Exploring food insecurity, food waste, and dietary diversity among rural and urban households of Lesotho

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DECLARATION

I declare that this thesis, titled **Exploring food insecurity, food waste, and dietary diversity among rural and urban households of Lesotho**, hereby submitted for the qualification of Master of Science in Consumer Science at the University of the Free State, is my independent work and that I have not previously submitted the same work for a qualification at/in another university/faculty.

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Maletsie Molapo	31/07/2023
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ABSTRACT

Lesotho is one of the sub-Saharan African countries that perpetually struggles with food insecurity. Consumers in Lesotho still waste food despite living in a low-income country. Most people live under the poverty line of US$1.00 per day and low-income households consume meals that are low in diversity, which elevates micronutrient deficiencies. Consequently, many children under five years of age experience stunting, obesity, and micronutrient deficiencies due to a lack of food or insufficient intake. The study sought to explore household food insecurity, estimate the quantity of household food waste, determine household dietary diversity, and identify food preservation techniques in rural and urban areas of Lesotho.

The research was conducted in four of the 10 districts of Lesotho, namely Mafeteng, Thaba-Tseka, Leribe, and Qacha's Nek. The sample size was 440 households, and stratified random sampling was used for the selection of participating households. A mixed-methods approach was utilised and an exploratory descriptive design was adopted. Both structured questionnaires and interviews were employed, which represented quantitative and qualitative elements. The questionnaire addressed socio-demographics, the Household Food Insecurity Access Scale (HFIAS), food waste, the Household Dietary Diversity Score (HDDS), and food preservation. The consumers who participated in the study were 18 years and older. The analysis was conducted using the Statistical Package for the Social Sciences, and Fisher's exact test was used to compare variables.

Food insecurity was significantly higher in the rural areas than the urban areas, where four categories were measured, namely food secure, mildly food insecure, moderately food insecure, and severely food insecure. Indicators of food insecurity were to be being a female, being unemployed, and cooking with open fire. Using liquefied petroleum gas (LPG) and electricity for cooking significantly were found to reduce food insecurity.

Total food waste estimations were calculated at 190.9 kg (rural) and 156.2 kg (urban) per week, resulting in annual estimated food waste of 13 003.2 kg (rural) and 7 496.8 kg

(urban), totalling 20, 500 kg of household food waste in Lesotho annually. The main ways that consumers discard food waste in both rural and urban areas are using compost heaps, discarding it in the garbage bin, and burying it. All these were significant predictors of food waste even though they had a weak correlation. It is also a common practice to give food waste to animals.

The main reasons for food waste in both the rural and urban areas were that consumers like to eat fresh food, they are too busy to cook planned meals, food is left too long in the refrigerator/freezer, they buy too much food, they do not check the cupboard or refrigerator/freezer before going shopping, and some members of the household do not always finish eating their food. Food groups that are not wasted in large quantities in rural and urban are fruits, vegetables, milk and dairy products, legumes, and grains.

The dietary diversity of the rural and urban areas differs significantly, with diversity in the urban areas being higher than in the rural areas. Food groups mostly consumed are cereals (soft/stiff porridge and bread) and leafy green vegetables (rape, cabbage, and spinach). Fruits are mostly consumed when they are in season because they are expensive otherwise. Factors that significantly contribute to increasing the HDDS are using electricity and LPG for cooking. Factors that significantly decrease the HDDS are being female, cooking with an open fire, and purchasing food every two weeks. More consumers preserve food in urban areas than in rural areas, and the prominent techniques for preserving food are sun drying and bottling, while fewer consumers in both rural and urban areas consider salting and freezing. Food insecurity is still high, even though diversity is promising. It is therefore recommended that the creation of awareness be established, through policies and other platforms regarding, household food waste, food security and eating patterns.

Keywords: food insecurity, food waste, dietary diversity, food preservation, Lesotho

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LIST OF ABBREVIATIONS

ATO	Agricultural Technical Officer
DAO	District Agricultural Officer
DBM	Double burden of malnutrition
DNO	District Nutrition Officer
FLW	Food loss and waste
FSC	Food supply chain
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity Access Scale
HIV/AIDS	Human immunodeficiency virus / acquired immunodeficiency syndrome
KES	Kenyan shilling
kg	Kilogram(s)
l	Litre(s)
LPG	Liquefied petroleum gas
LSL	Lesotho loti
SDG	Sustainable Development Goal
SPSS	Statistical Package for the Social Sciences
UFS	University of the Free State
UK	United Kingdom
UN	United Nations
UNICEF	United Nations Children’s Fund
US$	United States dollar
WASH	Water, sanitation, and hygiene
WFP	World Food Programme
ZAR	South African rand

CHAPTER 1:
INTRODUCTION

1.1 GENERAL INTRODUCTION

Food waste in households remains a sustainability challenge that poses environmental and social problems (Williams *et al*., 2020). Estimations reveal that in one-third of produced food, about 1.3 tons is annually wasted worldwide (Anstalt, 2013). Food waste and food insecurity negatively affect people's health, the environment, and the economy (Harduth, 2017).

While a significant part of the global population is food insecure, there is also a systematic food loss and food waste problem (Lee *et al*., 2017). The challenge is to meet the world's growing demand for food in an environmentally sustainable way while simultaneously ensuring food security (Cronjé *et al*., 2018), mitigating the effects of climate change, and limiting the expansion of agricultural land and water use (Bradford *et al.*, 2018).

The Sustainable Development Goal (SDG) for sustainable consumption and production, SDG 12, Target 3, "aims to halve per capita global food waste by 2030 at the retail and consumer level" (United Nations [UN], 2015). Food waste is influenced by psychological, social, situational, demographic, and socio-economic factors (Principato *et al.*, 2021). Understanding these factors and how they are associated with household food waste can provide insight into strategies to minimise food waste (Carroll *et al.*, 2020). Food waste management includes practices concerning the disposal of uneaten food, feeding food waste to animals, and practices such as home composting. This becomes important as certain household practices increase food waste, while others reduce it (Principato *et al.*, 2021). Research indicates that food waste habits may differ across contexts, which suggests the importance of conducting regional studies (Carroll *et al*., 2020).

The optimum use of food waste and by-products as raw materials or food additives could generate economic gains, contribute to reducing nutritional problems, produce beneficial health effects, and reduce the environmental implications of the mismanagement of waste (Tores-Leon *et al*., 2018). Food waste reduction implies reduced resources such as

energy and nutrients because a certain amount of nutrients are still present in food waste; it could allow consumers to eliminate spending money on unwanted food (Conrad & Blackstone, 2021; Tacoli, 2019). Reducing food loss and waste (FLW) could enhance food security because more food could be made available for consumption (Irani *et al*., 2018).

The State of Food Security and Nutrition in the World 2023 report, states that in 2022, the people who face chronic hunger worldwide were 9.2% as opposed to 2019, which was 7.9%, and the estimation shows that the population affected in 2022 was between 691 and 783 million (FAO, 2023).. Food insecurity is defined as the disruption of food intake or eating patterns because of a lack of money or other resources (Christian *et al*., 2020). Food security at the household level is the ability of a household to meet the dietary needs of its members, and it influences the nutritional status of the members (Kehinde & Favour, 2020).

Compared with food-secure counterparts, food-insecure households have a greater prevalence of nutrient inadequacy (Conrad & Blackstone, 2021). Lesotho is experiencing a major food security crisis due to drought and other factors, as approximately 41% of rural families spend more than half of their income on food. Over 30% of the Lesotho population across all 10 districts have been facing high levels of acute food insecurity (World Food Programme [WFP], 2020).

Poverty is defined as limited resources that cannot meet the available needs (Brady, 2023). Poverty and nutrition are interrelated as undernutrition negatively affects households' productivity. The lower-income segments of the population continue to carry the burden of malnutrition in all forms. This perpetuates the cycle of poverty, morbidity, and mortality, which lead to a reduced lifespan. The poorest households are the most vulnerable to food and nutrition insecurity and insecure livelihoods (Headey *et al*., 2022; Food and Nutrition Coordinating Office, 2016).

Previous studies conducted in Lesotho focused on the contribution of oyster mushroom production to household food security (Nkoko, 2020), the impact of COVID-19 on food security (Seliane, 2022), the impact of food prices on food security (Crush *et al*., 2019),

establishing the dietary diversity of Basotho households with emphasis on home gardening, and measuring consumers' knowledge and attitudes regarding food waste (Chenene, 2020; Fouché, 2018). This study focused on a combination of food insecurity, household dietary diversity, and food waste in rural and urban Lesotho to establish whether there is a linkage between these factors in the rural and urban contexts.

1.2 RESEARCH PROBLEM / PROBLEM STATEMENT

Food insecurity is considered a public health problem, and approximately 25% of people in Lesotho are food insecure (WFP, 2022). The National Action Plan for Food Security (Ministry of Agriculture and Food Security, 2006) in Lesotho states that poverty and unemployment are the leading causes of food insecurity in the country, which is confirmed by studies that revealed that poverty, which leads to food insecurity, will cause people to become susceptible to diseases as a result of micronutrient deficiencies (Makhorole *et al*., 2022; Sinha *et al*., 2020; Walsh *et al*., 2020). Lesotho among other African countries has a challenge of food insecurity. Agricultural production is adversely affected by land, resulting in poor production which leads to food insecurity. About 65.9% of households are food insecure, yet consist of employed household members (Nkoko, 2020). Lesotho, with 2.2 million inhabitants, is one of the poorest countries in the Southern African region.

There is a lack of current research in Lesotho on linking issues of food insecurity, dietary diversity, and food waste. Considering dietary diversity, the majority of children under five (78%) in Lesotho, are experiencing low dietary diversity, as they afford only to eat four groups of food. Furthermore, household dietary diversity is low due to low access and availability of fruits and vegetables (Nkoko *et al*., 2023) Research shows that the inflation rate is 6.2%, which is high (Zbelo *et al*., 2022), while the food inflation rate has been found to be 14.3% (Lesotho Vulnerability Assessment Committee, 2021). Although there is not much research done on household food waste in Lesotho, research of Chenene research shows that about 67% (urban) consumers waste food through spoilage, whereas in the rural areas 34% food waste is experienced likewise (Chenene, 2020). However, Wang *et al*., (2023), states that people with good education and income have more awareness on issues of food diversity and this may lead to more food waste in the households of young

and old house heads. Contrarily, food diversity awareness contributes to less food waste at households with middle-aged household heads. This indicates that dietary diversity and food waste are directly linked to food insecurity. This is further unveiled in another study where it was found that high level of a country's food waste emanates from good food security, while in contrast, low levels of food waste is derived from food insecure countries, (Durán-Sandoval *et al*., 2023). Approximately 57% of the people in Lesotho live below the poverty line, which is living on less than US$1 daily (WFP, 2022). Lesotho also loses around 7.13% of its gross domestic product to chronic malnutrition. Many people are dependent on food relief and handouts; however, reliance on food aid for food security is not a sustainable solution (Rantšo & Seboka, 2019).

Lesotho is battling with diseases related to micronutrient deficiencies such as vitamin A and iron, and, to a lesser extent, iodine deficiency disorder (Food and Nutrition Coordinating Office, 2016). Approximately 51% of children aged six to 59 months in Lesotho have some level of anaemia. In comparison, more than one in every four (27.3%) women aged 15 to 49 years have anaemia (Ministry of Health, 2016), and according to the state of Food and Nutrition Security in the world report of 2022/2023, 49% of pre-school-aged children have anaemia and children from 2years and under who have anaemia make 61%, and 25% of pregnant women suffer from anaemia as well (UNICEF, 2022). approximately 55% of women in urban areas are obese and overweight, and 42% of women in the rural areas are obese and overweight (Food and Nutrition Coordinating Office, 2016).

The state of poverty may affect food security and nutrition adversely, which calls for more research to be conducted to develop relevant mitigation strategies. Much deeper insights need to be sought around the issues of food insecurity, food waste, and dietary diversity to comprehend the dynamics thereof. However, Lesotho among SSA countries, is considered as one of those struggling with poor dietary diversity (Walsh *et al*., 2020; Rantšo *et al*., 2019) Lesotho has rural and urban areas that, if included in research, can provide broader knowledge that would reveal a wider picture of the conditions in geographical settings. This research could bring to light the underlying challenges, as well

as create an open platform where ideas may be generated as to how to bring about mitigation efforts into practice.

1.3 MAIN AIM OF THE STUDY

The main purpose of this study was to explore food insecurity, food waste, and dietary diversity in the rural and urban households of Lesotho.

1.4 OBJECTIVES

The following are the objectives of this research:

Objective 1: To assess food insecurity among rural and urban households in Lesotho.

- Sub-objective 1a: To determine the Household Food Insecurity Access Scale (HFIAS) scores for rural and urban households in Lesotho.
- Sub-objective 1b: To determine the food insecurity categories for rural and urban households in Lesotho.
- Sub-objective 1c: To identify socio-demographic variables that affect household food security.

Objective 2: To determine the level of food waste in the rural and urban households of Lesotho.

- Sub-objective 2a: To estimate generated household food waste among rural and urban households.
- Sub-objective 2b: To define food waste disposal mechanisms in rural and urban households.
- Sub-objective 2c: To identify possible behaviour and practices that lead to food waste at the household level.
- Sub-objective 2d: To define the frequency and reason for different food items being discarded by households.
- Sub-objective 2e: To describe the motivation that drives the reasons behind avoiding food waste.
- Sub-objective 2f: To establish how households handle leftovers.

- Sub-objective 2g: To determine frequencies of food purchasing practices.
- Sub-objective 2h: To evaluate whether the person responsible for cooking plays a role in food waste management.
- Sub-objective 2i: To identify the places of choice for regular food purchases.
- Sub-objective 2j: To determine household practices before and during food purchases.

Objective 3: To evaluate the dietary diversity among rural and urban households of Lesotho.

- Sub-objective 3a: To determine the Household Dietary Diversity Score (HDDS).

1.7 STRUCTURE OF THESIS

Chapter 1 contains the introduction of the study, a brief background of research on the topic, as well as the research problem / problem statement. Furthermore, the context of the study is introduced, together with the identified research objectives. It also describes the significance of the study to the existing body of knowledge.

Chapter 2 presents a literature review of several research reports, reviews, and other sources. The concepts of food security, food waste, and dietary diversity are discussed in detail.

In Chapter 3, a description of the methodology is articulated and the study's research design is discussed, which delineates the choice of instruments employed. The chapter also discusses ethical considerations, data analysis, and the limitations of the study.

In Chapter 4, an intensive presentation of the research results is outlined, as well as a discussion thereof.

In Chapter 5, conclusions are drawn from what the study accomplished, and recommendations are made.

1.8 LIST OF DEFINITIONS

Avoidable food waste: Food that people normally plan to eat (edible) but end up discarding (Coudard *et al*., 2021; Leverenz *et al*., 2019).

Dietary diversity: A tool used to assess the variety of foods consumed in a household (Tariku *et al*., 2019).

Food insecurity: Reduced or inconsistent access to food by people (Brown *et al*., 2019).

Food loss: The reduction of dry material or nutritional worth of food that was primarily intended for human consumption (Ishangulyyev *et al*., 2019).

Food security: The position of having stable access to available food in the correct quantities, food quality and food diversity adequately (Azadi *et al*., 2023; Clapp *et al*., 2022).

Food waste: Any food together with its inedible parts (skin, peels, bones, etc.) removed for discarding, whether fresh, decayed, or beyond expiry dates (Ishangulyyev *et al*., 2019).

Food quality: Refers to the properties including freshness of food, its shelf life, sensory attributes, as well as microbiological and mechanical influences (Hassoun *et al*., 2023)

Greenhouse gases: The gases that affect or cause an increase in temperature and global warming by trapping heat in the atmosphere. These gases are mainly carbon dioxide and methane (Jeffry *et al*., 2021).

Household dietary diversity: It describes every individual living collectively with other people in the same house, eating the same food together (Derso *et al*., 2021).

Household food waste: Food that was purposed to be consumed by household members but end up being destroyed due to poor planning practices such as not making a shopping list and not checking the cupboards or refrigerator/freezer before purchasing food (Dobernig & Schanes, 2019).

Malnutrition: Taking in insufficient nutrients necessary for growth and the avoidance of diseases brought on by a shortage or absence of nutrients. It is often recognised through stunting, wasting, underweight, and micronutrient deficiencies (Phillips *et al*., 2020).

Rural area: A geographical place that is situated away from cities (Benard *et al*., 2022).

Unavoidable food waste: Inedible food (fruit peels, etc.) that is usually excluded when eating (Nordin *et al*., 2020).

Urban area: A region normally encompassing the city, which has suburbs (Bodo, 2019).

CHAPTER 2:
LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discusses literature based on the objectives of this study, which were to determine food waste, to assess the extent of household food insecurity, to determine household dietary diversity, and to identify the storage and preservation of fruits and vegetables in rural and urban households of Lesotho. Lesotho among other African countries has a challenge of food insecurity. Agricultural production is adversely affected by land, resulting in poor production which leads to food insecurity. About 65.9% of households are food insecure, yet those households have employment (Nkoko, 2020). This is confirmed when the majority (78%) of children in Lesotho, are suffering from low dietary diversity, because they only afford to eat four food groups. Household dietary diversity is low due to low access and availability of fruits and vegetables (Nkoko *et al*., 2023). The findings have put that about 87% (rural) and 72% (urban) consumers do not have knowledge on the issues on food waste, and this might expose a lot of people to household food waste (Chenene, 2020).

2.2 THE LINK BETWEEN FOOD WASTE AND FOOD SECURITY

Food waste, together with food loss, has substantial consequences for food security and the atmosphere, but also, and more importantly, for the global, regional, and national economies. Food waste is one of the major determinants of food security, and the relationship between food waste and food security is that food waste affects the food security of a household through food access and availability (Fami *et al*., 2021). Food waste reduction may improve food security brought on by poverty and reduce negative climatic conditions created by greenhouse gas emissions (Huho *et al*., 2020). It is further illustrated that a reduction of food waste can result in capacity in feeding the world, and thereby securing food security (Trollman *et al*., 2023).

It may also be comforting to store up large quantities of food, for later use and as a result, food ends up wasted, affecting food security negatively through minimising food access and availability (Santeramo & Lamonaca 2021; Fami *et al*., 2021). In another instance, consumers who have a high income tend to waste more food as they may not just eat to fill their stomachs, but also eat for pleasure and this can work negatively against food security (Wang *et al*., 2022). Some consumers have behaviour such as purchasing too much food, which maybe lead by lack of planning or throwing away food that are past best before date, and all these can lead to scarcity of food which may imply food insecurity (Stancu & Lahteenmaki 2022). Emissions like greenhouse gases are the results of food which becomes a global concern, not only does food waste affect the world in that area, it also affects food security negatively (Metcalfe *et al*., 2022).

2.2.1 The impact of food preservation on food waste

Food preservation is the process that extends the shelf life of food items by suspending decay through chemical or biological processes (Huho *et al*., 2020). Food preservation can play a significant role in food waste reduction because it advances the use of food. Food preservation techniques can therefore minimise the spoilage of food and enhance the use of food at the household level (Martindale & Schiebel, 2017).

It is of essence to regard food waste minimisation as the ultimate product of consuming preserved food for it can enhance the sustainability of prepared meals (Martindale & Schiebel, 2017). Suitable food preservation can be implemented to eradicate the food waste challenge in developing countries. A variety of food preservation methods is used across the world. Some technologies are applied based on certain overall physical occurrences such as heat transfer, moisture removal, and inhibition of chemical reactions (Joarder & Masud, 2019).

Women in sub-Saharan Africa, particularly from Kenya, conveyed that traditional methods of preservation were not only suitable but also maintainable. Food preservation methods adopted by women depend on five factors, namely (1) traditions and culture, (2) climate, (3) food accessibility, (4) food-tolerated illnesses, and (5) existing preservation knowledge (Huho *et al*., 2020). Food preservation has the potential to reduce food waste six-fold if

food is correctly preserved through freezing (Martindale & Schiebel, 2017). In 2013, Lesotho consumers were provided with training on food preservation of fruits and vegetables, mainly concentrating on drying and bottling, which are the main preservation methods used in the households of Lesotho. The training was composed of demonstrations and practical (Daidone *et al*., 2017).

2.3 THE RELATIONSHIP BETWEEN FOOD WASTE AND MALNUTRITION

Millions of people globally suffer from malnutrition, and reducing food waste would be a positive step towards alleviating this global problem (Burlea-Schiopoiu *et al*., 2021). Malnutrition in Lesotho is evident through the statistics that show that children who are under the age of 5 has increased in stunting from 33% in 2014 to 35% in 2018. Furthermore, children aged 6-59 months experiencing micronutrient deficiencies are suffering from anaemia at 51% (UNICEF, 2021).

Striving to achieve the uptake of healthier diets, not only assist in reducing eating too much, but also in food waste reduction (Barrera & Hertel 2022). Acquiring skills in nutrition knowledge, shopping and cooking could be useful in reduction of food waste, and improvement of healthier diets (Metcalfe *et al*., 2022).

The social and behavioural aspects of food waste are crucial and have drawn more attention when looking into the issues of hunger and malnutrition in the world and the quantities of food waste that are produced. Estimations project that approximately one billion starving people could be relieved of malnutrition with less than a quarter of food that is presently wasted (Facchini *et al*., 2018). Another aspect that can lead people to malnutrition is parts of food that they do not eat due to certain reasons, such as throwing away parts that could still be edible, such as bread crust, or other foods that are not eaten because they are prepared in a certain way, such as potatoes cooked in their skins (Nicholes *et al*., 2019).

The SDG for sustainable consumption and production (SDG12-12.3), Target 3, aims to halve per capita global food waste by 2030 at the retail and consumer level (UN, 2015). According to Principato *et al*. (2021), food waste may be subject to psychological, social,

situational, demographic, and socio-economic factors. Food waste management deliberates how to dispose of uneaten food, such as by feeding it to animals, arranging practices such as home composting, etc. People who do not recycle or compost any of their kitchen waste tend to throw away more food than those who reuse kitchen waste (Principato *et al*., 2021).

2.4 HOUSEHOLD FOOD INSECURITY

2.4.1 Definition of food insecurity and food security

Food insecurity is described as inadequate access to sufficient nutrient-dense food for an energetic, fit life (Kolovos *et al*., 2020; Gubert *et al*., 2016). People who experience severe food insecurity can go for days without food due to a lack of or not enough money to purchase food (Wolfson & Leung, 2020). Any food insecurity situation, regardless of the severity, is stressful and has been correlated with many physical and mental health challenges (Wolfson & Leung, 2020; Kolovos *et al*., 2020; Loopstra, 2018). Food insecurity is associated with micronutrient deficiencies such as anaemia and many more, and it is a predictor of chronic illnesses such as psychological health disorders and suicidal feelings (Men *et al*., 2020; Thomas *et al*., 2019).

Food insecurity in households escalates the chances of depression in parents, which can result in the reduced psychological health of their children (Pourmotabbed *et al*., 2020; Koyanagi *et al*., 2019). . Food insecurity is defined as the interruption of food intake or eating arrangements because of an absence of money or other resources (Christian *et al*., 2020; Kehinde & Favour, 2020). It has been proven that socio-economic factors influence food security and dietary diversity (Cox, 2021). Food security is described as when all people at all times have access to enough safe and nutrient-dense food to satisfy their proper needs and wants for a strong and energetic life (Thomas *et al*., 2019; Magaña-Lemus *et al*., 2016).

2.4.2 Food Security Pillars

There are four pillars of food security, namely; accessibility, availability, utilisation and stability. Accessibility refers to as the ability to socially, financially and physically get enough, safe, nutritious food at all time for all people to meet dietary needs of individuals (Calloway *et al*., 2023). Availability communicates to available food in good quantities and quality for the people (Nguyen *et al*., 2023), while utilisation delineates making the most of nutrients in food, food preparation methods, and eating practices, while considering clean water and sanitation, and cultural aspects (Tyczewska *et al*., 2023). The stability communicates to continuous access to food, and this may be affected by unemployment, undesirable weather conditions and other economic factors (Calloway *et al*., 2023; Alabi & Ngwenyama 2023).

Food insecurity and malnutrition remain a global challenge, especially in Africa where the number of starving and undernourished people is escalating. Many low-income households eat monotonous diets that are of low quality, cereal-based, and lack diversity, which increases the danger of micronutrient shortages (Christian *et al*., 2020; Chakona, 2020). In 2021 in North Africa, 6.9% of the population were victims of hunger, while in sub-Saharan Africa, particularly West Africa, 32.8% of the population experienced hunger, while in sub-regions of Africa and in Southern Africa, 13.9% and 9.2% experienced hunger respectively (Food and Agriculture Organization, 2022). The task is to meet the world's escalating need for food, in an ecologically maintainable way, to ensure food security (Cronjé *et al*., 2018). Globally, in 2022, people affected are between 691 and 783 million (FAO, 2023)

Household food insecurity is a driving force of malnutrition and is responsible for approximately 300,000 deaths per annum. Food insecurity remains a public health threat; it is rampant in developing countries where a vast number of people continually suffer from food limitations and death due to food insecurity. Whereas a varied and balanced diet is the essence of alleviating malnutrition, food insecurity sabotages dietary intake (Drammeh *et al*., 2019).

Underweight and wasting in young children are meaningfully linked to household food insecurity; however, such a linkage has not been found between food insecurity and stunting (Pathak *et al*., 2020). Malnutrition is the highest result of food insecurity. Over the past 10 years, approximately 3.5 million children under five in sub-Saharan Africa died annually because of inadequate food consumption (Drammeh *et al*., 2019).

The results of food insecurity are obvious in vulnerable groups such as women of reproductive age and children under five as they are at high risk (Christian *et al*., 2020). Opposing childhood familiarities such as poverty, food insecurity, family stress, and abandonment are dangerous factors for early childhood development. Studies have discovered that household food insecurity is a powerful stressor with significant suggestions for decreased cognitive, memory, attention, problem-solving, and analytical skills (De Oliveira *et al*., 2020).

