CONSUMER BEHAVIOR, HABITS AND ATTITUDES REGARDING HOUSEHOLD FOOD WASTE IN URBAN VADODARA

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B.Sc.

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CONSUMER BEHAVIOR, HABITS AND ATTITUDES REGARDING HOUSEHOLD FOOD WASTE IN URBAN VADODARA

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(Dietetics)

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CERTIFICATE

This is to certify that the research work present in this thesis has been carried out independently by Ms. Mansi Anajwala under the guidance of Dr. Shonima Venugopal in the pursuit of the Degree of Master of Science (Family and Community Sciences) with the major in Food and Nutrition (Dietetics) and this is her original.

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LIST OD ABBREVATIONS

WRAP	Worldwide Responsible Accredited Production
FAO	Food and Agriculture Organization
UNEP	United Nations Environment Programme
UNDP	United Nations Development
FLW	Food loss and waste
IFAD	International Fund and Agriculture Development
PoU	Prevalence of Undernourishment
GHG	Greenhouse Gas
EU	European Union
Gt	Gigatonnes
U.S. EPA	United States Environmental Protection Agency
TWB	The World Bank
FUSION	Food Use for Social Innovation
GFSI	Global Food Security Index
MSW	Municipal Solid Waste
FCS	Food Consumption Score
HDDS	Household Diet Diversity Score

ABSTRACT

ABSTRACT

"Food waste" is defined as food and associated inedible parts removed from the human food supply chain in the following sectors: manufacturing of food products (under certain circumstances); food/grocery retail; food service; and households. According to FAO around 1.3 billion tons of food waste was generated in 2019, 61 per cent of which came from households, 26 per cent from food service and 13 per cent from retail. A total of 68 million tons of household food are wasted in India each year. Food security, greenhouse gas emissions from the food supply chain, and waste disposal are the three key global issues that food waste raises. The extent of home food waste demonstrates how individual decisions frequently depart from the core economic principle of optimising utility function. Food waste is generated at each stage of the life cycle, but the largest amount is recorded at the household level. Household per capita food waste generation is found to be broadly similar across country income groups, suggesting that action on food waste is equally relevant in high, upper-middle and lower-middle income countries. The main factors that contribute to food waste in households include: awareness, knowledge, preferences, planning, portion size, packing, and storage, among others. On the one hand, consumer food waste behaviour is influenced by time patterns decision-making in the present, and preferences for potential future food disposal methods. Household food waste is caused by consumer habits such as buying food from stores, malls, or markets for immediate consumption or storage for later use. Food waste also depends on the size of the family, family income, the demand and supply of the food item, the quality of the food anyone wants to buy, and poor planning and budgeting for each type of food that one wants to purchase. Large amount of food is wasted worldwide. In order to minimize household food waste or consumer related food waste, it is imperative to have an understanding of the factors influencing the food waste related behavior.

Thus with this background, the present study was planned with the following objectives:

1)To assess consumer purchasing behaviour towards food products 2) To determine household food waste composition based on consumer responses 3) To evaluate association between avoidable food waste and consumer purchasing behaviour

Data related to respondents' background information, behavior, habits, and attitudes were collected using a pre-tested questionnaire from urban Vadodara. Mean age of respondents was 47.6 years. From 404 total respondents, male (95.4%) and female (92.6%) respondents shopped from markets in the majority (93.1%) of cases. About half the male (50%) and female (51.2%) respondents bought food one to two times a week. Giving consideration to food storage practices (p< 0.01) and usage of leftover food products (p< 0.01) was shown to be more frequent among men. Female consumers reportedly made decisions more frequently based on price/kg (p< 0.05). Many respondents never (4.4) checked the refrigerator or store room before shopping, while the majority routinely (56.4%) check it before purchasing food. Menu planning used to be done very often (34.9%) by the majority of respondents, while many others never (21.5%) did it. Before purchasing food, the majority of respondents sometimes(29.2%) write a shopping list, although 18.3% never do so. When purchasing food, respondents often got only what they required; yet, very few respondents never(0.5%) purchased only what they needed. The information gathered shows that the majority of respondents sometimes (29.7%) and always (29.2%) checked the "best before" date, whereas 8.4% of respondents never do so. Only 1.7% of respondents didnot consider how to store food to keep it fresh, compared to 42.1% who always didso. Many respondents said that they always thought about food portion sizes. Few respondents never (1.73%) gave the size of the food portions any consideration. Only 0.5% of respondents did not consider using leftovers, compared to 44.8% who always did so. It was found that 59.6% of respondents always considered purchasing food based on the price per kg, whereas 1.4% never did. Around 41.7% of females and 46.9% of males expressed interest in special discounts/offers. Fruits (38.1%) and vegetables (37.1%) were the two major categories of food products that were over purchased and discarded. Around 22.5%, 28.5% and 7.92% of the respondents wasted fruits, vegetables and bread once every month respectively. Leftover food (19.8%) was thrown out once every two weeks, whereas rice was more frequently wasted one to twotimes per week (9.4%). No significant difference was found in food waste with respectto consumer purchasing behaviour. Only a very small percentage of respondents(0.74%) always wasted food. Around 25.7% of respondents rarely wasted food, compared to 10.6% who did so often.

Thus, it can be concluded that lack of planning meals, lack of adhering to meal plans, over purchasing of foods and inappropriate storage of foods could be some of the major reasons for food waste generation. It is thus recommended that awareness regarding proper food storage, food preservation, meal planning, leftovers utilization, being vigilant about the "best before" date and correct food purchasing behaviours needs to be created to reduce the generation of food waste. Educating the public about growing their own food by cultivating kitchen gardens, which is one of the most sustainable approaches to reducing food waste, can go a long way in alleviating the negative impacts of climate change.

INTRODUCTION

INTRODUCTION

There are several issues nowadays with the amount of food waste that is produced annually. Food waste is a subject that is receiving increasing attention both nationally and internationally (Guinea & Ghiuta,2018). While Parfitt et al. (2010) defined food waste as "spoilt food arising at the end of the food cycle, which refers to retailers' and consumers' practice," Brian et al. (2013) defined it as "food that is acceptable quality and qualified for human consumption but is not consumed because it is squandered either before or after it deteriorates." Although some food waste happens frequently at the retail and consumption stages of the food chain, the majority of it is produced as a result of negligence or food disposed of with caution. Food waste encompasses not only the improper use of foodstuffs but also the waste of resources such as energy, water, and land (Tsang et al, 2019).

Food that is discarded for human consumption includes both foods that have been stored past their expiration date and food that has been allowed to spoil. Due to its significant contribution to resource depletion and high levels of greenhouse gas emissions, food waste has a significant negative effect on sustainability. These challenges have influenced several global sustainability problems, including food security and climate change. Food waste happens at every point throughout the food supply chain, including during production, processing, retail, and home consumption. Concentrating on household consumption would account for more than half of all food waste (Dalilavati and Khana, 2019).

Households are the primary source of food waste in developed nations (Parfitt et al., 2010). For instance, in the UK, households discard about 8 million tonnes of food annually, or about 12% of all food and drink consumed at home and 30% of all domestic waste (WRAP, 2011).

It is difficult to comprehend the habits and routines that contribute to household food waste and to alter them. Food waste occurs most often in households as a result of the complex and contradictory needs of daily life (Evans 2011; 2012). As a result, consumer food waste is the outcome of a variety of interconnected actions that cause a disconnect between the action itself and its effects (Quested et al. 2013). Additionally, there is less social pressure associated with food waste because it frequently goes

unnoticed by neighbors or other community members. In contrast, there is an inherent social pressure to engage in environmentally responsible behaviors like recycling, reusing carrier bags, or driving a car (Quested et al. 2013). Last but not least, when people engage in behaviors that lead to food waste, key societal concerns including food safety, the family's anticipation of meals, and health are frequently on their minds (Watson and Meah, 2013).

Concerns about the tension between the moral obligations to protect the environment by preventing food waste and to ensure food safety for oneself and others compound the problem (Meah and Watson, 2011). The supply of the home is directly tied to the practices around food waste (Evans, 2011). For instance, it was discovered that in the UK, four-person families produced around half as much food waste per capita as single-person households (WRAP, 2009). This is likely because cooking for larger numbers tends to be easier because food is frequently only accessible in larger amounts (or is cheaper in larger quantities) (WRAP, 2013).

WRAP identified nine specific habits that might significantly reduce food waste after conducting an extensive study on the relationship between behaviors and food waste in the UK (WRAP, 2007). Meal planning, checking the amount of food in the refrigerator/cupboard before shopping, creating a shopping list, packaging meat and cheese properly, keeping apples and carrots in the refrigerator, using the freezer to extend the shelf life of food, portioning rice and pasta, using leftovers, and using "use-by" date labels on food are some of these (Quested et al, 2013).

However, it can be challenging to persuade people to embrace these tactics and alter their behavior when it comes to food waste because many people dispose of their food regularly and practically instinctively (Darnton et al, 2011). In addition, a lot of people tend to underestimate how much food they waste, which makes them less motivated to participate in education on reducing food waste (Quested et al, 2011). A good chance to modify habits and reconfigure behaviors related to food waste is provided by educational and awareness initiatives that target people when they are most receptive to change (e.g. when they are entering college or retirement) (Thompson et al, 2011).

Food loss along the production and supply chains has increased recently, and Target 12.3 of the Sustainable Development Goals calls for a 50% decrease in global per capita food waste at the retail and consumer levels by 2030. The most frequently cited statistic

states that 1/3 of the food produced for human use is lost or squandered each year. The amount of food wasted along the supply chain varies depending on the stage and the region of the world, with affluent nations wasting 56% of their food and poor nations 44%. FAO reports that 61% of food waste originated in families, 26% in food services, and 13% in retail, indicating that up to 17% of all food produced worldwide may be lost or squandered. According to the UNEP Food Waste Index (2021), 931 million tonnes of food are wasted every year, the majority of it coming from home waste. The typical household in the world throws out 74 kg of food annually, indicating that significant improvement is required (Food Waste Index, 2021). (Figure 1.1)

According to estimates, low-income Asian nations waste 11 kg of food annually, but high-income Asian nations waste 80 kg of food annually (FAO, 2013). Rising incomes, dietary shifts towards Westernized consumption habits, urbanization, modern retail distribution, rising obesity, and time Constraints are only a few trends in Asia that have an impact on food provisioning and food waste (Ramachandran & Snehalatha, 2010).

Asia accounts for approximately 50% of the world's food waste in the period of crisis in the food chain, with industrialized cities in the region being the primary offenders. Almost a quarter of the food produced around the world is wasted, with 28% of it coming from just three Asian nations: China, Japan, and South Korea. China alone wastes enough food to feed 100 million people. Meanwhile, 25% of the global food waste is produced by South and Southeast Asia together (Food Waste Index, 2021).

Over 1.3–1.4 billion tons of food produced for human consumption are wasted annually, with 275 million tons of the total being accounted for in South and Southeast Asia, which includes developing nations like India and China. In research comparing estimates of food waste generated by households for each nation in Southern Asia, it was discovered that India had a rate of 50 kg/capita/year, which was lower than Bhutan's (79 kg/capita/year), Bangladesh's (65 kg/capita/year), and Afghanistan's (82 kg/capita/year) (Food waste index, 2021; Nigum & Sharma,2017).

The United Nations Development Program (UNDP) (2021), estimates that up to 40% of the food produced in India is wasted. In India, almost 21 million tons of wheat are lost to trash, and 50% of all food produced worldwide experiences the same fate and never reaches those in need. The agricultural ministry estimates that the nation wastes food worth Rs. 50,000 crores annually. India is ranked 103 out of 119 nations in the

FIGURE 1.1

THE ENORMOUS SCALE OF GLOBAL FOOD WASTE

Source: UNEP Food Waste Index, 2021

2018 World Hunger Index. Food waste is a sign of various economic issues in the nation, including inflation, in addition to hunger, and pollution.

Why is Food Wastage an Important Issue?

For the benefit of the entire world's population, there must be physical, social, and economic access to sufficient, nutritious food. For instance, the expanding human population will require

substantially more food to be produced, yet there aren't any more resources on Earth to do it. To meet this issue in the future, food loss and waste prevention are essential. With 820 million hungry people worldwide, food security is a critical concern, especially in emerging nations (FAO, 2019). With no extra planetary resources available to generate it, it is predicted that food production must double by 2050 to feed the expanding population. Agricultural resources like land and water are already scarce, so decreasing food waste is crucial to fulfilling future population demands (Food Waste Index, 2021).

Water consumption, land use, and greenhouse gas emissions are the three main areas where food loss and waste affect the environment (FAO, 2013). Agriculture production is said to account for 92% of the world's water footprint and is a water-intensive industry (Hoekstra et al., 2012). The water footprint of a specific food item is made up of the water required for the production of the ingredients, their processing (such as washing, cleaning, moving, diluting, and using water as an ingredient), the production of the food product, the packaging, the distribution of the product, the use stage of the food product by the consumer, and the management of its end of life (Manzardo et al, 2016).

Consumer causes food waste

The majority of food waste happens in households; therefore, consumers are essential to lowering food waste (WRAP, 2020). Poor planning, purchasing more food than necessary, leaving meals incomplete, not understanding the significance of durability dates like "Use-by" and "Best-before," and later worries about food safety are all reasons why consumers throw food away (Ghinea and Ghiuta, 2018).

The following are the key decision points that consumers encounter: "(1) getting food by buying and preparing for meals, (2) storing food, (3) judging the edibility of food, (4) valuing food (Hebrok et al, 2019). Addressing these crucial consumer decision-

making moments may be most successful when encouraging and supporting behavioral changes for the decrease of food waste.

At the consumer level, several variables can contribute to food loss and waste (FLW):

 Poor storage, results in the food not being consumed before it spoils. Lack of visibility in refrigerators, half-used components, and incorrect estimations of food demands are all causes of food deterioration at home. **Cooking or serving excessive amounts of food-** Over time, cooking amounts have expanded, and huge dinners frequently contain more food than can be consumed. Also, a lot of people wind up tossing away leftovers because they forget to consume them. Food deterioration can result from uncertainty about whether a product is acceptable for freezing and how to freeze it to preserve its quality and storage life. **Oversized Portions -** A frequent occurrence at restaurants, larger portions significantly increase food waste. Unfinished meals and eatable leftovers from restaurants are frequently left there. All-you-can-eat buffets are especially wasteful because leftover food cannot legally be given or repurposed owing to health code constraints. Waste is produced by the custom of keeping buffets well stocked during business hours rather than letting supplies run low just before closure. Food being thrown out before it should be because date labels are unclear, leading to this problem (e.g., "sell by," "best by," "use by," etc.). **Lack of Planning -** Without menus and shopping lists, customers frequently estimate incorrectly how many and what kinds of ingredients they will use over the week. The food you have at home may spoil before you can utilize it as a result of unplanned restaurant meals or food deliveries. **Absence of freezing -** food deterioration may result from uncertainty about whether a product is appropriate for freezing and how to optimally freeze it to preserve its quality and storage life (WRAP, 2020).

Food Security and Food Waste

Food security occurs when all members of the household have reliable access to food in sufficient quantity and quality to support an active and healthy life. Even as food availability increases, evidence shows that widespread hunger still exists. This creates a need to understand food safety in general and also its relationship with household and individual security. Although households may have access to food supplies, individual food security requires adequate environment and distribution. Food shortages are a sad reality for millions of people all over the world. (FAO, 2002)

Food waste is one of the most challenging problems of modern times. The implications of food waste for food security are reviving the societal debate. While the global demand for food grows, millions of people suffer from malnutrition worldwide (FAO, 2011). The concept of food insecurity does not only refer to hungry people but also to uncertainty about macro- and micronutrients: an unbalanced diet can contribute to food shortages (Asghar et al, 2016).

Food security is a flexible concept as reflected by the many attempts to define it in research and policy usage. The concept of food security originated some 50 years ago, at a time of global food crises in the early 1970s. Even two decades ago, there were about 200 definitions for food security in published writings (Maxwell and Smith, 1992), showing the contextual dependent features of the definition. The current widely accepted definition of food security came from the Food and Agriculture Organization's (FAO) annual report on food security "The State of Food Insecurity in the World 2001": Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2002). The last revision to this definition happened at the 2009 World Summit on Food Security which added a fourth dimension – stability – as the short-term time indicator of the ability of food systems to withstand shocks, whether natural or man-made (FAO, 2009).

Among the major threats that global changes are imposing on food security, it is important to mention the increase in the amount of food lost and wasted. Wasting food is a relevant issue for (at least) two reasons: it emphasizes the need for economic efficiency, the necessity to produce foods for those who need it without losing (significant) shares of produced goods due to spoilage or inefficiencies in logistics; it calls for a reflection on the ethical concerns that the current production system imposes on our society. To put all these issues in one term, food waste, and food loss are detrimental to the status of food security, and, by implying sustained prices (Santeramo, 2015), impact the compositions of diets, that are sensitive to income and price changes (Sabnam et al, 2016). While the global demand for food grows, millions of people suffer from undernourishment worldwide (**Abiad & Meho, 2018**). About 1.3 billion tons of edible foodstuffs (one-third of the global food production) are lost or wasted along the food supply chain (FAO, 2011).

Food waste harms food security. In developing countries, industry and households typically throw away significant amounts of food, and it has been observed at the local level that better management and reduction of food waste can reduce food insecurity for businesses and households. Food waste can reduce the availability of food, thereby damaging the environment, the consumption chain, and the resources used to produce food (IFAD, 2022).

Food loss occurs from farm to retail and beyond, while food waste occurs at the retail, food service, and household levels. Causes range from poor handling, inadequate transport or storage, lack of cold chain capacity, and extreme weather conditions to cosmetic standards, and lack of planning and cooking skills among consumers (FAO, 2021).

According to the FAO study on food insecurity, 826 million people suffer from chronic hunger, and during the first half of the 1990s, the number of hungry people fell by only 8 million yearly, a shamefully insufficient pace of decline. Despite expectations that the COVID-19 epidemic would end and food security would start to recover in 2021, the world's hunger rate rose even higher that year. The prevalence of undernourishment (PoU), which had been largely stable since 2015, increased from 8.0 to 9.3 percent from 2019 to 2020 and then increased more slowly to 9.8 percent in 2021 (FAO, 2022).

An estimated 702 to 828 million people were affected by hunger in 2021. Since the outbreak of the COVID-19 pandemic, the number has increased by about 150 million – 103 million more between 2019 and 2020 and 46 million more in 2021, relative to the midpoint of the projected range. A further increase in global famine in 2021 reflects widening inequalities between and within countries due to the uneven pattern of economic recovery between countries and unreimbursed income losses for those most affected by the COVID-19 pandemic, all in the context of diminishing social protection measures, which was implemented in 2020 (IFAD, 2022). To accelerate progress, the 1996 WFS target of reducing the number of undernourished to 400 million by 2015 would not be reached before 2030. It is estimated that there are 842 million hungry people on the planet. I.e., every eighth person in the world suffers from chronic hunger and does not have enough food for an active and healthy life. Plus, the number of people on the planet is fast growing. The production of basic staple foods will have to increase by 60 percent to cover the expected growth in demand (Chaudhary, 2020).

Indians waste as much food as the whole of the United Kingdom consumes and millions of people in India's population of 1.3 billion go hungry as a result. (Saxena et al, 2018). India was ranked 71st in the Global Food Security (GFS) Index 2021 out of 113 countries with an overall score of 57.2 points on the GFS Index 2021 (GFSI, 2022).

According to the guidelines of the World Health Organization (2016), a minimum of 250 g of food grains is needed per person per day for survival. The cumulative loss could at least be a living seven million people.

Dimensions of Food Security

By definition, four dimensions of food security have been identified (FAO, 2008). 1) Availability of manufactured food locally and imported from abroad. 2) Accessibility. Food can get to the consumer (transport infrastructure) and to the consumer has enough money to buy. Added to such physical and economic availability is a socio-cultural approach that ensures that food will be culturally acceptable and that there are social safety nets to help the less fortunate. 3) Use and utilization. The individual must be able to eat sufficient in both quantity and quality to live a healthy and fulfilling life to realize his potential.

Food and water must be safe and clean, so sufficient water and sanitation are also included at this level. One must also be physically fit and healthy to be able to digest and utilize the food consumed. The fourth domain of stability deals with the nation's capabilities/ community/(household) person to withstand shocks to the food chain system, whether caused by natural disasters (climate, earthquakes) or man-made (wars, economic crises). Thus, it can be seen that food security exists on many levels. Availability - National; Accessibility - household; Usage – Individual; Stability – can be considered a temporal dimension that affects all levels. For full food safety, all four of these dimensions must be intact. These will affect the food security of future generations (The World Bank,2020).

Indicators of Food Security at the Household Level

This category of indicators usually captures the number of different types of food or food groups that people consume, and the frequency of their consumption. The result is a score showing the diversity of diets. Food Consumption Score (FCS) a Household Diet Diversity Scores (HDDS) are two common indicators measuring dietary diversity

(Maxwell et al., 2013; FANTA, 2006; FAO, 2010). People who spend more of their expenditure on food were considered less secure in household security. It is also measuring behavior related to food consumption, thereby indirectly capturing food security. Another well-known indicator is the Household Hunger Scale, which is used for more severe behaviors.

To ensure individual food security, food must be distributed in sufficient quantities to all household members. Several indicators provide an idea of the prevailing food insecurity in households. Achieving SDG2 plays a critical role in ending hunger, food security, improving nutrition, and promoting sustainable agricultural practices. A greater understanding of food

waste will lead to the implementation of pre-emptive or reactive solutions that reduce food waste (WHO,2020). A greater understanding of food waste will lead to the implementation of pre-emptive or reactive solutions that reduce food waste (WHO,2020).

Greenhouse Gas Emission and Food Waste

Food waste is estimated to account for roughly one-third of the food produced for human consumption in the United States. When food is wasted, all the inputs used in the production, processing, transportation, preparation, and storage of the wasted food are also wasted. Food loss and waste also exacerbate the climate change crisis with their significant greenhouse gas (GHG) footprint. The production, transportation, and handling of food generate significant emissions of carbon dioxide (CO_2), and when food ends up in landfills, it generates methane, an even more potent greenhouse gas. The link between food loss and waste and climate change is increasingly recognized as important, as is the link between climate change and agriculture and supply chain resilience. Increasingly, we are seeing extreme weather events disrupt both agriculture and supply chain resilience (USDA, 2022).

FIGURE 1.2

INDICATORS FOR FOOD SECURITY

Food security domain	FAO suite of indicators for food security 2013
Level	
Availability	
National	Average dietary energy supply adequacy
	Average value of food production
	Share of dietary energy supply derived from cereals, roots and tubers
	Average protein supply
	Average supply of protein of animal origin
Accessibility	
Household	Percentage of paved roads over total roads
	Road density
	Rail-lines density
	Domestic Food Price Level Index
	Prevalence of undernourishment
	Share of food expenditure of the poor
	Depth of the food deficit
	Prevalence of food inadequacy
Utilization	
	Access to improved water sources
	Access to improved sanitation facilities
	Percentage of children under 5 years of age affected by wasting
	Percentage of children under 5 years of age who are stunted
	Percentage of children under 5 years of age who are underweight
	Percentage of adults underweight
Stability/Vulnerability	
	Cereal import dependency ratio
	Percent of arable land equipped for irrigation
	Value of food imports over total merchandise exports
	Political stability and absence of violence/terrorism
	Domestic food price level index volatility
	Per Capita food production variability
	Per Capita food supply variability

Source: FAO, 2013

The carbon footprint of a food product is the total amount of greenhouse gases emitted during its life cycle, expressed in kilograms of CO_2 equivalents. Greenhouse gas emissions at the production stage (including all agricultural inputs, machinery, livestock, and land) and downstream stages (such as processing, transport, food preparation, and waste disposal) are all included in this calculation. Thus, one kg of wheat or one kg of beef has different carbon footprints because their life cycles are different and they emit specific types and different amounts of greenhouse gases (Clark et al, 2020).

Around 1.3 billion tons of food are wasted worldwide each year (Gustavsson et al., 2011). In addition to economic, ethical, and social- food waste carries a significant burden on the environment. Providing food causes greenhouse gas emissions (GHG) at all stages of the food supply chain (FSC), from entry generation through agricultural production, post-farm processing, and distribution to final consumption and waste disposal. In Europe, food consumption accounts for about 20-30% of GHG emissions from the consumption of all products, with the agricultural phase in FSC being a key factor (Tukker et al., 2006). Agriculture is one of the economic sectors with the highest intensity and sources of environmental pressure and accounts for about 15% of direct greenhouse gas emissions of all EU production (Moll and Watson, 2009). Major greenhouse gas farm-level emissions are CH_4 from livestock and N_2O emissions from soil and manure management (Moll and Watson, 2009). Globally, agriculture is the primary cause of increasing atmospheric concentrations of CH_4 and N_2O, producing 10-12% of total anthropogenic greenhouse gas emissions (Smith et al., 2007). In addition, the production of inputs such as fertilizers and energy consumption farm and for post-farm activities (e.g., transport, processing, storage, refrigeration) leads to food-related emissions (Garnett, 2011; Sonesson et al., 2010).

Global CO_2 emissions from energy combustion and industrial processes rebounded in 2021 to reach their highest annual level. The Covid-19 pandemic had far-reaching impacts on energy demand in 2020, reducing global CO_2 emissions by 5.1%. Emissions are up more than 2.0 Gt (Gigatonnes) from 2020 levels, making 2021 higher than 2010 as the largest year-on-year increase in energy-related CO_2 emissions in the year absolute conditions. The recovery in 2021 more than reversed the pandemic and induced a decrease in emissions of almost 1.9 Gt recorded in 2020. CO_2 emissions in 2021 rose

to around 180 megatons (Mt) above 2019 pre-pandemic levels. Food is responsible for approximately 26% of global GHG emissions. (IEA, 2021) (Figure 1.3).

FAO has quantified the footprint of food waste on natural resources, particularly its carbon footprint. Carbon footprint calculations – based on assessments of food waste volumes and 2011 emission factors taken from life cycle assessment studies – were estimated at 3.3 Gt eq for 2017. CO_2 (without land use change), the total carbon footprint of food waste, including land use change, is therefore around 4.4 Gt CO_2 eq. annually (FAO, 2015).

Being a megadiverse country endowed with abundant natural resources, India envisions achieving a carbon-neutral green growth and development pathway. The relatively rapid pace of urbanization (34.93% of the overall population in 2021 in the urban areas compared to 17.93% in 1960), quick economic growth (gross domestic product growth of 9.5% in 2021), industrialization, and agricultural intensification, however, have resulted in increasing levels of greenhouse gas (GHG) emissions in India in the past. The total GHG emissions (in million metric tons CO_2 equivalent, MtCO$_2$e) increased almost linearly from 746.5 in 1970 to 3375 in 2018.   India is the third-largest contributor to global energy use and anthropogenic carbon emissions, after China and the USA, with its energy sector contributing 75% (2129 Mt CO_2e) of overall emissions (Kumar & Arvindakshan, 2022). According to the Food Waste Index Report (2021), food wastage per capita in India is around 50 kg per year, which accounts for a total food wastage of 68.76 Mt per annum. Such food wastes from households and eateries usually end up in landfills, emitting GHGs.

What does waste food have to do with climate change?

The impact of food on the climate is measured in terms of the intensity of greenhouse gas emissions. Emission intensity is expressed in kilograms of "carbon dioxide equivalents" - which includes not only CO_2 but all greenhouse gases - per kilogram of food, per gram of protein, or calorie. Foods of animal origin, particularly red meat, dairy products, and farm-raised shrimp, are generally associated with the highest greenhouse gas emissions. This is because, meat production often requires extensive grasslands, which are often created by cutting down trees, releasing carbon dioxide stored in forests. Cows and sheep release methane when they digest grass and plants. Cattle waste

FIGURE 1.3

GREENHOUSE GAS INCREASE ANNUALLY, 1900-2021
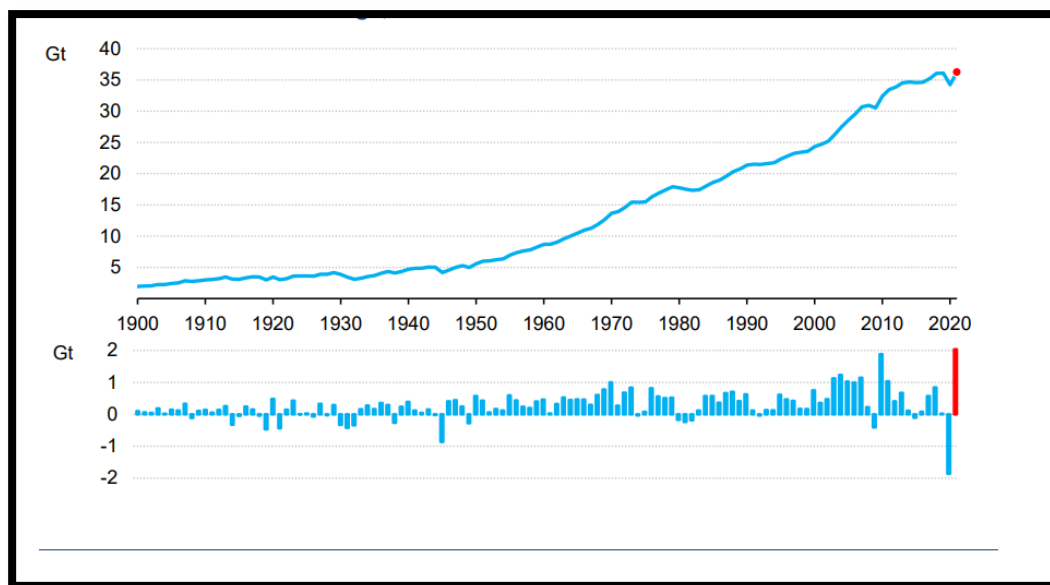
Source: International Energy Agency, 202

on pastures and chemical fertilizers used on crops for livestock feed release nitrous oxide, another potent greenhouse gas. Shrimp farms often occupy coastal land previously covered by mangrove forests, which absorb huge amounts of carbon. The large carbon footprint of shrimp or prawns is mainly due to the stored carbon that is released into the atmosphere when mangroves are cut down to create shrimp farms. Plant-based foods – such as fruits and vegetables, whole grains, beans, peas, nuts, and lentils – generally use less energy, land, and water and have a lower greenhouse gas intensity than animal-based foods. (Figure 1.4) Emissions can be compared based on weight (per kilogram of food) or in terms of nutritional units (per 100 grams of protein or 1000 kilocalories) (U.N., 2022).

