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Investigating the Behaviour and Practices of Household Food Waste Disposal of Consumers in the KwaDukuza Municipality, South Africa

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Abstract

Food waste poses a threat to both food security as well as the long-term sustainability of a country's food system. In South Africa, the expense of post-consumer food waste (mostly from households) is estimated at roughly US$2.7 billion annually, or 0.7% of South Africa's annual GDP. It is unfortunate that so much food is wasted in a country where 26% of people regularly experience hunger and another 28.3% are at risk of becoming hungry at a household level. This study aimed to investigate household food waste practices and behaviours in the KwaDukuza community using a consumer survey. The survey was conducted on 190 households which were randomly selected in KwaDukuza municipality and administered with the structured questionnaire. The study's findings showed that 75% of the households reported doing weekly food shopping, and 87.4 % said they shopped primarily at supermarkets. Bread accounted for the largest share of food waste (28.9%), followed by vegetables and salads (24.7%), and in general, consumers experienced difficulty in making sense of expiry dates. However, many households (67.9%) acknowledged feeling guilty about food waste, and many more (34.2%) said they would waste less if they were informed about the adverse effects of food waste on the environment and economy. The comprehensive information gathered from the food waste survey would contribute to a better understanding of consumers' behaviour and practices regarding the disposal of household food waste, allowing for the development of appropriate food literacy tools to reduce household food waste.

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Introduction

Food waste is connected to three of the world's most pressing issues—food insecurity, greenhouse gas emissions from the food supply chain, and proper waste disposal.[1] There are around 868 million malnourished people and approximately two billion individuals suffering from the adverse health effects of micronutrient deficiencies, posing a threat to the world's food security.[2] Nonetheless, at least a third of all food grown for human use is lost or wasted somewhere in the process of getting it from the farm to the plate. There is a broad range of definitions for "food waste and food loss". The Food and Agricultural Organization (FAO) differentiates between food loss

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and food wastage. Food loss is defined as the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain, excluding retailers, food service providers, and consumers and food waste is defined as the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service and consumers.[3] Raw or cooked food components, such as vegetable peelings, meat trimmings, rotten or extra ingredients, or prepared dishes, bones, carcasses, and organs, are considered food waste.[2] Our study was based on consumer food waste in households, which means food loss at the end of the food chain, which is the final consumption at the household or consumer level. Household food waste includes edible products intended to be eaten but thrown away for various reasons. Food waste occurs before, during, and after cooking a meal in the household and is directly linked to consumer behaviour and practices.

Reduced food waste is one of the most important ways to achieve sustainable global food security.[2] The term "food waste" encompasses the loss of food and the waste of resources utilized in farming, manufacturing, transporting, storing, distributing, and selling food. Due to the limited availability of resources, it is essential that they be used in a sustainable manner. Sustainability, especially in terms of its impact on the environment, has been proposed as the fifth pillar whilst agency, the ability of individuals to make decisions related to food consumption, has been proposed as the sixth pillar of food security. These two added dimensions should serve as a foundation for the other criteria, which include availability, accessibility, usability, and stability.[4] Since reducing food waste is a necessary first step towards achieving environmental sustainability, the United Nations has declared its reduction at the global consumer level in the Sustainable Development Goal (SDG) 12.3. which involves halving global food waste and reducing food waste among consumers worldwide along the production, storage, processing, and distribution stages of the food supply chain, including post-harvest losses by 2030.[5]

The Waste and Resources Action Programme (WRAP) classifies food loss as either avoidable, potentially avoidable, or unavoidable.[6] The term "edible food waste" refers to waste that refers to edible food and can be avoided or decreased.[7] Inedible food loss, however, is an unavoidable problem.[6] According to the FAO, “edible food waste” refers to discarded food despite being fit for human consumption. Edible food waste includes leftovers, stale bread, and bruised bananas.[8] Bread crusts, potato skins, and carrot shoots are all examples of food that could have been eaten but are thrown away instead. While some individuals enjoy these foods, others choose to avoid them.[7] Bones (meat and seafood), tea bags, and eggshells are all examples of foods that must be thrown away because they are unsuitable for human consumption.[6]

The literature indicates that up to 25% of food is wasted. Some estimates put it as high as 32% worldwide. The numbers account for the entire food chain, from farm to fork. However, many studies on several continents with both developed and developing nations show that households are the primary sources of food waste.[9] The amount of waste generated at the household level varies widely between countries, primarily based on affluence, industrialization, and community development.[10] Each week, individual Europeans and Americans discard away 95-115 kg of food, as reported by the Department of Environment, Forestry, and Fisheries (DEFF) and the Council for Scientific and Industrial Research (CSIR). In contrast, people in South and Southeast Asia and Sub-Saharan Africa discard away between 6 and 11 kg of food per individual per week.[11] South Africa is just one of many nations in sub-Saharan Africa where the problem of food waste in the household is not well recognized and empirically quantified,[2] even though this knowledge is essential for developing waste-reduction strategies that target specific behavioural factors.[12] Most food waste occurs due to over-cooking, over-serving, or over-shopping. Inadequate preparation, buying on impulse, or stocking up are common causes of excessive shopping. Wasting 1.3 billion tonnes of food annually is expected to cost the global economy $750 million. This wasted food would be enough to end malnutrition for one-eighth of the world's population.[10]

Food waste has an environmental cost that is quantified in terms of greenhouse gases (GHGs) emissions. Most developing nations, including South Africa, dispose of their solid waste in landfills, which emit GHGs like carbon dioxide (CO^2), nitrous oxide (N_2O), and methane (CH_4).[13] Methane warms the atmosphere 26–28 times more than CO_2. According to the World Wildlife Fund (WWF), life cycle assessment (LCA) is the most reliable technique for estimating the ecological effect of food waste. LCA calculates resource use and carbon footprints. LCA data includes energy, water, and other resources used to make foods and other products. According to WWF, the energy required to produce discarded food would be enough to power Johannesburg for 16 weeks. South Africa, the 30th driest nation, wastes an alarming quantity of water in food production. Furthermore, the waste includes enough wastewater to fill 600,000 Olympic-sized swimming pools.[14] The adverse effects on the ecosystem caused by this waste of resources can be reduced or eliminated with the help of efficient waste management.[15]

The World Food Summit defines food security as "a state that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that satisfies their dietary needs and food preferences for an active and healthy life."[16] One in nine people worldwide suffers from hunger, proving that this is still an important problem on a global scale. Despite efforts, food insecurity continues to grow.[17]

In South Africa, low-income families spend half their earnings on food, 23% can't afford it, and 21% go hungry to stretch their budge.[18] Food waste would raise food prices, making it harder for low-income families to eat healthily. Nutrients are lost when food is wasted that could have been used to feed someone hungry. South Africa can reduce hunger and food insecurity by reducing food waste.[14]