Well-being According to Gubert *et al*. (2016), food insecurity has been linked with illnesses such as diabetes mellitus, metabolic syndrome, and obesity, probably because it influences diet quality, and has also been linked to secondary infection (Loopstra, 2018). The irony of food insecurity and obesity has been credited to less healthy food choices and limited intake of meals and snacks. It is perceived that food-insecure families may be more prone to choosing lower-cost food options, which tend to be energy-packed but lack quality proteins and micronutrients (Spoede *et al*., 2021).

Food insecurity is more prevalent among older adults, considering the impact of social, economic, physiological, and pathological processes that take place during the ageing process. Poverty is a determinant of food insecurity; however, among older adults, other aspects are just as crucial as the economic aspect, such as multimorbidity, the greater value of the management of treating chronic diseases, physical and functional restrictions, and neurologic and mental diseases (Pereira *et al*., 2022; Wolfson & Leung, 2020).

Food insecurity in older adults results from a reduction in the amount of food consumed, which may induce susceptibility to infections due to decreased intake of nutrients, especially proteins, vitamins, and minerals (Pereira *et al*., 2022). Among older adults,

food insecurity can bring forth malnutrition and its consequences, such as cardiovascular diseases. Food insecurity and malnutrition pose serious public health threats because of their multiple causes, high prevalence, and impact on the quality of life of this population. Categorised by an inadequate dietary intake and by a loss of nutrients, malnutrition in older adults presents them with a greater risk of death, hospital readmissions, vulnerability to infections, and loss of self-sufficiency and independence (Pereira *et al*., 2022).

The food security and the malnutrition position of the most vulnerable population groups are likely to decline more due to the health and socio-economic impacts of the COVID-19 pandemic. The United Nations Children's Fund (UNICEF) report of 2020 paid attention to diet quality as a serious link between food insecurity and nutrition. Meeting SDG 2 will only be possible if people have sufficient food to eat and if what they are eating is healthy and affordable (UNICEF, 2020).

Initiatives in agriculture play a huge role in curbing malnutrition, especially among children. Crop-based solutions have proven maintainable outcomes. Livestock production can be another solution that can minimise malnutrition by providing nutrient-dense foods, as well as financial security as it provides sellable commodities (Hetherington *et al*., 2017).

2.4.3 Food insecurity situation in Lesotho

About 65.9% of households in Lesotho are food insecure, even though they are securing employment (Nkoko, 2020). According to the Food and Nutrition Coordinating Office (2016), poverty and nutrition are correlated as undernutrition adversely affects households' productivity. The low-income sections of the population endure malnutrition in all forms. This maintains the cycle of poverty, morbidity, and mortality, which leads to a reduced lifespan. The poorest households are the most susceptible to food and nutrition insecurity and insecure livelihoods. There is evidence that a large number of households that receive food aid may still face micronutrient malnutrition due to insufficient diets linked with inadequate consumption of micronutrient-rich foods such as fruits and vegetables (Lee *et al*., 2017).

2.4.4 Measuring tool for Food Insecurity

2.4.4.1 HFIAS

Household Food Insecurity Access Scale is a tool that will be used to determine food insecurity among the urban and rural areas of Lesotho. This HFIAS questionnaire has about nine questions which depicts food quantity anxiety about household food supply, food preferences and economic household access to food. These questions include the part that requires how often the circumstance occurred (Otekunrin *et al*., 2021). It measures the household food insecurity for the past four weeks. The score is calculated for each household by adding up the codes for each frequency of occurrence question and the maximum score of all nine questions is 27, while the lowest score is 0. This means, the higher the score, the more food insecure the household is experiencing, and the lower the score, the minimum food insecurity the household is experiencing (Andarge, 2022).

2.5 DETERMINANTS OF HOUSEHOLD FOOD INSECURITY

Food insecurity is a multifaceted issue with multiple causes that contribute to its existence, including poverty and low income, cultivated land size, level of education, household size, age, gender, and food price / expensive food.

2.5.1 Poverty and low income

Poverty remains one of the causes that hamper the availability of sufficient food in homes with low incomes. Amid other contributing factors such as socio-economic status in poor homes, food and other resources are not easily accessed, which exposes the family to further hunger. Poverty and food insecurity are intertwined and in combination lead to malnutrition (Drammeh *et al*., 2019). The suppression of famine and lack are the primary targets aimed at overcoming food insecurity. It was estimated that during the COVID-19 pandemic, food insecurity could double from 135 to 265 million people universally (Sinha *et al.*, 2020). Around 57.1% of the population in Lesotho live below the poverty line, which is linked to unemployment (Nkoko, 2020; Chenene, 2020).

In sub-Saharan Africa, income remains one of the most important determinants of food insecurity and hunger. Purchasing food items such as milk and meat is usually difficult for low-income households, compared to high-income households, and healthy food such as fruits and vegetables cannot easily be purchased by low-income families (Ahmed *et al*., 2021; Owens *et al*., 2020; Drammeh *et al*., 2019). Low household income is one of the factors that contributes significantly to food insecurity (Shahzad *et al*., 2021).

Households that experience income loss experience food insecurity more than households that have a higher income (Ahmed *et al*., 2020). It is important to have a clear understanding of the pressures on household incomes such as the management of health and its related expenses. Renting, escalating food costs, and poor financial and food management skills add to the chances of experiencing food insecurity. These skills nevertheless do not compensate for little or not enough money for food, nor do they keep people from feeling anxious about their household food situation (Loopstra, 2018).

2.5.2 Cultivated land size

Owning a piece of land is one of the important factors that determines the livelihood strategies of low-income people in rural areas (Alam *et al*., 2018). Households with arable land can produce various crops and receive income from their yields, which will enable them to purchase food for consumption in their homes (Moroda *et al*., 2018).

2.5.3 Level of education

Education is a factor that defines food security situations in households (Walsh *et al*., 2022; Shahzad *et al*., 2021; Moroda *et al*., 2018). Education assists farmers by being able to familiarise themselves with new agricultural technologies; for example, the right way of applying fertilisers for generating income that will make the household more food secure (Da Mota *et al*., 2019; Drammeh *et al*., 2019; Agidew & Singh, 2018).

The higher education level of the head of the house, particularly women, impacts correct food preparation and eating practices, which reduce child malnutrition in households (Drammeh *et al*., 2019; Agidew & Singh, 2018). Educated household heads are usually

familiar with family planning practices and consequently control their family size (Agidew & Singh, 2018). Education is a crucial component that drives the chance of creating a promising standing for food security (Magaña-Lemus *et al*., 2016).

2.5.4 Household size

The bigger the size of the household, the more food is needed to provide for such a household; thus increasing the possibility of food security compared to smaller households (Drammeh *et al*., 2019; Shahzad *et al*., 2021). However, this can be mitigated if other members contribute to the household income (Agidew & Singh, 2018; Alam *et al*., 2018; Walsh *et al*., 2022). The household income in Lesotho is already low because the majority (73.4%) of households have a monthly income of LSL100 to LSL1 000 (Turkson, 2018).

2.5.5 Age

The household head's age is important in decision making. The older the individual, the more food production is affected (Shahzad *et al*., 2021; Agidew & Singh, 2018). Younger people are more motivated to be involved in large-scale food production, which increases food and income for the household and thus improves food security (Drammeh *et al*., 2019; Alam *et al*., 2018). Also, the older the heads of the house are, the more resilient they are. They have more knowledge, and have access to stimulating livestock production and other income-generating activities, which render the household more resilient to food insecurity (Melketo *et al*., 2021).

2.5.6 Gender

Generally, women play a bigger role in ensuring food availability, accessibility, and utilisation in a household than men. Women produce more creative recipes, which means they can make a meal out of little food; however, they are more exposed to malnutrition than males (Drammeh *et al*., 2019). Women are more susceptible to food insecurity than men, which means that female-headed households are more affected by food insecurity than male-headed households (Broussard, 2019; Drammeh *et al*., 2019). When women

are involved in the decision making of a household, there is a high probability that food, health, and childcare will be prioritised.

2.5.7 Food price / expensive food

There is an indication of reduced quantities of food waste when consumers tend to buy discounted food or consider low prices an important factor when buying food (Schmidt & Matthies, 2018). Increased food prices place a burden on household food security. The lower-income homes in developing countries devote approximately 80% of their income to food. Expensive food prevents people from having nutritious food in their homes, which negatively affects the status of food security in the household (Drammeh *et al*., 2019).

2.6 MALNUTRITION AND DIETARY DIVERSITY

2.6.1 Definitions of malnutrition and dietary diversity

Malnutrition involves under nutrition seen in stunting and underweight, poor nutrient intake from micronutrients, and all these can result in overweight, obesity, and diet-related non-communicable diseases such as diabetes (Du Plessis, 2023). It continues to cause diseases, especially in women and children, particularly from low-income and middle-income countries (Keats *et al*., 2021).

Malnutrition is a product of the incompatibility of nutritional necessities with consumption. Many individuals suffering from malnutrition displays a correlated disease-related inflammation that influences both necessities and consumption (Keller, 2019). Malnutrition is one of the world's prime health challenges, while undernutrition is when a person is not fed enough nutrients (Adebisi *et al*., 2019). Dietary diversity is several different food groups that are micronutrient-rich and consumed by people over time (Makate & Nyamuranga 2023; Marron-Ponce *et al*., 2023).

Good nutrition is the correct foundation for children for their well-being; they mature, develop, acquire knowledge, and play, while malnutrition sabotages their potential, with negative repercussions (UNICEF, 2018).

2.6.2 Determinants of malnutrition and dietary diversity

Studies have shown that marital status impacts malnutrition, and there is evidence that being unmarried is correlated to an increased risk of developing malnutrition (Bardon *et al*., 2021). Low education levels are linked to malnutrition as compared to the successful ageing category (Bardon *et al*., 2021).

2.6.2.1 Age and sex

It has been reported that females have a 45% chance of being malnourished as opposed to their male equals, and the reason for this could be that, worldwide, women live longer than men. Women also are more exposed to negative social and economic conditions in their old age (Bardon *et al*., 2021). Children who are said to possess a birth weight of 2.5 to 3.0 kg have more chances of experiencing malnutrition later as compared to those weighing 3.1 kg and above. Several aspects are linked to this type of malnutrition, such as breastfeeding, post-breastfeeding weaning foods, hygiene, and clinic visits for the baby (Ncube *et al*., 2020). The mother's age is one of the indicators linked to the double burden of malnutrition (DBM) in the home. The danger of a woman who is overweight and obese having a child who is malnourished or has nutritional deficiencies escalates as age increases, especially after 35 years (Guevara-Romeo *et al*., 2021; Hong, Lyonga *et al*., 2020; Anik *et al*., 2019).

Age has an impact on dietary diversity, which manifests in the age of the household head. It is perceived that knowledge comes from experience, which includes knowledge that improves the understanding of diets and nutrition (Jebessa *et al*., 2019).

2.6.2.2 Mother's Education

A mother's level of education is a debatable subject. Some researchers state that a high level of education for a mother is a threat. For those who regard a mother's level of education as an important aspect, the mother's education plays a big role in the status of the child's nutrition. For example, when the mother has some level of education, it is

easier for her to become aware of the children's physical and dietary needs than one who is not educated (Guevara-Romero *et al*., 2021; Biswas *et al*., 2020; Anik *et al*., 2019).

Mothers with limited educational backgrounds do not have proper information on matters such as proper food consumption practices. Parental education could bring solutions to the problems faced by double-burdened households (Géa-Horta *et al*., 2016). In the case where the educational level is low, homes usually adopt negative eating practices such as feeding junk food instead of eating nutrition-rich foods because they are expensive (Géa-Horta *et al*., 2016).

On another note, other studies have not found a correlation between a mother's education and proper eating practices. It is said that even though a mother can have access to all the educational resources directed towards excellent dietary options, their decisions are still controlled by income and other expenditure at the household level (Jamaluddine *et al*., 2020; Jayalakshmi & Kannan, 2019).

It has been found that if the household head has a high education status, high dietary diversity in the household will be attained. The education of the mother in the house also contributes to dietary diversity. An educated household head will have a clear understanding of varying the diet and the health implications or benefits thereof. Educated household heads invest in purchasing more diversified foods than those who are not educated (Kundu *et al*., 2022; Derso *et al*., 2021; Jebessa *et al*., 2019).

2.6.2.3 Mother's occupation

Whether the setting of the mother's employment is linked to the DBM at home is still not clear (Oddo *et al*., 2018). It can, however, be concluded that a mother who has a job would be privileged enough to buy sufficient and varied food. Oddo *et al*. (2018) discovered that the danger of malnutrition lessens when the mother has a job. However, some researchers, such as Saibul *et al*. (2009), indicate that if mothers are working, their time to do quality cooking is limited and they therefore opt for junk/fast food instead of home-cooked meals. Linking the mother's work and its demands with the DBM in some homes could be accredited to insufficient time allocation for households. Limited time

could hinder meal planning, food choices and cooking, childcare, and feeding practices (Guevara-Romero *et al*., 2021).

2.6.2.4 Household income

The issue of household income regarding the DBM is still controversial (Guevara-Romero *et al*., 2021). Some researchers state that the higher the income, the higher the danger of the DBM (Biswas *et al*., 2020; Blankenship *et al*., 2020; Jayalakshmi & Kannan, 2019; Géa-Horta *et al*., 2016). This stresses the point that families with high income may not necessarily focus on obtaining high-quality, nutritious food that would offer adequate nutrients to growing children, which would equally lead to adult obesity (Guevara-Romero *et al*., 2021). Also, having an income that is not sufficient to take care of the family gives them no choice but to live in unpleasant conditions with poor infrastructure developed from inappropriate materials. These settings escalate the danger of infections (Guevara-Romero *et al*., 2021).

High-income households practise achieving dietary diversity more than low-income households because they can purchase highly nutritious foods due to the smooth facilitation of their income. The money that some households generate from selling crops produced from their fields facilitates access to different nutrient-dense food for their household members (Kundu *et al*., 2021).

2.6.2.5 Nutrition knowledge

Awareness that comes with information about good nutrition and health is crucial to every household member. This represents knowledge of different food items, the good choice of items, as well as the ability the prepare food the right way (Huluka & Wondimangegnhu, 2019).

2.6.2.6 Home gardening

Land plays a crucial role in dietary diversity (Derso *et al*., 2021). Home gardening affects dietary diversity positively and a difference is identified between households with home gardens and households without gardens. A higher variety of fruits and vegetables is

available from such gardens and, as a result, high dietary diversity is achieved (Jebessa *et al*., 2019).

2.6.2.7 Food intake

Limited consumption of diverse diets and poor child feeding habits lead to elevated levels of child undernutrition, which is more prominent in rural areas in developing countries. It leads to low birth weight, short stature, and lower resistance to infection (Derso *et al*., 2021). The imaginable factor for the cohabitation of maternal overfeeding and child underfeeding may be linked to variances in the family's eating routines (Hauqe *et al*., 2019). Numerous households decide to change from their traditional foods to diets packed with saturated fats and sugar and the minimum fruits and vegetables (Guevara-Romero *et al*., 2021).

The situation in most developing countries is that they are experiencing Stage 4 of the nutrition evolution, where consumers have a diet composed of high-energy and processed foods while eliminating nutritious foods such as fruits and vegetables, pulses and legumes, and meat with low or no fat content (Fouché, 2018). Some minerals such as sodium play an important role in providing balance in blood circulation processes; it is normally available in foods such as table salt, milk, snack items, fish, and condiments. However, improper use of sodium may contribute to acquiring chronic illnesses that can negatively impact the circulation system (Shaabe, 2019).

A family whose food choices are derived from energy-rich foods is set to have malnutrition because these types of food do not contain many beneficial nutrients (Mahmudiono *et al*., 2018). Aspects that influence the intake of food, such as the quantity of food consumed or the ability to eat, seem to be correlated with malnutrition. Lack of appetite seems to be linked with malnutrition too, which can be the result of many factors, including depression, cognitive decline, chewing or swallowing problems, and sensory alterations (Bardo *et al*., 2021).

Adequate intake of vitamins A and C has a positive impact on iron status, while insufficient intake of folate and vitamin B12 can lead to forms of anaemia. However, the content of

iron in food is not the only factor that determines the good use of iron in the body; the ability of the body to absorb iron or any other nutrient brings positive benefits to the body (Abu, 2015).

The insufficient intake of fruits and vegetables, which is generally low dietary diversity, and living without physical activity lead to non-communicable diseases in sub-Saharan Africa (Mabena, 2021; Van den Berg *et al*., 2019). Legumes, grain crops (maize, wheat, and sorghum), and vegetables enhance the dietary diversity of the diet, which improves the diet and promotes good nutrition and health (Gerrano *et al*., 2022). Dietary diversity is determined by the adults in a household, and children under six years do not influence dietary diversity; however, children from seven to 17 years contribute to determining dietary diversity (Fouché, 2018).

Diet value and amount play a role in malnourishment (Forgie *et al*., 2020). Compromised mouth health condition plays a significant role in influencing the choice of food and intake of nutrients, which all lead to malnutrition (Azzolino *et al*., 2019). Having few or no teeth can bring unpleasant results to the quality of the diet as highly nutritious foods may be avoided in favour of softer, more calorie-dense food with fewer nutrients (Bardon *et al*., 2021). Participating in dietary counselling and oral healthcare may be beneficial to managing the complications of older people, while approaches to prevention throughout life could preserve both oral and muscle function for a later stage (Azzolino *et al*., 2020).

2.6.2.8 Easy access to markets

Access to markets to sell produced crops would suggest that market linkages could enable smallholder farmers to consume diverse diets through demand and supply (Gupta *et al*., 2020). A long distance between the home and the market can be a prohibiting factor that discourages the household head to vary the diet at home. Short distance, as well as transport availability, may assist in motivating consumers to purchase nutritious food and, as a result, improve nutrition through high dietary diversity (Derso *et al*., 2021; Jebessa *et al*., 2019).

2.6.2.9 Food safety

Ingesting unsafe food and water has an impact on diarrhoea incidences. Steps taken to remedy contamination could end up leading to preferring soft drinks over water, and highly processed foods over fresh food, particularly in urban areas where these types of foods are mostly available. These types of dietary modifications can expose people to overweight and obesity and various diseases (Pradeilles & Holdsworth, 2019).

2.6.2.10 Health and water, sanitation, and hygiene (WASH)

WASH practices have been related to food and nutrition security (Van Cooten *et al*., 2019; Pritchard *et al*., 2019). The prominent relationship between less quality of WASH and undernutrition is demonstrated by episodes of diarrhoea, which can represent the reason for or the result of malnutrition. Diarrhoea negatively affects the absorption of nutrients and plays a role in reduced food intake (Momberg *et al*., 2020; Van Cooten *et al*., 2019). Studies have revealed that contaminated water, poor sanitation and hygiene, and hunger can be highly detrimental. They can cause diarrhoea, cholera, etc., which can be the product of dehydration and a hindrance to the absorption of nutrients from food. This creates a cycle because malnutrition causes the immune system to be weak, which makes the body vulnerable to diseases (O'Driscoll, 2018). Natural and health tragedies, such as drought, flooding, and cholera outbursts, have produced further demands for access to basic WASH services (UNICEF, 2017).

2.6.2.11 Lifestyle

Reports concerning lifestyle aspects such as drinking alcohol, smoking, physical exercise, and malnutrition remain feeble. Insufficient linkages have been conveyed for physical activity as a protective factor and smoking as a cumulative threat (Bardon *et al*., 2021). Williams *et al*. (2019) discovered that less body movement or an inactive lifestyle escalates the possibility of women gaining more weight, whereas other studies (Sassi *et al*., 2019) indicate that it does not correlate with the DBM in the home or contribute to obesity, and that the advantage of physical exercise is manifested in a healthy cardiovascular system (Cox, 2021).

2.6.2.12 Psychological factors

The occurrence of malnutrition is meaningfully higher among individuals with dementia, irrespective of age (Bardon *et al*., 2021). Foods with high-energy content reduce the stress response under the influence of multifaceted metabolic passageways involving the hormone cortisol and other signalling fragments. Within the body, these metabolic responses are correlated with poorer cardiometabolic profiles, including insulin fighting, raised blood pressure, and blood clots. Insulin resistance and continued escalations in appetite also result in additional weight increase, which leads to chronically amplified food intake (Wells *et al*., 2021). There are also various changes in behaviour, such as disturbed sleep patterns, lower levels of physical activity, faster eating behaviour, and minimised sociality around meals. The relationship between stress and appetite generates a generally elevated demand for high-energy foods (Wells *et al*., 2021).

2.6.2.13 Health-related issues/behaviours

It is stated that failure to breastfeed is a factor that is linked to the DBM (Hong, Winichagoon *et al*., 2020; Williams *et al*., 2019; Anik *et al*., 2019; Géa-Horta *et al*., 2016). Several studies have highlighted that breastfeeding protects against the DBM (Hong, Winichagoon *et al*., 2020). It is generally accepted that exclusive breastfeeding for six months is very beneficial for any child. Moreover, Anik *et al*. (2019) emphasise that the true benefits take place between 24 and 59 months. These DBM issues surface throughout all age groups, while illnesses such as cancer and osteoporosis only manifest within the accelerated ageing group. Malnutrition is prevalent among elderly people with cancer, alternating from 30% to 85% prevalence subject to the cancer type (Bardon *et al*., 2021).

2.6.2.14 Household size

Household size is linked with a higher probability of undernutrition and anaemia but a lesser probability of being overweight at the household level (Christian & Dake, 2022). Studies state that as the number of members in a single household grows, there is a higher chance of DBM threats in the same household (Lokossou *et al*., 2021; Alaofè &

Asaolu, 2019; Das *et al*., 2019). Das *et al*. (2019) indicate that when there are many children in the household, especially under five years old, they could suffer due to unavailable food (Fooken & Vo, 2021). Blankenship *et al*. (2020) elaborate that big families increase the economic obstructions to successfully attaining proper child nutrition and enhanced living conditions in households.

2.6.2.15 Location

Some studies have revealed that living in rural areas is a leading cause of the DBM at home (Alaofè & Asaolu, 2019; Tydeman-Edwards *et al*., 2018), while others state that the risk escalates if people live in rural areas (Fooken & Vo, 2021; Das *et al*., 2019; Mahmudiono *et al*., 2018). Some researchers, however, profess that the risk may be the same in both rural and urban areas (Hong, Winichagoon *et al*., 2020; Jayalakshmi & Kannan, 2019). Peri-urban areas are places in between rural and urban areas and they may pose a threat to acquiring the DBM because their infrastructure is not ideal for human settlements. Many such settlements are acquired illegally and do not offer conducive conditions and resources such as electricity, drinking water, etc. (Guevara-Romero *et al*., 2021; Lokossou *et al*., 2021).

2.6.2.16 Household religion

Religiosity is defined as a belief in God or a deity and adhering to the principles believed to be set by God or the deity. Food is important in religion because it provides a way to fill hungry stomachs and celebrate unique events; food also characterises certain religions or religious practices through the eating of certain foods at allocated times (Filimonau *et al*., 2022). Various religions such as Christianity and Islam view food as a blessing from God and its wastage is highly discouraged. Religions motivate people to share food to display a level of caring (Elhoushy & Jang, 2021).

2.6.2.17 The use of Household Dietary Diversity Score

It is a calculation that is done through the number of food groups consumed in the home and outside the home, within 24 hour and 7 days respectively. The food groups are 12,

consisting of cereal; white tubers and roots; fruits; vegetables; legumes; nuts and seeds; fish/seafood; meat; eggs; oils and fats; milk and milk products; sweets, spices; condiments and beverages (Althaiban *et al*., 2023). The households should be divided by three score groups being low (0-4 food groups), medium (5-8 food groups), and high (9-12 food groups), (Kasimba *et al*., 2018). A higher score signals high dietary diversity indicating high food security, while lower score signals low dietary diversity which indicates low food security (Banna *et al*., 2022).

2.7 HOUSEHOLD FOOD WASTE DETERMINANTS AND CONSUMER BEHAVIOUR

2.7.1 Definition of food waste/loss

Food waste is defined as both food and related inedible parts that are removed from the food supply chain (FSC) (Rolker *et al*., 2022). Types of food waste include avoidable food waste and non-avoidable food waste. Avoidable food waste is edible food that has been discarded for certain reasons. It is food that is thrown away that was acceptable at some point before disposal, such as a slice of bread, apples, and meat (Teigiserova *et al*., 2020). Non-avoidable food waste is inedible food that originates from food preparation such as bones, skin, shells, etc. Food waste is part of food loss and happens when edible food is not eaten (Ishangulyyev *et al*., 2019).

2.7.2 Food loss and waste (FLW)

Agricultural food crops undergo several handling practices before reaching the consumer and food loss may occur during these processes. Food loss may occur because of machine-driven damage, infection by microorganisms, and attacks by pests, rodents, and birds (Gashu *et al*., 2019). Food loss is a reduction in the quantity and quality of food that was primarily created for people to eat, and a reduction at all levels of the FSC in the quantity of food primarily produced for people (Ishangulyyev *et al*., 2019).

In developing countries, a great amount of FLW occurs during food production and post-harvest; however, in developed countries, it takes place through the distribution and

consumption phases of the FSC. For instance, FLW in handling and storing produce 12.7% and 1.3% in the consumption phase in sub-Saharan Africa respectively (Wang *et al*., 2021). It has also been found that in developing countries, FLW are generated through inadequate harvesting methods, a shortage of modern and suitable rural set-ups, climatic situations, and inadequate post-production practices. In developed countries, FLW are the result of consumer behaviours and retailers' lack of information transmission in the FSC (Wang *et al*., 2021).

In developing countries, FLW occur mostly in warm and humid climates, due to inadequate food storage and inefficient processing in these climates. In Rwanda, Ghana, Benin, and India, farmers lose 30% to 80% of their harvest before it reaches the consumer because of temperature, packaging, poor field health, and prolonged time before reaching the market (Wang *et al*., 2021).