Reducing food waste can also help feed the world's growing population more sustainably. The United Nations (UN) predicts that the world population will reach 9.3 billion by 2050. This population increase will require more than a 50 percent increase in food production over 2010 levels (Searchinger et al., 2019).

Waste Disposal and Food Waste

The world produces 2.01 billion tons of municipal solid waste each year, with at least 33 percent of that—extremely conservative—not disposed of in an environmentally safe manner. Globally, waste produced per person per day averages 0.74 kilograms, but varies widely, from 0.11 to 4.54 kilograms. Although they represent only 16 percent of the world's population, high-income countries produce about 34 percent, or 683 million tons, of the world's waste. Global waste is expected to rise to 3.40 billion tons by 2050, more than double the population growth over the same period. Overall, there is a positive correlation between waste generation and income levels. Daily per capita waste production in high-income countries is projected to increase by 19 percent by 2050, compared to low- and middle-income countries, which are expected to increase by around 40% or more. The East Asia and Pacific region produces most of the world's waste, at 23 percent, and the Middle East and North Africa region produce the absolute least, at 6 percent. However, the fastest growing regions are sub-Saharan Africa, South Asia and the Middle East, and North Africa, where total waste production is expected to more than triple, double, and double by 2050 (Figure 1.5).

FIGURE 1.4

A KILOGRAM OF GREENHOUSE GAS EMISSION PER KILOGRAM OF FOOD
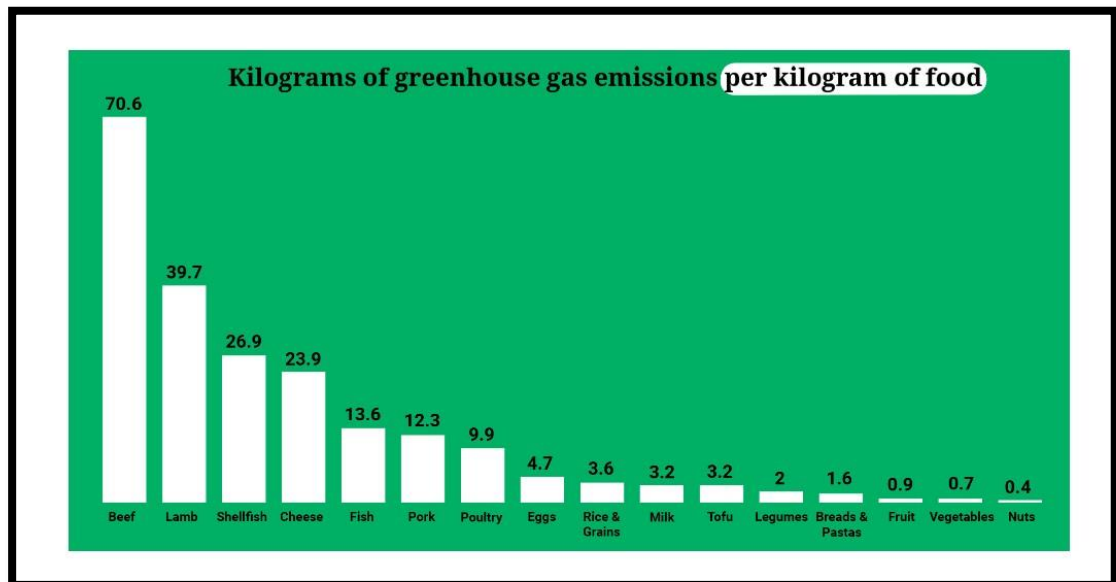
Source: U.N. Climate Action, 2022

FIGURE 1.5

WASTE GENERATION, BY REGION (MILLIONS OF TONNES/YEARS)
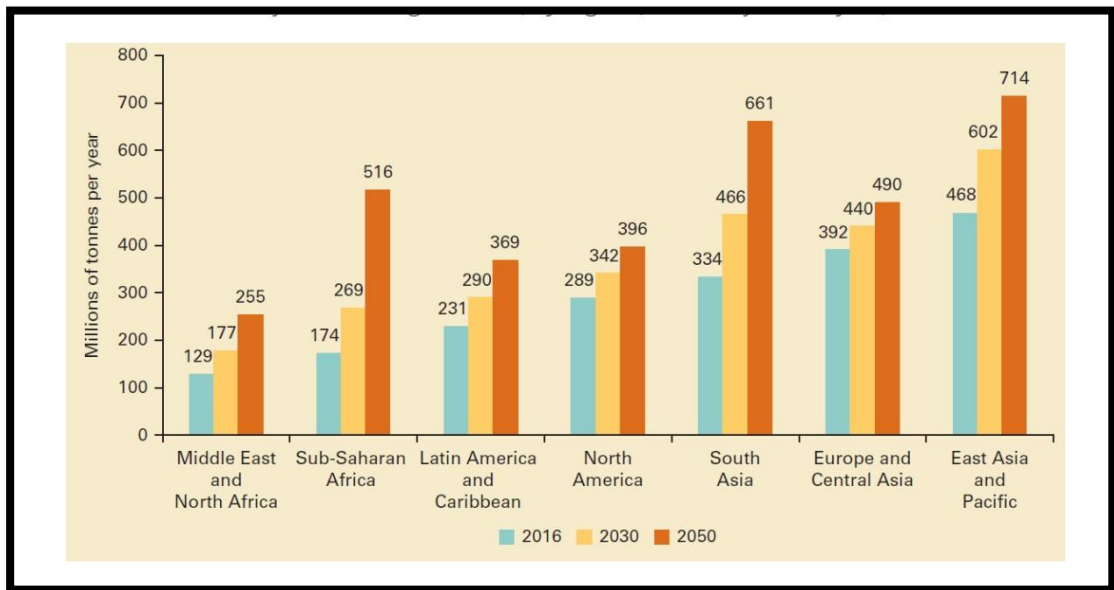
Source: The World Bank, 2017

In these regions, more than half of waste is currently openly dumped in landfills, and the growth trajectories of waste will have far-reaching consequences for the environment, health, and prosperity, and therefore require urgent action (TWB, 2017). The world continues to face the challenge of feeding its people sustainably. Approximately one billion people are undernourished worldwide (Naylor 2011). In the future, food production will also be affected by both projected population growth in many regions and climate change (Nelson et al, 2010).

A common misconception is that technology is the solution to the problem of unmanaged and growing waste. Technology is not a panacea and is usually only one factor to consider in solid waste management. Countries moving away from open dumping and other basic waste management methods have a better chance of succeeding by choosing locally appropriate solutions. Globally, most waste is currently landfilled. Approximately 37 percent of waste is landfilled, of which 8 percent is in sanitary landfills with landfill gas collection systems. Open landfills account for about 31 percent of waste, 19 percent are recycled and composted, and 11 percent are incinerated for final disposal. Adequate waste disposal or treatment, such as managed landfills or more stringent facilities, is almost exclusively the domain of high- and upper-middle-income countries. Lower-income countries generally rely on open dumping; 93 percent of waste is landfilled in low-income countries and only 2 percent in high-income countries. Three regions openly dump more than half of their waste – the Middle East and North Africa, sub-Saharan Africa, and South Asia (TWB, 2017).

In India, a countrywide sudden lockdown synchronized with the peak time of harvesting summer vegetables, paddy, and different grain crops. This led to the generation of enormous food waste which also created huge economic loss among farmers and also due to the abrupt lockdown in the nation, a large portion of the farm production was wasted (Sinha & Tripathi, 2021). However, the waste management system in the third-world city has either collapsed or is non-existent altogether. The seven measures composition for fa ood waste management system are waste generation, storage, collection, transfer, transport, processing, and disposal (Bhavannarayana, et al, 2014). Humans can not realize that poor consumption choices and management of food in their households can greatly damage the natural environment (Abdelradi et al, 2018).

FIGURE 1.6

GLOBAL WASTE COMPOSITION (%)
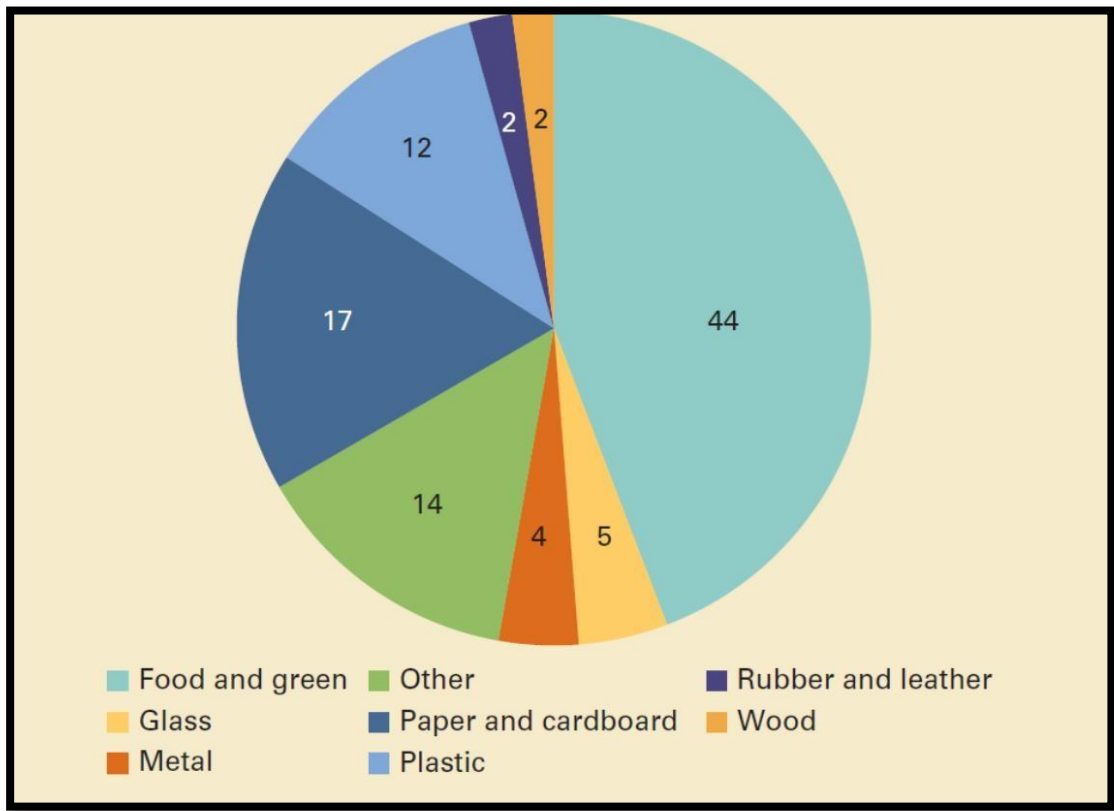
Source: The World Bank, 2017

According to U.S. EPA (2010), Reducing wasted food and packaging can save money by reducing not only disposal costs but also over-purchasing, labor, and energy costs. Food service establishments can receive tax benefits from donating wholesome, edible food to food banks or food rescue organizations.

RATIONAL OF THE STUDY

Large amount of food is wasted worldwide. The large amount of waste generated is a significant threat to the environment. Food waste is generated at each stage of the life cycle, but the largest amount is recorded at the household level. In India, 68 million tons of household food waste is generated annually. To reduce consumer-related food waste in developed countries, it is necessary to have an in-depth understanding of the factors shaping food waste-related consumer perception and behavior, both in the household as well as at the point of purchase.

OBJECTIVES OF THE STUDY

1. To assess consumer food purchasing behaviour
2. To evaluate association between avoidable food waste and consumer behaviour
3. To determine household food waste composition based on consumer responses

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Food Waste

Food waste has received increasing attention over the past few years. In the European Union, food is defined as something "…intended to be, or reasonably expected to be ingested by humans". It is increasingly acknowledged that when food is not used to this end, but for other purposes within the waste hierarchy, the food itself and the resources exploited in its production, transportation, or disposal are used inefficiently. This has unfavorable environmental, economic, and social consequences on the sustainability of the food sector (Hooge et al, 2015).

Moreover, food waste strikes many consumers and stakeholders as an inequitable and unjust "luxury" that humanity cannot afford in light of our challenge to provide food for more people with less and more stressed resources. Reducing this waste is accordingly listed as one of the necessary actions for more sustainable food security (Rockstrom et al, 2009).

However, there is no consensus about the exact meaning of the term "food waste". The Food and Agriculture Organisation of the United Nations (2021), distinguishes between the so-called "wastage" produced mainly at the beginning of the supply chain (during production, post-harvest, and processing stages), called food loss, and the wastage generated principally at the end of the supply chain once the food has been processed, known as food waste.

The disadvantages of this definition are the difficulty to measure and report these parameters separately; in addition, the concept of "food waste" can cover different stages of the supply chain for different food products or geographical areas (e.g. biscuits produced in a factory or directly in the point of sale) (Garcia et al, 2019). By contrast, the project funded by the European Commission Framework Programme named Food Use for Social Innovation by Optimising Waste Prevention Strategies (FUSIONS, 2015) and the UK Waste & Resources Action Programme (WRAP, 2016) refer to both of these concepts as food waste. Another major discrepancy is the consideration of the inedible parts of food as food waste.

FAO (2019) only counts the parts of the food that could have been eaten by people. FUSIONS (2015) and WRAP (2016) also include inedible parts of food (such as bones or eggshells) in the definition of food waste. The quantification and treatment of separate edible and inedible parts of the food are normally difficult, and commonly unfeasible (a wasted orange will normally consist of the inedible peel and the edible orange itself and will not be peeled for its treatment). There is also disagreement regarding the intended uses of the food: the planned use of it in another way other than for human consumption (such as animal feed or rendering) is not considered food waste in any case, while the unplanned use of it in a non-food use is considered food waste by FAO but not by FUSIONS and WRAP (FAO (2019), FUSION (2015), WRAP (2016), Garcia et al, 2019). (Figure 2.1)

The distinction between planned and unplanned non-food use is very relative and unclear, as some producers may not plan how much of their product is going to be directed for human consumption and how much for other use. Furthermore, the same food product in the same stage of the supply chain could either be considered or not considered waste according to different criteria (Needham et al, 2017).

While food losses at the early stages of the supply chain are a problem in developing countries, food wastage at the later stages is primarily observed in developed countries. The consumer role in the issue of food waste is thus especially crucial in developed countries. There are indications that the household food waste problem might be increasing although more recent data also suggest that, with specific actions, a downward development is possible (Hooge et al, 2015).

Together with food scraps and leftovers, constitute consumer-related food waste. It is not possible to give an exact number of the amount of waste according to this differentiation, but some often-cited data can provide an idea of the relation between in-store and at-home food wastage: For example, FAO (2019) data assessed that in Europe, consumption stage-related food waste accounted for around 35% of all food wasted, while the share of food waste is close to 10% at the distribution stage (Needham et al, 2017).

A study conducted by European Commission in 2021 suggested that 31% of food waste across the supply chain occurs in households and 14% of waste in trade and catering. Although some amount of food waste occurs commonly at the retail and consumption

FIGURE 2.1

**DEFINITIONS OF FOOD WASTE ACCORDING TO DIFFERENT
ORGANIZATIONS**
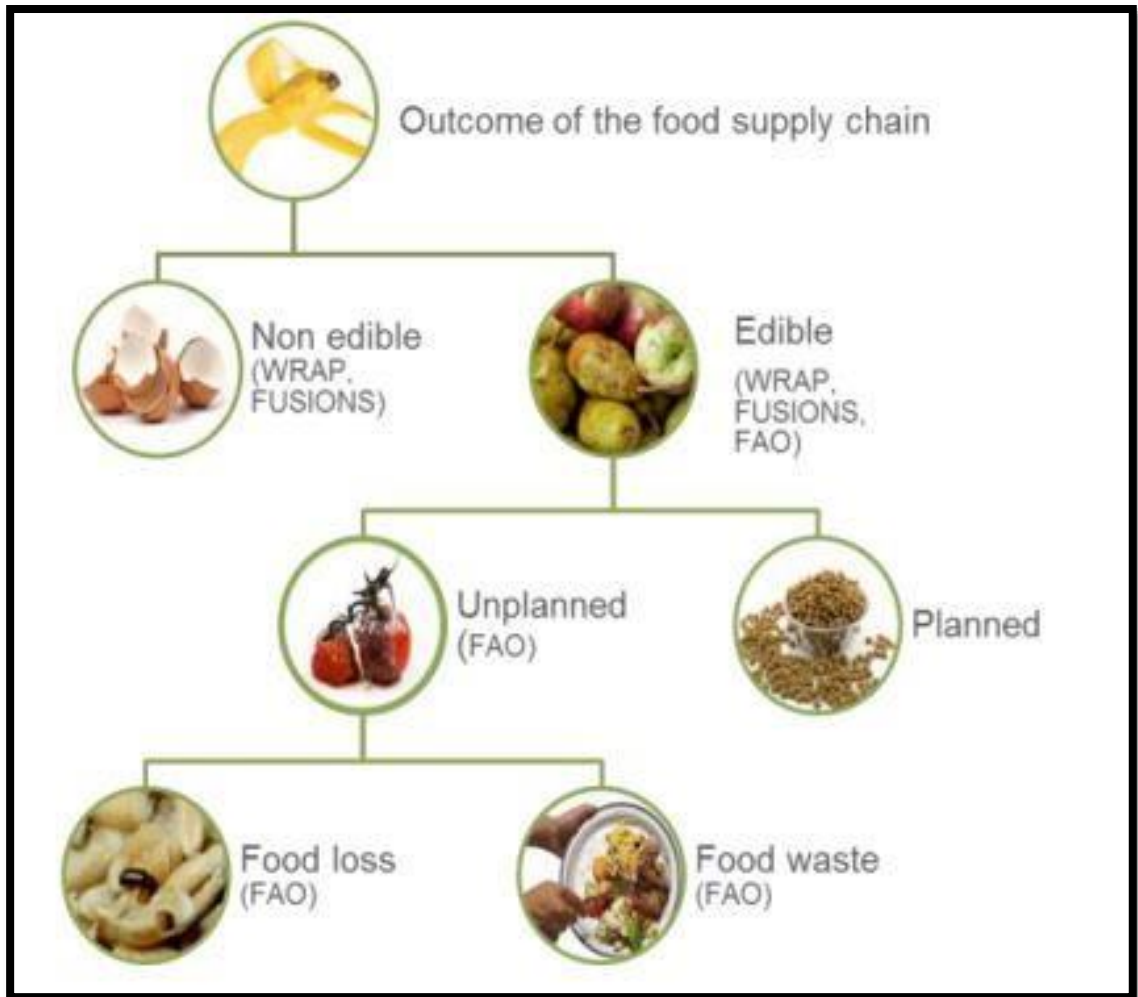
Source: FAO (2019), FUSION (2015), WRAP (2016)

stages of the food chain, most of it is produced as a result of carelessness or a cautious decision to throw the food away. Food waste is confined to the non-utilization of edibles and includes inappropriate waste of energy, water, and land resources (Tsang et al., 2019).

To reduce consumer-related food waste in developed countries, it is necessary to have an in-depth understanding of the factors shaping food waste-related consumer perception and behavior, both in the household as well as at the point of purchase (Amani et al, 2015).

Household Food-Related Routines and Food Waste Behaviour

Household food-related routines may influence the amount of food waste. For example, planning routines such as checking inventories or planning meals can contribute to a lower amount of food waste, while overcooking may lead to an increased amount of food waste. Household food waste prevention begins with shopping behaviour whereby consumers tend to be influenced by many incentives such as special offers and several psychological traps (Armitage et al, 2001).

Therefore, pre-shop planning and the use of shopping lists represent good practices for minimizing food waste. Shopping lists refer to the physical planning of the shopping event and the extent to which the person uses a shopping list to have a planned food purchase rather than an impulsive purchase. In addition, planning meals regularly, for example on weekly basis, may assist the households to estimate the food to buy and the amount needed to prepare the meals. This will consequently reduce the probability of food waste (Abdelradi et al, 2018).

Reducing global food waste has become an important agenda for achieving Sustainable Development Goals (SDGs), as it is expected to improve livelihood and preserve the environment. A examined the factors that influence household food waste behavior in Malaysia. Based on a survey gathered from 228 respondents, it was found that 70% of the respondents utilize leftovers, but only practice them once a week. Leftovers reuse routines includes practicing purposeful repurposing, whereby one plan to repurpose leftovers for other meals; freezing leftover single ingredients, in which freezing leftover

foods that will last long, such as bread that eventually makes breadcrumbs when needed; and lastly storing leftovers safely by keeping it in the correct containers with cover before storing them in the freezer or refrigerator (Zainal & Hassan, 2019).

Prevalence of Food waste

Global Prevalence of Food Waste

Global attention to food waste (FW) has grown tremendously in recent years (FAO, 2019). This is also reflected in the United Nations Sustainable Development Goals (SDGs), with Target 12.3 calling for a 50% reduction of global per capita food waste at the retail and consumer levels and for decreasing food loss along production and supply chains by 2030 (FAO, 2020).

The immense significance of the FW issue resides in its magnitude – roughly 1/3 of food produced for human consumption, amounting to 931 million tons annually, is lost or wasted according to the most widely-cited global estimate (Food waste Index,2021) (Table 2.1) and its intrinsic link to the grand challenges facing mankind, namely food security, climate change, and resource and environmental sustainability (FAO, 2019).

Apart from the differences regarding total food waste, waste across the supply chain also varies across the different stages and the different areas of the world. Woolly & Rahimifard, (2019) explains that in developing countries food waste is generated mainly at the beginning of the supply chain (caused by deficiencies in transportation and infrastructures and poor harvesting technologies), and in developed countries the end of the supply chain, mostly at a consumer level (strongly influenced by new trends in consumerism and mass marketing). Some analyses on this situation have been carried out measuring waste in terms of energy (kcal) lost instead of weight (kg or ton) of waste. According to World Resources Institute (2021), 56% of food is wasted by developed countries and 44% of food is wasted by developing countries (Figure 2.2). According to Food Waste Index (2021) around 61 percent of food waste came from households, 26 percent from food service, and 13 percent from retail. This suggests that 17 percent of total global food production may be wasted (11 percent in households, 7 percent in food service, and 14 percent in retail). (Figure 2.3)

TABLE 2.1

ESTIMATES OF GLOBAL FOOD WASTE BY SECTOR

	Global average food waste (kg/capita/year)*	2019 total (million tonnes)
Household	74	569
Food service	32	244
Retail	15	118
Total	121	931

Source: UNEP Food Waste Index Report, 2021

FIGURE 2.2

FOOD WASTAGE BY DEVELOPED AND DEVELOPING COUNTRIES

Source: World Resources Institute (2021)

TABLE 2.3

Out of the Total Food Wasted, Households are Responsible for the Major Chunk

Retail 13.00%
Food Service 26.00%
Households 61.00%
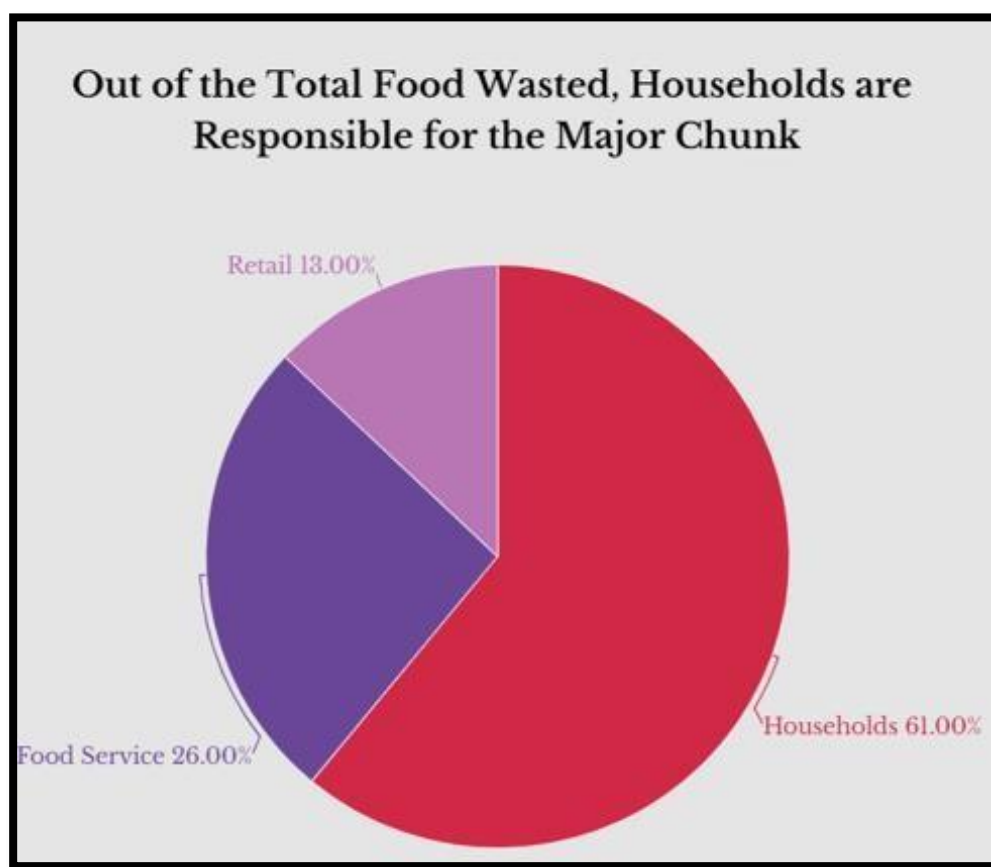
Source: UNEP Food Waste Index Report, 2021

The United Nations Environment programs, Food Waste Index (2021) has found that an estimated 931 million tons of food end up in the trash every year. Most of that figure, 569 million tons, falls under the category of household waste while the food service and retail.

On a per capita basis, the average global household wastes 74kg of food each year, a figure that's broadly similar across country income groups which indicates that widespread improvement is necessary. The latest figures recorded by UNEP show that the scale of the problem has been dramatically underestimated with the global waste at the consumer level more than twice as high as a previous FAO estimate. They estimate household food waste in each part of the country (UNEP Food Waste Index, 2021).

Perhaps unsurprisingly, the two countries with the largest populations generate the highest food waste totals. China came first with an estimated 91.6 million tons of discarded food annually, followed by India's 68.8 million tons. Elsewhere, U.S. households throw away an estimated 19.4 million tons of food every year while an estimated five to six million tons go into the garbage in France and Germany (UNEP Food Waste Index,2021) (Table 2.2).

Food waste is generated at each stage of the life cycle, but the largest amount is recorded at the household level (Ghinea and Ghiuta, 2018). The key causes of food waste generated in households are awareness, knowledge, preference, planning, portion size, packaging, storage, etc. (Stefan et.al.2013).

Jorissen et al. (2015) showed a strong correlation between the amount of food waste and household size in Italy (JRC/Ispra) and Germany (KIT/Karlsruhe). The absolute amount of food waste strongly depends on the number of persons per household, so smaller households ordinarily produce less waste than larger households, but the amount of food waste generated per person decreases with increasing household size.