According to Oelofse *et al*.[19] 10.2 million tonnes of locally grown and imported food (excluding exports) is lost or wasted annually. Consumers are responsible for only 0.5 million tonnes of food waste annually, with the rest being lost or wasted in production, storage, and transportation.[20]

The Department of Environment and Forestry (DEFF) and the Council for Scientific and Industrial Research (CSIR) reported that 6 kilograms of food are wasted in South African households every week. In addition, residents of Johannesburg throw away 12 kilos more of food than those of Ekurhuleni each year (8 kg).[11] de Lange and Nahman 21 estimated that South Africa's food loss amounts to R75 billion annually (2.2% of GDP). A total of roughly R3.6 billion will be needed to cover the expenses of disposal, social costs, and environmental damage.11 In 2011, food accounted for 22% of household expenditures in South Africa. Based on their research, Marx-Pienaar *et al*.[22] believe that food waste in South Africa costs the country's economy R61.5 billion per year. Ramukhwatho *et al*.[23] research on food waste in Mamelodi found that 82% of participating families wasted food, throwing away one bag per week on average (24 kg).

According to Ramukhwatho *et al*.[23] perishable food that has passed its expiration date, leftovers, special offers, and excess food made in the kitchen are the leading causes of food waste in households in the South's Mamelodi community. According to Chakona *et al*.[2] South African households throw away 27% of cooked food, 15% of raw food, and 8% of drinks. Oelofse and Nahman 24 discovered that while South African households waste a wide variety of foods, fruits and vegetables are the most commonly discarded items.

Food waste varies and is affected by household income, according to the results of the waste characterization study conducted in Johannesburg.[25] There is a significant weight difference between the amounts of food wasted by high- and low-income families in urban areas, with low-income families' amounts being between 12-26.2% or greater. In addition, since food is a necessity for low-income families, they spend a larger percentage of their earnings on it than middle- and upper-class families. Furthermore, due to financial constraints, low-income families rarely waste edible food.[24]

The primary objective of this study is to collect data on the food waste practices and behaviours of consumers within the KwaDukuza community. The comprehensive information collected from this survey on food waste will be used for the creation and dissemination of a suitable food literacy tool in the future aimed at mitigating household food waste among the broader community.

Materials and Methods

Location of Research

This study took place in the North of Durban, in the KwaDukuza municipality of KwaZulu-Natal, South Africa. The investigation was carried out in five districts: Ballito, Salt Rock, Stanger, Tinley Manor, and Blythedale Beach.

Sample and Data Collection

Every third house on every street in the five districts was systematically randomly selected until a sample size of 190 was attained, 38 households per district. To facilitate the systematic random selection of participants and to recruit participants for the second phase of the study, which was an audit of household food waste in the district, the survey was administered through an in-person interview. Surveys allow for inferences to be made about the general population, and the personal approach of the in-person survey carries the convincible element to successfully recruit participants.[25] The recruitment process entailed the following:

- An advertisement was published in a local newspaper to inform people about the study being conducted.
- A street map of each district was used to find a random starting point at a street level. Adults (18 or older) responsible for preparing and purchasing food for their households from every third household were approached to participate in the study. Sample selection continued in the interval of every third household.
- Upon recruitment, a letter of information was provided and informed consent was sought. All participants recruited in the study were informed that their responses would be de-identified. If participants agreed to take the survey at the recruitment stage, it was administered

immediately and conducted at the point of recruitment, however, for participants that expressed a preference for an alternate date, revisit appointments were scheduled.

Ethical Considerations

The Ethical Clearance Committee at the Durban University of Technology approved this study (IREC 196/22) before the start of fieldwork.

Analysis of Data

The statistical analysis was performed using IBM Corp's SPSS® version 28, developed in Armonk, New York, USA. Significant results were considered to be at a P-value of less than 0.01.

Results

Demographics and Household Composition

Each region's participants were profiled according to sex, race, age, education, monthly income, and the number of people living in their households.

Table 1 shows the demographic breakdown of the sample of households, with women making up 63.7% and men making up 36.3% of the total. A total of 42.6% were of Indian descent, while 40% were white, 15.8% were black, and 1.6% were from a different racial group. Approximately 24.7% of the participants were aged 45–55, and another 24.2% were aged 56–65. In addition, 20% were between the ages of 36 and 45, 15.3% were 65 and older, 8.9% were between the ages of 26 and 35, 6.3% were between the ages of 18 and 25, and 0.5% did not provide an age range. 60.5% of participants declined to reveal their monthly income range; 12.6% earned more than R30, 000.00 (1 USD=R18.17 approximately) per month (the highest income group); and 8.4% earned between R5, 000.00 and R10, 000.00. 7.9% of the participants had a monthly income between R26, 000 and R35, 000, 4.2% had a monthly income between R21, 000 and R25, 000; 3.7% reported an income bracket between R16, 000 and R20, 000; and 2.6% (n=5) had a monthly income between R11, 000 and R15, 000, making up the lowest income group. Regarding family composition, 45.3% of households consisted of just two adults, while 28% had three adults, and 13% had four adults. In addition, 1.1% of all households included six or more people, 6.8% had only one adult, and 5.3% included five adults. Families with two children made up 8.4%, those with one child made up 3.7%, those with three children made up 2.1%, and those with four children made up 0.5%.

Table 1: A display of the demographic profile of the household

Characteristics	Category	Responses (n)	Percentage (%)
Age (years)	Unspecified	1	0.5
	over 65	29	15.3
	56-65	46	24.2
	46-55	47	24.7
	36-45	38	20
	26-35	17	8.9
	18-25	12	6.3
Gender	Male	69	36.3
	Female	121	63.7
Race	Indian	81	42.6
	White	76	40
	Black	30	15.8
	Other	3	1.6
Income	Unspecified	115	60.5
	>R30000	24	12.6
	R26000-R35000	15	7.9
	R21000-25000	7	3.7
	R16000-R20000	5	2.6
	R11000-R15000	8	3.7
	R5000-R10000	16	8.4
Household composition	One adult	13	6.8
	Two adults	86	45.3
	Three adults	51	28
	Four adults	52	27
	Five adults	10	5.3
	Six or more adults	2	1.1

Families with children	Unspecified	162	85.26
	One child	7	3.7
	Two children	16	8.4
	Three children	4	2.1
	Four children	1	0.5

Food Purchasing Practices

Frequency of Grocery Shopping

The investigation (Table 2) showed that 75% of those who participated in the study reported weekly food shopping. Not only that, but 6.8% of the participants went shopping daily, while 5.3% went shopping once a month. In addition, 4.2% went shopping every other week, once or twice a month, three times a week, once every two weeks, every third day, or twice a week, and 3.2% went shopping every other day.

