Seasonal consumption and contribution of indigenous leafy vegetables to household food security and daily recommended intakes in a rural community in Ndwedwe, KwaZulu-Natal

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DECLARATION

I, Ayanda Sthabiso Wesley Hlekwane, declare that this research dissertation is the result of my own work. I can confirm that this thesis has not been submitted elsewhere for degree purposes or examination. All quoted sources are acknowledged, and this work is free from plagiarism as stipulated in the institution's policy and regulations. A reference list is attached to the thesis.

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DEDICATION

To my family and friends, Mthokozisi Mnyaiza, Nosipho Miti, Nontando Shabalala, Zanele Khanyile, Nosipho Mthembu, Siyabonga Nxele, Nkosi Shoba, Phumelele Msomi, Siphosethu Nase, Nqobile Ngcobo and Dr. Natisha Dukhi, I appreciate the love and support you gave me.

ABSTRACT

Food insecurity remains a significant challenge in sub-Saharan Africa. Improving food security in rural South Africa can be achieved by assisting smallholder farmers, offering agricultural loans, providing competent agricultural services, and promoting the consumption of indigenous leafy vegetables (ILVs). Studies indicate that ILVs can alleviate food and nutrition insecurity while enhancing dietary diversity, particularly among rural families. However, ILVs are still underutilised. This study investigated the seasonal patterns of ILV consumption and their role in household food security and daily nutrient intake recommendations in Mangangeni village, Ndwedwe, KwaZulu-Natal. A group of 118 participants (aged 18 and older) was selected through snowball sampling. Various questionnaires were employed, including those for demographic information, food frequency, 24-hour food recall, and food coping strategies. The data were analysed using the Statistical Package for the Social Sciences (SPSS) version 27, utilising descriptive statistics and one-way ANOVA for comparative analysis. The findings revealed that women (62.7%) primarily handled food preparation. Many participants were unemployed and relied on family members for essential needs. ILVs such as Bidens pilosa, blackjack, black nightshade, and amaranth were mainly foraged from the wild, household gardens, or farms. Households regularly consumed approximately six ILVs, with most participants eating them at least once or twice a week. All participants perceived ILVs as healthy, cheaper than other vegetables, tasty, beneficial for preventing and regulating illnesses, high in nutrients, quick to cook, and energy-giving. Seasonal shifts in ILV consumption were noted, with higher levels in summer and spring and a decrease in autumn and winter due to limited availability. Nutrient intake assessments revealed high carbohydrate consumption and imbalances in micronutrients. The most common strategy for coping with food insecurity involved choosing less expensive foods, while the least common strategy was consuming seed stocks intended for planting. While ILV consumption is influenced by seasonal availability, the results indicate that ILVs are crucial for mitigating food insecurity in rural South Africa. Enhancing access to ILVs year-round and promoting a balanced diet could improve dietary intake and diversity.

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ABBREVIATIONS

AI	Adequate Intake
ALVs	African Leafy Vegetables
ARC-VOPI	Agricultural Research Council - Vegetables and Ornamental Plants
CHO	Carbohydrates
DAFF	Department of Agriculture, Forestry, and Fisheries
DoH	Department of Health
DDS	Dietary Diversity Score
DRIs	Dietary Reference Intakes
DUT	Durban University of Technology
EAR	Estimated Average Requirement
EER	Estimated energy requirements
FBO	Farm-based organisation
FAO	Food and Agriculture Organization
FCS	Food Coping Strategy
FFQs	Food frequency questions
FGDS	Food group diversity scores
FVS	Food variety scores
G	Grams
HSRC	Human Sciences Research Council
ILVs	Indigenous Leafy Vegetables
INEM	Indigenous Leafy Vegetables Nutrition Education Model
IREC	Institutional Research Ethics Committee
INP	Integrated Nutrition Programme
kJ	Kilojoules
KZN	KwaZulu-Natal
MRC	Medical Research Council
µg	Micrograms
NCDs	Non-communicable diseases
NGOs	Non-governmental organisations
N	Numbers
RDA	Recommended Dietary Allowance
FBDGs	South African Food based Dietary Guidelines
SA-FBDGs	South African Food-based Dietary Guidelines
SAMRC	South African Medical Research Council
SPSS	Statistical Package for Social Sciences
SASS	Sustainable Agri-food Systems Strategies
SDG	Sustainable Goal Development
UL	Tolerable Upper Intake Level
TAV	Traditional African Vegetables
TLVs	Traditional Leafy Vegetables
UNICEF	United Nations International Children's Emergency Fund
VNR	Voluntary National Review
WFP	World Food Programme
WHO	World Health Organization
SLF	Sustainable Livelihoods Framework

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CHAPTER ONE - INTRODUCTION TO THE STUDY

1.1 Introduction

Food security and food insecurity are terms that are often used interchangeably. The World Bank (2024) para. 1 line 1) defines food security as physical and economic access to enough nutritious and safe food that always meets people's dietary needs and food preferences to have a healthy and active life. Food insecurity is the inadequate and/or lack of access to regular healthy, safe, nutritious and affordable food that promotes optimal health and quality of life (Food and Agriculture Organization 2024: para. 4 line 1). The challenge of food insecurity remains a critical global issue, exacerbated by the socioeconomic disparities in South Africa (Brown, Mannell, Washington, Khaula and Gibbs 2024: 1).

In rural Southern Africa, this challenge persists as a long-standing problem for most households (Rusere, Hunter, Collinson and Twine 2024: 180). Despite agriculture's significant economic role in the KwaZulu-Natal province, household food insecurity endures, and the relationship between crop production systems and value chains in addressing this issue remains unclear (Cele and Mudhara 2024: 1). The Human Sciences Research Council (HSRC) (2024: para. 1 line 1) reported that although South Africa is considered food secure nationally, with various food programmes in place, millions of people still face hunger. Moreover, they further noted that ensuring food and nutrition security is a constitutional right, and the government has prioritised it through child support grants, school feeding schemes, and farmer support programs. Yet, despite these efforts, many continue to experience food insecurity, with some people going to bed hungry or eating only once or twice a day (HSRC 2024: para. 1 line 6).

Improving food security in South African communities can be achieved through interventions such as supporting smallholder farmers, providing agricultural loans, ensuring high-quality agricultural services, and promoting the use of indigenous leafy vegetables (ILVs) (Mbajiorgu and Odeka, 2022: 1; Mungofa, Sibanyoni, Mashau and Beswa 2022: 1). Research shows that ILVs can play a significant role in combating food and nutrition insecurity, particularly in rural households (Ngidi, Zulu, Ojo, and Hlatshwayo 2023: 1; Zulu, Ngidi, Ojo and Hlatshwayo 2022: 2). Rural communities often rely on ILVs as a food source, especially when supermarket access is limited (Hendriks, Viljoen, Marais, Wenhold, McIntyre, Ngidi, Annandale, Kalaba and Stewart 2020: 2). In addition, Rankoana (2021: 60) confirms that ILVs are vital for survival and food security in poor rural communities.

In support of this, Otang-Mbeng and Mashabela (2020: 541) further noted the importance of rural households utilising ILVs during their season to combat hunger. However, since ILV consumption and cultivation are seasonal, rural communities are forced to rely on coping strategies, such as purchasing food from commercial markets when ILVs are out of season (Mungofa, Malongane and Tabit 2018: 64). This highlights the need for increased cultivation of ILVs to improve their availability and support food security in poor rural households. Researchers must look closely at and monitor the consumption patterns of ILVs to make assumptions about the consumption status and the impact ILVs have on the food and nutrition status of poor communities in South Africa (Bokelmann, Huyskesns-Keil, Ferenczi and Stober 2023: 2). This chapter explores the food status and consumption patterns, focuses on the importance of utilising seasonal ILVs to minimise food insecurity in South Africa, and outlines the research problem, study aims and objectives.

1.2 Background of the study

South African rural communities have been utilising ILVs to alleviate food insecurity for decades (Mungofa, Sibanyoni, Mashau and Beswa 2022: 2). Indigenous leafy vegetables can be defined as wild plants that grow naturally in cultivated lands in a country of origin (Maseko, Mabhaudhi, Tesfay, Araya, Fezzehazion and Du Plooy 2017: 1). Maseko *et al*. (2018: 8) further state that ILVs plant are a species that can tolerate heat and drought, and they are either native to a place or they were brought to that region in the past and have since evolved naturally. The most common ILVs in rural communities in KwaZulu-Natal include ILVs such as *Bidens pilosa (*blackjack*), Solanum nigrum (*black nightshade*), Cucurbita (*pumpkin leaves), and *amaranth* (Qwabe and Pittawaty 2023: 149). According to Tshikororo, Ajao and Moteetee (2023: 1), the leaves of the ILVs are the part most eaten. Rural communities serve ILV leaves as a relish or side dish, while starchy foods form the basis of the meal (Otang-Mbeng and Mashabela 2020: 534). Although they deteriorate quickly, which is why they are consumed while fresh from harvest, the ILV's edible leaves play an important role in providing communities with food throughout the availability period (Ngcaba and Maroyi 2021: 4049). Therefore, ILV promotion may have various benefits such as improving food security and nutrition, and they also have economic benefits (Mungofa *et al.* 2022: 2).

Despite all the benefits and their contribution to food and nutrition security, ILVs remain underutilised (Shayanowako, Morrissey, Tanzi, Mochuweti, Mendiondo, Mayes, Modi and Mabhaudhi 2021: 2). There are various reasons for their underutilisation including a lack of information regarding their health benefits, availability, cultivation, preparation knowledge and negative perceptions that ILVs are food for the poor (Akinola, Pereira, Mabhaudi, De Buin, and Rusch 2020: 2).

A healthy and nutritious diet should include vegetables to ensure a balanced nutrient intake to prevent nutrient deficiencies (Imathiu 2021: 117). Increasing the consumption of ILVs can help reduce malnutrition as they are rich sources of essential micronutrients and antioxidants that address nutrient deficiencies and related health conditions (Govender, Pillay, Siwela, Modi and Mabhaudi 2017: 2; Mungofa *et al*. 2022: 1). Indigenous leafy vegetables provide vital nutrients such as vitamins A, C, and E, magnesium, iron, and carotene (Masekoameng and Molotja 2019: 35; Managa, Remize, Garcia and Sivakumar 2019: 1; Otang-Mbeng and Mashabela 2020: 534; Kahara, Turoop and Majiwa 2021: 11). Apart from micronutrients, some of the ILVs are rich in antioxidants, flavonoids, flavones and tannins (Mbhenyane 2017: 6). Additionally, ILVs offer macronutrients such as fibre and proteins to support dietary needs (Maseko *et al.* 2017: 8). Therefore, educating rural communities about these benefits and the importance of meeting the recommended daily allowance (RDA) of micronutrients could enhance the acceptance and consumption of ILVs, leading to significant health improvements (Zulu *et al*. 2022: 1).

Indigenous leafy vegetables do not only support diversification of the diet to address food insecurity and micronutrient deficiencies, they also play a crucial role in sustaining the economy (Kasimba, Motwagole, Covicin and Claseen 2017: 1201). This means that smallholder farmers can cultivate ILV crops and sell them by the roadside or to vegetable markets and street vendors to generate an income in their regions (Mungofa, Malongane and Tabit 2018: 61). Moreover, Mungofa*,* Malongane and Tabit (2018: 62) further reported that agricultural development is effective in building a sustainable economy and reducing poverty and promoting agricultural productivity. Zulu *et al.* (2022:1) concurred that agriculture is responsible for economic growth in South Africa. This means that the availability and selling of ILVs through small-scale farming to supermarkets can sustain the economy of a region (Maseko *et al.* 2018: 7). Maseko *et al.* (2018: 8) further stated that small-scale farmers should be trained in modern production techniques and quality control that will allow ILVs to be sold in supermarkets and in this way contribute to the economy of the country. Therefore, it is important to advocate for the promotion of ILV cultivation and consumption as it will assist in the development of small-scale farming and food production, resulting in a constant food source for communities (Maseko *et al.* 2018: 9).

1.3 Consumption status of Indigenous leafy vegetables

Indigenous Leafy Vegetables play a crucial role in the food systems of millions worldwide, particularly in Asia and sub-Saharan Africa. However, their significance is often overlooked (Rankoana 2021: 2; Imathiu 2021: 117). These traditional crops are increasingly recognised for their potential to address major global challenges, including malnutrition, climate change adaptation, and biodiversity loss, aligning with various Sustainable Development Goals aimed at eradicating hunger and promoting health (FAO 2022).

Unfortunately, this potential is threatened by a troubling global trend: a decline in both the cultivation and consumption of ILVs, especially in sub-Saharan Africa. This decline is primarily driven by a preference for exotic vegetable varieties, influenced by globalisation and market dynamics, as well as environmental degradation and changing agricultural practices (Esiobu, Taremwa, Nambajimana, and Mugwaneza 2018: 134).

Despite this overall decline, ILVs remain essential for food security, particularly in rural and marginalised communities, where they provide accessible, affordable, and culturally relevant sources of vital nutrients and dietary diversity, serving as a crucial buffer against food scarcity (Otang-Mbeng and Mashabela 2021: 7).

Since ILVs are widely available in South Africa, they form an integral part of agriculture and diet because the country is rich in ILVs diversity with over 100 species of ILVs available in provinces like Limpopo, Mpumalanga, KwaZulu-Natal, Eastern Cape, and North-West (Bokelmann, Huyskens-Keil, Ferenczi and Stöber 2022: 3; Towns and Shackleton 2019: 462; Maseko *et al.* 2017: 4). The terminology used for ILVs varies across South Africa's diverse linguistic and cultural landscape. In Nguni languages, these vegetables are called *imifino*, while in Sotho languages, they are known as *morogo,* and in Tshivhenda, and they are referred to as *miroho* (Senyolo, Wale, and Ortmann 2018: 2; Akinola *et al.* 2020: 2). This diversity highlights the deep cultural connections to these vegetables, which are an essential part of the diet in sub-Saharan Africa (Imathiu 2021: 117).

In rural KwaZulu-Natal, women play a dominant role in ILV cultivation (Qwabe, Zwane and Swanepoel 2021:109; Masuku and Bhengu 2021: 14; Gido, Ayuya, Owuor and Bokelmann 2017: 2). However, challenges persist, such as limited access to formal markets forcing smallholder farmers to rely on informal channels like street vending (Ndlovu, Thamaga-Chitja, and Ojo 2021: 1). Literature reports that the summer season is optimal in terms of the availability of various indigenous leafy vegetables (Mahlangu, Belete, Hlongwane, Luvhengo and Mazibuko 2020: 3). Qwabe and Pittawaty (2022: 150) further report that *Amaranth* and *Bidens pilosa* are the most commonly available ILVs in the rural areas during spring and summer. Therefore, to promote ILVs, expanding the cultivation and commercialisation of ILVs could enhance food security and support rural livelihoods by making these vegetables more widely available and economically viable (Nambafu, Bett and Sibiko 2024: 1).

Although the cultivation of ILVs has historically been a cornerstone of the South African food system, it has seen a decline in recent years (Mabhaudhi, Chibarabada, Chimonyo, Murugani, Pereira, Sobratee, Govender, Slotow and Modi 2018: 2). Despite being an inexpensive and nutritious food source with economic potential, ILVs have received little attention from policymakers, particularly in terms of commercialisation (Omotayo, Ndhlovu, Tshwene and Aremu 2020: 2; Senyolo, Wale and Orthman 2018: 4).

1.4 Role of indigenous leafy vegetables in achieving Sustainable Development Goal (SDG) 2.

The Sustainability dimensions showing the trade-offs of food, centred on indigenous vegetables by The Sustainable Agrifood Systems Strategies presented in Figure 1.1. It illustrates how incorporating indigenous vegetables enhances crop diversity, strengthens the local value chain, and diversifies the food system. This leads to greater household food security, better livelihoods, and decreased hidden hunger, fostering a positive feedback loop.

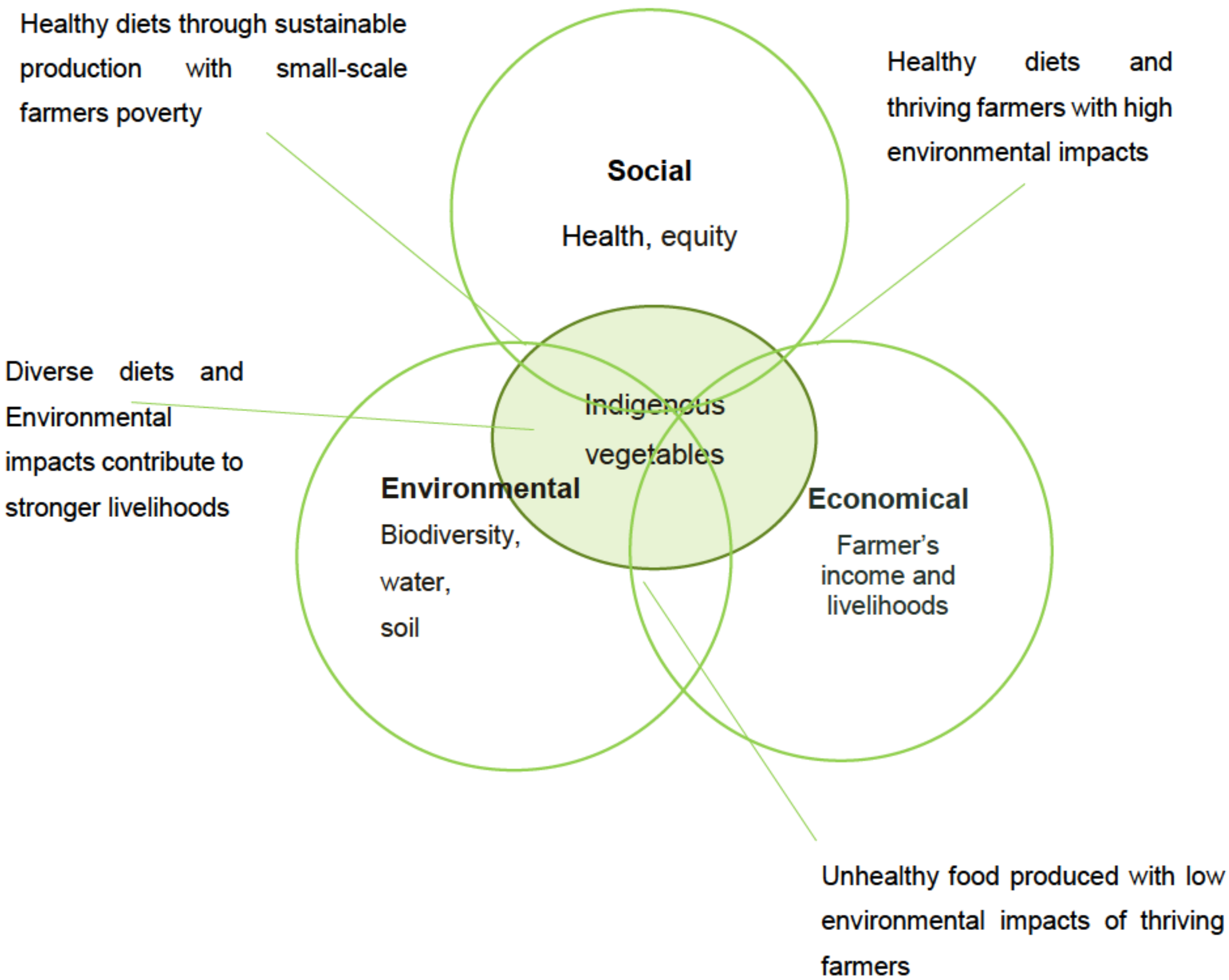


FIGURE 1.1 SASS REPORT: SUSTAINABILITY'S DIMENSIONS SHOWING THE TRADE-OFFS OF FOOD, CENTRED ON INDIGENOUS VEGETABLES (ADAPTED FROM MABHAUDHI *ET AL*. 2018)

A sustainable future requires a strong link between sustainable food safety and nutrition security (Vagsholm, Arzoomand and Boqvist 2020: 2). The United Nations' Sustainable Development Goals (SDGs) were created to address global challenges, including feeding 10 billion people by 2050, with a primary focus on eradicating hunger and improving the use of existing food resources (Vagsholm *et al.* 2020: 2). Sustainable Development Goal 2 adopted by South Africa aims to end hunger, achieve food security, promote sustainable agriculture, and improve nutrition by 2030 (United Nations 2016: para. 1 line 1). This goal contributes not only to food security but also to economic growth and poverty reduction (Bose and Khan 2022: 4).

South Africa's Voluntary National Review (VNR) by Tshediso Matona in 2019, then Secretary of National Planning in the Presidency, highlighted the adoption of SDG 2 within the broader context of regional plans under the African Union's Agenda 2063, which focuses on enhancing food systems and eradicating hunger across the continent (VNR 2019: 47). Achieving SDG 2 would signify progress in reducing household food insecurity and poverty (Viana, Freire, Abrantes, Rocha and Pereira 2022: 2). Therefore, encouraging sustainable farming practices, particularly the growth of various crops like indigenous leafy vegetables (ILVs), is crucial for tackling food insecurity and establishing resilient food systems (VNR 2019: 48).

Indigenous leafy vegetables play a key role in promoting sustainable agriculture, improving food diversity, and reducing food insecurity in impoverished regions, particularly in sub-Saharan Africa (Mugambiwa and Tirivangasi 2017: 2). The Sustainable Agrifood Systems Strategies (SASS) by Molina, D'Alessandro, Dekeyser and Marson (2020: 1) reported that there should be strategies to promote and sustain indigenous vegetables. Encouraging small-scale farmers to grow ILVs can help diversify diets and sustain food systems. Additionally, expanding ILV production will improve food availability and support local economies (SASS 2020: 9). Policymakers should enhance agricultural research, provide financial and technical support, and promote ILV cultivation to ensure sustainability (SASS 2020: 20).

1.5 Problem statement

Indigenous leafy vegetables have long been a relish prepared to accompany staple foods in diets across various regions, with their consumption forming an integral part of daily meals in many rural communities (Ngidi *et al.* 2023: 2). These vegetables, such as amaranth and blackjacks, have been a key component in the diets of people in Africa, Asia, and the Americas (Ngidi 2023: 2; Takaidza 2023: 1). They are known to contribute significantly to household food security and the overall food and nutritional diversity of local communities (Mncwango, Mavengahama, Ntuli and Van Jaarsveld 2020: 1; Ngidi 2023: 2). Despite the traditional importance of ILVs, patterns of consumption are often seasonal and influenced by availability, which can impact the extent to which these vegetables are incorporated into diets throughout the year (Mungofa *et al.* 2022: 13; Ntlanga, Jiba, Christian and Mdoda 2023: 124). This seasonal availability highlights a need for a deeper understanding of consumption trends and the factors that affect ILVs.

The nutritional benefits of indigenous leafy vegetables are well-documented and notable. These vegetables are rich in essential vitamins, minerals, and antioxidants, often surpassing conventional vegetables in these aspects. Furthermore, they provide crucial nutrients such as vitamins A and C, calcium and iron, which are vital for maintaining health and preventing malnutrition (Mungofa *et al.* 2022: 3; Bokelmann *et al.* 2022: 2). Their high nutrient density makes them particularly valuable for enhancing household food security, especially in regions where access to diverse and nutritious food sources may be limited. By integrating these vegetables more consistently into diets, households can improve their nutritional status and bolster their resilience against food shortages (Maseko *et al.* 2017: 8).

Despite their dietary advantages, ILVs remain underutilised in many regions (Talucder, Ruba and Robi 2024: 2). This underutilisation stems from a combination of factors including a lack of awareness, limited market access, insufficient integration into modern agricultural practices, and negative perceptions of these vegetables (Aderibigbe, Ezekiel, Owolade, Korese, Sturm and Hensel 2022: 1; Qwabe and Pittawaty 2023: 1). Moreover, existing research often neglects to factor in the seasonal patterns of consumption and the full scope of their potential contribution to food security (Knez, Ranic, Gurinovic, Gilibetic, Savic, Mattas and Yercan 2023: 2). This oversight is significant, as understanding seasonality is crucial for addressing food security in subsistence households in developing countries (Kitsuki and Sakurai 2023: 1). To bridge this gap, there is a need to reintroduce and better integrate traditional leafy vegetables into modern diets. This study aims to comprehensively analyse seasonal consumption trends, assess their impact on household food security, and explore strategies to enhance their utilisation. By addressing these areas, the study seeks to offer valuable insights into how these vegetables can be more effectively promoted and integrated into food systems to achieve better nutritional and food security outcomes.

Table 1.1 List of previously conducted studies on indigenous leafy vegetables in South Africa

Year	Author	Topic	Findings
2010	Faber, M., Oelofse, A., van Jaarsveld, P.J., Wenhold, F.A.M. and Jansen van Rensburg, W.S.	African leafy vegetables consumed by households in the Limpopo and KwaZulu-Natal provinces in South Africa	Six popular ILVs were identified found in KwaZulu-Natal rural areas. Namely; *Amaranth, Spider plant, blackjack*, and wild watermelon. These ILVs are boiled in salted water and then fried.
2011	Lewu, F.B. and Mavengahama, S.	'Utilisation of wild vegetables in four districts of northern KwaZulu-Natal province, South Africa'	Indigenous leafy vegetables were consumed as a relish and they are not cultivated. They are also utilised as medicine. They are abundant during the summer season. Local names varied among villages in the same district.
2011	Sithole, N.T.N., Thamaga-Chitja, J.M. and Mkanda, I.	'The Role of Traditional leafy vegetables (TLVs) in Household Food Security in rural KwaZulu-Natal (Mtubatuba)'	TLVs were abundant in summer and amaranthus, *blackjack and pumpkin* leaves were the most popular. Pumpkins were more popular for food security because they supplied leaves, seeds, and fruit. There was generally a positive attitude towards TLVs and the community did not consider them "poor people's food" or toxic, contrary to the popular notion.
2012	Ntuli, N.R., Zobolo, A.M., Siebert, S.J. and Madakadze, R.M.	'Traditional vegetables of northern KwaZulu-Natal, South Africa: Has indigenous knowledge expanded the menu?'	The survey documented 72 vegetable species of which nearly half were alien species. The majority of the vegetables were collected from the wild (56 species) and only 16 were cultivated. Alien species were preferred more extensively than native species (2.5 times more), despite the larger variety (larger choice) of the latter (38 native versus 34 alien species). Nearly 53% of traditional vegetables of alien origin belong to well-known vegetable families that are indigenous to the study area, suggesting that there is a classification system that allows people to explore new plant sources. This makes a case that Indigenous Knowledge Systems can expand the menu by incorporating newly introduced species. However, this also suggests that alien species, which are weeds and easily obtained around the home, are displacing native species as a major food source.

Table 1.1: List of previously conducted studies on indigenous leafy vegetables in South Africa (*Continued*)

Year	Author	Topic	Findings
2019	Ntuli, N.R.	'Nutrient content of scarcely known wild leafy vegetables from northern Kwazulu-Natal, South Africa'	Ten wild leafy vegetables were analysed for their proximate composition, amino acids, and mineral contents to evaluate their importance in human nutrition. Wild leafy vegetables differed significantly in terms of their nutrient content. Newly recorded and scarcely known wild leafy vegetables *Albertisia delagoensis, Ipomoea plebeia, Ipomoea wightii, Limeum sulcatum, Pyrenacantha kaurabassana, Pyrenacantha scandens, Riocreuxia torulosa* and *Sesamum alatum* had nutrient content higher than the well-known *Amaranthus hybridus,* with very few exceptions.
2020	Mncwango, N.C. and Mavengahama, S.	'Diversity, consumption, and ethnomedical claims of traditional vegetables consumed in the KwaMbonambi area, Northern KwaZulu-Natal, South Africa'	Vegetables were preferred primarily based on their taste; where most people ate them once a week when they were available. The major TLV consumption constraints were seasonal availability and low shelf life. A decline in the availability of TLVs was primarily caused by drought. Regardless of the observed decline, only 23% of respondents practiced informal cultivation of *Amaranthus* species. *Bidens pilosa, Momordica balsamina*, and *Corchorus olitorius* vegetable species were also known to possess some medicinal values.
2021	Qwabe, Q.N., Zwane, E.M. and Swanepoel, J.W.	'Recognising indigenous vegetables as potential contributors to livelihoods development: a case of two district municipalities in northern KwaZulu-Natal'	Indigenous vegetables have the potential to contribute to livelihood development. It was also found that these vegetables can thrive under diverse climatic conditions, including both irrigated and rain-fed areas.

Table 1.1: List of previously conducted studies on indigenous leafy vegetables in South Africa (*Continued*)

Year	Author	Topic	Findings
2022	Zulu, S.S., Ngidi, M., Ojo, T. and Hlatshwayo, S.I.	'Determinants of consumers' acceptance of indigenous leafy vegetables in Limpopo and Mpumalanga provinces in South Africa'	The study found that consumer acceptance is significantly influenced by perceived nutritional benefits, traditional consumption practices, and the availability of these vegetables in local markets. Additionally, the research highlighted that improving consumer awareness and accessibility could enhance the adoption of indigenous leafy vegetables in these provinces.
2023	Ngidi, M.S.C., Zulu, S.S., Ojo, T.O. and Hlatshwayo, S.I.	'Effect of consumers' acceptance of indigenous leafy vegetables and their contribution to household food security'	The results from descriptive statistics revealed that most consumers did not produce ILVs but consumed them. Meanwhile, a small number of people produced ILVs yet did not consume them. The results from the Household Food Insecurity Access Scale (HFIAS) showed that a large proportion of the population experienced moderate food security while some of the individuals within the population experienced severe food insecurity. The findings further revealed that age, gender, and education variables negatively influenced the consumption of ILVs.
2023	Qwabe. Q.N. and Pittawaty, T.	'Exploring the role of Indigenous vegetables in rural livelihoods: Perceptions from the Ntuze community.'	There is an under-appreciation of local varieties such as *imifino yasendle* (wild leafy vegetables) and stigmatisation of utilisation of these foods. Among the themes that were inductively identified, the consumption of ILVs was linked to (i) household food security, (ii) the perceived medicinal benefits to improve their health conditions, and (iii) the source of income.