2.7.3 Food waste in the food service sector

The food service sector is a broader sector that constitutes the hospitality industry, catering, restaurants, fast food chains, cafés, cafeterias, and dining halls. Others include hospitals, nursing homes, hotels, school canteens, enterprises' cafeterias, and prisons (Lemaire & Limbourg, 2019). All these sectors experience food waste at some stage, and it is important to note that hospitals are considered to produce more than twice the food waste of other food service sectors (Dias-Ferreira *et al*., 2015).

Another reason for food waste includes staff not being provided with the required training for internal routines such as purchasing, storing, and freezing food (Martin-Rios *et al*., 2018). Food waste in the food service sector depends mostly on the administration's beliefs, knowledge, goals, and actions (Martin-Rios *et al*., 2018). This study, however, focused on food waste at the household level.

2.7.4 Food waste at the household level

The major reasons for food waste at the consumer level are lack of knowledge about the availability of food, the location of the desired food, and the customers' experience with

food waste practices. FLW take place because of food purchasing and consumption habits (Lemaire & Limbourg, 2019). Some consumers lack knowledge of the extent of food waste, while others experience feelings of guilt when engaging in food waste (Schanes *et al*., 2018).

Food waste and food insecurity have undesirable effects on individuals' health, the environment, and the economy (Harduth, 2017). Lee *et al*. (2017) state that while a substantial part of the population is food insecure, there is also an organised FLW challenge.

2.8 DETERMINANTS OF HOUSEHOLD FOOD WASTE

2.8.1 Household size

The size of the household influences food waste development. Houses that have children create more food waste than households that do not have children, because children have a tendency to not finish the food on their plates (Thyberg & Tonjes, 2016). Huho *et al*. (2020) found that households with more than four members waste more food than households having three, two, or one member.

2.8.2 Gender

Women are regarded to waste more food than men do, especially women who live alone (Thyberg & Tonjes, 2016). However, in contradiction, Huho *et al*. (2020) state that men waste more food than women. This is further emphasised by Visschers *et al*. (2016), who found that women are associated with less food waste, while Heidari *et al*. (2020) found that gender does not have a significant influence on food waste.

2.8.3 Educational level

Regarding food waste production, it has been found that households with a university education experience less food waste as opposed to households with a secondary education and households with no education background (Abdelradi, 2018).

2.8.4 Household income

Food waste is incurred transversely in various phases and income levels (Thyberg & Tonjes 2016). Low-income households waste more food because they tend to buy large quantities of low-quality food that often decays before they can be consumed (Li *et al*., 2021).

2.8.5 Household residency and food waste

It has been discovered that more food is wasted in urban areas than rural areas in sub-Saharan Africa (Huho *et al*., 2020). Urbanisation and demographic variations are causing escalations in food waste development in homes; however, the reasons why behaviour and preferences affect the actions of consumers who reside in urban areas remain unknown (Hatab *et al*., 2022).

2.9 BEHAVIOUR THAT CONTRIBUTES TO HOUSEHOLD FOOD WASTE

2.9.1 Domestic food storage

Storage practices are primarily linked to consumers' ability to store and preserve food after purchasing it. When consumers do not store food correctly, there is a high probability that it will decay (Bravi *et al*., 2020). Storage practices seem to be one of the crucial components that affects household food waste. Refrigerators are filled to their maximum capacity, yet more food is added. Fresh produce is traditionally not kept in the refrigerator, which causes food to spoil in a few days; generally, this occurs when people lack food preservation skills and knowledge (Farr-Wharton *et al*., 2014).

Refrigerators and freezers play a major role in the convenience, freshness, and safety of food. The way that food is placed and moved in the refrigerator is important for food waste visibility and well-timed consumption. One solution to minimise food waste rests upon the improvement of information, labelling, and motivation to influence consumers to refrigerate and freeze their food to reduce food waste (Hebrok & Boks, 2017).

2.9.2 Purchasing practices

Consumers generally do not check what they have before they go shopping, which could lead them to purchase food they already have at home (Farr-Wharton *et al*., 2014; Principato *et al*., 2021). Prepared consumers do planning such as compiling a shopping list that coincides with planned meals (Farr-Wharton *et al*., 2014). Overprovisioning of food is also linked to the perceived storing of more-than-needed quantities of food (Schanes *et al*., 2018). The habit of creating a shopping list has been proven to be a working strategy for minimising food waste by up to 20% (Principato *et al*., 2021).

The burden of the COVID-19 pandemic brought about changes that led to unplanned shopping and overstoring, while travel restrictions also affected normal routines. Consequently, these changes increased food waste by cooking more than needed, going beyond storage time for frozen food, and buying more than needed (Burlea-Schiopoiu *et al*., 2021). Purchasing habits such as buying too much food and being tempted by promotions have a negative effect on household food waste. In addition, a lack of planning before buying food and information on how to store food correctly can exacerbate the situation (Chenene, 2020).

2.10 FOOD COOKING AND CONSUMPTION PRACTICES

2.10.1 Identification

Many people find it difficult to distinguish whether food is fresh or decayed, especially with stored leftovers. The quality of food comprises food that is acceptable to consumers in terms of appearance, texture, and packaging. Food labelling provides concise information on the quality of the food item. Canned and frozen food products are added to the market because low-income consumers tend to purchase these food items because they are the less expensive option (Jin & Lu, 2021).

2.10.2 Cooking

Food waste is common in most households. Improper handling and cooking practices lead to food waste (Hatab *et al*., 2022). Furthermore, expired food and cooking more food

than required are some of the causes of household food waste (Huho *et al*., 2020). Some people cook big meals to eat for several sessions, while others cook big meals that they cannot finish in a single session and they end up discarding such food (Principato et *al*., 2021; Schanes *et al*., 2018; Farr-Wharton *et al*., 2014). Approximately 90% of households in sub-Saharan Africa use firewood to cook meals, especially in rural areas. Cooking systems through the use of gas stoves save time and fuel, as well as reduce emissions (Njenga *et al*., 2019).

2.10.3 Tastes

Different tastes among family members can result in purchasing too much food in an attempt to accommodate each member. Furthermore, when family members normally eat food that is regarded as unhealthy, they purchase a lot of healthy, perishable food that decays quickly in an attempt to feel less guilty (Schanes *et al*., 2018).

2.10.4 Dates

Food becomes unsafe if consumed after a specified date. Best-before dates on food products inform consumers that food is in its best state before a specific date, but food can often still be eaten safely after this date (Principato *et al*., 2021). When the food item is approaching the expiry date, consumers envisage that it is not suitable for consumption. Consumers tend to overlook the expiry dates and confuse them with best-before or use-by dates, which leads to vast amounts of food waste (Bravi *et al*., 2020).

2.10.5 Eating out

Consumers who mostly eat out in restaurants waste more with a lower expression of guilt. Eating out is not an indication of spending less on groceries and it is often unplanned. This behaviour leads to unused groceries and food waste (Schanes *et al*., 2018). On the other hand, it has also been discovered that people who eat out reduce food waste, specifically in the food service sector such as restaurants (Kim *et al*., 2020).

2.11 CONSUMER BEHAVIOUR

2.11.1 Planning

A demanding lifestyle and a home with children make it challenging to plan properly for provisioning, meals, and food stock. However, it is not only families with children that do not attempt to plan; it is an overarching theme among consumers (Hebrok & Boks, 2017). Precise planning of food purchases is a good strategy to avoid overbuying, which leads to increased food waste (Brennan & Browne, 2021; Schanes *et al*., 2018).

Recommended planning tools include a shopping list, advance meal plans, and checking what is needed before making purchases (Principato *et al*., 2021; Schanes *et al*., 2018). Another crucial factor is date labels. Having clear knowledge that the best-before date is connected to food quality, while the use-by date is connected to food safety, is important to capacitate consumers to be wiser when they buy food (Bravi *et al*., 2020).

Planning solutions such as creating a shopping list, creating meal plans, and checking the cupboards and refrigerator/freezer before buying groceries will reduce food waste (Chenene, 2020; Bravi *et al*., 2020; Enos, 2019). Consumers who do not make a habit of making a shopping list and checking what is needed before buying fall into the trap of overestimating what they need (Chenene, 2020). A shopping list functions as a prompt more than a thorough plan of items to buy (Hebrok & Boks, 2017).

2.11.2 Managing leftovers

Food wastage by young consumers is influenced by a lack of food management skills in terms of purchasing, storing, and preparing food, as well as handling leftovers. Cooking skills make a huge contribution to possible food waste produced using leftovers. Food management skills that contribute to reducing the chances of food being wasted involve being familiar with the right portion sizes to prepare and serving the correct quantity of food on plates (Karunasena *et al*., 2021).

People are generally good at storing and eating leftovers. They prepare large quantities of food because they find it difficult to ration. What happens with leftover food is decided

by the material and socio-cultural aspects of food consumption. These may pertain to the preferences of other members of the family and what is appealing to them (Hebrok & Boks, 2017). Making use of leftovers is regarded as one of the most valuable practical ways to alleviate household food waste. Some households, however, tend to worry about the safety of leftovers, which makes them reluctant to use them (Schanes *et al*., 2018).

2.11.3 Composting

Compost and vermicomposts are supported as nutrient sources for plants, but they are still low-grade in nutrition compared to inorganic fertilisers. For example, urea has 46% nitrogen, and compound fertilisers such as 3:2:2 (35%) have 42.8% phosphorus and 28% potassium, while homemade compost is reported to have as low as 0.8% nitrogen, 0.27% phosphorus, and 0.08% potassium (Katakula *et al*., 2022).

A market investigation of the composting worm farm business in two countries, South Africa and India, was conducted, which established that the Indian market could supply over 70 000 kg of worms per month, while for the South African market, this was 3 000 kg. Both markets have the potential to double their production or more (Furlong *et al*., 2017). Composting can minimise the price of placing biological waste and provides profits because of its composition, which is beneficial for the improvement of the soil (Azis *et al*., 2022; Atif *et al*., 2020).

Utilising compost may provide a maintainable way of refining soil organic carbon and soil fertility, particularly for smallholder farms. The impact of compost differs with soil type, compost type, compost quality, and application method. An extensive variety of fresh ingredients (including organic waste, crop residue, and livestock and poultry manure) are utilised as feedstock in the production of compost (Maselesele *et al*., 2021).

There are various reasons for farming earthworms, such as bait for fishing or to sell to others, to control livestock manure or crop residues on farms, to process food scraps gathered on-site, to make vermicast to produce healthier food, or to generate an income from vermicomposting (Sherman, 2018).

Food waste habits may differ across settings, which proposes the significance of conducting regional studies (Carroll *et al*., 2020). Proper use of food waste and by-products as raw materials or food additives could create economic gains, contribute to alleviating nutrition problems, produce beneficial health effects, and reduce the ecological impact of mishandling of waste (Tores-Leon *et al*., 2018). The food date labelling process relies on the projected increase of decay bacteria, but inconsistencies in accounting for eco-friendly issues such as temperature variations play a role in food waste.

A dominant concern for the 21st century is to continue to provide food for the increasing human population in a sustainable manner while accepting the effects of climate change and controlling the increase in agricultural land and water use (Bradford *et al*., 2018). It is projected that just 25% of the global food waste would be sufficient to feed all hungry people globally (Garcia-Garcia *et al*., 2017). Food waste in households remains a sustainability problem that poses environmental and social difficulties (Williams *et al*., 2020).

Individuals who do not engage in reusing or composting the food waste from their households tend discarding more food than those who recycle their food waste (Principato *et al*., 2021). Compost is used as a soil fertiliser that produces healthier plants normally consumed by humans (Pearson *et al*., 2017). How food is discarded impacts the quantity of self-reported food waste. A generous quantity of food waste is given to animals, and emphasis on disposal practices such as reprocessing or composting often decreases people's enthusiasm for waste avoidance because they do not regard food given to animals or composted as wasted food (Principato *et al*., 2021; Schanes *et al*., 2018).

Recently, research has paid more attention to improved organic fertilisers in maintainable agriculture such as vermicomposts, which utilise solid organic materials such as food waste, animal waste, and processed sewage sludge (Katakula *et al*., 2022).

2.11.4 Disposal and the social, environmental, and economic impact of food waste

Leachate is any liquid caused by waste in a landfill and its creation level has a bearing on the leachate level. Leachate develops over time and is determined by the state of filling and solidity (Chen *et al*., 2021). Open dumping of solid waste is rampant in developing countries, especially in urban areas, which results in leachate and bad odours (Ongia *et al*., 2021). Landfilling is usually utilised for the disposal of municipal solid waste, which comprises more food waste in developing countries. The prime cause of geoenvironmental problems in landfills with high food waste content is quick leachate and landfill gas generation (Chen *et al*., 2021).

Among the consequences of disposal of food waste in landfills is the methane and carbon dioxide produced by the usual food spoiling process, which results in impurities in the air that cause in global warming, which in turn contributes to climate change. The production of food also has an impact on the environment because it creates greenhouse gas emissions from farm to transport, storage, distribution, and retail proceedings (Madondo *et al*., 2022; Huho *et al*., 2020).

People and social wellbeing are the foundational strongholds of sustainability. The two are connected to the environment and the economy. The sustainability of the economy is supported by the health of both the environment and society. When considering the economic consequences of food waste and achieving significant monetary savings, the sustainability of the environment should come first. Looking across the FSC, especially the household level, the reduction of avoidable and unavoidable food waste directly impacts final waste disposal expenses, which are borne primarily by the environment (Madondo *et al*., 2022).

2.12 CONCLUSION

This chapter explored the literature on the three aspects of food security, food waste and dietary diversity. It also unpacked the real challenges in those three areas exploring the global situation together with the current national situation in Lesotho. It also introduced the tools that were employed in the data collection process, HFIAS and HDDS.

CHAPTER3:
RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter describes the activities undertaken to conduct this study. It provides an outline of the research design, study population, sampling, data-collection methods, and data-analysis techniques. It also highlights the study's limitations, validity and reliability, as well as the ethical considerations. Mixing the quantitative and qualitative research methods enables investigators to gain in-depth understanding of the topic at hand, while compensating for the weaknesses of each approach (Mukumbang, 2023).

3.2 RESEARCH DESIGN

Research design is defined as a set of issues that guide the researcher's decisions on how to gather the research data, analyse and interpret it, and ultimately answer the research question as clearly as possible (Rezigalla, 2020). This study adopted an exploratory descriptive design because this type of research enables gaining insight (Nyampundu *et al*., 2020) as limited research is available on this topic. A mixed-methods approach was adopted whereby both quantitative and qualitative research was conducted. This approach aimed to provide deeper understanding of the underlying factors of food insecurity, food waste, and dietary diversity. For the quantitative method, a structured questionnaire was used, while for the qualitative component, semi-structured interviews were conducted.

The mixed method was done concurrently when the questionnaires were administered, and the participants interviewed at the same time. A mixed-methods design implied components of both quantitative and qualitative research (Bergman, 2016), where the findings were integrated to conclude with the help of both approaches (Palinkas *et al*., 2019).

The qualitative approach sought to provide deeper understanding of the underlying factors and to answer the "why" questions related to the study topic (Headley & Plano

Clark, 2020; Mukumbang, 2023), particularly food waste, food insecurity, and dietary diversity in rural and urban areas. Quantitative research follows a specific system and avails answers to research questions by collecting measurable data and using mathematical procedures for analysis (Panthee, 2020).

An exploratory design seeks to find the reasons behind challenges, but do not present solutions. It is used to identify the problem through a deeper unveiling of the challenge and providing more insight (Mathee, 2020). An exploratory design was appropriate for this study since limited data are available concerning similar research in Lesotho. A descriptive design was used because it would reveal the frequencies and percentages, expressed in tables regarding food waste, food insecurity, and dietary diversity. A simple way that a descriptive study is conducted is by utilising questionnaires in a survey (Schanes *et al*., 2018). This study also adopted an exploratory design as the topic required more insight to assist in finding the causes of and reasons for food waste, and it would allow the participants to share their experiences and views (Nyampundu *et al*., 2020) of food insecurity, household dietary diversity, and food waste, which was captured through interviews.

3.3 POPULATION AND SAMPLING

3.3.1 Sample population

Lesotho (see Figure 3.1) is a small landlocked Southern African country with a population of 2.2 million. It consists of 10 districts, namely Mokhotlong, Leribe, Maseru, Berea, Mafeteng, Mohale's Hoek, Qacha's Nek, Quthing, Thaba-Tseka, and Butha-Buthe. For this study, the research was conducted in the rural areas of four districts of Lesotho, that are representative of the four agro-ecological zones, namely Mafeteng and Leribe, representing the urban areas, and Thaba-Tseka and Qacha's Nek, which represented the rural areas.

The selected urban districts experience low income and job loss, which are exacerbated by the recent COVID-19 pandemic (Lesotho Vulnerability Assessment Committee, 2021), and they also have a high prevalence of HIV/AIDS of approximately 25%. The selected

rural areas have a high prevalence of stunting in children under five; 40% in Thaba-Tseka and 33% in Qacha's Nek (Ministry of Health, 2016). The other factors that prompted the motivation for the choice of study locations were poverty, low income, low food security, and a high percentage of female-headed households (Nkoko, 2020; Chenene, 2020). The four districts also represent distinct agro-ecological zones in Lesotho.

The overall sample size was 456, which consisted of 110 household respondents from each district that participated in the questionnaires, and four participants per district for the interviews. The participants/respondents were adults older than 18 years, capable of purchasing and cooking food. This was done with a 95% level of significance, 80% power, 50% defects, and 0.05 margin of error (Aragaw *et al*., 2023; Sekgala, 2020). Sample size means the number of participants selected from among people who particularly possess features to represent and make conclusions about the population (Madondo *et al*., 2022).

The sample size per district was calculated using the following formula:

$n = NC^2 \div [C^2 + (N-1)\, e^2]$

$= [\text{number of households}] \times 0.3^2 \div [0.3^2 + ((\text{number of households}-1) \times 0.02^2)]$

= number of households to be sampled

Where n=sample size; N=population size; C=Coefficient of variation which is ≤ 30%; e=margin of error which is fixed between 2-5% (Ali-Olubandwa, 2010; Nassiuma, 2000).

The rural and urban areas of Lesotho constitute four districts, which represent distinct agro-ecological zones. These zones are the mountains (Thaba-Tseka) or highlands, the foothills, the Senqu River valley, and the lowlands (New Partnership for Africa's Development & Food and Agriculture Organization, 2005). Thaba-Tseka represented the mountains with 33, 089 households; the foothills consisted of the Leribe district, which has a total number of 90,157 households; Senqu River valley was represented by Qacha's Nek district with 20, 210 households; and the lowlands was represented by the Mafeteng district, with 46,379 households (Bureau of Statistics, 2016). Based on the sample size calculations using the above formula, Thaba-Tseka provide a sample of 223

households, Qacha's Nek 222 households, Leribe 224 households, and Mafeteng 223 households, and all these summed up to a total of 892.

Due to unforeseen shortage of resources from the study sponsor, the sample had to be reduced by calculating 51% of 892 to get 456 as the final sample used. A total number of 440 respondents participated in the questionnaire survey, while an additional 16 participants participated in the face-to-face interviews, which made the total sample of 456. Therefore, the sample number 456 was divided by 4 which was the number of district to conduct a study from, which then made 114, and from this number, 4 people were chosen to participate in the interviews, which made a sum of 16 participants from all four districts, and left each district with 110 respondents who were used for qualitative data (questionnaires). The sampling employed was random stratified sampling, and the unit of analysis was the household.

Figure 3.1: Map of Lesotho and its 10 districts
Source: World Map (n.d.)

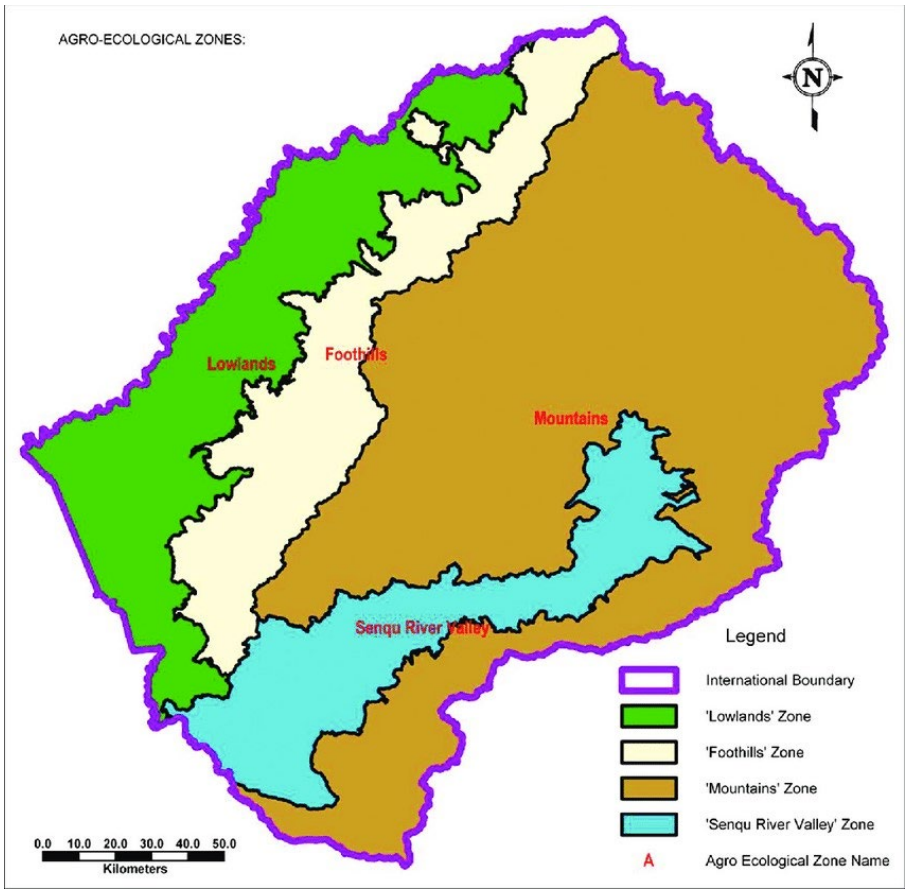

Figure 3.2: Agro-ecological zones map of Lesotho
Source: researchgate.com

3.3.2 Sampling method

3.3.2.1 Stratified random sampling

This research employed stratified random sampling. Sampling is described as a process where a sample is taken from a group of people for a research study. It saves time and money as a smaller representative sample size is used as opposed to the total number of people, and also provides quick and precise results (Bhardwaj, 2019). Stratified sampling occurs when a large group of people is divided into smaller groups or strata and the sample is taken randomly from the smaller group (Berndt, 2020; Bhardwaj, 2019). The District Agricultural Officers (DAOs) gave permission to conduct this study in each district. This permission was obtained telephonically for all four districts. The DAOs then assigned District Nutrition Officers (DNOs) to engage in making proper arrangements

before the study commenced. Each district had 16 resource centres, and out of these areas, only four areas (strata) were randomly selected from the lists available at the offices of the DAOs. Households were thus selected randomly from the four areas in each district. This type of sampling is also used when correlations need to be determined (Bhardwaj, 2019).

3.3.2.2 Purposive sampling

Non-probability purposive sampling was employed to select participants for the interviews. It is a form of sampling that is not random and is used deliberately by researchers to choose a sample that reflects specific characteristics such as age, gender, location, family structure, etc. (Andrade, 2021). It is also called judgemental, selective, or subjective sampling (Cash *et al*., 2022). The suitability procedures were based on the participants' origin, age, locality, and household/family structure. Only participants with the capacity to speak Sesotho and English were asked to participate, and they had to 18 years or older. Family structures were asked to participate only if they represented a household, namely families with or without children. A total of 16 participants were involved in the interviews, where four participants represented each of the four districts.

3.4 DATA COLLECTION

3.4.1 Data-collection instruments

A questionnaire was used in the quantitative method, while interviews were used in the qualitative method. The questionnaire was compiled in English and translated into Sesotho. It included socio-demographic, food waste, dietary diversity, and food insecurity questions. The questionnaire consisted of standardised questions (i.e., HFIAS and HDDS), and questions developed specifically to achieve the set objectives. The qualitative data were collected through face-to-face interviews via a dictaphone recorder. The unit of analysis was households.

3.4.1.1 Questionnaires

The questionnaire took a maximum of 30 minutes per person to complete, while the interviews took 15 to 20 minutes. The questions in the questionnaire (see Appendix C) were derived from the objectives of the study. The utilisation of questionnaires is well received and suitable in food waste research (Schanes, 2018; Cronjé *et al*., 2018; Quested *et al*., 2020). The different sections of the questionnaire covered demographics, food insecurity, dietary diversification, food waste, storage, and preservation. The questionnaire used nominal (e.g., categorical questions that seek to determine the religion, age, gender, etc.), ordinal (e.g., questions that seek to rank the item by asking how often food waste occurs: daily, once a week, once a month, etc.), and Likert-scale (questions that ask whether a person disagrees or not; e.g., strongly agree, agree, neutral, disagree, and strongly disagree) questions (Gavião *et al*., 2023; Nemoto & Beglar, 2014).

The questionnaire was divided into four sections. Section 1 involved the demographic profile of the participants, such as the size of the household, marital status, and employment status, with which religion they are affiliated, their biological gender, their educational background, and their estimated monthly income.

The second section of the questionnaire addressed food waste. Several aspects of grocery purchasing habits such as making a shopping list, checking cupboards or refrigerators/freezers before buying, storing food, food waste handling/behaviour, groups of food mostly discarded, and amount of food waste daily, weekly, and monthly were addressed.

The third section consisted of dietary diversification information (HDDS), where all foods consumed in the past 24 hours were recorded. Food frequency for seven days was also examined for each household, where all the food groups were presented and the consumers had to indicate which type was consumed and how many portions daily.

