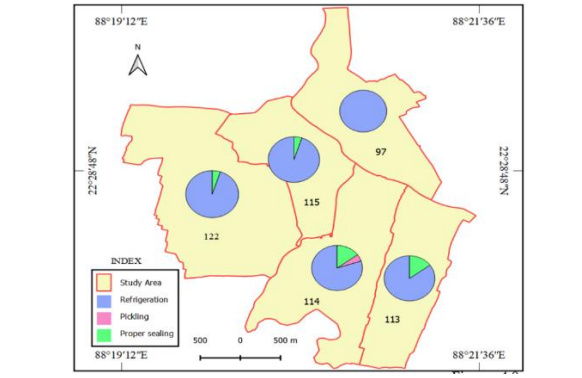


Fig 11 Source: Primary Survey	Fig 12 Source: Primary Survey



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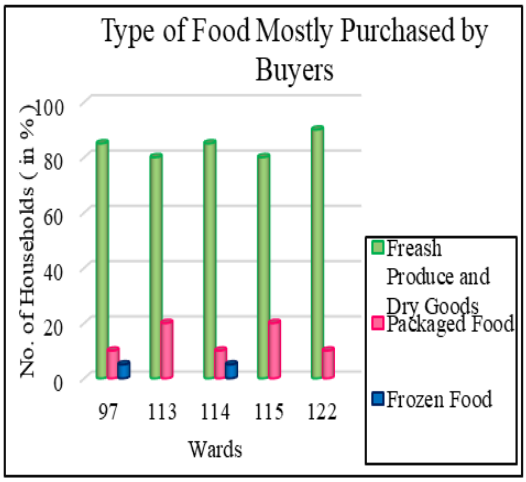


Fig 14 Source: Primary Survey

FOOD CONSUMPTION & WASTE PATTERNS OF RESPONDENTS

• Daily meal preparation is dominant across all wards, slightly less frequent in Wards 115 & 122 where more people cook a few times a week. Food waste frequency variation: Ward 97 shows mostly occasional waste, while Ward 122 records the highest daily waste. (Fig. 15) Main causes of food waste: Plate leftovers and food spoilage due to over-purchasing/overcooking are top contributors. Ward 97 leans toward plate leftovers, while Ward 122 shows high over-purchasing waste. Process of wastage: On-plate wastage exceeds meal-preparation waste in all wards, with Wards 113 & 114 highest. Leftovers disposal habits: 55–85% households never throw away uneaten leftovers; 2–3 times disposal is rare. (Fig. 16) Daily cooking habits and larger servings lead to higher on-plate wastage, especially in Wards 113 and 114. (Fig. 17) Over-purchasing and poor planning contribute to spoilage, which in turn raises overall food waste levels. Lower leftover disposal rates help offset waste generation despite frequent meal preparation. Daily cooking habits and larger servings lead to higher on-plate wastage, especially in Wards 113 and 114.Over-purchasing and poor planning contribute to spoilage, which in turn raises overall food waste levels. Lower leftover disposal rates help offset waste generation despite frequent meal preparation. Cooked meal wastage remains high despite low total weekly waste, linking to portion estimation gaps. High leftover reuse reduces overall waste but cannot fully offset losses from over-purchased fruits and vegetables. Lower confidence in portion planning, as in Ward 113, corresponds with higher waste in specific food categories..(Fig. 18)