Household food waste behavior is induced and predefined by consumers' food decisions, which depend on needs (according to heuristic and risk aversion criteria). However, these decisions neglect the effects of waste. In a review study conducted in Romania, most of the respondents preferred to buy food from the supermarket and almost half of them bought food products every day. They specified that sometimes they were attracted by special offers and they agreed that the main reason for food waste generation was the expiration date (Ghinea & Ghiuta, 2018)

TABLE 2.2

HOUSEHOLD FOOD WASTE ESTIMATES (FROM MEASURED DATA POINTS OR EXTRAPOLATION) FOR EACH COUNTRY

Region **Northern Africa**	
Country	**Household food waste estimate (tones/year)**
Algeria	3 918 529
Egypt	9 136 941
Libya	5 13 146
Morocco	3 319 524
Sudan	4 162 396
Tunisia	1 064 407
Region **Sub-Saharan Africa**	
Angola	3 169 523
Benin	1 175 297
Botswana	211 802
Congo	535 851
Burundi	1 184 127
Region **Latin America and the Caribbean**	
Argentina	3 243 563
Bahamas	28 794
Brazil	12 578 308
Chile	1 401 043
Colombia	3 545 499
Region **Northern America**	
Bermuda	4 606
Canada	2 938 321
Greenland	4 178
United State of America	19 359 951
Region **Central Asia**	
Kazakhstan	1 404 584
Kyrgyzstan	583 951
Tajikistan	906 209
Turkmenistan	449 895
Uzbekistan	3 001 868
Region **Eastern Asia**	
China	91 646 213
Hong Kong SAR	531 023

Japan	8 159 891
Mongolia	250 173
Republic of Korea	3 658 024
Region **South-Eastern Asia**	
Cambodia	34 742
Indonesia	1 423 397
Malaysia	20 938 252
Myanmar	4 666 125
Philippines	9 334 477
Thailand	5 478 532
Singapore	465 385
Region **Southern Asia**	
Afghanistan	3 109 153
Bangladesh	10 618 233
Bhutan	60 000
India	68 760 163
Nepal	2 249 412
Pakistan	15 947 645
Region **Western Asia**	
Armenia	275 195
Azerbaijan	934 872
Georgia	403 573
Iraq	4 734 434
Qatar	267 739
Turkey	7 762 575
Saudi Arabia	3 594 080
Region **Eastern Europe**	
Belarus	646 356
Poland	2 119 455
Romania	1 353 077
Russian Federation	4 868 564
Ukraine	3 344 904
Region **Northern Europe**	
Denmark	469 449
Finland	361 937
Iceland	25 829
Norway	423 857
Sweden	812 948
United Kingdom	5 199 825
Region **Southern Europe**	
Albania	469 449
Greece	1 483 996

Italy	4 059 806
Portugal	861 838
Spain	3 613 954
Slovenia	71 107
Region **Western Europe**	
Austria	349 249
Belgium	576 036
France	5 522 358
Germany	6 263 775
Netherland	854 855
Switzerland	616 037
Region **Australia and New Zealand**	
Australia	2 563 110
New Zealand	291 769
Region **Melanesia**	
Fiji	67 385
Papua New Guinea	798 767
Solomon Islands	60 963
Region **Micronesia**	
Guam	13 167
Nauru	850
Palau	
Region **Polynesia**	
American Samoa	4 187
French Polynesia	21 981
Samoa	14 923

Source: UNEP Food Waste Index Report, 2021

Consumers in the mid-to-low income/monetary wealth brackets waste food more frequently than those in the lower and higher income brackets do. This appears to be the result of consumers' decisions to renounce specific qualitative elements andservices of foodstuffs ("food storage practices and eating behavior") in favor of a relative compensatory increase in purchased quantities ("special offers," "food purchasing and preparation practices and behavior") (Setti et al, 2016).

According to Kazsa et al (2018), the most frequently wasted food categories were meals and bakery products. Bakery product waste was mainly dominant for middle-income consumers and fresh fruits were typically wasted by more affluent households in Hungry.

In Austria, 29% of food wastage occurs during the production stage like wastage from ingredients left during production and/or faulty forecasting techniques resulting in the form of over-cooked dishes (Hennchen et al, 2019).

Yu & Jaenicke, (2020) found that healthier diets and higher income lead to more household food waste, whereas lower household food security, food-assistance program participation, and larger household sizes are associated with less food waste.

Cronje et al. (2018), explored household food waste with a significant proportion of the respondents being female (81%), whereas only 19% were male and they reported that bananas and apples are the fruit that was most often wasted, and tomatoes and potatoes were the most wasted vegetables. Furthermore, leftover food was identified as one of the main sources of discarded food. Alternatives for the reuse of leftover food could aid in consumer reduction of food waste in Kimberley, South Africa.

A review study conducted by Falasconi et al (2019) reported that the perceived quantity of food waste declared by respondents was very low. Among the main determinants, food shopping habits and the level of awareness about the reasons why food is wasted played a key role. In contrast, the perception of the environmental effects of food waste seemed to be less important.

An exploratory survey was done in Morocco. Most of the respondents had a good understanding of food labels. It seems that FW is widespread in Morocco as only 3.3% of respondents declared that they do not waste any food. About two-fifths (39%) declare that their households throw away at least 250 g of still-consumable food each week (Abouabdillah et al, 2015).

In 2021 Mijares et al. (2021) in South Florida, explored food waste and its association with the diet quality of foods purchased and results show that fresh fruits (63%) and leafy greens (70%) were the foods that were the most wasted.

In Denmark, Stancu and Lahteenmaki (2022) investigated that food waste was directly and positively associated with excessive buying, and discarding of food past the best-before date without checking its edibility and disgust sensitivity. On the other hand, consumer food waste was directly and negatively related to motivation to reduce food waste and frugal self-identity.

Prevalence of Food Waste in Asia

Providing nutritious, safe, and affordable food for all in a sustainable manner is one of the greatest challenges the world faces today, particularly in the context of Asia – where 515 million people are estimated to be undernourished, with the highest rates of food insecurity in Central and Southern Asia (FAO, UNICEF, 2018).

Yet an estimated one-third of the food produced for human consumption is lost or wasted worldwide (Gustavsson et al., 2011). In developing countries where national economies depend more on the agricultural sector, such as many countries in Asia, food wastage tends to occur at the post-harvest stage, also termed "food loss" (Schneider, 2013).

Figure 2.4, Amid a global food system crisis, Asia produces over 50% of global food waste, with the main culprits being industrialized urban areas in the region. Just three countries in Asia combine to make up over a quarter of the world's wasted food – namely China, Japan, and South Korea being responsible for 28% of disposed of food. The amount of food wasted in China alone could feed 100 million people. Meanwhile, South and Southeast Asia together generate 25% of the planet's food waste (Food Waste Index, 2021).

FIGURE 2.4

FOOD WASTE IN ASIAN COUNTRIES
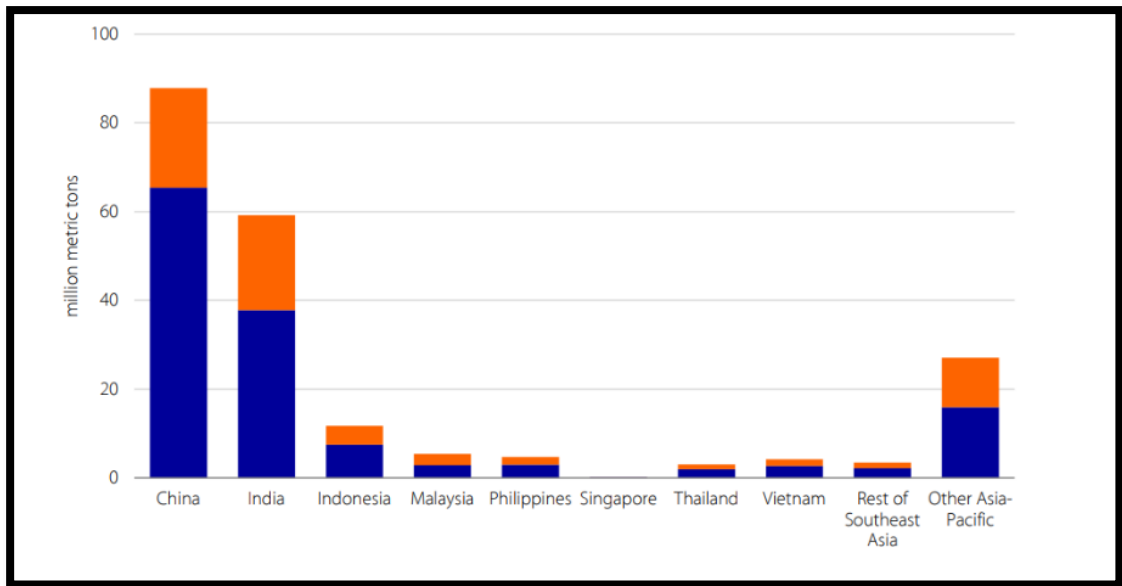
Source: UNEP Food Waste Index, 2021

It is estimated that 11 kg of food per capita per year is wasted in low-income Asian countries, while 80 kg of food per capita per year is wasted in high-income Asian countries (FAO, 2013). Trends in Asia, such as rising income, a dietary transition toward Westernized consumption patterns, urbanization, modern retail diffusion, increasing obesity, and time scarcity, are several factors that impact food provisioning and food waste in Asia (Ramachandran & Snehalatha, 2010).

In a household food waste study conducted in China, 37,000 households were enrolled in the China Health and Nutrition Survey (CHNS) from 1991 to 2009 and were described relevant food waste patterns and trends within households over a period of dramatic change. Over a period in which average real household incomes tripled, food discarded per person declined by about 20% on a quantity basis and by about 40% on a Calorie basis during the study, with an estimated annual per capita household waste of 14.9 kg in 2009 (Qi et al, 2010).

Ministry of Agriculture, Fisheries, and Food (MAFF) (2018) estimated that Japan discarded approximately 28.42 million tons of food annually (including 10.13 million tons of by-products such as soybean meal and bran which have been sold commercially as animal feed or fertilizer). The amount of food wasted is about 34% of the annual supplies for domestic consumption. Of this amount, 20.1 million tons were from the food industry (processing, wholesale, retail, and restaurants) while 8.32 million tons were from households (MAFF, 2018, Sahakian et al, 2019).

Prevalence of Food Waste in India

In countries like India 795 million, out of the world population of 7.6 billion people, don't have enough food to lead a healthy life or they are undernourished. That is approximately one out of nine people on earth. The reasons can be; firstly, that there is a shortfall in the food produced worldwide or second, there is a massive food wastage phenomenon occurring. Looking further into these reasons, today the world is yielding one and half times more for an individual, roughly that is enough to feed close to 10 billion people (Nigum & Sharma,2017).

One-third of food produced globally for human consumption is wasted worldwide per year which is around 1.3–1.4 billion tons of which 275 million tons have beenaccounted for in South and Southeast Asia which includes developing economies like India and China. In a study related to comparing household food waste estimates for each country in the Southern Asia region, 50 kg/capita/year was found to be for India which was lesser than Bhutan (79 kg/capita/year), Bangladesh (65 kg/capita/year) andAfghanistan (82 kg/capita/year) (Food waste index,2021 (Nigum & Sharma,2017).

Household food waste estimate for India was found to be nearly 68,760,163 tons/year with medium confidence in estimation and was higher than that in Bhutan (60,000 Tons/year), Bangladesh (10618233 tons/year), and Afghanistan (3109153 Tons/year) (Food Waste Index, 2021).

"Indians waste as much food as the whole of the United Kingdom consumes'' and because of this millions of people are sleeping hungry in a population of 1.3 billion in India. India ranks 100 among 119 countries ranking. In India, majorly food waste is generated in hostels, restaurants, supermarkets, households, cafeterias in airlines, and food processing industries (Global hunger index,2020).

According to the Food Waste Index report 2021 by United Nations Environment Program (UNEP), in India, 90 kg/per capita/year of food waste was recorded in the high-income group which was 68, and 63 in middle- and low-income groups. They found that family size and the high-income group had a positive correlation with residential waste generation such as food, paper, plastic, and metal.

In the characterization of municipal solid waste, India comprises a maximum of food waste (31.9%) as compared to other wastes such as plastic, textile, paper, glass, cardboard, ash, leather, and metal waste (Global Waste Management, 2019). Srivastava et al (2014) conducted a study in Varanasi, Uttar Pradesh to assess the amount of solid waste generated in different places in the city and they found that the maximum waste was food waste which was 31.9% followed by plastic (22%), textile (10.6%), paper (9.6%), glass (6.7%), cardboard (6.2%) and minimum metal waste (2.2%).

UN Food and Agriculture Organization (FAO) (2021) reports that over 190 million Indians are undernourished. Furthermore, it is stated that every third malnourished kid is Indian. Ironically, the same survey claims that over 40% of food produced in India is lost or squandered. It is also estimated that food waste costs in India are over 92,000 crores per year. This food waste, however, is not restricted to one level but pervades all stages, from harvesting through processing, packaging, and shipping to the final stage of consumption. Though food waste is a worldwide issue, India can turn it into an opportunity if addressed appropriately.

Food Security

Since well before the COVID-19 pandemic, several major drivers have put the world off track to ending world hunger and malnutrition in all its forms by 2030. Now, the COVID-19 pandemic and related containment measures have made it significantly more challenging to achieve this goal. But they have also highlighted the need for deeper reflection on how to better address the major drivers that are resulting in the global food insecurity and malnutrition situation we are experiencing right now (WHO, 2021).

The concept of food security originated some 50 years ago, at a time of global food crises in the early 1970s. Even two decades ago, there were about 200 definitions for food security in published writings, showing the contextual dependent features of the definition (Maxwell & Smith, 1992).

The current widely accepted definition of food security came from the Food and Agriculture Organization's (FAO) annual report on food security "The State of Food Insecurity in the World 2001": Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2002). The last revision to this definition happened at the 2009 World Summit on Food Security which added a fourth dimension – stability – as the short-term time indicator of the ability of food systems to withstand shocks, whether natural or man-made (FAO, 2009).

Four dimensions of food security have been identified according to the definition (FAO, 2008). 1) Availability: of food produced locally and imported from abroad. 2) Accessibility: The food can reach the consumer (transportation infrastructure) and the latter has enough money for the purchase. To such physical and economic accessibility is added socio-cultural access to ensure that the food is culturally acceptable and that social protection nets exist to help the less fortunate. 3) Utilization: The individual must be able to eat adequate amounts both in quantity and quality to live a healthy and full life to realize his or her potential. Food and water must be safe and clean, and thus adequate water and sanitation are also involved at this level (FAO, 2009). A person must also be physically healthy to be able to digest and utilize the food consumed. The fourth domain of Stability deals with the ability of the nation/ community/(household) person to withstand shocks to the food chain system whether caused by natural disasters (climate, earthquakes) or those that are man-made (wars, economic crises). Thus, it may be seen that food security exists at several levels (The World Bank,2020) (Figure 2.5).

Availability - National; Accessibility – Household; Utilization – Individual; Stability – may be considered as a time dimension that affects all the levels. All four of these dimensions must be intact for full food security. More recent developments emphasize the importance of sustainability, which may be considered as the long-term time (fifth) dimension of food security. Sustainability involves indicators at a supra-national/regional level of ecology, biodiversity, and climate change, as well as socio-cultural and economic factors (Berry et al., 2015). These will affect the food security of future generations.

Food loss and waste are some of the most urgent social, economic, and environmental issues affecting our planet's sustainability, and it has a direct and indirect impact on food security (Aramyan et al.,2021). Food security has been high on the political agenda in recent years, due to factors such as volatile food prices, the use of food crops as biofuel or fodder, and droughts (Rosegrant et al, 2009).
Several measures have been suggested to meet the increasing challenges of feeding the world's population and increasing food security in a sustainable way, such as: halting

FIGURE 2.5

THE PATHWAY OF THE DIMENSION OF FOOD SECURITY
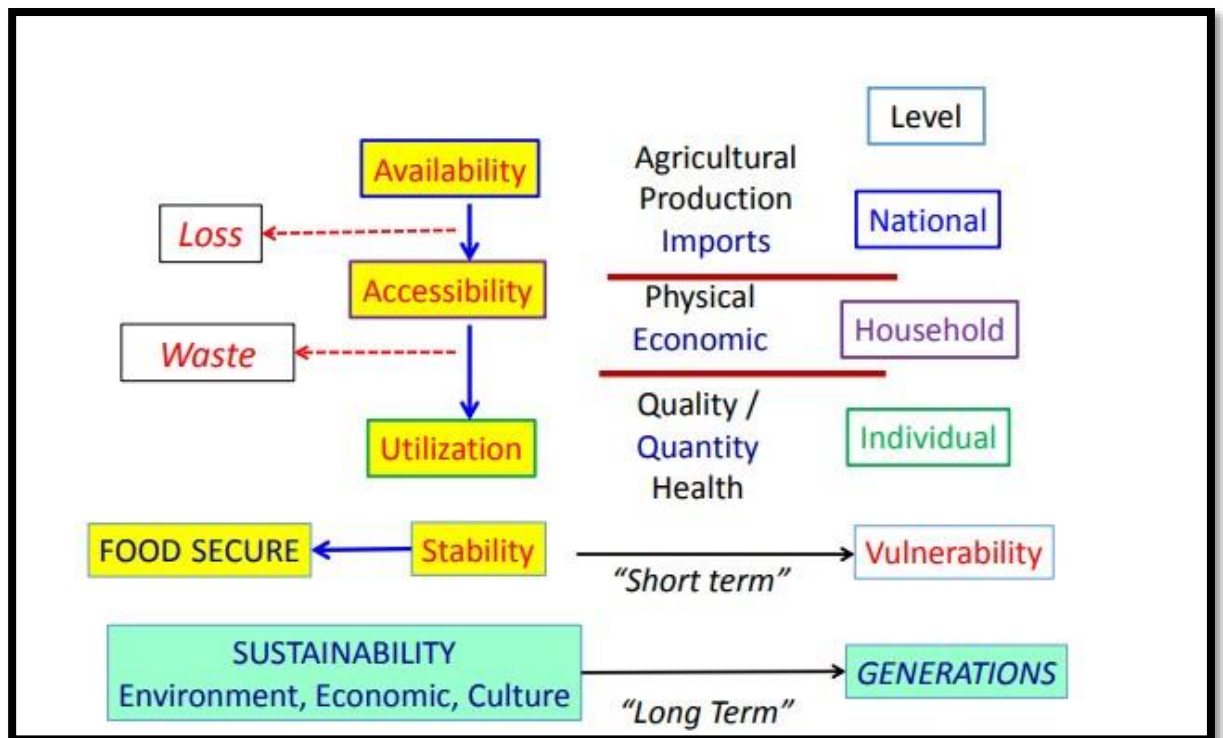
Source: FAO, 2009

farmland expansion, in particular in the tropics; closing 'yield gaps' on underperforming land; increasing cropping efficiency; shifting diets; and reducing waste (Godfray et al., 2010).By applying these measures to gather, food production could be doubled with our available resources without increasing environmental impacts (Foley et al., 2011)

Relationships Between Food Security and Food Insecurity

 Food security and food insecurity are dynamic, reciprocal, and time-dependent and the resultant status depends on the interaction between the stresses of food insecurity and the coping strategies to deal with them. The stresses of food insecurity may occur at any point along the food security pathway – Availability, Accessibility, Utilization, and Stability. The elicited coping responses may take place at the national, household, or individual levels. The two processes are interrelated linearly with re-iterative feedback loops such that stress leads to coping responses that may or may not be adequate, thereby requiring modifications in the coping strategies until food security is regained (Peng & Berry, 2018).

Food Waste and Food Security

Food waste asserts a negative effect on food security. In developing nations, a significant quantity of food is usually discarded by industries and households, and at a local level, it has been observed that better management and reduction of food wastage can lessen the food insecurity of households. Food waste can reduce the availability of food and therefore, harm the environment, consumption chain, and the resources used for the production of food (IFAD, 2022).

Food loss occurs from the farm up to and excluding retail, whilst food waste occurs at retail, food service, and household level. Causes range from poor handling, inadequate transport or storage, lack of cold chain capacity, extreme weather conditions to cosmetic standards, and a lack of planning and cooking skills among consumers (FAO, 2021).

Global Prevalence of Food Security

Despite hopes that the world would emerge from the COVID-19 pandemic in 2021 and food security would begin to improve, world hunger rose further in 2021. After remaining relatively unchanged since 2015, the prevalence of undernourishment (PoU) jumped from 8.0 to 9.3 percent from 2019 to 2020 and rose at a slower pace in 2021 to 9.8 percent (FAO, 2022).

It is estimated that between 702 and 828 million people were affected by hunger in 2021. The number has grown by about 150 million since the outbreak of the COVID-19 pandemic – 103 million more people between 2019 and 2020 and 46 million more in 2021, considering the middle of the projected range. The further increase in global hunger in 2021 reflects exacerbated inequalities across and within countries due to an unequal pattern of economic recovery among countries and unrecovered income losses among those most affected by the COVID-19 pandemic, all in a context of diminishing social protection measures that had been implemented in 2020 (IFAD,2022). (Figure 2.6) In 2021, hunger affected 278 million people in Africa, 425 million in Asia, and 56.5 million in Latin America and the Caribbean – 20.2, 9.1, and 8.6 percent of the population, respectively. While most of the world's undernourished people live in Asia, Africa is the region where the prevalence is highest. After increasing from 2019 to 2020 in most of Africa, Asia and Latin America, and the Caribbean, hunger continued to rise in most subregions in 2021, but at a slower pace. Compared with 2019, the largest increase was observed in Africa, both in terms of percentage and number of people. It is estimated that nearly 670 million people will still be undernourished in 2030 – 8 percent of the world population, which is the same percentage as in 2015 when the 2030 Agenda was launched. This is 78 million more undernourished people in 2030 compared to a scenario in which the pandemic had not occurred. After increasing sharply in 2020, the global prevalence of moderate or severe food insecurity remained mostly unchanged in 2021, whereas that of severe food insecurity rose higher, providing additional evidence of a deteriorating situation mainly for people already facing serious hardships. Around 2.3 billion people in the world were moderately or severely food insecure in 2021, or nearly 30 percent of the global population – more than 350 million more people than in 2019, the year before the COVID-19 pandemic unfolded. Close to 40 percent of people affected by moderate or severe food insecurity

in the world were facing food insecurity at severe levels. The prevalence of severe food insecurity increased from 9.3 percent in 2019 to 11.7 percent in 2021 – the equivalent

of 207 million more people in two years. In the last year, moderate or severe food insecurity increased the most in Africa, the region with the highest prevalence at both levels of severity. Food security also continued to worsen in Latin America and the Caribbean, although at a slower pace compared to the year before.

In Asia, the prevalence of moderate or severe food insecurity showed a slight decrease between 2020 and 2021, despite a small increase in severe food insecurity. The gender gap in food insecurity – which had grown in 2020 under the shadow of the COVID-19 pandemic – widened even further in 2021, driven largely by the widening differences in Latin America and the Caribbean, as well as in Asia (GFSI, 2022) (Figure 2.7).

In 2021, the gap reached 4.3 percentage points, with 31.9 percent of women in the world being moderately or severely food insecure compared to 27.6 percent of men. Although GFSI, (2022) report profiles the state of food security and nutrition up to 2021, the ongoing war in Ukraine poses an additional challenge for achieving the SDG 2 targets of ending hunger and casts a shadow over the state of food security and nutrition for many countries, in particular, those that are already facing hunger and food crises. After climbing year on year between 2012 to 2018, the overall food security score has not improved since 2019.

Across global food systems, food waste (FW) is a widespread issue, posing a challenge to food security, food safety, the economy, and environmental sustainability. No accurate estimates of the extent of FW are available, but studies indicate that FW is roughly 30 percent of all food globally (FAO, 2015).

The associations between food waste and food insecurity are potential areas of intervention for simultaneously reducing food waste and food insecurity, which could aid in achieving the SDG targets related to food waste and food security (Tomaszewska et al, 2022).

In Saudi Arabia, Althumiri et al, (2021) studied Food Waste, Food Insecurity, and the ap between the Two. They stated that the weighted prevalence of uncooked food waste in the last four weeks was 63.6% and the cooked food waste was 74.4%. However, the food insecurity weighted prevalence at the individual level was 6.8%. In terms of food insecurity at the household level, 13.3% were in the "severely food insecure" category.

FIGURE 2.6

BETWEEN 702 AND 828 MILLION PEOPLE IN THE WORLD FACED HUNGER IN 2021
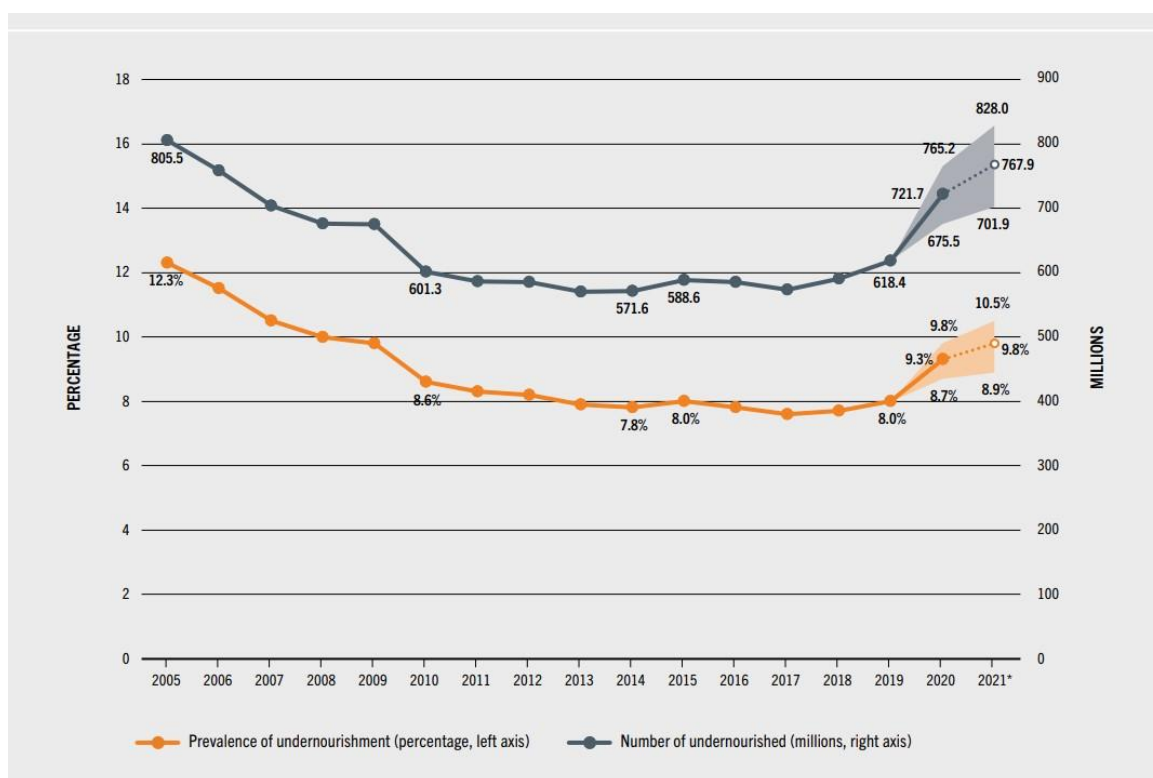
Source: IFAD, 2022

FIGURE 2.7

OVERALL GFSI 2022 SCORES, BY REGION

Region	Score
Global average	62.2
North America	78.6
Europe	74.8
Asia Pacific	63.4
Latin America	63.4
Middle East and North Africa	63.0
Sub-Saharan Africa	47.0
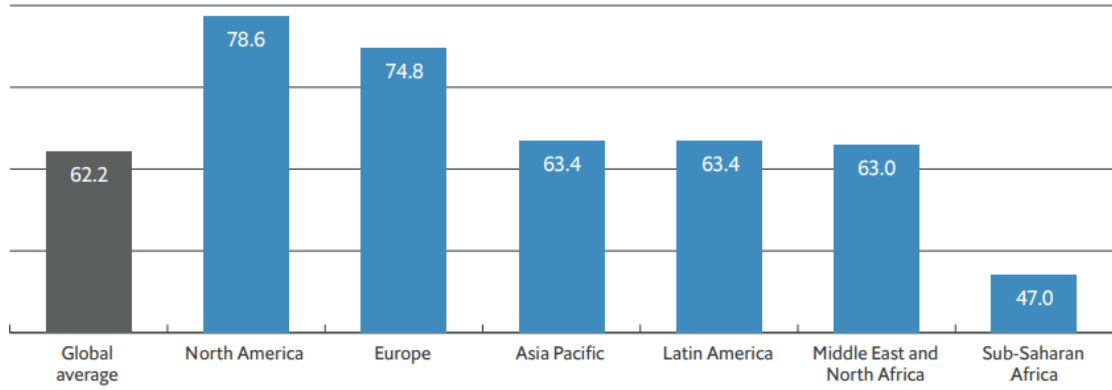
Source: GFSI, 2022

FIGURE 2.8

GFSI AVERAGE OVERALL SCORE, GLOBAL 2012-22
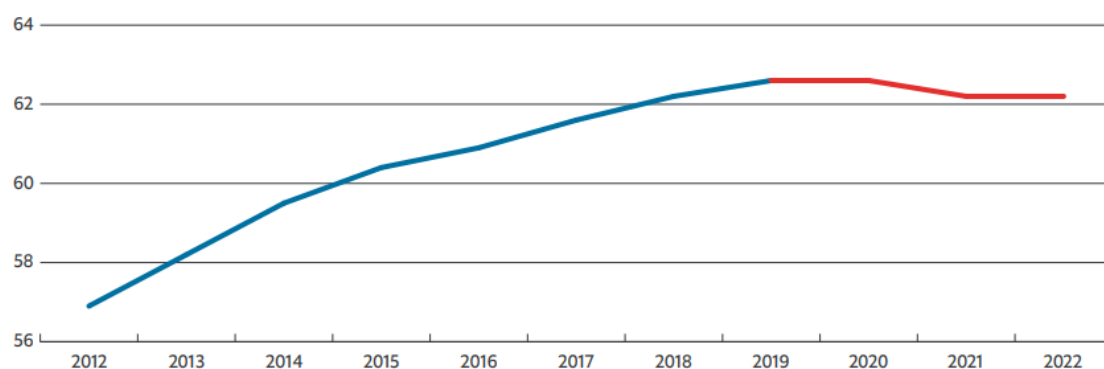
Source: GFSI, 2022

Amstrong et al, 2020, investigated food insecurity, food waste, food-related behaviours, and cooking confidence of UK consumers following the COVID-19 lockdown. They found that 39% of participants have experienced some food insecurity in the last 12 months and green leaves, carrots, potatoes, and sliced bread are the most wasted of purchased foods. Polenta, green leaves, and white rice are the most wasted cooked foods. Food secure participants reported wasting a smaller percentage of purchased and cooked foods compared to food insecure participants.