The HDDS is calculated by summing up the number of food groups consumed in 24 hours by the household members. The groups of food are divided into 16 different types (cereals, roots and tubers, vitamin A-rich vegetables, dark leafy vegetables, other

vegetables, vitamin A-rich fruits, other fruits, organ meat, flesh meat, eggs, fish and seafood, legumes, nuts and seeds, milk and milk products, oils and fats, sweets, spices, condiments, and beverages), which represent the household score when consumed in the last 24 hours or seven days by the members of the house. The score ranges from 0 to 12, where the highest score indicates high dietary diversity (Nandi *et al*., 2021). The HDDS is defined by consuming different food groups the previous day and the score is interpreted in the following set: 0-3 = low dietary diversity, 3-5 = medium dietary diversity, and 6-12 = high dietary diversity (Walsh *et al*., 2020).

The last section addressed food insecurity in households, where consumers were asked questions such as: “In the past four weeks, did you worry that your household would not have enough food?” The HFIAS questionnaire was used for this section and had nine questions in total. There are four categories of food insecurity status according to the HFIAS guidelines: food secure, mildly food secure, moderately food secure, and severely food insecure. The HFIAS scores range from complete food security (score = 0) to severely insecure (maximum score = 27).

The HFIAS questionnaire is a tool used to measure household food security in the past four weeks or 30 days before data collection. It uses nine predetermined questions that include the experiences of food insecurities in a home. It asks about drastic experiences of food limits at home. If any of the nine questions are answered, the frequency thereof is required; for example: 1) rarely, 2) sometimes, and 3) often (Nandi *et al*., 2021). The HFIAS collects the responses of the past 30 days from each household, where the captured responses result in one of the four HFIAS categories, namely 1) food secure, 2) mildly food insecure, 3) moderately food insecure, and 4) severely food insecure. The respondents were asked to indicate the occurrence (yes or no) and frequency of each question (rarely = once or twice), sometimes (three to 10 times), or often (more than 10 times). The HFIAS score was determined for each household in the rural and urban areas through the addition of the codes for a single-frequency-occurrence question (Ngidi *et al*., 2023). The maximum household score is 27 and the minimum score is 0, which means that the higher the score, the more food insecure the household, and the lower the score, the lower the household food insecurity. (Otekunrin *et al*., 2021). For the four HFIAS

categories, there is a score to each, and it is as follows; Food secure is a score 0-1, Mildly food insecure is 2-7, Moderately food insecure is 8-14, and severely food insecure is 15-27 scores (Bidigare-Curtis, 2021)

The participants were adults 18 years and older, who have some level of household responsibility, such as purchasing food. The questionnaires and the interviews were piloted before the actual data collection to measure the respondents' understanding of the questions and to be aware of factors that might affect the study in the future.

3.4.1.2 Semi-structured interviews

Semi-structured interviews are a qualitative approach to gathering data and are described as an organised conversation guided by new information (Ahlin, 2019). They narrate the stories behind the questions on any given topic (Mahat-Shamir *et al*., 2021) and offer added depth to an existing structured questionnaire by inviting dialogic exchange. The researcher is actively involved in extracting information from the respondents. This dialogic space offers the potential for critical reflection on concepts, ideas, and opinions that may be formed as answers are given (Husband, 2020).

In this study, semi-structured interviews were conducted in the four selected districts, namely Mafeteng, Thaba-Tseka, Leribe, and Qacha's Nek. In each district, four people were interviewed, with a total of 16 participants over 18 years of age. The interview questions covered demographics, food insecurity, food waste, and dietary diversity.

3.4.2 Data-collection process

Data were collected from January to February 2021 in the districts of Mafeteng, Thaba-Tseka, Leribe, and Qacha's Nek. The participants/respondents who took part in the study were 18 years and older. The team of fieldworkers first introduced themselves to the DAOs to make them aware that data collection was about to commence. The DAOs then sent the research team to the chief, who had to sign a form as evidence to the funder that the activity did take place in a particular place, day, and time, and by whom. Three fieldworkers were involved, namely the principal researcher, the DNO, and one research

assistant chosen by the principal researcher as a backup plan in case the district fieldworker was not available for any reason and so that there would always be a person available to assist the principal researcher.

Both the fieldworkers, namely the DNO in each district and the research assistant, were provided with a three-hour training session, where issues of research ethics were discussed concerning the fieldworkers and respondents. Each question in the questionnaire was also discussed to provide the fieldworkers with a common understanding of how to ask the questions and possible answers to expect. The principal researcher was the only one responsible for offering the training and conducting the interviews. Before the actual data collection began, a short introduction to the study, its purpose, and ethical issues that entailed the rights of the respondents and participants were presented and an opportunity to ask questions was provided.

All respondents and participants were provided with a written informed consent form before the study commenced. There was no prior relationship between the researcher and the respondents/participants (Kim *et al*., 2020). All the protocols at the district and village levels were adhered to before the study commenced. This means that permission to enter each district was sought by writing a letter of request to the DAOs, who then notified the chiefs, assigned DNOs, and instructed the Agricultural Technical Officers (ATOs) to make arrangements.

3.4.2.1 Quantitative data collection process

The questions in the questionnaire were written in English and translated to Sesotho, when the fieldworkers were administering the questions and filling in the consumers' answers. This was done to minimise too many hands having to hold the same document as the COVID-19 pandemic was still affecting many at that stage. It was also done for those participants who could not read or write, in which case the interviewer would interpret the questions verbally and assist with filling in the answers.

The data were collected while observing COVID-19 regulations at all times, which were compulsory during the time of data collection. To adhere to the regulations, face masks

were worn before any interview could commence, hand sanitisers were used before each interview session between the interviewer and the interviewee, a distance of two metres was observed between the researcher and the respondent, and the researcher recorded the respondents' responses in order to avoid an exchange of paperwork from one person to the other.

The representatives of households gathered in a communal location on the specified date of data collection, namely a community hall. Three trained fieldwork researchers, including the principal researcher, who were responsible to administer the questionnaires, worked with 10 respondents each day, for four consecutive days in each district. At the end of each daily data collection, the fieldworkers would capture the data in preparation for analysis. Furthermore, the collected data were kept safe and locked in a cabinet immediately after the data collection. The hard copies were destroyed according to University of the Free State (UFS) policy.

3.4.2.2 Qualitative data collection process:

The researcher made use of an audio recording device (dictaphone recorder) to gather data through clear voice recordings. The participants had given their consent before the recording, and they also agreed to participate in the interviews. The participants were also assured that after the interviews, the information would be kept safe and confidential. Each interview session lasted a maximum of 10-15 minutes, and a well-developed interview schedule was used to facilitate this process. The researcher would as the questions audibly, and the participant would respond audibly to the questions, while the answered were recorded into the device.

After the interviews, the researcher took time to familiarise herself with the audio recordings by listening attentively to the participants' answers and transcribing and translating the audio from Sesotho to English. Thereafter the transcription was read repetitively, and summarised and logically arranged by codes and into groups of comparable information for enhanced understanding (Madondo *et al*., 2022).

3.5 DATA ANALYSIS

3.5.1 Questionnaires

The collected data were analysed using the Statistical Package for the Social Sciences (SPSS), and descriptive statistics were calculated. Descriptive statistics deal with the presentation of numeric facts or data in either table or graph form. It collects vast amounts of data and information in a manageable and organised manner. It is a process that can translate results into a distribution of frequencies, percentages, and overall averages (Kaushik & Mathur, 2014).

A bivariate analysis approach was used to determine the correlations among the variables (Shi *et al*., 2023), for example the links that connected variables to food insecurity were determined and household dietary diversity vice versa. When a sample consists of more than one variable, descriptive analysis may be used to describe the relationship between pairs of variables; for example, cross-tabulations and contingency tables, graphical representation through scatter plots, qualitative measures of dependence, and descriptions of conditional distribution (Kaushik & Mathur, 2014). Chi-square tests were also used to test the correlations among the variables. A chi-square test is a statistical test employed to evaluate the categorical dataset and to identify any differences present (Ratul *et al*., 2022). The value of chi-square tests is that statistical methods that do not use the normal distribution to interpret findings can be used. The two functions of chi-square tests are to verify that there is no correlation between two or more groups, populations, or criteria, as well as to test to what extent the observed data distribution fits the expected distribution (Turhan, 2020). The significance level used was established at 5% (0.05) (Rathi *et al*., 2023), which means that only where the p-value is less than 0.05 are the results significant (Greenland, 2023). The comparison test among variables was done through Fisher's exact test (Cheng & He, 2023).

3.5.2 Semi-structured interviews

The audio recordings from the interviews were transcribed verbatim by the researcher, which refers to the word-for-word reproduction of verbal data, and the interviewees were

given pseudonyms (A to P). The written words were an exact replication of the interviewees' words (McGrath *et al*., 2019), and thematic analysis was used to reveal patterns of behaviour and perceptions in the data (Lochmiller, 2021).

3.6 RELIABILITY AND VALIDITY

Reliability refers to the repeatability of a research tool when testing or evaluating something and producing the same results after a repeat. It should be the leading element in a discussion about validity. If reliability is less than 100%, the degree of any statements about validity should be minimised (Patronek *et al*., 2019). Reliability not only focuses on the measuring tool but also the results produced by the tool (Sürücü & Maslakçi, 2020). Reliability in this study was ensured by utilising the same tools (questionnaire and interview) with different respondents/participants (Walsh *et al*., 2020).

Internal consistency shows the depth of gathered data and it is usually measured by Cronbach's alpha. Cronbach's alpha is normally utilised to measure the internal consistency coefficient of questionnaires and linkages between variables (Chenene, 2020). It is measured from 0 to 1, with perfect reliability equalling 1 and no reliability equalling 0. Alpha numbers above 0.7 are said to be acceptable and good, above 0.8 are very good, above 0.9 indicate exceptional internal consistency, and 0.95 and above indicate very high results (Schrepp, 2020).

The reliability of this study's questionnaire was ensured by conducting a pilot test. The measuring tool was administered to 10 experts in the field of consumer science and given to non-expert consumers. They all completed the questionnaire without any help. The pilot test discovered that questions were understood and answered without any difficulty.

Validity is making certain that the study achieves what the researcher anticipated it to achieve (Senekane *et al*., 2021). Validity in this study was ensured by making use of studied and tested literature (Wash *et al*., 2020). Construct validity ensures that the method of measurement matches what needs to be measured, and to achieve this, the questions in the questionnaire were relevant to measure the indicators. Face validity

means the depth to which the respondents perceive the content of the test as matching the context in which the test is given (Yusoff, 2019).

3.7 ETHICAL CONSIDERATIONS

Ethical issues need to be adhered to before and after any form of research is conducted, which include permissions, informed consent, anonymity, confidentiality, risks of the study, benefits analysis, data management, and the dissemination of results (Chenene, 2020). Ethical approval (see Appendix A) was obtained from the UFS (UFS-HSD2021/0710/21). The participants in the research were given comprehensive information about the study. They were requested to consent to participate in the study through informed consent forms, which they signed willingly, and they were not promised any incentive for their participation.

The participants were informed of the procedure of their selection. They were also given a chance to inquire about anything unclear to them concerning their participation in the study. They were assured that they had the right to withdraw at any time from the study without any repercussions. Later, as they were presented with the questionnaire, they were again reminded that they volunteered willingly to be part of the research, but could still withdraw from the study for any reason whatsoever. Before the study commenced, the research assistants were given detailed training on the UFS's research ethics policy, including how to conduct themselves as a researcher and how to handle the participants in an ethical manner.

The participants' names were not included in the questionnaire so that no participant could be linked to their response, as a way of protecting their anonymity and confidentiality. They were also not forced to answer any questions that they were not comfortable answering. The completed questionnaires were gathered by the researcher and put in a box for later use and moved to a safe place where access was given to the principal researcher only in order to ensure confidentiality. The data were also captured onto a laptop to which only the principal researcher had access through a private password. Later, when all the data had been captured, the hard copies of the questionnaires were destroyed.

3.8 LIMITATIONS OF THE STUDY

Social desirability was a limiting factor as some participants gave answers to please the fieldworkers. In addition, the desired sample size could not be achieved due to shortage of financial resource.

3.9 CONCLUSION

This chapter provided a summary of the research methodology utilised to conduct the research. The next chapter focuses on the results captured from the research and deliberates on the discoveries in detail.

CHAPTER 4:
RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

This chapter introduces the results of the data analysis regarding five aspects: demographics, food insecurity, food waste, dietary diversity, and preservation practices. The study's main aim was to explore and highlight facts about food insecurity, food waste, and dietary diversity in the rural and urban areas of Lesotho.

4.2 SOCIO-DEMOGRAPHIC PROFILE

This section discusses the socio-demographic attributes of the research participants who reside in the rural (Qacha's Nek and Thaba-Tseka) and urban (Leribe and Mafeteng) areas of Lesotho (see Table 4.1). Just over half (57.3% rural; 51.8% urban) of the participants were household heads. Approximately one-third (34.1% rural; 33.6% urban) were the spouses of the household heads. Regarding marital status, 60.1% (rural) and 55% (urban) of the participants were married, while 35.3% (rural) and 37.1% (urban) were single. Participants who were separated (6.4% urban; 4.1% rural) or divorced (0.5% rural and urban) constituted the minority of the sample.

Table 4.1 shows that female participants represented 76.6% (urban) and 71.7% (rural) of the sample, while male consumers comprised 28.3% (rural) and 23.4% (urban). The percentage of households composed of four members was 29.5% (urban) and 18.7% (urban). Five-member households represented 19.2% from both the rural and urban areas respectively. Six-member households comprised 13.7% (rural) and 4.1% (urban). Households with three members represented 6.4% (rural) and 18.2% (urban), and households with only one member comprised 6.4% (rural) and 5.0% (urban) of the sample. Two-member households comprised 10.5% (urban) and 9.6% (urban) (see Table 4.1).

Table 4.1: Socio-demographic profile of the participants

Relationship with the head/breadwinner of the household		Rural	Urban
Spouse	N	75	74
	%	34.1	33.6
Son/daughter	N	9	12
	%	4.1	5.5
Grandchild	N	0	3
	%	0	1.4
Parent of head	N	8	3
	%	3.6	1.4
Sister/brother	N	2	10
	%	0.9	4.5
Servant	N	0	2
	%	0	0.9
Household head	N	126	114
	%	57.3	51.8
Marital status		**Rural**	**Urban**
Single	N	77	83
	%	35.3	37.1
Married	N	131	120
	%	60.1	55.0
Divorced	N	1	1
	%	0.5	0.5
Separated	N	9	14
	%	4.1	6.4
Gender		**Rural**	**Urban**
Female	N	157	167
	%	71.7	76.6
Male	N	62	51
	%	28.3	23.4
Number of people living in the household		**Rural**	**Urban**
One	N	14	11
	%	6.4	5.0
Two	N	21	23
	%	9.6	10.5
Three	N	29	40
	%	13.2	18.2
Four	N	41	65
	%	18.7	29.5
Five	N	42	42
	%	19.2	19.2
Six	N	30	9
	%	13.7	4.1
Seven or more	N	42	30
	%	19.2	13.6

*LSL1 000.00 = ZAR1 000.00

Approximately a quarter (25.7%) of the rural households had no income, while 14.6% of the urban households were in the same position. Households earning less than LSL1 000 represented 60.6% of the rural areas and 50.7% of the urban areas. Approximately one in every 10 (10.6%) rural households had an income from LSL1 001 to LSL4 000, which increased to 28.3% in the urban areas. A combined monthly income of LSL4 001 to LSL9 000 was reported as under 10% for both the rural (2.3%) and urban (5.0%) areas. Less than 1% of the households from both the rural (0.9%) and urban (0.5%) areas received an income of LSL9 001 to LSL15 000. A combined household income ranging from LSL15 001 to LSL20 000 represented 0.9% of the sample in the urban areas, while no households in the rural areas had an income higher than LSL15 001 (see Table 4.1).

Christianity constituted the religion of the vast majority of rural (99.5%) and urban (98.6%) participants. Hinduism was represented only in the urban areas (0.5%). Other religions constituted 0.5% of the rural and 0.9% of the urban areas (see Table 4.1).

Approximately 11.5% (rural) and 5.1% (urban) of the participants who purchased food at the household level did not go to school at all. Participants who attended only primary school represented 52.8% (rural) and 47.0% (urban) of the sample. Participants who went to secondary school represented 22.9% (rural) and 29.5% (urban) of the sample. Of the participants, 7.3% (rural) and 12.0% (urban) achieved a Grade 12 or equivalent qualification, while 4.1% of the participants from both the rural and the urban areas achieved a post-school certificate or diploma. In comparison, 1.4% (rural) and 2.3% (urban) of the respondents had obtained a bachelor's or honours degree (see Table 4.1).

The employment status of the household head was as follows: employed part-time: 10.0% (rural) and 6.4% (urban); employed full-time: 10.0% (rural) and 19.6% (urban); self-employed: 19.1% (rural) and 28.3% (urban); unemployed: 46.4% (rural) and 37.0% (urban); and retired/pensioners: 14.5% (rural) and 8.7% (urban) (see Table 4.1).

The employment status of a person purchasing food other than the household head who was employed part-time was 8.3% (urban) and 0.0% (rural). The employment status of a person responsible for purchasing food other than the household head as employed full-time represented 8.3% (rural) and 20.8% (urban), while self-employment represented

8.3% (rural) and 8.3% (urban). The majority of persons responsible for purchasing food other than the household head from the rural (83.3%) and urban (62.5%) areas were unemployed. None of the participants in the sample from either the rural or urban areas were retired or on pension (see Table 4.1).

Animal dung as one of the energy sources was used for cooking by 4.6% (rural) and 12.7% (urban) of the households. Less than 10% (2.8% rural; 8.2% urban) of the households used electricity as their main source of cooking. LPG was used by 20.7% (rural) and 21.4% (urban) of the households. Liquid paraffin was used by 8.8% (rural) and 16.8% (urban) of the households. Twenty-nine percent (29.0%) of the rural and 16.8% of the urban households used an open fire for cooking. The use of firewood constituted 34.1% (rural) and 24.1% (urban) (see Table 4.1).

4.3 THE EXTENT OF FOOD INSECURITY AMONG THE HOUSEHOLDS

Table 4.2 presents the results of HFIAS occurrence and frequency descriptive for both the rural and urban areas. The HFIAS concept consists of a 30-day period prior to data collection and contains two sets of questions: nine occurrences and nine frequency-of-occurrence questions. The respondents were asked a question and given an option (yes or no). If the answer was yes, the frequency (i.e., rarely, sometimes, or often) also had to be stated. The response was then changed into a continuous or categorical indicator of food security from 0 to 3, where 3 was the highest frequency of occurrence. The total HFIAS score ranges from 0 to 27, where 0 to 1 is food secure, 2 to 7 is mildly food insecure, 8 to 14 is moderately food insecure, and 15 to 27 is severely food insecure (Bidigare-Curtis, 2021; Devereux & Tavener-Smith, 2019; International Dietary Data Expansion Project, 2018).

Table 4.2 delineates the nine HFIAS questions directed at the participants. To the occurrence questions, 71.8% (rural) and 61.4% (urban) of the household members indicated that they were worried about not having enough food, with a significant difference between the rural and the urban areas ($p = 0.055$). In answering the second question, 82.7% (rural) and 80.5% (urban) of the participants indicated that they were not able to eat their preferred types of food due to lack, with an insignificant difference

between the rural and urban areas (p = 0.110). Furthermore, 86.7% (rural) and 81.7% (urban) of the participants reported household members who ate a limited variety of food due to lack of resources, with no significant difference (p = 0.439). The participants had to indicate whether any member of the household had to eat foods that they did not like because of a lack of resources, and the results were 75.5% (rural) and 76.3% (urban), which rendered an insignificant difference between the rural and urban areas (p = 0.096).

Table 4.2: Household Food Insecurity Access Scale (HFIAS)

Question	Response		Rural	Urban
1. In the past four weeks, did you worry that your household would not have enough food?	Yes	%	71.8	61.4
		N	158	135
	No	%	28	38.6
		N	62	85
	How often does this happen?			
	Rarely	%	26.4	27.4
		N	42	37
	Sometimes	%	18.2	12.6
		N	29	17
	Often	%	55.3	60.0
		N	88	81
2. In the past four weeks, were you or other members not able to eat the kinds of food you preferred because of a lack of resources?	Yes	%	82.7	80.5
		N	182	177
	No	%	17.3	19.5
		N	38	43
	How often does this happen?			
	Rarely	%	19.2	25.4
		N	35	45
	Sometimes	%	22.0	18.1
		N	40	32
	Often	%	58.8	56.5
		N	107	100
	Rarely	%	19.2	25.4
		N	35	45
3. In the past four weeks, did you or other members have to eat a limited variety of food (fewer kinds of food on a plate) due to a lack of resources?	Yes	%	86.7	81.7
		N	189	179
	No	%	13.3	18.3
		N	29	40
	How often does this happen?			
	Rarely	%	13.8	25.8
		N	26	46
	Sometimes	%	17.5	19.1
		N	33	34
	Often	%	68.8	55.1
		N	130	98
	Yes	%	75.5	76.3

Question	Response		Rural	Urban
4. In the past four weeks, did you or other members have to eat food that you really did not like to eat because of lack of resources to obtain other types of food?		N	166	167
	No	%	24.5	23.7
		N	54	52
	How often does this happen?			
	Rarely	%	24.8	26.3
		N	41	44
	Sometimes	%	14.5	21.6
		N	24	36
	Often	%	60.6	52.1
		N	100	87
5. In the past four weeks, did you or other members have to eat a smaller meal than you felt you needed because there was not enough food?	Yes	%	73.2	65.5
		N	161	144
	No	%	24.5	23.7
		N	54	52
	How often does this happen?			
	Rarely	%	25.5	35.4
		N	41	51
	Sometimes	%	26.7	20.1
		N	43	29
	Often	%	47.8	44.4
		N	77	64
6. In the past four weeks, did you or other members have to eat fewer meals per day because the food was not enough?	Yes	%	65.0	64.4
		N	143	141
	No	%	26.8	34.5
		N	59	76
	How often does this happen?			
	Rarely	%	29.4	29.6
		N	42	42
	Sometimes	%	25.9	25.4
		N	37	36
	Often	%	44.8	45.1
		N	64	64
7. In the past four weeks, was there ever not any kind of food to eat in your household because of a lack of resources to get food?	Yes	%	47.7	35.0
		N	105	77
	No	%	35.0	35.6
		N	77	78
	How often does this happen?			
	Rarely	%	32.7	36.4
		N	34	28
	Sometimes	%	31.7	20.8
		N	33	16
	Often	%	35.6	42.9
		N	37	33
8. In the past four weeks, did you or other members go to	Yes	%	34.5	30.0
		N	76	66

Question	Response		Rural	Urban
sleep at night hungry because there was not enough food?	No	%	52.3	65.0
		N	115	143
	How often does this happen?			
	Rarely	%	50.0	47.0
		N	38	31
	Sometimes	%	25.0	21.2
		N	19	14
	Often	%	25.0	9.5
		N	19	21
9. In the past four weeks, did you or other members go the whole day without eating anything because there was not enough food?	Yes	%	28.6	26.4
		N	63	58
	No	%	65.5	70.0
		N	144	154
	How often does this happen?			
	Rarely	%	42.9	34.5
		N	27	20
	Sometimes	%	33.3	27.6
		N	21	16
	Often	%	23.8	37.9
		N	15	22

In response to Question 5, 73.2% (rural) and 65.5% (urban) of the participants indicated that they had to eat smaller portions because the food was not enough, with no significant difference between the rural and urban areas ($p = 0.918$). In response to Question 6, 65.0% (rural) and 64.4% (urban) of the participants had to eat fewer meals because the food was insufficient, with a statistically insignificant difference ($p = 0.232$) between the rural and urban areas. Furthermore, 47.7% (rural) and 35.0% (urban) of the participants had experienced not having any food at all, with no significant difference ($p = 0.846$). In response to Question 8, 34.5% (rural) and 30.0% (urban) of the participants had gone to sleep hungry, with a significant difference between rural and urban areas ($p = 0.001$). Finally, 28.6% (rural) and 26.4% (urban) of the participants had gone the whole day without food due to the food not being enough, with a statistically significant difference ($p<0.0001$).

4.3.1 The categories of the HFIAS

The HFIAS is a tool used to evaluate challenges in households concerning access to food for the past 30 days per household. The tool captures four HFIAS categories, namely (1) food secure, (2) mildly food insecure, (3) moderately food insecure, and (4) severely food insecure. Respondents who answered “Yes” to the occurrence questions mentioned previously also had to indicate the frequency of each question: rarely (once or twice), sometimes (three to 10 times), or often (more than 10 times).

The HFIAS mean for the rural area was 13.5, with a standard deviation of 8.236, and the mean for the urban areas was 10.7, with a standard deviation of 7.3. Furthermore, when testing the difference between the rural and urban areas on the HFIAS, there was a significant difference of p = 0.0003. Similar findings in Kenya stipulated that food security issues are really of concern especially in the rural area where level of education is low, with low incomes, and pure access to natural resource such as water; four pillars of food security are not properly addressed (Rono *et al*., 2023). In SSA countries like Uganda food security is still a challenge where food is very limited and others go for days without food and this calls about 70% households living through coping mechanisms of reducing a number of meals eaten per week in the urban areas (Mackay *et al*., 2023).