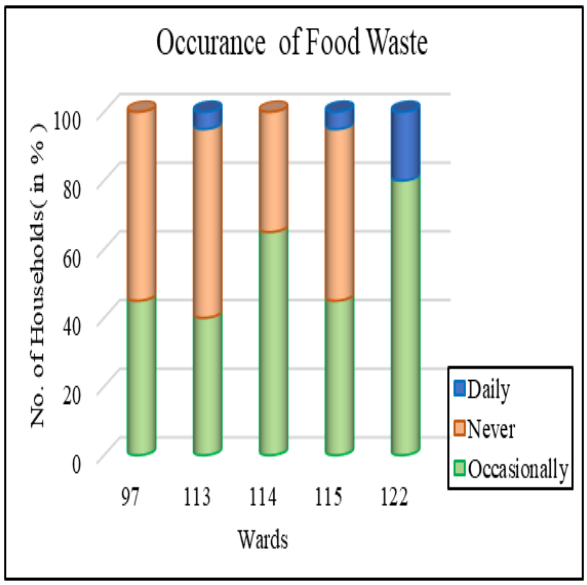


Fig 15 Source: Primary Survey

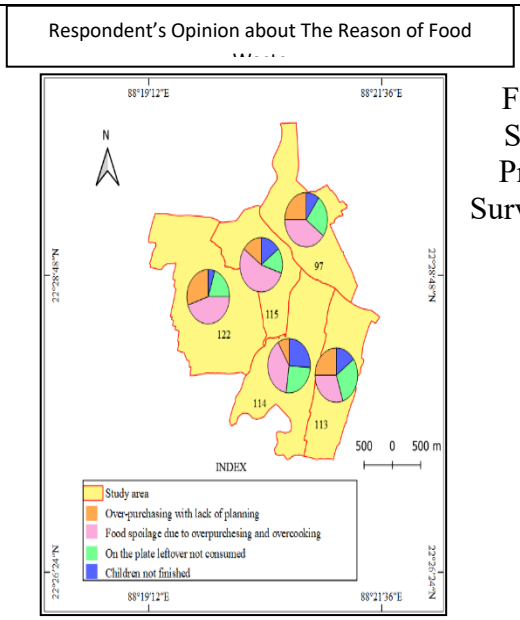


Fig 16 Source: Primary Survey

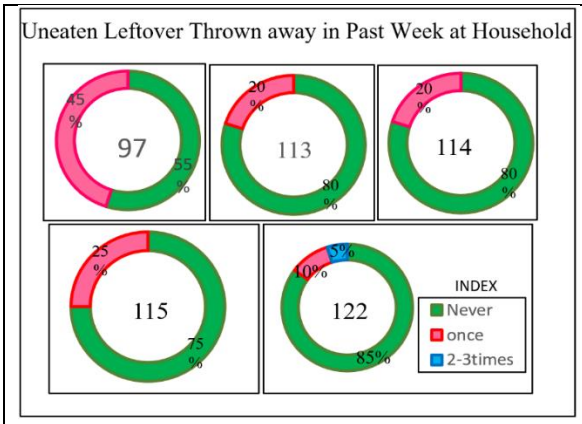
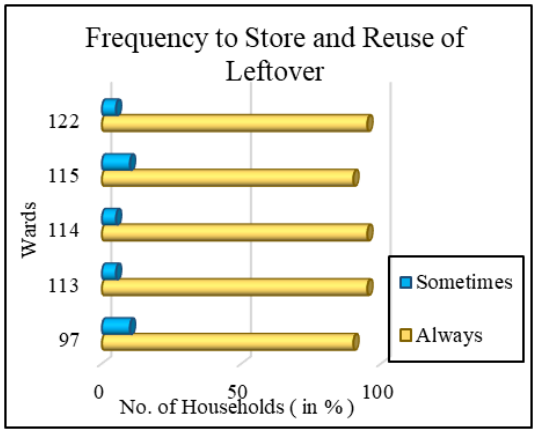


Fig 17 Source: Primary Survey



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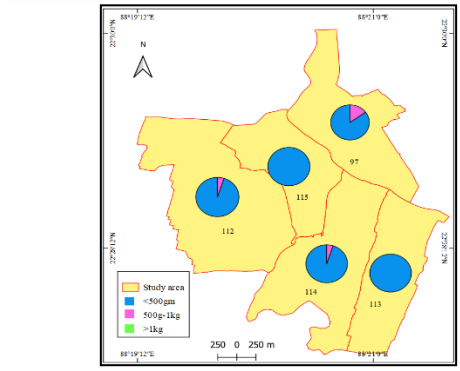