1.6 Motivation for the study

This study was motivated by the need to address food security concerns in rural communities and improve consumption of ILVs, and nutritional outcomes in resource-constrained situations. Despite their high nutritional value and potential to improve household food security, indigenous leafy vegetables are underutilised or even rejected. Understanding their seasonal consumption patterns in a rural community and their effects on household food security can lead to developing new strategies for more successful ILV consumption and promotion. This study intends to give actionable insights that can educate policy, encourage sustainable agricultural practices, and promote healthy dietary habits within communities by identifying possible challenges to their use. Additionally, bridging the knowledge gap regarding the underutilisation of ILVs will contribute to the broader goal of diversifying food sources and improving resilience in rural communities against household food insecurity. As climate change and other factors increasingly threaten traditional food systems, leveraging indigenous knowledge and resources can play a role in building adaptive and sustainable solutions. This study seeks to empower communities by integrating ILVs into modern food security strategies, ultimately supporting both local nutrition and global efforts towards sustainable development. Therefore, this study aims to answer the following questions: What is the perception and consumption frequency of ILVs in the different seasons, and how do they contribute to household food security and dietary recommended intake in the rural Mangangeni village.

1.6.1 Rationale for Exclusive Focus on Indigenous Leafy Vegetables

The category of indigenous foods encompasses a wide variety of crops, but this research specifically examines six widely consumed ILVs in Mangangeni village. This focused selection is based on several key factors. Firstly, ILVs, such as amaranth and blackjacks, are culturally significant and vital sources of micronutrients in local diets, particularly during certain seasons. By concentrating on these specific ILVs, the study aims to provide a detailed understanding of their consumption patterns, contributions to dietary health, and associated perceptions insights that could be overlooked if the research included all indigenous crops.

Moreover, focusing on the most commonly used ILVs ensures that the findings are directly applicable and practical for community-level interventions aimed at food security, targeting these established food sources. While acknowledging the importance of other indigenous crops, an in-depth exploration of ILVs, especially their seasonal variations, lays a crucial foundation for future comprehensive studies and ensures that the current research objectives remain practical and focused.

As highlighted in the problem statement, a significant challenge for ILVs is their seasonal availability, which can hinder their regular incorporation into diets. However, their role in securing household food supplies and promoting dietary diversity can be sustained year-round through traditional methods, thoughtful dietary planning, and their unique nutritional properties. Even when fresh ILVs are not readily available, seasonal harvesting supports various preservation methods, such as drying or fermentation, which extend their usability and nutrient retention beyond the growing season (Dlamini and Viljoen 2020: 57). These preserved forms can then be incorporated into culinary practices throughout the year, providing essential vitamins and minerals when other fresh vegetables are scarce.

1.7 Research Aim and Objectives

To answer the research questions, this research aims to examine the seasonal consumption, frequency, and contribution of ILVs to household food security and daily recommended intakes in rural households of Mangangeni village, Ndwedwe, KwaZulu-Natal.

1.7.1 Objectives

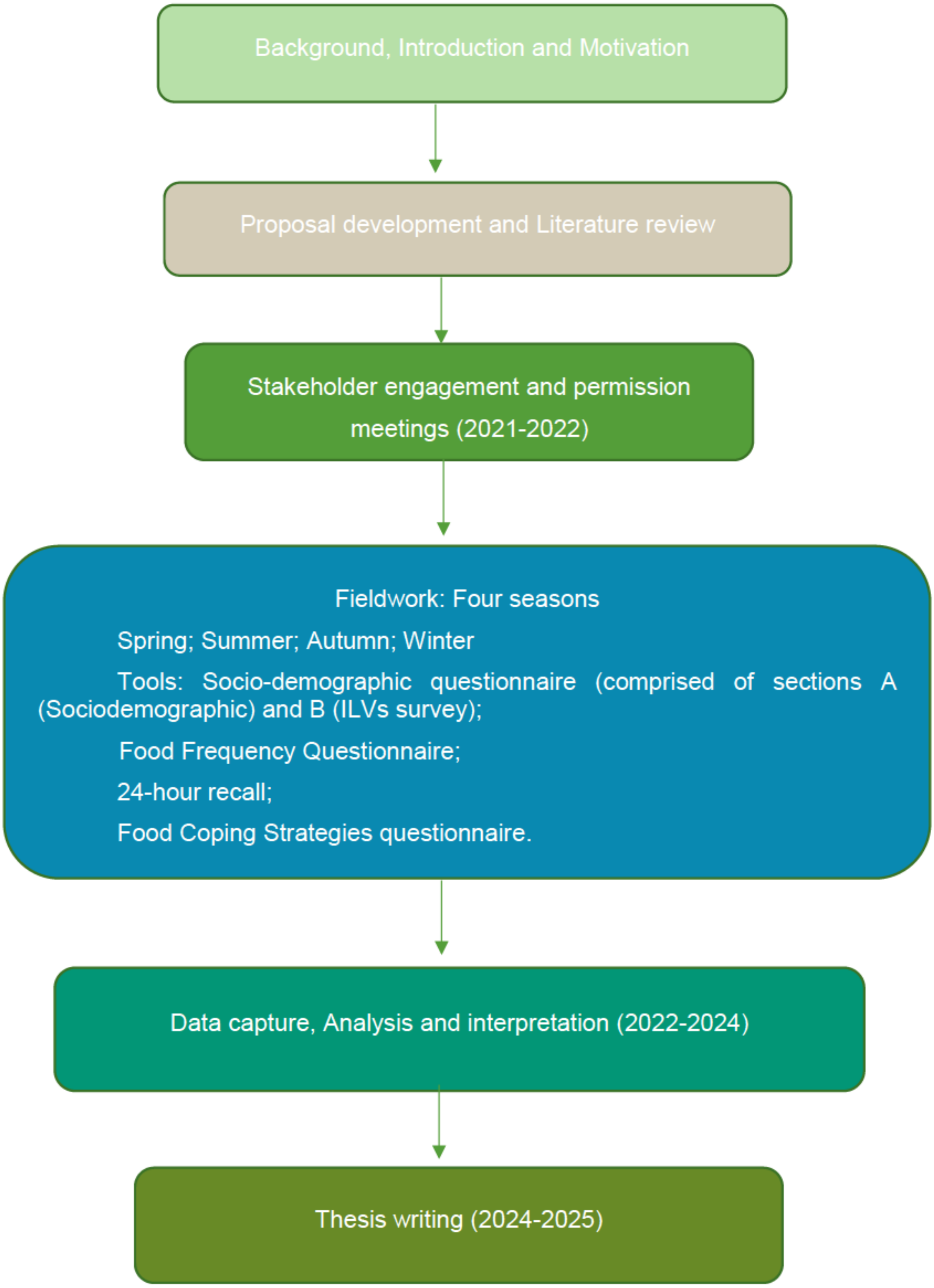
To achieve this aim, the following objectives have been identified:

- To investigate the socio-demographic profile of 118 participants of Mangangeni village by using a socio-demographic questionnaire.
- To identify consumers' perception and sourcing of ILVs using a survey through in-person interviews.
- To assess ILVs, and their contribution to dietary diversity, using a food frequency questionnaire administered in each of the four seasons.
- To evaluate the contribution of ILVs to daily nutritional requirements by using 24-hour recall questionnaires administered in the four seasons.
- To determine availability of food as an indicator of access to food when ILVs are out of season using a Coping Strategies questionnaire.

1.7.2 Assumptions, Delimitations, and Demarcations of the Study

This research is based on several key assumptions, including the expectation that participants will accurately and honestly report their consumption habits and perceptions, as well as the validity and reliability of the selected research tools for gathering necessary data. The study specifically focuses on six widely consumed ILVs in Mangangeni village, chosen for their cultural significance and prevalence in local diets. This targeted approach allows for a detailed analysis of their seasonal consumption, nutritional value, and associated perceptions, rather than a broader and less thorough examination of all indigenous crops. Furthermore, the study is geographically confined to Mangangeni village in Ndwedwe, South Africa, and temporally limited to the years 2022 to 2024, encompassing all four distinct seasons to effectively capture significant seasonal variations. This careful delineation ensures that the research remains manageable and practical while providing precise, actionable insights relevant to the seasonal food patterns in the local area.

1.8 Framework of the study: Flow diagram of the research process



1.9 Structure of the thesis

The dissertation consists of five chapters.

Chapter 1: Introduction

Chapter 1 consists of the **Introduction**, which gives the background to the research problem statement, the motivation, and the layout of the thesis.

Chapter 2: Literature Review

This chapter provides a background to knowledge on ILVs and its significance to the subject matter under discussion.

Chapter 3: Research Methodology

This chapter gives detailed information on the research area, data collection, and an outline of the research instruments used in the study.

Chapter 4: Results and discussion

Chapter 4 presents the analysed findings of the study according to the study objectives. A discussion of the key findings of the study is discussed with reference to the literature.

Chapter 5: Recommendations and Conclusion

This chapter presents possible recommendations and conclusions drawn from the study results.

1.10 Conclusion

In conclusion, the widespread underutilisation of ILVs, primarily due to their seasonal availability and the resulting fluctuations in dietary integration, poses a significant challenge to household food security and nutrition. While the nutritional benefits of ILVs are well established, previous research has often overlooked the impact of seasonality on consumption patterns and overall contributions. This study addresses this gap by setting clear objectives to investigate socio-demographics, consumer perceptions, dietary diversity, and nutritional contributions across all four seasons, as well as exploring coping strategies for when ILVs are out of season. By employing a novel and comprehensive seasonal approach, this research aims to provide a nuanced understanding of ILV utilisation, offering actionable insights to enhance their consistent integration into diets and improve year-round food security and nutritional well-being.

CHAPTER TWO - LITERATURE REVIEW

Mapping literature review to research objectives

Table 2.1 highlights the key connections by illustrating the relationship between the literature review contents and research objectives and demonstrating how the review informs and supports the study goals to ensure a clear investigation.

TABLE 2.1 INDEX AND CHAPTER OUTLINE

Research Objective	**Relevant literature**
To investigate the socio-demographic profile of 118 participants of Mangangeni village by using a socio-demographic questionnaire.	There is no socio-demographic literature discussed in the literature. However, sociodemographic surveys are instruments used to collect social and demographic data on the population. It lays the foundation on the participants' profile. In this literature food security status in different socio-demographics from both a global and a regional perspective is discussed to assist with understanding their perceptions about ILVs and food consumption patterns.
To identify consumers' perception and sourcing of ILVs using a survey through in-person interviews.	This section gives an overview of ILVs and discusses consumers' perceptions on ILVs and sourcing of ILVs. This includes knowledge, attitudes and practices which are essential to understanding sourcing patterns, the role of ILVs to food security, and determinants of ILV consumption.
To assess ILVs, and their contribution to dietary diversity, using a food frequency questionnaire administered in each of the four seasons.	Highlights the role of ILVs in dietary diversity which is important for understanding nutritional outcomes. The food variety scores, and food group diversity scores clearly describe dietary diversity.

Table 2.1 Index and chapter outline (*Continued*)

Research Objective	Relevant literature
To evaluate the contribution of ILVs to daily nutritional requirements by using 24-hour recall questionnaires administered in each of the four seasons	Report on the nutritional content of ILVs and their contribution to daily nutritional requirements, providing insights into their contribution to nutritional requirements, and nutritional and dietary requirement strategies to address malnutrition such as South African Food based dietary guidelines (FBDGs), and the use of dietary reference intakes (DRIs) to compare the study results.
To determine availability of food as an indicator of access to food when ILVs are out of season using a Coping Strategies questionnaire	This section looks at the coping strategies used during food scarcity, shedding light on the challenges community members face accessing nutritious food.

2.1 Introduction

Understanding individuals' perceptions of food and their experiences with food insecurity is essential for developing culturally relevant and community-driven food security initiatives (Brown *et al.* 2024: 20). Global challenges, such as severe weather patterns characterised by heavy rainfall and prolonged drought, significantly disrupt food security by affecting agricultural practices, reducing crop production, and impacting food accessibility and affordability (Mazibuko and Letsoko 2024: 120; Maziya, NkoNki-Mandleni, Mbizana and Tirivanhu 2024: 11). These climatic changes have also diminished forest resources, further affecting household income and self-sufficiency (Maziya et al. 2024: 11).

In this context, Indigenous Leafy Vegetables represent a vital yet often underutilised resource. Research indicates that increasing the production and consumption of a diverse range of ILVs can substantially enhance household food security, particularly in impoverished rural areas, as these vegetables thrive in harsh conditions, support resilient agricultural practices, and provide high nutritional value (Shelembe et al. 2024: 14; Ngidi et al. 2023: 10). ILVs are rich in essential nutrients, including vitamins, minerals, and dietary fiber, and their regular consumption is associated with a lower risk of chronic illnesses (Nko et al. 2024: 65; Ngidi et al. 2023: 10).

Despite their notable benefits, ILVs face significant barriers to wider adoption. Challenges include their absence from formal market structures, high processing costs due to electricity rates for prolonged cooking, limited market options, and a lack of knowledge and skills for incorporating them into formal food chains (Shelembe, Hlatshwayo, Modi, Mabhaudhi and Ngidi 2024: 14; Vilakazi 2024: 112). Additionally, cultural perceptions often regard them as inferior to exotic vegetables, compounded by limited awareness of their nutritional advantages and preparation methods (Nko, Mpolokeng, Mokgau, Asong, Omotayo and Aremu 2024: 65). A critical gap in much of the existing literature is the insufficient focus on the seasonal patterns of ILV consumption and availability, which significantly affects their consistent contribution to year-round food security.

This chapter provides a comprehensive review of the existing literature on the consumption of indigenous leafy vegetables and their role in household food security, with a specific focus on the KwaZulu-Natal context. As introduced in Chapter One, while ILVs hold immense potential to enhance food security in rural South African regions, their consumption has declined. This review critically examines current understandings, identifies key gaps especially regarding the seasonal variability of ILV consumption and their exact nutritional contributions throughout the year and clarifies how the current study's research design is uniquely equipped to address these gaps. Understanding the current state of food security and ILV consumption will facilitate new insights into the determinants of ILV seasonal consumption and perceptions, as well as how these factors impact food security. A subsequent discussion will explore the impact of ILVs on food security, integrating literature on various ILV species, their nutritional profiles, dietary diversity, recommended dietary intakes, and challenges associated with nutrient intake. Importantly, this chapter will also connect coping strategies literature with the associated nutritional implications, particularly when ILVs are out of season, to establish a robust conceptual framework for the study.

2.2 Food security status: A Global, National and Local Perspective

The World Bank (2024: para. 1 line 1) defines food security, as resolved at the World Food Summit held in 1996, as access to adequate, safe, and nutritious food that always meets dietary intake needs at the household level. The world's food insecurity and nutrition state report by the World Bank in 2024 shows that there are challenges in minimizing food insecurity and ending hunger (World Bank 2024: para. 4 line 1). These challenges have been exacerbated by the Russia-Ukraine war that has caused a global food crisis which has halted food imports resulting in rising food prices worldwide (Filho, Fedoruk, Eustachio, Barbir, Lisovska, Lingos and Baars 2023: 1; Al-Saidi 2023: 1). The increasing costs of food, as stated by the World Food Programme (WFP) (2023: para. 1 line 1) and the World Bank (2024: para. 2 line 2), have placed additional pressure on food security, especially for individuals in low socio-economic communities.

When looking at the statistics, the United Nations International Children's Emergency Fund (UNICEF 2023: para. 2 line 1) reported that approximately 2.4 billion people, primarily women and those residing in rural areas, face challenges in accessing an adequate food supply. Countries in East Africa face big challenges in achieving food security due to the economic crisis, conflicts, and climate change (Abdullahi, Kalengyo and Warsame 2024: 1). To minimize food insecurity globally requires the involvement of directing resources primarily towards promoting nutritious food and agricultural development practices and implementing effective strategies to mitigate climate change (Brenya, Jiang, Sampene and Zhu 2024: 1).

Addressing food insecurity is a dire need in sub-Saharan countries as it is influenced by climate change and food price changes (Burchi, Scarlato and Agostino 2018: 1). Other than climate change, persistent food insecurity is also influenced by a growing population (Brenya *et al.* 2024: 9). According to Wudil, Usman, Rosak-Szyrocka, Pliar and Boye (2022: 1), food insecurity has increased in sub-Saharan African countries since 2015, with the recent COVID-19 virus and Ukrainian conflict worsening the situation. The WFP (2024: para. 2 line 3) indicated that about 1.8 million people are food insecure in Angola and the number of people living in poor conditions continues to grow and noted that climate impacts food security. In Namibia, the Integrated Phase Classification (IPC 2024: para. 1 line 1) reported high levels of acute food insecurity which accounted for 40% of the sampled population. It further reported that urgent action is needed to reduce food gaps. Moreover, the IPC highlighted that economic decline, unemployment, food prices, and climate change contribute to severe food insecurity. To fight food insecurity, Giller (2020: 1) highlighted that sub-Saharan countries need a multi-faceted approach to ensure enough affordable food to feed the growing population and sustain national food security.

South Africa ranks as one of the countries with the most significant income inequality globally and has exceptionally high levels of poverty (World Bank 2022: para. 1 line 7). Since the start of South Africa's democratic transition in 1994, poverty, unemployment, and inequality have continued to persist, along with the resulting food insecurity (World Bank 2018: 4). Despite the national dedication to ending hunger by 2030, the issue of food insecurity continues to be a public health concern (Tambe, Mabapa, Mbhatsani, Mandiwana, Mushapi, Mohlala and Mbhenyane 2023: 1). Factors such as food prices, climate change, population growth, and poverty contribute to increased food insecurity (Nengovhela, Mokhaukhau and Hlongwane 2024: 1).

The recent food and nutrition security report published by the Human Sciences Research Council (HSRC) indicated that most households (63.5%) in South Africa experienced food insecurity compared to food secure households (36.5) (Simelane, Mutanga, Hongoro, Parker, Mjimba, Zuma, Kajombo, Ngidi, Masamha, Mokhele, Managa, Ngungu, Sinyolo, Tshililo, Ubisi, Skhosana, Ndinda, Sithole, Muthige, Lunga, Tshitangano, Dukhi, Sewpaul, Mkhongi and Marinda 2023: 81). The food insecurity was classified, and the levels revealed that 17.5% of households were severely food insecure, 26.7% experienced moderate food insecurity, and 19.3% were mildly food insecure (Simelane *et al.* 2023: 81).

The levels of food insecurity differ across South Africa's nine provinces. The food security and nutrition indicators as reported by Simelane *et al.* (2023: 84) indicate that in the Western Cape 45% of the population were food secure, 15% were mildly food insecure, 22% were moderately food insecure, and 17% were severely food insecure; Eastern cape statistics show that 27% were food secure, 22% were mildly food insecure, 31% were moderately food insecure, and 20% were severely food insecure; Northern Cape results show that 35% were food secure, 18% were mildly food insecure, 26% were moderately food insecure, and 21% were severely food insecure; Free State showed that 32% were food secure, 19% were mildly food insecure, 27% were moderately food insecure, and 22% were severely food insecure; in North West, 27% were food secure, 18% were mildly food insecure, 30% were moderately food insecure, and 25% were severely food insecure; in Gauteng, 49% were food secure, 17% were mildly food insecure, 30% were moderately food insecure, and 14% were severely food insecure; in Mpumalanga, 30% were food secure, 18% were mildly food insecure, 30% were moderately food insecure, and 22% were severely food insecure. Conversely, Rusere, Hunter, Collinson and Twine (2024: 160) reported that there have been improvements in the level of food security within households over the past ten years in the Mpumalanga province. In Limpopo, 37% were food secure, 18% were mildly food insecure, 32% were moderately food insecure, and 12% were severely food insecure. In addition, Mbhenyane and Tambe (2024: 15) conducted a study in two villages in Limpopo, which revealed that less than one-quarter (23.7%) of the households surveyed had adequate food, while 39.4% were at risk and 36.9% were facing hunger.

In KwaZulu-Natal, many factors have a significant impact on household food security. These factors include the head of household gender, cash transfers, financial access, participation in a farm-based organisation (FBO), and the availability of agricultural training (Mncube, Ngidi, Ojo and Nyam 2023: 1). Cele and Mudhara (2024: 1) concur that food insecurity in this province may be negatively influenced by factors such as education, traditional knowledge, livestock ownership, and [lack of] market integration. Additionally, historical disparities in rural parts of KZN are linked to challenges such as high poverty levels, unemployment, and increased food insecurity (Brown *et al.* 2024: 1).

The food and nutrition survey report published by HSRC in 2024 indicated that KZN household food and nutrition security indicators show that 30% of the population is food secure, 24% is mildly food insecure, 29% is moderately food insecure, and 17% is severely food insecure (Simelane *et al.* 2023: 83). In 2009, food security intervention programmes such as “One Home, One Garden” developed by the Department of Agriculture, Forestry, and Fisheries (DAFF) in response to the inadequate outcomes of past food security intervention initiatives were initiated in KwaZulu-Natal province to attain food security. Despite this, households in the province continue to experience food security challenges, particularly in Maphumulo Local Municipality (Ngema, Sibanda and Musemwa 2018: 3).

In the iLembe region, Drysdale, Moshabela and Bob (2019: 393) found that food insecurity and shortages were widespread, and while there seemed to be no difference between urban and rural households, there were differences in behaviours and the kinds of strategies used to cope with food shortages. Crop farming, especially in rural areas, is a common strategy to eliminate food insecurity (Masuku, Selepe and Ngcobo 2017: 1). A report compiled by Ubhaqa Land and Agrian Reform Agency (2016: 37-38) for Ndwedwe local municipality reported that local communities in this region collect local cultivated and uncultivated plants from the wild and their own farms, to support their diets. This includes crops like taro, amaranth and blackjacks, sweet potatoes and cassava, and production and promotion of these vegetables and adding value to them can be a source of income generation, a food security initiative, and an enterprise development opportunity. Other strategies used in the iLembe region included relying on government grants to assist during hard times (Drysdale, Bob and Moshabela 2021: 36).

2.3 Food Coping Strategies in sub-Saharan Africa

Challenges related to food access in sub-Saharan Africa are underscored by the diverse coping strategies employed by households experiencing food insecurity. Specifically, food-insecure households frequently depend on social networks for assistance or seek support from family members (Biadgilign 2023: 1). The strategies adopted by these households during food crises may encompass consuming less preferred meals, skipping meals, borrowing money, reducing meal frequency, and decreasing portion sizes (Danso-Abbeam, Asale and Ogundeji 2023: 1; Masha, Bojago, Abrhama, Leja and Delango 2023: 1). Additional reported strategies include soliciting help from friends, making do with available food resources, and occasionally resorting to the consumption of low-quality or unsafe foods (Militao, Salvador, Silva, Uthman, Vinberg and Macassa 2022: 1). Nickanor, Kazembe and Crush (2022: 1) concur that coping strategies, such as relying on less preferred and cheaper food options, are prevalent in efforts to alleviate food insecurity. Ali and Kumari (2024: 1) corroborated these findings, identifying the five most common coping strategies as reliance on less preferred or cheaper foods, reducing meal frequency and portion sizes, purchasing food on credit, and obtaining food from family and friends. Moreover, the efficacy of these coping mechanisms is often contingent upon household demographics and socioeconomic status, with wealthier households typically utilising fewer strategies compared to their poorer counterparts, who rely heavily on a range of methods, including taking on additional work and liquidating assets (Carley, Graff, Konisky and Memmott 2022: 1; Ahmad, Shahnawaz and Alam 2021: 1).

South African households utilise different coping strategies in times of food scarcity (Dlamini, Mtintsilana, Craig, Mapanga and Norris 2024: 705). These strategies include relying on less preferred and less expensive foods, sending a household member to beg for food, borrowing food, or borrowing money to buy food, purchasing food on credit, limiting portion sizes at mealtimes, skipping meals and going the whole day without eating, and reducing the number of meals eaten in a day (Dlamini, Mtintsilana, Craig, Mapanga and Norris 2024: 705). The coping strategies employed exhibit significant variation across different demographic groups. For instance, older heads of households tend to prefer food adjustment strategies instead of selling assets, whereas larger families frequently prioritise meal adjustments over asset sales (Ogunyemi, Olutumise and Adegoroye 2022: 5).

The interaction between these coping strategies can offer insights for developing policies and interventions that can improve food security and increase resilience for vulnerable populations.

A study by Drysdale, Moshabela and Bob (2019: 388) found that in the iLembe region, in rural KwaZulu-Natal the results from the study indicated that the common coping strategies utilised included purchasing more affordable food and limiting portion sizes. Other coping strategies included borrowing food, reducing meal frequency, early harvesting or hunting, and using credit to buy food. The least utilized coping strategies were going the entire day without eating and sending a household member to beg for food. These findings correlate with Bavuma, Ebioha and Mugari (2023: 1) who reported that people facing food insecurity in semi-rural Eastern Cape province utilise coping strategies such as consuming less preferred food and reducing portion sizes to ensure food security. Hlongwane and Ledwaba (2018: 58) concur that relying on more affordable food and reducing the number of meals consumed in a day are the common coping strategies used to ensure food security in rural parts of the province. In addition, Mbhenyane, Tambe, Phooko-Rabodiba and Nesamvuni (2020: 1) concurred that coping strategies such as buying food on credit or borrowing food from friends are prevalent and utilised as primary strategies for low socioeconomic households to manage food security.

2.4 Overview of South African Indigenous Leafy Vegetables (ILVs)

The Department of Agriculture, Forestry, and Fisheries (DAFF) defines ILVs as crops that originate from a specific region and are integral to local food systems (DAFF 2013: 2). Kansiime, Ochieng, Kessy, Karanja, Romney and Afari-Sefa (2018: 724) assert that indigenous plants should be locally sourced and possess a long-standing recognition as traditional vegetables. In South Africa, a diverse array of over 100 ILV species has been documented, as identified by Wehmeyer and Rose in 1983 (Van Rensburg, Van Averbeke, Slabbert, Faber, Van Jaarsveld, van Heerden, Wenhold and Oelofse 2007: 317). These species are referred to by various names across different linguistic groups in South Africa, including *imifino* in *IsiZulu*, *morogo* in SeSotho, and *miroho* in Tshivhenda (Maunder and Meaker 2007: 403). Indigenous leafy vegetables are also designated by several terms, such as traditional leafy vegetables (TLVs), African leafy vegetables (ALVs), and traditional African vegetables (TAV), which are frequently used interchangeably based on cultural and geographical contexts (Towns and Shackleton 2018: 465).

Indigenous leafy vegetables can be cultivated in home gardens, providing a practical solution to food insecurity (Maroyi 2022: 227). African leafy vegetables such as amaranth and blackjacks are easily accessible and resistant to droughts and form an integral part of traditional diets but remain underutilised despite their benefits (Shayanowako *et al.* 2021: 2). Therefore, it is important to look at consumption status and promotion of ILVs because they are facing many problems including inadequate production and underutilisation which need to be addressed (Imathiu 2021: 122).

The consumption of ILVs can be limited by negative perceptions and limited availability. The negative perceptions such as that ILVs are old-fashioned food or food associated with poverty limit the consumption of ILVs in South Africa (Ntlanga, Jiba, Christian and Mdoda 2023: 123). The limited availability is attributed to small-scale production since ILVs are found in cultivated lands in the wild, which then leads to underutilisation (Maseko *et al*. 2017: 1). The two abovementioned determinants contribute to the underutilisation of ILVs, and they are posing a threat to food security and rural development (Senyolo, Wale and Ortmann 2018: 771). As a result, it is imperative to expand ILV production and availability to create new value chains, address food security directly and enhance household income (Imathiu 2021: 120). The ILVs such as blackjack, amaranth, and pumpkin leaves can be utilized to generate household income (Mayekiso, Belete and Hlongwane 2018: 90). To promote utilisation of ILVs, preserving knowledge of edible ILVs is vital for maintaining their benefits, enhancing cultural practices, and improving food security in biodiversity-rich communities (Maroyi 2022: 227).

2.4.1 Role of indigenous leafy vegetables in food security and as a coping strategy

Leafy vegetables play a vital role in enhancing food security, particularly in low-income households and during periods of food scarcity. Their rapid growth, nutritional value, and availability make them a key coping strategy for communities facing food insecurity. These vegetables are often cultivated locally, require minimal resources, and can be harvested multiple times, making them an affordable and sustainable food source. Table 2.2 presents nutrient content of ILVs.