Table 4.3: Categories of the HFIAS in the rural and urban areas

HFIAS categories		Rural	Urban
Food secure	N	24	19
	%	10.9	8.6
Mildly food insecure	N	11	13
	%	5	5.9
Moderately food insecure	N	45	73
	%	20.5	33.2
Severely food insecure	N	140	115
	%	63.6	52.3

Table 4.3 indicates the results of the different HFIAS categories for both the rural and urban areas. In the rural areas, 10.9% of the participants were food secure, while 5.0% of the participants in the rural areas were mildly food insecure and 20.5% were moderately food insecure. However, 63.6% of the participants in the rural areas were severely food

insecure. Table 4.3 indicates that 8.6% of the participants in the urban areas were food secure, 5.9% were mildly food insecure, and 33.2% were moderately food insecure. However, 52.3% of the participants in the urban areas were severely food insecure. Sub-Saharan Africa is still experiencing food insecurity at some level, which is consistent with these findings. In a study conducted in Ethiopia, 13.3% of the respondents were found to be food secure, 20% were mildly food insecure, 50% were moderately food insecure, and 16.7% were severely food insecure (Andarge, 2022).

4.3.2 Correlation / variables that contribute to food insecurity

Being a female household head significantly increased the probability of a household being food insecure (p = 0.001), which confirms previously reported significant gender differences in food insecurity (Broussard, 2019). In Cameroon and Ghana, gender equality is perceived to contribute to improving food security, where women should be freely allowed to be fully involved in food production if the target is to reach zero hunger (Fonjong & Gyapong, 2021).

Table 4.4 Correlation/ variables that contribute to food insecurity

Correlation of variables	P-Value
Being a female household head	P = 0.001*
Being unemployed	P = 0.004*
Employed part-time	P = 0.033*
Using electricity for cooking	P = 0.002*
Using LPG for cooking	P = 0.001*
Using open fire for cooking	P = 0.044*

*Statistically significant as p<0.05

Being unemployed or employed part-time significantly increases household food insecurity (p = 0.004 and 0.033 respectively), which indicates a significant difference in the employment status of a household head concerning the HFIAS. Unemployment negatively impacts households' access to food and, as a result, affects food security (Wegenast & Beck, 2020; Dzanku, 2019). Using electricity or LPG for cooking significantly reduces food insecurity in households (p = 0.002 and 0.001 respectively). It was shown in Table 4.1 that electricity (2.8% rural; 8.2% urban) and the severity of food insecurity

are a bit higher in the rural than in the urban areas, as discussed in the previous paragraphs. The use of LPG has been indicated to reduce household food insecurity, and changing from LPG to other forms of fuel lowers food consumption, yet it is also considered not well matched with other household situations (Shupler *et al*., 2021).

Using an open fire for cooking significantly increases food insecurity ($p = 0.044$). The demographic data indicated that 29.0% (rural) and 16.8% (urban) of the participants used an open fire for cooking. Cooking on an open fire increases the score of food insecurity because it takes longer to prepare food using an open fire than other forms of fuel; the reason being that one of the resources needed for open fire is wood. Gathering wood can take an hour or more, which can make cooking a discouraging task. Cooking on an open fire is also regarded as a threat to the environment as it contaminates the air (Shupler *et al*., 2021).

4.4 DETERMINING THE LEVEL OF FOOD WASTE IN RURAL AND URBAN HOUSEHOLDS IN LESOTHO

4.4.1 Estimation of household food waste

Conversions were necessary to quantify the estimated food waste (in litres [l]) to mass (in kilograms [kg]). A standardised online conversion table was used, which utilised a conversion factor of 0.425 (see Table 4.5). The factor was multiplied by the number of litres to calculate the equivalent mass in kilograms using Green Industries SA's (2018) volume to weight calculator.

Table 4.5: Conversions for household food waste

Quantity	Conversion factor	Equivalent mass
1 l	0.425	0.43 kg
2.5 l	0.425	1.06 kg
5 l	0.425	2.13 kg
10 l	0.425	4.25 kg
15 l	0.425	6.38 kg

Source: Green Industries SA (2018)

When consumers were asked to give estimations of wasted food, it was seen that only 15 households from the rural areas and 38 households from the urban areas never had

food waste (see Table 4.4). It was unexpected as all families would produce some amount of unavoidable food waste of different types such as eggshells, bones, and others.

Table 4.5 is linked to Table 4.6, which presents a detailed summary of food waste discarding behaviour per category. Table 4.5 calculates estimations of household food waste to approximate weekly, monthly, and yearly household food waste. A 10-l bucket was used to measure different quantities, which represented a small amount (2.5 l), a reasonable amount (5 l), a great amount (10 l), and an excessive amount (15 l).

Table 4.6: Estimations of food waste per timeframe

2.5 l waste = 1.06 kg*N (rural & urban)	**Rural**	**Urban**
A little (quarter of 10-l bucket)		
Per week	98.6	64.7
TOTAL	**163.3**	
Per month	98.6*4 = 394.4	258.8
TOTAL	**653.2**	
Per year	394*12 = 4 732.8	3 105.6
TOTAL	**7 838.4**	
5 l waste = 2.13 kg*N	**Rural**	**Urban**
A reasonable amount (half of 10-l bucket)		
Per week	80.9	51.1
TOTAL	**132**	
Per month	323.6	204.4
TOTAL	**528**	
Per year	3 883.2	2 452.8
TOTAL	**6 336**	
10 l waste = 4.25 kg*N	**Rural**	**Urban**
A great amount (more than half of 10-litre bucket)		
Per week	46.8	21.3
TOTAL	**68.1**	
Per month	187.2	85.2
TOTAL	**272.4**	
Per year	2 246.4	1 022.4
TOTAL	**3 268.8**	
15 l waste = 6.38 kg*N	**Rural**	**Urban**
Excessive amount (more than a 10-l bucket)		
Per week	44.6	19.1
TOTAL	**63.7**	
Per month	178.4	76.4
TOTAL	**254.8**	
Per year	2 140.8	916
TOTAL	**3 056.8**	
TOTAL YEARLY WASTE	**13 003.2**	**7 496.8**

TOTAL	**20 500**	
TOTAL TONS	**14.3**	**8.26**
TOTAL	**22.6**	

Table 4.6 shows that the estimated food waste per week was 190.9 kg (rural) and 156.2 kg (urban). Estimations of monthly food waste were 1 083.6 kg (rural) and 624.8 kg (urban), which total 1 708.4 kg of monthly waste. The yearly estimated food waste was 13 003.2 kg (rural) and 7 496.8 kg (urban), which together total 20 500 kg or 22.6 tons of waste.

The total weight for weekly estimations for a small amount (2.5 l) was 163 kg (rural and urban), monthly estimations were 653.2 kg (rural and urban), and yearly estimations were 7 838.4 kg (rural and urban). The total weight for a reasonable amount (5 l) of waste estimated weekly was 132 kg (rural and urban), monthly estimations were 528 kg (rural and urban), and yearly estimates were 6 336 kg (rural and urban). The total estimations of food waste for a great amount (10 l) per week were 68.1 kg (rural and urban), monthly estimations were 272.4 kg (rural and urban), and yearly estimations were 3 268.8 kg (rural and urban). The estimated total weight of wasted food for an excessive amount (15 l) per week was 63.7 kg (rural and urban), the monthly estimate was 254.8 kg (rural and urban), and the yearly estimate was 3 056.8 kg (rural and urban). In South Africa, the estimated household food waste per week is 6 kg, which, when converted, is between 8 kg and 12 kg of food waste per capita per annum, resulting in between 25 198 and 51 462 tons of food waste per year. The total cost of food waste amounts to ZAR21.7 billion per year (Oelofse *et al*., 2018). In Kenya, the estimated household food waste ranges from 250 g to 2 kg per week, which, when converted to annual food waste, costs between KES2 100 and KES5 000 (or US$50) (Huho *et al*., 2020).

In Singapore, food waste is estimated at around 0.80 million tons annually, which is far less than the waste estimated in previous findings (Grandhi & Singh, 2016).

In Table 4.7, food waste estimates in households were calculated using 10-l buckets as a point of reference for the participants. It was divided into four sections: 2.5 l (a small amount), 5 l (a reasonable amount),10 l (a great amount), and 15 l (an excessive

amount). The waste estimation was done by concentrating on different times, namely daily, once a week, twice a week, once in two weeks, and once a month.

Table 4.7: Estimations of household food waste

Amount	Area		Daily	Once a week	Twice a week	Once in two weeks	Once a month
A little (quarter of a 10-l bucket)	Rural	N	4	93	5	3	18
		kg	4.2	98.6	5.3	3.2	19.08
	Urban	N	3	61	6	14	35
		kg	3.2	64.7	6.4	14.8	37.1
A reasonable amount (half of a 10-l bucket)	Rural	N	0	38	4	3	7
		kg	0	80.9	8.5	6.4	14.9
	Urban	N	1	24	5	5	9
		kg	2.13	51.1	10.7	10.7	19.2
A great amount (more than half of a 10-l bucket)	Rural	N	0	11	0	0	0
		kg	0	46.8	0	0	0
	Urban	N	0	5	0	1	8
		kg	0	21.3	0	4.3	34
Excessive amount (more than a 10-l bucket)	Rural	N	0	7	0	1	1
		kg	0	44.6	0	6.4	6.4
	Urban	N	1	3	1	0	5
		kg	6.4	19.1	6.4	0	31.9

The conversion factor was multiplied by the number of litres to obtain the equivalent mass in kilograms, then the mass was multiplied by the number of households to obtain the weight of wasted food.

In Table 4.7, estimations of a small amount of waste collected in rural areas were 4.2 kg (daily), 98.6 kg (once a week), 5.3 kg (twice a week), 3.2 kg (once in two weeks), and 19.08 kg (once a month). Estimations of a small amount of wasted food in urban areas were 3.2 kg (daily), 64.7 kg (once a week), 6.4 kg (twice a week), 14.8 kg (once in two weeks), and 37.1 kg (once a month). Estimations of a reasonable amount of food waste in the rural areas were 0 kg (daily), 80.9 kg (once a week), 8.5 kg (twice a week), 6.4 kg (once in two weeks), and 14.9 kg (once a month). In the urban areas, estimations of food waste were 2.13 kg (daily), 51.1 kg (once a week), 10.7 kg (twice a week), 10.7 kg (once in two weeks), and 19.2 kg (once a month).

Table 4.7indicates that the estimated food waste of a great amount in the rural areas was 0 kg (daily), 46.8 kg (once a week), 0 kg (twice a week), 0 kg (once in two weeks), and 0 kg (once a month). However, estimations of food waste in the urban areas were 0 kg (daily), 21.3 kg (once a week), 0 kg (twice a week), 4.3 kg (once in two weeks), and 34 kg (once a month). It was also estimated that the excessive amount of food waste in rural areas was 0 kg (daily), 44.6 kg (once a week), 0 kg (twice a week), 6.4 kg (once in two weeks), and 6.4 kg (once a month). The estimated excessive amount of food waste in the urban areas was 6.4 kg (daily), 19.1 kg (once a week), 6.4 kg (twice a week), 0 kg (once in two weeks), and 31.9 kg (once a month).

4.4.2 Disposal mechanisms for food waste

Table 4.8 shows that most (96.4% rural; 85.8% urban) of the participants indicated that they never made a compost heap, with a significant difference of $p = 0.006$ between the rural and urban areas. Those who rarely made compost heaps represented 0.9% (rural) and 4.1% (urban) of the sample, while 0.5% (rural) and 1.8% (urban) of the participants sometimes made compost heaps. Consumers who often or always made compost heaps represented 2.3% (rural) and 8.2% (urban) of the sample. Composting is a managed practice of decay and conversion of biological waste through the effect of varied aerobic bacterial inhabitants (Atif *et al*., 2020). In the past, the rural areas of Lesotho had only biodegradable solid waste that was traditionally well managed by employing methods such as composting and manuring. Compared to urban areas, rural areas cannot manage solid waste appropriately because of lack of experts, financial support, and technological capacity (Senekane *et al*., 2021).

The majority (83.2% rural; 83.2% urban) of the participants indicated that they never discarded food waste in the garbage bin and 5.5% (rural) and 7.3% (urban) rarely discarded waste in the garbage bin. Participants who sometimes discarded food waste in the bin represented 2.3% (rural) and 4.1% (urban) of the sample. Participants who often or always discarded waste in the bin represented 9.1% (rural) and 5.4% (urban), with a significant difference between rural and urban areas ($p<0.0001$). Rural areas face

difficulties such as a lack of waste collection and sanitation services, which emphasises a void in solid waste management (Senekane *et al*., 2021; Motaung, 2020).

Table 4.8: Strategies to manage household food waste

Strategy	Area		Always	Often	Sometimes	Rarely	Never
Compost heap	Rural	N	0	5	0	2	212
		%	0	2.3	0.5	0.9	96.4
	Urban	N	9	9	4	9	188
		%	4.1	4.1	1.8	4.1	85.8
Discard it in the garbage bin	Rural	N	9	11	5	12	183
		%	4.1	5.0	2.3	5.5	83.2
	Urban	N	6	6	9	16	183
		%	2.7	2.7	4.1	7.3	83.2
Give it to the animals	Rural	N	68	54	19	32	47
		%	30.9	24.5	8.6	14.5	21.4
	Urban	N	67	48	28	25	52
		%	30.5	21.8	12.7	11.4	23.6
Composting bin	Rural	N	1	2	0	0	217
		%	0.5	0.9	0	0	98.6
	Urban	N	1	3	1	4	210
		%	0.5	1.4	0.5	1.8	95.9
Bury it	Rural	N	0	1	0	1	218
		%	0	0.5	0	0.5	99.1
	Urban	N	2	1	7	8	201
		%	0.9	0.5	3.2	3.7	91.8
Worm farm	Rural	N	0	0	0	0	220
		%	0	0	0	0	100
	Urban	N	0	1	0	2	217
		%	0	0.5	0	0.9	98.9

Participants who always or often gave food waste to animals represented 55.4% (rural) and 52.3% (urban), and this is important as it seems to be how most consumers dispose of their food waste (Chenene, 2020). Some (8.6% rural; 12.7% urban) participants sometimes gave food waste to animals, while 14.5% (rural) and 11.4% (urban) of the participants rarely gave it to animals (see Table 4.8). Some participants 21.4% (rural) and 23.6% (urban) never gave food waste to animals. Inedible wasted food contains remains such as bones, peels, and pips. Most consumers discard food when it no longer smells fresh, as well as food left on plates (Chenene, 2020). Feeding animals wasted food has become common practice in households (Girotto & Cossu, 2019); foods that are unacceptable for human consumption can thus be utilised as animal feed, provided that

they do not cause any health risks. Recycling (i.e., composting) fruits, vegetables, and cereal grains as animal feed is largely advised (Moult *et al*., 2018). Feeding animals wasted food can be a mechanism of food waste recycling in that where food remains cannot be recooked or reused, they can be utilised as animal feed (Bunditsakulchai & Liu, 2021).

According to Table 4.8, the majority (98.6% rural; 95.9% urban) of the participants never used compost bins. In both the rural and urban areas, 0.5% of the participants always made use of composting bins, while 0.9% (rural) and 1.4% (urban) often used composting bins. No (0.0%) rural participants sometimes or rarely made use of composting bins, while 2.3% of the urban participants did. Composting is the aerobic-microbial process of breaking down organic matter into products such as fertilisers or manure (Mahapatra *et al*., 2022). Composting at home is easy to carry out using a bin, and it can be done in the backyard or on the balcony of a home. It reduces the organic fraction of solid waste and also helps with the growth of plants through nourishment of the soil (Mahapatra *et al*., 2022; Geethamani *et al*., 2021; Hashim *et al*., 2021).

Almost all rural participants (99.1%) never buried food waste, compared to 91.8% of the urban sample (see Table 4.7). In comparison, no (0.0%) participants always buried their food waste in rural areas, but 0.5% of the urban participants always buried food waste. Participants who often buried food waste in both the rural and urban areas represented 0.5% of the sample, while 3.2% of the urban participants sometimes buried food waste. Few participants (rural 0.5%; urban 3.7%) rarely buried food waste, with no significant difference ($p = 0.026$) between the rural and urban areas. Some consumers in rural areas of Lesotho use old waste management methods such as burying or burning it. These customs may discharge harmful pollutants into the environment, which adversely affect health and the environment (Senekane *et al*., 2021; Motaung, 2020). When buried in a landfill, food waste decomposes to form methane, which is a greenhouse gas that contributes to global warming (Beheshti *et al*., 2022; Rattanapan *et al*., 2019).

Worm farms were not common among the rural participants, as 100% never used worm farms. A few urban consumers (0.5%) often used them, and 0.9% rarely used worm farms. The vast majority of the urban participants (98.9%) never used any worm farm

(see Table 4.7). Worm composting is the use of worms to reprocess food and other biological surplus to create nutrient-rich produce called vermicast that is used as a soil activator, which has a beneficial impact on soil ventilation, water-holding capabilities, and nutrient resources (Namulisa *et al*., 2022).

4.5 IDENTIFICATION OF POSSIBLE PRACTICES THAT LEAD TO FOOD WASTE

The results in Table 4.9 reveal that 55.9% (rural) and 66.4% (urban) of the participants who strongly agreed or agreed that they wasted food did so because they liked to eat fresh food. This is a significant predictor of food waste ($p = 0.006$), which indicates that there is a significant difference in the preference of fresh food between the rural and the urban areas. In contrast, 40.4% (rural) and 32.2% (urban) of the participants strongly disagreed or disagreed that they discarded food because they preferred fresh food. Some interviewees testified to this by indicating that they still consumed food even if it was not fresh anymore. Participant H said: *"We neutralise that by heating the food before consumption with the belief that we are destroying harmful bacteria*." The conclusion is that more participants from both the rural and urban areas preferred eating fresh food. Some participants (3.6% rural; 1.4% urban) were neutral about this. Participants F and O stated that they did not like repeatedly eating the same leftovers because it was boring, but they continued to eat it because they did not have a choice. One of the reasons for food waste is because it is no longer fresh (Phooi *et al*., 2022).

Table 4.9: Food waste practices

Reason	Area		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
We like to eat fresh food.	Rural	N	4	85	8	64	59
		%	1.8	38.6	3.6	29.1	26.8
	Urban	N	12	58	3	34	110
		%	5.5	26.7	1.4	15.7	50.7
We are too busy to cook planned meals.	Rural	N	1	94	21	104	0
		%	0.5	42.7	9.5	47.3	0
	Urban	N	1	89	17	94	9
		%	5.0	0.5	7.7	42.7	4.1
We do not know how to store food properly.	Rural	N	9	75	11	103	21
		%	4.1	34.2	5.0	47.0	9.6
	Urban	N	44	79	15	69	13
		%	20.0	35.9	6.8	31.4	5.9

Food is left too long in the fridge/freezer.	Rural	N	88	111	2	18	1
		%	40.0	50.5	0.9	8.2	0.5
	Urban	N	78	105	11	22	3
		%	35.6	47.9	5.0	10.0	1.4
We cook too much food.	Rural	N	17	97	4	99	2
		%	7.8	44.3	1.8	45.2	0.9
	Urban	N	61	81	8	67	3
		%	27.7	36.8	3.6	30.5	1.4
We buy too much food.	Rural	N	56	132	3	28	1
		%	25.5	60.0	1.4	12.7	0.5
	Urban	N	80	114	5	21	0
		%	36.4	51.8	2.3	9.5	0
We do not check cupboards or the fridge/freezer before shopping.	Rural	N	40	130	2	34	14
		%	18.2	59.1	0.9	15.5	6.4
	Urban	N	54	110	6	34	16
		%	24.5	50.0	2.7	15.5	7.3
Some house members do not always finish their food.	Rural	N	7	72	6	129	6
		%	3.2	32.7	2.7	58.6	2.7
	Urban	N	26	45	15	130	4
		%	11.8	20.5	6.8	59.1	1.8

The participants were also asked to what extent they agreed to discarding food because they were too busy to cook planned meals. Less than half (47.3% rural; 46.8% urban) of the participants strongly agreed or agreed that they discarded food because they were too busy to cook planned meals. This is a significant predictor of food waste ($p<0.0002$). Participant E confirmed this during an interview by stating: *"We normally do not plan meals because we have limited food, therefore we only cook what is available at the time."* Conversely, 43.2% (rural) and 5.5% (urban) of the participants strongly disagreed or disagreed with wasting food because of being too busy to cook planned meals. Some participants were neutral (9.5% rural; 7.7% urban) because they were not sure whether being too busy to cook planned meals was their reason for wasting food or not. A demanding lifestyle may create challenges to make proper plans for provisioning, meals, and food stock (Hebrok & Boks, 2017).

Table 4.9 shows that 56.6% of the rural and 37.3% of the urban participants strongly agreed or agreed that they did not know how to store food properly, which was revealed as a significant predictor of food waste ($p = 0.001$). Participants C and H confirmed this in the interviews by saying that they had not been taught how to store food so they did

not know how. This shows a disparity concerning food storage between the rural and urban participants in that the urban participants were more knowledgeable. Five percent (rural) and 6.8% (urban) of the participants were neutral regarding whether they knew or did not know how to store food. Furthermore, 38.3% (rural) and 55.9% (urban) of the participants strongly disagreed or disagreed that they did not know how to store food and they indicated that even though they did not have refrigerators, they had the option to place their food in a cool place such as a cold floor to keep it fresh (Participants C and H). This indicates that, to some degree, some participants had general knowledge of how to store food, but they might be limited by the affordability of equipment that would help them to keep food fresh for longer. Of the urban participants, 55.9% knew how to store food properly, as they strongly disagreed or disagreed with the statement. Refrigerators and freezers play a significant role in convenience and the freshness and safety of food. How food is placed and moved in the refrigerator impacts food waste visibility and well-timed consumption (Hebrok & Boks, 2017). Storage practices are primarily linked to consumers' ability to store and preserve food after purchasing it. When consumers do not properly store food, there is a strong possibility that the food will decay (Bravi *et al*., 2020).

Table 4.9 indicates that 50.5% (rural) and 47.9% (urban) of the participants disagreed that food was left too long in the refrigerator, while 40% (rural) and 35.6% (urban) strongly disagreed that food was left too long in the refrigerator. Some participants (8.2% rural; 10.0% urban) agreed that food was left too long in the refrigerator, which shows that fewer participants kept food too long in the refrigerator, which is a significant predictor of food waste ($p<0.0001$). These findings agree with research conducted by Chenene (2020), who found that most rural consumers in Lesotho did not own refrigerators in their homes. Leftover food is therefore the outcome of the over-preparation of food and is one of the precursors of food waste (Cronjé *et al*., 2018).

Table 4.9 shows that more than half (52.1%) of the rural participants either strongly disagreed or disagreed that they cooked too much food. In contrast, 64.5% of the urban participants disagreed that they discarded food because they cooked too much food. Of the participants, 46.1% (rural) and 31.9% (urban) strongly agreed or agreed that they cooked too much food. One of the reasons that lead to food waste is cooking more than

what is needed. Consumers face a challenge with correct estimations of portions and usually follow their own judgement (Chenene, 2020).

Buying too much food is one of the reasons for household food waste; however, 85.5% (rural) and 88.2% (urban) of the participants disagreed that they bought too much food. Buying too much food is a significant predictor of food waste ($p = 0.029$), as seen in Table 4.9. Few participants (12.7% rural; 9.5% urban) agreed that they bought too much food. Consumers are likely to purchase more than enough food when they must cook for many people (Graham-Rowe *et al*., 2014). However, some consumers buy too much food due to the habit of buying food too frequently, especially in households with a higher income. This may be the leading cause of buying more food than is needed, and part of it ultimately might not be consumed; thus causing more food waste (Hatab *et al*., 2022). The differences in the literature might emanate from different cultural practices, as well as geographical backgrounds (Gérard, 2022). Precise planning for food purchases is a good strategy to avoid overbuying, which leads to food waste (Brennan & Browne, 2021; Schanes *et al*., 2018).

As shown in Table 4.9, 77.3% (rural) and 74.5% (urban) of the participants disagreed that they did not check cupboards or refrigerators/freezers before shopping, which is a significant predictor of food waste ($p = 0.030$). Of the participants, 21.9% (rural) and 22.8% (urban) agreed that they did not check cupboards and refrigerators/freezers before going shopping. Consumers who do not make a list and check what is needed before buying could fall into the trap of overestimating what they need, which leads to wasted food (Schanes *et al*., 2018).

Many participants (58.6% rural; 59.1% urban) agreed that some household members did not always finish their food (see Table 4.9), which is a significant predictor of food waste ($p = 0.001$). Participants who strongly agreed that some members did not finish their food represented 2.7% (rural) and 1.8% (urban) of the sample. Less than 40% of the participants (35.9% rural; 32.3% urban) did not agree. In the interviews, the participants raised concerns about “boredom” as a reason for plate waste, especially when eating the same food repeatedly without variety. Participants C and H stated that they often ate the same food for longer than a week, which became monotonous and was the reason why

food was not finished. Some of the causes of plate waste are unfamiliar foods or preparations, bad food selection or food mixture, utilisation of bigger plates, and being unsure of how to eat edible portions (Dolnicar & Juvan, 2019).

4.6 FREQUENCY OF DIFFERENT FOOD ITEMS DISCARDED IN HOUSEHOLDS

Table 4.10 shows that 72.3% (rural) and 65.0% (urban) of the participants never discarded fruits. Of the participants, 19.1% (rural) and 23.6% (urban) rarely discarded fruits, while those who sometimes discarded fruits were less than 10% (4.1% rural; 6.4% urban). Few participants (4.6% rural; 5.0% urban) often or always discarded fruits. The interviews revealed that people consume fruits more often when they are in season because they are easily accessible and available, and when they are out of season, they are not consumed much due to their higher cost. Participants E, F, N, and O testified to this by stating that fruits were very expensive when out of season and thus eaten less and that the money they had could only purchase food and that buying fruits felt more like a luxury.