Fig 19

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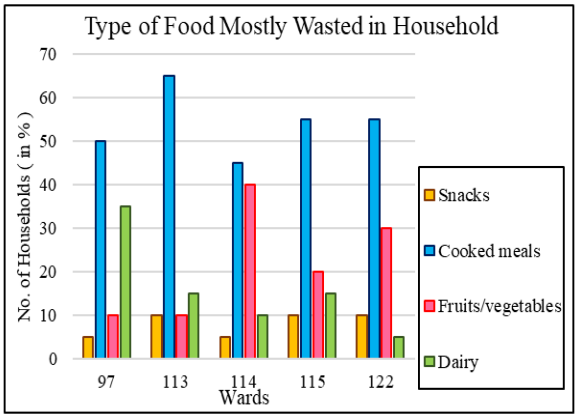

Fig 20 Source: Primary Survey

- **FOOD WASTE MANAGEMENT PRACTICES ON HOUSEHOLD**

Donation of Excess Food is higher in affluent wards (97, 115) due to frequent surplus cooking; lower in wards with limited resources. Composting Awareness is moderate—wards 113 & 122 show better knowledge but limited actual practice. (Fig. 21). Segregation of Waste is more consistent in wards with active municipal drives (114, 122). Storage Facilities directly affect waste—wards with poor refrigeration face more spoilage. Behavioral Habits—meal planning and expiry-date checks vary significantly between wards. Waste arises mainly from avoidable surplus; donation practices are higher but composting adoption is low. (Fig. 22) Waste mostly from spoilage; composting knowledge exists but space and infrastructure are barriers in low-income wards.

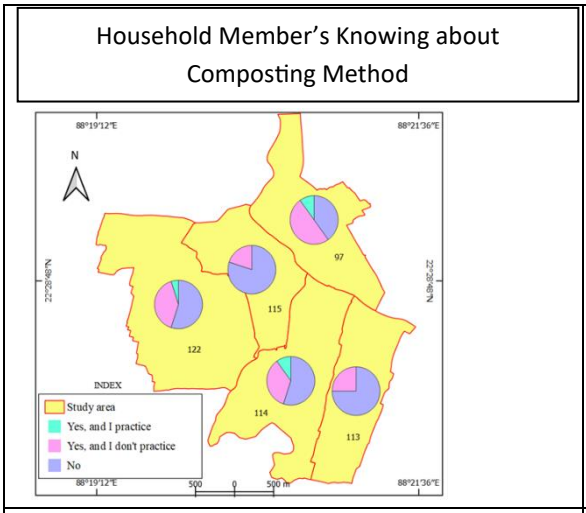

Fig 21 Source: Primary Survey

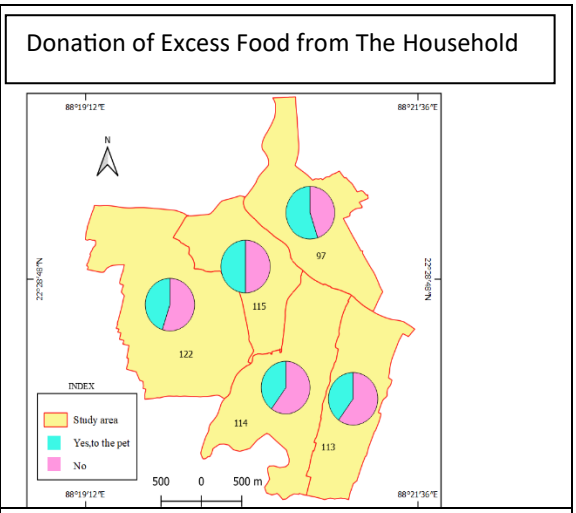

Fig 22 Source: Primary Survey

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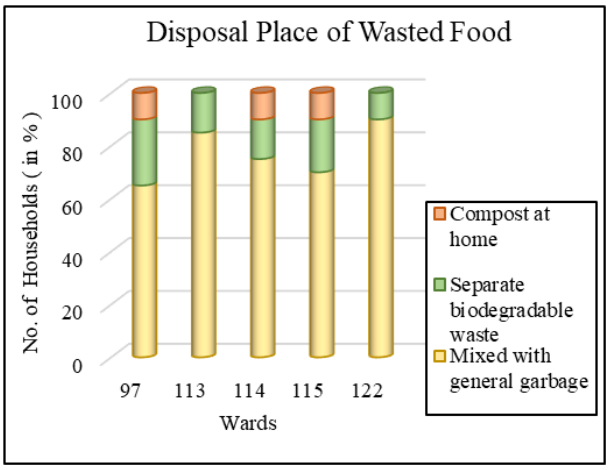