Urbano et al, (2022), investigated poverty, household structure, and consumption of foods away from home in Peru, the result show that the bulk of familieswas represented by nuclear families (61.97%). The highest expenditure in the CFAH was for families defined as composite with a yearly average of USD 1652.89.

Food Security in India

India remains an important global agricultural player; even though agriculture's share in the country's economy is declining. It has the world's largest area under cultivation for wheat, rice, and cotton, and is the world's largest producer of milk, pulses, and spices (The World Bank, 2012). While India has seen impressive economic growth in recent years, the country still struggles with widespread poverty and hunger.

India was ranked at 71st position in the Global Food Security (GFS) Index 2021 of 113 countries with an overall score of 57.2 points on the GFS Index 2021 (GFSI, 2022).

India loses forty percent of its food due to spoiling. India lacks sufficient infrastructure to store and transport food products; a concomitantly substantial amount of food simply decays away. The inadequate storage infrastructure resulted in the wastage of fruits, grains, and vegetables worth Rs 44,000 crore every year (Chaudhry et al, 2020).

Foodgrains damaged in Food Corporation of India (FCI) god owns across the country were more than 40,000 tons. It was increased in the last two years. The losses are due to natural calamities like cyclones and floods as well as poor storage facilities and transit loss in India (GFSI, 2022).

The wastage of food grains was 25,353 MT in 2006-07, 4,426 MT in 2013- 14, and 20,114 in 2015-16. At least 17,546 tons of food grains were damaged between 2017-

18 and July 2019. The damaged quantity rose threefold in five years — from 6,346 tons in 2019-20 to 18,847.22 tons in 2021-22. A total of more than 56,000 tons of food grains, including 27,000 tons of rice and 26,000 tons of wheat, were damaged since 2020, which are the main reasons of food insecurity (FCI, 2021).

Prevalence of Food Security in Gujarat

Before the implantation of the scheme providing food grains at subsidized prices, Gujarat showed a high level of food insecurity. Especially in rural areas, food insecurity was at high levels. According to International Food Policy Research Institute (2021) reports, Gujarat had a food insecurity level of 0.621-0.776, making it a highly food-insecure state.

According to NGO Centre for Health Education, Training and Nutrition Awareness (CHETNA), despite economic development and progress in several key health and mortality indicators, the food security level ranges from 0.218 to 0.89 in the country.

Chandorkar & Ahuja (2021) investigated food and nutrition security of households in Vadodara, Gujarat. They find that the availability of good quality (unadulterated) grains would improve the utilization of the system further and promote food security.

Greenhouse Gas Emission (GHG)

Greenhouse gases trap heat and make the planet warmer. Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities in the United States is burning fossil fuels for electricity, heat, and transportation (U.S. EPA, 2021).

The primary sources of greenhouse gas emissions in the United States are: Transportation (27% of 2020 greenhouse gas emissions) – The transportation sector generates the largest share of greenhouse gas emissions. Greenhouse gas emissions from transportation primarily come from burning fossil fuel for our cars, trucks, ships, trains, and planes. Over 90% of the fuel used for transportation is petroleum based, which includes primarily gasoline and diesel. Electricity production (25% of 2020 greenhouse gas emissions) Electric power generates the second largest share of greenhouse gas emissions. Approximately 60% of our electricity comes from burning

fossil fuels, mostly coal and natural gas. Industry (24% of 2020 greenhouse gas emissions) – Greenhouse gas emissions from industry primarily come from burning fossil fuels for energy, as well as greenhouse gas emissions from certain chemical reactions necessary to produce goods from raw materials. Commercial and Residential (13% of 2020 greenhouse gas emissions) – Greenhouse gas emissions from businesses and homes arise primarily from fossil fuels burned for heat, the use of certain products that contain greenhouse gases, and the handling of waste (Figure 2.9). Agriculture (11% of 2020 greenhouse gas emissions) – Greenhouse gas emissions from agriculture come from livestock such as cows, agricultural soils, and rice production. Land Use and Forestry (13% of 2020 greenhouse gas emissions) – Land areas can act as a sink (absorbing CO_2 from the atmosphere) or a source of greenhouse gas emissions. In the United States, since 1990, managed forests and other lands are a net sink, i.e., they have absorbed more CO_2 from the atmosphere than they emit (U.S. EPA, 2021)

Commercial and Residential Sector Emissions

The residential and commercial sectors include all homes and commercial businesses (excluding agricultural and industrial activities). Greenhouse gas emissions from this sector come from direct emissions including fossil fuel combustion for heating and cooking needs, management of waste and wastewater, and leaks from refrigerants in homes and businesses as well as indirect emissions that occur offsite but are associated with the use of electricity consumed by homes and businesses (U.S. EPA, 2021)

Direct emissions are produced from residential and commercial activities in a variety of ways: Combustion of natural gas and petroleum products for heating and cooking needs emits carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Emissions from natural gas consumption represent 79% of the direct fossil fuel CO_2 emissions from the residential and commercial sectors in 2020. Coal consumption is a minor component of energy use in both of these sectors. 1) Organic waste sent to landfills emits CH_4. 2) Wastewater treatment plants emit CH_4 and N_2O. 3) Anaerobic digestion at biogas facilities emits CH_4. 4) Fluorinated gases (mainly hydrofluorocarbons, or HFCs) used in air conditioning and refrigeration systems can be released during servicing or from leaking equipment. **Indirect emissions** are produced by burning fossil fuel at a power plant to make electricity, which is then used in residential and commercial activities such as lighting and appliances (FAO, 2013; EPA, 2021).

FIGURE 2.9

TOTAL GREENHOUSE GAS EMISSION
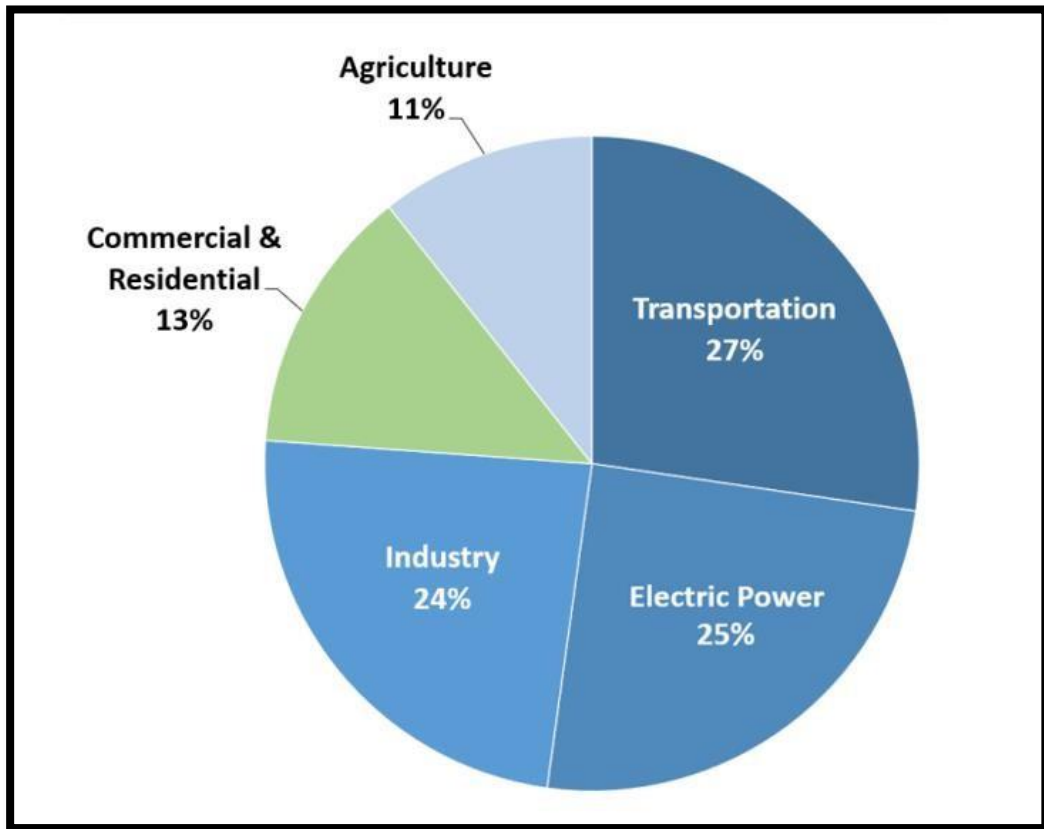
Source: U.S. EPA, 20

Global Greenhouse Gas Emission (GHG)

Over one-third of the food produced in the United States is never eaten, wasting the resources used to produce it and creating a myriad of environmental impacts (FAO, 2019). According to global food waste management Food waste accounts for 4.4 giga-tonnes (Gt) of CO_2eq. per year, which represents 8% of global anthropogenic GHG emissions. In comparison, the overall emissions from China, USA and India are 12.45, 6.34 and 3.00 Gt of CO_2 eq. per year (FAO, 2013). (Figure 2.10)

FAO quantified the food wastage footprint on natural resources, most notably its carbon footprint. Carbon footprint calculations – based on the 2011 assessment of food wastage volumes and emissions factors taken from Life Cycle Assessment studies – were estimated at 3.3 Gt CO_2eq for 2017 (excluding land use change). Using the most recent Foods Sheets updated to 3.6 Gt CO_2 eq which does not include the 0.8Gt CO_2 eq of deforestation and managed organic soils associated with the food wastage. Thus, the total carbon footprint of food wastage, including land use change, is around 4.4 Gt CO_2 eq per year (FAO, 2015).

The carbon footprint of a food product is the total amount of GHG eitted throughout its lifecycle, expressed in kilograms of CO_2 -equivalents. GHG emissions of the production phase (including all agricultural inputs, machinery, livestock, soils) and successive phases (such as processing, transportation, preparation of food, waste disposal) are all included in this calculation. Thus, one kg of wheat, or one kg of beef, have different carbon footprints, since their life cycles are different, emitting specific types and varying amounts of greenhouse gases (Clark et al, 2020).

Products hold different carbon intensities. For example, vegetable production in Europe is more carbon-intensive than vegetable production in Industrialized and Southeast Asia, as Europe uses more carbon-intensive means of production, such as artificially heated greenhouses. Inversely, cereal production in Asia is more carbon intensive than cereal production in Europe due to the difference in the type of cereal grown: rice on average has higher impact factors than wheat. Rice is a CH_4 emitting crop because of the decomposition of organic matter in paddy fields (1 kg of CH_4 is the equivalent of 25 kg of CO_2) (FAO, 2011). (Figure 2.11)

Despite meat being a relatively low contributor to global food wastage in terms of volumes (less than 5% of total food wastage) it has a significant impact on climate

change, contributing to over 20% of the carbon footprint of total food waste. This is because meat's carbon footprint includes the emissions from producing a kilogram of meat (e.g., the methane emitted by ruminants), the emissions related to feed provision (e.g., the fertilizer used for the production of feed), and emissions from manure management. Thus, efforts to reduce GHG related to food wastage should focus on major climate hotspots commodities, such as meat and cereals. The highest carbon footprint of wastage occurs at the consumption phase (37% of the total), whereas consumption only accounts for 22% of total food wastage. This is because one kilogram of food that is wasted further along the supply chain will have a higher carbon intensity than at earlier stages (FAO, 2011). (Figure 2.12)

Ritchie et al., (2020) found that almost one-quarter – 24% – of food's emissions come from food that is lost in supply chains or wasted by consumers. Almost two-thirds of this (15% of food emissions) comes from losses in the supply chain which results from poor storage and handling techniques; lack of refrigeration; and spoilage in transport and processing. The other 9% comes from food thrown away by retailers and consumers. This means that food wastage is responsible for around 6% of total global greenhouse gas emissions.

In Oakville and Ontario, quantifying the carbon footprint of household food waste and associated GHGs. The study's results identified where the greatest impacts on the carbon footprint of food waste can be achieved and the role that the municipality can play in motivating and enabling behaviors that lead to reductions in household food waste and associated greenhouse gases (Inamura et al, 2022).

Solarch et al., (2018), focused on the energy demand and carbon footprint of treating household food waste compared to its prevention in the United Kingdom. The results suggested that anaerobic digestion has the lowest, net-negative carbon footprint of -40 kg CO_2 eq. per tonne of waste treated and the highest life cycle energy recovery efficiency of 12% with respect to the total primary energy recovered.

Reducing food waste can also help feed the world's growing population more sustainably. The United Nations (UN) predicts that the world population will reach 9.3 billion by 2050. This population increase will require a more than 50 percent increase in food production from 2010 levels (UN, 2020).

FIGURE 2.10

TOTAL GHGS EMISSIONS TOP 20 OF COUNTRIES (YEAR 2013) VS.

FOOD WASTAGE
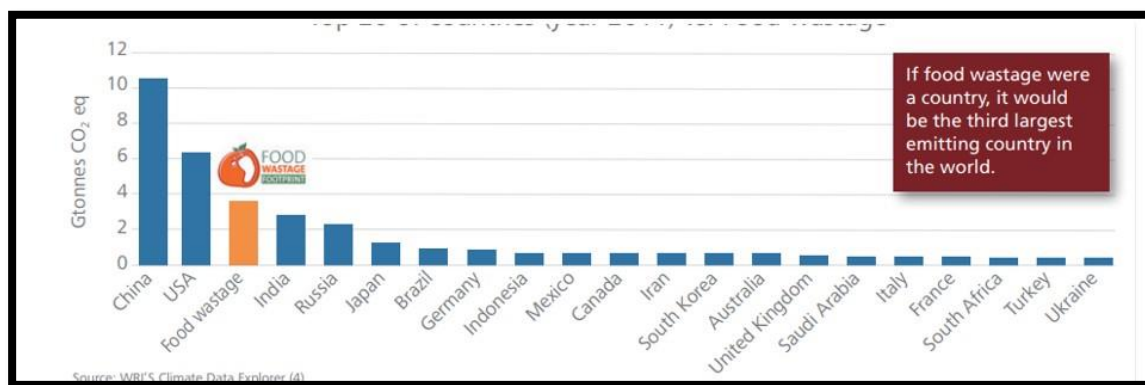
Source: FAO, 2013

FIGURE 2.11

CONTRIBUTION OF EACH COMMODITY TO CARBON FOOTPRINT AND FOOD WASTAGE

Contribution of each commodity to carbon footprint and food wastage
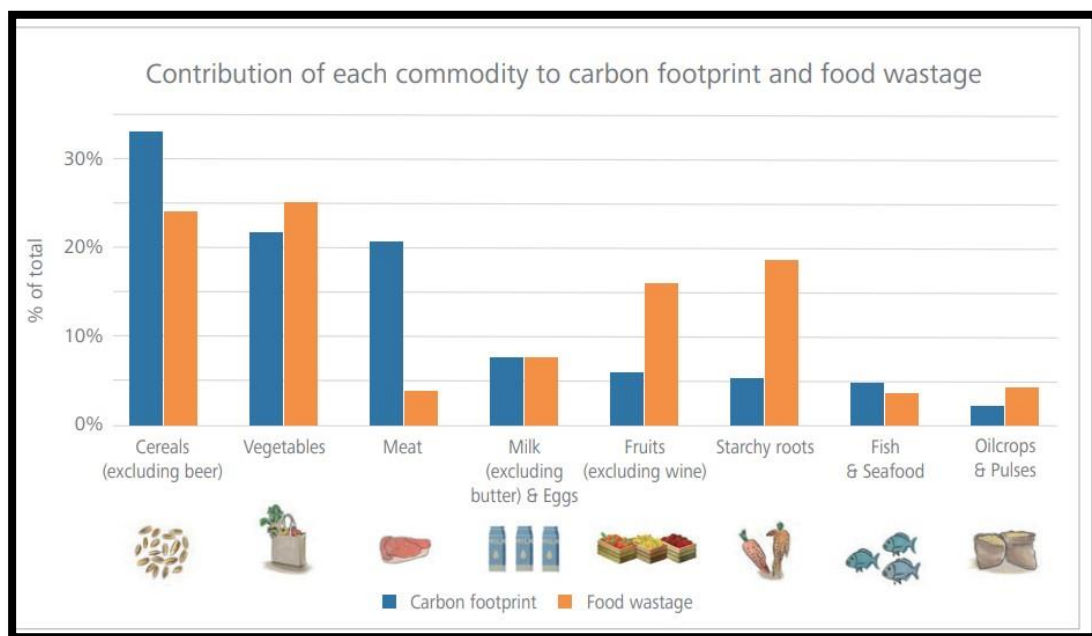
Source: FAO, 2011

FIGURE 2.12

CONTRIBUTION OF EACH PHASE OF THE FOOD SUPPLY CHAIN TO CARBON FOOTPRINT AND FOOD WASTAGE
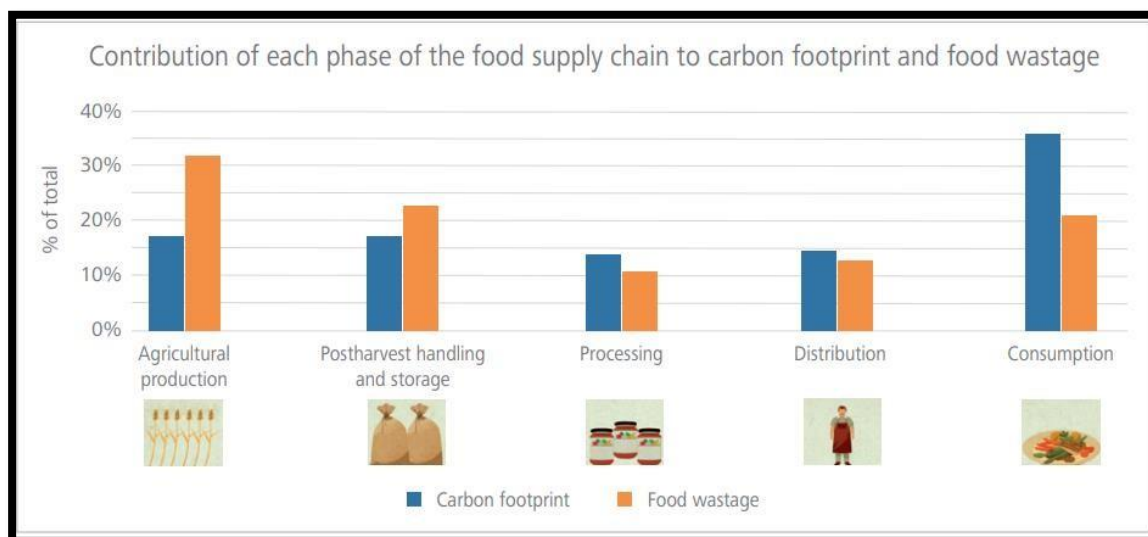
Source: FAO, 2011

Greenhouse Gas Emission (GHG) in India

The food consumption in relation to environmental impact has received political and social attention in recent years. The growth in food consumption causes increasing pressure on the environment (Pathak et al.,2010).

India, the most populous and largest country in South Asia, faces the challenge of rapid economic growth without increasing carbon emissions that threaten the climate system. At the COP26 session in Glasgow (31 October to 12 November 2021), India vowed to meet its climate change commitments by setting a net-zero target for 2070.

Being a megadiverse country endowed with abundant natural resources, India envisions achieving a carbon-neutral green growth and development pathway. The relatively rapid pace of urbanization (34.93% of the overall population in 2021 in the urban areas compared to 17.93% in 1960), quick economic growth (gross domestic product growth of 9.5% in 2021), industrialization, and agricultural intensification, however, have resulted in increasing levels of greenhouse gas (GHG) emissions in India in the past (Kumar & Arvindakshan, 2022).

The total GHG emissions (in million metric tons CO_2 equivalent, $MtCO_2e$) increased almost linearly from 746.5 in 1970 to 3375 in 2018. India is the third-largest contributor to global energy use and anthropogenic carbon emissions, after China and the USA, with its energy sector contributing 75% (2129 $MtCO_2e$) of overall emissions (Kumar & Arvindakshan, 2022).

India emits more GHGs from food waste than any other country except China and the USA. Post-harvest losses accounted for about US $ 15.19 billion worth of food in India in 2014, according to Agarwal et al, (2022) indeed, more than 40% of agricultural produce is damaged before reaching consumers. Of these, post-harvest loss of cereals from mishandling and lack of storage accounts for a major share. Highly perishable commodities such as fruits, milk, and vegetables are also wasted during post-harvest handling, primarily due to unhygienic handling and lack of cold chain facilities. Households in India also generate significant amounts of food waste (Agrwal et al.,2018).

According to the Food Waste Index Report (2021), food wastage per capita in India is around 50 kg per year, which accounts for a total food wastage of 68.76 Mt per annum.

Such food wastes from households and eateries usually end up in landfills, emitting GHGs.

Greenhouse Gas Emission (GHG) data in Gujarat

Climate change, better known as climate crisis, is the biggest global threat in this century. Gujarat cities have a dual role to play in combating this crisis as on one hand, cities are contributing more to GHG emissions compared to their rural counterparts, and on the other hand, cities are also more vulnerable to short-term and long-term impacts of climate change. Population density, income levels, and infrastructure are some of the factors affecting people (Patel et al., 2021).

According to Climate Change Department (2022), the state reduced its carbon emissions by about 15 percent in 2022 as compared to 2017, mainly due to an increase in the installed capacity of renewable energy in power generation. The reduction in carbon emissions from renewable energy in Gujarat was 12.08 million tons in 2017-18, which increased to 26.01 million tons, or around 115 percent in 2021-22. Climate changes and environment actional plan done in Ahmedabad district in 2022. According to them in 2015 to 2030, emissions of Gujarat are likely to increaseby 157 percent (given a CAGR of 6.5 percent). (Figure 2.13)

A study was done by Patel et al., (2021) in Bhuj, Gujarat, that investigated carbon footprint analysis of two wards of Bhuj city. The results showed that the organic waste ends up in landfill and it was found that carbon footprint is associated with organic waste disposal.

In 2010 alone, more than 34 million tons of wasted food were generated, with a meagre three percent of this diverted from landfills and incinerators to composting. (Figure 2.13) The damaging environmental effects of wasted food start with food rotting in landfills, which releases methane, a greenhouse gas (GHG) 21 times more potent than carbon dioxide. Thirteen percent of GHG emissions in the United States result from the growth, manufacturing, sale, transportation, and disposal of food (U.S. EPA,2010).

Food Waste and Waste Disposal

Global Data of Food Disposal:

Municipal solid waste (MSW) consists of a high proportion of biodegradable matter, which when disposed to a landfill decomposes leading to the formation of gas and leachate. Concerns over the environmental impacts of landfill emissions have resulted in efforts to identify alternative management options for MSW. Food waste constitutes a significant fraction of MSW, and its management presents considerable challenges due to its highly putrescible nature and the environmental, public health, and amenity implications (Gronow et al., 2012).

Food waste has been also identified as a significant social, nutritional, economic, and environmental 28 problem and interest in preventing food waste and diverting it from disposal has grown rapidly in globally. The world continues to face a challenge to feed its people sustainably (FAO, 2009; Pelletier and Tyedmers, 2010; Tilman et al., 2001); globally around one billion people are malnourished (e.g. Naylor,2011). In the future, food production will also be affecte by both projected increases in population in many regions (UN, 2011) and climate change (Nelson et al, 2010, Schmidhuber & Tubiello, 2007).

Sujauddin et al, (2008) investigated the household waste characterization and management in Chittagong, Bangladesh. They reported waste generation rate in the ranges of 0.25 kg/capita/day to 1.3 kg/capita/day. According to them household waste was comprised of nine categories of waste with vegetable/food waste being the largest composition (62 %). The high-income group and low-income group showed great variations in terms of total waste generation and quality of the waste. In high income and low-income group, the component of vegetable/food waste was 47 % and 66 %, respectively of the total waste generated per day.

However, the waste management system in the third world cities has either collapsed or is non-existent altogether. The seven measures composition of the food waste management system is waste generation, storage, collection, transfer, transport, processing, and disposal

FIGURE: 2.13

DATA OF GREENHOUSE GAS EMISSION (GHG)
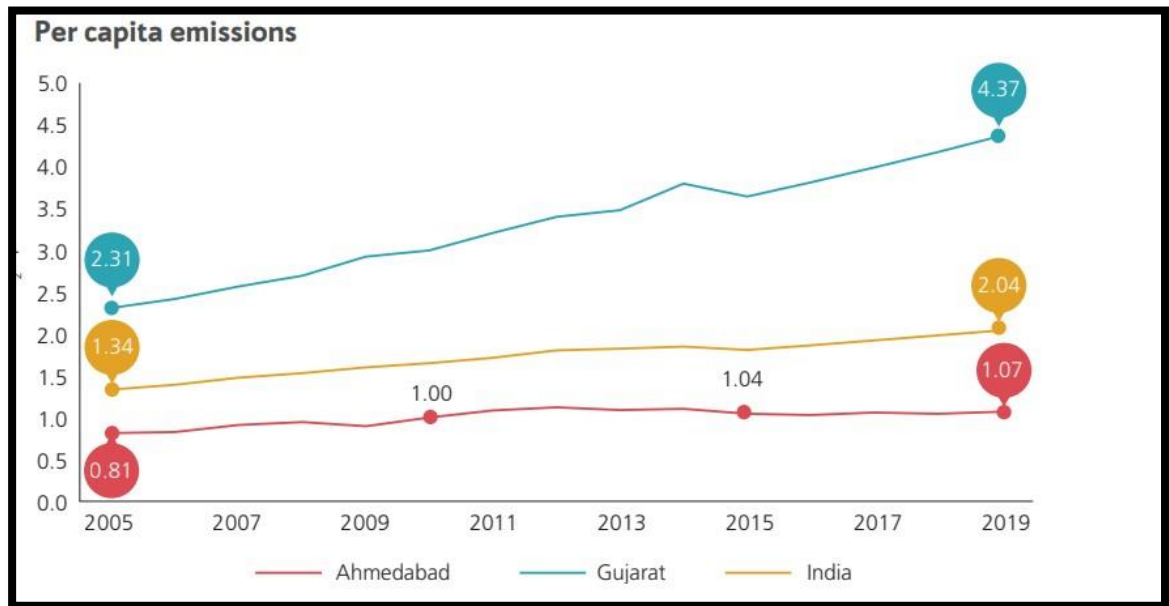
Source: Climate Change Department, 2022

(Bhavannarayana et al, 2014). Humans can not realize that poor consumption choices and management of food in their households can greatly damage the natural environment (Abdelradi et al, 2018).

According to U.S. EPA (2010), reducing wasted food and packaging can save money by reducing not only disposal costs but also over-purchasing, labor, and energy costs.

Additionally, food service establishments can receive tax benefits from donating wholesome, edible food to food banks or food rescue organizations.

National Data on Waste Disposal

In India, during Covid 19 pandemic countrywide sudden lockdown synchronized with the peak time of harvesting of summer vegetables, paddy, and different grain crops. These led to the generation of enormous food wastes which also created huge economic loss among farmers and also due to abrupt lockdown in the nation, a large portion of the farm production was wasted (Sinha & Tripathi, 2021).

Grover & Singha (2014), carried out an analytical study of effect of family income and size on per capita Household Solid Waste Generation in Developing Countries. The found that food, paper, plastic, metal and glass waste generation increases with an increasing income level whereas polyethylene waste generation decreases with increasing income level. Further, residential waste generation increases with increasing family size.

Shah et al. (2015) reported that at least some minimum number of species is essential for ecosystem functioning under steady conditions and that a large number of species is probably essential for maintaining stable processes in changing environments. Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. A number of processes are involved in effectively managing solid waste. These include monitoring, collection, transport, processing, recycling, incineration, landfilling and composting.

In order to understand the challenges of food waste management, we need to understand the characteristics of food waste (Dutta et al. 2021). Carbohydrates, proteins, lipids, and traces of inorganic substances make up the majority of food waste (Paritosh et al. 2017). Strong variations can be seen in the physicochemical properties of food waste, such as

in the C/N ratio, moisture content, pH, and, moisture and volatile solids (Abo et al. 2019).