Table 4.10: Frequency of food discarded at the household level

Food type	Area		Never	Rarely	Sometimes	Often	Always
Fruits	Rural	N	159	42	9	9	1
		%	72.3	19.1	4.1	4.1	0.5
	Urban	N	143	52	14	10	1
		%	65.0	23.6	6.4	4.5	0.5
Vegetables	Rural	N	76	44	26	73	1
		%	34.5	20.0	11.8	33.2	0.5
	Urban	N	74	40	35	64	6
		%	33.8	18.3	16.0	29.2	2.7
Milk and dairy products	Rural	N	172	27	7	13	0
		%	78	12.3	3.2	5.9	0
	Urban	N	173	29	10	8	0
		%	78.6	13.2	4.5	3.6	0
Bread	Rural	N	145	38	16	20	1
		%	65.9	17.3	7.3	9.1	0.5
	Urban	N	133	45	32	10	0
		%	60.5	20.5	14.5	4.5	0
Meat	Rural	N	158	32	15	14	0
		%	72.1	14.6	6.8	6.4	0
	Urban	N	172	24	17	7	0
		%	78.2	10.9	7.7	3.2	0

Legumes	Rural	N	99	26	19	46	30
		%	45.0	11.8	8.6	20.9	13.6
	Urban	N	89	44	31	35	20
		%	40.6	20.1	14.2	16.0	9.1
Fish	Rural	N	198	17	2	3	0
		%	90.0	7.7	0.9	1.4	0
	Urban	N	197	15	3	4	1
		%	89.5	6.8	1.4	1.8	0.5
Grains	Rural	N	154	21	15	30	0
		%	70.0	9.5	6.8	13.6	0
	Urban	N	164	31	17	6	1
		%	74.9	14.2	7.8	2.7	0.5

It was found that 34.5% (rural) and 33.8% (urban) of the participants never discarded vegetables, while 20% (rural) and 18.3% (urban) rarely discarded vegetables. Of the participants, 11.8% (rural) and 16.0% (urban) indicated that they sometimes discarded vegetables. However, 33.7% (rural) and 31.7% (urban) of the participants always or often discarded vegetables (see Table 4.9), with a significant difference between the rural and urban areas ($p<0.0001$). In some cases, consumers buy too many vegetables (Cronjé *et al*., 2018). Vegetables are first-rate sources of nutrients with various advantages. Many consumers are deficient in the required daily ingestion of vegetables, yet a substantial quantity of vegetables is still wasted (Augustin *et al*., 2020).

Table 4.10 shows that 78% (rural) and 78.6% (urban) of the participants never discarded milk and dairy products, 12.3% (rural) and 13.2% (urban) rarely discarded milk and dairy products, and 3.2% (rural) and 4.5% (urban) sometimes discarded these products. Few participants (5.9% rural; 3.6% urban) often or always discarded milk and dairy products. Participants A, D, K, and J indicated that they did not consume milk often because it is expensive and they cannot afford it. In South Africa, approximately 30% of consumers waste milk, while some consumers indicate buying more than enough milk (Cronjé *et al*., 2018). In Tanzania, the annual estimated loss of milk is 59.5 million litres; this is more than 16% of the total milk produced in the dry season and 25% in the wet season (Mukumbang, 2023). These findings contradict the findings in this research as milk and dairy products were discarded less. Stankiewicz *et al*. (2019) found that even though milk is not considered as important as other food items, such as meat, it is highly consumed,

which indicates more waste, because food safety concerns may imply food waste as people become unsure of the freshness of food (Oláh *et al*., 2022). More food waste is experienced in developing countries than in developed countries (Grandhi & Singh, 2016).

Table 4.10 reveals that 65.9% (rural) and 60.5% (urban) of the participants never discarded bread, while 17.3% (rural) and 20.5% (urban) of the participants rarely discarded bread. Of the participants, 7.3% (rural) and 14.5% (urban) sometimes discarded bread and 9.6% (rural) and 4.5% (urban) often discarded bread. Consumers in neighbouring South Africa waste approximately 25% of their bread (Cronjé *et al*., 2018); for example, in Mamelodi, consumers waste approximately 16% of their bread (Phooi *et al*., 2022). In the United Kingdom (UK), bread is the most wasted food item as it is a traditional staple that is largely accessible and available (Gadkari *et al*., 2021).

Table 4.10 shows that 72.1% (rural) and 78.2% (urban) of the participants never discarded meat, while 14.6% (rural) and 10.9% (urban) rarely discarded meat. Of the participants, 6.8% (rural) and 7.7% (urban) sometimes discarded meat, while 6.4% (rural) and 3.2% (urban) often did so. During the interviews, Participants J, M, and N indicated that meat was one of the least consumed foods as they considered it expensive. Contrarily, in South Africa, meat is overbought and for that reason stands a higher chance of being discarded (Cronjé *et al*., 2018). Consumers in sub-Saharan African countries eat more meat even though it is considered expensive because they can afford it, and some excess meat may be used to produce other meat dishes (Alao *et al*., 2021).

The results of this study show that 45% (rural) and 40.6% (urban) of the participants never discarded legumes, 11.8% (rural) and 20.1% (urban) rarely discarded legumes, 8.6% (rural) and 14.2% (urban) sometimes discarded legumes, and 34.5% (rural) and 25.1% (urban) always or often discarded legumes. Previous studies have indicated legume waste from faba beans, but also that faba bean waste can be used to produce biofuel (Jasinskas *et al*., 2020; Bayomie *et al*., 2020). This is also confirmed in another study where faba bean waste was mixed through combustion process to produce emissions of biofuel (Minajeva *et al*., 2021). It is also shown that faba bean residues carry important components that may be utilised in various forms including biomass (Krenz *et al*., 2023)

In terms of discarding fish, the majority (90% rural; 89.5% urban) of the participants never discarded fish. In the interviews, Participants F, M, N, I, and O indicated that, generally, fish is commonly consumed in the form of tinned fish and because the tin is small, there are never times where it is not finished and even if it is not finished, it is consumed during the next meal; chances that it will spoil are therefore highly unlikely. Few participants (7.7% rural; 6.8% urban) rarely discarded fish, while 0.9% (rural) and 1.4% (urban) sometimes discarded fish and 1.4% (rural) and 2.3% (urban) did so often or always (see Table 4.9). Commonly recognised fish waste is mostly fish heads, bones, skin, and the internal organs in the main cavity, especially the intestines (Kratky & Zamazal, 2020). The utilisation of fish in different forms varies from country to country; for example, in countries such as Italy, shrimp and raw fish are consumed more and wasted less. In contrast, in Iran, much fish goes to waste, while more shrimp is wasted in India, and the most prevalent form of household discarding is through the municipal waste gathering system, followed by biogas creation (Masoumeh *et al*., 2021). This reveals that in other countries, fish waste is used to create other forms of products that are of great value. Fish waste can be utilised as a component of liquid organic waste, which is beneficial (Dewilda *et al*., 2021).Most rural (70%) and urban (74.9%) consumers never discarded grains. On the other hand, 9.5% (rural) and 14.2% (urban) of the participants rarely discarded grains. Few participants (6.8% rural; 7.8% urban) sometimes discarded grains, while 13.6% (rural) and 3.2% (urban) often or always discarded grains. During the interviews conducted for this study, Participants E, L, I, and P confirmed that it was highly unlikely for them to throw away grain and even when it had pests, it would rather be given to animals as livestock feed. While similar findings have been made in other countries, Malawi has low levels of grain waste, and other eastern and southern regional African countries have shown some grain waste. Previous research reveals the total percentages of food waste for countries, but not for individual crop waste such as maize, wheat, and rice (Ghosh *et al*., 2016). Birhanu *et al*. (2022) found that grain waste in three African countries (Ethiopia 55.5%; Nigeria 35.6%; Tanzania 26.8%) is mostly utilised for feed.

4.7 MOTIVATION FOR AVOIDING FOOD WASTE

Table 4.11 shows that less than half of the participants in the rural areas (41.3%) and slightly more than half of the urban participants (53.9%) avoided food waste as it saved money. Consumers who avoid wasting food are aware of the financial implications thereof, which in itself helps them to try to avoid food waste (Chenene, 2020). Food waste symbolises financial losses individually and nationally (Bravi *et al*., 2020; Ponis *et al*., 2017), which is one of the reasons consumers avoid food waste to save money (Chun T'ing *et al*., 2021; Talwar *et al*., 2021; Thyberg & Tonjes, 2016), especially in Africa (Huho *et al*., 2020).

Table 4.11: Motivation for avoiding food waste

Motivation		Rural	Urban
It saves money.	N	90	118
	%	41.3	53.9
Its saves time.	N	0	1
	%	0	0.5
It is a family expectation.	N	0	12
	%	0	5.5
It is the right thing to do.	N	34	28
	%	15.6	12.8
Environmental concern.	N	5	0
	%	2.3	0
It is easy to do.	N	0	1
	%	0	0.5
Other.	N	89	59
	%	40.8	26.9
If "other" was selected, additional reasons for avoiding food waste			
Food is hard to find.	N	29	12
	%	13.2	5.5
We struggle to find food.	N	27	13
	%	6.8	5.9
Food is already limited.	N	5	1
	%	2.3	0.5
Food is expensive.	N	5	1
	%	2.3	0.5
It saves food.	N	4	3
	%	1.8	1.4

There were no participants from the rural areas whose motivation for avoiding food waste was to save time, and a minute percentage from the urban areas (0.5%). Research has shown that for some consumers, avoiding food waste is used to save time, especially time for cooking (Talwar *et al*., 2021).

It is indicated in Table 4.11 that there were no participants in the rural areas whose motivation to avoid food waste was based on family expectations, whereas 5.5% of the urban participants selected family expectations as motivation. It is a family expectation in some cultures to avoid food waste by using leftover food (Soma, 2017). Chenene (2020) found that reusing leftovers is an act of sacrifice for family members and is mostly done for the benefit of the family.

Some participants (15.6% rural; 12.8% urban) avoided food waste because it was the right thing to do (see Table 4.10). Consumers are aware that they should not waste food because other people need such food, which is derived from a moral perspective that targets reducing hunger and assisting people in need of food (Chun T'ing *et al*., 2021). Furthermore, consumers avoid food waste due to social expectations that would come with feelings of guilt; in their view, avoiding food waste is the right thing to do (Geffen *et al*., 2020). Additionally, consumers work towards avoiding food waste as wasting food brings feelings of moral regret, which are brought on by not doing something right (Hatab *et al*., 2022).

Only 2.3% of the rural participants avoided food waste because they stated that it was something that affected the environment. None of the rural participant (0.0%) and only 0.5% of the urban participants avoided food waste because it was an easy thing to do (see Table 4.11).

It is evident from Table 4.11 that 40.8% (rural) and 26.9% (urban) of the participants revealed other options than those mentioned in the questionnaire. For example, 13.2% (rural) and 5.5% (urban) of the participants indicated that food was hard to find. A similar situation exists in sub-Saharan Africa, where consumers indicated difficulty accessing enough food (Blekking *et al*., 2020). In addition, some participants (6.8% rural; 5.9% urban) indicated that their reason for avoiding food waste in their homes was that they

struggled to find food. In recent years, struggling to find food has not been uncommon due to the COVID-19 pandemic. Struggling to find food forces people to avoid wasting food (Nechifor *et al*., 2021).

Fewer participants (2.3% rural; 0.5% urban) indicated that their food was already limited, while the same percentage (2.3% rural; 0.5% urban) mentioned their reason for avoiding food waste was because food was expensive. This study found that 60.6% (rural) and 50.7% (urban) of the participants earned less than LSL1 000 (ZAR1 000). Lesotho is regarded as a low-income country, which is in agreement with other findings that indicate that 57% of people fall in the low-income group (LSL0 to LSL999), while the middle-income group (34%) earns LSL1 000 to LSL4 999, and the high-income group (9%) earns LSL5 000 and above (Mothala *et al*., 2022). Food is expensive, which serves as one of the reasons why food waste is avoided (Seliane, 2022; Mpholo *et al*., 2020). A few (1.8% rural; 1.4% urban) participants indicated that their practice of avoiding food waste was due to their belief that it saved food. In other developing countries, consumers avoid wasting food to save food (Joardder & Masud, 2019).

4.8 FREQUENCY AND REASON FOR FOOD BEING DISCARDED IN DIFFERENT FORMS

Table 4.12 shows that 21.5% (rural) and 11.9% (urban) of the participants always or often discarded food because it had spoiled, 62.6% (rural) and 68.6% (urban) sometimes or rarely discarded spoiled food, and 16.0% (rural) and 19.5% (urban) never discarded spoiled food. Spoiled food could be a potential cause of disease; consumers therefore discard spoiled food because they are aware of the health risks that may follow the consumption of such food (Van Bemmel & Parizeau, 2020; Dianati *et al*., 2021). Chenene (2020) reported that consumers from rural areas discarded food when it was mouldy.

Table 4.12: Frequency and reason for discarding food in different forms

Reason	Area		Always	Often	Sometimes	Rarely	Never
Spoiled	Rural	N	0	47	51	86	35
		%	0	21.5	23.3	39.3	16.0
	Urban	N	1	25	39	112	43
		%	0.5	11.4	17.7	50.9	19.5
Burnt	Rural	N	9	9	14	89	97

		%	4.1	4.1	6.4	40.8	44.5
	Urban	N	1	11	13	88	107
		%	0.5	5.0	5.9	40.0	48.6
Bones	Rural	N	85	40	13	75	6
		%	38.8	18.3	5.9	34.2	2.7
	Urban	N	49	44	36	68	22
		%	22.4	20.1	16.4	31.1	10.0
Peels	Rural	N	91	44	15	60	9
		%	41.6	20.1	6.8	27.4	4.1
	Urban	N	51	64	37	45	23
		%	23.2	29.1	16.8	20.5	10.5
Expired (past use-by date)	Rural	N	34	0	3	43	139
		%	15.5	0	1.4	19.6	63.5
	Urban	N	40	6	7	30	137
		%	18.2	2.7	3.2	13.6	62.3
Past best-before date	Rural	N	20	1	5	43	150
		%	9.1	0.5	2.3	19.6	68.5
	Urban	N	24	5	7	32	152
		%	10.9	2.3	3.2	14.5	69.1
Cultural/religious beliefs	Rural	N	1	0	0	11	206
		%	0.5	0	0	5.0	94.5
	Urban	N	1	2	5	6	206
		%	0.5	0.9	2.3	2.7	93.6
Pips	Rural	N	100	43	16	25	35
		%	45.7	19.6	7.3	11.4	16.0
	Urban	N	43	54	34	31	58
		%	19.5	24.5	15.5	14.1	26.4

Participants who always or often discarded food because it was burnt represented 8.2% (rural) and 5.5% (urban) of the sample, while 40.8% (rural) and 40.0% (urban) of the participants sometimes discarded burnt food. This was emphasised by Participants E and P, who stated that they did not feel bad when they discarded burnt food because it was utilised by animals. Almost half of the participants (44.5% rural; 48.6% urban) never discarded food due to it being burnt. Participants M and O indicated that they reused burnt food because discarding it felt like a waste, and they did so by removing the parts that were badly burnt and eating the parts that were not that badly burnt. A similar study found that approximately one out of 10 consumers discard food that was burnt while cooking (Mathee, 2020).

Of the participants, 57.1% (rural) and 42.5% (urban) always or often discarded bones. During the interviews, Participants I and E revealed that bones were normally given to animals or thrown into a pit dug in the garden. In terms of discarding bones, 5.9% (rural) and 16.4% (urban) of the participants sometimes did so, 34.2% (rural) and 31.1% (urban) rarely did so, and 2.7% (rural) and 10.0% (urban) never discarded bones (see Table 4.12).

Bones are considered unavoidable food waste; discarding bones is therefore inevitable (Sadhukhan *et al*., 2020; Olaoye *et al*., 2020).

It was found that many (61.7% rural; 52.3% urban) participants always or often discarded peels, while 6.8% (rural) and 16.8% (urban) sometimes did so. Of the participants, 27.4% (rural) and 20.5% (urban) rarely discarded peels and 4.1% (rural) and 10.5% (urban) never discarded peels. The peels of fruits are discarded after the inner fleshy part has been eaten. Banana peels can be used as a medium for yeast strains. The peels are said to be more convenient because they are not toxic and are eco-friendly (Tsado *et al*., 2021). Participants L and P stated that they normally used peels as compost, threw them away, or gave them to animals. Discarded peels are mostly derived from fruits and vegetables, which can be processed into animal feed or composting (Adeleye *et al*., 2021), while in other instances peels may be used in making marmalades and jams to produce pectin (Mashau *et al*., 2022). Peels can further be of benefit since they can be processed into other products for medicinal use (Jedidiah, 2019).

Regarding discarding expired food, 15.5% (rural) and 20.9% (urban) of the participants always or often did so, 1.4% (rural) and 3.2% (urban) sometimes discarded expired food, 19.6% (rural) and 13.6% (rural) rarely did so, and 63.5% (rural) and 62.3% (urban) never discarded expired food (see Table 4.12). Participant I said: *"We never check the expiry dates because we forget to do so before buying food."* South Africa, through the Food Bank initiative, in 2016 allowed consumers to donate food that was approaching its expiration date, and that food could make over 11 000 000 meals to feed people in need (Cronjé *et al*., 2018).

Participants who always or often discarded food that has passed its best-before date represented 9.6% (rural) and 13.2% (urban) of the sample, 2.3% (rural) and 3.2% (urban) sometimes discarded such food, 19.6% (rural) and 14.5% (urban) rarely discarded such food items, while most (rural 68.5%; urban 69.1%) of the participants never discarded food that was past its best-before date (see Table 4.12). Producers are only required to place best-before dates on packaged food items with an expected shelf life of less than 90 days. Anything that would be expected to last more than 90 days is considered shelf stable and does not require a best-before date, although these items are often labelled

with best-before dates as well (Van Bemmel & Parizeau, 2020). In the UK, consumers know the difference between use-by and best-before dates on food packaging. This knowledge is important in equipping consumers to avoid food waste (Facchini *et al*., 2018). Furthermore, Cronjé *et al*. (2018) found that consumers use food more when it is approaching the best-before date, which indicates that they know the difference.

Participants who always and often discarded food because of their culture or religious beliefs represented only 0.5% (rural) and 1.4% (urban) of the sample, while those who sometimes discarded food due to the same reason were only found in urban areas (2.3%). Few participants (5.0% rural; 2.7% urban) rarely discarded food due to cultural/religious reasons. However, the majority (rural 94.5%; urban 93.6%) of the participants never discarded food because of cultural or religious reasons (see Table 4.12). High religiosity levels of populations cannot be considered default or sufficiently good indicators of waste less consumer behaviour. The role of other socio-demographic, psychographic, cultural, and social influences should be recognised and cautiously explored in order to gain more insight (Filimonau *et al*., 2022).

Religion plays a role in curbing food waste within its confines. Holy scriptures often point to the link between religious belief and household food waste avoidance behaviour. For example, in the Quran it is stated: “Enjoy your food and drinks but be careful not to waste” and “Nothing is so annoying than a person who overeats. It should be measured to satisfy hunger only but not to overindulge. Therefore, if he wants to have some more, it should be one-third of everything like food and drink he had taken before”.

The Christian Holy Bible states: “Do not be part of those who drink too much wine or gorge themselves on meat, for drunkards and gluttons become poor, and drowsiness clothes them in rags.” Most religions advise against excessive consumption of food (Khorakian *et al*., 2022).

Furthermore, a religious individual who balances food and drink often cares about the environment and does not consume food excessively (Khorakian *et al*., 2022). Similarly, in some parts of Africa, Islam and Christianity discourage food waste and motivate the

avoidance thereof. Religious individuals seem to know how to balance their needs concerning food and drinks and avoid overindulging (Abdelradi, 2018).

Table 4.12 indicates that many (rural 65.3%; 44.0% urban) participants always or often discarded pips, 7.3% (rural) and 15.5% (urban) sometimes discarded pips, 11.4% (rural) and 14.1% (urban) rarely did so, and 16.0% (rural) and 26.4% (urban) never discarded pips. During the interview, Participant O indicated: *"We normally discard pips by throwing them into the pit, or better still, give to the animals."* In other regions, such as Southern, West, and East Africa, pips are reutilised to process other products such as beer (Krige, 2011).

There are a number of ways in which pips may be utilised; for example, seeds can be consumed fresh, dried, or milled and incorporated into vegetables, meat, and soups to enhance the flavour of food. Fresh pips are also added to porridge and boiled meat to improve their flavour. It has also been found that in some parts of Southern Africa, consumers process marula pips into cakes, which are stored as dried patties for future use. However, in other parts of Africa, some people process marula pips into oil that is used to preserve meat or consume the pips as a snack (Mashau *et al*., 2022).

4.9 HOUSEHOLD HANDLING OF LEFTOVERS

According to Table 4.13, more participants (78.2% rural; 63.2% urban) never stored leftovers in the refrigerator/freezer than participants who sometimes or rarely stored leftovers (4.6% rural; 5.9% urban), while 17.3% (rural) and 30.9% (urban) always or often stored leftovers in refrigerators/freezers. It is a common practice for consumers who have refrigerators to keep leftovers in the refrigerator (Kandemir *et al*., 2022; Marshall, 2021). Compared to Lesotho, the majority of consumers in South Africa store their leftovers in refrigerators/freezers (Mathee, 2020), whereas in the rural areas of Lesotho, many consumers do not have refrigerators/freezers (Chenene, 2020). Planning solutions such as developing a shopping list, meal planning, and checking cupboards and refrigerators/freezers before buying groceries will reduce food waste (Principato *et al*., 2021; Bravi *et al*., 2020; Enos, 2019; Schanes *et al*., 2018).

Table 4.13: Handling of leftovers

Method	Area		Always	Often	Sometimes	Rarely	Never
Give to the needy.	Rural	N	5	47	44	32	92
		%	2.3	21.4	20.0	14.5	41.8
	Urban	N	22	50	50	20	78
		%	10.0	22.7	22.7	9.1	35.5
Store in the fridge/freezer.	Rural	N	14	24	5	5	172
		%	6.4	10.9	2.3	2.3	78.2
	Urban	N	39	29	4	9	139
		%	17.7	13.2	1.8	4.1	63.2
Give it to the animals.	Rural	N	4	11	12	17	176
		%	1.8	5.0	5.5	7.7	80.0
	Urban	N	6	33	24	31	126
		%	2.7	15.0	10.9	14.1	57.3
Throw it away.	Rural	N	0	1	0	2	217
		%	0	0.5	0	0.9	98.6
	Urban	N	1	3	2	20	194
		%	0.5	1.4	0.9	9.1	88.2
Use it to prepare other meals.	Rural	N	91	111	2	8	8
		%	41.4	50.5	0.9	3.6	3.6
	Urban	N	84	73	19	16	28
		%	38.2	33.2	8.6	7.3	12.7
Repurpose leftovers.	Rural	N	97	108	0	7	8
		%	44.1	49.1	0	3.2	3.6
	Urban	N	82	75	21	17	23
		%	37.6	34.4	9.6	7.8	10.6

The majority (80.0% rural; 57.3% urban) of the participants never gave leftovers to animals, 13.8% (rural) and 25.0% (urban) sometimes or rarely fed leftovers to animals, while 6.8% (rural) and 17.7% (urban) always or often did so (see Table 4.13). Consumers in Lesotho are generally not eager to eat leftovers when they suspect it is no longer fresh, and in many instances they are unsure how to store leftovers (Chenene, 2020; Schanes *et al*., 2018). Some households use leftovers such as maize and wheat as animal feed (Patyal *et al*., 2020), and it has become normal practice to feed household leftovers to indigenous free-range chickens in Africa (Waithanji *et al*., 2020). In some instances, leftovers are used to feed dogs (Kankya *et al*., 2022). Large portions of crops and food are still given to animals despite the existence of hunger and undernutrition, which are driven by the world nutrition paradox (Di Paola *et al*., 2017).

Most participants (98.6% rural; 88.2% urban) never threw away leftovers, while 0.9% (rural) and 10.0% (urban) sometimes or rarely discarded leftovers, and 0.5% (rural) and 1.9% (urban) always or often threw away leftovers (see Table 4.13). Consumers are motivated to cook but testified that they threw away leftovers even after refrigeration and freezing (Ahmad *et al*., 2021; Cronjé *et al*., 2018). Gojard *et al*. (2021) found that some consumers throw away leftovers for the purpose of protecting their good health, especially if they do not know how safe the food is and, in other instances, the reason for throwing away leftovers is lack of knowledge.

Of the participants, 91.9% (rural) and 41.4% (urban) always or often used leftovers for preparing other meals, 4.5% (rural) and 15.9% (urban) sometimes or rarely used leftovers to prepare other meals, and 3.6% (rural) and 12.7% (urban) never used leftovers for preparing other meals.

The study found that most (93.2% rural; 72.0% urban) of the participants repurposed their leftovers. Furthermore, 3.2% (rural) and 17.4% (urban) of the participants sometimes or rarely repurposed leftovers and 3.6% (rural) and 10.6% (urban) never did so (see Table 4.12). A Tunisian study showed that women who are 40 years or older and people with university qualifications limit leftover waste by recycling it into animal feed or compost (Pinotti *et al*., 2021; Jribi *et al*., 2020). In other countries, food waste and leftovers are reused as animal and fish feed (Karmee, 2018).

4.10 HOUSEHOLD PURCHASE PRACTICES

Table 4.14 shows that some breadwinners purchased food every day (4.4% rural; 3.2% urban). In South Africa, breadwinners purchase food daily (Mathee, 2020), which is seen when some breadwinners visit street vendors daily to purchase food (Giroux *et al*., 2021; Kilders *et al*., 2021).

Table 4.14 shows that 1.4% (rural) and 0.9% (urban) of the breadwinners bought food every second day. Mathee (2020) discovered that breadwinners buy food every second to third day. Furthermore, other breadwinners buy food three times a week from small shops and grocers (Blekking *et al*., 2020). This study found that, in some instances, the

breadwinner bought food twice a week (3.7% rural; 5.0% urban). In some communities, households buy food from street vendors at least twice a week (Kilders *et al*., 2021; Blekking *et al*., 2020). Studies have found that frequent food purchasers tend to waste more food as they sometimes buy more than what is needed, which eventually results in wastage (Hatab *et al*., 2022).