Preference of Grocery Shopping Outlets

Table 2 depicts the purchasing of groceries at various retail stores. When comparing supermarket chains and online supermarkets, it was found that 87.4% of households prefer to shop at supermarket chains, while 12.1% prefer to shop at online supermarkets. While most households reported shopping at supermarkets, 12.6% and 87.4% of households did not. In addition, 21.6% of households purchased food from neighborhood convenience stores, while 78.4% did not. In addition, only 14.7% of households bought groceries at a farmers' market, while 85.3% did not. Almost as many homes grew their own food (10.0%) as shopped at green groceries (9.5%). Nonetheless, 90.5% and 90% of consumers did not shop at green grocery stores or grow their food.

Food Storage Practices

Storage of Fruits and Vegetables

General fruit and vegetable storage in homes is shown in Table 3. 93.2% of families refrigerated their fruits and vegetables, while 6.8% did not. While 61.1% of households had no fruit or vegetable storage, 38.9% kept vegetables and fruits in the kitchen or a fruit bowl. And while most homes (13.7%) kept fruit and vegetables in the kitchen (cupboards or under the counter), 1.6% kept theirs in the garage or outdoors, and 5% kept them elsewhere. In contrast, only 13.5% of households stored the fruits and vegetables in the shed or outside, while 86.3% of households did not keep them in the cupboard or under the sink.

Understanding The Expiry Date

More than a third (37.9%) of participants say an expiration date is a day after a product is no longer fresh to consume, while only 28.9% say it's the day after an item can no longer be used based on its shelf life. In addition, 12.6% of respondents recognize an expiration date as the time after which a product poses a health risk to consumers. In comparison, 12.1% identify it as the time after which an item must be discarded, and 5.8% recognize it in a different manner.

Keeping Food After Expired

In this study, over half (51.1%) of participants kept expired food for 1-3 days, 27.9% disposed of it immediately, and 7.4% kept it for 4-7 days. In addition, 6.8% store the food for 1-2 weeks, 1.1% store it for a month, and 2.6% store it for more than a month.

Food Discarding Practices

Products Discarded in Households in The Past Week

Table 4. shows what people have thrown away at home over the previous week. The most frequently thrown-away food item was bread (28.9%), followed by vegetables and salads (24.7%), and then fresh fruit (21.6%). The percentage of non-fresh vegetables thrown away was 10%, while the percentage of non-fresh fruits was only 1.6%. Similarly, 16.3% more rice and other cereals were wasted than pasta (3.7%). No one disposed of their alcoholic beverages. Meat alternatives had the second-lowest rate of waste, after alcoholic beverages, at 1.1%. Surprisingly, 33.7% of homes did not discard perishable food or beverage items within the previous week.

Frequency of Discarding Food

The research also looked at weekly food waste to determine how much people typically throw away after cooking or shopping. The majority of homes (44.7%) do not waste much food. While 16.3 % of households throw away a fair quantity of food, 8.4 % throw away a few meals. In addition, 1.6% of homes waste a considerable amount of food, while 4.7% do not waste any.

Most Common Reasons for Throwing Away Food in The Past Week

The most prevalent causes of food waste are depicted in Table 5. The majority of participants (42.60%) discarded food if it had an unpleasant odor, and 41.1% did so if it had a sticky or moldy texture. In addition to being past their expiration date (32.1%), having an unpleasant appearance or texture (24.2%), having cooked or purchased more than was necessary (14.7%), or simply not liking the food (5.5%), were other frequent causes of food waste. The need for more storage rooms only accounted for 1.6% of all cases of food waste.

Feeling Towards Discarding Food

67.9% of respondents said they felt bad about wasting food, and 56.8% said they tried to avoid wasting food as much as possible. Fewer than a third of respondents were bothered by food waste (25.3%) and made some attempt (29.5%) to reduce their food waste. Only 4.2% of participants were significantly impacted by the amount of food they threw away, and 9.5% of respondents made some attempt to cut down on food waste. In addition, 1.1% of participants did not attempt to reduce food waste, and 2.6% said they were unconcerned about wasting food.

Table 3: Storage of the general fruit and vegetables within the home

Storage of fruits and vegetables	Responses (n=190)	Percentage (%)
In the fridge	177	93.2
Kitchen/Fruit bowl	74	38.9
Cupboard/ under the sink	26	13.7
Garage/ Outdoor storage	3	1.6
Other	1	0.5

Food Purchasing, Preparation, and Storage Practices

Food Purchasing and Use of Leftover Foods

Research indicates that people have different habits when it comes to buying, preparing, and storing food. Only 8.9% of households routinely threw away leftovers after a meal, while 91.1% did not. More than half of households contemplated what could be prepared with leftover food when purchasing food (61.1%), when planning meals (56.8%), and when purchasing food in bulk (56.3%). However, when it came to meal planning (43.2%) or meal preparation (38.4%), households did not consider what could be made with leftover food, and 43.7% did not purchase in bulk. Furthermore, 26.8% of participants indicated that they frequently purchase more food than they need, while 73.2% disagreed. Only 26.3% of families dated and labelled frozen food, while 73.7% did not.

Family Action in Food that is Approaching its Best-Before Date

The vast majority of households (78.4%) utilized the food item immediately. However, 3.7% of households prepared the food item before freezing it, 21.6% froze it, and only 3.2% simply threw it away.

Management of Cooked Food in Households

The majority of households (52.6%) ate leftover cooked food the following day for lunch. Donating the food (18.9%), freezing it to consume at a later time (11.6%), feeding it to pests/animals (10.5%), repurposing it to make another dish (3.2%), or using it as compost (2.1%) were other methods used by households to deal with leftover cooked food. Only 1.1% of families reported discarding their leftover cooked food.

Strategies Used to Plan Meals in the Household

Table 6 depicts that 32.1% of families pre-planned their meals. In addition, 23.7% likely determined adequate serving sizes for household members, while 32.6% had never implemented a policy where no new groceries were bought until the existing ones had been depleted. Almost half of all households (57.4%) rarely prepare multiple meals at once, while a third (30%) always use clear containers for storage to keep leftovers in the fridge.

Factors Leading to Household Food Waste

The causes of wasted consumer goods are shown in Table 7. Most families discard food because it has gone rotten (41.1%), making this the leading cause of food waste at home. The appearance of mold on food was the second most common reason for food waste in homes (32.6%), after storing perishables in the fridge for too long (27.9%) and unappealing presentation (22.6%). A number of factors led to food waste in the home, including over-preparation (14.2%), improper storage (4.2%), and improper meal planning and buying (4.2%). In addition, the least significant component in food waste in homes was incorrect or unclear labeling (2.6%).