Food waste made up of vegetables and rice is heavy in carbohydrates, whereas food trash made up of meat and eggs is high in proteins and lipids (Paritosh et al. 2017). Food waste can be utilized as a feedstock for butanol fermentation because it contains a lot of carbohydrates. Potato peels, whey, and apple pomace contain a very high concentration of carbohydrates making them a suitable substrate for butanol fermentation (Kosmala et al. 2011).

Kitchen garbage, other food waste, and restaurant waste all contained 84 percent water, with the remaining 16 percent of these wastes' weight being made up of solids (Kim et al. 2017). It was noted that the compositional features of food waste from various sources typically varied. To ascertain the changes in compositional content for five distinct forms of food waste, including kitchen waste, a comparative examination was conducted (Ho and Chu 2019). The highest protein content (approx. 26%) was found in household food waste (Haldar et al. 2022). All wasted food contains energy so it can be also used as a biogas.

Avoiding food waste along its lifecycle is therefore imperative for all those managing food production, distribution and sales. However, a significant fraction of food waste, especially at the household stage, still occurs. The correct management of these materials at the end of their lifecycle is essential in order to avoid the environmental and societal impacts caused by untreated, decomposing food (Benjamin & Mansoor, 2004).

FIGURE 2.14

PERCENT OF TOTAL WASTE GENERATION AND DISPOSAL
OF MUNICIPAL SOLID WASTE
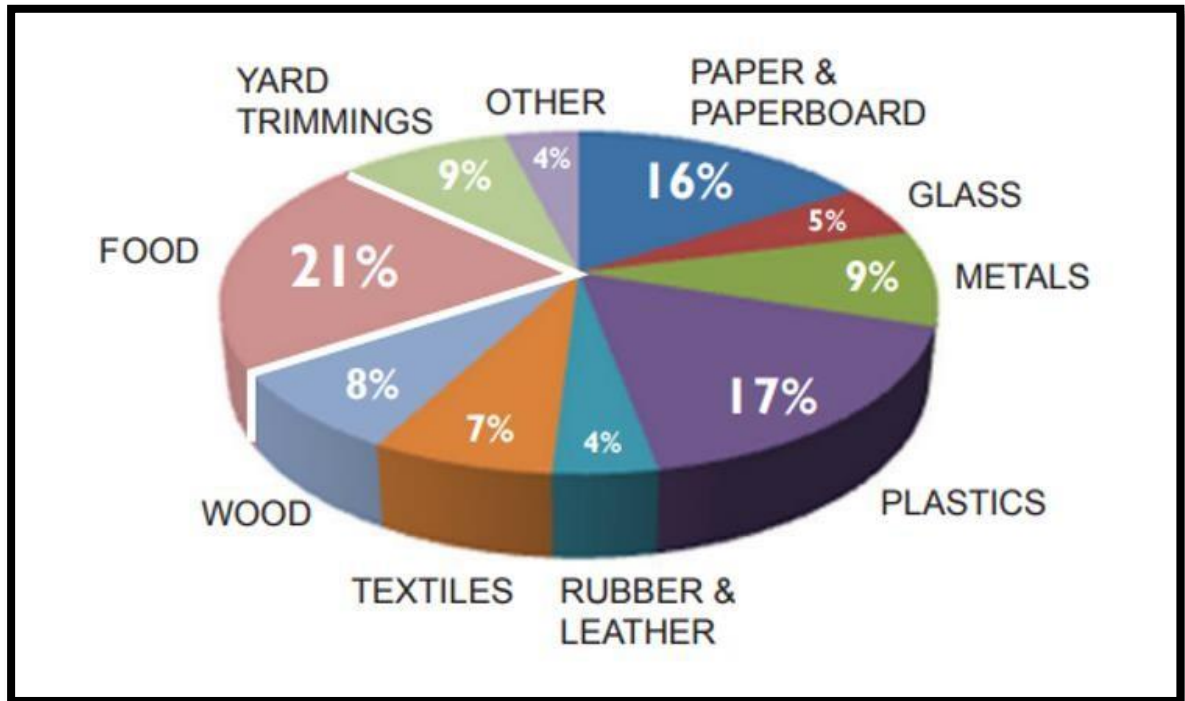
Source: U.S. EPA, 2010

METHODS AND MATERIALS

METHODS AND MATERIALS

Food that is intended for human consumption and that is wasted includes food that has been stored beyond its use-by date, as well as food that may have gone bad. Large-scale food waste is extremely detrimental to sustainability as it contributes to resource depletion and high levels of greenhouse gas emissions. These challenges have affected several global sustainability issues, including food security and climate change. Food waste occurs at every point in the food supply chain, including production, industrial processing, retail sales, and home consumption (Zainal & Hassan et al, 2019).

There are currently many debates about the amount of food waste produced annually, its impact on the environment, and ways to prevent food waste and plan relevant systems such as food and solid waste management systems (Ghinea et al. 2016). More than 1.3–1.4 billion tons of food intended for human consumption are lost annually, with 275 million tons occurring in South and Southeast Asia, including developing countries such as India and China. Indians waste as much food as the entire UK consumes, and millions of its 1.3 billion people go to bed hungry as a result. According to the World Hunger Index (2018), India ranks 100 out of 119 countries. Hostels, restaurants, supermarkets, apartment buildings, airline cafeterias, and the food industry are major sources of food waste in India.

The role of the consumer in the issue of food waste is therefore crucial, especially in developed countries. There are indications that the problem of household food waste may be increasing, although more recent data also suggest that a downward trend is possible with specific measures (Hooge et al, 2015).
FAO data (2019) estimated that in Europe consumption-related food waste represented around 35% of all food waste, while the proportion of food waste at the distribution stage is close to 10% (Needham et al, 2017). 31% of food waste in the entire supply chain is generated in households and 14% in retail and catering.

Although some amount of food waste normally occurs in the retail and consumption stages of the food chain, most of it is caused by carelessness or the careful decision to throw food away. Food waste is limited to the non-use of edibles and includes the inappropriate waste of energy, water, and land resources (Tsang et al. 2019).

Thus, the present study was planned to investigate consumer behaviour, habits, and attitudes regarding household food waste in Urban Vadodara. The study was approved by the institutional ethics committee for human research of the Faculty of Family and Community Sciences, The Maharaja Sayajirao University, Baroda (No. IECHR/FCSc/MSc/2022/42).

BROAD OBJECTIVE

To investigate consumer behaviour, habits, and attitudes regarding household food waste

SPECIFIC OBJECTIVES

1. To assess consumer food purchasing behaviour.

2. To evaluate the association between avoidable food waste and consumer purchasing behaviour.

3. To determine household food waste composition based on consumer responses.

STUDY DESIGN

The present study was undertaken to investigate consumer behavior, habits, and attitudes regarding household food waste in urban Vadodara, Gujarat. The study design is mentioned in Figure 3.1

SAMPLE SIZE

For the number of respondents to be included in a research study, the sample size of the study is an important aspect in designing the research.

- Sample Size = 404 Subjects

Required Sample size was obtained using formula $n = Z^2 * P (1 - P)/ d^2$

- P = expected prevalence 60.6% (based on the review of literature)
- Z = Statistic Corresponding will be taken as 1.96
- d= Absolute precision will be taken as 5 %

  Thus, the required sample size will be 367, and considering 10% attrition, the total calculated sample size is 404.

FIGURE 3.1

STUDY PLAN
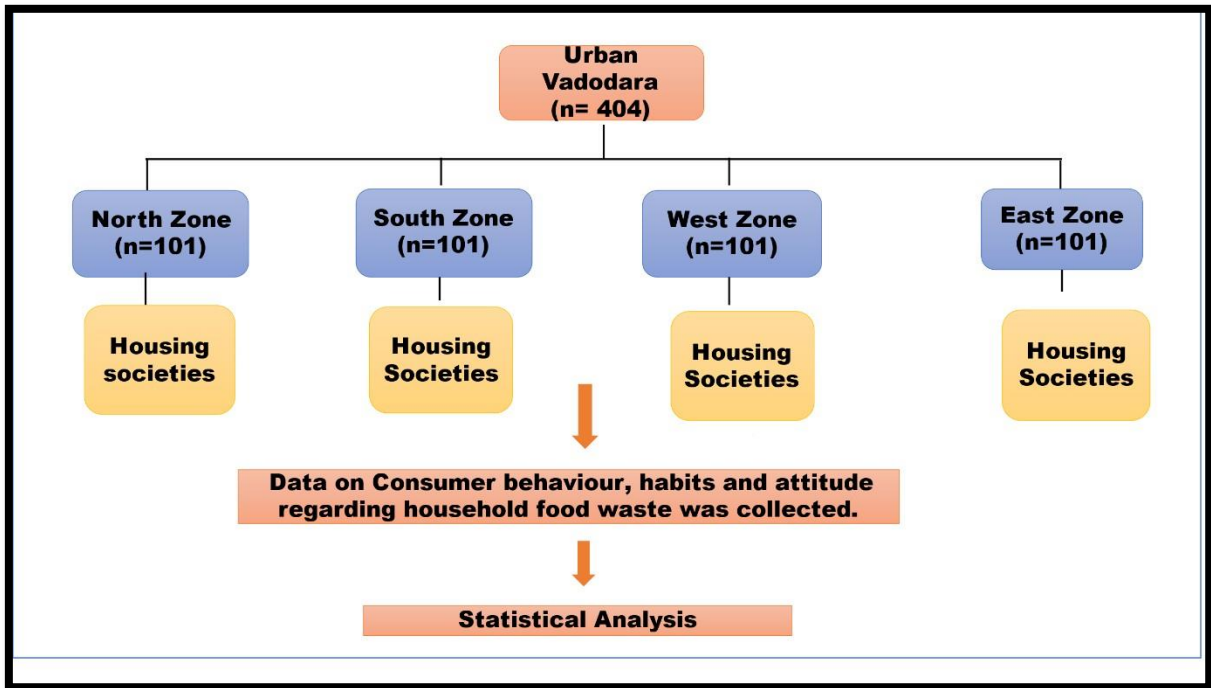
SAMPLE SELECTION

The study will be a cross-sectional study. Data was collected from urban Vadodara. Urban Vadodara was divided into four zones. i.e., North zone, South Zone, East zone and West zone. From each zone one housing society was purposively selected and subsequently societies were selected in a concentric manner till the desired sample size of 101 households from each zone was achieved. From each household data on consumer behavior, habits and attitudes regarding household food waste was collected. The data was statistically analyzed.

INCLUSION CRITERIA

- Age >18 years old
- Consent to take part in the study
- Person responsible for food provisioning activities

EXCLUSION CRITERIA

- Urban slums and VMC-constructed houses.

STUDY PLAN

The study was a cross-sectional study that to investigated consumer behavior, habits, and attitudes regarding household food waste in urban Vadodara.

The data was collected by used of a pre-tested questionnaire to assess consumer food purchasing behaviour. The tool and techniques used to collect data are mentioned in Table 3.1.

BACKGROUND INFORMATION

General information data were collected for the following using a structured pre-tested questionnaire

- Age
- Type of family
- Household size
- Education qualification
- Total monthly income
  Dietary Habits

TABLE 3.1 METHODS AND TOOLS

Parameter	Tools
Socio-demographic information	Pre-tested semi-structured questionnaire
Consumer behavior, attitudes, and habits	Pre-tested semi-structured questionnaire

CONSUMER BEHAVIOR, HABITS, AND ATTITUDES

Data related to consumer behavior, habits, and attitudes were collected using a pre-tested questionnaire. The questionnaire also included questions on categories of avoidable food waste in the previous 2 days, the usual amounts of food wasted, and reasons for food waste, and also investigated how they were disposed of.

STATISTICAL ANALYSIS

The data were entered into Microsoft Excel Spreadsheet, and verified for statistical analysis. The data was segregated appropriately and the calculation of the following was done.

- Mean and standard deviation
- Percentages
- Chi-square

- "t" test was used to find out the significance between and within the groups.

The result was considered to be significant if the p-value of the analysis was less than 0.05.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

Food waste according to its origin in the food chain, a distinction is made between food loss and food waste. Food waste is the loss of weight or nutritional quality of food originally intended for human consumption, usually caused by inefficiencies in the chain. food loss refers to edible food discarded in the early stages of supply, such as production, harvesting/harvesting, and industrial processing. However, food waste includes edible food thrown away at the final stages of sale and consumption. Food waste is generated in huge quantities during the life cycle of food, which has serious environmental, social, and economic consequences.

The largest share of waste is represented by households, where the final stages of the sales and consumption process occur along the food chain due to the impact that this waste causes climate change. That's why it's crucial to prevent this at this stage. The main causes of food waste generated in households are awareness, knowledge, preferences, planning, portion sizes, packaging, storage, etc. In general, very few cases are known in depth several studies have examined consumer behavior. More specifically, if the food is wasted at the end supply chain, i.e., in households, it is a waste of resources used in its production, processing, transport, cooling, and preparation as well as extra carbon footprint and water footprint arising in vain. In this context, the present research aims to study to investigate consumer behavior, habits, and attitudes regarding household food waste.

The study was a cross-sectional study. Data was collected from urban Vadodara. Urban Vadodara was divided into four zones. i.e., North zone, South Zone, East zone and West zone. From each zone one housing society wa purposively selected and subsequently societies were selected in a concentric manner till the desired sample size of 101 households from each zone is achieved. From each household data on consumer behavior, habits and attitudes regarding household food waste will be collected. The data will then be statistically analyzed.

BACKGROUND INFORMATION

Through interviews, background data about respondents was gathered using a pre-tested questionnaire. Female respondents represented 83.66% of the total respondents to the study. The mean age of the respondents was 47.6 years. While more women live in joint households, more men live in nuclear families. Only 0.5% of responders live alone, with the majority of respondents belonging to households of at least four. According to the respondents' educational backgrounds, the majority of males and females were graduates, with only 2.7% females being illiterate. While 9.9% of respondents were having monthly incomes below 5,000 rupees, the majority of respondents have monthly incomes between rupees 50,000 and 100,000. Only 14.8% of respondents were non-vegetarians in terms of their dietary habits. (Table 4.1)

FREQUENCY OF FOOD PREPARATION AT HOME

It was noted that the majority of respondents (79.5%) prepared food at home every day, although only 0.2 percent did it three to four times each week. (Figure 4.1)

MEASURING FOOD PRODUCTS DURING THE COOKING PROCESS

The majority of respondents measured food products when making food, as shown in the figure 4.2 whereas 29% did not measure food products. According to Katajajuuri et al. (2016) homemade food was thrown out mostly because majority of the consumers never measure food during the preparation process.

SHOPPING PLACES OF THE RESPONDENTS

Male (95.4%) and female (92.6%) respondents both shopped from markets in the majority (93.1%) of cases, whereas male respondents (3.03%) ordered food less frequently online. (Table 4.2)

A study by Ghinea and Ghiuta (2018), reported that only a small percentage of people (both men and women) prefer to buy their food from the manufacturers directly, and no one uses the internet to make their purchases. It can be seen that the responses of men and women in this situation were extremely similar; many of them chose to purchase food items from the supermarket.

A research by Jorissen et al. (2015), around 47% of respondents in Ispre and 42% of respondents in Karlsruhe claimed that they only buy food fromthe supermarkets. 25% of respondents in Karlsruhe and 21% in Ispre often buy in localmarkets. About 49% of respondents in Karlsruhe and 35% in Ispre also buy food in small stores. Food waste increases when individuals only shop at supermarkets, lowerswhen they shop at other stores, boutiques, and local markets, and is at its lowest when people also grow their own food.

FREQUENCY OF BUYING FOOD

About half of the males (50%) and females (51.2%) bought food one to two times a week,while male respondents (13.6%) bought food products daily and female (13.3%)respondents bought food products daily. (Figure 4.3)

According to Ghinea & Ghiuta (2018), 27% of surveyed females and 53% of surveyed males buy food products daily. So, one of the factors that could contribute to food waste in households was overspending on shopping.

A study was conducted by Bilali & Drioech (2015), where it was observed that around 53% of males and 27% females bought food products every day, while 22% of males and 35% of females reported that they shop for food twice a week.

According to a study by Jorissen et al. (2015), the majority of households in the cities of Karlsruhe and Ispra make food purchases twice each week. In Karlsruhe, there was a minor decline in the amount of food waste produced when shopping frequency rose, whereas the opposite was observed in Ispre.

CONSUMER BEHAVIOUR TOWARD FOOD PRODUCTS BEFORE BUYING FOOD

According to the table, many respondents never (4.4%) checked the refrigerator or store room before shopping, while the majority routinely (56.4%) check it before purchasing food. Menu planning used to be done very often (34.9%) by the majority of responders, while many others never (21.5%) did it. Before purchasing food, the majority of respondents sometimes (29.2%) write a shopping list, although 18.3% never do so. When purchasing food, respondents often got only what they required; yet, very few respondents never (0.5%) purchased only what they needed. The information gathered shows that the majority of respondents sometimes (29.7%) and always (29.2%) checked the "best before" date, whereas 8.4% of respondents never do so. Only1.7% of respondents did not consider how to store food to keep it fresh, compared to

TABLE 4.1

BACKGROUND INFORMATION OF RESPONDENTS N (%)

<table>
<tr><td colspan="5" align="center">Age (N= 404)</td></tr>
<tr><td>Male
(N=66)</td><td>Female
(N=338)</td><td>Total
(N=404)</td><td>'t'-value</td><td>p-value</td></tr>
<tr><td>47.22 ± 15.33</td><td>47.74 ± 14.56</td><td>47.66 ± 14.67</td><td>0.26</td><td>0.79</td></tr>
<tr><td colspan="5" align="center">Type of family N (%)</td></tr>
<tr><td></td><td>Male
(N=66)</td><td>Female
(N=338)</td><td colspan="2">Total
(N=404)</td></tr>
<tr><td>Nuclear</td><td>42 (63.6)</td><td>210 (62.1)</td><td colspan="2">252 (62.4)</td></tr>
<tr><td>Joint</td><td>24 (36.4)</td><td>128 (37.9)</td><td colspan="2">152 (37.6)</td></tr>
<tr><td colspan="5" align="center">Household Size (N=404)</td></tr>
<tr><td colspan="2" align="center">1</td><td colspan="3" align="center">2 (0.5)</td></tr>
<tr><td colspan="2" align="center">2</td><td colspan="3" align="center">47 (11.6)</td></tr>
<tr><td colspan="2" align="center">3</td><td colspan="3" align="center">76 (18.8)</td></tr>
<tr><td colspan="2" align="center">4</td><td colspan="3" align="center">108 (26.7)</td></tr>
<tr><td colspan="2" align="center">More than 4 persons</td><td colspan="3" align="center">171 (42.3)</td></tr>
<tr><td colspan="5" align="center">Educational Qualification (N=404)</td></tr>
<tr><td></td><td>Male
(N=66)</td><td>Female
(N=338)</td><td colspan="2">Total
(N=404)</td></tr>
<tr><td>Professional</td><td>7 (10.6)</td><td>27 (7.9)</td><td colspan="2">34 (8.4)</td></tr>
<tr><td>Graduate</td><td>35(53.03)</td><td>190 (56.2)</td><td colspan="2">225 (55.7)</td></tr>
<tr><td>Post-high school diploma</td><td>2 (3.03)</td><td>10 (2.9)</td><td colspan="2">12
 (2.9)</td></tr>
<tr><td>Higher Secondary</td><td>12 (18.2)</td><td>64 (18.9)</td><td colspan="2">76 (18.8)</td></tr>
<tr><td>Middle School</td><td>9 (13.6)</td><td>26 (7.7)</td><td colspan="2">35
(8.7)</td></tr>
<tr><td>Primary School</td><td>1 (1.5)</td><td>12 (3.6)</td><td colspan="2">13 (3.22)</td></tr>
<tr><td>Illiterate</td><td>0 (0)</td><td>9 (2.7)</td><td colspan="2">9 (2.23)</td></tr>
</table>

Total Monthly Income (In Rupees) (N=404)			
<25,000	40 (9.9)		
25,000-50,000	151 (37.4)		
50,000-1,00,000	207 (51.2)		
>1,00,000	6 (1.5)		
Dietary Habits N (%)			
	Male (N=66)	**Female (N=338)**	**Total (N=404)**
Vegetarian	52 (78.8)	285 (84.3)	344 (85.2)
Non-vegetarian	14 (21.2)	53 (15.7)	60 (14.8)
Ovo-vegetarian	0 (0)	0 (0)	0 (0)

FIGURE 4.1

FREQUENCY OF FOOD PREPARATION AT HOME N (%)_
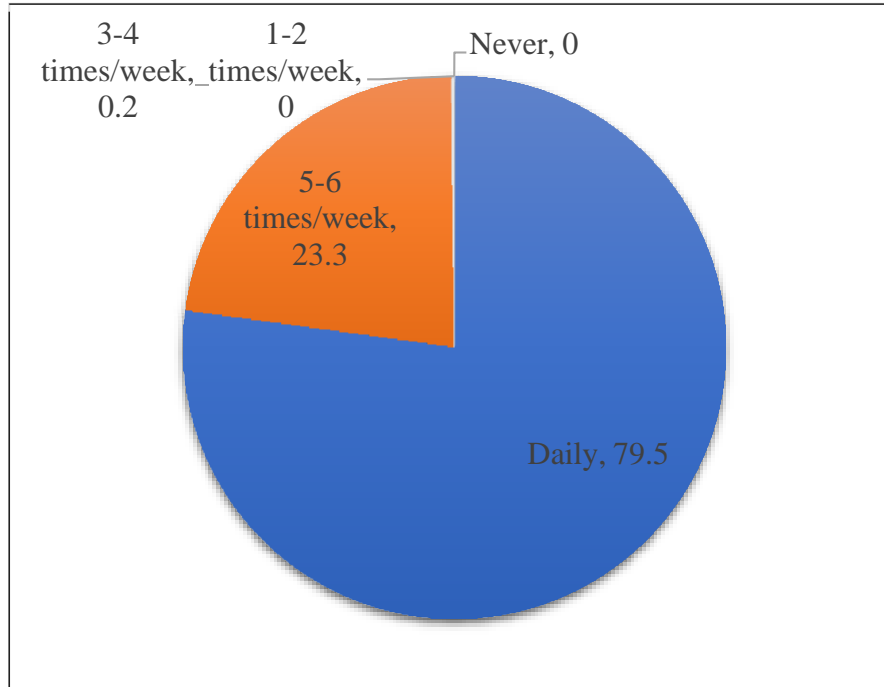
FIGURE 4.2

MEASURING FOOD PRODUCTS DURING THE COOKING PROCESS N

(%)
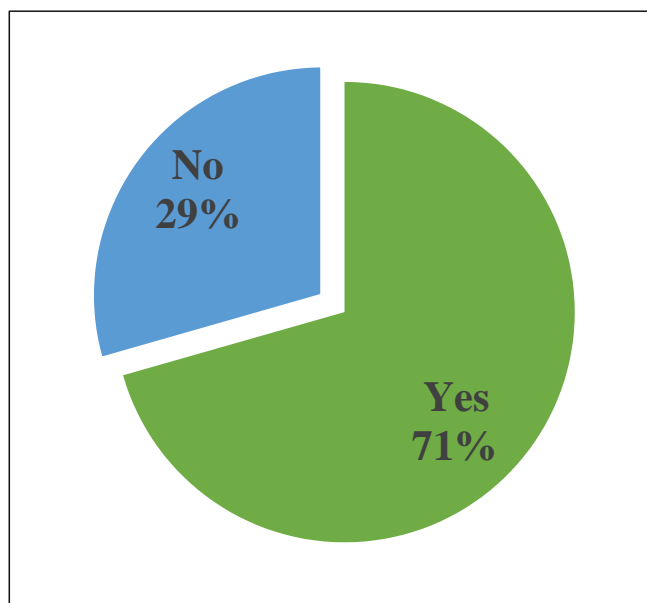
TABLE 4.2 SHOPPING PLACES OF CONSUMERS N (%)

Variable	Male (N= 66)	Female (N= 338)	Total (N= 404)
Market	63(95.4)	313 (92.6)	376 (93.1)
Supermarket	17 (25.8)	80 (23.7)	97 (24.01)
Internet	2 (3.03)	21 (6.2)	23 (5.7)
Grocery store	16 (24.2)	106 (31.4)	122 (30.2)
Directly from producers	0 (0)	8 (2.4)	8 (1.9)

FIGURE 4.3 FREQUENCY OF BUYING FOOD N (%)
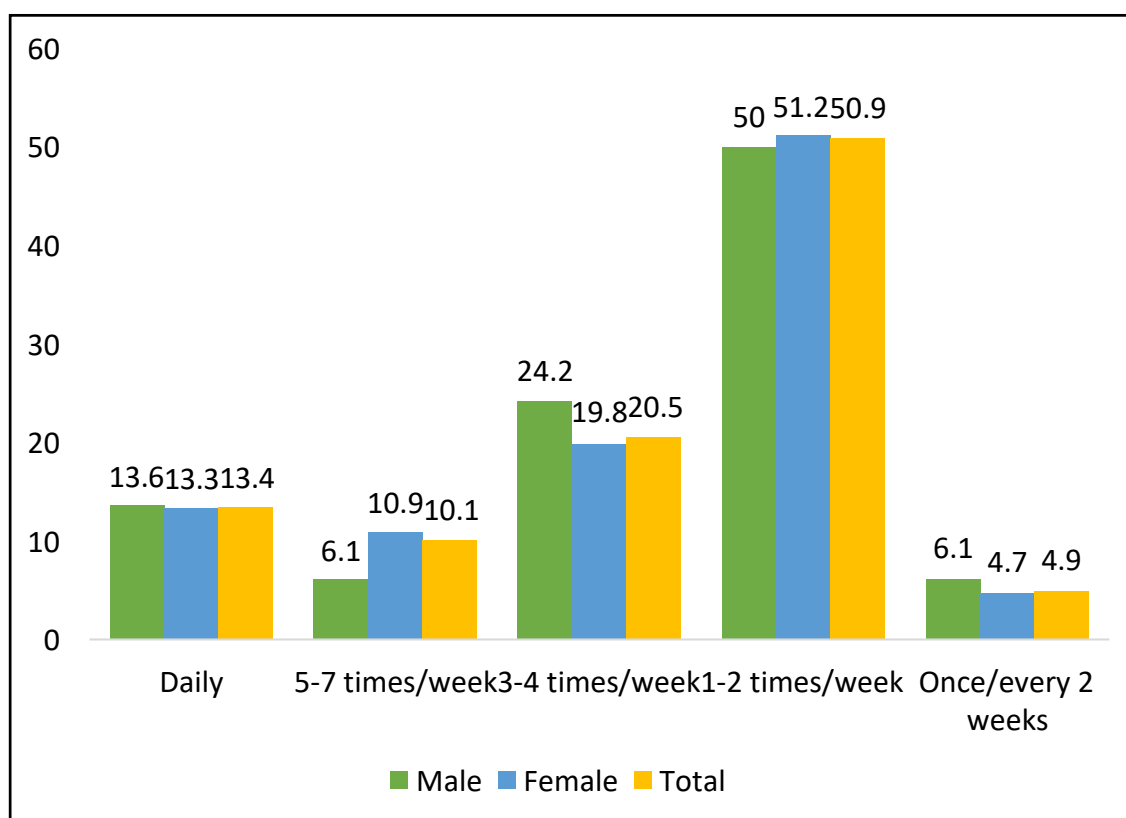
42.1% who always did so. Many respondents said that they always thought about food portion sizes. Few respondents never (1.73%) gave the size of the food portions any consideration. Only 0.5% of respondents did not consider using leftovers, compared to 44.8% who always did so. It was found that 59.6% of respondents always considered purchasing food based on the price per kg , whereas 1.4% never did. (Table 4.3 (a))

In Table 4.3 (b), The consideration of food storage practices ($p< 0.01$) and usage of leftover food products ($p< 0.01$) were shown to be more frequent among men. Female consumers reportedly made decisions more frequently based on price/kg ($p< 0.05$). According to a study, done in Romania, 53% of males and 47% of females always check the refrigerator before purchasing food, while 37.5% of males said they often prepare lists and 27% of females said they rarely do so. Based on survey respondents, 40% of males and 33% of females, sometimes find themselves distracted with planning the day's menu (Ghinea & Ghiuta, 2018).

According to Jorissen et al. (2015), 70% of surveyed households utilise a shopping list in the cities of Karlsruhe and Ispra. In Karlsruhe and Ispre, creating the shopping list reduces food waste per capita by about 20% and 25%, respectively.

In a study by Setti et al. (2016), majority of respondents in Italy plan their purchases by creating a shopping list (92%), and they usually purchase food when there are unusual discounts available (90%).

Another study reported by Cronje et al. (2018), showed a major part (70%) of respondents did not plan their weekly meals. Only 54% of the 30% who said they planned their meals for the week said they were actually doing it. A backup meal plan and additional shopping lists may reduce waste since the amount of unnecessary purchases has been limited, according to research.