Table 2.2 Nutrient composition per 100 g of cooked indigenous leafy vegetable

Common Name	*IsiZulu* Name	Scientific Name(s)	Nutrient retention per cooked 100g	References
Amaranth	*ugabolo*	*Amaranthus spp.*	Energy: 272 kJ, protein: 4.2 g, calcium (421 mg), magnesium (230 mg), phosphorus (73 mg), sodium (9 mg), potassium (413 mg), copper (161 µg), zinc (0.66 mg), iron (4.9 mg), manganese (2.34 mg), thiamine (0.03 mg), riboflavin (0.05mg), folic acid (49 µg), vitamin C (1 mg), and vitamin A (510 µg RAE)	van Jaarsveld, Faber and van Heerden 2012: 233-234.
Black Nightshade	*Umsobosobo*	*Solanum retroflexum*	Energy: 162kJ, protein: 0.5g, calcium (189mg), magnesium (87mg), phosphorus (33mg), sodium (8mg), potassium (232 mg), copper (152µg), zinc (0.53mg), iron (6.9mg), manganese (2.08mg), thiamine (0.07mg), riboflavin (0.16 mg), folic acid (37µg), vitamin C (3 mg), and vitamin A (401µg RAE).	van Jaarsveld, Faber and van Heerden 2012: 233-23.
Taro Stems	*Imithebe*	*Colocasia esculenta*	Rich in proteins, carbohydrates, dietary fibre, vitamins C and B complex, potassium, calcium, magnesium and iron.	Muinat, Mulidzi, Gerrano and Adebola (2017: 593); Gerrano, van Rensburg, Adebola, Manjeru, Bairu and Venter (2018: 219); Mitharwal, Kumar, Chauhan and Taneja (2022: 3)
Blackjack	*Uqadolo*	*Bidens pilosa*	Rich in calcium, phosphorus, zinc and magnesium.	DAFF (2011: 1-4); Mtenga and Ripanda (2022: 10)
Pumpkin Leaves	*Izintanga*	*Curcubita spp.*	Energy: 222kJ, protein: 2.9g, calcium (168mg), magnesium (64mg), phosphorus (92mg), sodium (11 mg), potassium (316mg), copper (196µg), zinc (0.71mg), iron (8.8 mg), manganese (0.54mg), thiamine (0.03mg), riboflavin (0.09mg), folic acid (30µg), vitamin C (1mg), and vitamin A (309µg RAE).	van Jaarsveld, Faber and van Heerden 2012: 233-234.
Gallant Soldier	*Isishukweyana*	*Galinsoga parviflora*	Contains carbohydrates, proteins, fiber, magnesium, calcium, iron, zinc, and phosphorus.	Ripanda, Luanda, Sule, Mtabazi, and Makangara (2023: 10); Odhav, Beekrum, Akula and Baijnath (2007: 433).

Spider Flower	*Amanzonde*	*Cleome gynandra*	Energy: 195kJ, protein: 5.0g, calcium (220mg), magnesium (72mg), phosphorus (125mg), sodium (14mg), potassium (337mg), copper (238µg), zinc (0.99mg), iron (2.0mg), manganese (0.58mg), thiamine (0.05mg), riboflavin (0.20mg), folic acid (79µg), vitamin C (1mg) and vitamin A (412µg RAE).	van Jaarsveld, Faber and van Heerden 2012: 233-23).
Jew's Mallow	-	*Corchorus olitorius, C. tridens*	Energy: 319kJ, protein: 3.2g calcium (295mg), magnesium (82mg), phosphorus (106mg), sodium (10mg), potassium (366mg), copper (181µg), zinc (0.54mg), iron (3.4mg), manganese (0.79mg), thiamine (0.02mg), riboflavin (0.03mg), folic acid (29µg), vitamin C (1mg), and vitamin A (312µg RAE).	van Jaarsveld, Faber and van Heerden 2012: 233-23).
Cowpea Leaves	*Isihlumanya*	*Vigna unguiculata*	Energy: 280kJ, protein: 4.7g, calcium (378mg), magnesium (59mg), phosphorus (45mg), sodium (10mg), potassium (214mg), copper (12µg), zinc (0.40mg), iron (4.5mg), manganese (2.69mg), thiamine (0.06mg), riboflavin (0.08mg), folic acid (68µg), vitamin C (5mg) and vitamin A (510µg RAE).	van Jaarsveld, Faber, and van Heerden 2012: 233-23).

2.5 Medicinal benefits of Indigenous leafy vegetables

Indigenous leafy vegetables possess considerable nutritional and medicinal properties that can be beneficial in the treatment of various ailments (Takaidza 2023: 15). Traditional knowledge facilitates the utilisation of plants for medicinal purposes, with practices differing globally according to local contexts (Eshete and Molla 2021: 2). The incorporation of ILVs into dietary regimens provides essential nutrients, addresses malnutrition, and reduces the risk of diet-related diseases (Senyolo, Wale and Ortmann 2018: 771). Furthermore, these vegetables are recognised for their anti-inflammatory and antioxidant properties (Dada, Otitoloju, Adjonu, Crockett and Nwose 2021: 2564).

Jute (Corchorus spp.) has the potential to be used as a medicinal product for treating various illnesses. In traditional medicine, it has been used to address ailments such as constipation, dysentery, intestinal worms, ascites, pain, piles, tumours, dysuria, and cystitis. Additionally, it has been employed for its remedial properties as a demulcent, carminative, anthelmintic, intestinal antiseptic, febrifuge, and stomachic (Ali, Ra, Rokeya, Nasreen and Ahmed 2019: 10). Indigenous leafy vegetables can also help prevent diseases such as typhoid fever and malaria due to their phytochemical and antioxidant content. Furthermore, rural communities have historically utilised ILVs as traditional medicinal resources for decades (Qwabe and Pittawaty 2022: 147). In addition to the leaves, the roots and seeds of various ILVs are also employed for medicinal purposes (Akinola *et al*. 2020: 7). Notably, amaranth has been traditionally employed in Africa for the treatment of constipation, urinary infections, and gastrointestinal complications, utilising its seeds, roots, stems, and leaves (Jimoh, Afolayan and Lewu 2018: 71).

2.6 A Study Theoretical framework

A robust theoretical framework offers crucial perspectives for formulating research questions, analysing data, and interpreting results, effectively positioning the study within established academic discussions. In examining the seasonal use of ILVs and their role in enhancing household food security in rural areas, an integrated theoretical approach is most suitable. This research will utilise the Food Security Framework, supplemented by the Sustainable Livelihoods Framework, while also incorporating aspects of Indigenous Knowledge Systems Theory to establish a comprehensive conceptual foundation.

- **The four pillars of food security by Food Agriculture organisation**

The Food and Agriculture Organisation has a well-defined and globally recognised framework for food security, which is based on four key pillars: availability, access to food, utilisation of food, and stability. These pillars ensure a consistent supply of food and its accessibility (FAO 2024: para. 1 line 1).

This framework is highly relevant to the current research as it offers a systematic approach for assessing the role of ILVs. The seasonality of ILVs significantly influences their availability and stability throughout the year, prompting households to adjust their access strategies accordingly. Furthermore, the nutritional value of ILVs is essential for promoting health and well-being. By applying this framework, the research can thoroughly analyse how ILVs impact various aspects of food security in Mangangeni village, with a specific focus on the challenges faced.

- **Sustainable livelihoods framework**

The Sustainable Livelihood Framework (SLF) is particularly useful for analysing resilience and sustainability. The seasonal availability of ILVs significantly affects the vulnerability context, influencing how households adapt their natural capital (such as foraging for ILVs), human capital (knowledge of ILV preparation), and social capital (sharing ILVs). This framework enables an examination of how households leverage their resources to navigate periods of ILV scarcity and maintain food security. By applying the SLF, the research not only focuses on consumption but also seeks to understand the essential household strategies and capabilities that facilitate or hinder the sustainable use of ILVs within their livelihood systems.

- **Indigenous knowledge systems**

Indigenous Knowledge Systems (IKS) Theory provides a vital framework for understanding the cultural significance, customary practices, and ecological wisdom associated with ILVs. It can be generally described as the knowledge and practices that a local community acquires over generations while living in a specific environment. By incorporating IKS Theory, this study acknowledges and values the traditional knowledge surrounding ILVs, including their identification, cultivation, harvesting, preservation, and preparation techniques within the Mangangeni community. This perspective is essential for examining consumer perceptions and sourcing, as well as for identifying strategies to enhance the use of ILVs in ways that respect cultural traditions and promote sustainability. It highlights how traditional knowledge systems strengthen the resilience of local food systems, offering valuable insights into practices that can address the challenges of seasonal availability (Department of Science and Innovation n.d.). This research develops a conceptual framework to explore the dynamics of

ILV consumption and its impact on household food security. Figure 2.1, adapted from Ngidi et al. (2023), illustrates the relationships among the key variables examined in this study.

2.6.1 Indigenous leafy vegetables consumption and their contribution to household food security Framework

The research framework in Figure 2.1 was designed by Ngidi *et al.* (2023: 6) to assess how the use of ILVs influences household food security. It outlines factors affecting the adoption of ILVs and their impact on food security. The framework explores how the cultivation and consumption of ILVs by rural populations could enhance food security. It summarizes the potential benefits for small-scale farmers and consumers and examines additional variables affecting ILV cultivation and utilization, including necessary assets for production and consumption.

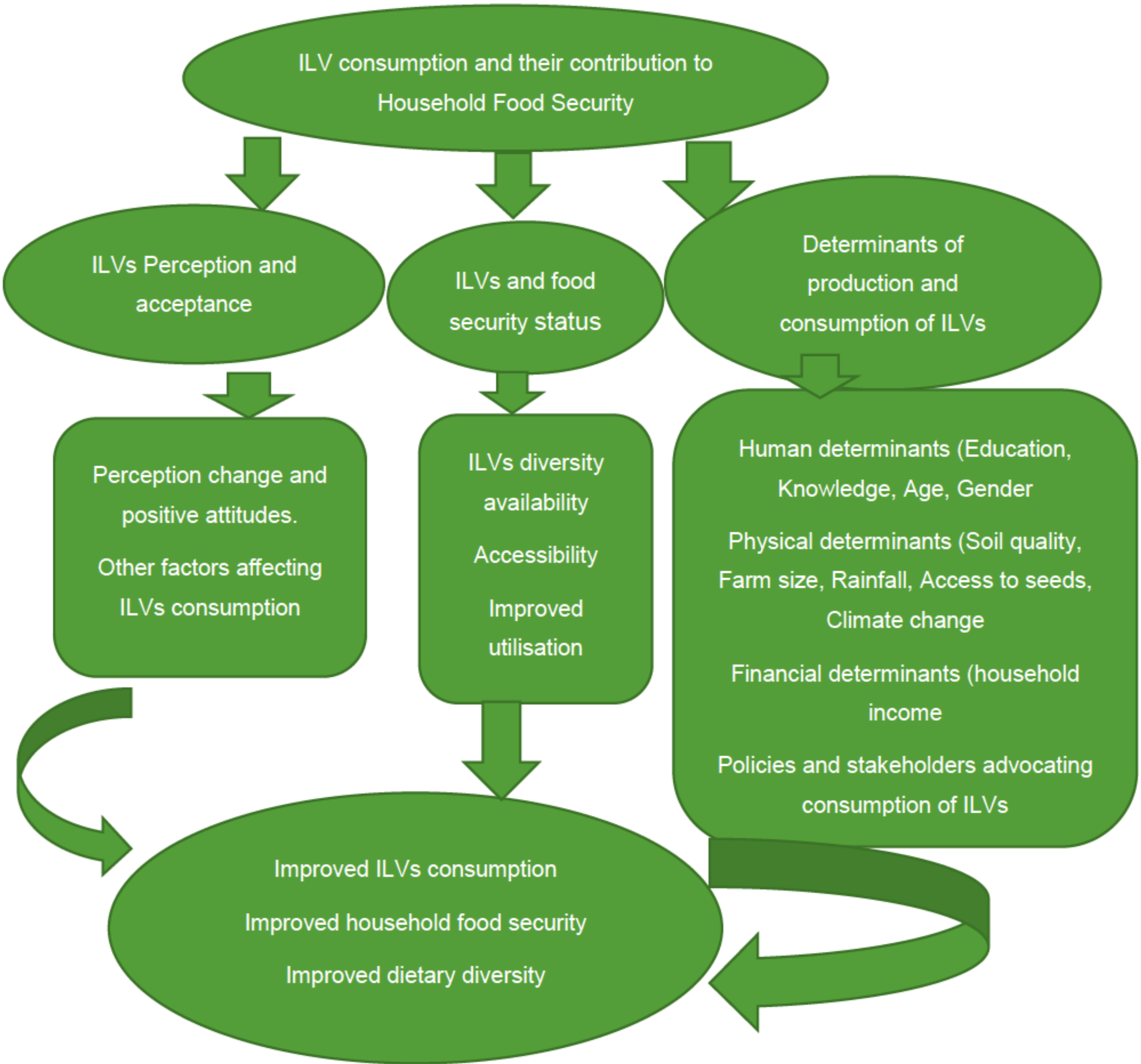


FIGURE 2.1 CONCEPTUAL FRAMEWORK FOR ILV CONSUMPTION AND THEIR CONTRIBUTION TO HOUSEHOLD FOOD SECURITY (NGIDI *ET AL*. 2023)

The framework was used as a guideline in this thesis to discuss ILV consumption and its contribution to household food security. The information extracted from the framework discussed below provides information on how perceptions and acceptance may lead to positive attitudes and perception changes, the role ILVs play in household food security, and the determinants of ILV consumption. Other factors that may contribute to the consumption of ILVs may include culture. The factors discussed in the framework summarise how these factors may contribute to improved ILV consumption, food security, dietary diversity, and sustainable livelihoods**.**

2.6.1 Indigenous leafy vegetables perception and acceptance

Perceptions of ILVs vary across demographics. Negative perceptions such as ILVs are considered food for the poor, and limited knowledge about ILVs significantly influence their consumption while positive perceptions may assist in harvesting ILVs and providing income (Mdiya, Taruvinga, Mushunje, Mopipi and Ngarava 2021: 766). Traditionally, knowledge and cultural practices related to ILVs have been passed down through generations; however, this transfer is not always systematic or effective for younger individuals (Dlamini and Viljoen 2020: 52). This generational gap contributes to negative perceptions among the youth, who often view the consumption and cultivation of ILVs as outdated or indicative of poverty (Kansiime *et al*. 2018: 487). In contrast, older generations typically hold more positive views, valuing ILVs for their cultural and nutritional significance (Kansiime *et al.* 2018: 481-490).

Perceptions play a significant role in shaping consumer behavior and decision-making processes related to food consumption (Senyolo, Wale and Ortmann 2019: 12). Negative perceptions may result in the underutilisation of ILVs, as evidenced by Qwabe and Pittawaty (2023: 5), who highlight that in certain rural areas of KwaZulu-Natal, individuals often consume ILVs primarily for their convenience rather than their nutritional value. Distinct differences in perceptions of ILVs are particularly evident among younger populations, who frequently associate ILVs with poverty and an older demographic (Shayanowako *et al.* 2021: 2). Additionally, Akinola *et al.* (2020: 10) reported that younger generations perceive ILVs as antiquated, contributing to their underutilisation (Dlamini and Viljoen 2020: 53). Negative perceptions are also influenced by what people hear from sources like the media, community programmes, and schools (Kansiime *et al.* 2018: 483).

In relation to perception, a negative link exists between the belief that ILVs are primarily food for rural populations and the cultivation of ILVs. This implies that as communities continue to view ILVs as being solely suitable for poor rural people, it could hinder their involvement in ILV production (Mayekiso, Taruvinga and Mushunje 2017: 286). The acquisition of knowledge of ILV is important to ensure their continuous utilisation and a perception change (Dlamini and Viljoen 2020: 63). Educating people about the advantages of ILVs could help change these perceptions and informing consumers about the nutrition they offer and involving men in their production and promotion might improve attitudes and increase consumption (Senyolo, Wale and Orthman 2019: 13; Shayanowako *et al.* 2021: 2-3). A change in the way the consumers perceive ILVs will have a significant impact which may lead to positive attitudes towards ILVs.

Factors such as culture may also influence the consumption of the ILVs. Culturally, women are responsible for food preparation and ILV knowledge is transferred to the younger generation by women (Dlamini and Viljoen 2020: 62). Culture is frequently highlighted as a crucial factor influencing food security by practitioners in development and policymaking (Alonso, Cockx and Swinnen 2018: 121). According to Qwabe and Pittawaty (2022: 148-151), indigenous vegetables are significant to people's cultural identity and heritage. In many cultures, this traditional knowledge is practical and typically passed down by elders as young people engage in subsistence activities, harvesting, and foraging. Since culture is acquired and dietary practices are a component of it, knowledge about food, including its nutritional benefits and what is considered consumable, is transferred within the cultural group to which an individual belongs (Dlamini and Viljoen 2020: 53).

2.6.2 Indigenous leafy vegetables and food security status

Historically, indigenous leafy vegetables have been an essential component of rural diets and have played a significant role in ensuring food security (Mungofa *et al* 2022: 13). According to Ngidi (2023: 9), an increase in the consumption of indigenous leafy vegetables leads to minimal food insecurity. Therefore, embracing ILV cultivation could lead to improved availability throughout the year and support food security by establishing sustainable value chains from cultivation to market (Mungofa Malongane and Tabit 2018: 61). Indigenous leafy vegetables are known to contribute not only to food security but to dietary diversity (Garekae and Shackleton 2020: 13).

Despite their significance, the large-scale production of ILVs in South Africa remains underdeveloped, with a predominant focus on exotic vegetables (Mayekiso, Belete, Hlongwane, Oluwatayo and Gido 2019:17). To enhance food security, it is imperative to recognize and promote ILVs as a critical component of local diets and commercial agriculture.

The strategic objective is to ensure that affordable, readily available, and nutritious food is accessible at the household level (Nxusani, Zuma and Mbhenyane 2023:19). Although the South African government has implemented social grants to provide households with income, these financial resources are inadequate to guarantee access to safe, sufficient, and nutritious food (Integrated Phase Classification 2021: 6).

2.6.2.1 Availability and diversity of Indigenous leafy vegetables

The availability of ILVs in South Africa is closely linked to seasonal rainfall patterns. Specifically, during the rainy season, the availability of these vegetables increases significantly, whereas their availability may diminish during dry periods unless preservation methods are employed (Mungofa, Malongane and Tabit 2018: 65). The consumption of ILVs tends to peak in conjunction with their availability, serving as a vital source of nutrition for numerous households (Gido *et al.* 2017: 3). Furthermore, the presence of indigenous leafy vegetables enhances dietary diversity (Nyaruwata 2019: 174). While certain ILVs, such as *Cucurbita*, exhibit resilience to abiotic stress and environmental fluctuations, the development and promotion of effective processing techniques are crucial to minimizing postharvest losses and ensuring a continuous supply (Maja, Mavengahama and Mashilo 2022: 10).

South Africa is home to a rich diversity of ILV species, with over 100 species documented within the country, as noted in section 2.4. Van Rensburg *et al.* (2007: 318-319) noted that ILV species include some of the most commonly utilized leafy vegetables, which are either gathered from the wild or considered weeds, such as Amaranthus hybridus, *Bidens pilosa, B. biternata, Cleome gynandra, Corchorus tridens, Chenopodium album*, and *Tribulus terrestris*, rape or Chinese cabbage *(Brassica rapa subsp. chinensis*), nightshade (*Solanum retroflexum* and other selected species from the *S. nigrum complex*), Jew's mallow (*Corchorus olitorius and C. tridens*), cowpeas (*Vigna unguiculata*), and various types of pumpkins (*Cucurbita pepo, C. maxima, and C. moschata*), melons (*Citrullus lanatus and Cucumis melo*), as well as other indigenous cucurbits like balsam pear (*Momordica balsamina*). A survey conducted in northern KZN identified 72 vegetable species, nearly half of which were alien, and most of these vegetables, making up 56 species, were gathered from the wild, while only 16 were cultivated (Ntuli, Zobolo, Siebert and Madakadze 2012: 6034). Among the various vegetables, amaranths, blackjack, and pumpkin leaves were the most favoured ILVs in KZN (Sithole, Thamaga-Chijta and Makanda 2011: 195). Similarly, Ngidi (2023: 6) found that pumpkin leaves and blackjack were the most consumed in a surveyed rural area of KZN.

2.6.2.2 Indigenous leafy vegetables accessibility

Accessibility pertains to the various locations from which each ILV was frequently gathered. A study by Dlamini and Viljoen (2020: 57) indicated that women retrieved ILVs from home gardens, river banks, natural areas, cultivated fields, and additional sites. Indigenous leafy vegetables can be accessed from local farmers or street vendors in informal markets and can be harvested. Those who harvest ILVs can harvest them from their own gardens or obtain them from uncultivated lands in the wild (Mungofa*,* Malongane and Tabit 2018: 61). Seasonality plays a significant role in the irregular access of indigenous products. Most indigenous vegetables are collected from the maize fields in summer and personal connections to rural communities make it easy to access ILVs that are not available in urban areas (Vilakazi 2024: 107).

2.6.2.3 Indigenous leafy vegetables consumption

Low consumption of ILVs contributes to increased hunger and food insecurity in both rural and urban households (Zulu *et al.* 2022: 8). Improved consumption of ILVs can minimize food insecurity and hidden hunger and contribute to achieving the SDGs goal of ending hunger and poverty (Imathiu 2021: 115). Hidden hunger and malnutrition could be significantly reduced by diversifying diets through greater use and consumption of ILVs (Kimiywe Waudo, Mbithe and Maundu 2017: 2). Indigenous leafy vegetables offer not only physical health benefits, but also cultural continuity, preservation of food heritage, and knowledge of local plants for cultivation, storage, and preparation. For these reasons, the production and consumption of underutilized crops must be actively encouraged (Knez, Ranic and Gurinovic 2023: 1114). To increase ILV consumption in rural areas, it is important to pass on traditional ILV knowledge to younger as well as more male decision-makers. In urban areas, increased consumption could be achieved by promoting value-added activities like sorting and plucking vegetable leaves before marketing (Gido *et al*. 2017: 1). It is important to understand consumer preferences for ILVs in whole fresh, fresh value-added, or dried powdered form to guide farmers and develop quality and safety standards because this knowledge is vital for fresh produce practitioners, including food technologists (Imathiu 2021: 121).

2.6.3 Determinants of production and consumption of ILVs

The production and consumption of ILVs are shaped by a multitude of factors, including agricultural practices, environmental conditions, and socio-economic variables (Mayekiso, Belete and Hlongwane 2023: 83; Ngidi *et al.* 2023: 1). Socioeconomic factors, such as income levels and educational attainment, significantly influence dietary diversity; impoverished households frequently exhibit low dietary diversity due to financial limitations and restricted access to a variety of food options (Chakona and Shackleton 2017: 2). Numerous underlying determinants either facilitate or hinder the consumption of ILVs. The subsequent discussion will elucidate the relationship between these determinants and consumption patterns.

2.6.3.1 Human determinants

The consumption of ILVs is influenced by various socio-economic and demographic factors, including education, age, gender, and household size.

a) Education

Higher education levels contribute to the acquisition of new information and the enhancement of decision-making skills (Mdiya 2020: 8). Furthermore, education significantly influences the consumption of ILV by shaping food preferences and dietary practices. Educated individuals may prefer market-purchased vegetables over locally cultivated or collected ILVs, potentially leading to reduced ILV consumption (Zulu *et al.* 2022: 8). However, higher education levels are generally associated with better nutritional practices and an increased understanding of ILVs' benefits (Kansiime *et al.* 2018: 491).

b) Age

Age significantly influences the consumption patterns of ILVs. Research indicates that older generations exhibit higher consumption rates and possess a deeper knowledge of ILVs compared to their younger counterparts, who may regard these vegetables as antiquated or less appealing (Nyaruwata 2019: 181). Kansiime *et al.* (2018: 487) further corroborate this assertion, noting that the consumption of ILVs is particularly prevalent among older men and women. In contrast, the younger generation often harbours negative perceptions, viewing these vegetables as foods associated with poverty and outdated traditions (Kansiime *et al.* 2018: 487). Promoting ILV benefits to younger generations is essential for changing perceptions and increasing consumption (Rankoana 2021: 6).

c) Gender

Gender significantly influences the production and consumption of ILVs, with women frequently playing a more prominent role in both cultivation and marketing (Mayekiso *et al.* 2023: 90). Additionally, cultural norms and household dynamics further impact ILV consumption, as men typically exhibit a lower preference for these vegetables (Nyaruwata 2019: 176). The gender of the household head is significant in deciding the types of crops to be grown and dishes consumed by a household (Nyaruwata 2019: 181). In a study by Ngidi *et al.* (2023: 10) it was found that if the household head's gender was male it had a negative impact on ILV consumption but was not statistically significant. However, it had a statistically significant impact and improved household food security. Therefore, gender roles and cultural factors should be considered in strategies to promote ILV consumption (Zulu *et al.* 2022: 11).

d) Knowledge

There is growing concern about the diminishing knowledge about and consumption of ILVs in several African countries (Dlamini and Viljoen 2020: 52). Contributing factors include the failure to transfer knowledge between generations and shifts in food values and preferences. This loss of knowledge affects food selection, as consumers often prioritise commercially available foods over traditional diets (Dlamini and Viljoen 2020: 52). Knowledge can be described as an acquired behaviour formed through shared information and experiences gained through learning (Kucharska and Rebelo 2022: 651). Similarly, culture is also a learned behaviour; thus, knowledge of food consumption is often transferred from one person to another. Awang, Mat, and Mahmud (2020: 32) reported that individuals who are knowledgeable about ILV consumption tend to be from the older generation. This knowledge is typically passed down, with older women in rural communities often being the primary holders of this information (Dlamini and Viljoen 2020: 54). Understanding indigenous leafy vegetables is fundamental for managing these crops effectively, and knowledge about ILVs is generally adequate within these communities (Mungofa *et al.* 2022: 13).

Furthermore, knowledge functions as an essential resource for promoting the consumption of ILVs and developing innovative strategies for engaging in nutrition education. This understanding is vital for increasing ILV consumption and bolstering food security (Obianuju and Olubukola 2022: 455). However, inadequate knowledge regarding the benefits and preparation methods of ILVs may restrict their utilisation (Akinola *et al.* 2020: 11; Dlamini and Viljoen 2020: 52). The knowledge and cultural practices associated with ILV consumption are dynamic, emerging from culturally specific cognitive skills (Dlamini and Viljoen 2020: 53). Individuals generally rely on their existing knowledge to make informed decisions about food consumption (Dlamini and Viljoen 2020: 54).

The transfer of knowledge concerning ILVs occurs across generations, and the preservation of this knowledge enables consumers to extend the shelf life and availability of these vegetables (Shembe, Ngobese, Siwela and Kolanisi 2023: 8). Consequently, enhancing knowledge through education and awareness campaigns can significantly improve ILV consumption and contribute to enhanced nutrition and food security.

e) Household size

Household size significantly influences the intensity of ILV consumption. Larger households may have a greater demand for ILVs, which could lead to increased consumption; however, the findings remain inconclusive (Zulu *et al.* 2022: 8). Ngidi *et al.* (2023: 10) demonstrated that household size positively correlates with ILV consumption, indicating that as household size increases, more individuals may cultivate various indigenous leafy vegetables for personal consumption as well as for commercial purposes. Similarly, Nyaruwata (2019: 181) posited that a larger household size necessitates a greater quantity of ILV leaves. Analysing the relationship between household size and ILV consumption is essential for informing strategies aimed at optimizing production and distribution.

2.6.3.2 Physical determinants

According to Ngidi *et al.* (2023), as depicted in the conceptual framework, physical determinants such as climate change and agricultural activities are linked to the consumption of ILVs.

a) Agricultural activities

Agriculture has been the cornerstone of human sustenance for over 12,000 years, evolving continually to meet changing needs and challenges (Alt, Al Ahmad and Woelber 2022: 1). The farming of indigenous foods is complex, sustainable, and cost-effective, and their cultivation plays an essential role among indigenous communities including promotion of agricultural sustainability (Akinola, Pereira, Mabhaudhi, De Bruin and Rusch 2020: 15). To enhance the production of ILVs, it is imperative to implement diversified agricultural practices and improve overall efficiency (Mulaudzi, Oyekale and Ndou 2019: 778). Nevertheless, challenges such as water scarcity and climate variability significantly affect the growth potential of ILVs (Bello and Walker 2017: 299). Therefore, effective water management and the adoption of sustainable farming practices are essential for maintaining ILV production in the face of these challenges. Furthermore, soil erosion diminishes the amount of land available for agricultural use, leading to a decline in biodiversity and constraining crop growth (Gido, Ayuya, Owuor and Bokelmann 2017: 355).

b) Climate change

Climate change represents a substantial challenge to agricultural productivity, particularly in the context of the cultivation of ILVs (Abbass, Qasim, Song, Murshed, Mahmood and Younis 2022: 42539). Rising temperatures and shifting precipitation patterns negatively impact crop growth and threaten food security. (Ekemini-Richard, Ayanwale and Adelegan 2022: 117). Moreover, it is important to understand the vulnerability of populations and socioeconomic factors in addressing climate change. Tanimonure and Naziri (2021: 14) noted that climate change threatens the sustainability of food security in agriculture. A blend of strategies and adaptations is necessary to support rural communities that rely on rainfall. Adaptation strategies, such as leveraging the natural resilience of ILVs to environmental stresses, are essential for mitigating these impacts (Tanimonure and Naziri 2021: 14). Therefore, understanding and addressing the vulnerabilities of farming communities to climate change is crucial for sustaining ILV production (Grigorieva, Livenets and Stelmakh 2023: 31).

c) Soil type

Soil quality is a fundamental determinant of crop production, including ILVs. Fertile soil supports plant growth by providing necessary nutrients and facilitating root development (Schlüter, Sammartino and Koestel 2020: 1; Onyutha 2018: 7). Soil erosion and fertility loss present significant challenges for smallholder farmers, impacting ILV productivity and sustainability (Unkovich, McKenzie and Parker 2023: 201). Requirements for good ILV production and other crops include soil humidity, moisture, texture, and fertility. In addition, light-intensity rainfall and humid temperatures also contribute to good vegetable production (Shrama and Chauhan 2020: 610).

d) Rainfall

Marginalised communities in developing countries within sub-Saharan Africa rely predominantly on rain-fed agriculture (Ayanlade, Oluwaranti, Ayanlade, Borderon, Sterly, Sakdapolrak, Jegede, Weldermariam and Ayinde 2022: 1). Variability of rainfall has a substantial impact on the cultivation of ILVs. Unpredictable precipitation patterns intensify the challenges associated with agricultural practices, directly affecting crop yields and overall food security. (Affoh, Zheng, Dangui and Dissani 2022: 16). Effective rainfall management and irrigation strategies are essential to support ILV production and mitigate the adverse effects of climate change. Then, when rainfall becomes more variable, plant tissues begin to lignify, altering their composition (Leweri, Msuha and Treydte 2021: 5). Consequently, crop yields may become more sensitive to climate change due to their increased vulnerability (Olabanji, Davis, Ndarana, Kuhudzai and Mahlobo 2021: 13). Extreme rainfall can damage crop growth, potentially washing away soil. Provinces like KwaZulu-Natal experience reduced rainfall during autumn and winter, leading to a decrease in ILV availability, particularly in the dry seasons (Masingi and Maposa 2021: 1).

e) Access to seeds

The quality and availability of seeds are paramount for the production of ILVs. High-quality seeds not only enhance productivity but also support sustainable agricultural practices (Walsh, Remington, Kugbei and Ojiewo 2015: 3). Nonetheless, challenges such as inadequate seed legislation and low-profit margins deter investment in ILV seeds, thereby adversely affecting production levels (Nugent, Levin, Hale and Hutchinson 2020: 156).