RESPONDENT'S PERCEPTION ABOUT AWARENESS AND ENVIRONMENTAL IMPACT OF FOOD WASTE

• Environmental Awareness: Higher in wards 113 & 115, where landfill burden, greenhouse gas emissions, and loss of resources were well recognized. Lower awareness in wards 97 & 122.Benefit Perception: Wards with high awareness (113, 114) believe strongly in environmental gains from waste reduction; low-awareness wards remain indifferent. Eco-friendly Practices: High willingness in wards 113 & 115 aligns with greater awareness; reluctance is seen where knowledge is limited. Awareness is the primary driver of eco-friendly behavior; where awareness is low, waste reduction efforts are minimal. Urban food waste behavior varies significantly between wards, reflecting socio-economic and educational differences. Targeted awareness programs and community initiatives are critical to improving waste management in low-awareness wards. (Fig. 24,25,26)

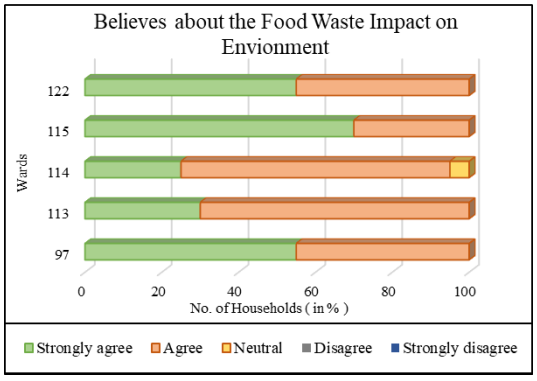


Fig 24 Source: Primary Survey

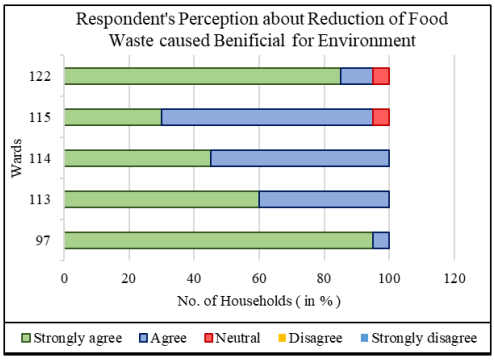


Fig 25 Source: Primary Survey

Respondent's Perception about The Initiatives Need to Reduce Food Waste in Home

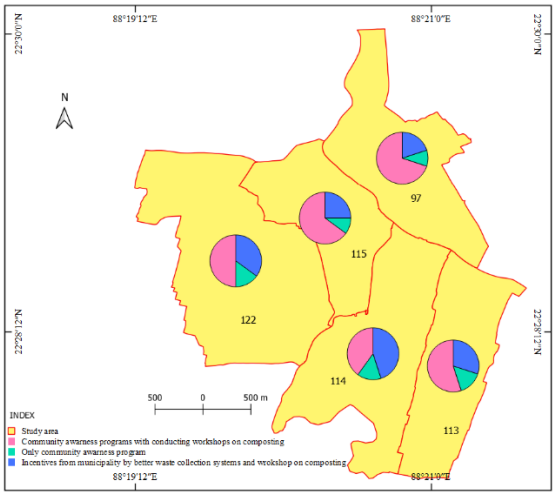


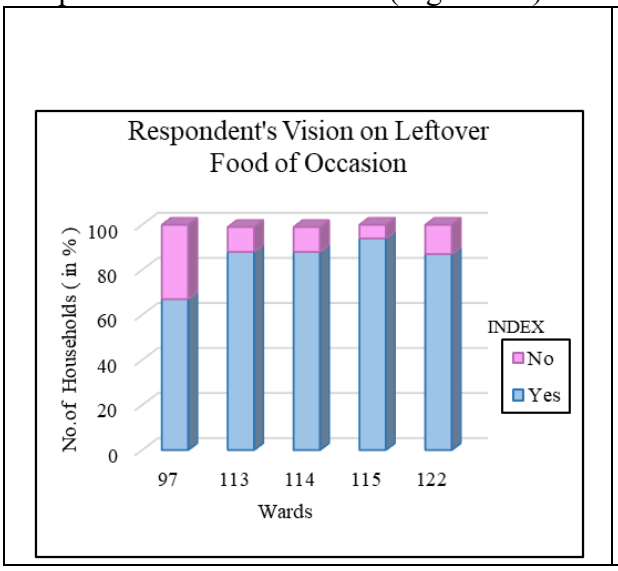
Fig No.26 Source: Primary Survey

- **FOOD WASTE PATTERNS ON CEREMONY OCCASIONS OF HOUSEHOLD**

Across Wards 97, 113, 114, 115, and 122, buffet style dominates, followed by sit-down plates, then self-service. Buffet style linked to more leftovers due to self-serving excess. Caterers are the main planners in all wards; family members and event managers play smaller roles. Heavy dependence on caterers increases risk of over-production. Majority rely on advice from caterers; previous experience is less used. Strengthening pre-event planning and using past experience data could cut waste. All wards have 60–90% households reporting leftovers on special occasions. Ward 122 reports highest leftover rate and Ward 97 reports lowest, suggesting better portion control and smaller gathering.

Buffet style + Caterer-led planning = Consistently high leftovers

- High plate waste noticed in all wards; counts vary but remain significant- mostly from buffet over-serving. Most households consume leftovers themselves; Ward 113 notable for giving more to guests; donations vary, discarded portion is low. Overestimation is the top cause; some blame both overestimation and guest wastage; guest wastage alone is less cited. Majority of households consume leftover themselves within the households. Food donation rates are low across all the wards. Overestimation + Buffet system is the strongest drivers of unfinished plate waste. Encouraging smaller initial serving and offering refills can reduce both unfinished plate counts. Donation networks and guest take-home options could reclaim significant quantities of wasted food. (Fig. 27-32)