CONSUMER PURCHASE ONLY WHAT IS NEEDED

It was discovered that 26.9% of female respondents always purchased only what was necessary, compared to 31.8% of male respondents. (Table 4.4)

Cronje et al. (2018) found that around 48% of respondents said they always just bought what was available, while 52% of respondents believed they sometimes buy more than is necessary.

CONSUMER INTEREST IN SPECIAL OFFERS/DISCOUNT OFFERS

Figure 4.4 shows that 41.7% of females and 46.9% of males expressed interest in special discounts/offers, respectively. According to Billali & Driouch (2015), many respondents were always (34%) or occasionally (42%) interested in discounts when it came to the attractiveness of offerings.

According to a survey by Berjan et al. (2019), around 53.4% of respondents were attracted to special food offers that were usually provided at super- and hypermarkets.

A study conducted in Finland by Koivupura et al. (2018) shows that households with less frequent utilisation of discounts and buy one get one free deals have higher rates of food waste, because they cannot afford to spend money on food, respondents who frequently purchase discounted items are more considerate of food.

CATEGORIES OF FOOD PRODUCTS THAT TEND TO BE OVER-PURCHASED AND DISCARDED

Around 38.1% fruits and 37.1% vegetables were the two major categories of food products that were over purchased and discarded. (Figure 4.5)

According to a study by Cronje et al. (2018), excessive grocery shopping may be one of the causes of the high rates of waste, particularly in dairy, fruits and vegetables. Respondents indicated they frequently spent too much money on dairy (21%), fruit (22%), and vegetables (42%).

REASONS FOR PURCHASING EXTRA FOOD PRODUCTS

Males (45.4%) and females (32.5%) bought additional food for guests. Around 22% of the male and female respondents bought additional items that were marked down and another 21% of the respondents purchased extra food products when the shopping lists were incomplete. (Table 4.5)

In the findings of Cronje et al. (2018), about 68% additional products that were purchased were marked down, 15% impulsively purchased, lacking of shopping lists (14%) and the influence of a co-shopper (3%), were the causes for the excess purchases

Table 4.3 (a) CONSUMER BEHAVIOUR TOWARDS FOOD PRODUCTS BEFORE BUYING FOOD N (%)

Consumer behavior toward food products	Always	Very often	Sometimes	Rarely	Never
Checking the refrigerator/freezer/store room before shopping	228 (56.4)	97 (24.01)	48 (11.9)	13 (3.2)	18 (4.4)
Plan daily menu	47 (11.6)	141 (34.9)	88 (21.8)	41 (10.1)	87 (21.5)
Writing a shopping list	66 (16.3)	112 (27.7)	118 (29.2)	34 (8.4)	74 (18.3)
Buying only what is needed	115 (28.4)	174 (43.1)	107 (26.5)	6 (1.5)	2 (0.5)
Check use by and best before dates	118 (29.2)	107 (26.5)	120 (29.7)	25 (6.2)	34 (8.4)
Consider how food is stored to keep fresh	170 (42.1)	135 (33.4)	93 (23.01)	16 (3.9)	7 (1.7)
Consider portion size	149 (36.9)	139 (34.4)	93 (23.01)	16 (3.96)	7 (1.73)
Use leftover	181 (44.8)	100 (24.7)	100 (24.7)	21 (5.19)	2 (0.5)
Decided based on price/kg	241 (59.6)	92 (22.8)	55 (13.6)	10 (2.5)	6 (1.4)

TABLE 4.3 (b) CONSUMER BEHAVIOUR TOWARDS FOOD PRODUCTS BEFORE BUYING FOOD (Mean± SD)

Consumer behavior toward food products	Male (N=66)	Female (N=338)	Total (N=404)	't' Value	p Value
Checking the refrigerator/freezer/store room before shopping	4.14 ± 1.32	4.26 ± 1.02	4.24 ± 1.07	0.45	0.65
Plan daily menu	2.85 ± 1.41	3.08 ± 1.31	3.08 ± 1.33	1.14	0.26
Writing a shopping list	3.06 ± 1.58	3.17 ± 1.25	3.15 ± 1.31	-0.53	0.6
Buying only what is needed	3.82 ± 1.08	4.01 ± 0.74	3.97 ± 0.81	-1.72	0.08
Check use by and best before dates	3.5 ± 1.59	3.64 ± 1.11	3.62 ± 1.2	-0.87	0.38
Consider how food is stored to keep fresh	4.41 ± 1.02	4.05 ± 0.94	4.11 ± 0.95	2.86	0.004**
Consider portion size	3.74 ± 1.41	4.06 ± 0.83	4.01 ± 0.96	-2.48	0.013*
Use leftover	4.41 ± 0.87	4.01 ± 0.98	4.017 ± 0.97	3.02	0.0026**
Decided based on price/kg	4.12 ± 1.19	4.41 ± 0.84	4.37 ± 0.91	-2.4	0.016*

* Significantly different at $p < 0.05$

** Significantly different at $p < 0.01$

TABLE 4.4 PURCHASING ONLY WHAT IS NEEDED (N=404)

Variable	Male (N=66)	Female (N=338)	Total (N=404)
Always	21 (31.8)	91 (26.9)	112 (27.7)
Very often	20 (30.3)	118 (34.9)	138 (34.2)
Sometimes	19 (28.8)	99 (29.2)	118 (29.2)
Rarely	4 (6.1)	24 (7.1)	28 (6.9)
Never	2 (3.03)	6 (1.7)	8 (1.9)

FIGURE 4.4 CONSUMER INTEREST IN SPECIAL OFFERS/ DISCOUNT OFFERS N (%) (ARE YOU ATTRACTED BY SPECIAL OFFERS/DISCOUNT IN SHOPS?)
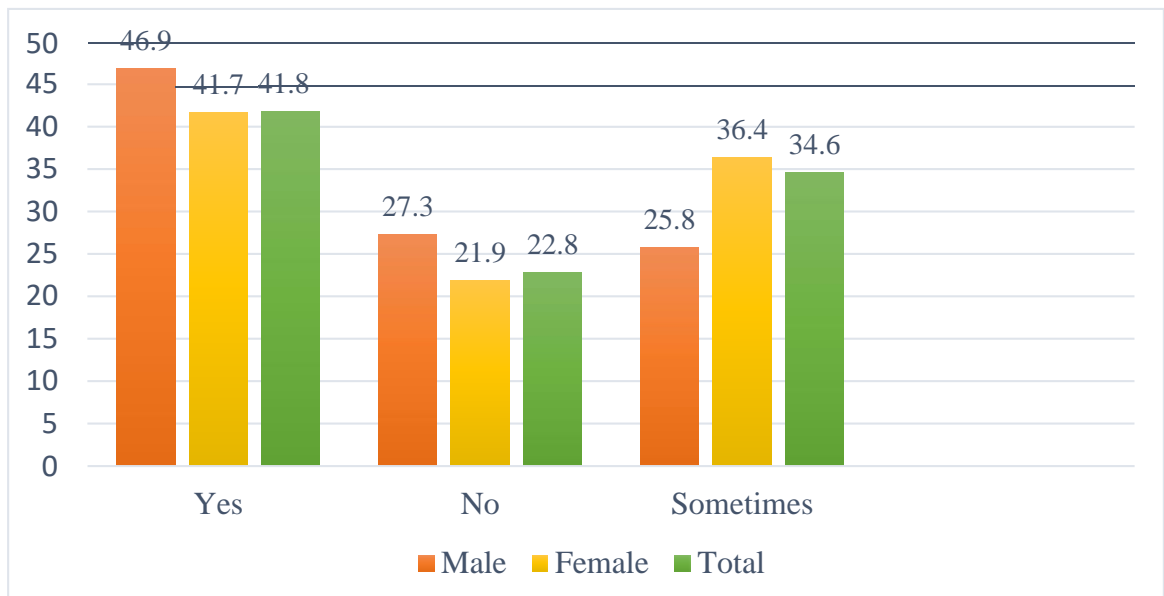
FIGURE 4.5 CATEGORIES OF FOOD PRODUCTS THAT TEND TO BE OVER-PURCHASED AND DISCARDED (N=404)

Legend:
- Cereal/pulses
- Fruits
- Vegetables
- Milk & milk products
- Meat/Fish/Poultry
- Sweets
- Juices/Beverages
- Bread
- None of them
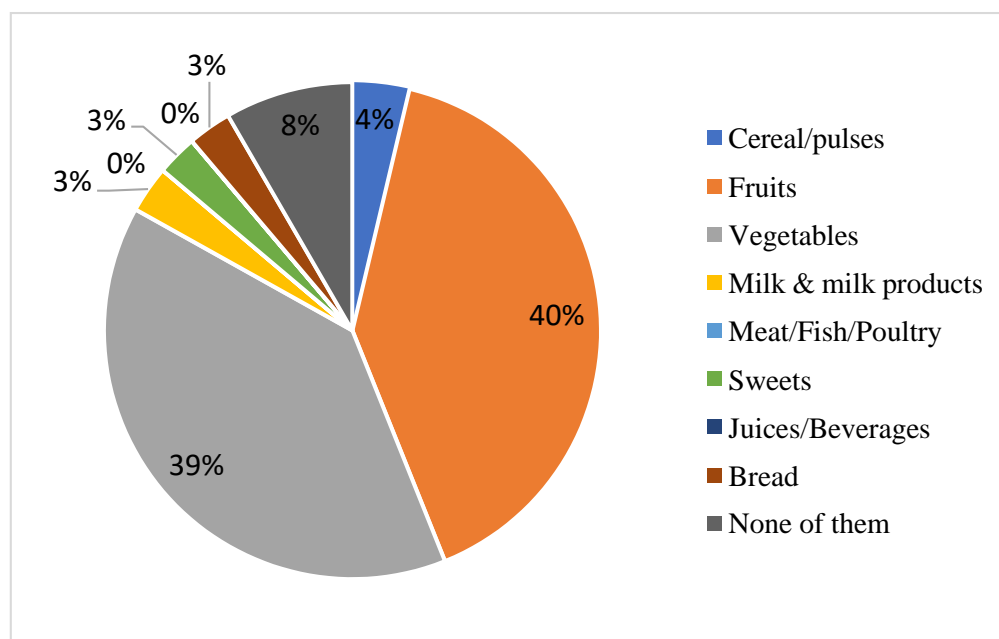
TABLE 4.5 REASONS FOR PURCHASING EXTRA FOOD PRODUCTS N (%)

Variable	Male (N= 66)	Female (N= 338)	Total (N= 404)
Additional items bought that were marked down	15 (22.7)	75 (22.2)	90 (22.3)
Some were impulsively bought	5 (7.6)	37 (10.9)	42 (10.4)
Shopping lists were incomplete	12 (18.2)	74 (21.9)	86 (21.3)
Co-shopper influenced the purchase	5 (7.6)	40 (11.8)	45 (11.1)
Extra food purchased for a guest	30 (45.4)	110 (32.5)	140 (34.6)
According to the season, more fruits and vegetables bought	0 (0)	11 (3.2)	11 (2.7)
Two people in the house bought the same food	1 (1.5)	0 (0)	1 (0.2)
When food items are cheaper	0 (0)	1 (0.3)	1 (0.2)
If rupees are more, then the food items are taken	1 (1.5)	2 (0.6)	3 (0.7)
No reasons	6 (9.1)	32 (9.5)	38 (9.4)

CONSUMER ATTITUDE REGARDING FOOD ITEMS NEARING BEST-BEFORE DATE

In studying consumer attitude regarding food items nearing their best before date it was observed that around 13.9% of the respondents felt that the food item should be discarded as compared to 64.6% of the respondents who felt that it should be used as soon as possible.

Another 21.5% of the respondents felt that the food should be given to someone. More female respondents (67.4%) as compared to male (50%) respondents felt that the food nearing its best before date should be used as soon as possible (Figure 4.6).

According to a study by Capone et al. (2015), 68% of respondents confuse the "best before" label with the "use by" mark because they believe that food should be thrown away after that date. Only 31% of the survey group showed they had an excellent knowledge of this label's meaning. It illustrated how challenging it is for Moroccan consumers to fully understand the portions of information on the label.

In another study was done by Cronje et al, (2018), they discovered that the vast majority (85%) of respondents use the products as soon as possible when they are getting close to their "best before" date. This demonstrates good food waste avoidance procedures. More than 6% of the respondents said they throw away food. There is a case to be made that despite the high cost of food, respondents do not throw food away unnecessarily.

USING PRODUCTS AFTER BEST BEFORE DATE

About 8.2% of the respondents reported always using the products after their best before date whereas 34.6% of the respondents reported rarely doing so (Table 4.6).

DISCARDING FOOD THAT HAS EXCEEDED ITS SHELF LIFE, BUT HAS NO SIGN OF DETERIORATION

It was revealed that 29.2% and 26.5% of the respondents respectively always or very often discarded food that has exceeded its shelf life but has no sign of deterioration. Only 8.4% of the respondents reported that they never discard such food. (Table 4.7)

**FIGURE 4.6 CONSUMER ATTITUDE REGARDING FOOD ITEMS
NEARING BEST-BEFORE DATE N (%)**
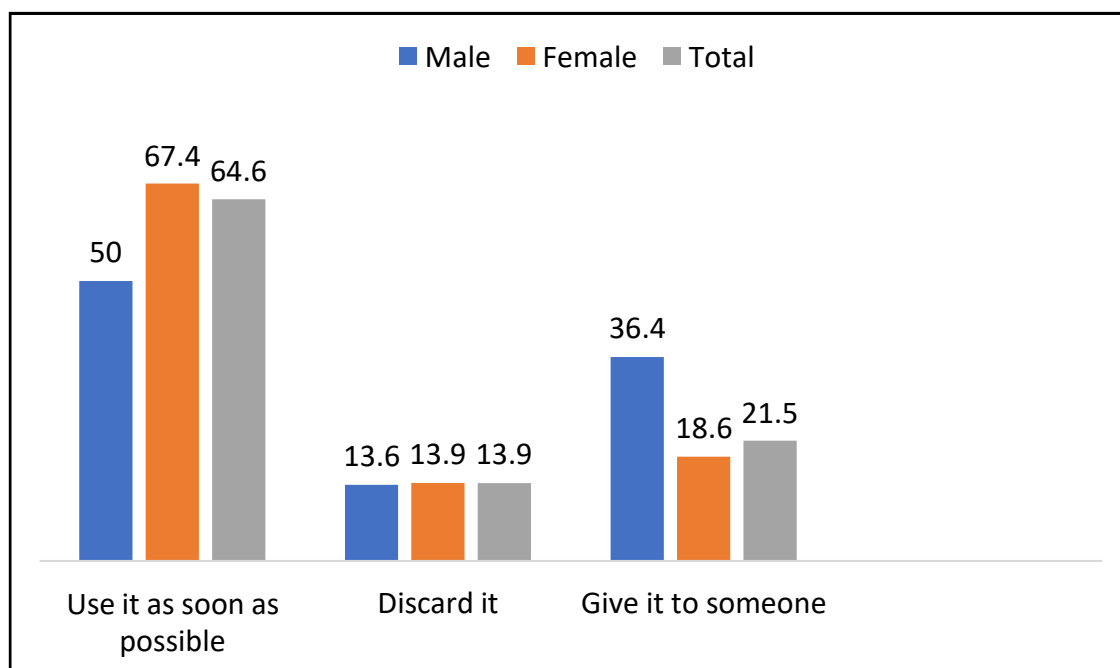
TABLE 4.6 USING PRODUCTS AFTER BEST BEFORE DATE N (%)

	Male (N=66)	Female (N=338)	Total (N=404)
Always	7 (10.6)	26 (7.7)	33 (8.2)
Very often	3 (4.5)	20 (5.9)	23 (5.7)
Sometimes	19 (28.8)	76 (22.5)	95 (23.5)
Rarely	20 (30.3)	120 (35.5)	140 (34.6)
Never	17 (25.8)	96 (28.4)	113 (27.9)

**TABLE 4.7 DISCARDING FOOD THAT HAS EXCEEDED ITS SHELF LIFE,
BUT HAS NO SIGN OF DETERIORATION N (%)**

	Male (N=66)	Female (N=338)	Total (N=404)
Always	20 (30.3)	98 (28.9)	118 (29.2)
Very often	18 (27.3)	89 (26.3)	107 (26.5)
Sometimes	12 (18.2)	108 (31.9)	120 (29.7)
Rarely	7 (10.6)	18 (5.3)	25 (6.2)
Never	9 (13.6)	25 (7.4)	34 (8.4)

According to a study by Ghinea & Ghiuta (2018), females regularly discard food that has passed its expiration date but shows no signs of deterioration as compared to males.

CONSUMER HABITS DURING FOOD STORAGE

Majority of the respondents 41.1%, 56.7%, 40.3%, 34.4%, and 68.3% reported always checking the expiration date of food products like ready to eat food, milk and milk products, bread and bakery products, juices/beverages and meat and meat products respectively (Table 4.8 (a)).

There was a significant difference found between male and female respondents in the frequency of checking the expiration date of meat and meat products ($p < 0.01$). (Table 4.8 (b))

Ghinea and Ghuita (2018) found that males always checked the expiration dates of eggs (80%), milk and dairy products (78%), meat (75%), and bread (71%), whereas females were more concerned with the dates for milk and dairy products (88%), meat (83%), and eggs (80%). Male consumers were least concerned about the expiration date for juices, whereas female consumers were least concerned about the expiration date for vegetables and fruits.

FREQUENCY OF PLANNING DAILY/WEEKLY MEALS

The majority of respondents (41.6%) never planned a daily or weekly menu, whereas 21.03% of respondents sometimes did so. (Table 4.9)

FREQUENCY OF ADHERING TO MEAL PLANS

During the survey, it was observed that 42.8% of respondents never adhered to meal plans and 17.1% of respondents always adhered to them. (Table 4.10)

FREQUENCY OF ORDERING FOOD OR EATING OUT

According to the table, 31.8% of males and 39.05% of females sometimes order food or eat outside. There was no significant difference between males and females in terms of ordering food or eating outside. (Table 4.11(a and b)). Ghinea and Ghuita (2018) found that around 31% more men than women were eating outside or ordering food.

TABLE 4.8 (a) CONSUMER HABITS DURING FOOD STORAGE (N=404)

Check the expiration date the of food	Always	Very often	Sometimes	Rarely	Never
Ready-to-eat food	166 (41.1)	118 (29.2)	70 (17.3)	24 (5.9)	26 (6.4)
Eggs (N=60)	11 (18.3)	15 (25)	13 (21)	5 (8.3)	16 (26.7)
Milk & milk products	229 (56.7)	109 (26.9)	53 (13.1)	6 (1.5)	7 (1.7)
Bread and bakery products	163 (40.3)	83 (20.5)	92 (22.7)	29 (7.2)	37 (9.1)
Juices/Beverages	138 (34.1)	89 (22.02)	77 (19.05)	50 (12.4)	50 (12.4)
Meat and meat products (N=60)	41 (68.3)	5 (8.3)	7 (11.7)	3 (5)	4 (6.7)

TABLE 4.8 (b) CONSUMER HABITS DURING FOOD STORAGE (Mean±SD)

Check the expiration date of the food	Male (N=66)	Female (N=338)	Total (N=404)	't' Value	p Value
Ready-to-eat food	3.92 ± 1.23	3.92 ± 1.17	3.92 ± 1.18	0.01	0.99
Eggs (N= 60)	2.41 ± 1.44	3.14 ± 1.46	3 ± 1.47	1.55	0.13
Milk and dairy products	4.27 ± 1.18	4.36 ± 0.82	4.35 ± 0.89	0.81	0.41
Bread and bakery products	3.76 ± 1.33	3.76 ± 1.29	3.76 ± 1.3	0.001	0.99
Juices/Beverages	3.62 ± 1.35	3.51 ± 1.39	3.53 ± 1.39	0.56	0.57
Meat and meat products (N= 60)	2.91 ± 1.56	4.62 ± 0.87	4.28 ± 1.23	3.64	0.002**

** Significantly different at $p < 0.01$

TABLE 4.9 FREQUENCY OF PLANNING DAILY/WEEKLY MEALS (N=404)

Frequency	N (%)
Always	24 (5.9)
Very often	71 (17.6)
Sometimes	85 (21.03)
Rarely	56 (13.9)
Never	168 (41.6)

TABLE 4.10 FREQUENCY OF ADHERING TO MEAL PLANS (N=404)

Frequency	N (%)
Always	69 (17.1)
Very often	57 (14.1)
Sometimes	45 (11.1)
Rarely	60 (14.8)
Never	173 (42.8)

TABLE 4.11 (a) FREQUENCY OF ORDERING FOOD OR EATING OUT N (%)

Variable	Male (N=66)	Female (N=338)	Total (N=404)
Always	0 (0)	0 (0)	0 (0)
Very often	6 (9.1)	32 (9.5)	38 (9.4)
Sometimes	21 (31.8)	132 (39.05)	150 (37.1)
Rarely	33 (50)	129 (38.2)	162 (40.1)
Never	6 (9.1)	45 (13.3)	51 (12.6)

TABLE 4.11 (b) FREQUENCY OF ORDERING FOOD OR EATING OUT

(Mean± SD)

Male (N=66)	Female (N=338)	Total (N=404)	't' Value	p Value
2.35 ± 0.88	2.46 ± 0.82	2.44 ± 0.83	1.01	0.31

FREQUENCY OF EATING PRE-COOKED FOOD

When comparing males and females who consumed pre-cooked food, the majority of males rarely (33.3%) did so. Around 34.6% females were in the habit of eating pre-cooked food sometimes. The frequency of eating pre-cooked meals was significantly higher in males as compared to females (p <0.05). (Table 4.12 (a and b))

USING THE REFRIGERATOR TO KEEP PRODUCTS FRESH FOR A LONG TIME

98.5% of respondents reported that they used the refrigerator to keep products fresh for a long time; the rest of the respondents did not, resulting in a lot of food waste. (Figure 4.7)

WASTE COMPOSITION IN TRASH BIN

Table 4.13 (a) displays the types of waste that respondents put in their trash bins. According to the survey, only a very small percentage of respondents (0.74%) always wasted food. Around 25.7% of respondents rarely wasted food, compared to 10.6% who did so often. The respondents sometimes (3.5%) and rarely (35.1%) discarded wood. The majority of respondents (60.6%) rarely disposed of textiles in the trash. About 60.9% of respondents said they never threw away metal. According to the respondents, they rarely (60.1%) threw glass in the trash. 17.1% of the respondents saidthey often disposed of plastic in the trash. There was no significant difference betweenmale and female respondents in the frequency of food waste being found in the trash bin. (Table 4.13 (b))

In a study by Ghinea & Ghiuta (2018), it was revealed that food waste is the main waste fraction that is consistently present in the waste generated by male respondents. Plastic and paper waste were also frequently present, along with occasional glass, metal, and other waste. According to the majority of female respondents, plastic, food waste, glass, and other garbage are always present in their trash. It is evident that the majority of the trash produced by respondents was likely to be food waste, followed by paper and plastics, glass, metals, and then plastics and paper.

TABLE 4.12 (a) FREQUENCY OF EATING PRE-COOKED FOOD N (%)

Variable	Male (N=66)	Female (N=338)	Total (N=404)
Always	5 (7.6)	4 (1.2)	9 (2.2)
Very often	8 (12.1)	27 (7.9)	35 (8.7)
Sometimes	17 (25.8)	117 ((34.6)	134 (33.2)
Rarely	22 (33.3)	111 (32.8)	133 (32.9)
Never	14 (21.2)	79 (23.4)	93 (23.02)

TABLE 4.12 (b) FREQUENCY OF EATING PRE-COOKED FOOD (Mean± SD)

Male (N=66)	Female (N=338)	Total (N=404)	't' Value	p Value
2.48 ± 0.99	2.31 ± 0.1	2.34 ± 0.1	2.11	0.03*

* Significantly different at p < 0.05

FIGURE 4.7 USING THE REFIGERATOR TO KEEP PRODUCTS FRESH FOR A LONG TIME (N=404)

No, 3.2

Yes, 98.5
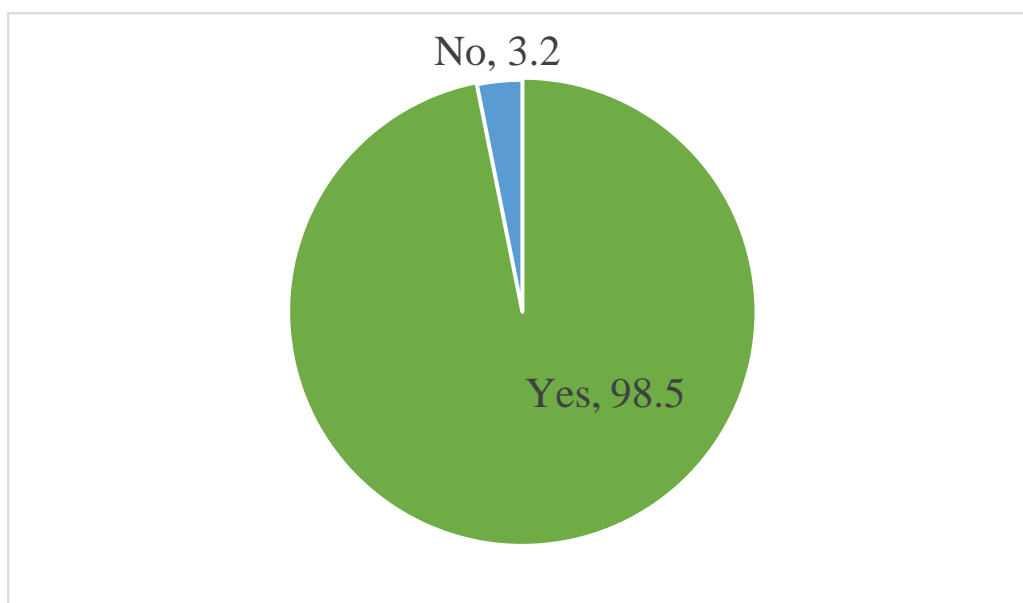
TABLE 4.13 (a) WASTE COMPOSITION IN TRASH BIN N (%)

	Always	**Very often**	**Sometimes**	**Rarely**	**Never**
Food waste	3 (0.74)	43 (10.6)	247 (61.1)	104 (25.7)	7 (1.7)
Wood	0 (0)	0 (0)	14 (3.5)	142 (35.1)	248 (61.4)
Textile	0 (0)	2 (0.5)	53 (13.1)	245 (60.6)	104 (25.7)
Metals	0 (0)	0 (0)	6 (1.5)	152 (37.6)	246 (60.9)
Glass	0 (0)	0 (0)	71 (17.6)	243 (60.1)	90 (22.3)
Plastic	3 (0.7)	69 (17.1)	228 (56.4_)	102 (25.4)	2 (0.5)
Paper/Cardboard	2 (0.5)	73 (18.1)	209 (51.7)	96 (23.8)	24 (5.9)

TABLE 4.13 (b) WASTE COMPOSITION IN TRASH BIN (Mean± SD)

Type of waste	Male (N=66)	Female (N=338)	Total (N=404)	t- Test	P Value
Food waste	2.89 ± 0.64	2.82 ± 0.66	2.83 ± 0.66	0.89	0.37
Wood	1.47 ± 0.56	1.41 ± 0.56	1.42 ± 0.56	0.78	0.4
Textile	1.78 ± 0.69	1.90 ± 0.61	1.88 ± 0.63	1.35	0.17
Metals	1.31 ± 0.47	1.42 ± 0.53	1.40 ± 0.52	1.5	0.13
Glass	2.71 ± 0.55	1.8 ± 0.53	1.95 ± 0.63	6.9	1.7
Plastic	3.08 ± 0.77	2.89 ± 0.66	2.92 ± 0.68	1.7	0.07
Paper/Cardboard	2.94 ± 0.86	2.81 ± 0.79	2.83 ± 0.8	1.16	0.24

FREQUENCY OF WASTING FOOD

Majority of the respondents (32.2%) reported wasting food once in two weeks. Almost 16.6% and 19.5% of the male and female respondents reported wasting food one to two times per week respectively. (Table 4.14)

TYPES OF DISCARDED FOOD PRODUCTS

According to Table 4.15, relatively few respondents wasted milk and milk products, and the same was true of meat and meat products. Meanwhile, 22.5%, 28.5% and 7.92% of the respondents wasted fruits, vegetables and bread once every month respectively. Leftover food (19.8%) was thrown out once every two weeks, whereas rice was more frequently wasted one to two times per week (9.4%).

A study was conducted by Voca et al. (2018). They observed that cakes, cookies, processed food, fruit and vegetables were the least likely to be thrown away, while fruit and vegetables were most frequently discarded. Fruit and vegetables constitute nearly half of the total amount of waste (46%), along with other foods, such as egg shells (12%), tea leaves (3.4%), and coffee grounds (1.4%).

In another study done by Cronje et al. (2018), they found that leftovers were the food item that was wasted the most in households (34%), followed by milk and dairy products (30%). Additionally, bread (25%) was wasted substantially more often than other food items.