Addressing these issues is vital for improving seed accessibility and ensuring the sustainability of ILV cultivation. The Food and Agriculture Organization (2021: para. 1. line 1) states that "for the seed production system to be sustainable, production of high-quality seeds of a wide range of varieties and crops should be fully available in time and affordable to farmers and other stakeholders". Additionally, high-quality seeds of various types and crops must be produced, made available promptly, and priced reasonably through a sustainable seed system (Food and Agriculture Organization 2021: para. 3. line 1). The sustainability of seed production systems involves several components: seed quality, availability, accessibility, and the profitability of seed businesses (Ayenan, Anglinglo, Zohoungbogbo, N'Danikou, Honfoga, Dinssa, Hanson and Afari-Sefa 2021: 3).

The importance of these physical determinants highlights the requirement for comprehensive approaches to boost the creation and use of ILVs. Tackling these obstacles can greatly enhance food security and nutritional variety in at-risk populations.

2.6.3.3 Financial determinants

As depicted on the conceptual framework by Ngidi *et al.* (2023: 5), the consumption of ILVs can also be affected or influenced by financial determinants. These determinants are discussed below.

a) Employment status and household income

Qwabe and Pittawaty (2023: 143) highlighted that there is a positive correlation between ILV consumption and low socio-economic status communities. More non-employed people have been found to consume more ILVs than employed personnel (Nyaruwata 2019: 175-176). Employment status and income levels significantly influence ILV consumption. Low-income households are often more reliant on ILVs due to their affordability and availability (Nyaruwata 2019: 175; Zulu *et al.* 2022: 7). Conversely, higher-income households may have access to a wider variety of foods, potentially reducing ILV consumption (Ngidi *et al.* 2023: 11). In addition, addressing income disparities and improving access to ILVs can enhance their consumption and support food security.

b) Indigenous leafy vegetables' role in income generation

The production of vegetables in South Africa serves as a significant source of income and sustenance for many small-scale rural farmers. The expansion of agricultural activities correlates with a notable increase in income among impoverished households (Mahlangu, Belete, Hlongwane, Luvhengo and Mazibuko 2020: 1). Indigenous leafy vegetables offer significant income generation opportunities for rural farmers. Selling ILVs can provide additional income to purchase staple foods and support household needs (Mulaudzi, Oyekale and Ndou 2019: 778; Qwabe and Pittawaty 2023: 150). Promoting ILV commercialization and improving market access can enhance financial stability for small-scale farmers and support rural economies (Mungofa*,* Malongane and Tabit 2018: 65). Senyolo, Wale and Orthmann. (2018: 8) reported that smallholder farmers achieve substantial gross margins from the trading of ILVs. Akinola *et al.* (2020: 12) further concurs that the sales of ILVs significantly contribute to household income. In conclusion, the consumption and production of ILVs are influenced by a complex interplay of environmental, socio-economic, and demographic factors. Addressing these determinants through targeted interventions has the potential to enhance the availability of ILVs, improve nutritional outcomes, and support sustainable agricultural practices.

2.6.3.4 Policies and stakeholders on indigenous leafy vegetable consumption

Organizations such as the Agricultural Research Council (ARC), the Department of Science and Technology, and the Water Research Commission provide funding for the upscaling of ILVs in South Africa (Maseko *et al.* 2017: 7). The Agricultural Research Council Vegetables and Ornamental Plants Institute (ARC-VOPI) is one of the major role players involved in research and training of indigenous vegetables in South Africa (Venter, Jansen van Rensburg, Vorster, van der Heever and Zijl 2007: 4). The ARC-VOPI is actively involved in promoting various ALVs by gathering significant literature on their production, collaborating with universities for research, and engaging with farmers. Nonetheless, sustained partnerships and financial support from both the government and the private sector are crucial elements that drive the enhanced production of ALVs in South Africa (Maseko *et al.* 2017: 7). The Agricultural Research Commission supports the promotion of indigenous leafy vegetables, and they work with various stakeholders such as the Department of Agriculture, Forestry and Fisheries, the Department of Science and Technology, provincial departments and the Water

Research Commission who support them financially on big projects (ARC 2014: para. 2 line 1).

The Medical Research Council has concentrated on the utilization and nutritional benefits of ILVs within rural households, alongside various other projects (Maseko *et al.* 2017; 7). All South African universities contribute to promoting use of ILVs (Maseko *et al.* 2017: 8). In addition, The South African Department of Agriculture, Forestry and Fisheries (DAFF) is a key role player at policy level in promoting the value of ILVs (DAFF 2008: 2). To increase food and nutrition security at the home level, these policies emphasize the need to promote sustainable practices and increase smallholder participation in mainstream agriculture (Mabhaudhi, Chimonyo, Chibarabada and Modi 2017: 10).

To boost ILV consumption, efforts should concentrate on raising consumer awareness of their benefits, connecting farmers with markets to ensure a steady supply, and implementing supportive policies for strategic promotion. Promoting the advantages of ILVs to policymakers is challenging due to difficulties in demonstrating their benefits (Labuini, Turoop and Bokelmann 2020: 89).

2.7 Nutritional and dietary requirement strategies to address malnutrition

South Africa uses different strategies to address malnutrition in communities and these are discussed below.

2.7.1 South African Food-Based Dietary Guidelines (FBDGs)

Food-based dietary guidelines (FBDGs) were introduced as a strategy to be used for effective nutrition communication by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) following the International Conference on Nutrition held in Rome in 1992. Then, South Africa was among the first countries to create specific FBDGs, as encouraged by the FAO and WHO. These guidelines were officially adopted by the South African Department of Health in 2002 and underwent an update in 2013 to incorporate recent research findings, ensuring the ongoing relevance of each guideline (Vorster, Badham and Venter 2013: 3).

The South African Food-based Dietary Guidelines (SA-FBDGs) function as a nutritional education instrument employed by the government to advocate for healthy eating behaviours and lifestyles among individuals, communities, and the nation at large (Ainuson-Quampah, Amuna, Holdsworth and Aryeetey 2022: 1). Food-based dietary guidelines provide succinct and affirmative recommendations designed to assist consumers in selecting food and beverage combinations that foster a balanced diet, satisfy nutritional requirements, and mitigate the risk of non-communicable diseases (NCDs) (FAO 1998). The primary objective of the SA-FBDGs is to alter public eating habits by endorsing diets that are more favourable in terms of energy and nutrient composition while concurrently aiding in the prevention of NCDs (Vorster, Badham and Venter 2013: 4). When the SA-FBDGs were first created and by the Department of Health, it was recommended that they be regularly updated to ensure alignment with the most recent scientific evidence concerning the relationship between dietary intake and health outcomes (Vorster, Badham and Venter 2013: 4). Furthermore, these guidelines are characterized by their brevity, optimism, and grounded in science (FAO 2024: para. 5 line 1).

The FBDGs were evaluated across diverse socioeconomic settings, including informal urban areas, rural regions, and various cultural communities. This extensive consumer testing informed necessary modifications to the FBDGs. For these guidelines to be effective, nutrition educators must understand the dietary preferences of different groups, identify potential barriers to implementation, and provide practical solutions. By addressing these factors, nutrition educators can enhance the effectiveness of the FBDGs and promote healthier dietary choices and improved health outcomes for the population (Vorster, Badham and Venter 2013: 5). The FBDGs guidelines are: enjoy a variety of foods; be active; make starchy foods part of most meals; eat plenty of fruits and vegetables; eat dry beans, split peas and soya regularly; have milk, *maas* or yoghurt every day; fish, chicken, lean meat or eggs can be eaten daily; drink lots of clean safe water; use sugar and foods and drinks high in sugar sparingly; and use salt and food high in salt sparingly.

To enhance nutrient consumption and dietary variety, it is important to include a broad selection of vegetables, particularly traditional and ILVs, which are often more readily available and culturally significant (Mungofa *et al.* 2022: 13). The WHO recommends that people consume at least five servings of vegetables and fruits combined each day to guarantee an adequate intake of vital vitamins, minerals, and dietary fibre (WHO 2020: para. 6 line 3). A balanced diet should feature a wide array of foods, as highlighted by the FBDG, which encourages the inclusion of different meals from all food categories, innovative cooking methods, and greater dietary diversity. A balanced diet supplies enough energy, water, macronutrients, and micronutrients (Steyn 2013: 13).

A limited variety in the diet increases the likelihood of vitamin deficiencies, resulting in malnutrition and food insecurity. Therefore, the FBDGs should be utilized alongside applicable food guides created for South Africa and analysed in conjunction with other FBDGs (Steyn 2013: 13). It is essential to include a varied selection of vegetables and fruits, especially those differing in colour and type. At a minimum, it recommended to eat one serving of dark-green leafy vegetables, like spinach (*imifino*) per day.

The objective of the FBDGs is to boost the consumption of vegetables and fruits, which can help lower the incidence of nutrition-related illnesses, particularly by reducing the risk of vitamin A deficiency (Naudé 2013: 54). Including ILVs in diets aligns well with these recommendations, as their incorporation promotes meal variety. Studies show that ILVs are rich in nutrients, enhancing dietary diversity; ILVs such as amaranth, black nightshade, taro, and pumpkin leaves are packed with vital nutrients, making them important elements of the local diet (Mungofa *et al.* 2022: 14). According to Zulu *et al.* (2022: 1), ILVs play a role in boosting food security and help diversify diets, enhancing micronutrient intake.

Despite the benefits, the intake of fruits and vegetables in South Africa is considerably lower than the recommended levels for both adults and children (Sinyolo, Ndida, Murendo, Sinyolo and Neluheni 2020: 1). ILVs are frequently served alongside staple foods as a side dish, enhancing their nutritional value (Mushaphi, Magoro and Tshiambara 2022: 200). Incorporating ILVs into diets enriches staple foods with vital vitamins and minerals, improving overall health and food security. ILVs are hardy and can flourish in difficult conditions, ensuring a reliable food supply during times of scarcity while promoting health. Regularly including dark green leafy vegetables (DGLVs) is especially crucial due to their high nutrient density, particularly in vitamins A and C, iron, and calcium (Amagloh, Atuna McBride, Carey and Chrisides 2017: 1). This strategy supports local food sovereignty and improves food security for at-risk populations.

2.7.2 Dietary Reference Intakes (DRIs)

The Dietary Reference Intakes (DRIs) are developed from a comprehensive framework that includes indicators of good nutrition, good health, disease prevention, and the risks associated with overconsumption. These guidelines provide recommendations for individuals and groups regarding their nutrient needs, which are defined as the minimum intake levels necessary for optimal health. These specific indicators of adequacy help ensure that individuals maintain an appropriate level of nutrition (Murphy, Yates, Atkinson, Barr and Dwyer 2016: 157).

In 1941, the National Research Council introduced its first set of Recommended Dietary Allowances (RDAs) for vitamins, minerals, protein, and energy. Food and Nutrition Board of the Institute of Medicine developed these recommendations to provide guidance for good nutrition and serve as a benchmark for measuring progress in dietary health. Since then, RDAs have formed the foundation for nearly all federal and state food and nutrition programmes and policies (IoM 2006: 5).

To support the use of these guidelines, the DRIs were established, offering a framework for interpreting and applying DRI values when assessing and planning nutrient intakes for individuals and groups. Please refer to Table 2.3 for the DRIs which include several key reference values.

TABLE 2.2 DIETARY REFERENCE INTAKE KEY REFERENCE VALUES

DRI Reference values	Description
Estimated Average Requirement (EAR)	The EAR represents the average daily nutrient intake needed to meet the requirements of half of the healthy individuals within a specific life stage and gender group. The EAR serves as a primary reference for assessing nutrient adequacy in populations and is essential for planning group intakes (IoM 2006: 10).
Recommended Dietary Allowance (RDA)	The RDA is the average daily intake that is enough for nearly all (97-98%) healthy individuals in a specific life stage and gender group. Intakes below the RDA are generally not considered inadequate, as usual intake at this level is expected to have a low probability of deficiency (IoM 2006: 10).
Adequate Intake (AI)	When there is insufficient scientific evidence to establish an EAR and RDA, an AI is derived instead. The AI is based on observed or estimated nutrient intakes from apparently healthy populations, indicating that these levels are assumed to be adequate. This reference value is used when more data is needed to determine the mean and distribution of nutrient requirements (IoM 2006: 11).
Tolerable Upper Intake Level (UL)	The UL is the maximum average daily nutrient intake likely to pose no risk of adverse health effects for nearly all individuals in a population (IoM 2006: 11).

2.7.3 Macro- and micronutrient requirements for adults

Promoting general health and preventing chronic diseases requires an understanding of the macronutrient requirements for adults. Macronutrients supply the body with energy needed for physiological processes and daily activities and the essential macronutrients come from carbohydrates, fats, proteins and dietary fibres. Below is a discussion of the various macronutrients:

2.7.3.1 Macronutrients

Macronutrients are essential nutrients that sustain life and include nutrients such as protein, fats, and carbohydrates (Venn 2020: 1). Macronutrient intakes support the body with optimal functions of physical and brain health (Muth and Park 2021: 1). Refer to Table 2.1 for DRIs macronutrients recommendations for different age groups. Refer to Table 2.4 for macronutrients recommendations.

TABLE 2.3 DIETARY REFERENCE INTAKES FOR MACRONUTRIENTS RECOMMENDATIONS FOR MEN AND WOMEN AGED 19-30, 31-50, AND 51-70 YEARS OLD (IoM 2006)

Nutrients	DRIs		(Age Groups)	Description	Sources
	19-30 Years	31-50 Years	51-70 Years		
Energy	♂ 12881kj EER ♀10093kj EER	♂ 12881kj EER ♀10093kj EER	♂ 12881kj EER ♀10093kj EER	Energy is essential for supporting the body's various functions, such as respiration, circulation, physical activity, metabolism, and protein synthesis. The high intake of energy-dense foods may lead to health complications (James-Stubbs, Horgan, Robinson, Hopkins, Dakin and Finlayson 2023: 1). This indicates that eating a high quantity of energy-dense foods, which contain many calories but few nutrients, may lead to health problems such as obesity, heart disease, and diabetes because of consuming too many calories.	The IoM (2006: 96 reported that energy comes from carbohydrates, proteins, fats, and alcohol in the diet. Each macronutrient provides a different amount of energy: carbohydrates and proteins provide 17kJ per gram, while fats provide 38kJ per gram. An individual's energy balance is determined by the relationship between dietary energy intake and energy expenditure, which is influenced by factors like age, body composition, gender, and physical activity level (IoM 2006: 96).

TABLE 2.4 DIETARY REFERENCE INTAKES FOR MACRONUTRIENTS RECOMMENDATIONS FOR MEN AND WOMEN AGED 19-30, 31-50, AND 51-70 YEARS OLD (IOM 2006) (*CONTINUED*)

Nutrients	DRIs		(Age Groups)	Description	Sources
	19-30 Years	31-50 Years	51-70 Years		
Carbohydrates	♂ 100g EAR ♀100g EAR	♂ 100g EAR ♀100g EAR	♂ 100g EAR ♀100g EAR	Carbohydrates are the macronutrients required in the largest amounts, primarily serving as an energy source for the body's cells (Campos, Tappy, Bally, Sievenpiper and Le 2022: 1200). Carbohydrate-rich foods are an important part of a balanced diet because they deliver glucose to the body, which supports biological functioning and physical activity. Carbohydrates can be simple and complex (Puddu and Menotti 2021: 1950). However, excessive consumption of refined, simple, and low-quality carbohydrates has a direct impact on physical and mental health. Nutrition guidelines state that carbohydrates should account for 40% to 65% of total daily energy intake to meet the body's energy demands and lower the risk of several non-communicable diseases (Clemente-Suarez, Ayuso, Martin Rodriguez, Ramos-Campo, Redondo-Florez and Tornero-Aguilera 2022:17).	The daily recommended intake of carbohydrates should be based on whole grains. Key sources of starch include grains and certain vegetables (such as corn, tapioca, flour, cereals, pasta, rice, potatoes, and crackers, while fruits and dark vegetables contain little or no starch (IoM 2006: 103).

TABLE 2.4 DIETARY REFERENCE INTAKES FOR MACRONUTRIENTS RECOMMENDATIONS FOR MEN AND WOMEN AGED 19-30, 31-50, AND 51-70 YEARS OLD (IOM 2006) (*CONTINUED*)

Nutrients	DRIs		(Age Groups)	Description	Sources
	19-30 Years	31-50 Years	51-70 Years		
Proteins	♂ 56g EAR ♀46g EAR	♂ 56g EAR ♀EAR	♂ 56g EAR ♀46g EAR	Proteins are vital macronutrients, and their nutritional quality can vary based on factors like digestibility, amino acid profile, and bioavailability. However, traditional animal protein sources have several drawbacks. As the global population continues to grow, a significant challenge lies in identifying low-cost, readily available protein sources that also meet environmental and social concerns (Sá, Moreno and Carciofi 2020): 1). Dietary proteins are mostly obtained from animals and plants, but their composition varies significantly (Day, Cakebread and Loveday 2022: 429).	Plant-based proteins from legumes, grains, nuts, seeds, and vegetables often lack one or more essential amino acids, classifying them as 'incomplete proteins. Protein is essential for various functions, primarily focused on building and maintaining body tissues, including muscle, connective tissue, blood vessels, skin, and internal organs (IoM 2006: 146).
Dietary fibre	♂ 38g AI ♀25g AI	♂ 38g AI ♀ 25g AI	♂ 30g AI ♀ 21g AI	Fibre is an important component of human health that is often underestimated (Hojsak, Benninga, Hauser, Kansu, Kelly, Stephen, Lopez, Slavin and Tuohy 2022: 977). Dietary fibre is made up of non-digestible carbohydrates, mainly in the form of polysaccharides derived from plant sources (Barber, Kabisch, Pfeiffer and Weickert 2020: 1). To increase the fibre consumption, one would need more non-processed foods in our supermarkets, as well as fewer highly processed ones (Barber, Kabisch, Pfeiffer, and Weickert 2020: 10).	The sources include whole grains such as oats, rice, wheat, and barley (Khan, Khan, Ma, Meng, Mushtaq, Shen and Xu 2022: 14). Indigenous leafy vegetables such as Jews mallows, Amaranth leaves, Cowpea leaves, pumpkin leaves, and black nightshade contain some dietary fibre (van Jaarsveld, Faber and van Heerden 2021: 233).

♂: Male; ♀: Female

2.7.3.2 Micronutrients

Micronutrients, including vitamins and minerals, are essential nutrients that our bodies require in smaller quantities. A reduced intake and an imbalanced diet can lead to deficiencies, particularly among older adults (Panzeri, Pecoraro, Dianin, Sboarina, Arnone, Piacentini and Pietrobelli 2024: 2). Nutritional well-being is crucial for maintaining health, autonomy, and overall quality of life, especially for the elderly. It is estimated that at least half of non-institutionalized seniors require nutritional intervention to enhance their health, with 85% suffering from one or more chronic diseases that could be improved through proper nutrition (Cristina and Lucia 2021: 1). Historically, immune support from micronutrients was highlighted through vitamin C deficiency and its role in preventing scurvy. However, it is now understood that the immune system relies on a variety of micronutrients such as vitamins A, D, C, E, B6, B12, folate, zinc, iron, copper and selenium that work synergistically throughout the immune response. Enough intake of these micronutrients is essential for the effective functioning of physical barriers and immune cells. Even marginal deficiencies in these micronutrients can impair immune function (Gombart, Pierre and Maggini 2020: 1). As stated, ILVs such as amaranth leaves and black nightshade are regarded as significant sources of iron and vitamin A (Amagloh *et al.* 2017: 1).

a) Vitamins

Micronutrients are vital components that humans require in variable amounts throughout their lives to coordinate a variety of physiological functions that are necessary for health. Micronutrients are often required in amounts of less than 100 milligrams per day for human nutrition, whereas macronutrients are required in gram amounts every day. Vitamins and minerals are necessary micronutrients that play an important role in the human body (Godswill, Somtochukwu, Ikechukwu and Kate 2020: 24).). Vitamin deficiency is defined as a persistent lack of a specific vitamin or vitamins. It may be a primary or secondary deficit (Godswill, Somtochukwu, Ikechukwu and Kate 2020: 17). Refer to Table 2.2 for a comprehensive vitamins profile that includes a breakdown of the functions, sources, and DRI recommendations of various vitamins according to age groups (IoM 2006).

TABLE 2.4 COMPREHENSIVE NUTRITION PROFILE: VITAMINS

Nutrients	DRIs		(Age Groups)	Function	Sources
	19-30 Years	31-50 Years	51-70 Years		
Biotin	♂ 30µgA ♀ 30µg AI	♂ 30µgAI ♀ 30µg AI	♂ 30µgAI ♀ 30µg AI	Acts as a co-factor in cellular metabolism for physiology and biochemistry (Karachilou and Livaniou 2024: 20).	Dark green leafy vegetables are said to be a good source of biotin (Akram, Munir, Daniyal, Egbuna, Gaman, Onyekere and Olatunde 2020: 158).
Vitamin A	♂ 625mcg EAR ♀ 500 mcg EAR	♂ 625mcg EAR ♀ 500 mcg EAR	♂ 625mcg EAR ♀ 500 mcg EAR	Improves vision and immune system functioning (Carazo, Macakova, Matousova, Krcmova, Protti and Mladenka 2021: 1)	Indigenous leafy vegetables such as pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 234).
Vitamin C	♂ 75mg EAR ♀ 60mg EAR	♂ 75mg EAR ♀ 60mg EAR	♂ 75mg EAR ♀ 60mg EAR	Enhances Iron absorption and supports immune system (Choughari 2023: 1)	Indigenous leafy vegetables such as pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 234).
Vitamin E	♂ 12mg EAR ♀ 12mg EAR	♂ 12mg EAR ♀ 12mg EAR	♂ 12mg EAR ♀ 12mg EAR	Protects cells from oxidative damage, supports immune function and modulates inflammatory responses (Liao, Omage, Börmel, Kluge, Schubert, Wallert and Lorkowski 2022: 1:	Vitamin E can be found in a variety of food sources, including grains, wild plants, legume seeds, animal products, and edible flowers (Shahidi, Pinaffi-Langley, Fuentes, Speisky and de Camargo 2021: 317).
Vitamin B6	♂ 1.1mg EAR ♀ 1.1mg EAR	♂ 1.1mg EAR ♀ 1.1mg EAR	♂ 1.4mg EAR ♀ 1.3mg EAR	Plays an important function in glucose, lipid, amino acid, and nucleic acid metabolism as well as cellular signalling (Stach, Stach and Augof 2021: 1).	The most important food sources for B6 are meat, cow's milk, cabbage, potatoes, beans, whole grains, peanuts, soybeans and certain fish (Santos, Khemiri, Simoes, Prista, Sousa and Raymundo 2023: 12).

TABLE 2.5 COMPREHENSIVE NUTRITION PROFILE: VITAMINS (*CONTINUED*)

Nutrients	DRIs		(Age Groups)	Function	Sources
	19-30 Years	31-50 Years	51-70 Years		
Vitamin B12	♂ 2.0mg EAR ♀ 2.0mg EAR	♂ 2.0mg EAR ♀ 2.0mg EAR	♂ 2.0mg EAR ♀ 2.0mg EAR	It is important for red blood cell formation, cognitive function, and the absorption of calcium, which is vital for healthy bones and teeth (Department of Health KZN 2023: para. 1 line 1).	Dietary sources of vitamin B12 are of animal origin and include meat, eggs, milk, dairy products, fish and poultry (Butola, Kute, Anjakar, Dhok, Gusain and Vagga 2020: 3139).
Thiamine	♂ 1.0mg EAR ♀ 0.9mg EAR	♂ 1.0mg EAR ♀ 0.9mg EAR	♂ 1.0mg EAR ♀ 0.9mg EAR	It contributes significantly to cell metabolism through both coenzymatic and non-coenzymatic mechanisms; it protects tissues and organs (Mrowicka, Mrowicki, Dragan and Majsterek 2023: 12).	Thiamine can be found in plant sources (Fitzpatric and Chapman 2020: 12010). Indigenous leafy vegetables such as pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsvel, Faber and van Heerden 2012: 234).
Riboflavin	♂ 1.1mg EAR ♀ 0.9mg EAR	♂ 1.1mg EAR ♀ 0.9mg EAR	♂ 1.1mg EAR ♀ 0.9mg EAR	It plays critical roles in essential cellular processes such as mitochondrial energy metabolism, stress responses, vitamin and cofactor biogenesis, where they act as cofactors to ensure flavoenzyme catalytic activity and folding/stability (Mosegaard, Dipace, Bross, Carlsen, Gregersen and Olsen 2020:1)	Major dietary sources of riboflavin for the adult population include milk and milk products, bread, and fortified cereals (IoM 2006: 275). Other sources include dark green leafy and yellow/orange vegetables (Wenhold, Annandale, Faber and Hart 2012: 114). Indigenous leafy vegetables such as pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 234).
Niacin	♂ 12mg EAR ♀ 11mg EAR	♂ 12mg EAR ♀ 11mg EAR	♂ 12mg EAR ♀ 11mg EAR	It plays a vital role in energy metabolism and the synthesis of fatty acids and steroids (IoM 2006: 263).	Dietary sources of niacin include meat, liver, poultry, and fish (IoM 2006: 263).
Folate	♂ 320mcg EAR ♀ 320mcg EAR	♂ 320mcg EAR ♀ 320mcg EAR	♂ 320mcg EAR ♀ 320mcg EAR	Folate molecules serve as cofactors in one-carbon metabolism, a crucial process for cellular life (Shulpekova, Nechaev, Kardasheva, Sedova, Kurbatova,	Rich sources of folate include fortified grain products, dark green vegetables, and beans and legumes (IoM 2006: 245).

				Bueverora, Kopylov, Malsagova, Dlamini and Ivashkin 2021: 20).	

b) Minerals

Minerals play a crucial role in the optimal functioning of the immune system, supporting both innate and adaptive immune responses. They are essential for defence mechanisms against pathogens and for maintaining a balance between pro- and anti-inflammatory processes. Generally, a balanced diet provides enough minerals to support immune health. However, certain at-risk groups should be mindful of their mineral intake, particularly magnesium, zinc, copper, iron, and selenium, as deficiencies in these minerals can temporarily impair immune function and disrupt the long-term regulation of systemic inflammation (Weyh, Krüger, Peeling and Castell 2022: 1). Understanding the mechanisms and sources of these minerals is vital for maintaining immune competence. In exceptional cases of deficiency, supplementation may be necessary, but it is important to approach this carefully, as excessive mineral intake can negatively affect the immune system. Therefore, any supplementation should be guided by medical advice and administered in prescribed amounts (Weyh *et al*. 2022: 1). Refer to Table 2.3 for a comprehensive minerals profile that includes a breakdown of the functions, sources, and DRI recommendations of various minerals according to age groups.

TABLE 2.5 COMPREHENSIVE MICRONUTRIENTS PROFILE: MINERALS

Nutrient	**DRIs**	**Age**	**Groups**	**Functions**	**Sources**
	19-30 Years	**31-50 Years**	**51-70 Years**		
Calcium	♂ 1000mg AI ♀ 1000mg AI	♂ 1000mg AI ♀ 1000mg AI	♂ 1200mgAI ♀ 1200mg AI	Helps with development, growth and maintenance of bones and stabilising cytoskeletal function (Beto 2015: 1).	Indigenous leafy vegetables such as pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 233).
Iron	♂ 6mg EAR ♀ 8.1mg EAR	♂ 6.0mg EAR ♀ 6.8mg EAR	♂ 6.0mg EAR ♀ 5.0mg EAR	Transports oxygen in the body and good sources of non-heme iron (Yiannikourides and Latunde-Dada 2019: 1).	Indigenous leafy vegetables (pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 233).

Table 2.6 Comprehensive micronutrients profile: Minerals (*Continued)*

Nutrient	DRIs	Age	Groups	Functions	Sources
	19-30 Years	**31-50 Years**	**51-70 Years**		
Zinc	♂ 9.4mg EAR ♀ 6.8mg EAR	♂ 9.4mg EAR ♀ 6.8mg EAR	♂ 9.4mg EAR ♀ 6.8mg EAR	Maintains healthy bones, growth and development (Ceylan, Akdas and Yazihan 2020: 535; IoM 2006: 403).	Indigenous leafy vegetables (pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 233).
Magnesium	♂ 330mg EAR ♀ 255mg EAR	♂ 350mg EAR ♀ 265mg EAR	♂ 350mg EAR ♀ 265mg EAR	Controls body activities such as protein synthesis, muscle and nerve transmission, neuromuscular conduction, signal transduction, blood glucose control, and blood pressure regulation (Pinotti, Manoni, Ferrari, Tretoli, Cazzola and Givens 2021: 12).	Green leafy vegetables (Barbagallo, Veronese, and Dominguez 2021: 13). Indigenous leafy vegetables such as pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 233).
Phosphorus	♂ 580mg EAR ♀ 580mg EAR	♂ 580mg EAR ♀ 580mg EAR	♂ 580mg EAR ♀ 580mg EAR	Regulates body PH levels and metabolic activities (IoM 2006: 366).	Indigenous leafy vegetables are good sources (pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 233).
Selenium	♂ 45µg EAR ♀ 55µg EAR	♂ 45µg EAR ♀ 55µg EAR	♂ 45µg EAR ♀ 55µg EAR	Regulates thyroid hormone actions (Gorini, Sabatino, Pingitore and Vassalle 2021: 8).	Cereals and grains (Olza, Bartrina, Gonzalez-Gross, Oretag, Seraa-Majem, Varela-Moreiras and Gill 2017: 1).
Potassium	♂ 4700mg AI ♀ 4700mg AI	♂ 4700mg AI ♀ 4700mg AI	♂ 4700mg AI ♀ 4700mg AI	Assists with cellular activities such as fluid balance and osmolality of cells (McLean and Wang 2021: 89).	Indigenous leafy vegetables such as pumpkin leaves, Spider flower, Cowpea leaves, Jews mallows, Amaranth, and Black nightshade (Van Jaarsveld, Faber and van Heerden 2012: 233).