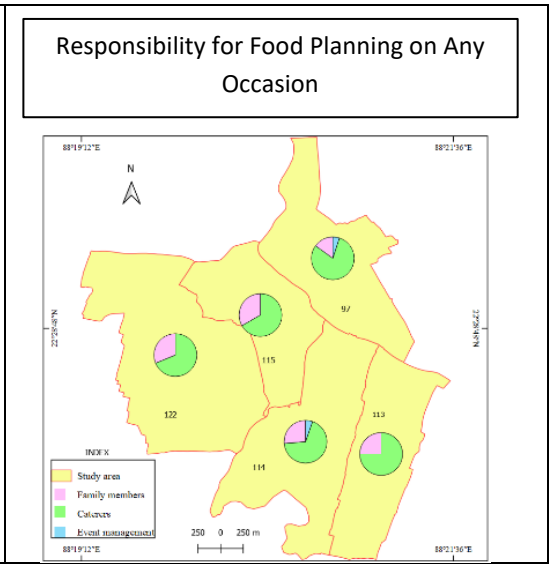


	Fig 28 Source: Primary Survey

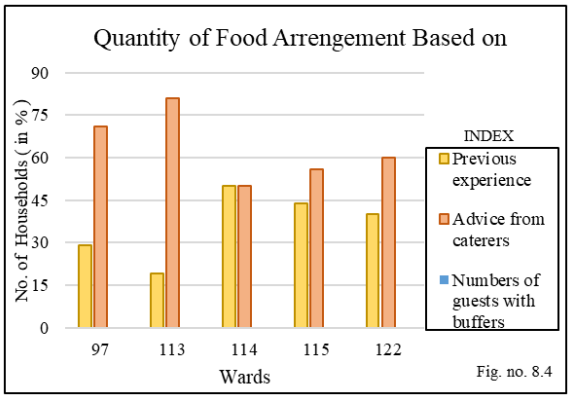


Fig 29 Source: Primary Survey

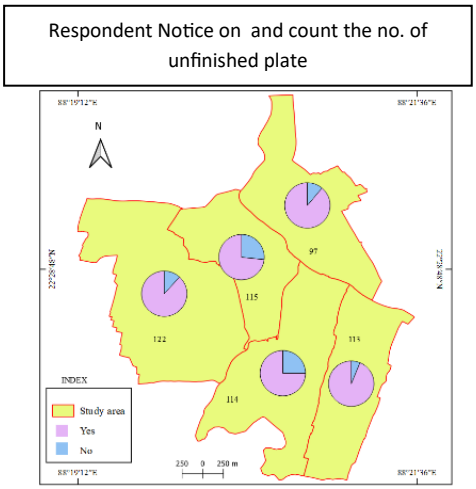


Fig 30 Source: Primary Survey

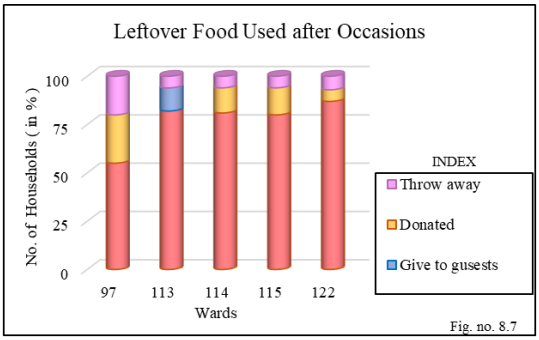


Fig 31 Source: Primary Survey

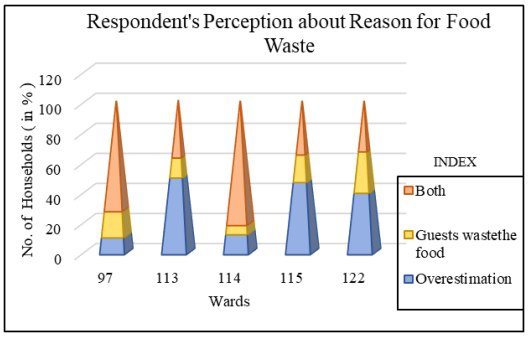


Fig 32 Source: Primary Survey

- **FOOD WASTE AND MANAGEMENT INITIATIVES ON RESTAURANT**

Wards show varied restaurant profiles—Ward 97 has more fine dining; others mix casual dining, fast food, and cafes, with casual dining dominant. Most restaurants waste less than 5% of food; wards 114 & 115 slightly higher at 5–10%. Restaurant type diversity influences waste patterns; fine dining controls waste better, casual dining faces more leftover risk. Over-preparation (Ward 113), plate leftovers (Ward 122),

inventory issues & kitchen errors (Wards 97 & 114). Barriers for sustainable practices: lack of staff awareness, no extra time, and budget constraints. Strong agreement across wards on the importance of waste reduction. Staff training and low-cost sustainable practices can convert strong intent into measurable waste reduction. Restaurants primarily use Municipal food waste collection for disposing of unsold and scarp food, with varying percentages across different wards. But expanding donation channels and composting can align with urban sustainability goals. A significant majority of respondents across all wards agree or strongly agree on prioritizing the reduction of food waste at their restaurants. The importance of understanding food waste management practices in restaurants and the need for targeted intervention. (Fig. 33-36)