Table 4.14: Purchasing practices

Frequency		Rural	Urban
Number of times food is purchased by the breadwinner			
Every day	N	9	7
	%	4.4	3.2
Every second day	N	3	2
	%	1.4	0.9
Twice a week	N	8	11
	%	3.7	5.0
Once a week	N	15	23
	%	6.8	10.6
Every two weeks	N	35	25
	%	16.0	11.5
Once a month	N	115	109
	%	52.5	50.0
Other	N	34	15.5
	%	15.5	18.8
If "other" was selected, the number of times food is purchased by the breadwinner			
Almost never	N	1	4
	%	3.0	9.8
Two to three times per month	N	6	7
	%	18.2	17.1
Five or more times per month	N	12	13
	%	36.4	31.7
When money is available	N	14	18
	%	43.8	43.9

The participants indicated that there were times when the breadwinner bought food once a week (6.8% rural; 10.6% urban), as also found by Slotnick *et al*. (2021) and Mathee (2023). Some participants bought food items every two weeks (16.0% rural; 11.5% urban). Blekking *et al*. (2020) found that some people buy food from supermarkets once in two weeks. Half of the participants who were breadwinners (52.5% rural; 50.0% urban) preferred to buy food only once a month (see Table 4.14). Some consumers purchase food once a month (Kilders *et al*., 2021; Mathee, 2020). Breadwinners who prefer online

shopping buy food at least once a month, which may eliminate food waste as these shoppers do shopping less often (Alaimo *et al*., 2022).

The participants could also select the “Other” option regarding the number of times food is purchased by the breadwinner, namely never/rarely, two to three times a month, and only when money was available. Under this option (“Other”), 15.5% (rural) and 18.8% (urban) of the participants mentioned other intervals of buying food, and 3.0% (rural) and 9.8% (urban) mentioned the breadwinners never (or rarely) buying any food. This was found to also be the case with consumers who practise online shopping (Alaimo *et al*., 2022). Furthermore, some breadwinners bought food two to three times a month (18.2% rural; 17.1% urban), while others bought food five or more times a month (36.4% rural; 31.7% urban) (see Table 4.14). In some cases, food purchase frequencies range from four to five times a month (Amicarelli *et al*., 2022), and purchasing food more frequently has been found to encourage food waste at the household level (Hatab *et al*., 2022). Some breadwinners bought food only when money was available (43.8% rural; 43.9% urban).

4.11 PEOPLE RESPONSIBLE FOR COOKING IN THE HOUSE

Table 4.15 indicates that the majority (75.9% rural; 70.6% urban) of the people who were responsible for cooking in the household were the mothers. Most mothers carry out the responsibility of cooking. They perfect their cooking skills to the point where most meals are planned, which limits food waste at the household level (Hagmann *et al*., 2020; Taillie, 2018). A mother’s home-cooked meal is said to bring union and comfort to the family members and is regarded as important as it is usually done to improve the nutrition of family members and to promote families that have meals together, which may discourage members of the family from eating meals separately (Ampansirirat *et al*., 2022). It is also African culture for the mother to be the primary person that takes responsibility for household chores, of which cooking is one (Ahmed *et al*., 2019). Furthermore, food provisioning in a household is often the responsibility of the mother; she is therefore the one who takes care of food security and proper use of food at the household level, which

facilitates proper meal planning and food purchasing, which are very useful in limiting wasted food (Vercillo, 2020).

In only a few instances did the participants indicate that the father took responsibility for cooking (5.9% rural; 4.6% urban). In European households, fathers are less involved in cooking than mothers (Hagmann *et al*., 2020). In some parts of sub-Saharan Africa, it is culturally unacceptable for the father or man to cook when a woman is present (Adisa *et al*., 2019). However, there are communities where the father assumes the responsibility of cooking even when women are present in the household (Raphaeli & Hutchinson, 2020).

Table 4.15: The person responsible for cooking in the household

Person responsible for cooking		**Rural**	**Urban**
Mother	N	167	154
	%	75.9	70.6
Father	N	13	10
	%	5.9	4.6
Children	N	27	36
	%	12.3	16.5
Each person prepares individually	N	2	7
	%	0.9	3.2
Helper	N	2	0
	%	0.9	0
Other	N	9	11
	%	4.1	5.0
If "other" was selected, person responsible for cooking			
Anyone can cook	N	1	0
	%	0.5	0
Aunt	N	1	0
	%	0.5	0
Myself	N	6	6
	%	2.7	2.7
Both mother and father	N	0	1
	%	0	0.5
Grandmother	N	0	1
	%	0	0.5
Uncle	N	0	1
	%	0	0.5
Wife and daughter-in-law	N	0	1
	%	0	0.5

Children (12.3% rural; 16.5% urban) also took responsibility for cooking (see Table 4.15). Early involvement with cooking improves the skills thereof; adults who learned how to cook as children are thus more acquainted with the dynamics of food preparation (Hagmann *et al*., 2020). In other instances, parents allow children to make a meal with them to encourage them to cook, and they sometimes eat the food prepared by children even if it is not very tasty in order to encourage them. However, it is not always certain whether children showed interest in cooking because they were involved or because they were naturally interested (Lavelle *et al*., 2019). Nonetheless, in the African community, a female child is expected to do household chores, of which cooking is one, to mould the girl into motherhood (Metsing, 2020).

There were cases where the participants indicated that individuals in the household prepared food for themselves (0.9% rural; 3.2% urban) (see Table 4.15). Very few (0.9% rural; 0.0% urban), if any, helpers cooked meals (see Table 4.15). Monya (2021) found that helpers assist in various ways in taking care of the house and children, as well as helping with cooking at home. It is not generally accepted for women to have helpers to cook their meals, with the men demanding that their wives cook for them (Adisa *et al*., 2019). However, in developed countries it is common to have helpers in households, where they generally have several chores, including cooking (Nyaura & Ngugi, 2019; Faturiyele *et al*., 2018).

As seen in Table 4.15, 0.5% (rural) and 0.0% (urban) of the participants responded that anyone was responsible for cooking. An aunt was responsible for cooking in 0.5% of the rural cases and 0% of the urban cases. The situation where the participants indicated the option “myself” as responsible for cooking represented 2.7% (rural) and 2.7% (urban). Where the option of both mother and father was indicated, the results were 0.0% (rural) and 0.5% (urban), and in situations where the uncle was responsible for cooking, the responses were 0.0% (rural) and 0.5% (urban). There are uncles who cook at home, as indicated in a study where an uncle was responsible for cooking, but the niece had to assist when the uncle was no longer capable of cooking due to illness (Moore, 2023). No or almost no wives and daughters-in-law were responsible for cooking (0.0% rural; 0.5% urban).

4.12 FREQUENT PLACES TO PURCHASE FOOD

Approximately half (58.2% rural; 47.3% urban) of the participants preferred buying food at local shops (see Table 4.16). Consumers often prefer local stores for food purchases because they perceive the location to be convenient and the food affordable. Additionally, they believe that food bought locally is fresh and safe (Witzling & Shaw, 2019). Furthermore, some consumers prefer buying food locally to support the local economy (Philippe *et al*., 2021).

Table 4.16: Place of choice for regular food purchases

Area		Local	Market	Supermarket	Wholesaler
Rural	N	128	2	90	0
	%	58.2	0.9	40.9	0
Urban	N	104	2	113	1
	%	47.3	0.9	51.4	0.5

Very few participants (0.9%) purchased food from markets in both the rural and urban areas (see Table 4.16). In developing countries, markets sell food at affordable prices, which allows less-privileged people to buy more food, which may in turn encourage consumers to buy more than is required (Oluwatayo, 2019).

Purchasing at a supermarket was the choice of 40.9% (rural) and 51.4% (urban) of the participants (see Table 4.16), as also found by Crush *et al*. (2017). Some consumers purchase groceries from supermarkets, especially when they buy in bulk. When there are promotions, people tend to buy more and also purchase food items that have passed their best-before date, which contribute to food being wasted (Crush *et al*., 2017). This may not be common in areas where consumers cannot afford transport fare to go purchase food at a supermarket (Blekking *et al*., 2020). Some studies show that the fastest supermarket growth is on the African continent, which may become a challenge as people have a tendency of purchasing more from supermarkets (Debela *et al*., 2020). The least number of participants purchased food at a wholesaler (0.0% rural; 0.5% urban) (see Table 4.16). The increase in wholesale has shown to provide more citizens with staple food, which builds their investment in capacity due to improved supply and also reduces

transportation costs where people need to travel to access certain foods (Reardon *et al*., 2021).

4.13 HOUSEHOLD PRACTICES BEFORE AND DURING FOOD PURCHASES

As shown in Table 4.17, many participants (66.7% rural; 56.55% urban) never planned their meals, 11.4% (rural) and 14.7% (urban) sometimes or rarely did so, and 20.1% (rural) and 25.9% (urban) always or often planned their meals. Mathee (2020) found that almost half of consumers planned their meals. In addition, consumers seem to be proactive concerning meal planning (Bravi *et al*., 2020).

Table 4.17: Household practices before and during food purchases

Practice	Area		Always	Often	Sometimes	Rarely	Never
Do meal planning in advance.	Rural	N	4	40	12	17	146
		%	1.8	18.3	5.5	7.8	66.7
	Urban	N	24	32	15	23	122
		%	11.1	14.8	6.9	10.6	56.5
Go to the store with a shopping list.	Rural	N	43	32	16	2	126
		%	19.6	14.5	7.3	0.9	57.5
	Urban	N	76	34	11	6	93
		%	34.5	15.5	5.0	2.7	42.3
Check use-by, best-before, and expiry dates of food items.	Rural	N	73	47	15	10	74
		%	33.3	21.5	6.8	4.6	33.8
	Urban	N	129	25	21	7	37
		%	58.9	11.4	9.6	3.2	16.9
Consider how food is stored to keep it fresh.	Rural	N	12	105	27	24	52
		%	5.5	47.7	12.3	10.9	23.6
	Urban	N	51	88	18	16	46
		%	23.3	40.2	8.2	7.3	21.0

Table 4.17 shows that 57.5% (rural) and 42.3% (urban) of the participants never used a shopping list when going to the store. During the interviews, Participants E and M said that they never made a shopping list because they did not buy in bulk, and they already knew what to buy. Of the participants, 8.2% (rural) and 7.7% (urban) sometimes or rarely made lists and 34.1% (rural) and 50% (urban) always or often made a shopping list. Some participants are aware of the importance of making shopping lists before shopping. In some instances, participants used shopping lists and in other cases did not. A shopping list helps with the discipline of not purchasing more than what is needed, which may lead

to unnecessary food waste (Principato *et al*., 2021; Ismail *et al*., 2021; Duffet & Foster, 2017).

Table 4.17 also shows that 33.3% (rural) and 58.9% (urban) of the participants always check best-before and expiry dates, 21.5% (rural) and 11.4% (urban) of the participants often checked these dates, 4.6% (rural) and 3.2% (urban) rarely did so, and 33.8% (rural) and 16.9% (urban) never checked. Consumers are increasingly practising the habit of checking use-by, best-before, and expiry dates on food items, which contributes to minimising household food waste to some extent, as people purchase food they will use in time (Danilola *et al*., 2019; Davenport *et al*., 2019).

Lastly, Table 4.17 shows that many (53.2% rural; 63.5% urban) participants always or often considered how food is stored to keep it fresh, 12.3% (rural) and 8.2% (urban) sometimes considered how to store food to keep it fresh, 10.9% (rural) and 7.3% (urban) rarely made this consideration, and 23.6% (rural) and 21.0% (urban) never considered food storage to keep it fresh.

4.14 DIETARY DIVERSITY AMONG RURAL AND URBAN HOUSEHOLDS

Table 4.18 presents the results collected from a 24-hour recall questionnaire, which indicates how diverse the diets of households were. The HDDS is defined by the consumption of different food groups the previous day. The scores are categorised as 0-3 = low dietary diversity, 3-5 = medium dietary diversity, and 6-12 = high dietary diversity (Walsh *et al*., 2020). According to the findings, the HDDS for the urban areas was 9.427, which indicates high dietary diversity, while the HDDS for the rural areas was 8.859, which also indicates high dietary diversity. Statistically, there is a significant difference ($p = 0.003$) between the HDDS of the rural and urban areas in Lesotho.

Table 4.18 indicates the different food groups consumed according to the 24-hour recall. Cereals (99.5% rural; 96.9% urban) were consumed the most. The participants also consumed portions of dark green leafy vegetables (60.0% rural; 57.1% urban). The Basotho's most common staples are maize and sorghum, which are eaten throughout the day in the form of bread and sour, soft, or stiff porridge, which makes their diet more rich

in carbohydrates than other food groups (Rothman *et al*., 2019; Crush *et al*., 2017). Dietary diversity is still a challenge, and most Basotho consume a great deal of cereal and green leafy vegetables (*pap* and *moroho*), which affects dietary diversity (Rothman *et al*., 2019).

Table 4.18: Household dietary diversity for urban and rural households

Food group	Area		Breakfast	Lunch	Supper	Snacks
Cereals: Maize/corn, rice, wheat, sorghum, bread, noodles, and porridge	Rural	N	185	162	215	4
		%	99.5	98.8	97.7	1.8
	Urban	N	189	161	203	7
		%	96.9	98.8	96.7	3.2
White roots and tubers: White potato, white yam, white cassava, and other foods made from roots	Rural	N	4	7	9	1
		%	2.2	4.3	4.1	0.5
	Urban	N	5	12	8	4
		%	2.6	7.4	3.8	1.8
Vitamin A-rich vegetables and tubers: Pumpkin, carrot, sweet potato, and red sweet pepper	Rural	N	3	2	7	0
		%	1.6	1.2	3.2	0.0
	Urban	N	3	7	5	2
		%	1.6	4.3	2.4	0.9
Dark green leafy vegetables: Dark leafy vegetables, including wild and locally available forms such as spinach, amaranth, and kale	Rural	N	74	76	132	0
		%	39.8	46.3	60.0	0.0
	Urban	N	60	68	120	0
		%	30.8	41.7	57.1	0.0
Other vegetables: Tomato, onion, eggplant, etc.	Rural	N	3	5	5	0
		%	1.6	3.0	2.3	0.0
	Urban	N	9	10	13	3
		%	4.6	6.1	6.2	1.4
Vitamin A-rich fruits: Mango, cantaloupe, apricot, papaya, dried peach, and 100% juice made from these or other locally available vegetables	Rural	N	1	0	1	5
		%	0.5	0.0	0.5	2.3
	Urban	N	0	0	0	24
		%	0.0	0.0	0.0	10.9
Other fruits: Other fruits, including wild fruits and 100% juice made from these	Rural	N	1	2	0	18
		%	0.5	1.2	0.0	8.2
	Urban	N	1	0	0	30
		%	0.5	0.0	0.0	13.6
Organ meats: Liver, heart, or other organ meats or blood-based foods	Rural	N	0	0	0	0
		%	0.0	0.0	0.0	0.0
	Urban	N	0	0	0	0
		%	0.0	0.0	0.0	0.0
Flesh meats: Beef, pork, lamb, chicken, goat, rabbit, duck, game, other birds, and insects	Rural	N	8	10	23	0
		%	4.3	6.1	10.5	0.0
	Urban	N	14	18	33	1
		%	7.2	11.0	15.7	0.5
Eggs: Eggs from chicken, duck, guinea fowl, or any other egg	Rural	N	4	4	6	0
		%	2.2	2.4	2.7	0.0
	Urban	N	6	7	4	0
		%	3.1	4.3	1.9	0.0

Food group	Area		Breakfast	Lunch	Supper	Snacks
Fish and seafood: Fresh or dried fish or shellfish	Rural	N	1	3	2	0
		%	0.5	1.8	0.9	0.0
	Urban	N	2	6	5	0
		%	1.0	3.7	2.4	0.0
Legumes, nuts, and seeds: Dried beans, dried peas, lentils, nuts, seeds, or food made from these (e.g., hummus, peanut butter)	Rural	N	7	24	32	1
		%	3.8	14.6	14.5	0.5
	Urban	N	9	19	31	1
		%	4.6	11.7	14.8	0.5
Milk and dairy products: Milk, cheese, yoghurt, or other dairy products	Rural	N	13	15	12	0
		%	7.0	9.1	5.5	0.0
	Urban	N	7	12	11	0
		%	3.6	7.4	5.2	0.0
Oils and fats: Oil, fats, or butter added to food or used for cooking	Rural	N	0	1	0	0
		%	0.0	0.6	0.0	0.0
	Urban	N	7	2	0	2
		%	3.6	1.2	0.0	0.9
Sweets: Sugar, honey, sweetened soda or juice drink, sugary foods such as chocolates, candies, cookies, and cakes	Rural	N	0	1	0	5
		%	0.0	0.6	0.0	2.3
	Urban	N	2	2	1	16
		%	1.0	1.2	0.5	7.3
Spices, condiments, and beverages: Spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, and alcoholic beverages	Rural	N	47	16	13	3
		%	25.3	9.8	5.9	1.4
	Urban	N	66	9	7	3
		%	33.8	5.5	3.3	1.4

Fruit consumption was very low, with only 13.6% (urban) and 10.9% (urban) of the participants indicating consuming fruits. Participants E, F, N, and O testified to this by saying that because fruits were very expensive, they did not eat them regularly, and also that the money they had could only purchase food and that buying fruits therefore felt more like a luxury.

4.15 THE SIGNIFICANT VARIABLES THAT AFFECT THE HOUSEHOLD DIETARY DIVERSITY SCORE (HDDS)

Being a female household head decreases the HDDS significantly ($p<0.0001$); thus minimising dietary diversity. Using electricity increases the HDDS, as seen from data on socio-demographics, where only 2.8% (rural) and 8.2% (urban) of the participants used electricity to cook, which increased household dietary diversity with a p-value of 0.040, which indicates a significant indicator. Using LPG for cooking also increases the HDDS.

Of the participants, 20.7% (rural) and 21.4% (urban) cooked with LPG, which increased dietary diversity (p<0.0001).

Table 4.19 variables affecting HDDS with p-values

Variables affecting HDDS	P-Values
Being female a household head	P = 0.0001*
Using electricity for cooking	P = 0.040*
Using LPG for cooking	P = 0.0001*
Using open fire for cooking	P = 0.008*
Breadwinner purchasing food every two weeks	P = 0.028*

*Statistically significant as p<0.05

In other sub-Saharan African countries such as Kenya, using LPG for cooking allows an increase in dietary diversity of food to be cooked, which results in minimising food insecurity (Shupler *et al*., 2021). Using an open fire decreases the score, as seen from the data, where 29% (rural) and 16.8% (urban) of the participants used an open fire to cook, which might have influenced their HDDS. The implication is that it decreases dietary diversity in households (p = 0.008). If the breadwinner purchases food every two weeks, then the score also decreases (p = 0.028) Table 4.19.

4.16 MEAN NUMBERS AND PVALUES PF SERVINGS PER DAY FOR FOOD GROUPS

As shown in Table 4.20, the mean servings for consuming cereal in rural areas were 12.9 compared to 12.1 in urban areas, while the root consumption mean servings per day for rural areas were 5.7 compared to 5.8 in urban areas, which differed significantly (p = 0.02). The mean servings per day for vitamin A-rich vegetables and tubers were 6.2 (rural) and 6.5 (urban). The mean servings per day for dark green leafy vegetables were 8.3 (rural) and 8.5 (urban). For other vegetables, the mean servings per day were 6.6 (rural) and 7.6 (urban), which is a significant difference between the rural and urban areas (p<0.001). The mean servings per day for vitamin A-rich fruits were 4.9 (rural) and 5.1 (urban), and for other fruits, the mean servings per day were 7.3 (rural) and 7.7 (urban), which differed significantly between the areas (p = 0.003).

Table 4.20: Mean number of servings per day of different food groups

Food group	Rural	Urban	P-value
Cereals: Maize/corn, rice, wheat, sorghum, bread, noodles, and porridge	12.8727	12.1045	0.67
White roots and tubers: White potato, white yam, white cassava, and other foods made from roots	5.7182	5.8455	0.02*
Vitamin A-rich vegetables and tubers: Pumpkin, carrot, sweet potato, and red sweet pepper	6.2182	6.4591	0.13
Dark green leafy vegetables: Dark leafy vegetables, including wild and locally available forms such as spinach, amaranth, and kale	8.3455	8.4864	0.06
Other vegetables: Tomato, onion, eggplant, etc.	6.5727	7.5636	<0.001*
Vitamin A-rich fruits: Mango, cantaloupe, apricot, papaya, dried peach, and 100% juice made from these or other locally available vegetables	4.8773	5.0955	0.06
Other fruits: Other fruits, including wild fruits and 100% juice made from these	7.2955	7.6591	0.003*
Organ meats: Liver, heart, or other organ meats or blood-based foods	3.7727	4.1091	0.04*
Flesh meats: Beef, pork, lamb, chicken, goat, rabbit, duck, game, other birds, and insects	8.6545	8.9136	0.03*
Eggs: Eggs from chicken, duck, guinea fowl, or any other egg	2.7136	2.7045	0.38
Fish and seafood: Fresh or dried fish or shellfish	3.5136	3.5773	0.37
Legumes, nuts and seeds: Dried beans, dried peas, lentils, nuts, seeds, or food made from these (e.g., hummus, peanut butter)	6.3000	6.0955	0.42
Milk and dairy products: Milk, cheese, yoghurt, or other dairy products	3.7864	3.8409	0.55
Oils and fats: Oil, fats, or butter added to food or used for cooking	3.7909	4.1689	0.003*
Sweets: Sugar, honey, sweetened soda or juice drink, sugary foods such as chocolates, candies, cookies, and cakes	6.6182	6.9955	0.09
Spices, condiments, and beverages: Spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, and alcoholic beverages	9.7682	10.4455	0.28

*Statistically significant as $p<0.05$

The mean servings per day for organ meats were 3.8 (rural) and 4.1 (urban), which is a significant difference ($p = 0.04$), while for flesh meat the mean servings were 8.7 (rural) and 8.9 (urban) per day, which is also significantly different between the areas ($p = 0.03$). For eggs, the mean servings per day were 2.7 for both the rural and urban areas. The mean servings for fish were 3.5 (rural) and 3.6 (urban) per day. Per day, the mean servings for legumes were 6.3 (rural) and 6.1 (urban). For milk, the mean servings per day were 3.8 for both the rural and urban areas. The mean servings for oils were 3.8

(rural) and 4.2 (urban) per day, which differed significantly between the areas (p = 0.003). For sweets, the mean servings per day were 6.6 (rural) and 7.0 (urban). Lastly, the mean servings per day for spices, condiments, and beverages were 9.8 (rural) and 10.4 (urban).

4.17 CONSUMPTION OF SNACKS OUTSIDE OF THE HOME

Most participants did not consume snacks outside of the home (70.8% rural; 82.7% urban). In a study in Lesotho, Adebayo (2010) discovered that *makoenya* (flour balls or fat cakes) are common snacks, of which individuals eat six to 12 pieces monthly. Also in Lesotho, Rothman *et al*. (2019) found that the Basotho also consumed dried beans as a snack. Among the mentioned snacks, maize is one of the snacks consumed as freshly boiled maize or roasted (Erenstein *et al*., 2022; Nuss & Tanumihardjo, 2011). It was discovered that consumers in other parts of Africa consume one to three servings of snacks outside of the home (Nordhagen *et al*., 2019) (see Table 4.21).

Table 4.21: Consumption of snacks outside of the home

Response		Rural	Urban
Yes	N	64	38
	%	29.2	17.3
No	N	155	182
	%	70.8	82.7

4.18 PRESERVATION TECHNIQUES AND METHODS USED IN HOUSEHOLDS

Approximately half of the participants in both the rural (49.1%) and urban (55.3%) areas preserved fruits and vegetables. The participants who indicated that they preserved food, used the following methods: bottling, drying, freezing, and salting. A combination of techniques and methods was also used.

Table 4.22 shows that most of the participants (65.7% rural; 80.5% urban) used bottling as a way of preserving food items. Consumers use bottles to preserve food, such as cowpeas, while others use them to preserve vegetables such as sweetcorn (Osei-Asibey *et al*., 2022; Ekpa *et al*., 2019).

Table 4.22: Techniques/methods of preservation

Preservation technique/method		Rural	Urban
Bottling	N	71	99
	%	65.7	80.5
Sun drying	N	54	66
	%	50.0	53.7
Freezing	N	1	7
	%	0.9	5.7
Salting	N	0	1
	%	0	0.8

Fifty percent (rural) and 53.7% (urban) of the participants preferred sun drying as a method of food preservation, which was done mostly with fruits and vegetables on corrugated iron or flour bags, according to the information derived from the questionnaires. It is also common in Africa that some consumers dry their food items on roofs, mats, trays, concrete slabs, or in solar driers, where all these initiatives are used to prevent food from going to waste, especially fruits and vegetables (Sturm *et al*., 2022; Bauchet *et al*., 2021; Dereje & Abera, 2020; Ekpa *et al*., 2019).

Very few consumers (0.9% rural; 5.7% urban) used freezing for preservation. Chenene (2020) found that most Basotho do not own refrigerators, especially in the rural areas, which could be the reason why few participants indicated using freezing to preserve food. During the COVID-19 pandemic, some consumers embraced the habit of preserving their food by freezing it (Bolek, 2021). When consumers know how to preserve food by freezing, it minimises food waste (Heng & House, 2022; Kwadzo *et al*., 2022) (see Table 4.22).

No participants (0.0%) in the rural areas used salt as a way of preservation, while in the urban areas, 0.8% of the participants used salt to preserve food, especially meat and fish (Nagao-Sato *et al*., 2021; Odusola *et al*., 2014). Salt is also used as an ingredient when preserving fish through fermentation (Ayeloja & Jimoh, 2022) (see Table 4.22).

4.19 CONCLUSION

This chapter presented the results and discussions of the aspects of food insecurity, food waste, and dietary diversity in both the rural and urban areas of Lesotho. The results of the research were interpreted and discussed.