♂: Male; ♀: Female

2.8 Dietary diversity: Food Variety and Food Group Diversity scores

The low-income communities in low-income countries often lack dietary diversity since their diets comprise mainly starchy staples, with little to no animal products and few fresh fruits and vegetables (Zhao, Yu, Tan, Zheng, Zhao, Wang and Zhang 2017: 8). Sambo Oguttu and Mbombo-Dweba (2022: 1) highlighted that dietary diversity is a good indicator of nutritional adequacy and food security. Diets that are not diverse with high intake of refined grains are associated with an increased risk of overweight and obesity (Jakobsen, Brader, and Brunn 2023: 10). Chakona and Shackleton (2017: 3) concurred that this lack of dietary diversity is particularly problematic for many impoverished households globally, due to diets largely composed of starchy foods. This unhealthy consumption contributes to the rising prevalence of overweight, obesity, and diet-related non-communicable diseases (Madlala, Hill, Kunneke, Kegne, Peer and Faber 2022: 1). Therefore, a healthy diet should provide enough water, energy, macronutrients, and micronutrients to meet nutritional needs (Tasgin 2017: 15). Savarino, Corsello and Corsello (2021: 1) agree that macronutrients and micronutrients are essential for physiological growth.

Researchers typically assess dietary variety by tallying the total number of different foods or food groups consumed over recall periods of one (1) to three (3) days, although some studies have extended this to a seven (7)-day timeframe. Food frequency questions (FFQs) measure the frequency of eating specific foods or dietary groups over time. The questionnaire consists of a food list and a frequency category part, and it can be completed by the respondent or an interviewer. The data collection may occur daily, weekly, monthly, or yearly based on the study objectives. Furthermore, FFQs may include information about portion sizes and/or the quantity of food consumed (FAO 2018: 10-11). Huang, Zhao, fang, Yu, Yang, Li, Mu, Ju, Li, Cheng and Xu (2022: 13) recommend that to increase accuracy and reduce survey costs and subject burden, large-scale nutrition surveys are conducted over two non-consecutive 24-hour periods, one on the weekend and one on a weekday.

The 24-hour recall provides information on portion quantities, preparation methods, and ingredients utilized. Portion sizes are measured using various tools, including cups, plates, mugs, glasses, measuring spoons, dishing spoons, and rulers. The first step in the 24-hour recall is determining the time and location of meal consumption. Participants are instructed to record the items they ingest at specific times. Next, the participants should be asked to describe their meal preparation practices and then they provide portion sizes for meals (Govender *et al.* 2021: 5).

Dietary diversity is measured by the number of individual foods consumed, which is known as the food variety score (FVS) and the number of food groups consumed is labelled as food group diversity scores (FGDS) (Clausen, Charlton, Gobotswang and Holmboe-Ottesen 2005: 88). These scores contribute to the overall dietary diversity score (DDS), which is used to determine nutrient adequacy, often referred to as the Nutrient Adequacy Ratio (NAR) (Arimond and Ruel 2004: 3). The FVS calculates the total number of distinct foods consumed during a specified recall period, while the DDS groups similar foods into broader categories, counting the number of these groups within the same timeframe (Gupta 2016: 7).

Promoting dietary variety is a key aspect of the ten FBDGs, which aim to reduce health issues linked to insufficient dietary diversity and encourage individuals to expand their daily food choices. The DDS and FVS are effective, non-invasive tools for assessing nutritional adequacy. Specifically, the DDS measures the number of food groups consumed within a designated timeframe (e.g., the past 24 hours), while the FVS tracks the total individual food items consumed during that period. Both scores provide qualitative insights into dietary variety, with research indicating a significant association with micronutrient intake and reflecting the availability and accessibility of diverse food items within households (Vispute, Mandlik, Senwalka, Gondhalekar and Khadilkar 2023: 2).

2.9 Burden of malnutrition in South Africa

Nutrient deficiencies remain a significant public health issue, causing conditions such as anaemia, night blindness, and cognitive impairment, particularly in sub-Saharan Africa (Mrimi, Palmeirim, Minja, Long and Keiser 2022: 1). The World Health Organization (2024: para. 1 line 1) describes malnutrition as an imbalance in a person’s diet that is characterised by either excessive or insufficient energy and nutrient intake. Moreover, malnutrition is divided into two categories: undernutrition, which encompasses wasting, underweight, stunting, and other nutritional deficiencies, whereas overnutrition includes overweight, obesity, and diet-related non-communicable illnesses such as diabetes, cancer, stroke, and heart disease. Approximately 890 million people globally suffer from obesity, whereas 390 million are underweight. Moreover, an estimated 37 million children under the age of five are overweight, with 149 million stunted. Adding to this burden are the 571 million, or 30%, of women of reproductive age worldwide who suffer from anaemia, of which almost half could benefit from iron supplementation. (WHO 2024: para. 2 line 1).

Access to nutritious and balanced diets is a major challenge in rural areas, contributing to both under- and over-nutrition in South Africa (Govender, Pillay, Siwela, Modi and Mabhaudhi 2021: 1). The double burden of malnutrition, characterized by both overnutrition and undernutrition, is increasingly affecting low socio-economic rural households, particularly children and mothers in South Africa (Modjadji and Madiba 2019: 1). Seedat, Tollaman, Twine, Cappola, and Wade (2024: 1) reported that a rise in the burden of malnutrition, partly due to rapid epidemiological and nutritional transitions and poor dietary choices, contributes to numerous health issues and increased mortality. Unhealthy diets, characterized by high sugar and saturated fat intake and low fibre that people consume are linked to increased incidence of non-communicable diseases (NCDs) (Godbharle, Kesa, and Jeyakuma 2024: 1; Kalmpourtzidou, Eilande and Talsma 2020: 1; Steyn, Jaffer, Nel, Levitt, Steyn, Lombard and Peer 2016: 1). Overnutrition from consuming energy-dense and poor processed foods significantly impacts morbidity and mortality. Moreover, other unhealthy dietary habits include ultra-processed foods which negatively impact essential nutrient intake and contribute to obesity (Juul and Bere 2023: 1).

KwaZulu-Natal is considered to have more obese adults (39.4%) compared to other provinces whereas underweight adults were low at 3.0% (Simelane *et al.* 2024: 126). Moreover, this was supported by Simelane *et al.* (2024: 126) who reported that KwaZulu-Natal has a significantly higher prevalence of obesity (51.9%) in women compared to all other provinces. Other statistics showed that KwaZulu-Natal has a higher prevalence of overall overweight in children (Simelane *et al.* 2024: 122). In addition, obesity can be minimized by educating affected populations on proper food preparation and processing, as well as promoting healthier and more affordable food options and portion control (Govender *et al.* 2021: 18).

Undernutrition and overnutrition coexist in rural communities in KwaZulu-Natal (Govender *et al.* 2021: 18). The recent food and nutrition survey published by HSRC reported that there are many cases of undernutrition in South Africa. Approximately six-point zero percent (6.0%) of adults were considered underweight in South Africa after using Body Mass Index (BMI) calculation and classification. Distribution of BMI in adults using age indicated that 10% were aged 18-24, 5.4% (25-34 years old), 4.4% (35-44), 3.8 (45-54), 3.5% (55-64), and 4.2% (65+ years old). In KwaZulu-Natal, only four percent (4%) were underweight (Simelane *et al.* 2023: 127).

The food and nutrition survey further recorded the overall prevalence of stunting on children under the age of 5 years and recorded 28% of severe and moderately stunted children (Simelane *et al.* 2023: 113). Govender *et al.* (2021: 18) reported that stunting and risk of obesity is prevalent in children under the age of 5 years old. KwaZulu-Natal recorded a 27.5% of stunted children. Regarding wasting, for children under the age of 5 years, a 9.8% wasting prevalence was reported nationally and KwaZulu-Natal recorded 2.1% overall wasting. Then the overall underweight prevalence for children under 5 years old was 7.7%, and in KwaZulu-Natal, a total of 4.4% was recorded. Regarding overweight, approximately 22.6% children under age of 5 were overweight across South Africa. In KwaZulu-Natal, 30% of children overall were overweight.

Food-based dietary guidelines (2013: 5) offer concise recommendations to guide consumers towards a balanced diet. The FBDGs emphasize the importance of nutritious food intake for elderly health, while dietary diversity is recognized as a crucial component of a high-quality diet in several countries' dietary guidelines, including South Africa's (Saha, Mukherjee, Miller, Peng, Napier, Grobbelaar and Odlewage-Theron 2021: 551). Adopting FBDGs helps avoid malnutrition, improves health, and minimizes environmental impact (Cámara, Giner, González-Fandos, López-García, Mañes, Portillo, Rafecas, Domínguez and Martínez 2021: 1). Effective application of FBDGs can help address these issues by promoting balanced diets, considering traditional eating patterns, food availability, and affordability. Food-based dietary guidelines, which promote diverse and nutritious food consumption, face challenges due to high food costs (Madlala, Hill, Kunneke and Faber 2023: 1).

Community gardens have been shown to increase the consumption of dark green leafy vegetables and improve dietary diversity, and such initiatives should be recognized for their role in enhancing household nutrition despite various constraints (Hendriks *et al.* 2020: 1). Vegetables, which are rich in essential micronutrients, play a vital role in addressing these deficiencies. Africa's diverse climates support a wide range of indigenous and exotic vegetables, though many remain underutilised (Issa-Zacharia, Majaliwa, Nyamete and Chove 2024: 1). Social grants often limit poor households' ability to afford balanced diets. Promoting traditional vegetable crops and pulses, as well as supporting household and community food gardens, can improve access to nutritious foods and address malnutrition (Govender *et al.* 2017: 1). The World Health Organization advocates for maintaining healthy body weight, achieving proper dietary intake, and avoiding excess sugar and saturated fats (Mphasha, Mothiba and Skaai 2021: 1). Therefore, health and regulatory authorities should emphasize clear recommendations on whole grains and dietary fibre to enhance public health (Alahmari 2024: 1).

2.10 Chapter Summary

This chapter has delved into the multifaceted role of ILVs in promoting food security and nutritional health. It has highlighted the challenges related to perceptions, accessibility, and availability of ILVs while discussing their potential benefits in improving dietary diversity and addressing micronutrient deficiencies. By promoting ILVs as a viable agricultural crop and enhancing public knowledge about their benefits, we can contribute to better utilisation and improved food security in rural communities.

Furthermore, recognising the significance of ILVs within the broader context of sustainable agriculture is crucial for fostering resilient food systems. Policymakers and stakeholders should implement targeted strategies to raise awareness, support local farming initiatives, and facilitate market access for ILVs. Future research should also focus on understanding consumer preferences, barriers to adoption, and the economic viability of ILV cultivation. Overall, a concerted effort to integrate ILVs into food security strategies can have far-reaching benefits for both individual health and community well-being.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter provides a detailed description of the research methods used in the study. The main purpose of this study was to determine the seasonal consumption and contribution of ILVs to household food security and dietary recommended intakes in Mangangeni rural village. The research methods and instruments were selected to meet the research objectives as set out in Chapter 1. In this chapter, the ethical considerations, planning and administration, the research design, the setting of the study, sampling method and sampling size, research instruments, and data analysis are discussed.

3.2 Ethical considerations

The research proposal was submitted for ethical approval in 2022 to the Institutional Research Ethics Committee (IREC) at Durban University of Technology (DUT). Approval was granted with ethics reference number: IREC 042/22 before the commencement of the study. Once approval for the study was received, the researcher approached the *induna (*village governor) of Mangangeni village to request permission to conduct the research in the rural village through a gatekeeper letter (Annexure A) and approval was granted. Participants were informed through a letter of information (Annexure B). The information letter was explained to the participants and once they agreed to participate in the study, an informed consent agreement was signed (Annexure C). During the discussions with the participants, it was emphasised that all information collected would remain anonymous and would be kept confidential and locked away at the DUT in the Department of Food and Nutrition archives for five years. Only the researcher and the supervisors would have access to this information. After that, it would be disposed of by shredding.

3.3 Planning and administration:

Figure 3.1 indicates the roll-out of the study. The study was done across four seasons (spring, summer, autumn, and winter) in the rural village of Mangangeni. The researcher conducted a pilot study to test comprehension of the questionnaires with 10 people who did not participate in the study. The data collection was done by the researcher through one-on-one inter-person interviews in the rural households.

The following process was followed:

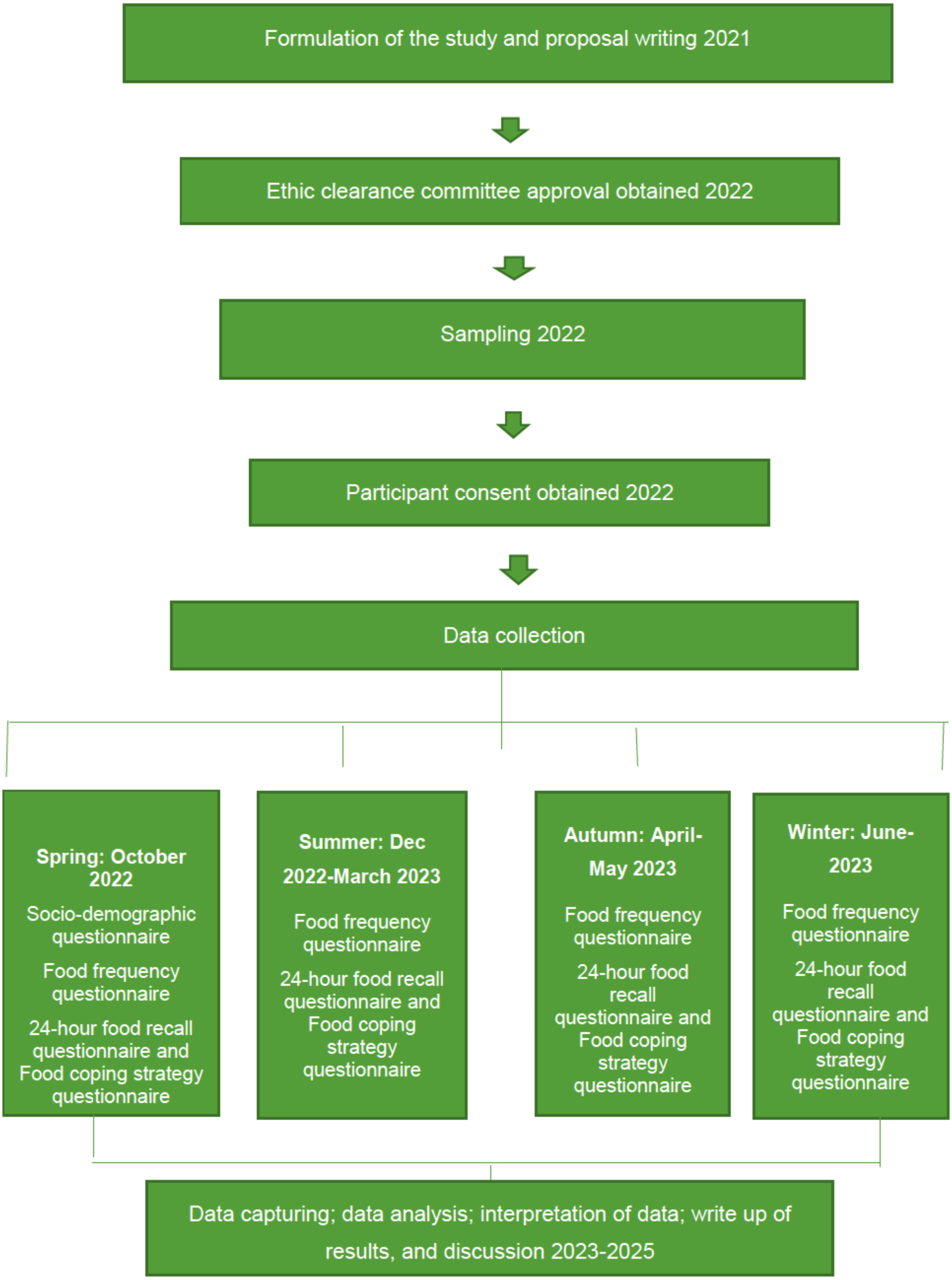


FIGURE 3.1 FLOW DIAGRAM ILLUSTRATING RESEARCH ACTIVITIES.

3.3.1 Research objectives and associated instruments

Table 3.1 below illustrates the research objectives, and the measuring instruments used to accomplish the research goals. The study used a variety of measuring instruments: a sociodemographic questionnaire was used to gather information about the participants in Mangangeni village; an ILVs survey, which is a subset of the sociodemographic questionnaire, investigated consumers' perceptions, sourcing and consumption frequency of ILVs; a food frequency questionnaire evaluated the contribution of ILVs to seasonal dietary diversity; a 24-Hour recall questionnaire assessed their contribution to daily nutritional needs; and a food coping strategy questionnaire identified available foods and coping strategies for seasonal ILVs. Each instrument was implemented to gather pertinent data, providing an accurate evaluation of the goals. Table 3.1 present the research Objectives and instruments used to achieve the specified objective.

TABLE 3.1 RESEARCH OBJECTIVES AND MEASURING INSTRUMENT

Research objectives	Measuring instrument
To investigate the socio-demographic profile of 118 participants of Mangangeni village by using a socio-demographic questionnaire	Sociodemographic questionnaire (Napier 2006).
To identify consumers' perception and sourcing of ILVs using a survey through in-person interviews	Indigenous leafy vegetables survey (Section B of the sociodemographic questionnaire) (Mavengahama 2013)
To assess ILVs, and their contribution to dietary diversity, using a food frequency questionnaire administered across the four seasons.	Food Frequency Questionnaire (FAO 2009).
To evaluate the contribution of ILVs to daily nutritional requirements by using 24-hour recall questionnaires administered across the four seasons.	24-hour recall (FAO 2018)
To determine the availability of food as an indicator of access to food when ILVs are out of season using a coping strategies questionnaire.	Food Coping Strategy Questionnaire (Maxwell *et al.* 2003).

3.4 Research design

The study was categorised as cross-sectional descriptive because it systematically documented and analysed the seasonal consumption patterns of ILVs and their contribution to household food security and daily recommended intake over four seasons. Cross-sectional studies are studies that analyse data from a population at a single point in time (Wang and Cheng 2020: 1). Kesmodel (2018: 1) stated that cross-sectional studies are characterized by the collection of relevant information (data) at a given point in time. A descriptive study aims to detail the distribution of one or more variables without addressing causal relationships or hypotheses, focusing on systematically and accurately describing the characteristics of a population, situation, or phenomenon (Aggarwal and Ranganathan 2019: 34). This aligns with the study's objective to offer a thorough understanding of seasonal variations of ILVs and their contextual significance. By collecting and examining data across four distinct seasons, the research aimed to provide a comprehensive portrayal of these consumption patterns and their impacts within the rural community of Mangangeni village, Ndwedwe, KwaZulu-Natal. Streefkerk (2020: 2) states that quantitative research provides data that is based on statistics using numbers and graphs to explain the phenomena.

3.5 Setting of the study

3.5.1 Sociodemographic profile

Ndwedwe Local Municipality, part of the District Municipality in KZN alongside Maphumulo, KwaDukuza and Mandeni, spans 1,076 sq. km and is primarily inhabited by poor black communities reliant on subsistence farming (Ndwedwe Local Municipality 2022). The municipality features unique tourist attractions along the Zulu Rural Cultural Trail, with the Nhlangakazi Holy Mountain being a notable cultural and religious site (Statistics South Africa 2022: para. 1 line 1). Ndwedwe is one of the poorest municipalities in KwaZulu-Natal, lacking basic infrastructure and services, with up to 70% of its population living in poverty and facing significant inequalities (Munien 2016: 1; iLembe District Municipality 2020: 66-78). The area's unemployment trends mirror those of the province. Located south of eThekwini Municipality and north of Maphumulo Municipality, Ndwedwe faces challenging socioeconomic conditions (Munien, Phungula and Bob 2018: 66).

With a population of 140,820, Ndwedwe's demographics are as follows: 57% are aged 15-64, 37% are under 15, and 6% are over 65 (Ndwedwe Local Municipality 2022). In Mangangeni, most residents are unemployed older women who rely on social grants, elderly grants, and remittances from family members working in urban areas. Women, who head 52.80% of households, stay behind to practice subsistence farming while men migrate to cities for work (Ndwedwe Local Municipality 2022). Youth unemployment stands at 58.30%, and among those aged 20 and over, 22.30% have no schooling, 22.20% have completed Matric, and only 2.90% have higher education (Ndwedwe Local Municipality 2022).

Public transportation in Ndwedwe mainly consists of taxis and buses, which residents use to shop for groceries either in Ndwedwe Central or Durban City. The Ndwedwe Central area features a Boxer supermarket near the municipality offices, a community health care centre, a community hall, a police station, and businesses along the P100 main road (Munien 2016: 4). Additionally, local tuckshops help reduce travel time for essential items. Figure 3.2 and figure 3.3 indicate a detailed map of the research area.

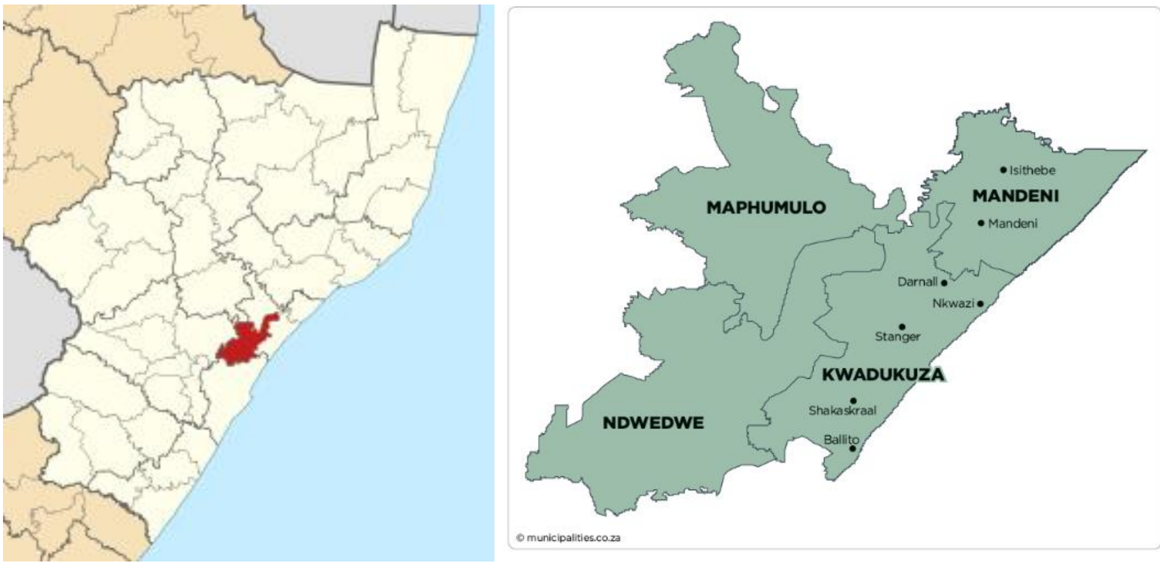


FIGURE 3.2 A MAP DETAILING THE AREA OF RESEARCH IN KZN

The Mangangeni tribal authority, a rural village within Ndwedwe, consists of 210 households according to Google Maps.

FIGURE 3.3 A MAP DETAILING MANGANGENI RURAL VILLAGE IN NDWEDWE, KZN
***SOURCE GOOGLE MAPS* 2023.**

The Mangangeni tribal authority, a rural village within Ndwedwe, consists of 210 households according to Google Maps.

3.6 Methodology

This study was done throughout four seasons (spring, summer, autumn, and winter). The data were collected by visiting households in the Mangangeni Village. The data collection duration with each participant lasted from 45 to 60 minutes.

3.6.1 Sampling method and sample size

The sample size calculator by SurveySystems.com was used to calculate the final study sample size. The rural village population size is 210 households, as was discovered using Google Satellite Google Maps (Google Maps 2023). A confidence level of 95% and a confidence interval of six (6) were used to calculate the sample size. Therefore, a sample size of 118 participants was included in the study (Creative Research Systems 2012: 1). All the participants included in the study were above 18 years of age.

Sampling is described as the process of selecting a group of participants to represent the whole population (Naderifar, Goli and Ghaljie 2017: 1). The sampling method employed in this study was snowball sampling, a non-probability technique where existing study participants recruit future subjects from their acquaintances. This approach is particularly effective in studies focusing on specific, less visible populations, such as households utilising Indigenous leafy vegetables (ILVs). Given the study's objective to investigate seasonal consumption of ILVs, it was important to target households that actively plant and/or utilise ILVs. Therefore, the researcher applied snowball sampling, because it allowed the researcher to access this specific group by leveraging the networks within the community to identify and include households with relevant experience (Joubert, Ehrlich, Katzenellenbogen and Karim 2007: 101). This method facilitated a more targeted and effective data collection process in a rural setting. Thus, the selected sampling was well-suited for gathering detailed insights into the seasonal patterns and contributions of ILVs in the study area.

3.6.1.1 Inclusion and exclusion criteria

Inclusion criteria

- Residents from Mangangeni rural village.
- Adults 18 years and older.

Exclusion criteria

- People residing in neighbouring villages.

3.6.2 Measuring instruments

Data collection is the process of collecting data aiming to gain insights regarding the research topic. Data collection instruments in research include interviews, questionnaires, interviews, observations, and focus groups (Taherdoost 2021: 1). This study utilised a variety of tools and these are discussed below.

3.6.2.1 Socio-demographic questionnaire and Indigenous leafy vegetables consumption survey

This measuring instrument consisted of two sections; Sections A and B. Section A, the socio-demographic questionnaire, was adopted from Napier (2006). It is comprised of socio-demographic information, including personal information, education level, employment status, household income, number of household members, and household assets (Annexure A). Section B consisted of an ILV consumption survey, which included questions regarding knowledge, awareness, sourcing, consumption frequency, and perception of indigenous vegetables. The ILV consumption survey was adapted from an existing questionnaire developed by Mavengahama (2013).

This measuring instrument was translated from English to *IsiZulu* to make it easier for the rural participants as *IsiZulu* is their primary language. This questionnaire was piloted in the community with 10 people who did not participate in the main study prior to the commencement of the study to test their comprehension and understanding of all the instrument contents, and no changes were made to either section of the questionnaire. The pilot test is a trial study conducted with a small number of participants to evaluate the methodology before a full study is carried out to allow the researcher to make adjustments and improvements where necessary. Arain, Campbell, Cooper and Lancaster (2010: 5) described a pilot study as a concise examination of feasibility aimed at assessing multiple aspects of the methods planned for a larger, more rigorous, or validating research effort. It was completed once during the first season of the data collection. A total of n=118 sociodemographic questionnaires were collected.

3.6.2.2 Food Frequency Questionnaire

A food frequency questionnaire (FFQ) is a dietary tool designed to track the frequency consumption of specific foods across different food groups. The FFQ used in this study was based on the existing questionnaire used by Oldewage-Theron and Kruger (2008) in a study “Food variety and dietary diversity as indicators of the dietary adequacy and health status of an elderly population in Sharpeville”. The FFQ originally included nine food groups: meats/animal proteins, legumes, starches, vegetables, dairy products, fruits, sweets, and oils, as recommended by FAO (2009).

In this study, The FFQ was implemented and adapted to the local community’s dietary habits by including an additional food group related to indigenous leafy vegetables (ILVs), resulting in a total of ten food groups. To ensure participants understood the questionnaire, this questionnaire was piloted in the community with 10 individuals who did not participate in the main study, prior to the study's commencement, to assess their comprehension and understanding of all the instrument's content and leading to modifications such as the addition of the ILVs food group. Data collection took place across all seasons, with each participant completing one FFQ per season. From spring through to winter, a total of n=472 FFQs were collected, with each participant contributing one questionnaire per season.

3.6.2.3 24-hour Food Recall

A structured 24-hour food recall is a dietary assessment tool used to determine the food consumed by individuals during the last 24 hours (Huang *et al.* 2022: 1). This questionnaire is used to determine the food consumed by the participants and relies on the participant's memory. However, the details recalled may be biased.

In this study, the researcher conducted data collection using 24-hour food recall questionnaires through face-to-face interviews with the participants. The 24-hour food recall questionnaires were completed twice (one during weekdays and one during weekends per participant in each season) to indicate a clear food consumption pattern and evaluate the contribution of ILVs to the daily nutritional requirements and the food consumption during each of the four seasons. The researcher was trained in using a 24-hr recall collecting dietary information. The questionnaire was adapted from FAO (FAO 2018: 130).

Measuring cups, tablespoons, and teaspoons were used to determine accurate portion sizes in the interviews to yield reliable data and a detailed report of what they ate. These tools are essential for achieving accuracy in food intake reporting, as they provide standardized units of measurement. By using measuring cups, spoons, and other calibrated utensils, researchers can minimise errors associated with estimating portion sizes based on subjective judgements or visual approximations (FAO 2018: 20).