Possible Solutions to Reduce Household Food Waste

The various approaches that could be taken to cut down on food wastage in homes are shown in Table 8. The majority of households (34.7%) would discard less food if they were required to pay a tax on food waste. However, greater education about the environmental consequences of food waste is the second most recommended solution, with 34.2% of households saying they would waste less if they knew more about these impacts. Furthermore, households would waste less if they were educated about the costs of food waste to the economy (13.2%), if the food was packaged more appropriately (12.1%), and if labels were easy to understand (5.3%).

Table 4: Products discarded in households in the past week (n=190)

Question	Yes (%)	No (%)
I have not thrown away any food or drink product	33.7	66.3
Alcoholic beverages	-	100
Non-alcoholic beverages (milk, juice, soft drinks)	8.4	91.6
Sauce (ketchup, mayonnaise, cocktail sauce, etc.)	2.6	97.4
Soups/curry	8.9	91.1
Eggs	3.2	96.8
Cheese (cheese cubes, French cheese, sprinkle cheese)	5.8	94.2
Yogurt, custard, etc.	8.9	91.1
Cereals (muesli, granola, oats, mealie meal porridge, etc.)	5.3	94.7
Bread	28.9	71.1
Bread toppings (cold meat slices, cheese slices, sweets)	11.6	88.4
Fish	3.2	96.8
Meat substitute (soya products)	1.1	98.9
Meat	8.4	91.6
Beans, lentils, chickpeas, etc.	6.8	93.2
Rice and remaining grains (including maize meal, samp, etc.)	16.3	83.7
Pasta	3.7	96.3
Non-fresh fruit (jar, canned, dried, frozen)	1.6	98.4
Fresh fruit	21.6	78.4
Non-fresh vegetables (jar, canned, frozen)	10	75.3
Fresh vegetables and salad	24.7	75.3

Table 5: Most common reasons for throwing food away (n=190)

Most common reasons for food disposal	Response (%)
Past food date	32.1
Bought more than needed	6.8
Moldy/slimmy	41.1
Off appearance or texture	24.2
Smell off	42.6
Do not like it	5.8
Needed space	1.6
Prepared too much food	14.7
Other	5.0

Discussions

Demographics and Household Composition

The study found the following racial distribution: 15.8% were black, 40% were European, 42.6% were Indian, and 1.6% were other ethnicities. KwaDukuza Municipality's multicultural population and long history of settlement make it particularly diversified. KwaDukuza's eastern flavour is linked to Indian families' early settlement.[18]

A larger proportion of females than males took part in this research. Participants purchased and prepared meals for their households. Seventy-one percent of South Africa's 18 million female customers buy groceries, while 60% of big purchases are made by women, according to StatsSA 27 Recent research has indicated that women living alone are responsible for wasting the greatest quantity of food per capita. Food waste was higher in families where women purchased food. The 'post-war generation' wastes the least food. Previous experiences and knowledge may affect purchasing and food waste behaviours.[28]

Most participants were 45 or older, but a minority were younger. A prior study found that elders prepare food for their families since young people are still in college and dependent on their parents' kitchens.[27]

Several participants did not disclose their income. The majority of participants had monthly salaries over R30,000. This can be attributed to the high socio-economic standards of certain areas in KwaDukuza. Ntloedibe and Ngqinani [29] estimated that high-LSM (Living Standard Measure) households earn between R13 210 and R32 521 per month. Di Talia *et al*.[30] observed that higher-income households threw away more edible food. Wansink [31] discovered that low-income families waste more food than middle-income families. A possible cause is that the cook has negative experiences with empty plates because of their own experiences with childhood hunger or food poverty. As a result, people often cook more food than they need so that it is always available whenever they get hungry.

However, Parfitt *et al*. [32] found no connection between household income and food waste.

The majority of studied households (45.3%) had two adults and two children. This reflects metropolitan household demographics. According to Stats ..S.A. , metropolitan areas had more households with fewer than four people than rural areas.[27] Ramukhwatho 33 found that smaller families waste more food than larger ones. This is because the meals may be more easily shared and consumed by members of a larger family. Households with children throw away more food than those without children. Because kids can be picky eaters, some of those meals may go to waste if they aren't consumed.[34]

Table 6: Strategies used to plan meals in the household (n=190)

Strategies used to plan meals in the household	Response (%)				
	Never	Rarely	Likely	Most likely	Always
Cook a number of meals simultaneously to consume throughout the week	57.4	17.9	15.8	15.8	33.2
Use leftovers to create meals	16.3	12.1	21.1	26.8	23.2
Use clear storage containers to store leftovers in the fridge	11.6	13.7	20.5	24.2	30
Use a system where no additional food is purchased until all the foods are used	32.6	25.8	23.2	8.4	10
Calculate appropriate portions for the members of the household	23.2	10.5	19.5	23.7	23.2
Plan meals for households in advance	20.5	9.5	24.2	32.2	13.7

Table 7: Factors leading to household food waste (n=190)

Factors affecting household food waste	Response (%)
Expired food	41.1
Food does not look appealing	22.6
Food has mould	32.6
Labels generate confusions	2.6
Foods kept in the fridge for too long	27.9
Poor meal planning and purchasing	4.2
Incorrect storage	4.2
Prepared excess food than required	14.2

Food Purchasing Practices

The findings showed that most households buy fruits and vegetables weekly. The majority of households only buy groceries once a week. Mathee 26 showed that 63.3% of Mangaung residents buy groceries monthly. Supermarkets near homes, transportation hubs, and other sites may explain this shopping pattern. Private vehicles allow high-income families to reach supermarkets quickly. Walking or taking public transit to supermarkets takes longer for low-income families. People are more likely to buy fresh food if they go grocery shopping once a week. Perishables have a shorter shelf life in the humid climate of KZN; therefore, customers in this study shopped at least once a week. Hebrok and Heidenstrøm 35 proposed buying fresh food more often to improve shopping habits and reduce food waste. Consumers who make fewer visits to the supermarket are more likely to waste food than those who shop more frequently.[26]

The findings showed that many households shop at one supermarket chain. Woolworths, Shoprite, Checkers, Pick 'n Pay, and Cambridge are popular South African supermarkets. These supermarkets carry several foods and household supplies. Studies have found that most urban residents buy groceries at supermarkets. Due to fast growth over the previous few decades, the majority of South Africa's food is now purchased from supermarkets. Supermarkets offer more food alternatives and lower pricing than spaza stores and street vendors.[26]

However, 87.4% did not buy groceries online. Consumers are slow to embrace the convenience of online grocery shopping. Customers prefer to see a product before buying it, prefer the best product available, and don't like to change their routines. Online grocery shopping simplifies meal planning and stock monitoring. It reduces overbuying, portioning, and pantry waste. Apps make grocery shopping easy because it can be done anytime, day or night, without leaving the house.[35] Checkers Sixty60, PnP ASAP, and Woollies Dash are popular South African web applications. These essential apps are becoming more popular. The outbreak of COVID-19 has sparked this tendency, which is expected to continue growing.