DEALING WITH UNCONSUMED FOOD

The majority of the respondents claimed that they either gave unconsumed food to someone else (83.9%) or threw it away (5.2%). Almost no respondents (1.2%) utilized leftover food as compost. Additionally, respondents stated that they either threw away (46.5%) or gave unconsumed liquid food to someone else (79.4%). (Figure4.7)

In Ghinea & Ghuita's (2018) study, around 39% of female respondents and 31% of male respondents, respectively, discard unconsumed liquid food. Only 22% of males and 18% of females said they brought the leftover liquid food to containers, compared to 47% of males and 43% of females who said they fed the animals with uncooked liquid food.

Bilali & Driouech (2015), found that the households of respondents disposed uneaten food in various ways. Unfortunately, the study's findings revealed that 69% of respondents discard the foods in the trash. However, a sizable portion of respondents (24%) successfully dispose of uneaten food by giving it to someone else. Unused food was also fed to animals (24%) and used to make compost (2.5%), according to survey participants.

USE OF FRIED OIL

According to Figure 4.9, the majority of respondents (99%) reused the oil, whereas 1.5% disposed of it. As stated by Guinea & Ghiuta (2018), 75% respondents threw away the fried oil, which was beneficial to health.

FACTORS LEADING TO GENERATION OF FOOD WASTE

Major factors leading to generation of food waste were when the food was past the expiration date (91.6%), the products looked bad or smelled odd (98.3%), the products had been in the refrigerator for a very long time (62.1%) and when the food was not cooked properly e.g burnt food (72.3%). (Table 4.16)

Ghinea & Ghiuta (2018) noted that the majority of the persons they interviewed declined to pay regard to the expiration date, used the refrigerator to preserve food, checked the food items they already owned before buying other items, and only purchased what was necessary.

AMOUNT OF FOOD DISCARDED PER WEEK AS INDICATED BY THE CONSUMERS

Most respondents wasted less than 250 grams (58.9%) of food on a weekly basis, but few respondents wasted between 500 and 1000 grams (11.1%) of food. (Table 4.17)

In a study by Capone et al, (2015) in comparison, around 39% of respondents claimed that their households discard at least 250g of still-consumable food each week. About half of respondents (45%) claimed that they never throw away food that is still edible.

TABLE 4.14 FREQUENCY OF WASTING FOOD N (%)

Frequency	Male (N=66)	Female (N=338)	Total (N=404)
Daily	1 (1.5)	0 (0)	1 (0.2)
5-6 times/week	0 (0)	1 (0.3)	1 (0.2)
3-4 times/week	3 (4.5)	11 (3.2)	14 (3.5)
1-2 times/week	11 (16.6)	66 (19.5)	77 (19.05)
Once/2 weeks	19 (28.8)	111 (32.8)	130 (32.2)
Once/month	23 (34.8)	101 (29.9)	124 (30.7)
More than one month	5 (7.5)	36 (10.6)	41 (10.1)
Once/6 months	2 (3.03)	6 (1.8)	8 (1.9)
Never	2 (3.03)	6 (1.8)	8 (1.9)

TABLE 4.15 TYPES OF DISCARDED FOOD PRODUCTS (N=404)

Discarded food products	Never	Daily	5-6 times/week	3-4 times/week	1-2 times/week	Once/2 weeks	Once/month	More than one month	Once/6 months
Rice	275 (68.1)	1 (0.24)	3 (0.7)	15 (3.7)	38 (9.4)	6 (1.5)	35 (8.7)	20 (4.9)	11 (2.7)
Fruits	110 (27.2)	1 (0.5)	2 (0.5)	27 (6.7)	22 (5.4)	2 (0.5)	91 (22.5)	104 (25.7)	45 (11.1)
Vegetables	110 (27.2)	1 (0.24)	2 (0.49)	21 (5.19)	31 (7.67)	60 (14.8)	115 (28.5)	62 (15.3)	2 (0.49)
Milk & milk products	356 (88.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.74)	16 (3.9)	29 (7.2)
Meat & meat products	60 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eggs	48 (80)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (3.3)	9 (15)	1 (1.7)
Sweets	285 (70.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	13 (3.2)	7.4 (30)	18.8 (76)
Beverages	389 (96.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	15 (3.7)
Bread	280 (69.3)	0 (0)	0 (0)	1 (0.24)	12 (2.97)	10 (2.47)	32 (7.92)	41 (10.1)	28 (6.9)
Leftovers	93 (23.01)	1 (0.24)	0 (0)	5 (1.2)	49 (12.1)	80 (19.8)	127 (31.4)	42 (10.4)	7 (1.7)
Ready-to-eat foods	318 (78.7)	0 (0)	0 (0)	0 (0)	2 (0.5)	7 (1.7)	4 (0.9)	31 (7.6)	42 (10.4)

FIGURE 4.8 DEALING WITH UNCONSUMED FOOD N (%)
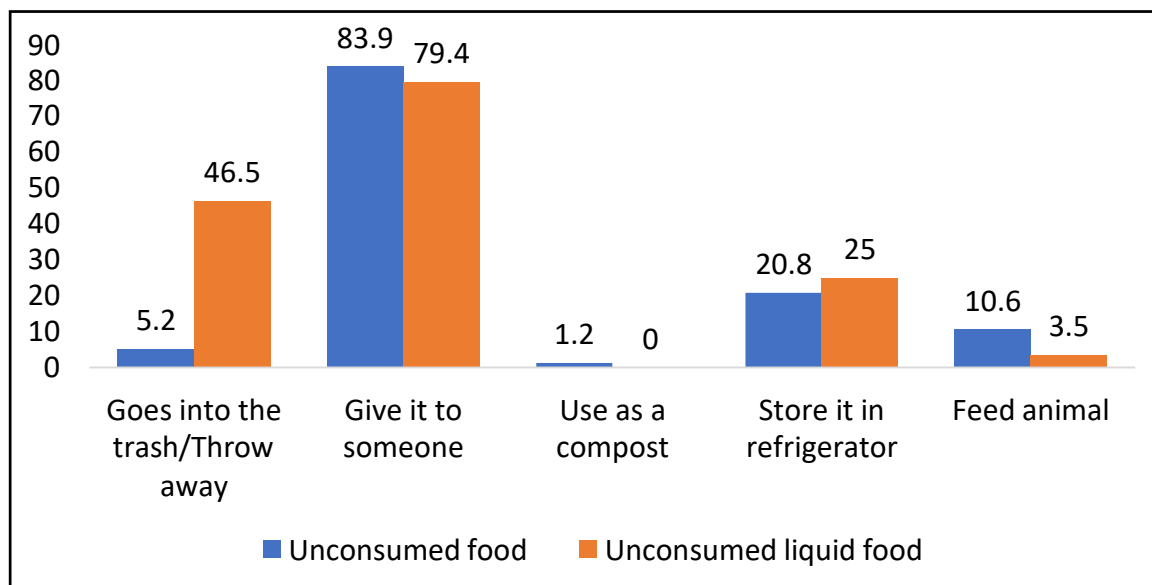

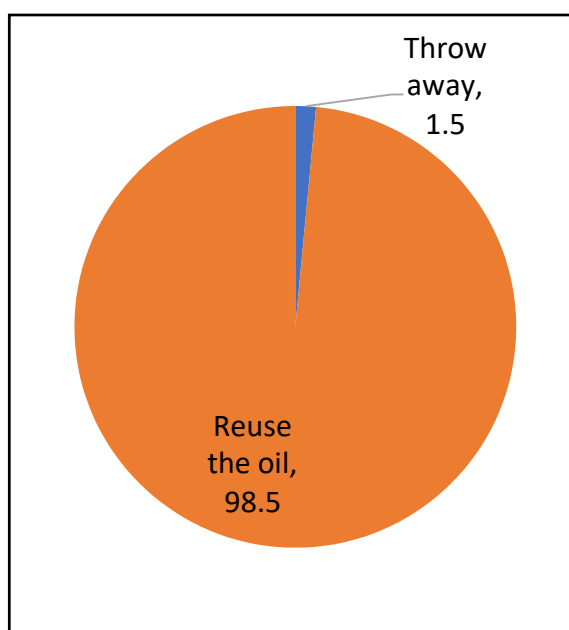**FIGURE 4.9 USE OF FRIED OIL (N=404)**

TABLE 4.16 FACTORS LEADING TO GENERATION OF FOOD WASTE

N (%)

	Male (N=66)		Female (N=338)		Total (N=404)	
	Yes	No	Yes	No	Yes	No
Food past expiration date	63 (95.4)	3 (4.5)	307 (90.8)	31 (9.2)	370 (91.6)	34 (8.4)
Improper storage/ Not enough storage space	7 (10.6)	59 (17.4)	28 (8.3)	310 (91.7)	35 (8.7)	369 (91.3)
Improper packaging size	5 (7.5)	61 (92.4)	31 (9.2)	306 (90.5)	37 (9.15)	367 (90.8)
Products have stayed in the kitchen for a long period	30 (45.4)	36 (54.5)	116 (34.3)	222 (65.7)	146 (36.1)	258 (63.9)
Products look bad/odd smell/spoiled food	66 (100)	0 (0)	331 (97.9)	7 (2.1)	397 (98.3)	7 (1.7)
Products have stayed in the fridge for a very long time	37 (56.1)	29 (43.9)	214 (63.3)	124 (36.7)	251 (62.1)	153 (37.9)
Only scraps remain	22 (33.3)	44 (66.7)	146 (43.2)	192 (56.8)	168 (41.6)	236 (58.4)
Over purchasing of foods	25 (37.8)	41 (62.1)	97 (28.7)	241 (71.3)	122 (30.2)	282 (69.8)
Plate waste (food left on a plate after a meal)	33 (50)	33 (50)	146 (43.2)	192 (56.8)	179 (44.3)	225 (55.7)
It was more than what could be eaten by you	17 (25.8)	49 (74.2)	57 (16.8)	281 (83.1)	74 (18.3)	330 (81.7)
Cooked food or leftover food are not stored	23 (34.8)	43 (65.2)	101 (29.9)	237 (70.1)	124 (30.7)	280 (69.3)
Food was not cooked properly (e.g., burnt)	46 (69.7)	20 (30.3)	246 (72.8)	92 (27.2)	292 (72.2)	112 (27.7)

TABLE 4.17 AMOUNT OF FOOD DISCARDED PER WEEK AS INDICATED BY THE CONSUMER (N=404)

Amount of food	N (%)
Nothing	30 (7.4)
<250 gm	238 (58.9)
250-500 gm	89 (22.03)
500-1000 gm	45 (11.1)
1000-2000 gm	2 (0.49)
>2000 gm	0 (0)

In the study by Ghinea & Ghiuta (2018), it was observed that most of the respondents considered that they generated between 250 and 500 gm of food waste per week.

HAVE YOU EVER TRIED ANY TYPE OF FOOD COMPOSTING?

Only 1.3% of respondents reported composting food, and the other 98.7% reported not composting any food at all. (Figure 4.10)**.**

TO WHAT EXTENT DOES IT BOTHER YOU WHEN YOU THROW AWAY/DISCARD FOOD

Figure 4.9 shows that around 57.6% males and 54.7% females were affected a great deal by wastage of food whereas 36.4% males and 38.5% females reported that they were fairly affected by food wastage. (Figure 4.11). According to Cronje et al. (2018), nearly half (43%) of the respondents reported that it disturbed them a considerable deal when food was thrown away.

DO YOU THINK DISCARDING/WASTING FOOD COULD POSE A PROBLEM TO THE ENVIRONMENT?

A large percentage of respondents (96.3%) stated that they were aware that food waste had an adverse effect on the environment. 0.6 % of respondents were unaware and 3.2% of the respondents did not know that throwing away food had negative environmental effects. (Table 4.18).

DO YOU THINK THERE IS A PROBLEM OF WASTE DISPOSAL?

Majority of female respondents (93.7%) and male respondents (93.9%) reported having issues with waste disposal. Only 1.8% of females reported having no issues with waste disposal. (Table 4.19)

As reported by Ghinea & Ghuita's (2018) study, about 94% of the female respondents thought there was an issue with waste disposal, compared to 65% of the male respondents.

FIGURE 4.10 HAVE YOU EVER TRIED ANY TYPE OF FOOD COMPOSTING (N=404)

Yes, 1.3

No, 98.7
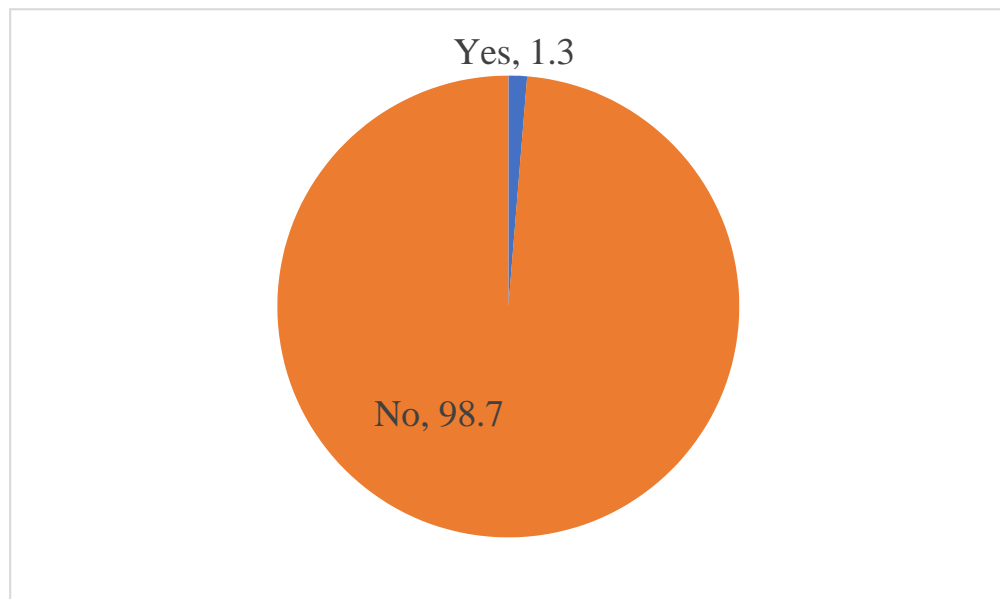
FIGURE 4.11 TO WHAT EXTENT DOES IT BOTHER YOU WHEN YOU THROW AWAY/DISCARD FOOD? N (%)

	Not at all	Net very much	A little	Fair amount	A great deal
Male	0	0	6.1	36.4	57.6
Female	0	0	6.8	38.5	54.7
Total	0	0	6.7	38.1	55.2
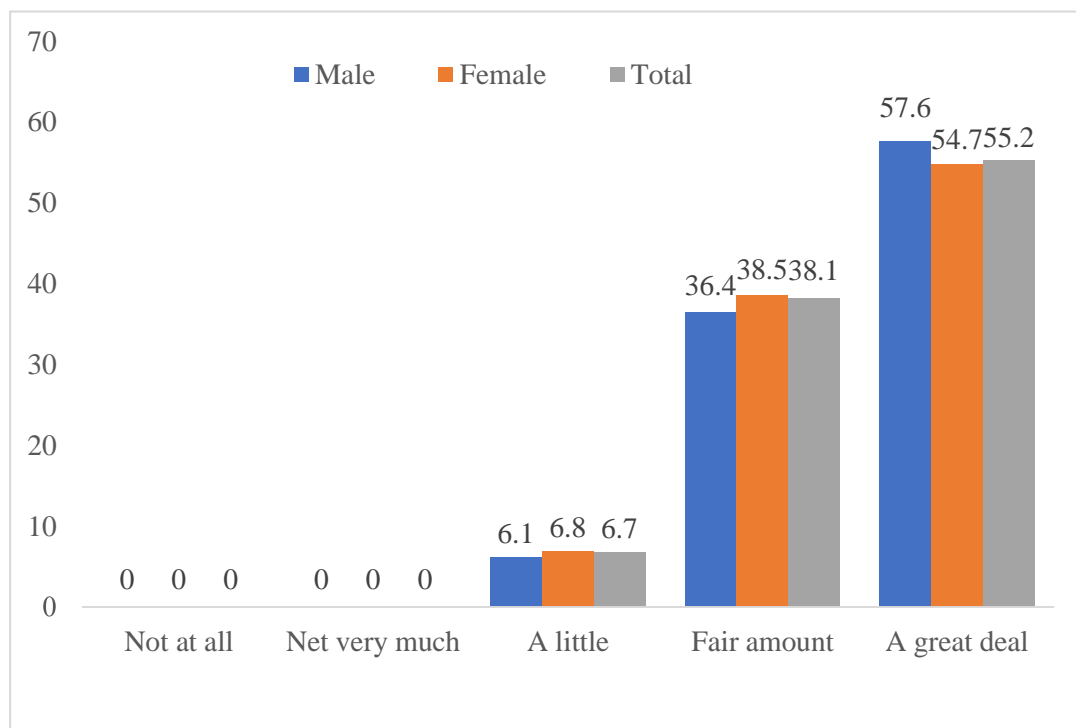
TABLE 4.18 DO YOU THINK DISCARDING/WASTING FOOD COULD POSE A PROBLEM TO THE ENVIRONMENT? (N=404)

Variable	Male (N=66)	Female (N=338)	Total (N=404)
Yes	62 (93.9)	327 (96.7)	389 (96.3)
No	0 (0)	2 (0.6)	2 (0.5)
Do not know	4 (6.1)	9 (2.7)	13 (3.2)

TABLE 4.19 DO YOU THINK THERE IS A PROBLEM OF WASTE DISPOSAL?

N (%)

Variable	Male (N=66)	Female (N=338)	Total (N=404)
Yes	62 (93.9)	317 (93.7)	379 (93.8)
No	0 (0)	6 (1.8)	6 (1.5)
Do not know	4 (6.1)	15 (4.4)	19 (4.7)

DO YOU THINK DISCARDING/WASTING FOOD COULD RESULT IN AN ECONOMIC LOSS TO THE SOCIETY?

It was noted that 100% of the male and female respondents believed that food waste could result in an economic loss to the society. (Table 4.20)

COOKING ADDITIONAL MEALS FROM THE LEFTOVER FOOD

Table 4.21 reveals that more women (94.1%) than men (89.4%) cook additional meals from the leftovers. Only 1.2% of respondents claimed that they never cooked additional meals with leftovers.

A study was carried out by Bilali and Driouech (2015), and it was observed only 12% of respondents said they never throw away leftover food, compared to more than 46% of respondents who claimed they do.

WASTAGE OF FOOD IN THE PREVIOUS TWO DAYS

According to Figure 4.12, the food item category that was most commonly wasted was cooked food items (66.7%), followed by fruits (14.3%), condiments/sauces/chutneys/spices (7.1%), bakery food (7.1%), and vegetables (4.8%).

Bilali & Driouech (2015), estimated that cereals and bread items are the food groups that are most frequently wasted, followed by fruits and vegetables. The least wasted food categories include meat and meat products, fish and sea food, dried vegetables and oilseeds, and roots and tubers.

The majority of the participants in a study self-reported that they discarded fresh fruits and green leafy vegetables on average once each week (Mijares et al, 2021).

AMOUNT OF FOOD WASTED IN THE PREVIOUS TWO DAYS

Table 4.22 reveals that fruits (228.5gm) and condiments/chutney/sauces/spices (216.7gm) account for the maximum amount of food waste generated over the previous two days.

TABLE 4.20 DO YOU THINK DISCARDING/WASTING FOOD COULD RESULT IN AN ECONOMIC LOSS TO THE SOCIETY? N (%)

Variable	Male (N=66)	Female (N=338)	Total (N=404)
Yes	66 (100)	338 (100)	404 (100)
No	0 (0)	0 (0)	0 (0)
Do not know	0 (0)	0 (0)	0 (0)

TABLE 4.21 COOKING ADDITIONAL MEALS FROM THE LEFTOVER FOOD (N%)

Variable	Male (N=66)	Female (N=338)	Total (N=404)
Yes	59 (89.4)	318 (94.1)	377 (93.3)
No	1 (1.5)	4 (1.2)	5 (1.2)
Sometimes	6 (9.1)	16 (4.7)	22 (5.4)

FIGURE 4. 12 WASTAGE OF FOOD IN THE PREVIOUS TWO DAYS (N=42)
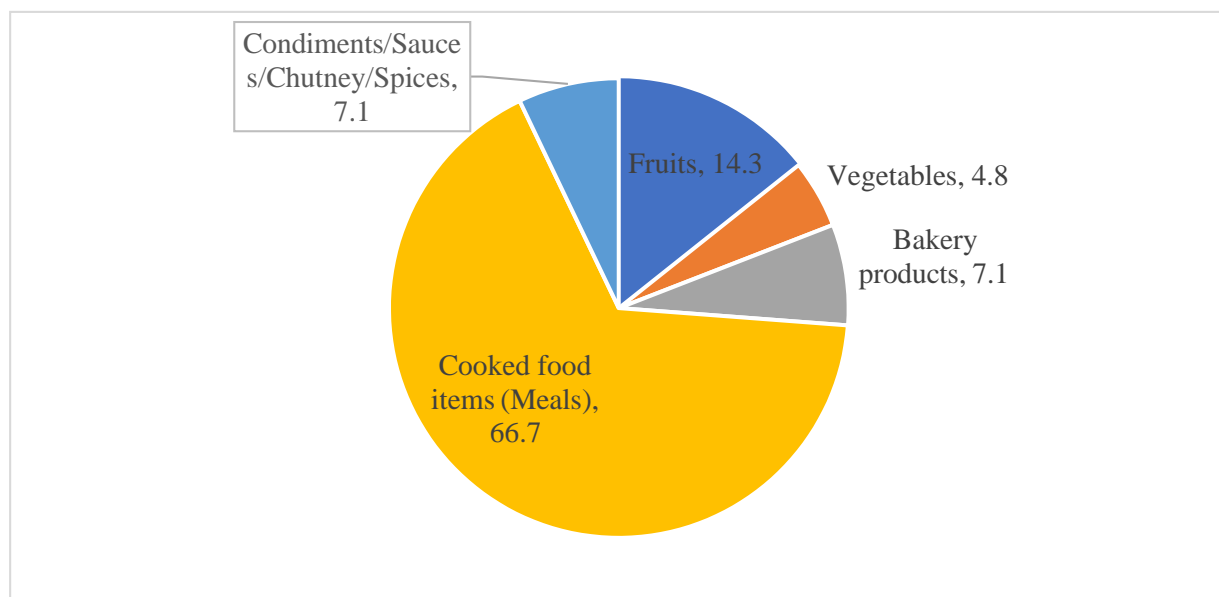
TABLE 4.22 AMOUNT OF FOOD WASTED IN PREVIOUS TWO DAYS (g)

Food Groups	Mean ± SD
Vegetables	52.7± 27.7
Fruits	228.5± 143.5
Bakery products	29.8± 14.56
Cooked food items (Meals)	58.07± 44.52
Condiments/Sauces/Chutney/Spice	216.67±131.23

CATEGORIES OF DISCARDED FOOD PRODUCTS

It was found that 90.5%, 2.4%, and 7.1% of the wasted food was from the perishable, non-perishable, and semi-perishable category respectively. (Figure 4.13)

REASONS FOR DISCARDING FOOD IN THE PREVIOUS TWO DAYS

Around 52.9% of the respondents discarded food due to preparation of extra food and around 11.9% of the respondents reported that fruits were discarded as they were overripe. (Table 4.23)

An investigation conducted by Bilali and Driouech (2015), around 67% of respondents waste food because it is kept in the refrigerator for an extended period of time. Poor preservation contributes to the rise in food waste for food products that were not kept in the refrigerator. Poor food management at home, such as mistakes in meal planning (30%), suggests that leftovers are frequently present and that serving sizes are excessive.

DISPOSING FOOD WASTED IN THE PREVIOUS TWO DAYS

Around 64.3% of respondents threw food waste in the trash bin. Liquid food that wasn't consumed was washed down the drain (14.3%), and 21.4% of respondents put food in a polythene bag and threw it on the road. (Figure 4.13)

ASSOCIATION BETWEEN PER CAPITA INCOME AND FREQUENCY OF WASTING FOOD

Table 4.24 showed that there was no association between household income (per capita) and frequency of household food waste.

According to a study by Chalak et al. (2019), there is a link between income and food waste that is unfavourable. One explanation was that people with higher incomes are more likely to have better food storage arrangements, which will enable them to preserve food for longer periods of time.

Machate et al. (2020) found a negative relationship between household income and the volume of food waste generated by households. These findings suggest that there is less food waste the greater the monthly household income.

ADHERING TO MEAL PLANS

Out of 168 respondents who frequently planned their daily menu, around 40.5% of them said they always did not follow the meal plans, and 13.1% of the respondents never adhered.

A study reported by Cronje et al. (2018), showed that only 54% of the 30% of respondents said that they planned their meals for the week which they were actually follow it. (Table 4.25)

ASSOCIATION BETWEEN HOUSEHOLD SIZE AND FREQUENCY OF FOOD WASTE

There was no significant correlation between household size and the frequency of food waste. (Table 4.26)

According to Blesa et al. (2020), the number of persons living in the household had a clear correlation with the amount of waste that was generated. It was discovered that single homes in general created more waste than other types when looking at waste per person. Females who were single in particular created the greatest amount of food waste.A study conducted by Machate's (2020), found that larger size households wasted less food than their smaller counterparts on a per capita basis. Compared to houses with larger sizes, households with one person wasted more food.