To further support the collection of reliable dietary intake data, the researcher asked probing questions regarding the types of foods consumed. For example, "What was the first meal you ate yesterday and at what time was it eaten?"; "How much did you consume; if you were to use a measuring cup, how many cups would you say you consumed?"; "If you were to use a tablespoon or a teaspoon, would you say it was heaped or level"; "If you used milk, what type of milk was it, was it powdered or liquid, was it full cream or low fat or fat free, and what brand was it?"; "If you used sugar, was it brown or white, how much did you use, were the tablespoons/teaspoon level or heaped?".

This approach enhanced the reliability of data collected, ensuring that portion sizes and food types were recorded accurately and consistently. Consequently, this led to more accurate assessments of nutrient intake and dietary patterns, which are crucial for the validity of dietary studies and subsequent nutritional analysis. A total of n=944 24-hour recalls (two 24-hour recalls per participant per season across four seasons) were conducted with participants.

3.6.2.4 Food Coping Strategy

An adapted Food Coping Strategy (FCS) questionnaire developed by Maxwell, Watkins, Wheeler and Collin (2003) was used for this study (Annexure D). This instrument was used to determine livelihood-based coping strategies which rural households use to access food in times of scarcity. This questionnaire provides insights into the specific actions taken to mitigate the impact of food shortages, such as altering food consumption patterns, reducing meal sizes, or seeking alternative sources of food.

Before data collection, the questionnaire was piloted by conducting focus group discussions with community members from the Mangangeni village to identify the strategies used in the community and to rank the severity of those strategies identified from one to four (1-4) where one meant least severe and four most severe. The questionnaire initially had 13 strategies, but after the piloting, a total of eight strategies were finalised and ranked. The questionnaire covered sensitive topics such as the availability of food, and the distribution of food among the family members either by limiting the portion size or limiting the number of meals per day.

During the implementation of the adapted questionnaire (refer to Table 3.2) the participants in the study ranked strategies according to relative frequency scores. The options ranged from zero: never to 7: daily.

The adapted FCS questionnaire was implemented across the four seasons (one for each season per participant). A total of n=472 FCSs were collected in this study. Table 3.2 indicates the adapted food coping strategies questionnaire used in the study.

Table 3.2 Food Coping Strategy Index (FCS) for Mangangeni rural area people

In the past 30 days, if there have been times when you did not have enough food or money to buy food, how often has your household had to:	Relative Frequency						
	All the time? Every day	Pretty often? 3-6 */week	Once in a while? 1-2 */week	Hardly at all? <1 */ week	Never 0*/week	Severity Ranking	Score
Relative frequency scores	7	4.5	1.5	0.5	0		
a. Rely on less preferred and less expensive foods?						4	
b. Borrow food, or rely on help from a friend or relative?						4	
c. Purchase food on credit?						4	
d. Gather wild food, hunt, or harvest immature crops?						4	
e. Consume seed stock held for next season?						1	
f. Limit portion size at mealtimes?						2	
g. Reduce the number of meals eaten in a day?						2	
h. Make beads and sell them every Friday?						4	
TOTAL							

Severity score: least severe=1 and most severe=4

3.7 Data analysis and interpretation

This section details the data analysis of each measuring instrument used in this study.

3.7.1 Socio-demographic Questionnaire (Section A)

Data from sections A and B of the questionnaire comprised the participants' personal information, household food consumption information, and ILVs survey questions. Data was coded on an Excel® spreadsheet by the researcher and was analysed by a statistician using the Statistical Package for Social Sciences (SPSS) version 27 for analysis and presented in the form of frequencies, percentages, graphs, and tables in descriptive statistics.

3.7.2 Food Frequency Questionnaire

The food frequency questionnaire data were sorted and checked for accuracy by the researcher, resulting in n=472 usable responses. The researcher captured the data from the questionnaires on an Excel® spreadsheet. The data was analysed using SPSS version 27 for descriptive statistics, with the assistance of a statistician. Dietary diversity measures, including the Food Variety Score (FVS) and Food Group Diversity Score (FGDS), were calculated as follows: one (1) overall variety score based on the sample count of food items, two (2) variety score across all ten food groups, and three (3) variety score within each food group. These scores, reflecting a seven-day reference period, were used to assess dietary diversity in various ways.

The FVS represented the count of individual foods and food groups. The relationship between the FVS and FGDS was analysed, comparing scores across all seasons and the most frequently consumed food items across seasons were listed. The data was used to evaluate the dietary diversity within the community. Additionally, the top 20 most frequently consumed food items were identified, and tables displaying percentages of various variables were created. Data were presented as frequencies, percentages, and standard deviations for different categories.

3.7.3 24-hour recall

The 24-hour recall data was captured and analysed using the South African Medical Research Council (SAMRC) Food Finder version 3.0 (SAMRC 2022). This program was developed to analyse the nutrient content of food items consumed. The 24-hour results were analysed to determine the actual intake of energy, macro nutrients (carbohydrates, protein and total fat), dietary fibre, vitamins (vitamins A, E, C, B6, B12, biotin, thiamine, riboflavin, niacin and folate) and minerals (calcium, iron, zinc, magnesium, phosphorus, selenium, potassium). The data were analysed for means, standard deviation and compared to the Dietary Recommended Intakes (DRIs). Estimated Average Requirements (EARs) were used as the reference measure and if not available, Adequate Intake (AI) was used (Institute of Medicine 2006). Tables were used to illustrate the results by means and standard deviation for interpretation.

3.7.4 Food Coping Strategy

The researcher sorted and checked the completed Food Coping Strategy questionnaire data for completeness and accuracy**.** Then the data was recorded in an Excel® spreadsheet by the researcher and analysed by the statistician using SPSS Version 27. The highest frequency score (a maximum of seven) was multiplied by the severity weight, which was from one (1) (least severe) to four (4) (most severe) multiplied by eight strategies = a maximum score of 175 could have been scored by households. Thus, the higher the score the greater the prevalence of food insecurity and the lower the score the less food insecure the household was.

Descriptive statistics, including means and standard deviations were computed. A table was created to display various variables from the questionnaires, and the data were presented as frequencies and percentages to assess coping strategy index scores, with higher scores reflecting greater food insecurity.

3.8 Data quality control

Reliability and validity are important for ensuring transparency in research and enhancing the quality of study instruments (Mohajan 2017: 2). All questionnaires were administered through face-to-face interviews conducted by the researcher.

3.8.1 Validity

Validity can be described as the extent to which the instrument correctly measures what it is supposed to measure and if the instrument is not reliable, it can't be valid (Maree 2007: 260). It refers to how well the results among the study participants represent true findings among similar individuals outside the study (Pattino and Ferreira 2018: 1). Moreover, validity is a central factor in choosing an instrument for a research study. This means that the items on the instrument need to be checked as to whether the content has been measured in accordance with the attributes to be evaluated (Roebianto, Savili, Aulia, Suciyana and Mubarokah 2023: 5).

In this study, validity was ensured by using previously tested questionnaires such as a socio-demographic questionnaire, a food frequency questionnaire, a 24-hour recall, and a food coping strategy questionnaire and the researcher piloted these instruments to confirm participants' understanding.

Reliability

Reliability refers to the stability or consistency of measured values obtained from repeated measurements using the same instrument. Data is considered reliable when the researcher achieves consistent results. Surucu and Maslakci (2020: 2706) define reliability as a measure of consistency, while Mohajan (2017: 20) views it as validating the collected information.

To maintain reliability and avoid bias, the researcher administered the questionnaire uniformly, having received comprehensive training on administering instruments in this process. Additionally, reliability was ensured by piloting the questionnaires with community members not involved in the study to assess the trustworthiness of the information. Test-retest reliability was implemented by repeating each question to verify consistent results, indicating both measurement stability and clear comprehension of the instruments. The researcher also regularly checked data for errors, inconsistencies, discrepancies, and missing values.

During the 24-hour recall interviews, the researcher used cups and utensils to accurately measure portion sizes and identify food items, thereby ensuring reliable data. A pilot study was conducted in the study area using all the research instruments to test comprehension and understanding in the community with 10 people who did not participate in the main study prior the commencement of the study, and validated the questionnaires for reliability, assessing both consistency and participant understanding. Modifications were made to two questionnaires only (FFQ and FCS).

3.9 Conclusion

This chapter has outlined the research methodology, detailing the approach, the measuring instruments, and the roles and ethics involved. The next chapter will interpret the study's results and discuss the instruments used to assess the seasonal consumption of ILVs and their impact on household food security. All instruments employed were appropriate for data collection and addressing the research problem.

CHAPTER FOUR: FINDINGS

4.1 Introduction

The purpose of the study was to determine the seasonal consumption frequency, and contribution of ILVs and dietary recommended intakes to household food security in rural households of Mangangeni village, Ndwedwe, KwaZulu-Natal.

This chapter will report on the results of the data obtained in this study over four seasons. The findings include socio-demographic factors, ILV perceptions and consumption frequency, dietary intake, food frequency scores, and coping strategies. The sampling technique used resulted in a total of n=118 participants who were aged 18 years old and above.

4.2 Results of the Mangangeni village study

4.2.1 Socio-demographic results

The socio-demographic results present the study population categorised in percentages (%) and numbers (n) according to the sample size, accommodation, family composition, work status, income, and education.

4.2.2 Participant profile, accommodation and family composition

This section examines the family and household dynamics by analysing the various living arrangements of individuals within households. Residents are classified into 11 distinct categories, as shown in Table 4.1. Each category offers insights into the nature of social support systems, financial stability, and the potential implications for individuals' lifestyles

TABLE 4.1 PARTICIPANTS PROFILE: ACCOMMODATION AND FAMILY COMPOSITION

Variable	Number of participants (n=118)	Percentage (%)
Rural	118	100
Home Language		
IsiZulu	118	100
Education level		
Primary	6	5.1
Secondary	12	10.2
Matric	72	61.0
Tertiary	28	23.7
Age		
18-35	60	50.8
36-55	40	33.9
56+	18	15.3
Gender		
Male	45	38.1
Female	73	61.9
Marital status		
Single	**53**	**44.9**
Married	**45**	**38.1**
Divorced	**2**	**1.7**
Widowed	**8**	**6.8**
Never Married	**10**	**8.5**
Living set-up		
Relatives	**13**	**11.0**
Friends	**2**	**1.6**
Home	**103**	**87.3**
Are there children in the household?		
Yes	**117**	**99.2**
No	**1**	**0.8**
Number of children in the household		
Five or less (<5)	**93**	**78.8**
Six or more (6+)	**24**	**20.33**
None	**1**	**0.8**
Co-habitants in the household		
Yes	**118**	**100**
Household size		

Table 4.1 Participants profile: Accommodation and Family Composition (*Continued*)

Variable	Number of participants (n=118)	Percentage (%)
11 or more (11+)	**22**	**18.6**
Six to ten (6-10)	**87**	**73.7**
One to five (1-5)	**9**	**7.6**

The information in Table 4.1 indicates that all the participants (100%; n=118) were situated in a rural geographical location. All participants (100%; n=118) were native *IsiZulu* speakers as indicated in Table 4.1. Concerning the education level, the majority (61.0%; n=72) of the participants had matric, 23.7% had a tertiary education, and 10.2% had a secondary education, and 5.1% (n =6) reported having a primary education. The majority of the participants (61.9%; n=73) were women and 38.1% (n=45) were male. The marital status of the participants shows that 44.9% (n=53) were single, 38.1% (n=45) were married, 8.5% (n=10) were never married, 6.8% (n=8) were widowed and lastly 1.7% (n=2) were divorced. The age range of the participants indicated that 50.8% (n=60) were aged 18-35 years, 33.9% (n=40) were between the ages of 36-55, and lastly, 15.3% (n=18) were 56 years and older. The living set-up shows that the majority (87.3%; n=103) of the participants lived in their own homes, 11.0% (n=13) lived with relatives, and 1.6% (n=2) lived with a friend. Ninety-nine-point two percent (99.2%; n=117) reported that they have children in their household, while 0.8% (n=1) do not have children in the household. Seventy-point eight percent (78.8%; n=93) of the households reported that there were five or fewer children who live in the household, 20.33% n=24) reported that they had six or more children, and 0.8% (n=1) had no children in their household. All the participants (100%; n=118) indicated that they lived with other people in their households. The number of people within the household information indicated that 73.7% (n=87) of the households had six to ten people living there, 18.6% (n=22) had 11 or more people, and 7.6% (n=9) had one to five people in the household.

4.2.3 Household type and amenities

This section provides information on living conditions by looking at access to facilities such as electricity, toilet type and availability of a source of water. It also identifies the additional structures or shacks in the yard and the number of rooms in the main house which ranged from one to more than five. Lastly, it looked at the materials used for construction of the house to give insights to quality and longevity. These factors collectively illustrate the entire household environment and its influence on the household members.

TABLE 4.2 HOUSEHOLD TYPE AND AMENITIES

Variables	(n=118)	(%)
Access to electricity		
Yes	118	100
Type of toilet		
Pit latrine	118	100
Water source		
River	26	22.0
Rain water	36	30.5
Borehole	56	47.5
Are there other houses/shacks within the yard of the main house?		
Yes	104	88.1
No	14	11.9
Number of rooms in your house		
Five plus (5+)	26	22.0
Four (4)	35	29.7
Three (3)	44	37.3
Two (2)	10	8.5
One (1)	3	2.5
House type		
Bricks and clay	7	5.9
Sticks	1	0.8
Clay	35	29.7
Bricks	75	63.6

The results in Table 4.2 show that all participants (100%; n=118) stated that they have access to electricity and they all (100%; n=118) use a pit latrine as a toilet. Regarding the water source, 47.5% (n=56) of the participants indicated that their water source is a borehole, 30.5% (n=36) indicated that they use rainwater often and 22.0% (n=26) use a river as a water source. The majority (88.1%; n=104) of the participants stated that they have other houses and/or shacks in their yard while 11.9% (n=14) stated that they do not have other houses in the yard. Moreover, the number of rooms within the households was recorded as follows: 37.3% (n=44) of the participants indicated that they had three rooms, 29.7% (n=35) had four rooms, 22.0% (n=26) had five plus number of rooms, then 8.5% (n=10) had two rooms, and lastly 2.5% (n=3) had one room. Lastly, the house type information shows that 63.6% (n=75) participants live in a brick house, while 29.7% (n=35) live in a clay house, 5.9% (n=7) live in a brick and clay house, and 0.8% (n=1) live in a sticks house.

4.2.4 Employment status, job profile and income of participants

This section provides information regarding household members' employment status, job descriptions and overall household income. Understanding the work status and household income of the participants provides an important information into the household's economic stability which influences resources and living conditions within the household.

TABLE 4.3 EMPLOYMENT STATUS, JOB PROFILE AND HOUSEHOLD INCOME

Employment status		
Variables	(n=118)	(%=100)
Unemployed	79	66.9
Educator	3	2.5
Nurse	2	1.7
Educator Assistant	5	4.2
Security	7	5.9
Social worker	2	1.7
Cleaner	12	10.2
Store manager	2	1.7
Petrol attendant	1	.8
Supervisor	2	1.7
Cashier	1	0.8
Taxi driver	1	0.8
Packer	1	0.8
Total	**118**	**100.0**
Household income/month	<R3500 R3501-R10 000.00 >R10100	11.9 68.6 19.5

Table 4.3 illustrates that 66.9% (n=79) of the participants were unemployed and 33.1% (n=39) were employed. Of those who were employed, 10.2% (n=12) were cleaners, 5.9% (n=7) were security officers, 4.2% (n=5) were educator assistants, 2.5% (n=3) were educators, 1.7% (n=2) were nurses, 1.7% (n=2) were social workers 1.7% (n=2) were store managers and 1.7% (n=2) were store supervisors. Further results showed that 0.8% (n=1) was a petrol attendant, 0.8% (n=1) was a cashier, 0.8% (n=1) was a taxi driver, and 0.8% (n=1) was a packer. The

household income results show that 68.6% had a household income that ranged from R3501, 00 to R10000, 00 followed by 19.5% with a household income from R10100, 00 and above, and 11.9% had a household income of R3500 and less.

4.2.5 Household food practices and consumption

This section provides information related to food consumption practices such as meal preparation and responsibilities within the households. It is important to understand these practices because they provide insight into and understanding of the different practices within the household.

TABLE 4.4 FOOD CONSUMPTION AND COOKING PRACTICES IN THE HOUSEHOLD

Variables	Response (n=118) (%)	Response (n=118) (%)	Response (n=118) (%)	Response (n=118) (%)	Response (n=118) (%)
	Father	Mother	Sister	Grandmother	Grandfather
Person responsible for meal preparation	32 (27.1)	72 (61.0)	2 (1.7)	12 (10.2)	-
Person responsible for grocery purchases	25 (21.2)	82 (69.5)	-	11 (9.3)	-
Person responsible for feeding children	28 (23.7)	72 (61.0)	8 (6.8)	9 (7.6)	1 (0.8)
Person identified as the household head	73 (62)	72 (61.0)	-	8 (7)	10 (8)
Person responsible for money spent on food	27 (22.9)	79 (66.9)	-	12 (10.2)	-

Table 4.4 presents the household responsibilities related to specific individuals within the household. The results showed that the person responsible for the meal preparation within the household was primarily the mothers (61%; n=72), 27.1% (n=32) fathers, 10.2% (n=10) grandmothers, and 1.7% (n=2) reported that sisters were responsible for the meal preparation.

The decision maker for household grocery purchases was found to be a mother as reported as 69.5% (n=82), followed by 21.2% (n=25) of the participants who were fathers, and lastly, 9.3% (n=11) of the participants who were grandmothers.

The majority 61% (n=72) of the participants responsible for feeding children were mothers, while 23.7% (n=28) were fathers, 6.8% (n=8) were sisters, 7.6% (n=9) were grandmothers, and 0.8% (n=1) was the grandfather.

Regarding the household head, the findings revealed that 62% (n=73) of the participants were fathers, 23% (n=27) were mothers, 7% (n=8) were grandfathers, and 8% (n=10) were grandmothers.

The results further showed that 66.95% (n=79) of the participants indicated that mothers took charge of the money spent on food, while 22.9% (n=27) were fathers, and 10.2% (n=12) were the grandmothers.

TABLE 4.5 MEAL CONSUMPTION PATTERNS AND COOKING PRACTICES

Variables	Response (n=118) (%=100)
Food consumption frequency per day	Twice 39 (33.3) Three times 72 (61.5) Four or more times 6 (5.1)
Place where meal consumption most likely takes place during the day	Home 106 (89.8) Friends 4 (3.4) Work 8 (6.8)
Type of fuel used for cooking	Wood fire 72 (61.5) Paraffin 8 (6.8) Electricity 38 (31.6)

The majority of participants (61.5%; n=72) ate three times a day, 33.3% (n=39) indicated that they ate twice a day and 5.1% (n=6) indicated that they ate four times or more per day. Eighty-nine-point eight percent (89.8%; n=106) of the participants reported that they ate their meals at home often, 6.8% (n=8) stated that they ate at work and 3.4% (n=4) mentioned that they ate at a friend's house. The results also indicated that 61.5% (n=72) of the participants used wood for cooking, 6.8% (n=8) used paraffin, and 31.6% (n=38) relied on electricity for food preparation.

4.3 Indigenous leafy vegetables perceptions, sourcing, and consumption

The results below present the data on the perceptions, sourcing and consumption frequency of indigenous leafy vegetables. It gives the reader information regarding ILV practices of the participants from Mangangeni rural village.

4.3.1 Indigenous leafy vegetable perceptions

This section provides household members' perceptions, knowledge and attitudes toward consumption of ILVs. Understanding these attitudes can provide information on dietary choices, agricultural practices, and ability to promote sustainable food systems in the community.

TABLE 4.6 INDIGENOUS LEAFY VEGETABLES KNOWLEDGE AND PERCEPTIONS

Variable	(n=118)	(%)
Do you know what ILVs are?		
Yes	118	100
Are ILVs available in your community?		
Yes	118	100
Are ILVs easily accessible?		
Yes	118	100
Do you consider preparation as easy?		
Yes	118	100
Do you eat ILVs (if not, say why)		
Yes	117	99.2
No (I dislike them)	1	0.8

Table 4.6 shows that all respondents (100%; n=118) reported having some knowledge of the ILVs by responding 'yes' when asked if they know what ILVs are, and that they are available in their community. They further claimed that they are easily accessible, they considered ILVs preparation easy, and most households reported to eat ILVs, only 0.8% of the participants claimed that they don't eat ILVs because they dislike them. Specifically exploring the perceptions of the participants regarding ILVs consumption, the last part of the ILV survey consisted of a series of questions with a 'yes' or 'no' answer required regarding ILV perceptions, and all participants (100%; n=118) answered 'yes' and indicated that indigenous leafy vegetables are high in nutrients, are healthy, are cheaper than other vegetables, have a pleasant taste, are easily accessible, can prevent and regulate illnesses, are easy to prepare, cook faster, and give them energy, as well as strength to live longer.

4.3.2 Indigenous leafy vegetables sourcing

This section addresses how households' source ILVs. It investigates possible sourcing practices, such as foraging and home gardens and evaluates the accessibility and availability of ILVs in the community. Understanding sourcing patterns emphasizes the relevance of ILVs in the local diets, food security and sustainable agriculture.

TABLE 4.7 HOUSEHOLDS' SOURCING OF INDIGENOUS LEAFY VEGETABLES

Variable	Categories	(n=118)	(%)
Where do you obtain ILVs?	Garden	36	30.5
	Wild	8	6.8
	Own farm	74	62.7
Do you have a garden?	Yes	66	55.9
	No	52	44.1
Where do you cultivate ILVs?	Own farm/garden	118	100
What ILVs do you cultivate?	Pumpkin leaves	117	99.2
	Pumpkin leaves and Taro *(Colocasia Esculenta)*	1	0.8
Cultivation months	August	12	10.2
	September	26	22.0
	October	80	67.8
Do you buy ILVs? If yes where?	Do not buy	103	87.3

	Buy them from roadside vendor	15	12.7
The person responsible for ILV collection	Grandmother	56	47.5
	Mother	61	51.7
	Sister	1	0.8

The ILVs sourcing information illustrated in Table 4.7 indicates that 62.7% (n=74) of the participants obtain ILVs from their farms, 30.5% (n=36) stated they source ILVs from their garden, whilst 6.8% (n=8) reported that they obtain ILVs from the wild. The majority (55.9%; n=66) of the participants were found to own a garden, whereas 44.1% (n=52) of the participants did not own a garden. All the participants (100%; n=118) indicated that they cultivate ILVs on their farm or garden located behind the house. The results further show that the participants cultivate pumpkin leaves (99.2%; n=117) and 0.8% (n=1) cultivate both pumpkin leaves and *colocasia esculenta*, while other available ILVs in the area were reported to be sourced from cultivated lands where they grow on their own. The participants reported that ILV cultivation months started in August (10.2%; n=12), September (22.0%; n=26), and most of the participants cultivated their ILVs in October (67.3%; n=80). Eighty-seven-point three percent (87.3%; n=103) of the participants indicated that they do not buy ILVs and 12.7% (n=15) stated that they do buy ILVs from street vendors. Over half of the households (51.7%; n=61) reported that mothers are responsible for ILV collection, followed by grandmothers (47.5%; n=56), and sisters (0.8%; n=1).

4.3.3 Frequently consumed indigenous leafy vegetables

This section outlines the indigenous leafy vegetables that are frequently consumed in the village, emphasizing the regularity of use and cultural importance in the local diet. The information demonstrates how these vegetables are integrated into everyday meals and underscores their contribution to enhancing nutrition and food security within the community. Stems and leaves are the parts of the reported ILVs that are eaten. Figure 4.1 shows common and frequently consumed ILVs in the community.

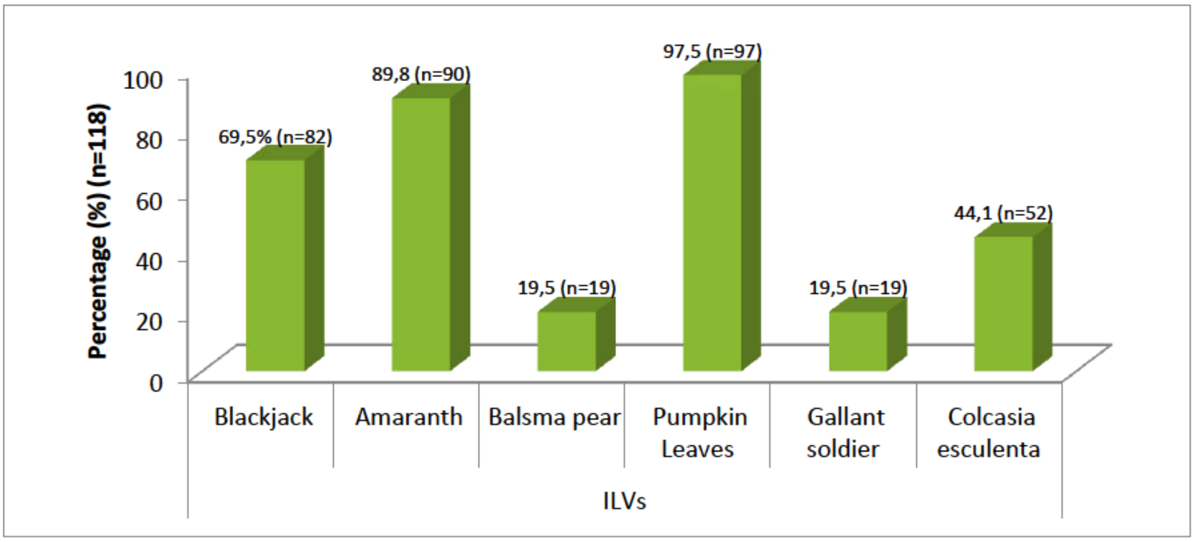


FIGURE 4.1 INDIGENOUS LEAFY VEGETABLES COMMONLY AND FREQUENLY CONSUMED IN THE VILLAGE

Figure 4.1 presents data concerning the consumption frequency of the various types of ILVs in the community. Most of the households (90.5%; n=97) consumed the ILVs as follows: pumpkin leaves, 89.8%(n=90) *amaranths*, 69.5% (n=82) blackjacks, 44.1% (n=52) *Colocasia esculenta* stems, 19.5% (n=19) *Balsma pear,* and 19.5% (n=19) consumed gallant soldier.

4.3.4 Consumption frequency of indigenous leafy vegetables

This section discusses how often indigenous leafy vegetables are consumed in the community emphasizing the differences in their dietary inclusion. The findings indicate that some households include these vegetables in their daily diets, while others eat them less often, with frequency being influenced by seasonal availability or cultural traditions.

TABLE 4.8 HOUSEHOLD PREPARATION AND CONSUMPTION OF INDIGENOUS LEAFY VEGETABLES

Variable	Categories	(n=118)	(%)
Frequency consumption/week	once	43	36.4
	twice	60	50.8
	3 times	14	11.9
	4 times	1	0.8
Who cooks ILVs in the household?	Grandmother	67	56.8
	Mother	49	41.5
	Sister	2	1.7
What do you eat ILVs with?	**Phuthu*	114	96.6

	Potatoes	2	1.7
	Phuthu and Potatoes	2	1.7
Cooking method	Boil	11	9.3
	Cook with the addition of cooking oil	105	89.0
	Boil first and cook with the addition of cooking oil	2	1.7
Parts eaten	Stem and leaves	118	100

**Phuthu*: Crumbly porridge made with maize meal

The consumption frequency information shows that most households (50.8%; n=60) consumed ILVs twice a week, then 36.4% (n=43) once a week, 11.9% (n=14) and 0.8% (n=1) consumed ILVs three times and four times a week, respectively. Fifty-six-point eight percent (56.8%; n=67) of the households reported that the grandmothers were responsible for cooking ILVs, whereas 41.5% (n=49) of the households indicated that the mothers cooked the ILVs, and lastly, the sisters (1.7%; n=2) were responsible for ILVs preparation. The most frequently used staple food eaten with ILVs was *phuthu* (96.6%; 114) followed by potatoes (1.7%; n=2) and lastly, both *phuthu* and potatoes (1.7%; n=2). The preparation method used to prepare ILVs was cooking (cooking /addition of cooking oil 89.0% (n=105), 9.3%(n=11) participants indicated that they boiled ILVs, and 1.7% (n=2) participants stated that they boiled then cooked ILVs. When asked what part of the ILVs they ate, all participants (100%; n=118) reported that they ate both the stem and the leaves.

4.4 Dietary assessment

Dietary assessment was conducted by using two 24-hour recalls per participant per season. One 24-hour recall was taken on a weekday and one on a weekend day. Dietary diversity was assessed by using one Food Frequency questionnaire per participant per season indicating a variety of food consumed over seven days.

The total frequency in Table 4.9 is the number of households that consumed a specific food item in a season.