Table 8: Possible solution to reduce household food waste (n=190)

Possible solution to reduce household food waste	Response (%)
You had to pay taxes for food wastage	34.7
Labels were made clear to you	5.3
The packaging of food was more suitable	12.1
You were better informed about the negative impacts of food waste on the economy	13.2
You were better informed about the negative impacts of food waste on the environment	34.2

Grocery shopping without a list often results in excessive purchasing.[30] Consumers throw away food when they overbuy.[36] The data showed that over half of all households used promotions and sales to buy food in quantity or to save money. Discounts also led consumers to buy more food than necessary.[33] Over-purchasing, driven by laziness, impulse, or the desire to save money, wastes food because it doesn't get utilized promptly.[35] Marketing encourages consumers to buy more food than they need or throw away edible food.[37] The "four Ps" of marketing product, promotion, pricing, and place—guide these strategies. Bundles and "buy one, get one free" promotions can make an item appear cheaper.[31] The study found that households threw away the most fresh produce and ready-to-eat meals. Consumers may be buying too much food and not properly storing it, which could be contributing to the problem. Because of refrigerators and freezers, people can and are often encouraged to purchase more food. Most food waste occurs when perishables are stored at the rear of the fridge, vegetables at the bottom of the drawer, and jars at the door. People also keep leftovers in the fridge until they spoil. Customers only eat what they crave, so their refrigerated food goes to waste.[35]

Food Handling Practices

The current survey indicated that a female or mother head of household prepared the evening meal showing the gender power imbalance at home. According to Iradukunda *et al*.[38] mothers and wives prepare dinner for their families. When men are expected to prepare meals at home, it is often portrayed as a "favour" or considered superfluous.[39]

When food was near its expiration date, most households (78.4%) ate it immediately or froze it (21.6%). This explains why very little food was wasted in the homes used in the research.[40]

Food Storage Practices

Findings indicated that many households refrigerated perishable foods such as fruits and vegetables. Refrigerators are incredibly convenient because of their capacity to keep perishables fresh for longer. Proper food storage minimizes food waste by reducing spoilage. An organized and controlled food storage system reduces food waste for customers who are conscious of what they have in their refrigerators.[26]

Research by Hebrok and Heidenstrøm 35 shows that the current date labeling method (which contains the expiry date and best-before date) is confusing to consumers. Product safety is determined by its manufacturing date and "best before" or "expiration" date.[41] Aschemann-Witzel *et al*.[42] report that some consumers throw away potentially edible food after its expiration date. According to the results, most participants misunderstood the best-by or use-by date for the expiration date. In contrast to the "best by" or "use by" date, which indicates when the product is at its freshest and highest quality, the "expiration date" indicates when it should not be consumed due to safety issues. This survey supports earlier findings that consumers struggle with understanding product expiration dates. Hebrok and Heidenstrøm 35 noted that customers who rely on their sense of smell and sight to determine if food is still edible are less likely to waste edible food.

Most people waited one to three days before discarding spoiled food. According to Kavanaugh and Quinlan,[43] customers use smell and sight to judge whether food

is edible. However, 30% of the survey participants disposed of expired food demonstrating that consumers continue to discard food based on its expiration date.

The findings confirmed that many consumers actually read and followed the storage instructions on the labels. High-LSM individuals have space and appliances like refrigerators to store food according to packaging guidelines. Dobernig and Schanes 44 note that having enough storage options, such as enough space and optimal storage conditions, is crucial for maintaining the quality of purchased food (temperature and illumination). Buying smaller refrigerators and freezers is a simple technique to reduce food waste in the house because it reduces the total amount of food that can be stored. Hebrok and Heidenstrøm 35 suggested that modern freezers should have enhanced visibility, the ability to track perishability, and more convenient food-handling options.

It was evident that most people did not properly date and label frozen foods. Freezing is one of the easiest, fastest, most flexible, and most useful ways to preserve food.[45] Date tags are helpful for tracking perishables. Dated and tagged food encourages "First in, First out" (FIFO) storage, reducing food waste.[46]

Food Discarding Practices

Understanding household food waste is essential. Education is the key to reducing food waste, and understanding this habit is the first step.[26] Consumers have busy schedules and often don't have time to plan meals, organize shopping lists, or store perishables.[42] Even with time to cook, customers may choose takeout instead of a healthy meal. Unfinished meals may be wasted.[47] Improper food storage wastes food. Food waste occurs primarily due to an abundance of food.[33] Consistent with Ramukhwatho, Hebrok and Heidenstrøm 35 report that customers prepare excessive amounts of food for each serving size. When cooking for a family, a person may overestimate their hunger and end up with leftovers.[46] The custom of serving too much food to guests contributes to this issue.[48] Kibler *et al*.[36] emphasized that cooking additional food involves the risk of having to throw it away. Leftovers are frequently wasted because customers are either unsure about what to do with them or cannot determine whether they are still safe to eat.[14]

Bread was the most commonly discarded food because of the makeup of the families (the vast majority of which included children) and the weekly occurrence of grocery shopping. Østergaard and Hanssen[49] found that households with children discarded 45% more bread than those without children. The weekly grocery shopping is a second possible explanation. They also stated that families who wasted the least amount of bread were more likely to toast stale bread and more likely to freeze fresh loaves for later use. Those who wasted more bread did not even bother to toast it or put it in the freezer.[49]

The most recent study found that fresh fruits and salads were the second and third most wasted foods, followed by fresh vegetables and fruits. Rapid spoilage and subsequent fresh produce waste are major problems in the food industry. Vegetables and fruits are cheap, so customers throw away imperfect ones.[50] Overbuying, neglecting to consume, or unexpected spoilage can also waste fruits and vegetables.[51]

The research found that most families rarely or never throw away edible food. Soma [52] in Indonesia and Ramukhwatho [53] in the City of Tshwane Metropolitan Municipality in South Africa found that families with higher incomes wasted less food than those with lower incomes.