ASSOSIATION BETWEEN FOOD WASTE AND CONSUMER PURCHASING BEHAVIOUR

There was no association between consumer purchasing behaviour and frequency of wasting food. (Table 4.27)

FIGURE 4.13 CATEGORIES OF DISCARDED FOOD PRODUCTS (N=42)
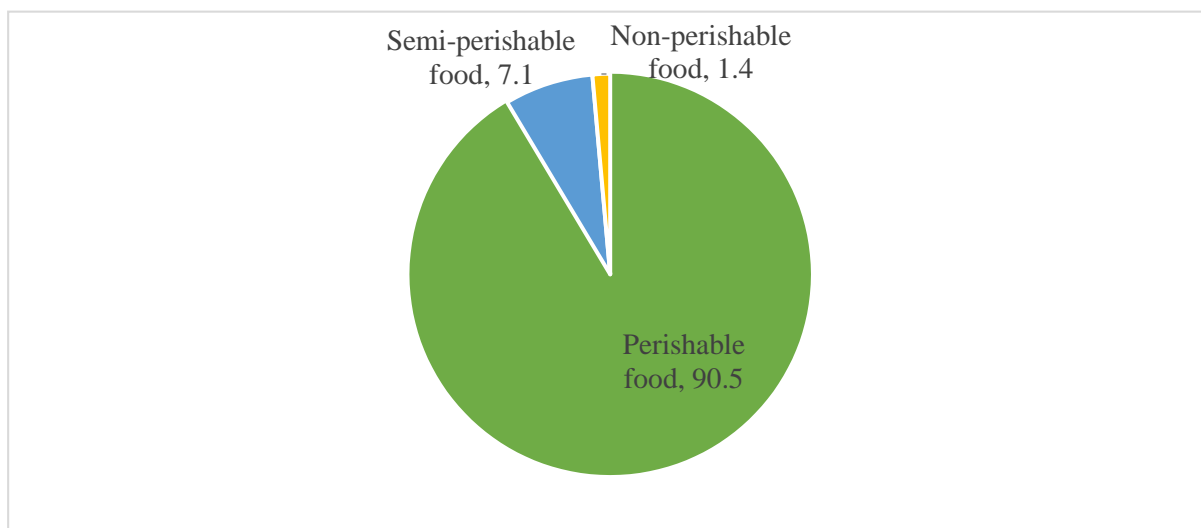
TABLE 4.23 REASONS FOR DISCARDING FOOD IN THE PREVIOUS TWO DAYS (N=42)

Reasons	N (%)
Due to the preparation of extra food	22 (52.9)
The fruit was overripe	5 (11.9)
The person was not feeling well	2 (4.8)
No one wanted to eat the food	3 (7.1)
Food was past the expiry date.	2 (4.8)
Food was in the fridge since a long time	3 (7.1)
Breaking of storage jar	1(2.4)
Food spoiled by fungus.	1 (2.4)
Food was in the kitchen storage since a long time	1 (2.4)
Infested by ants	1 (2.4)
The food was burnt	1 (2.4)

TABLE 4.14 DISPOSING OF FOOD (N=42)

Wash down the drain, 14.3
Put in a polythene bag and thrown on the road, 21.4
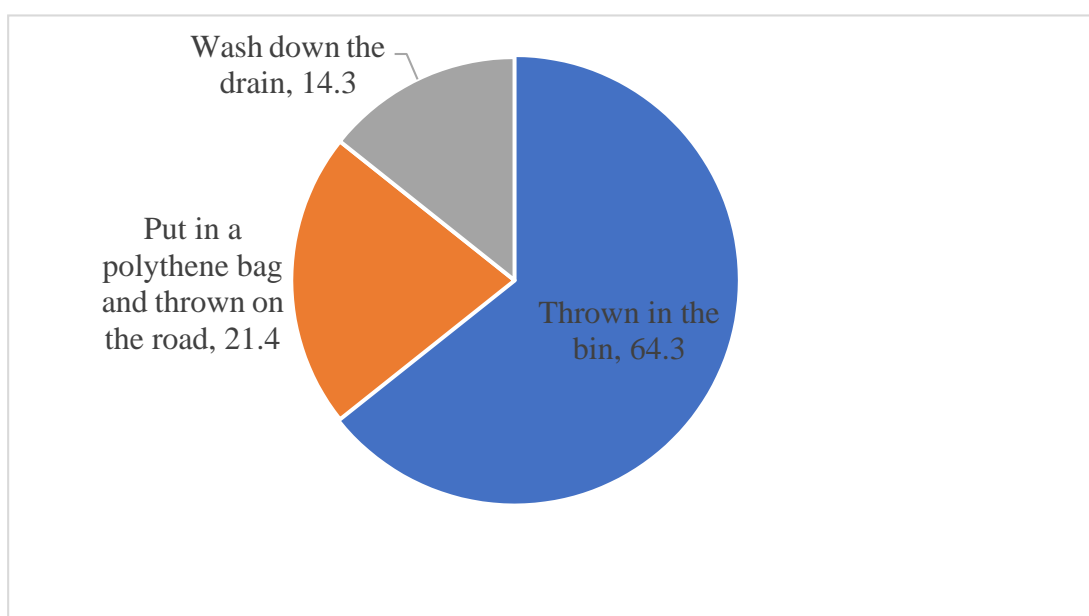Thrown in the bin, 64.3

TABLE 4.24 ASSOCIATION BETWEEN HOUSEHOLD PER CAPITA INCOME AND FREQUENCY OF WASTING FOOD

	<8220 per capita income (N= 92)	≥8220 Per capita Incomes (N=312)	Chi-square	p-value
Once/week	27 (29.3)	66 (21.2)		
More than once a week	65 (70)	246 (78.8)	2.69	0.38

TABLE 4.25 ADHERING TO MEAL PLANS N (%)

Do you plan a daily/weekly menu?	Do you adhere to your meal plan?					
	Always	Very often	Sometimes	Rarely	Never	Total
Always	68 (40.5)	19 (11.3)	18 (10.7)	22 (13.1)	41 (24.4)	168 (41.6)
Very often	22 (39.3)	13 (23.2)	5 (8.9)	10 (17.8)	6 (10.7)	56 (13.9)
Sometimes	37 (43.5)	13 (15.3)	12 (14.1)	14 (16.5)	9 (10.6)	85 (21.03)
Rarely	36 (50.7)	13 (18.3)	7 (9.8)	8 (11.3)	7 (9.8)	71 (17.6)

TABLE 4.26 ASSOCIATION BETWEEN
HOUSEHOLD SIZE AND FREQUENCY OF
FOOD WASTE

	≤3 person (N= 125)	Greater than 3 person (N= 279)	Chi-square	p-value
Once/week	32 (25.6)	61(21.2)	0.6	0.4
More than once a Week	93 (74.4)	218 (78.1)		

TABLE 4.27 ASSOSIATION BETWEEN FOOD WASTE AND CONSUMER PURCHASING BEHAVIOUR

Consumer behavior toward food products	Once/month	More than one month	t- value	p-value
Checking the refrigerator/freezer/store room before shopping	4.2± 1.1	4.2± 1.1	0.5	0.9
Plan daily menu	3.1± 1.4	3.2± 1.3	1.3	0.6
Writing a shopping list	3± 1.3	4.0± 0.8	0.9	0.2
Buying only what is Needed	3.9± 0.8	3.6± 1.2	0.9	0.3
Check use by and best before dates	3.6 ± 1.2	4.1± 0.9	0.2	0.8
Consider how food is stored to keep fresh	4.04± 0.9	4.01± 0.9	0.7	0.4
Consider portion size	4± 0.9	4.1± 0.9	0.08	0.9
Use leftover	4.06± 0.9	4.1± 0.9	0.2	0.8
Decided based on price/kg	4.3± 0.9	4.3± 0.9	0.2	0.7

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSION

There are several issues nowadays with the amount of food waste that is produced annually. Food waste is a subject that is receiving increasing attention both nationally and internationally. The most frequently cited statistic states that 1/3 of the food produced for human use is lost or squandered each year, or 1.3 billion tons. There needs to be a considerable improvement because the average household globally discards 74 kg of food each year. Food security, greenhouse gas emissions from the food supply chain, and waste disposal are the three key global issues that food waste raises. The extent of home food waste demonstrates how individual decisions frequently depart from the core economic principle of optimising utility function. The main factors that contribute to food waste in households include: awareness, knowledge, preferences, planning, portion size, packing, and storage, among others. On the one hand, consumer food waste behaviour is influenced by time patterns decision-making in the present, and preferences for potential future food disposal methods. Household food waste is caused by consumer habits such as buying food from stores, malls, or markets for immediate consumption or storage for later use. Food waste also depends on the size of the family, family income, the demand and supply of the food item, the quality of the food anyone wants to buy, and poor planning and budgeting for each type of food that one wants to purchase. On the other hand, socioeconomic conditions, traditions, feelings, culture, and the variety of food sources illustrate how people have complex diets and waste food. This study aims to investigate consumer behaviour, habits and attitudes regarding household food waste. Thus, with this background the present study was planned with following objectives:

1. To assess consumer behaviour towards food products

2. To determine household food waste composition based on consumer responses.

3. To evaluate association between avoidable food waste and consumer

   purchasing behaviour.

ENROLMENT OF THE STUDY SUBJECTS:

The study was a cross-sectional study. Data was collected from urban Vadodara. Urban Vadodara was divided into four zones. i.e., North zone, South Zone, East zone and West zone. From each zone one housing society was purposively selected and subsequently societies were selected in a concentric manner till the desired sample size of 101 households from each zone is achieved.

DATA COLLECTION

Data related to respondents' background information, behavior, habits, and attitudes were collected using a pre-tested questionnaire. The questionnaire included questions on categories of avoidable food waste in the previous 2 days and estimated the usual amounts of food wasted, and reasons for food waste, and also asked the questions about how they were disposed of.

OBSERVATIONS

Background Information of the Subjects

- The mean age of the respondents was 47.6 years. While more women lived in joint households, more men lived in nuclear families. Only 0.5% of respondents lived alone, with the majority of respondents belonging to households of at least four.

- According to the respondents' educational backgrounds, the majority of males and females were graduates, with only 2.7% females being illiterate.The majority of respondents have monthly incomes between rupees 50,000 and 100,000. Only 14.8% of respondents were non-vegetarians in terms of their dietary habits.

Consumer purchasing behaviour towards food products

- From 404 total respondents, male (95.4%) and female (92.6%) respondents both shopped from markets in the majority (93.1%) of cases.

- Most of the male respondents (3.03%) ordered food less frequently online.

- About half of males (50%) and females (51.2%) bought food one to two times a week, while male respondents (13.6%) bought food products daily and female (13.3%) respondents bought food products daily.

- The consideration of food storage practices ($p< 0.01$) and usage of leftover food products ($p< 0.01$) were shown to be more frequent among men. Female consumers reportedly made decisions more frequently based on price/kg ($p< 0.05$).

- Many respondents never (4.4%) checked the refrigerator or store room before shopping, while the majority routinely (56.4%) check it before purchasing food.

- Menu planning used to be done very often (34.9%) by the majority of responders, while many others never (21.5%) did it.

- Before purchasing food, the majority of respondents sometimes (29.2%) write a shopping list, although 18.3% never do so.

- When purchasing food, respondents often got only what they required; yet, very few respondents never (0.5%) purchased only what they needed.

- The information gathered shows that the majority of respondents sometimes (29.7%) and always (29.2%) checked the "best before" date, whereas 8.4% of respondents never do so.

- Only 1.7% of respondents did not consider how to store food to keep it fresh, compared to 42.1% who always did so.

- Many respondents said that they always thought about food portion sizes. Few respondents never (1.73%) gave the size of the food portions any consideration.

- Only 0.5% of respondents did not consider using leftovers, compared to 44.8% who always did so.

- It was found that 59.6% of respondents always considered purchasing food based on the price per kg, whereas 1.4% never did.

- Around 41.7% of females and 46.9% of males expressed interest in special discounts/offers, respectively.

- Around 38.1% fruits and 37.1% vegetables were the two major categories of food products that were over purchased and discarded.

- Category of wasted food, 22.5%, 28.5% and 7.92% of the respondents' wasted fruits, vegetables and bread once every month respectively.

- Leftover food (19.8%) was thrown out once every two weeks, whereas rice was more frequently wasted one to two times per week (9.4%).

Association between avoidable food waste and consumer purchasing behaviour

- No Significant difference was found in food waste with respect to consumer purchasing behaviour.

Household food waste composition based on consumer responses.

- Only a very small percentage of respondents (0.74%) always wasted food. Around 25.7% of respondents rarely wasted food, compared to 10.6% who did so often.

CONCLUSION

Most of the respondents always purchased the food products based on the price, and the availability of that product in their house. Almost half the respondents were attracted by special offers. On assessing attitude regarding food waste it was found that many of the respondents gave unconsumed food and unconsumed liquid food to someone, some of the respondents fed unconsumed liquid to animals which was one of the ways to reduce the amount of food waste. The oil used to fry was rarely thrown away, and was reused which is considered unhealthy and may lead to health problems. Perishable foods: vegetable, fruits and cooked items (meals) were discarded the most. Lack of planning meals, lack of adhering to meal plans, over purchasing of foods and inappropriate storage of foods could be some of the major reasons for food waste generation.

RECOMMENDATION

- Awareness regarding proper food storage, food preservation, meal planning, leftovers utilization, and being vigilant a bent the "best before" date, needs to be created to reduce the generation of food waste.
- Consumers need to be sensitized about the correct food purchasing behaviours like using shopping lists and avoiding unnecessary purchases, not getting attracted by discounts and over spending while shopping; and opting for local shops and markets instead of supermarkets for buying food items.

- Educating the public about growing their own food by cultivating kitchen gardens, which is one of the most sustainable approaches to reducing food waste, can go a long way in alleviating the negative impacts of climate change.

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APPENDICES

APPENDIX I

ETHICAL CERTIFICATE

**FACULTY OF FAMILY AND COMMUNITY SCIENCES
THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA**

Ethical Compliance Certificate 2022 – 2023

This is to certify that Ms. Mansi K. Anajwala's study titled, "**Consumer behavior, habits and attitudes regarding household food waste in urban Vadodara**" from Department of Foods and Nutrition has been approved by the Institutional Ethics Committee for Human Research (IECHR), Faculty of Family and Community Science, The Maharaja Sayajirao University of Baroda. The study has been allotted the ethical approval number **IECHR/FCSc/MSc/2022/42.**

Prof Mini Sheth
Member Secretary
IECHR

Prof Shagufa Kapadia
Chairperson
IECHR

CONSENT FORM IN GUJARATI

અભ્યાસનું શીર્ષક: વડોદરા શહેરમું ઘરના ખોરાકના બગાડને લગતાઉપભોક્તાના વતષન, આદતો અને વલણ

સુંશોધક:

ડૉ. શોનીમા વેણુગોપાલ

આસસસટન્ટ પ્રૉફેસર (CES)

ડૅપાટમેન્ટ ઓફ ફ઼ૂડ્સ એન્ડ ન્યુટૉશન

સાયન્સીસ ફૅકલ્ટી ઓફ ફૅમલી એન્ડ કૉમ્યૂસનટૉ

બરોડૉ ધી મહારાજા સયાજીરાવ યુસનવસસટટી ઓફ બરોડા

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ફૅકલ્ટી ઓફ ફૅમલી એન્ડ કૉમ્યૂસનટૉ સાયન્સીસ ઘી મહારૉજા સયૉજીરાવ યુસનવસસટટી ઓફ

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અભ્યાસનો હેતુ

હવે ખોરાકનો બગાડ સિવસેને સિવસે વધી રહ્યો છે. જીવનચક્રના િરક તબક્કે ખોરાકનો બગાડ ઉત્પન્ન થાય છે, પરંતુ સૌથૉી વધુ જથ્થૉ ઘરગથ્થુ સ્તરૉ નૉધાય છૉ. આ ખાધપિૉાથ઼નો બગાડ અજાણતૉા પૂવટક અથવા ક્યારૉ ઈરાિૉાપૂવટક હોઈ શકે છે પરંતુ બંને રીતે તે અન્ય લોકોને ખોરાકની અછત તરફ િૉૉરી જાય છે. ઉપરાંત, તૅપયાટવરણને લગતી સમસ્યાઓ સાથે જોડાયેલ છે. તેથી વડૉિરા શહેરમાં ઘરના ખાધપિૉાથ઼ોના બગાડને લગતાઉપભોક્તાના વતટન, ઑિાતો અને વલણની તપાસ કરવા માટે આ અભ્યાસની યોજના કરવામાં આવે છે.

અભ્યાસનો પ્રોટોકોલ

જો તમે આ અભ્યાસમાં જોડાવવાનું નક્કી કરો તો પ્રશ્નાવલીનો ઉપયોગ કરીને ઘરના ખોરાકના બગાડને લગતા

ખર્

ઉપભોગતાનું વતટન, ઝિાતો અને વલણ સવશેની માસહતી લેવામાં આવશે.

ખર્

આ અભ્યાસ માટે ફક્ત તમારો સમય અને સહકાર જરૂરી છે. સમાસવષ્ટ તમામ ખયટ સંશોધક દ્વારા ઉઠાવવામાં આવશે અને આ સંશોધનમાં તમારી ભાગીઃ્ઃારી માટે કોઇ નાણાકીય વળતર નથી.

સુંભવવત લાભો અને જોખમો

આ અભ્યાસ ઘરના ખાધપિાથોના બગાડને લગતા ઉપભોક્તા વતટન, ઑિાતો અને વલણને સમજવામાં મિઃ કરશે. અમે માનીએ છીએ કે આ સંશોધન અભ્યાસમાં ભાગીઃ્ઃારી સાથે કોઇ જોખમ સંકળાયેલું નથી.

ગોપનીયતા

અભ્યાસમાં, તમારી ઓળખ ગુપ્ત રાખવામાં આવશે. અભ્યાસના પસરણામો વૈજ્ઞાસનક હેતુઓ માટે પ્રકાસશત થઇશકે છે પરંતુ તમારં નામ જાહેર કરવામાં આવશે નહીં અથવા તમારા માટે કોઇ ઓળખી શકાય તેવા સંઃભોનોસમાવેશ કરવામાં આવશે નહી.ઃં

સ્ૂવૈવછઃ⊂ક ભાગીદારી

આ અભ્યાસની સફળતા માટે તમારો સહકાર મહત્ૂવપૂણ છે. જ⊂ાં સુધ⊂ી તમારા જવા ઘણા સહભ⊂ાગી આ અભ્યાસમાં ભાગ નહીં લે ત્યાં સુધી તે શક્ય બનશે નહી.ઃં

સુંમવત પાઃ્ઃી ખેંવર્ાનો અવધકાર

આ અભ્યાસમાં જોડાવાનો તમારો સનણટય સ્વૈસછછિક છે. તમે કોઈપણ સમયે, કોઈપણ કારણોસર, સૂચના આપ્યા સવના અભ્યાસ છોડી શકો છો. અમે આશા રાખીએ છીએ કે તમે સમગ્ર અભ્યાસ સમયગાળા માટે ભાગ લેશો કારણ કઃે અમને સાય⊂ા સનષ્કર્ૂ પર પહ⊂ોયવા માટઃે બધ⊂ી માસહતીન⊂ી જરૂર છઃે.

પવરણામોની ઉપલબ્યતા

અભ્યાસના અંતે, સંબંસધત માસહતી ની તમને જાણ કરવામાં આવશે.

સુંપ

જો તમને આ અભ્યાસ અંગે કોઈ પ્રશ્નો હોય, તો તમે સંશોધકોનો સંપક કરી શકો છો.

સુંમવતનુઃં પ્રમાણપત્ર

મેં આ માસહતી વાંયી છે (અથવા આ માસહતી સવશે મને જાણ કરવામાં આવી હતી.) અને અભ્યાસનું વણટન સમજુઃં છે અને હું ડો. શોનીમા વેણુગોપાલ અને તેમની સવધ્યાથીની કુ.માનસી અનાજવાલા દ્વારા વડોિરા શહેરમાં ઘરના ખાધ્યપિાથોના બગાડને લગતા વતટન, આિતો અને વલણ સવશે હાથ ઘરવામાં આવેલા સંશોઘનમાં ભાગ લેવા માટે સંમત છું . હું સમજુ છું કે આ સવશે માસહતી એક પ્રશ્નાવલી દ્વારા લેવામાં આવશે અને હું કોઈપણ સમયે અભ્યાસ સવશે પ્રશ્ન પૂછી શકું છું . હું કોઈપણ સમયે અભ્યાસમાંથી બહાર રહેવાના મારા અસઘકાર સવશે પણ વાકેઇફછું .

અભ્યાસ સહભાગી નું નામ અને હસ્તાક્ષર:＿＿＿＿＿＿＿＿＿＿   તારીખ

STUDY TITLE: **CONSUMER BEHAVIOUR, HABITS AND ATTITUDES REGARDINGHOUSEHOLD FOOD WASTE IN URBAN VADODARA**

INVESTIGATORS

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PURPOSE OF THE STUDY

The amount of food being wasted is increasing globally. Food waste is generated at each stage of the life cycle,but the largest amount is recorded at the household level. This food waste may be accidental or sometimes intentional but both ways it leads to scarcity of food to other people. Also, it is associated with environmental problems. This study plans to investigate consumer behavior, habits and attitudes regarding household food waste in urban Vadodara.

PROTOCOL OF THE STUDY

If you decide to join this study, information on consumer behavior, habits and attitudes regarding food waste will be collected using a questionnaire.

COSTS

This study requires only your time and co-operation. All the costs included will be borne

by the researcher andthere is no financial compensation for your participation in this research.

POSSIBLE BENEFITS AND RISKS

The study will help in understanding the consumer behavior, habits and attitudes regarding household food waste. We believe that there is no risk associated with participation in this research study.

CONFIDENTIALITY

Your cooperation is important for the success of this study. Unless many volunteers like you participate in thisstudy it will not be possible.

RIGHT TO WITHDRAW

Your decision to join this study is voluntary. You can quit the study at any time, for any reason, without notice.We hope you will take part for the entire study period because we need all the information to draw a correct conclusion.

AVAILABILITY OF RESULTS

At the end of the study, relevant information will be shared with you.

CONTACT

If you have any questions regarding this study, you can contact the investigators.

CERTIFICATE OF CONSENT

I have read this information (or had the information read to me) and understood the description of the study, Iagree to take part in the research being carried out by Dr. Shonima Venugopal and her student, Ms. Mansi Anajwala, on consumer behavior, habits and attitudes regarding household food waste in urban Vadodara. I understand that this information will be collected using a questionnaire. I understand that I may ask questions about the study at any time. I am also aware of my right to opt out of the study anytime

Name of the consumer and signature: Date:

QUESTIONNAIRE OF CONSUMER BEHAVIOR, HABITS AND ATTITUDES REGARDING HOUSEHOLD FOOD WASTE:

Name:

Address:

Mobile No:

Age:

Gender: □ Male □ Female □ Other

Type of family: □ Nuclear □ Joint □ Extended □ Others

Number of family members:

Household income:＿＿＿＿＿＿＿/month

Number of children in household:

Dietary habits:

□ Vegetarian □ Non-vegetarian □ Ovo- vegetarian

Education level: □ Professional
□ Graduate
□ Post-high school diploma
□ Higher Secondary
□ Middle School
□ Primary School
□ Illitera

1) Where do you buy foods needed for everyday cooking?

□ Market □ Grocery store

□ Supermarket producers □ Directly from

□ Internet

2) Before buying food which of the following do you do?

- Checking the refrigerator/ freezer/ store room before shopping

  □ Always □ Very often □ Sometimes □ Rarely □Never

- Plan daily menu

  □ Always □ Very often □ Sometimes □ Rarely □ Never

- Writing a shopping list

  □ Always □ Very often □ Sometimes □ Rarely □ Never

- Buying only what is needed

  □ Always □ Very often □ Sometimes □ Rarely □ Never

- Check use by and best before dates

  □ Always □ Very often □ Sometimes □ Rarely □ Never

- Consider how food is stored to keep fresh

  □ Always □ Very often □ Sometimes □ Rarely □ Never

- Consider portion size

  □ Always □ Very often □ Sometimes □ Rarely □ Never

- Use leftovers

  □ Always □ Very often □ Sometimes □ Rarely □ Never

- Decide based on price/kg

  □ Always □ Very often □ Sometimes □ Rarely □ Never

3) How frequently do you buy food?

    □ Daily   □ 5-7times/week   □ 3-4 times/week

    □ 1-2 times/week   □ Once every 2 weeks   □ Once/month

4) Which type of food do you tend to overbuy and end up discarding?

    □ Cereal/pulses   □ Fruits
    □ Vegetables   □ Milk & milk products
    □ Meat/Fish/Poultry   □ Ready to eat foods
    □ Sweets   □ Juices/Beverages
    □ Breads

5) Are you attracted by special offers/discount coupons in shops?

    □ Yes   □ No   □ Sometimes

6) Do you feel that you purchase only what is necessary?

    □ Always   □ Very often   □ Sometimes   □ Rarely   □ Never

7) If you buy more than what is already needed, what is the reason for purchasing extra?

    □ additional items bought that were marked down

    □ some were impulsively bought

    □ shopping lists were incomplete

    □ co-shopper influenced the purchase

    □ Any other _____

    □ No reasons

8) How often do you check the expiration date of food?

  - Ready-to-eat food

    □ Always   □ Very often   □ Sometimes   □ Rarely   □ Never

  - Eggs

    □ Always   □ Very often   □ Sometimes   □ Rarely   □ Never

  - Milk and Dairy products

    □ Always   □ Very often   □ Sometimes   □ Rarely   □ Never

  - Bread and bakery products

    □ Always   □ Very often   □ Sometimes   □ Rarely   □ Never

- Juices/Beverages

□ Always □ Very often □ Sometimes □ Rarely □ Never

- Meat and meat products

□ Always □ Very often □ Sometimes □ Rarely □ Never

9) What do you do when the items near their 'best before' date?

□ Use it as soon as possible □ Discard it □ Give it to someone

10) Do you use products after the 'best before date'?

□ Always □ Very often □ Sometimes □ Rarely □ Never

11) How often do you throw away food that has exceeded its shelf life, but with no signofdeterioration?

□ Always □ Very often □ Sometimes □ Rarely □ Never

12) How often do you cook in your home?

□ Daily □ 5-6 times/week

□ 3-4 times/week □ 1-2 times/week

□ Never

13) Do you use any scale and portion measuring products during your cooking process?

□ Yes □ No

14) Do you plan daily/weekly meals?

□ Always □ Very often □ Sometimes □ Rarely □ Never

15) Do you adhere to your meal plans?

□ Always □ Very often □ Sometimes □ Rarely □ Never

16) How often do you:

- Eat out or order food delivery

□ Always □ Very often □ Sometimes □ Rarely □ Never

- Eat pre-cooked food

□ Always □ Very often □ Sometimes □ Rarely □ Never

17) Do you always use the refrigerator to keep products for a long time?

□ Yes □ No

18)   What types of waste are found in your trash?

Food waste	□ Always	□ Very often	□ Sometimes	□ Rarely	□ Never
Wood	□ Always	□ Very often	□ Sometimes	□ Rarely	□ Never
Textiles	□ Always	□ Very often	□ Sometimes	□ Rarely	□ Never
Metals	□ Always	□ Very often	□ Sometimes	□ Rarely	□ Never
Glass	□ Always	□ Very often	□ Sometimes	□ Rarely	□ Never
Plastic	□ Always	□ Very often	□ Sometimes	□ Rarely	□ Never
Paper/card Board	□ Always	□ Very often	□ Sometimes	□ Rarely	□ Never

19) How often is food wasted?

□Never   □ Daily   □ 5-6 times/week

□ 3-4 times/week   □ 1-2 times/week   □ Once/2 weeks

□ Once/month   □ More than one month   □ Once/ 6 months

20) Which type of food product is discarded?

a) Rice: □ Yes   □ No
   -   If yes, how often?   □Never   □ Daily   □ 5-6 times/week

                    □ 3-4 times/week   □ 1-2 times/week   □ Once/ 2 weeks

                    □ once/month   □ More than one month   □ Once/6 months

b) Fruits: □ Yes   □ No

- If yes, how often? □Never □ Daily □ 5-6 times/week

□ 3-4 times/week □ 1-2 times/week □ Once/ 2 weeks

□ once/month □ More than one month □ Once/6 months

c) Vegetables: □ Yes □ No

- If yes, how often? □Never □ Daily □ 5-6 times/week

□ 3-4 times/week □ 1-2 times/week □ Once/ 2 weeks

□ once/month □ More than one month □ Once/6 months

d) Milk and milk products: □ Yes □ No

- If yes, how often? □Never □ Daily □ 5-6 times/week

□ 3-4 times/week □ 1-2 times/week □ Once/ 2 weeks

□ once/month □ More than one month □ Once/6 months

e) Meat and meat products/Fish/Poultry: □ Yes □ No

- If yes, how often? □Never □ Daily □ 5-6 times/week

□ 3-4 times/week □ 1-2 times/week □ Once/ 2 weeks

□ once/month □ More than one month □ Once/6 months

f) Eggs: □ Yes □ No

- If yes, how often? □Never □ Daily □ 5-6 times/week

□ 3-4 times/week □ 1-2 times/week □ Once/ 2 weeks

□ once/month □ More than one month □ Once/6 months

g) Sweets: □ Yes □ No

- If yes, how often? □Never □ Daily □ 5-6 times/week

□ 3-4 times/week □ 1-2 times/week □ Once/ 2 weeks

□ once/month □ More than one month □ Once/6 months

h) Beverages: □ Yes   □ No

  - If yes, how often?   □Never   □ Daily   □ 5-6 times/week

                    □ 3-4 times/week   □ 1-2 times/week □ Once/ 2 weeks

                    □ once/month   □ More than one month □ Once/6 months

i) Breads: □Yes   □ No

  - If yes, how often?   □Never   □ Daily   □ 5-6 times/week

                    □ 3-4 times/week   □ 1-2 times/week   □ Once/ 2 weeks

                    □ once/month   □ More than one month □ Once/6 months

j) Leftovers: □ Yes   □ No

  - If yes, how often?   □Never   □ Daily   □ 5-6 times/week

                    □ 3-4 times/week   □ 1-2 times/week   □ Once/ 2 weeks

                    □ once/month   □ More than one month □ Once/6 months

k) Ready-to-eat foods: □ Yes   □ No

  - If yes, how often?   □Never   □ Daily   □ 5-6 times/week

                    □ 3-4 times/week   □ 1-2 times/week   □ Once/ 2 weeks

                    □ once/month   □ More than one month □ Once/6 months

21) When cooking a meal how often are you thinking that the portion size is too large?

    □ Always   □ Very often   □ Sometimes   □ Never

22) What do you do with the unconsumed food?

      □ Goes into the trash bin/ Throw away   □ Store it in refrigerator

      □ Give it to someone   □ Feed animal

      □ Use as a compost

23) What do you do with the unconsumed liquid food?

      □ Goes into the trash/ Throw away   □ Store it in refrigerator

      □ Give it to someone   □ Feed animal

      □ Use as compost

24) What do you do with the oil used for frying?

 □ Throw away   □ Reuse the oil

25) Can you estimate the amount of avoidable food waste produced by you on a weekly basis?

 □ Nothing   □ <250gm

 □ 250-500gm   □ 500-1000gm

 □ 1000-2000gm   □ >2000gm

26) What are the reasons that lead to food waste being generated?

Food past expiration date	□ Yes	□ No
Improper storage / Not enough storage space	□ Yes	□ No
Improper packaging size	□ Yes	□ No
Products have stayed in the kitchen for a long period of time	□ Yes	□ No
Products look bad/ odd smell / spoiled food	□ Yes	□ No
Products have stayed in the fridge for a very long time	□ Yes	□ No
Only scraps remain	□ Yes	□ No
Over purchasing of foods	□ Yes	□ No
Plate waste (food left on a plate after a meal)	□ Yes	□ No
It was more than what could be eaten by you	□ Yes	□ No
Cooked food or leftover food are not stored	□ Yes	□ No
Food was not cooked properly (e.g., burnt)	□ Yes	□ No

27) Do you think there is a problem of waste disposal?

 □ Yes   □ No   □ Do not know

28) Have you ever tried any type of food composting?

 □ Yes   □ No

29) To what extent does it bother you when you throw away/discard food?

 □   Not at all   □ Not very much

 □   A little   □ Fair amount

 □   A great deal

30) Do you think discarding/wasting food could pose a problem to the environment?

□ Yes □ No □ Do not know

31) Do you think discarding/wasting food could result in an economic loss to the society?

□ Yes □ No □ Do not know

32) Do you consider cooking some additional meal from the leftover food?

□ Yes □ No □ Sometimes

33) Was any food wasted in the previous 2 days?

□ Yes □ No

l) If yes, what was wasted? _____

m) How much? _____

n) What was the reason? _____

o) How was it discarded? _____