4.4.1 Top 20 food consumed measured by FFQ

TABLE 4.9 TOP 20 FOOD ITEMS CONSUMED BY HOUSEHOLDS OVER FOUR DIFFERENT SEASONS MEASURED BY FOOD FREQUENCY QUESTIONNAIRE (N=118)

	Food items	Spring	Summer	Autumn	Winter
1	Sunflower oil	117	117	118	118
2	All kinds of rice	118	115	118	118
3	Maize. (Pap, Mealie Rice, Mealie meal, Samp, Porridge, Corn on cob, Popcorn and Sweet corn)	118	110	118	118
4	Onions	118	109	110	107
5	Potatoes	104	114	108	108
6	All kinds of beans Dried	80	96	116	118
7	Pumpkin	76	104	110	94
8	All bread (White/Brown/Whole wheat)	108	93	92	61
9	Chicken	92	93	74	68
10	Tomatoes	98	99	65	62
11	Lemon	86	71	84	71
12	Coffee creamer (Cremora, Ellis brown)	95	65	78	69
13	Margarine	107	87	59	50
14	Cabbage	96	87	54	64
15	Maas/Inkomazi	89	86	63	58
16	Avocado	42	43	107	86
17	Dumplings/Steamed bread/Fat koek	46	65	89	77
18	Wild leafy vegetables: Fresh and dried	104	112	50	9
19	Processed meat (Polony and sausages)	77	64	67	56
20	All tubers/Roots (amadumbe/sweet potato)	62	65	83	53

Table 4.9 reflects the top 20 food items, measured by the food frequency questionnaire, consumed by the households (n=118) over the previous seven days across all seasons. Sunflower oil from the fats and oils diversity group appeared as number one on the mostly consumed items list as the most n=117 households consumed sunflower oil in spring followed by n=117, 118, and 118 households respectively over four seasons. This was followed by carbohydrates-based food items such as rice (2nd with 118, 115, 118, and 118 households per season) and maize (3rd with a score of 118, 110, 118, and 118 respectively across all seasons). Notably, only 104 households consumed ILVs in spring and only 112 households consumed ILVs during summer. During autumn and winter, the number of households who consumed ILVs declined to 50 and nine respectively and this may be due to availability. The consumption of plant-based proteins like dried beans was moderate as dried beans (sugar beans) are listed as number six on the list. Their consumption increased during autumn and winter. Avocado consumption also peaked in autumn as 107 households consumed avocado, and 86 households consumed avocado in winter because of seasonal availability.

Consumption of chicken was high during spring and summer and declined during autumn and winter as 92 and 93 households consumed chicken in spring and summer respectively. However, the consumption remained average, and it was listed 9th on the list. The consumption of pumpkin was also moderate. Pumpkin consumption was high in summer and autumn as 104 and 110 households consumed pumpkin in comparison with a low number of households consuming pumpkin in spring and winter. The intake of fruits was very concerning across all seasons as they are not on the list of the most consumed foods.

4.4.2 Food variety scores and Food Group diversity scores

Food variety scores (FVS) consisted of a count of single foods consumed within the 10 nutritional food groups (FAO 2009). The Food Group Diversity Score (FGDS) indicates the number of food groups consumed over seven (7) days as measured by the FFQ.

4.4.2.1 Food Variety Scores

Table 4.10 shows the summary of food variety within food groups consumed during spring and summer. The mean FVS (±SD) for all foods consumed in all the food groups in seven days during spring was 32.68 (±13.74) and for summer it was 25.07 (±13.01). Table 4.14 shows the summary of food variety within food groups consumed during autumn and winter. The mean FVS (±SD) for all foods consumed from all food groups in seven days was 24.48 (±11.71) for autumn and 20.14 (±11.17) for winter.

TABLE 4.10 SUMMARY OF FOOD VARIETY SCORE BY FOOD GROUP OF RURAL HOUSEHOLDS FOR SPRING AND SUMMER

	Spring			Summer		
Food groups	**Mean**	**±SD**	**Range of Scores (Individual food items)**	**Mean**	**±SD**	**Range of Scores (Individual food items)**
Meat products	3.21	1.684	1-8 (8)	2.73	1.517	1-7 (7)
Eggs	0.66	0.475	1-1 (1)	0.41	0.493	1-1 (1)
Dairy products	2.19	1.109	1-5 (5)	1.30	0.870	1-4 (4)
Cereal roots and tubers	6.04	1.452	2-10 (10)	5.42	1.837	1-9 (9)
Legumes and nuts	1.48	0.913	1-4 (4)	1.22	0.706	1-4 (4)
Vitamin A-rich fruits and vegetables	3.55	1.517	1-6 (6)	2.60	1.071	1-6 (6)
Other fruits and juices	5.28	2.755	1-13 (13)	3.04	2.019	1-9 (9)
Other vegetables	4.66	1.655	1-9 (9)	3.37	1.407	1-8 (8)
Oils and fats	3.30	0.918	1-5 (5)	2.36	0.792	1-4 (4)
Indigenous leafy vegetables	2.31	1.259	1-5 (5)	2.62	1.300	1-6 (6)
Total food items	**32.68**	**13.737**	**66**	**25.07**	**13.012**	**58**

Low = 0-3 food groups or <30 individual foods.

Medium = 4-5 food groups or 30-60 individual foods.

High = 6-9 food groups or >60 individual food.

During the spring season, a maximum of 66 different food items were consumed in seven days from all food groups by the rural households. Other fruits and vegetables had the most variety of individual food items consumed with a total of 13 food items. The mean for FVS (±SD) for all food consumed by the households from all food groups during spring in seven (7) days was 32.68 (±13.737), indicating a medium food variety score. Cereals, roots and tubers had the highest mean variety score of 6.04 (±SD 1.452). Eggs had the lowest mean variety score of 0.66 (±0.475).

In summer a maximum of 58 different individual food items were consumed in seven days by all households from all food groups. The most consumed food group was group four (cereals, tubers, and roots). Eggs, other vegetables, oils and fats, legumes nuts, and dairy products were food groups that were poorly consumed during summer. Other fruits and juices and cereals, roots and tubers had the most diversity of individual food items with a total of nine food items consumed under these groups. The mean FVS (±SD) for all food consumed in summer from all the food groups in seven days was 25.07 (±13.012), indicating a medium variety score. Cereals, roots and tubers had the highest mean score of 5.42 (±1.837). Eggs diversity had the lowest mean score of 0.41 (±0.493).

TABLE 4.11 SUMMARY OF FVS BY FOOD GROUP OF RURAL HOUSEHOLDS IN AUTUMN AND WINTER (N=118)

	Autumn			Winter		
Food groups (10)	**Mean**	**±SD**	**Range of Scores (Individual food items)**	**Mean**	**±SD**	**Range of Scores (Individual food items)**
Meat products	2.86	1.558	1-9 (9)	2.19	1.537	1-6 (6)
Eggs	0.32	0.469	1-1 (1)	0.32	0.469	1-1 (1)
Dairy products	1.18	0.966	1-4 (4)	0.99	0.991	1-4 (4)
Cereal roots and tubers	6.04	1.571	2-10 (10)	5.25	1.391	2-9 (9)
Legumes and nuts	1.77	0.756	1-3 (3)	1.86	0.678	1-3 (3)
Vitamin A-rich fruits and vegetables	2.48	1.589	1-13 (13)	1.51	1.084	1-5 (5)
Other fruits and juices	3.54	1.777	1-8 (8)	3.08	1.879	1-8 (8)
Other vegetables	2.97	1.768	1-8 (8)	2.52	1.652	1-10 (10)
Oils and fats	2.45	1.018	1-5 (5)	2.31	1.035	1-4 (4)
Indigenous leafy vegetables	0.87	1.237	1-5 (5)	0.11	0.449	1-3 (3)

Total food items	**24.48**	**11.709**	**66**	**20.14**	**11.165**	**53**

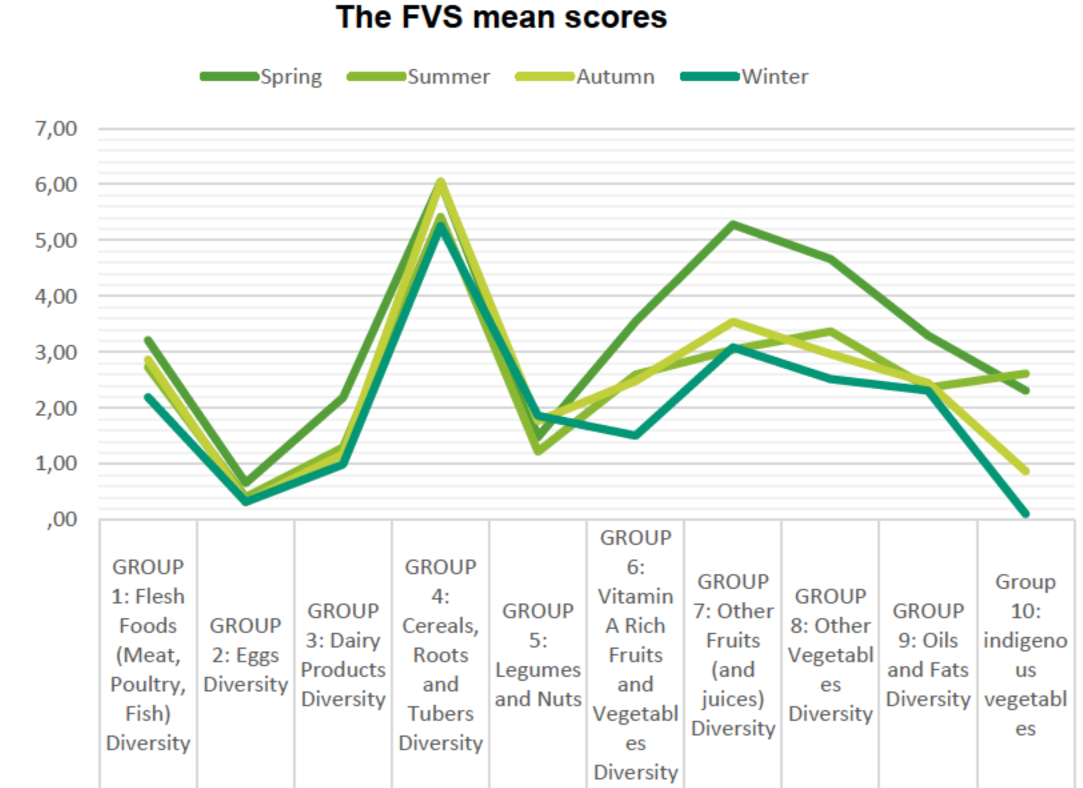
Low FVS =<30 individual foods, Medium FVS = 30-60 individual foods, High FVS = > 60 individual food

Table 4.11 shows the food variety within food groups during autumn and winter. In autumn, in total, a maximum number of 66 different individual food items were consumed from all food groups. Vitamin A-rich fruits and vegetables had the most variety of foods consumed with a total of 13 individual food items consumed from this group. The mean FVS (±SD) for all food consumed in summer from all the food groups in seven days was 24.48 (±SD 11.709). The cereal group had the highest mean FVS (±SD) of 6.04 (±1.571). Eggs diversity had the lowest mean score of 0.32 (±0469) The total mean FVS (±SD) for all the foods consumed in autumn from all food groups in seven days was 24.48 (±11.709).

During the dry season of winter, a maximum of 53 individual food items were consumed in seven days by all rural households. Other vegetables had the most variety of consumed food items with a total of 10 individual food items. The cereal, tubers and roots group had the highest mean variety score of 5.25 (±SD 1.391). Indigenous leafy vegetables had the lowest mean score of 0.11 (±0.449). The mean FVS (±SD) for all the food consumed by rural households in winter from all food groups in seven days was 20.14 (SD 11.165). This indicated poor diversity.

4.4.2.2 Food group diversity scores (FGDS) (n=10 Food groups) comparison across all seasons

This section provides an overview of the Food Group Diversity Scores (FGDS), comparing the intake variations across different seasons. The analysis, derived from data on 10 separate food groups, reveals how dietary diversity varies with the seasons. By looking at these scores, we can understand the shifts in food group consumption over the year, which are influenced by seasonal availability and food preferences. This analysis provides important insights into how seasonal trends affect overall dietary diversity. Figure 4.2 shows the comparison of FGDS across all seasons.



	GROUP 1: Flesh Foods (Meat, Poultry, Fish) Diversity	GROUP 2: Eggs Diversity	GROUP 3: Dairy Products Diversity	GROUP 4: Cereals, Roots and Tubers Diversity	GROUP 5: Legumes and Nuts	GROUP 6: Vitamin A Rich Fruits and Vegetables Diversity	GROUP 7: Other Fruits (and juices) Diversity	GROUP 8: Other Vegetables Diversity	GROUP 9: Oils and Fats Diversity	Group 10: indigenous vegetables
Spring	3,21	,66	2,19	6,04	1,48	3,55	5,28	4,66	3,30	2,31
Summer	2,73	,41	1,30	5,42	1,22	2,60	3,04	3,37	2,36	2,62
Autumn	2,86	,32	1,18	6,04	1,77	2,48	3,54	2,97	2,45	,87
Winter	2,19	,32	,99	5,25	1,86	1,51	3,08	2,52	2,31	,11

Figure 4.2 The FVS mean intake comparison of rural households across all seasons (n=118)

Figure 4.2 indicates the FVS mean of food consumption in different seasons. Cereal groups were consumed mostly in autumn and spring in which seasons they both attained an average of 6.04 respectively. The eggs group was the lowest food group consumed in spring, summer, autumn and winter while ILVs were the lowest consumed food group in winter.

Indigenous leafy vegetable consumption declined in autumn and winter due to low seasonal availability. The results show that indigenous leafy vegetables were mostly eaten during summer due to their seasonal availability and the consumption mean score was 2.62 compared with winter which had a mean of 0.11.

TABLE 4.12 COMPARISON OF THE FOOD GROUP DIVERSITY SCORES (FDGS) WITH THE NUMBER OF PARTICIPANTS IN 4 SEASONS

FDGS ⇨	1	2	3	4	5	6	7	8	9	10
Spring	-	-	-	-	-	-	3	25	37	53
Summer	-	-	-	-	-	2	15	31	47	23
Autumn	-	-	-	-	1	14	31	34	30	8
Winter					15	14	45	27	13	4

Low FGDS**=0-3 groups**

Medium FGDS**=4-5 groups**

High FGDS**= 6-10 groups**

Table 4.12 shows the number of participants who consumed the food from the 10 different food groups in four seasons. In spring and summer there was a high FGDS of 7-10 and 6-10 FGDS respectively. Most participants (n=53) consumed food from 10 different food groups in spring while most (n=47) participants consumed food from nine food groups in summer. During autumn and winter, the participants could be classified with a medium to high FGDS (consumed 5-10 food groups). Most participants (n=34) consumed food from eight food groups in autumn and (n=45) consumed food from seven food groups in winter.

This information indicates that the participants had a high FGDS, which indicates that they consumed food from most food groups, although it lacks the variety of foods within each food group. Although it's positive that the households were eating a variety of food groups, it's concerning that their diet still lacked a good variety of foods within those groups. To support optimum health, a balanced diet should ideally consist of a variety of FGDs and individual foods from different food groups. Thus, it's a complex situation that needs to be addressed to improve dietary diversity. In the results, participants were shown to consume mostly CHO-based foods in most food groups. A good aspect of this is the high FGDS, but the bad aspect is that their diet was low in FVS.

4.4.3 Nutrients Intake Analysis

This section presents the macro-micronutrient intake of men and women from three age categories: 19-30 years old, 31-50 years old, and 51-70 years old as measured by the 24-hr recall questionnaire. The DRIs of the age groups are compared to the essential guide to nutrient requirements DRIs presented by Otten, Hellwing and Meyers (2006). The table 4.13 below presents the mean intake and standard deviations, along with the percentages of participants whose nutrients daily consumption was less than 100 percent of the DRIs daily requirements (<100% DRIs).

Table 4.13 Nutrient intake (*Male 19-30 years old*)

Nutrient	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Energy	6578.52 ±1380.07	100	6309.43 ±1372.73	100	6883.68 ±1270.86	100	6028.21 ±1565.98	100	12881 kJ/day EER
Total protein	44.43 ±14.03	85.7	31.49 ±8.2	100	35.86 ±14.07	89.3	37.59 ±22.19	82.1	56 g RDA
Carbohydrates	244.55 ±60.08	0	219.22 ±43.55	0	242.95 ±58.9	0	206.2 ±55.85	0	100 g/day EAR
Total dietary fibre	29.34 ±14.55	82.1	22.78 ±9.49	89.3	28.41 ±10.83	82.1	24.17 ±10.4	96.4	38 g/day AI
Biotin	19.23 ±9.33	92.9	15.66 ±5.64	96.4	18.32 ±9.88	85.7	17.64 ±9.6	85.7	30 ug/day AI
Vitamin A	498.29 ±232.4	75	526.13 ±200.39	67.9	479.07 ±354.22	78.6	314.39 ±189.2	92.9	625 mcg/day EAR
Vitamin C	29.46 ±19.81	100	16.29 ±10.49	100	37.16 ±20.73	92.9	24.5 ±17.65	96.4	75 mg/day EAR
Vitamin E	16.42 ±7.88	21.4	17.16 ±7.86	25	20.04 ±9.09	14.3	16.24 ±9.81	32.1	12 mg/day EAR
Vitamin B6	2.81 ±0.93	3.6	2.61 ±1.08	10.7	1.96 ±1.13	28.6	1.67 ±0.72	32.1	1.1 mg/day EAR
Vitamin B12	1.73 ±2.72	85.7	0.94 ±1.89	85.7	1.85 ±2.95	78.6	2.03 ±3.6	78.6	2 ug/day EAR
Thiamine	1.33 ±0.37	17.9	1.22 ±0.32	21.4	1.25 ±0.37	28.6	1.25 ±0.47	39.3	1 mg/day EAR

TABLE 4.13 **TABLE 4.14 NUTRIENT INTAKE (MALE 19-30 YEARS OLD)** (*CONTINUED*)

Nutrients	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	**% <DRI**	**Mean ± SD**	**% <DRI**	**Mean ± SD**	**% <DRI**	**Mean ± SD**	**% <DRI**	
Riboflavin	**0.67 ±0.29**	**89.3**	**0.53 ±0.2**	**100**	**0.7 ±0.21**	**92.9**	**0.7 ±0.37**	**89.3**	**1.1 mg/day EAR**
Niacin	19.03 ±5.74	7.1	14.75 ±4.54	32.1	14.39 ±5.36	32.1	14.41 ±6.35	39.3	12 mg/day EAR
Folate	15.23 ±24.7	100	5.21 ±5.97	100	20.69 ±27.63	100	10.17 ±17.12	100	320 ug/day EAR
Calcium	391.77 ±213.11	100	310.16 ±154.87	100	373.13 ±166.17	100	289.07 ±152.23	100	1000 mg/day AI
Iron	13.63 ±4.68	0	12.24 ±3.53	7.1	11.01 ±2.56	0	10.43 ±3.41	7.1	6 mg/day EAR
Zinc	9.78 ±2.61	50	8.19 ±2.31	71.4	7.37 ±3.16	82.1	7.57 ±4.02	85.7	9.4 mg/day EAR
Magnesium	250.82 ±86.97	85.7	222.04 ±58.72	96.4	244.54 ±142.22	92.9	204.41 ±60.4	100	330 mg/day EAR
Phosphorus	697 ±208.6	32.1	583.18 ±189.45	57.1	754.52 ±454.3	25	600.09 ±183.6	50	580 mg/day EAR
Selenium	38.93 ±19.54	57.1	25.35 ±11.88	92.9	25.3 ±14.91	92.9	25.49 ±16.76	92.9	45 ug/day EAR
Potassium	1441.16 ±406.92	100	1160.71 ±299.79	100	1886.8 ±808.01	100	1451.93 ±500.31	100	4700 mg/day EAR

Table 4.13 indicates that the recommended EER intake for energy in the group was 12881 kJ/day and the total energy requirements recommended for DRIs were not met. The total mean intake in spring for men was 6683.95 kJ; during summer the mean intake was 5845.92 kJ, which is slightly lower in comparison with the total intake for energy in spring. In autumn, the total energy intake was 6607.47 kJ and in winter the energy intake was 6319.79 kJ. The protein intake shows that in spring the mean intake was 46.31 g which is less than the recommended dietary allowance of 56 g/day for proteins. Summer, autumn, and winter showed that the protein mean intake was 31.66 g, 40.39 g and 48.63 g respectively. The protein intake in all seasons was less than 100% of the DRI daily requirement for proteins.

In all the seasons, there were no participants who consumed less than 100% of EAR intake of 100g/day for carbohydrates (CHO). The mean carbohydrate consumption in all the seasons was higher than the estimated adequate requirements for carbohydrates. The mean intake for CHO in all the seasons was 238.17 g in spring, 216.08 g in summer, 210.86 g in autumn, and 215.66 g in winter. This correlates with the top three foods on the top 20 list for all the seasons which show carbohydrate-based foods. Dietary fibre consumption indicates that the mean intake was low at 29.34 g during spring, 22.78 g in summer, 28.41 g in autumn, and 24.17 g in winter, compared to the recommended adequate intake of 38g/day. The micronutrient intake indicates that biotin intake was low at 21.16μg in spring, 15.96μg in summer, 20.03 μg in autumn, and 13.41 μg in winter compared to the recommended adequate intake of 30 μg/day. In spring, the vitamin A consumption shows that participants consumed on average more vitamin A than the required 625 mcg/day. The mean intake for vitamin A was 727.21mcg in spring, 530.68 mcg in summer, 573.68 mcg in autumn, and 364 mcg in winter. The vitamin C intake was less than the recommended 75 mg/day DRIs across all seasons. The mean intake for vitamin C was 41.95 mg in spring, 18.45 mg in summer, 37.87 mg in autumn, and 19.29 mg in winter.

Vitamin E intake was high across all seasons. The mean intake for vitamin E was 13.06 mg in spring, 13.08 mg in summer, 16.45 mg in autumn, and 16.34mg in winter, while the recommended Vitamin E intake is 12 mg/day EAR. The vitamin B6 intake was more than double the recommended EAR 1.1 mg/day in spring, summer, and winter. The mean intake for vitamin B6 across all seasons was 2.77 mg in spring, 2.37mg in summer, 1.87 mg in autumn, and 2.03 mg in winter. The vitamin B12 intake was less than the recommended intake of 2μg/day EAR in spring, summer, and autumn; however, the intake of vitamin B12 was met in winter. The mean intake of vitamin B12 was 1.16 μg in spring, 1.39 μg in summer, 1.87 uμg in autumn, and 2.8μg in winter. Thiamine intake was higher than the recommended intake 1 mg/day EAR across all seasons. The mean intake for thiamine was 1.37 mg in spring, 1.23 mg in summer, 1.22 mg in autumn, and 1.39 mg in winter. The riboflavin intake was less than the required amount of 1.1 mg/day EAR. The mean intake across all seasons for riboflavin was 0.63 mg in spring, 0.62 mg in summer, 0.75mg in autumn, and 0.86 mg in winter. Adequate intake of niacin was noted in summer, autumn, and winter as the intake was slightly above the recommended intake. In spring, the niacin intake was above the recommended EAR intake of 12 mg/day. The mean intake of niacin was 19.03 mg in spring, 14.75 mg in summer, 14.39 mg in autumn, and 14.41 mg in winter. The deficient intake of folate was notably low across all seasons because it was less than the recommended 320 µg/day EAR. The mean intake of folate was 25.23 µg in spring, 5.21 µg in summer, 20.69 µg in autumn, and 10.17 µg in winter. This indicates that 100% of the participants did not meet the recommended requirement of folate.

The results indicate a mineral-deficient intake of calcium as the intake was less than the recommended 1000 mg/day AI across all seasons. The mean intake of calcium across all seasons was 391.75 mg in spring, 310 mg in summer, 373.13 mg in autumn, and 289.07 mg in winter. This indicates that 100% of the participants did not consume adequate intake requirements of calcium. The iron intake indicates that the consumption was double and more than the required 6 mg/day EAR. The mean intake of iron was 13.63 mg in spring, 12.24 mg in summer, 11.01 mg in autumn, and 10.43 mg in winter. Zinc intake was average in autumn and winter. The results show that the mean intake was 7.32 mg/day and 7.57 mg/day for autumn and winter respectively, which is slightly less than the required EAR intake of 9.4 mg/day and the mean intake for spring and summer was 9.78 mg and 8.19 mg respectively. The participants did not meet the recommended intake of 330 mg/day for magnesium. The mean intake for magnesium was 250.82 mg in spring, 222.04 mg in summer, 244.54 mg in autumn, and 204.41 mg in winter. The phosphorus intake was higher than the recommended 580 mg/day. The mean intake for phosphorus was 697 mg in spring, 583.18 mg in summer, 754.52 mg in autumn, and 600.09 mg in winter. Only 57% consumed <100% phosphorus in summer. The selenium intake was less than the recommended 45 µg/day. The mean intake of selenium was 38.93 ug/day in spring, 25.35 µg in summer, 25.3 µg in autumn and 25.49 µg in winter. The potassium intake was less than the recommended 4700 mg/day and <100% consumed adequate amounts of potassium across all seasons. The mean intake of potassium was 1441.16 mg in spring, 1160.71 mg in summer, 1886.8 mg in autumn, and 1451.93 mg in winter.

TABLE 4.15 NUTRIENT INTAKE (*FEMALES 19-30 YEARS OLD*)

Nutrient	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Energy	5363.65 ±1419.38	100	5845.04 ±931.08	100	5747.12 ±1674.98	100	6252.81 ±1761.75	100	10093 kJ/day EER
Total protein	42.24 ±24.25	69.2	28.85 ±5.89	100	35.7 ±14.39	84.6	42.78 ±18.94	76.9	46g RDA
Carbohydrates	220.38 ±65.1	0	194.23 ±39.1	0	201.51 ±64.23	0	215.35 ±69	0	100 g/day EAR
Total dietary fibre	18.28 ±7.55	53.8	14.13 ±5.43	92.3	21.67 ±9.76	76.9	20.01 ±6.15	84.6	25 g/day AI
Biotin	19.86 ±9.44	84.6	19.07 ±4.84	100	13.24 ±6.57	100	23.06 ±8.78	84.6	30 ug/day AI
Vitamin A	437.62 ±215.06	69.2	436.65 ±163.35	61.5	412.77 ±174.07	61.5	438.54 ±196.47	53.8	500 mcg EAR
Vitamin C	31.31 ±11.78	100	22.71 ±9.52	100	19.96 ±8.45	100	28.5 ±19.77	84.6	60 mg/day EAR
Vitamin E	14.49 ±9.47	46.2	18.88 ±6.31	15.4	17.3 ±10.56	23.1	19.46 ±8.89	23.1	12 mg/day EAR
Vitamin B6	2.49 ±0.85	7.7	2.15 ±0.9	7.7	1.88 ±1.41	30.8	1.57 ±0.65	23.1	1.1 mg/day EAR
Vitamin B12	0.6 ±0.46	100	1.28 ±2.32	84.6	2.07 ±5.14	92.3	0.92 ±0.94	84.5	2 ug/day EAR
Thiamine	1.31 ±0.42	7.7	1.06 ±0.28	15.4	1.14 ±0.4	23.1	1.3 ±0.48	23.1	0.9 mg/day EAR

TABLE 4.14 **TABLE 4.16 NUTRIENT INTAKE (*FEMALES 19-30 YEARS OLD*) (CONTINUED)**

Nutrients	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Riboflavin	**0.6 ±0.26**	**84.6**	**0.5 ±0.15**	**100**	**0.64 ±0.21**	**84.6**	**0.79 ±0.51**	**69.2**	**0.9 mg/day EAR**
Niacin	17.06 ±7.81	23.1	13.4 ±3.9	30.8	13.95 ±6.33	30.8	13.73 ±4.81	23.1	11 mg/day EAR
Folate	14.57 ±17.99	100	5.72 ±6.64	100	23.17 ±37.33	100	6.95 ±7.13	100	320 ug/day EAR
Calcium	238.54 ±113.3	100	292.73 ±111.24	100	298.42 ±127.33	100	278.35 ±178.01	100	1000 mg/day AI
Iron	10.94 ±4.3	30.8	10.23 ±1.83	15.4	11.06 ±3.34	15.4	10.66 ±4.72	38.5	8.1 mg/day EAR
Zinc	8.35 ±3.03	38.5	7.16 ±1.76	53.8	7.46 ±3.12	38.5	9.11 ±5.02	38.5	6.8 mg/day EAR
Magnesium	180.19 ±50.26	84.5	194.27 ±37.19	92.3	176 ±49.78	92.3	204.23 ±68.96	69.2	255 mg/day EAR
Phosphorus	507.31 ±141.79	84.6	514 ±94.95	76.9	558.23 ±157.86	53.8	583 ±195.78	53.8	580 mg/day EAR
Selenium	34.65 ±22.49	76.9	24.95 ±12.31	100	28.78 ±15.25	76.9	24.48 ±13.81	100	55 ug/day EAR
Potassium	1180.69 ±372.43	100	1085.04 ±116.48	100	1232.27 ±628.88	100	1744 ±1399.81	92.3	4700 mg/day EAR

Table 4.14 indicates that the recommended EER intake for energy in the group was 10093 kJ/day and the total energy requirements were not met. The mean intake for energy across all

seasons was 5363.65 kJ in spring, 5845.04 kJ in summer, 5747.12 kJ in autumn, and 6252.81 kJ in winter. Protein intake for women aged 19-30 was low at 42.24 g in spring, 28.87 g in summer, 35.7 g in autumn, and 42.78 g in winter, compared to the recommended RDA of 46 g/day. Carbohydrate intake was high in all seasons: the mean intake of CHO was 220.38 g in spring, 194.23 g in summer, 201.51 g in autumn, and 215.35 g in winter, compared to the recommended EAR intake of 100 g/day. The dietary fibre consumption was less than the AI requirement of 25 g/day. The mean intake of dietary fibre across all seasons was 18.28 g in spring, 14.23 g in summer, 21.67 g in autumn, and 20.01 g in winter.