CHAPTER 5:
CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

In this chapter, the conclusions that emanated from the results and discussions chapter are presented. The conclusions also provide feedback on the objectives of this study, which were to determine the level of food waste in rural and urban households, to define the food waste disposal mechanisms identified in the households, to identify possible practices leading to food waste, to assess the extent of food insecurity in households, to determine the dietary diversity among the consumers, and to identify preservation techniques used in households. Recommendations directed toward policymakers, extension and research, and the Ministry of Agriculture, Food Security and Nutrition are also presented, as well as recommendations for future research directions.

5.2 CONCLUSIONS

5.2.1 Food insecurity among rural and urban households in Lesotho

Overall food insecurity in Lesotho is of concern, and the present situation indicates that the nation is suffering from severe food insecurity, especially in the rural areas. From all four categories of food security, being food secure, mild food insecure, moderately food insecure, and severely food insecure, both the rural and urban experience severe food insecurity Statistically, there is a significant difference between rural and urban areas regarding food insecurity. In this case, the significant indicators of food insecurity are employment status and using an open fire for cooking. Significant indicators, rom socio-demographics contributing to increasing food security are, using electricity and LPG for cooking, and the socio-demographic factors that increase food insecurity are, using open fire for cooking, being a female.

5.2.2 The level of food waste in the rural and urban households of Lesotho

Regarding quantities of wasted food, the study found that the rural areas waste more food than the urban areas in quantities. Exploring disposal mechanisms revealed that giving food waste to animals was the most preferred method for dealing with food waste for both the rural and urban areas. Not many consumers are aware of other mechanisms such as composting, burying the waste, worm farms, but they also throw wasted food away .

More consumers from the urban areas discard food because they prefer fresh food, while more rural consumers do not discard spoiled food but rather reheat it and consume it again, which might expose them to health consequences from ingesting unsafe food. Food is still left too long in the refrigerator, and more consumers from the urban areas revealed that they did not know how food should be stored, while most rural consumers did not own refrigerators. Cooking and buying too much food is a concern in both rural and urban households, which indicates the reality of insufficient planning before the purchase of food and in terms of meal planning. One of the indicators of this is that the majority of consumers do not check their cupboards and refrigerators/freezers before going shopping, especially in the urban areas. The study found that a large number of urban and rural consumers do not dispose of food waste by making compost or discarding it into the bins, making worm farms, or burying food waste, but over half of both of them give food waste to animals. It was also seen that consumers have a habit of not finishing food on their plates, and this too contributes to household food waste.

The estimations of food waste discarded in households indicated that most waste is discarded once a week. Fruits, grains, meat, fish, milk, and dairy products are discarded less, while food items such as vegetables, bread, and beans are frequently discarded. One of the reasons consumers avoid waste, especially in urban areas, is because it saves them money. Furthermore, consumers from both the rural and urban areas do not discard expired food or food past the best-before date, because people still do not know the difference between the two and still think that discarding such food is a waste. The majority of the households in the study did not cite religious or cultural beliefs as a reason to discard food.

Approximately half of the consumers in both the rural and urban areas purchase food once a month, with more consumers from the rural areas purchasing from local shops, while urban consumers buy from supermarkets. Consumers in the rural areas check their cupboards and refrigerators/freezers before going shopping, and they usually do not make shopping lists because they do not buy many items. The majority of the households in the study indicated mothers as the main person who is responsible for buying and cooking food, followed by children, and having a mother as the responsible person for purchasing and cooking of food does not necessarily make her the main reason of food waste at home. Some consumers still give leftovers to people in need, some use leftovers to prepare other meals, while some think that eating leftovers in another meal is boring. The majority of consumers, particularly in the rural areas, do not store leftovers in the refrigerator, probably because most of them do not own refrigerators.

5.2.3 The dietary diversity of rural and urban households of Lesotho

The 24-hour recall revealed that cereal was consumed more than other food groups in the rural and urban areas alike. This was followed by dark green leafy vegetables, which are a traditional meal common to most Basotho households. The consumption of fruits was rather low because they were mostly consumed when in season, when they were less expensive. With the average low income that consumers receive, they prioritise other food items over fruits when shopping.

Organ meats were not consumed at all; the reason might be that they simply were not consumed during the 24-hour recall period. Flesh meat, eggs, fish, and milk were among the least consumed food groups. Legumes were fairly consumed, while oils, fats, sweets, spices, and condiments were not consumed much. The study found that the significant indicators of low dietary diversity were being female, using an open fire for cooking, and purchasing food every two weeks. Significant indicators of high dietary diversity were using electricity and LPG for cooking.

According to the food frequency data, where the past seven days' consumption was examined, maize meal, bread, and porridge were found to be the most consumed cereals. Vegetables such as potatoes, beetroot, and carrots were consumed more in the urban

areas than in the rural areas, while spinach and rape were consumed more in the rural areas than in the urban areas. Cabbage was not consumed more or less as it was not in season; while it may be more accessible in the winter, the data were collected in the summer. Indigenous vegetables were also not consumed much. Fewer consumers consumed fruits such as peaches and apricots, but apples were fairly consumed. Meat was less consumed, while chicken was consumed more, especially in the urban areas. Fish was also not consumed often, especially fresh and dried fish. Legumes were fairly consumed in both the rural and urban areas. Cheese and yoghurt were not consumed much, but milk was consumed often. Oil was not consumed much, while sugar was consumed more in the rural areas. Condiments and beverages that were mostly consumed in the rural and urban households were salt, spices, and tea. We can conclude that dietary diversity is high as per the assessment of the foods consumed in both the rural and the urban areas, which counterfeits the results for severe food insecurity experienced. The maximum score should be 12 and minimum 5, but rural areas had a mean of 8.86, indicating that they are able to access 8 food groups, while urban areas had a mean of 9.43, indicating that out of 12 food groups, urban consumers are able to access 9 food groups.

5.2.4 Food preservation strategies

Urban consumers preserve fruits and vegetables more than those in the rural areas, probably because urban consumers have more access to the ingredients needed for preservation. The techniques found to be more useful are bottling, drying, freezing, and salting; however, the two mostly used techniques in rural and urban alike, are bottling and drying.

5.3 RECOMMENDATIONS

Based on the study's findings, recommendations are made for policymakers, research and extension, and the Ministry of Agriculture, Food Security and Nutrition.

5.3.1 Recommendations for policymakers

The study's findings may be an important tool to guide policymakers draw useful information that might be of great use in future decision making. It could serve as a point of reference in situations where policy amendments are possible, as well as strengthening of existing food policies.

5.3.2 Recommendations for research and extension

The information presented in this study may be useful to the extension sector because it has the potential to form part of the basis for intervention strategies. The extension sector might use this information as a guide to create awareness of indicators that influence food insecurity at the household level. Areas that may be paid closer attention are issues of food storage, handling of leftovers, purchasing practices, and consumer behaviour towards food before making food purchases. It may be a guide to encourage food diversity through affordable means at households, as well as using food preservation as an initiative that might limit household food waste.

5.3.3 Recommendations for the Ministry of Agriculture, Food Security and Nutrition

The Ministry of Agriculture, Food Security and Nutrition may share the results of this study with all the stakeholders in the food value chain, particularly researchers, consumer scientists, and nutritionists. All these bodies may collectively develop solutions that could make a significant change to the aspects of food security, food waste, dietary diversity, and food preservation. Initiatives can be carried out to improve awareness of the dynamics of food security, food waste, and dietary diversity at the household level. This would materialise successfully when structures in districts are mobilised, to embark on community training to inform and empower families on how to tackle these issues at the household level.

Consumer scientists, researchers, and nutritionists would have to work with the extension sector through information-sharing platforms and campaigns to enlighten consumers

about what may be workable at the household level to mitigate the challenges of food insecurity, food waste, and low dietary diversity. Farmers would know how best to avoid losses at the production stage through plans put in place to ensure good-quality produce that will not lead to food waste at the household level. They should therefore also be involved in initiatives.

5.3.4 Recommendations for future research

It is recommended that the dietary intake survey should be conducted for longer than seven days, at least four weeks of continuous capturing of data in the same households, so that a more accurate idea of what is going on may be captured.

It would be more revealing if the HFIAS could be conducted in at least two different cropping seasons, such as summer and winter.

This study could also be replicated in the six other districts of Lesotho to highlight the differences (or similarities) between the districts.

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APPENDICES

APPENDIX A: ETHICAL APPROVAL

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS UV

GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

16-Sep-2021

Dear Mrs Maletsie Molapo

Application Approved

Research Project Title:
The relationship between food insecurity, malnutrition and food waste in the rural and urban areas of Lesotho.

Ethical Clearance number:
UFS-HSD2021/0710/21

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Yours sincerely

Dr Adri Du Plessis
Chairperson: General/Human Research Ethics Committee

Dr Adri du Plessis
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APPENDIX B: PROPOSED INTERVIEW SCHEDULE

Household characteristics / Matsoao a lelapa

- How many people live in your house seven days a week? / Batho ba lulang moo lapeng matsatsi a supileng bekeng ba bakae?

Food security / Kanetso ea lijo

- Between fruits and vegetables, which ones do you have in your garden? And why? / Ho litholoana le meroho, ke li feng tse teng jareteng ea lona? Hobaneng?

Food waste / Tsenyeho ea lijo

- What comes to your mind when we talk of food waste? / Ha re bua ka tsenyeho ea lijo, hotla eng kelellong ea hau?
- How do you manage excess food in your household? E.g., peels, leftovers, big harvest. / Ebe lijo tse sa sebetsang le li etsa joang? mohlala, makhapetla, lijo tse setseng lipitseng, kotulo e ngata.

Dietary diversity / Phepo e nepahetseng

- How many times a day do you eat as a family? / Le ja makhetlo a makae letsatsi ka leng?
- What types of food do you normally eat? / Le ja lijo tsa mofuta o feng?

APPENDIX C: FINAL QUESTIONNAIRE

EvaSys	Relationship between Food Insecurity, Malnutrition and Food Waste	Electric Paper
Consumer Science	M Molapo 2021 Paper	

Mark as shown: ☐☒☐☐☐ Please use a ball-point pen or a thin felt tip. This form will be processed automatically.
Correction: ☐■☐☒☐ Please follow the examples shown on the left hand side to help optimize the reading results.

1. DEMOGRAPHICS

1.1 What is your relationship to the head/bread winner of the household?
☐ Spouse ☐ Son/Daughter ☐ Grand child
☐ Step child ☐ Parent of head/spouse ☐ Sister/Brother
☐ Servent ☐ Other

1.2 What is your marital status?
☐ Single ☐ Married ☐ Divorced
☐ Separated ☐ Living together

1.3 What gender do you associate with?
☐ Female ☐ Male ☐ Other

1.4 How many people are living in this household?
Sleeping here at least 5 nights per week
☐ 1 ☐ 2 ☐ 3
☐ 4 ☐ 5 ☐ 6
☐ 7 or more

1.5 Please estimate your combined monthly household income:
☐ No income ☐ Less than M1 000 ☐ M1 001 - M4 000
☐ M4 001 - M9 000 ☐ M9 001 - M15 000 ☐ M15 001 - M20 000
☐ M20 001 - M25 000 ☐ More than M25 0001

1.6 What religion are you affiliated to?
☐ Bahai ☐ Buddhism ☐ Christianity
☐ Hinduism ☐ Islam ☐ Other

1.7 What is the highest level of education of the person responsible for purchasing the household's food?
☐ No schooling ☐ Primary School ☐ Secondary School
☐ Grade 12 or Equivalent ☐ Post school Certificate / Diploma ☐ Bachelor / Honours Degree
☐ Masters / PhD

1.8 What is the employment status of the head of the household?
☐ Still in school ☐ Employed part-time ☐ Employed full-time
☐ Self-employed ☐ Unemployed ☐ Retired / Pension

1.9 What is the employment status of the person responsible for purchasing the household's food?
If it is the household head who is responsible for purchasing food, please proceed to the next question.
☐ Still in school ☐ Employed part-time ☐ Employed full-time
☐ Self-employed ☐ Unemployed ☐ Retired / Pension

1.10 What is the main source of energy you use for cooking in your home?
☐ Animal Dung ☐ Coal ☐ Electricity
☐ Liquefied petroleum gas (LPG) ☐ Liquid paraffin ☐ Open fire
☐ Other

2. FOOD WASTE

2.1 How often does the bread winner purchase food?
☐ Every day ☐ Every second day ☐ Twice a week
☐ Once a week ☐ Every two weeks ☐ Once a month
☐ Other

2.2 If other, please specify:

2.3 Who is responsible for cooking in your home?
☐ Mother ☐ Father ☐ Children
☐ Each person prepares individually ☐ Helper ☐ Other

2. FOOD WASTE [Continue]

2.4 If other, please specify:

2.5 Where do you usually purchase food you cook at home?

☐ Local shop ☐ Market ☐ Supermarket
☐ Wholesaler ☐ Other

If you can no longer consume some food items in your household, how do you manage it?
Food no longer fit for human consumption, for example: pips, peels, bones, decayed food, moulded food.

		Always	Often	Sometimes	Rarely	Never
2.6	Compost heap	☐	☐	☐	☐	☐
2.7	Discard it in the garbage bin	☐	☐	☐	☐	☐
2.8	Give it to the animals	☐	☐	☐	☐	☐
2.9	Composting bin	☐	☐	☐	☐	☐
2.10	Bury it	☐	☐	☐	☐	☐
2.11	Worm farm	☐	☐	☐	☐	☐

Please indicate to what extent you agree with the following statements concerning the main reasons for food waste occurring in your home.

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
2.12	We like to eat fresh food	☐	☐	☐	☐	☐
2.13	We are too busy to cook planned meals	☐	☐	☐	☐	☐
2.14	We do not know how to store food properly	☐	☐	☐	☐	☐
2.15	Food is left too long in the fridge/freezer	☐	☐	☐	☐	☐
2.16	We cook too much food	☐	☐	☐	☐	☐
2.17	We buy too much food	☐	☐	☐	☐	☐
2.18	We do not check cupboards, fridge/freezer before shopping	☐	☐	☐	☐	☐
2.19	Some household members do not always finish their food	☐	☐	☐	☐	☐

Please indicate how often the following food groups are discarded in your household:
Discarded when it is no longer suitable to be eaten.

		Never	Rarely	Sometimes	Often	Always
2.20	Fruits	☐	☐	☐	☐	☐
2.21	Vegetables	☐	☐	☐	☐	☐
2.22	Milk and milk products	☐	☐	☐	☐	☐
2.23	Bread	☐	☐	☐	☐	☐
2.24	Meat	☐	☐	☐	☐	☐
2.25	Legumes	☐	☐	☐	☐	☐
2.26	Fish	☐	☐	☐	☐	☐
2.27	Grains	☐	☐	☐	☐	☐

Please estimate how much food is wasted in your household(daily , once in three days, weekly, fortnightly, monthly)

2. FOOD WASTE [Continue]

		Daily	Once a week	Twice a week	Once in two weeks	Once a month
2.28	None	☐	☐	☐	☐	☐
2.29	A little (Quarter of 10 a litre bucket)	☐	☐	☐	☐	☐
2.30	A reasonable amount (Half of a 10 litre bucket)	☐	☐	☐	☐	☐
2.31	A great amount (More than half a of 10 litre bucket)	☐	☐	☐	☐	☐
2.32	Excessive amount (More than a 10 litre bucket)	☐	☐	☐	☐	☐

2.33 What is the main reason that motivates you to avoid food waste?

☐ It saves money ☐ It saves time ☐ It is family expectation
☐ It is the right thing to do ☐ Environmental concern ☐ It is easy to do
☐ Other

2.34 If other, please specify

		Always	Often	Sometimes	Rarely	Never
	Please indicate how often food is discarded in the following forms:					
2.35	Spoiled	☐	☐	☐	☐	☐
2.36	Burnt	☐	☐	☐	☐	☐
2.37	Bones	☐	☐	☐	☐	☐
2.38	Peels	☐	☐	☐	☐	☐
2.39	Expired (Past Use-by date)	☐	☐	☐	☐	☐
2.40	Past the Best-before date	☐	☐	☐	☐	☐
2.41	Cultural or Religious beliefs	☐	☐	☐	☐	☐
2.42	Pips	☐	☐	☐	☐	☐
	What do you usually do with your left overs in your household?					
2.43	Give to the needy	☐	☐	☐	☐	☐
2.44	Store in the fridge or freezer	☐	☐	☐	☐	☐
2.45	Give it to the animals at home	☐	☐	☐	☐	☐
2.46	Throw it away	☐	☐	☐	☐	☐
2.47	Use it to prepare other meals	☐	☐	☐	☐	☐
	How often do you do the following?					
2.48	Check pantry, fridge and freezer before shopping	☐	☐	☐	☐	☐
2.49	Do meal planning in advance	☐	☐	☐	☐	☐
2.50	Go to the store with a shopping list	☐	☐	☐	☐	☐
2.51	Buy only what is needed	☐	☐	☐	☐	☐
2.52	Check use by, best before and expiry dates of food items	☐	☐	☐	☐	☐
2.53	Consider how food is stored to keep it fresh	☐	☐	☐	☐	☐
2.54	Consider recommended food portion sizes	☐	☐	☐	☐	☐
2.55	Repurpose left over food	☐	☐	☐	☐	☐

2. FOOD WASTE [Continue]

2.56 Do you preserve fruits and vegetables in your household?
If no, please proceed to Section 3.

☐ Yes ☐ No

2.57 What techniques/methods of preserving fruits and vegetables are you using in your household?

3. DIETARY DIVERSITY

Please describe the food (meals and snacks) that you ate and drank yesterday during the day and night, at home. Start with the first food or drink in the morning.

3.1 BREAKFAST

3.2 SNACK

3.3 DINNER

3.4 SNACK

3.5 LUNCH

3.6 SNACK

For the past seven days, how many servings per day did you consume of the following food groups?

	Cereals	0	1-2	3-4	5	6
3.7	Bread	☐	☐	☐	☐	☐
3.8	Maize/corn	☐	☐	☐	☐	☐
3.9	Maize meal (Pap)	☐	☐	☐	☐	☐

3. DIETARY DIVERSITY [Continue]

3.10	Samp	☐	☐	☐	☐	☐
3.11	Porridge	☐	☐	☐	☐	☐
3.12	Sorghum	☐	☐	☐	☐	☐
3.13	Wheat	☐	☐	☐	☐	☐
	Roots and tubers					
3.14	White potatoes	☐	☐	☐	☐	☐
3.15	Turnip	☐	☐	☐	☐	☐
3.16	Radish	☐	☐	☐	☐	☐
3.17	Beetroot	☐	☐	☐	☐	☐
	Vitamin A rich vegetables and tubers					
3.18	Sweet potatoes	☐	☐	☐	☐	☐
3.19	Pumpkin	☐	☐	☐	☐	☐
3.20	Carrots	☐	☐	☐	☐	☐
3.21	Squash	☐	☐	☐	☐	☐
3.22	Yellow Peppers	☐	☐	☐	☐	☐
	Dark leafy vegetables					
3.23	Cabbage	☐	☐	☐	☐	☐
3.24	Spinach	☐	☐	☐	☐	☐
3.25	Rape	☐	☐	☐	☐	☐
3.26	Lettuce	☐	☐	☐	☐	☐
3.27	Indigenous Vegetables	☐	☐	☐	☐	☐
	Other vegetables					
3.28	Tomato	☐	☐	☐	☐	☐
3.29	Onion	☐	☐	☐	☐	☐
3.30	Green pepper	☐	☐	☐	☐	☐
3.31	Green beans	☐	☐	☐	☐	☐
3.32	Green peas	☐	☐	☐	☐	☐
	Vitamin A rich fruits					
3.33	Ripe mango	☐	☐	☐	☐	☐
3.34	Apricot(dried or fresh)	☐	☐	☐	☐	☐
3.35	Peaches(dried or fresh)	☐	☐	☐	☐	☐
	Other fruits					
3.36	Apples	☐	☐	☐	☐	☐
3.37	Bananas	☐	☐	☐	☐	☐
3.38	Oranges	☐	☐	☐	☐	☐
3.39	Plums	☐	☐	☐	☐	☐
3.40	Pears	☐	☐	☐	☐	☐
3.41	Grapes	☐	☐	☐	☐	☐
	Organ meat from ox, mutton, goat, chicken					
3.42	Liver	☐	☐	☐	☐	☐
3.43	Heart	☐	☐	☐	☐	☐
3.44	Offal meat	☐	☐	☐	☐	☐
	Flesh meat					
3.45	Beef	☐	☐	☐	☐	☐
3.46	Goat	☐	☐	☐	☐	☐
3.47	Mutton	☐	☐	☐	☐	☐
3.48	Pork	☐	☐	☐	☐	☐
3.49	Chicken	☐	☐	☐	☐	☐
3.50	Duck	☐	☐	☐	☐	☐
3.51	Rabbit	☐	☐	☐	☐	☐
	Eggs					
3.52	Chicken eggs	☐	☐	☐	☐	☐
3.53	Duck Eggs	☐	☐	☐	☐	☐
	Fish and Seafood					
3.54	Fresh Fish	☐	☐	☐	☐	☐
3.55	Tinned Fish	☐	☐	☐	☐	☐
3.56	Dried Fish	☐	☐	☐	☐	☐

3. DIETARY DIVERSITY [Continue]

	Legumes, Nuts and Seeds					
3.57	Dried beans	☐	☐	☐	☐	☐
3.58	Dried peas	☐	☐	☐	☐	☐
3.59	Lentils	☐	☐	☐	☐	☐
3.60	Seeds (Pumpkin seeds ,etc.)	☐	☐	☐	☐	☐
3.61	Nuts (Peanuts, almonds, cashew etc.)	☐	☐	☐	☐	☐
	Milk and Milk Products					
3.62	Milk	☐	☐	☐	☐	☐
3.63	Cheese	☐	☐	☐	☐	☐
3.64	Yoghurt	☐	☐	☐	☐	☐
	Oils and Fats					
3.65	Oils	☐	☐	☐	☐	☐
3.66	Fats or Butter	☐	☐	☐	☐	☐
	Sweets					
3.67	Sugar	☐	☐	☐	☐	☐
3.68	Honey	☐	☐	☐	☐	☐
3.69	Sweetened drink/juice	☐	☐	☐	☐	☐
3.70	Sugary Foods (cakes ,biscuits, chocolates, candies)	☐	☐	☐	☐	☐
	Spices, Condiments and Beverages					
3.71	Salt	☐	☐	☐	☐	☐
3.72	Spices	☐	☐	☐	☐	☐
3.73	Condiments (tomato sauce, hot sauce, soy sauce)	☐	☐	☐	☐	☐
3.74	Coffee	☐	☐	☐	☐	☐
3.75	Tea	☐	☐	☐	☐	☐
3.76	Alcohol beverages	☐	☐	☐	☐	☐

3.77 Did you or any household member eat anything (food or snack) OUTSIDE home yesterday?

☐ No ☐ Yes

4. HOUSEHOLD FOOD INSECURITY

4.1 In the past four weeks, did you worry that your household would not have enough food?

☐ No ☐ Yes

If your answer is No, skip question 4.2 and move to 4.3

4.2 How often did this happen?

☐ Rarely ☐ Sometimes ☐ Often

4.3 In the past four weeks, were you or any member of your household not able to eat the kinds of foods you preferred because of lack of resources?

☐ No ☐ Yes

If your answer is No, please move to question 4.5

4.4 How often did this happen?

☐ Rarely ☐ Sometimes ☐ Often

4.5 In the past four weeks, did you or any household member have to eat a limited variety of foods(less kinds of foods on a plate) due to lack of resources?

☐ No ☐ Yes

If your answer is No, please move to question 4.7

4.6 How often did this happen?

☐ Rarely ☐ Sometimes ☐ Often

4.7 In the past four weeks, did you or any household member have to eat foods that you really did not like to eat because of lack of resources to obtain other types of food?

☐ No ☐ Yes

If your answer is No, please move to question 4.9

4.8 How often did this happen?

☐ Rarely ☐ Sometimes ☐ Often

4.9 In the past four weeks, did you or any member of your household have to eat a smaller meal than you felt you needed because there was not enough food?

☐ No ☐ Yes

If your answer is No, please do not go to question 4.11

4. HOUSEHOLD FOOD INSECURITY [Continue]

4.10 How often did this happen?
☐ Rarely ☐ Sometimes ☐ Often

4.11 In the past four weeks, did you or any member of your household have to eat fewer meals per day, because food was not enough?
☐ No ☐ Yes
If your answer is No, please move to question 4.13

4.12 How often did this happen?
☐ Rarely ☐ Sometimes ☐ Often

4.13 In the past four weeks, was there ever not any kind of food to eat in your household because of lack of resources to get food?
☐ No ☐ Yes
If your answer is No, please move to question 4.15

4.14 How often did this happen?
☐ Rarely ☐ Sometimes ☐ Often

4.15 In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?
☐ No ☐ Yes
If your answer is No, please move to question 4.17

4.16 How often did this happen? ☐ Rarely ☐ Sometimes ☐ Often

4.17 In the past four weeks, did you or any household member go a whole day and without eating anything because there was not enough food?
☐ No ☐ Yes
If your answer is No, please do not attempt question 4.18.

4.18 How often did this happen?
☐ Rarely ☐ Sometimes ☐ Often

Thank you for your time and participation, it is much appreciated!

APPENDIX D: EDITING LETTER

GRAMMAR GUARDIANS

28 July 2023

To whom it may concern

Re: Proofreading and academic editing: M. Molapo

I, J.L. van Aswegen of Grammar Guardians, hereby confirm proofreading and academic editing of the master's thesis entitled "Exploring food insecurity, food waste, and dietary diversity among rural and urban households of Lesotho" by Maletsie Molapo during July 2023.

Please contact me on 082 811 6857 or at jeanne@grammarguardians.co.za regarding any queries that may arise.

Kind regards,

J.L. van Aswegen

Grammar Guardians