Three leading causes of food waste include unpleasant odor, sliminess, and expiration dates. This research identified expiration dates and mold on food as major causes of food waste. Sensory factors (poor appearance, unpleasant odor, and bad taste or moldiness) and the expiration date were the most frequently stated reasons for discarding food in studies by Mathee.[26] Possible reasons for the strange odor and slimy, moldy appearance include improper food preservation. However, according to Ramukhwatho's study, overbuying and overcooking are major contributors to food loss.[33]

Most families also plan ahead for leftovers when shopping and cooking. The majority of participants are seniors, who are known for their kitchen skills, especially in preserving food and finding novel uses for leftovers.[53]

Most participants strongly disapproved of wasting food and made significant efforts to reduce food waste. Consumers' morals and conscience may influence their reluctance to waste food. If people feel bad about themselves when they throw away food, they may take great initiatives to avoid wasting food. As stated by Talwar *et al*.[54] people are more motivated to prevent waste after experiencing regret and guilt over wasted food.

Strategies to Reduce Food Waste

The data showed that leftover cooked food was often packed for tomorrow's lunch or donated to a food bank. The majority of participants in this study are elderly and have much experience creating new recipes from leftovers.[53]

The most common dinner preparation method was using clear storage containers to keep leftovers fresh in the fridge. This method would help customers find food faster and waste less.[26] The data also showed that participants calculated family portions reasonably that prevented overproduction and food spoilage. Participants always used leftovers to make new meals. However, several studies found that a significant number of participants threw away leftover food.

This study suggests that people rarely or never practice a system where no new foodstuffs are bought until the current stock is depleted. Most people in the study bought groceries weekly, so food was always available, and people bought it as needed. Most people never made enough food for the week at once. Preparing food ahead of time was also common. Meal planning reduces food loss. Those who prefer to purchase lesser foodstuffs should use it in the following days' meals. Food waste is higher among consumers who try new dishes and use unusual ingredients. When familiar ingredients are used in different dishes, customers are more likely to finish them.[35]

Results showed that households would waste less food if they were taxed for wasting food and made aware of its environmental costs. Food waste, global warming, and food donation can all be mitigated with the help of government revenue policies. Katare *et*.[55] report that several U.S. counties have implemented disposal taxes to lessen this waste. Moberg *et al*.[56] found that many tax scenarios reduced food consumption, relieving pressure on other environmental impacts like climate change. If society wants to reduce food loss by 50% by 2030, economists should adopt a food waste tax.

Limitations of the Study

Current research fills significant literature gaps and provides interesting new results. Limitations and study gaps must be considered. In the first place, what is generally understood to be food waste. The reader decides since experts differ on how to define this topic. Participants may have defined food waste differently from the official meaning. This study used only quantitative methods. It is essential to combine qualitative and quantitative methods for optimal results. The questionnaire survey was difficult to perform due to the high number of appointment cancellations, rescheduling, and door-to-door participant recruitment. Since participants were only selected from KwaDukuza, KwaZulu-Natal, the study's results cannot be generalized to low- and middle-income South Africa. Household make-up is another constraint. Multi-person households find it harder to monitor food waste than single-person households, so their estimates of wasted food are often more inaccurate. Because the findings of this research were based on self-reported food waste, their accuracy was limited. There is a substantial difference between the reported and actual amounts of food waste because self-reported food waste often represents social desirability. People's responses to food waste survey queries may be influenced by social desirability bias. The results reflect adults' views and behaviours rather than those of younger or mixed generations because participants had to be 18 or older. Another limitation is that people may be less likely to disclose food waste if they know they are participating in a study about it.

Strengths of the Study

A reliable assessment tool (a survey) was used to analyse family food waste habits. To enhance survey validity, open-ended questions were reduced. A systematic random selection method was used to give each community household an equal chance of being chosen. Participants' freedom to ask the interviewer for clarification on any question made the survey more likely to get a complete answer and enhance data quality.

A thorough mapping of household waste generation factors can help food loss prevention strategies. South Africa doesn't have a household food waste reduction policy. The results of this investigation will be used to develop food literacy resources for the first intervention research in South Africa addressing food waste in households.

This study supports previous studies on high LSM consumers' food waste. The research also provided details on the causes of food wastage. The relationship between consumer attitudes toward food waste and attempts to reduce the causes of food waste was also made more evident by the research.

Recommendations

The Following Suggestions are Based on the Findings of this Research:

Consumers should be educated and motivated, and families should besubsidized for food waste management. Families need to be made more conscious of the environmental costs of food waste, as well as the social and economic costs of issues like hunger and malnutrition, through campaigns. People can be encouraged to waste less food by appealing to their sense of guilt.

Children can influence their parents' environmental views by sharing their knowledge, attitudes, and actions. If climate awareness programs convinced children to reduce food waste, perhaps school-based efforts could do the same for their parents. Teaching people how to cook effectively may reduce home food waste.

Policymakers should not focus solely on home food loss end-of-pipe solutions. Instead, food waste policies

must consider how food is prepared and stored, how retail packaging and marketing affect food purchase decisions, how eating out affects food waste at home, and how municipal waste collection systems function. Policymakers shouldn't just focus on people's personal preferences and how food purchasing has changed people's daily routines and increased food waste.

Conclusion

The results revealed that households in KwaDukuza engaged in a wide range of food purchasing, storage, consumption, and discarding behaviours.

The findings of this study indicate there is room for further investigation into methods for decreasing food wastage in private households. It is recommended that additional research be conducted on people's attitudes and perceptions regarding food waste in the home. Qualitative methods can provide a rich context for current practices. These results could be used to create targeted consumer interventions and learning initiatives. Other themes and the current study can be replicated with larger samples.

There is a need to conduct an investigation into the potential changes in consumers' attitudes and behaviours towards food waste following their exposure to information regarding its adverse environmental consequences. South Africa's many geographic regions and ethnically diverse consumer groups need more study on food waste attitudes and behaviours, which will provide a deeper understanding of South African households. Consumers can reduce food waste by learning about reusing uneaten meals. Family composition impacts food waste, so culturally and geographically tailored initiatives may be helpful.

Customers may reduce food waste if they are educated about "best by" and "use by" dates and encouraged to freeze perishable foods. Businesses, NGOs, and governments could explore standardizing food packaging expiration dates to educate consumers. Investigating how customers use smart labels when buying, cooking, eating out, and throwing away food is important.

Food loss and structural factors like retail layouts and domestic storage facilities need more study. Research into the relationship between food waste and packaging is required in South African homes and throughout the food distribution system. Smart fridges, boxes that extend shelf life, apps on in-home food availability, and other emerging technologies can reduce food waste, making this a crucial topic for future research. Finally, more research is needed on how policy efforts and interventions affect food waste management.

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Conflict of Interest

No potential conflict of interest was reported by the author(s).