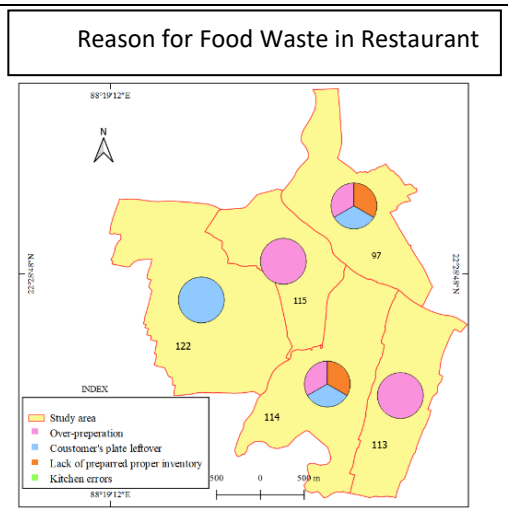


Fig 33 Source: Primary Survey

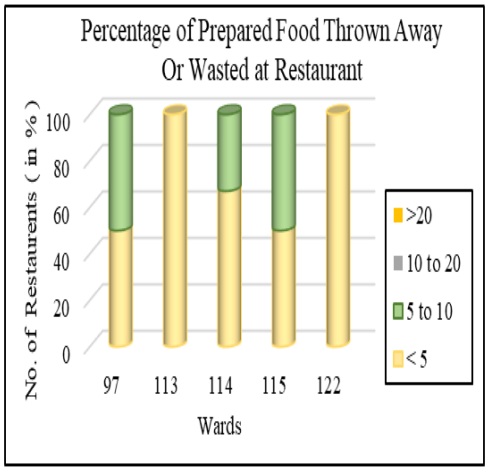


Fig 34 Source: Primary Survey

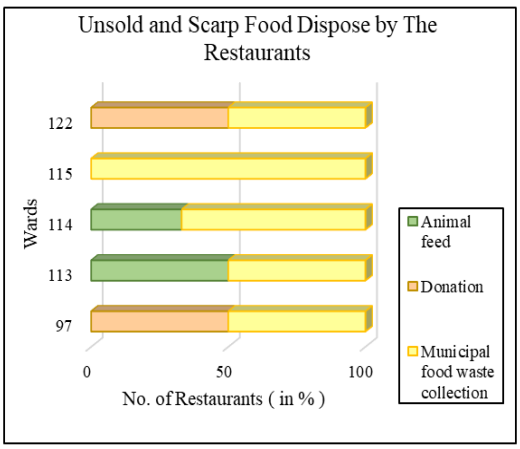


Fig 35 Source: Primary Survey

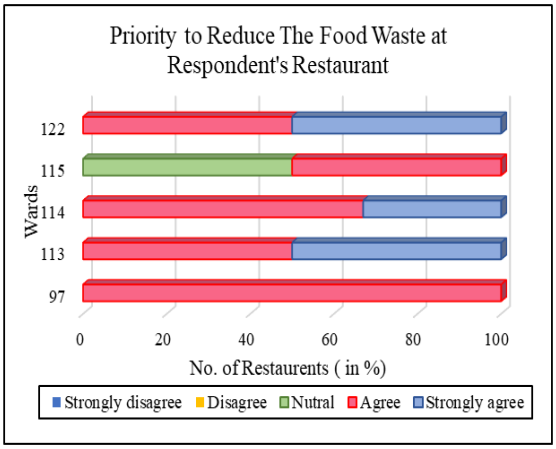


Fig 36 Source: Primary Survey

- **MAJOR FINDINGS**

➢ **IN HOUSEHOLDS**

Waste Linked to Over-Purchasing: Buying more food than needed leads to spoilage before consumption. Poor Storage Practices: Inadequate refrigeration and lack of expiry date cheeks increase waste. Cultural Event Impact: Festivals and family gathering temporarily spike household food waste.

➢ **IN RESTAURANTS**

• High plate leftovers: Oversized portions and over-ordering are the primary sources of food waste. Waste Reduction Potential: Menu planning and food redistribution programs can cut restaurant waste significantly.

• **MEASURMENTS OF FOOD WASTAGE**

• If consumers have a fair idea or keep a track of what percentage of food purchased gets discarded as pre-consumer waste, costs can be saved on various fronts like labor, disposal and goods purchased. By increasing individual savings, food waste prevention contributes towards India's GDP. If the resulting bio-waste is not thrown away into landfills but is rather reused and recycled, greenhouse gases like methane which is more harmful than CO2, can be debarred from deteriorating the environment. In the process of reducing waste, the society awakens about the sensitive and unrealized issue of food wastage. In return the community i.e. farmers, food industry, guests, consumers, government, policymakers etc., gets engaged and contributes thus making a positive move towards Food security in India.

The Target-Measure-Act Approach

1. TARGET Develop a national strategy and plan and set targets.
2. MEASURE and assess hotspots.
3. ACT Develop action plans, funding plans and public private partnerships.

RECOMENDATIONS

Awareness, capacity building and behavioral change

□ Put food loss and waste on the research agenda;
□ Foster collaboration and partnerships to manage food loss and waste;
□ Raise awareness of the different dimensions of food loss and waste among diverse stakeholders, and the costs and benefits of action;

Policies and incentives

□ Develop strategies and mobilize action to reduce food loss and waste; and
□ Support policy and its implementation for sustainable food systems.

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