References

1. Cronjé N., Van Der Merwe I., Müller I. M. Household Food Waste: A Case Study in Kimberley, South Africa. *Journal of Consumer Sciences.* 2018; 46.
2. Chakona G., Shackleton C. M. Local Setting Influences The Quantity of Household Food Waste in Mid-Sized South African Towns. *PLoS One*. 2017; 12(12): e0189407. DOI:10.1371/journal. pone.0189407.
3. Food and Agriculture Organization (FAO). Moving Forward on Food Loss and Waste Reduction. 2019. www.fao.org/publications. [accessed 28 March, 2023].
4. Clapp J., Moseley W. G., Burlingame B., Termine P. The Case for A Six-Dimensional Food Security Framework. *Food Policy.* 2022; 106: 102164. DOI:10.1016/j.foodpol.2021.102164
5. One Third Food Waste Prevention. 2020. https://onethird.io/understanding-un-sdg-12-3/. [accessed 28 March, 2023].
6. Quested T., Johnson H. (Household food and drink waste in the U.K.: final report. *Wastes & Resources Action Programme* (WRAP). 2009.
7. Ramukhwatho F. R. An Assessment of the Household Food Wastage in a Developing Country: A Case Study of Five Areas in the City of Tshwane Metropolitan Municipality, Gauteng Province, South Africa (Doctoral dissertation, University of South Africa). 2016.
8. Food and Agricultural Organization (FAO). *Global Food Losses and Food Waste*. 2013. https://www.fao.org/3/i2697e/i2697e.pdf. [accessed 28 March 2023].
9. Schmidt K. Explaining and Promoting Household Food Waste-Prevention by An Environmental Psychological Based Intervention Study. *Resources, Conservation and Recycling.* 2016; 111: 53-66. DOI:10.1016/j.resconrec.2016.04.006
10. Chalak A., Abou-Daher C., Chaaban J., Abiad M. G. The Global Economic and Regulatory Determinants of Household Food Waste

Generation: A Cross-Country Analysis. *Waste management.* 2016; 48: 418-422.
11. DEFF and CSIR. Food Waste Prevention & Management: A Guideline for South Africa. Edition 1, 2021. DEFF & CSIR, Pretoria.
12. Painter K., Thondhlana G., Kua H. W. Food Waste Generation and Potential Interventions at Rhodes University, South Africa. *Waste Manag.* 2016; 56: 491-497. DOI:10.1016/j.wasman.2016.07.013
13. Zhang C., Xu T., Feng H., Chen S. Greenhouse Gas Emissions from Landfills: A Review and Bibliometric Analysis. *Sustainability.* 2019; 11(8): 2282. DOI:10.3390/su11082282
14. World Wildlife Fund (WWF). Food Loss and Food Waste: Facts and Future. 2017. http://awsassets.wwf.org.za/downloads/WWF_Food_Loss_and_Waste_WEB.pdf . [accessed 28 March, 2023]
15. Tonini D., Albizzati P. F., Astrup T. F. Environmental Impacts of Food Waste: Learnings and Challenges from A Case Study on U.K. Waste Manag. 2018; 76: 744-766. DOI:10.1016/j.wasman.2018.03.032
16. Food and Agricultural Organisation (FAO). Policy Brief on Food Security. 2006. https://www.fao.org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf. [accessed 28 March, 2023].
17. Food and Agricultural Organisation (FAO). The State of Food Security and Nutrition in the World. 2020. https://www.fao.org/3/ca9692en/ca9692en.pdf. [accessed 28 March, 2023].
18. Statistics South Africa (StatsSA). Provincial Profile Free State Community Survey 2016. 2016. http://cs2016.statssa.gov.za/wp-content/uploads/2018/07/FreeState.pdf. [accesed 28 March, 2023)
19. Oelofse S. H. H., Polasi T., Haywood L., Musvoto C. Increasing Reliable, Scientific Data and Information on Food Losses and Waste in South Africa. CSIR: Pretoria. 2021. https://wasteroadmap.co.za/wp-content/uploads/2021/06/17-CSIR-Final_Technical-report_Food-waste.pdf. [accessed 28 March 2023].
20. Oelofse S. H. H. Food Waste Research for South Africa. Council for Scientific and Industrial Research (CSIR). 2019. https://www.csir.co.za/sites/default/files/Documents/Food%20waste%20prevention_LANDSCAPE%28EDMS%29%20-%2005-02-2021.pdf. [accessed 28 March 2023].
21. de Lange W., Nahman A. Costs of Food Waste in South Africa: Incorporating Inedible Food Waste. *Waste Manag.* 2015; 40: 167-172. DOI: 10.1016/j.wasman.2015.03.001
22. Marx-Pienaar N., Du Rand G. D., Viljoen A., Fisher H. Food Wastage: A Concern Across The South African Quick Service Restaurant Supply Chain. *WIT Transactions on Ecology and the Environment.* 2019; 23: 237-243.
23. Ramukhwatho F. R., Du Plessis R., Oelofse S. H. Household Food Wastage in A Developing Country: A Case Study of Mamelodi Township in South Africa. 2014. http://hdl.handle.net/10204/7757
24. Oelofse S. H., Nahman A. Estimating The Magnitude of Food Waste Generated in South Africa. *Waste Management & Research*. 2013; 31(1): 80-86. DOI:10.1177/0734242X12457117
25. Kelley K., Belinda C., Vivienne B., John S, Good Practice in the Conduct and Reporting of Survey Research. *International Journal for Quality in Health Care*. 2003; 15(3):261–266. https://doi.org/10.1093/intqhc/mzg031
26. Mathee L. M. Exploring Household Behaviour Contributing to Food Waste in Mangaung, Free State (Doctoral dissertation, University of the Free State). 2020.
27. Statistics South Africa. General Household Survey. 2019. https://www.statssa.gov.za/publications/P0318/P03182019.pdf. [accessed 28 March, 2023).
28. Richter B. Knowledge and Perception of Food Waste Among German Consumers. *Journal of Cleaner Production.* 2017; 166: 641-648. DOI:10.1016/j.jclepro.2017.08.009
29. Ntloedibe M., Ngqinani P. Understanding the Living Standards Measure Segmentation in South Africa. 2020. https://www.fas.usda.gov/data/south-africa-understanding-living-standards-measure-segmentation-south-africa [accessed 28 March 2023).
30. Di Talia E., Simeone M., Scarpato D. Consumer Behaviour Types in Household Food Waste. *Journal of Cleaner Production.* 2019; 214: 166-172. DOI:10.1016/j.jclepro.2018.12.216
31. Wansink B. Household Food Waste Solutions for Behavioral Economists and Marketers. *Journal of Food Products marketing.* 2018; 24(5): 500-521. DOI:10454446.2018.1472694
32. Parfitt J., Barthel M., Macnaughton S. Food Waste within Food Supply Chains: Quantification and Potential for Change to 2050. *Philosophical Transactions of The Royal society B: biological sciences*. 2010; 365(1554): 3065-3081. DOI:10.1098/rstb.2010.0126
33. Ramukhwatho F. R., Du Plessis R., Oelofse S. H. Household Food Wastage by Income Level: A Case Study of Five Areas in The City of Tshwane Metropolitan Municipality, Gauteng Province, South Africa. .https://www.researchgate.net/publication/309407621_Household_food_wastage_by_income_level_A_case_study_of_five_areas_in_the_city_of_Tshwane_

Metropolitan_Municipality_Gauteng_Province_South_Africa [accessed 28 March, 2023].
34. Van Geffen L., van Herpen, E. van Trijp H. Household Food Waste—How to Avoid It? An Integrative Review. Food Waste Management: Solving the Wicked Problem. 2020; 27-55. DOI:10.1007/978-3-030-20561-4_2
35. Hebrok M., Heidenstrøm N. Contextualising food Waste Prevention-Decisive Moments Within Everyday Practices. *J Clean Prod.* 2019; 210: 1435-1448. DOI:10.1016/j.jclepro.2018.11.141
36. Kibler K. M., Reinhart D., Hawkins C., Motlagh A. M., Wright, J. Food Waste and The Food-Energy-Water Nexus: A Review of Food Waste Management Alternatives. *Waste Manag.* 2018; 74: 52-62. DOI:10.1016/j.wasman.2018.01.014
37. Lee K. C. Grocery Shopping, Food Waste, and The Retail Landscape of Cities: The Case of Seoul. *J Clean Prod*. 2018; 172: 325-334. DOI:10.1016/j.jclepro.2017.10.085
38. Iradukunda F., Bullock R., Rietveld A., van Schagen B. Understanding gender roles and practices in the household and on the farm: Implications for Banana Disease Management Innovation Processes in Burundi. *Outlook Agric.* 2019; 48(1): 37-47. DOI:10.1177/0030727019831704
39. Reiheld A.N.C. Gender Norms and Food Behavior. In: Thompson P., Kaplan D. (eds) Encyclopedia of Food and Agricultural Ethics. *Springer, Dordrecht.* 2014. DOI: 10.1007/978-94-007-6167-4_458-1
40. Russell S. V., Young C. W., Unsworth K. L., Robinson, C. Bringing Habits and Emotions into Food Waste Behaviour. *Resour Conser Recycl.* 2017; 125: 107-114. https://doi.org/10.1016/j.resconrec.2017.06.007
41. Graham-Rowe E., Jessop D. C., Sparks P. Identifying Motivations and Barriers to Minimising Household Food Waste. *ResourConser Recycl.* 2014; 84: 15-23. DOI:10.1016/j.resconrec.2013.12.005
42. Aschemann-Witzel J., De Hooge I., Amani P., Bech-Larsen T., Oostindjer M. Consumer-related food waste: Causes and potential for action. *Sustainability*. 2015; 7(6): 6457-6477. DOI:10.3390/su7066457
43. Kavanaugh M., Quinlan J. J. Consumer knowledge and behaviors regarding food date labels and food waste. *Food Control.* 2020; 115: 107285. DOI:10.1016/j.foodcont.2020.107285
44. Dobernig K., Schanes K. Domestic spaces and beyond: Consumer food waste in the context of shopping and storing routines. *Int J Consum Stud.* 2019; 43(5): 480-489. DOI:10.1111/ijcs.12527
45. Garden-Robinson J. Food Freezing Basics: Packaging, Loading the Freezer and Refreezing. 2005. https://library.ndsu.edu/ir/bitstream/handle/10365/5177/fnw614.pdf?sequence=1 [accessed 28 March, 2023)
46. Johnston E. How to use a FIFO food storage system. 2020. https://cpdonline.co.uk/knowledge-base/food-hygiene/using-fifo-food-storage-system/ [accessed 28 March, 2023).
47. Schanes K., Dobernig K., Gözet B. Food waste matters-A systematic review of household food waste practices and their policy implications. *J Clean Prod.* 2018; 182: 978-991. DOI:10.1016/j.jclepro.2018.02.030
48. Henz G. P., Porpino G. Food losses and waste: how Brazil is facing this global challenge?. *Hortic Bras.* 2017; 35: 472-482. DOI:10.1590/S0102-053620170402
49. Østergaard S., Hanssen O. J. Wasting of fresh-packed bread by consumers—influence of shopping behavior, storing, handling, and consumer preferences. *Sustainability*. 2018; 10(7): 2251. DOI:10.3390/su10072251
50. De Laurentiis V., Corrado S., Sala S. Quantifying Household Waste of Fresh Fruit and Vegetables in The E.U. *Waste Manag.* 2018; 77: 238-251. DOI:10.1016/j.wasman.2018.04.001
51. Heng Y., House L. 'Consumers' Perceptions and Behavior Toward Food Waste Across Countries. *Int Food Agribusiness Manag Rev.* 2022; 25(2): 197-209. DOI:10.22434/IFAMR2020.0198
52. Soma T. Space to waste: the influence of income and retail choice on household food consumption and food waste in Indonesia. *Int Plan Stud.* 2019. 25(4): 372-392,DOI:10.1080/13563475.2019.1626222.
53. Visschers V. H., Wickli N., Siegrist M. Sorting out food waste behaviour: A survey on the motivators and barriers of self-reported amounts of food waste in households. *J Environ Psychol.* 2016; 45: 66-78. DOI:10.1016/j.jenvp.2015.11.007
54. Talwar S., Kaur P., Kumar S., Salo J., Dhir A. The Balancing Act: How Do Moral Norms and Anticipated Pride Drive Food Waste/Reduction Behaviour? *J Retail Consum Serv.* 2022; 66: 102901. DOI:10.1016/j.jretconser.2021.102901
55. Katare B., Serebrennikov D., Wang H. H., Wetzstein M. Optimal Food Waste: Taxes and Government Incentives. In 2016 Annual Meeting, July 31-August 2, Boston, Massachusetts (No. 252703). *Agricultural and Applied Economics Association.* 2016. DOI: 10.22004/ag.econ.252703
56. Moberg E., Säll S., Hansson P. A., Röös E. Taxing Food Consumption to Reduce Environmental Impacts–Identification of Synergies and Goal Conflicts. *Food Policy.* 2021; 101: 102090. DOI:10.1016/j.foodpol.2021.102090