The micronutrient intake results indicated that biotin intake was low at 19.86 µg in spring, 19.07 µg in summer, 13.24 µg in autumn, and 23.06 µg in winter, compared to the recommended AI of 30 µg/day. The vitamin A intake was slightly lower at 437.62 mcg in spring, 436.65 mcg in summer, 412.77 mcg in autumn, and 438.54 mcg in winter, compared to the recommended AI intake of 500 mcg/day, and the deficient of Vitamin A could lead to night blindness and *xerophthalmia*. Vitamin C intake was low at 31.31 mg in spring, 22.71 mg in summer, 19.96 mg in autumn, and 28.5 mg in winter, compared to the recommended EAR of 60 mg/day. Vitamin E intake exceeded the recommended intake of 1.1 mg/day EAR; it was high at 2.49 mg in spring, 2.15 mg in summer, 1.88 mg in autumn, and 1.57 mg in winter. Vitamin B6 intake was double the recommended intake of 1.1 mg/day, compared with the mean intake of 2.49 mg in spring and 2.15 mg in summer. However, the mean intake of 1.88 mg and 1.57 mg was slightly higher in autumn and winter respectively. Vitamin B12 intake was notably low in spring (0.6 µg), summer (1.28 µg), and winter (0.92 µg), compared to the recommended EAR of 2 µg/day. The vitamin B12 intake was adequate in autumn with a mean intake of 2.07 µg. Thiamine intake was high at 1.31 mg in spring, 1.06 mg in summer, 1.14 mg in autumn, and 1.3 mg in winter, compared to the recommended EAR intake of 0.9 mg/day. Riboflavin intake was low in all seasons at 0.6 mg in spring, 0.5 mg in summer, 0.64 mg in autumn, and 0.79 mg in winter, compared to the recommended intake of 0.9 mg/day EAR. Niacin intake was high and exceeded the recommended EAR intake of 11mg/day in all seasons. The mean intake of niacin was 17.06 mg in spring, 13.4 mg in summer, 13.95 mg in autumn, and 13.73 mg in winter. Folate intake was low across all seasons at 14.57µg in spring, 5.72 µg in summer, 23.17 µg in autumn, and 6.95 µg in winter, compared to the recommended EAR requirement of 320 µg /day.

The results of the diet analysis indicated deficient intake of calcium across seasons, as reported in Table 4.14, the mean intake was 238.54 mg in spring, 292.73 mg in summer, 298.42 mg in autumn, and 278.35 mg in winter, compared to the recommended AI intake requirements of 1000 mg/day. The iron intake was slightly higher at 10.94 mg in spring, 10.23 mg in summer, 11.06 mg in autumn, and 10.66mg in winter, compared to the recommended

EAR intake of 8.1 mg/day. Zinc intake was high at 8.35 mg in spring, 7.16 mg in summer, 7.46 mg in autumn, and 9.11mg in winter, compared to the recommended EAR intake of 6.8 mg/day. Magnesium intake was low in comparison with the recommended intake of 255 mg/day EAR. The mean intake of magnesium across all seasons was 180.19mg in spring, 194.27 mg in summer, 176 mg in autumn, and 204.23 mg in winter. The phosphorus intake was average in spring (507.31 mg), 514 mg in summer, and 558.23 mg in autumn. However, in winter, the phosphorus intake met the recommended EAR intake of 580 mg/day, with the recorded 583 mg. A deficient intake of selenium was noted at 34.65 µg in spring, 24.95 µg in summer, 28.78 µg in autumn, and 24.48 µg in winter, compared to the recommended EAR intake of 55 µg/day. Potassium intake was very low across all seasons with a noted 1180.69 mg in spring, 1085.04 mg in summer, 1232 mg in autumn, and 1744mg in winter, compared to the recommended EAR intake of 4700 mg/day.

TABLE 4.17 NUTRIENT INTAKE (*MALES 31-50 YEARS OLD*)

Nutrient	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Energy	6683.95 ±1406.07	100	5845.92 ±1190.37	100	6607.47 ±1326.67	100	6319.79 ±1133.59	100	12881 kJ/day EER
Total protein	46.31 ±16.57	73.7	31.66 ±12.28	94.7	40.39 ±21.49	94.7	48.63 ±26.02	68.4	56 g RDA
Carbohydrates	238.17 ±50.3	0	216.08 ±63.84	0	210.86 ±59.26	0	215.66 ±34.49	0	100 g/day EAR
Total dietary fibre	28.51 ±14.88	84.2	18.53 ±7.85	94.7	21.41 ±7.73	94.7	19.54 ±8.61	94.7	38 g/day AI
Biotin	21.16 ±11.61	84.2	15.96 ±5.12	100	20.03 ±8.46	89.5	13.41 ±5.49	100	30 ug/day AI
Vitamin A	727.21 ±571.32	63.2	530.68 ±267.97	68.4	573.68 ±274.59	57.9	364 ±125.09	100	625 mcg/day EAR
Vitamin C	41.95 ±27.59	89.5	18.45 ±10.54	100	37.87 ±23.68	94.7	19.29 ±13.53	100	75 mg/day EAR
Vitamin E	13.06 ±7.18	42.1	13.08 ±6.17	47.4	16.45 ±9.09	26.3	16.34 ±11.7	42.1	12 mg/day EAR
Vitamin B6	2.77 ±0.9	0	2.37 ±1	10.5	1.92 ±1.05	26.3	2.03 ±1.12	26.3	1.1 mg/day EAR
Vitamin B12	1.16 ±1.84	89.5	1.39 ±2.29	84.2	1.87 ±3.14	84.2	2.84 ±3.64	63.2	2 ug/day EAR

TABLE 4.15 **TABLE 4.18 NUTRIENT INTAKE (*MALES 31-50 YEARS OLD*) (*CONTINUED*)**

Nutrient	**Spring**		**Summer**		**Autumn**		**Winter**		**DRIs**
	Mean ± SD	**% <DRI**	**Mean ± SD**	**% <DRI**	**Mean ± SD**	**% <DRI**	**Mean ± SD**	**% <DRI**	
Thiamine	1.37 ±0.35	15.8	1.23 ±0.35	21.1	1.22 ±0.39	31.6	1.39 ±0.36	10.5	1 mg/day EAR
Riboflavin	0.63 ±0.21	100	0.62 ±0.22	94.7	0.75 ±0.52	89.5	0.86 ±0.4	84.2	1.1 mg/day EAR
Niacin	18.87 ±7.37	10.5	14.29 ±5.15	36.8	14.06 ±5.06	31.6	16.49 ±6.83	26.3	12 mg/day EAR
Folate	15.33 ±17	100	9.34 ±18.94	100	17.31 ±30.84	100	14.15 ±21.86	100	320 ug/day EAR
Calcium	372.34 ±221.46	100	385.5 ±155.62	100	321.92 ±143.85	100	336.37 ±166.12	100	1000 mg/day AI
Iron	13.76 ±6	5.3	10.51 ±2.7	0	10.84 ±3.39	0	11.84 ±2.62	0	6 mg/day EAR
Zinc	9.67 ±2.51	42.1	7.99 ±2.89	73.7	8.17 ±4.29	68.4	9.53 ±4.73	57.9	9.4 mg/day EAR
Magnesium	243.05 ±75.89	94.7	210.87 ±78.1	89.5	205.61 ±60.22	100	181.18 ±45.93	100	350 mg/day EAR
Phosphorus	687.21 ±209.64	31.6	632.58 ±172.93	47.4	657.42 ±181.21	36.8	676.05 ±155.8	26.3	580 mg/day EAR
Selenium	42 ±21.99	68.4	26.79 ±16.3	84.2	27.41 ±21.55	84.2	31.53 ±14.52	73.7	45 ug/day EAR
Potassium	1566.58 ±461.07	100	1184.45 ±456.89	100	1464.26 ±534	100	1310.61 ±526.51	100	4700 mg/day EAR

Table 4.15 indicates that the recommended EER intake for energy in this group was 12881kJ/day and the total intake did not meet the requirements. The mean energy intake was 6683.95 kJ in spring, 5845.92 kJ in summer, 6607.47 kJ in autumn, and 6319.79 kJ in winter. The protein intake for males aged 31-50 was less at 46.31 g in spring, 31.66 g in summer, 40.39 g in autumn, and 48.63 g in winter, compared to the 56 g/day RDA intake. Carbohydrate intake was high and double the required amounts across all seasons; the mean intake of CHO was 238.17 g in spring, 216.08 g in summer, 210.88g in autumn, and 215.66 g in winter, compared to the recommended EAR of 100 g/day. Dietary fibre intake was lower across all

seasons at 28.51 g in spring, 18.53 g in summer, 21.41 g in autumn, and 19.54 g in winter, compared to the recommended AI requirements of 38 g /day.

The micronutrient intake of biotin was lower than the recommended AI intake of 30 μg/day. The mean intake of biotin across all seasons was 21.16μg in spring, 15.96 μg in summer, 20.03 μg in autumn, and 13.4 μg in winter. Vitamin A intake was higher than the recommended EAR of 625 mcg/day in spring which was 727.21 mcg, and in summer and autumn it was average at 530.68 mcg and 573.68 mcg respectively, and it was low in winter at 364 mcg. Vitamin C intake was low across all seasons, the mean intake was 41.95 mg in spring, 18.45 mg in summer, 37.87 mg in autumn, and 19.29 mg in winter, compared to the recommended intake of 75 mg/day. Vitamin E intake was average and slightly higher than the recommended intake of 12 mg/day. The mean vitamin E intake was 13.06 mg in spring, 13.08 mg in summer, 16.45 mg in autumn, and 16.34 mg in winter. Vitamin B6 intake was double the recommended intake at 2.77 mg in spring, 2.37 mg in summer, 1.92 mg in autumn, and 2.03 mg in winter, compared to the EAR of 1.1 mg/day. Vitamin B12 intake was half the recommended intake in spring (1.16 μg), 1.39 μg in summer, and 1.87 μg in autumn, and then in winter, the vitamin B12 intake was met with the mean intake of 2.8 μg. Thiamine intake was met although it was slightly higher in all seasons compared with the recommended EAR intake of 1 mg/day. The mean intake of thiamine was 1.37 mg in spring, 1.23 mg in summer, 1.22 mg in autumn, and 1.39 mg in winter. Riboflavin intake was low in all seasons at 0.63 mg in spring, 0.62 mg in summer, 0.75mg in autumn, and 0.86 mg in winter, compared to the recommended EAR of 1.1mg/day. Niacin intake was high at 18.87mg in spring, 14.29mg in summer, 14.06 mg in autumn, and 16.49 mg in winter, compared to the recommended EAR intake of 12 mg/day. Folate intake was deficient across all seasons at 15.33 μg in spring, 9.34 μg in summer, 17.31 μg in autumn, and 14.15 μg in winter, compared to the recommended EAR intake of 320 μg/day.

The results of the diet analysis indicated low intake of calcium across all seasons at 372.34 mg in spring, 385 mg in summer, 321.92 mg in autumn, and 336.37 mg in winter, compared to the recommended AI of 1000 mg/day. The iron intake exceeded the recommended EAR intake of 6mg/day. The mean intake for iron was 13.76 mg in spring, 10.51 mg, 10.84 mg in autumn and 11.84 mg in winter. Zinc intake was met in spring and winter with the mean intake of 9.67 mg and 9.53 mg respectively in comparison to the recommended EAR intake of 9.4 mg/day. However, it was slightly lower in summer and autumn with a reported mean intake of 7.99 mg and 8.17 mg respectively. Magnesium intake was lower than the recommended EAR intake of 350 mg/day. The mean intake was 243.05 mg in spring, 210.87 mg in summer, 205.61 mg in autumn, and 181.18 mg in winter. Phosphorus intake met the recommended EER intake although it was high in comparison with the recommended EAR intake of 580 mg/day. The mean intake for phosphorus was 687 mg in spring, 632.58 mg in summer 657.42 mg in autumn, and 676 mg in winter. Selenium intake was average in spring at 42 µg when compared to the recommended EAR intake of 45 µg/day. The mean intake of selenium was low in other seasons at 26.79 µg in summer, 27.41 µg in autumn, and 31.53 µg in winter. Potassium intake was very low across all seasons with a reported 1566.58mg in spring, 1184.45 mg in summer, 1464.25 mg in autumn, and 1410.61 mg in winter, compared with the recommended EAR intake of 4700 mg/day.

TABLE 4.19 NUTRIENT INTAKE (*FEMALES 31-50 YEARS OLD*)

Nutrient	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Energy	6245.39 ±1305.52	100	5851.97 ±1138.97	100	6110.29 ±1280.9	100	5576.17 ±1632.45	100	10093 kJ/day EER
Total protein	45.95 ±18.47	60.6	31.6 ±11.42	84.8	35.78 ±12.35	75.8	35.17 ±20.26	75.8	46 g RDA
Carbohydrates	233.76 ±59.45	0	201.51 ±48.91	0	224.87 ±75.31	0	188.73 ±53.23	3	100 g/day EAR
Total dietary fibre	24.79 ±9.84	57.6	18.79 ±9.74	72.7	23.97 ±9.96	57.6	23.13 ±13.56	72.7	25 g/day AI
Biotin	18.68 ±8.43	87.9	19.58 ±5.38	97	17.21 ±7.43	97	15.71 ±9.59	93.9	30 ug/day AI
Vitamin A	511.29 ±360.86	57.6	494.64 ±170.04	51.5	466.35 ±244.49	54.5	358.24 ±272.07	81.8	500 mcg EAR
Vitamin C	36.39 ±26.75	81.8	22.32 ±17.5	97	31.65 ±20.2	87.9	25.89 ±17.39	93.9	60 mg/day EAR
Vitamin E	14.42 ±6.87	36.4	15.58 ±6.09	24.2	17.4 ±9.42	27.3	17.16 ±13.76	36.4	12 mg/day EAR
Vitamin B6	2.65 ±0.88	3	2.46 ±1	15.2	2.27 ±0.92	12.1	1.37 ±0.65	45.5	1.1 mg/day EAR
Vitamin B12	1.99 ±3.72	84.8	1.6 ±3.49	84.8	3.28 ±4.95	69.7	2.45 ±8.57	84.8	2 ug/day EAR
Thiamine	1.27 ±0.41	15.2	1.19 ±0.35	15.2	1.24 ±0.37	9.1	1.14 ±0.58	39.4	0.9 mg/day EAR
Riboflavin	0.61 ±0.26	78.8	0.5 ±0.21	93.9	0.71 ±0.31	78.8	0.81 ±1.2	81.8	0.9 mg/day EAR

Niacin	18.43 ±7.02	12.1	15.18 ±4.91	24.2	15.15 ±5.35	24.2	11.98 ±4.97	48.5	11 mg/day EAR

TABLE 4.16 TABLE 4.20 NUTRIENT INTAKE *(FEMALES 31-50 YEARS OLD)* (*CONTINUED*)

Nutrients	**Spring**		**Summer**		**Autumn**		**Winter**		**DRIs**
	Mean ± SD	**% <DRI**	**Mean ± SD**	**% <DRI**	**Mean ± SD**	**% <DRI**	**Mean ± SD**	**% <DRI**	
Folate	14.71 ±28.79	100	6.11 ±6.57	100	28.6 ±47.99	100	20.45 ±45.61	100	320 ug/day EAR
Calcium	307.24 ±192.13	100	286.39 ±164.45	100	363.79 ±155.79	100	279.55 ±204.99	97	1000 mg/day AI
Iron	11.42 ±4.44	9.1	10.7 ±2.58	6.1	10.93 ±3.27	3	10.54 ±6.21	21.2	6.8 mg/day EAR
Zinc	8.99 ±3.25	33.3	7.94 ±2.15	30.3	8.07 ±2.41	30.3	7.06 ±3.49	60.6	6.8 mg/day EAR
Magnesium	216.53 ±67.53	72.7	205.12 ±53.74	84.8	211.02 ±64.25	87.9	181.18 ±66.95	90.1	265 mg/day EAR
Phosphorus	641.05 ±232.6	48.5	531.71 ±175.4	69.7	663.94 ±184.06	36.4	560.94 ±274.52	63.6	580 mg/day EAR
Selenium	32.33 ±20.98	84.8	24.27 ±14.04	100	26.26 ±17.6	90.9	34.86 ±67.79	90.9	55 ug/day EAR
Potassium	1430.59 ±558.47	100	1097.8 ±295.76	100	1537.29 ±579.11	100	1323.67 ±693.19	100	4700 mg/day EAR

Table 4.16 indicates that the recommended EER intake for energy for this age group was recommended at 10093 kJ/day when compared with the group energy intake across four seasons, and it was reported that the energy consumption met half the requirement with the mean intake of 6245.39 kJ in spring, 5851.97 kJ in summer, 6110.29 kJ in autumn and 5576.17 kJ in winter, which indicates that 100% of the participants consumed diets that supplied <100% of DRIs. The protein contribution showed that the mean intake was met at 45.95 g in spring, compared with the RDA requirement of 46 g/day. However, other seasons did not meet the recommended intake of proteins as the mean intake was 31.6 g in summer, 35.78 g in autumn, and 35.17 g in winter. The mean carbohydrate intake was high and double the amount of the recommended EAR intake of 100 g/day, compared with the mean intake in all seasons which was 233.76 g in spring, 201.51 g in summer, 224.87 g in autumn and 188.73 g in winter. The

dietary fibre intakes during spring (24.79 g), 23.97 g in autumn, and 23.13 g in winter were average and slightly lower than the recommended AI intake of 25 g/day. Then during summer, the mean intake was low at 18.79 g in comparison with the recommended AI intake per day. The micronutrient intake data indicated that biotin mean intake was low at 18.68 µg in spring, 19.58 µg in summer, 17.21 µg in autumn, and 15.71 µg in winter, compared to the recommended AI of 30 µg/day and most of the group consumed a diet that supplied <100% EER. Vitamin A intake was sufficient in spring with the recorded 511 mg mean intake; however, during other seasons the vitamin A intake was lower at 494.64 mg in summer, 466.35 mg in autumn, and 358.24 mg in winter, compared to the recommended Ear intake of 500 mg/day.

Vitamin C intake was low across all seasons as the reported mean intake was 36.39 mg in spring, 22.32 mg in summer, 31.65 mg in autumn, and 25.89 mg in winter, compared with the recommended EAR intake of 60 mg/day. Vitamin E intake was higher across all seasons at 14.42 mg in spring, 15.58 mg in summer, 17.4 mg in autumn, and 17.16 mg in winter compared to the recommended EAR intake of 12 mg/day. Vitamin B6 intake was notably double the amount as the mean intake was 2.65 mg in spring, 2.46 mg in summer, and 2.27 mg in autumn and it was slightly higher in winter with a reported 1.37 mg, compared to the recommended EAR intake of 1.1 mg/day. Vitamin B12 intake was average across all seasons with a reported mean intake of 1.99 µg in spring, 1.6 µg, 3.28µg in autumn, and 2.45 µg in winter, compared to the recommended EAR intake of 2µg/day. Thiamine intake was higher than the recommended EAR intake of 0.9 mg/day. The mean intake for thiamine was 1.27mg in spring, 1.19 mg in summer, 1.24 mg in autumn, and 1.14 mg in winter. Riboflavin intake was average at 0.61 mg in spring, 0.5 mg in summer, 0.71 mg in autumn, and 0.81 mg in winter, compared to the recommended EAR intake of 0.9 mg/day. Niacin intake exceeded the required intake of 11 mg/day. The reported mean intake of niacin was 18.43 mg in spring, 15.18 mg in summer, 15.15 mg in autumn, and 11.98 mg in winter. Folate intake was very low across all seasons at 14.71 mg in spring, 6.11 mg in summer, 28.6 mg in autumn, and 20.45 mg in winter, compared to the recommended EAR intake of 320 mg/day.

The minerals analysis indicated a low intake of calcium at 307.24 mg in spring, 286.39 mg in summer, 363.79 mg in autumn, and 279.55 mg in winter, compared to the recommended AI requirement of 1000 mg/day. The Iron intake exceeded the required amount at 11.42 mg in spring, 10.42 mg in summer, 10.93 mg in autumn, and 10.54 mg in winter, compared to the recommended EAR intake of 6.8 mg/day. Zinc intake was above the recommended intake at 8.99 mg in spring, 7.94 mg in summer, 8.07 mg in autumn, and 7.06 mg in winter, compared to the EAR requirements of 6.8 mg/day for zinc. Magnesium intake was slightly lower than the recommended EAR intake at 216.53 mg in spring, 205.12 mg in summer, 211.02 mg in autumn, and 181.18 mg in winter, compared to the recommended EAR intake of 265 mg/day. Magnesium intake was <100% EAR for this age group. Phosphorus intake was average in all seasons with a reported mean intake of 641.05 mg in spring, 531 mg in summer, 663.94 mg in autumn, and 560.94 mg in winter, compared to the recommended EAR intake of 580 mg/day. A deficient intake of selenium was noted as the mean intake was half of the required intake at 32.33 mg in spring, 24.27 µg in summer, 26.26 µg in autumn, and 34.86 µg in winter when compared to the recommended EAR intake of 55 µg/day. Potassium intake was very low across all seasons at 1430.59 mg in spring, 1097.8 mg in summer, 1537.29 mg in autumn, and 1323.67 mg in winter, compared to the recommended EAR intake of 4700 mg/day

TABLE 4.21 NUTRIENT INTAKE *(MALES 51-70 YEARS OLD)*

Nutrient	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DR	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Energy	5810 ±200.82	100	5911.25 ±1426.59	100	6327 ±362.75	100	7552.5 ±43.84	100	12881 kJ/day EER
Total protein	42.13 ±1.17	100	28.68 ±12.06	100	33.9 ±7.35	100	28.93 ±0.53	100	56 g RDA
Carbohydrates	192.9 ±14.14	0	207.03 ±24.15	0	221.53 ±32.77	0	275.08 ±86.73	0	100 g/day EAR
Total dietary fibre	15.53 ±3.78	100	15.1 ±1.84	100	18.5 ±2.69	100	36.05 ±9.33	50	30 g/day AI
Biotin	23.8 ±8.63	100	40.25 ±536.34	50	23.73 ±5.9	100	17.6 ±6.43	100	30 ug/day AI
Vitamin A	536.25 ±204	50	256.75 ±336.94	100	503.5 ±120.21	100	515.75 ±21.57	100	625 mcg EAR
Vitamin C	43.75 ±20.86	100	19.86 ±7.28	100	37.25 ±10.25	100	46 ±9.19	100	75 mg/day EAR
Vitamin E	12.81 ±0.28	0	8.48 ±6.83	50	13.87 ±0.33	0	14.84 ±9.74	50	12 mg/day EAR
Vitamin B6	2.1 ±0.67	0	1.03 ±0.02	100	1.78 ±0.76	50	2.71 ±1.31	0	1.4 mg/day EAR

TABLE 4.17 NUTRIENT INTAKE (MALES 51-70 YEARS OLD) (*CONTINUED*)

Nutrients	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Vitamin B12	0.6 ±0.42	100	0.9 ±0.98	100	4.05 ±5.73	50	0.53 ±0.11	100	2 ug/day EAR
Thiamine	1.04 ±0.08	50	0.98 ±0.27	50	0.96 ±0.1	50	1.53 ±0.29	0	1 mg/day EAR
Riboflavin	0.55 ±0.11	100	0.95 ±0.29	50	0.48 ±0.2	100	0.66 ±0	100	1.1 mg/day EAR
Niacin	19.3 ±0.07	0	4.63 ±6.54	100	13.75 ±5.44	50	13.53 ±0.67	100	12 mg/day EAR
Folate	3.5 ±4.95	100	244.58 ±342.84	50	12.74 ±10.05	100	40.54 ±49.81	100	320 ug/day EAR
Calcium	307.25 ±165.82	100	219.78 ±291.65	100	323 ±241.83	100	267 ±73.54	100	1200 mg/day AI
Iron	8.75 ±1.06	0	10.52 ±1.73	0	9.15 ±2.69	0	10.58 ±1.38	0	6 mg/day EAR
Zinc	6.78 ±0.43	100	113 ±1.74	50	7.43 ±0.31	100	8.56 ±1.16	100	9.4 mg/day EAR
Magnesium	204.5 ±21.92	100	486 ±438.41	50	212 ±36.06	100	317.25 ±55.51	50	350 mg/day EAR
Phosphorus	578 ±180.31	50	333.43 ±435.68	50	587.75 ±189.15	50	733.25 ±152.38	100	580 mg/day EAR
Selenium	42.13 ±3.57	100	19.03 ±2.93	100	31.03 ±9.72	100	14.63 ±10.36	100	45 ug/day EAR
Potassium	1284.75 ±439.47	100	1208.5 ±0	100	1580.25 ±764.03	100	2771 ±857.72	100	4700 mg/day EAR

Table 4.17 indicates that the energy intake requirements were not met as the reported mean intake was 5810 kJ in spring, 5911 kJ in summer, 6327 kJ in autumn, and 7552.5 kJ in winter, compared to the recommended EER of 12881 kJ/day. Protein intake was lower than the recommended intake at 42.13 g in spring, 28.68 g in summer, 33.9 g in autumn, and 28.93 g in winter compared to the RDA requirements of 56 g/day. Carbohydrate intake exceeded the recommended EAR intake of 100 g/day as the reported mean intake was 192.9 g in spring, 207.03 g in summer, 221.53 g in autumn, and 275.08 g in winter. Total dietary fibre intake was

half the required intake with the reported 15.53 g in spring, 15.1g in summer, and 18.5 g in autumn, compared to the recommended AI of 30 g/day. Notably in winter, the dietary fibre intake was higher than the recommended AI as the reported mean intake was 36.06 g.

The micronutrients indicate that biotin intake was higher in summer (40.25 μg.) but it was lower in other seasons at 23.8 μg in spring, 23.73 μg, in summer and 17.6 μg in winter, compared to the recommended AI of 30 μg/day. Vitamin A intake was notably low in summer with a mean intake of 265.75 mcg. However, in other seasons, the vitamin A intake was average and below the recommended intake at 536.25 mcg in spring, 503 mcg in autumn, and 515.75 mcg in winter, compared to the recommended EAR intake of 625 mcg/day. Vitamin C intake was low at 43.75 mg in spring, very low at 19.86 mg in summer, 37.25 mg in autumn, and 46 mg in winter, compared to the recommended EAR intake of 75 mg/day. Vitamin E intake was above the EAR intake with the reported mean intake of 12.81 mg, 13.87 mg in autumn, and 14.84 mg in winter, compared to the recommended EAR intake of 12 mg/day. Notably, the Vitamin E mean intake was below the recommended EAR at 8.48 mg in summer. Vitamin B6 intake was met in summer and autumn with the mean intake at 1.03 mg and 1.78 mg respectively, while the mean intake showed to be above the requirements in spring and winter with the mean intake of 2.1 mg and 2.71 mg respectively, compared to the recommended EAR intake of 1.4 mg/day. Vitamin B12 intake was double the recommended requirement at 4.05 mg in autumn. In other seasons, the vitamin B12 intake was 0.6 μg in spring, 0.9 μg in summer, and 0.53 μg in winter, compared to the recommended intake of 2 μg/day. Thiamine EAR intake was met in spring and winter at 1.04 mg and 1.53 mg respectively, whereas in summer and autumn, the intake mean intake was 0.98 mg and 0.96 mg respectively, compared to the recommended EAR intake of 1mg/day. Riboflavin mean intake was half the requirement at 0.55 mg in spring, very high in summer with a recorded 0.95 mg, and 0.48 mg, and 0.66 mg for autumn and winter respectively, compared to the recommended EAR intake of 1.1 mg/day. Niacin intake was higher than the recommended EAR intake of 12 mg/day in spring (19.3 mg), 13.75 mg in autumn, and 13.53 mg in winter. However, it was notably low in summer with a mean intake of 4.63 mg. Folate intake was lower than the required EAR intake of 320 μg/day in all seasons. The mean intake was 3.5 in spring, 244.56 μg in summer, 12.74 μg in autumn and 40.54 μg in winter.

The calcium intake was low in all seasons with a mean intake of 307.25 mg in spring, 219.78 mg in summer, 323 mg in autumn, and 267 mg in winter, compared to the recommended AI of 1200 mg/day and 100% of the participants consumed diet <100% EAR for calcium. Iron intake was high in all seasons at 8.78 mg in spring, 10.52 mg in summer, 9.15 mg in autumn, and 10.58 mg in winter compared to the recommended EAR intake of 6 mg/day. Zinc intake was above the recommended intake in summer at 11.52 mg, whereas it was below the recommended intake at 6.78 mg in spring, 7.43 mg in autumn, and 8.56 mg in winter, compared to the recommended EAR intake of 9.4 mg/day. Magnesium intake was high in summer and winter at 486 mg and 317.25 mg respectively. However, it was low in spring and autumn with the reported mean intake of 204.5 mg and 212 mg respectively. Phosphorus intake was low in summer at 333.43 mg, average in spring at 578 mg, and high in autumn and winter at 587.75 mg and 733.25 mg respectively, compared to the recommended EAR intake of 580 mg/day. Selenium intake was below the recommended requirements in all seasons at 42.13 µg, 19.03 µg in summer, 31.03 µg in autumn, and 14.63 µg in winter compared to the recommended EAR intake of 45 µg/day. Potassium intake was low across all seasons with a mean intake of 1284.75 mg in spring, 1208.5 mg in summer, 1580.25 mg in autumn, and 2771 mg in winter, compared to the recommended EAR intake of 4700 mg/day.

TABLE 4.22 NUTRIENT INTAKE *(FEMALES 51-70 YEARS OLD)*

Nutrient	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Energy	6195.52 ±1413.68	100	6394.46 ±868.88	100	6371.72 ±1318.67	100	6077.15 ±1561.93	100	10093 kJ/day EER
Total protein	37.93 ±16.01	73.9	33.22 ±9.66	87	37.25 ±19.1	78.3	39.1 ±14.7	73.9	46 g RDA
Carbohydrates	222.58 ±51.97	0	228.87 ±41.31	0	266.9 ±75.92	0	264.78 ±86.15	0	100 g/day EAR

TABLE 4.23 NUTRIENT INTAKE (*FEMALES 51-70 YEARS OLD*) (*CONTINUED*)

Nutrients	Spring		Summer		Autumn		Winter		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Total dietary fibre	22.7 ±9.33	47.8	26.34 ±17.07	34.8	27.38 ±11.81	39.1	27.6 ±11.95	43.5	21 g/day AI
Biotin	17.13 ±10.38	95.7	22.43 ±8.44	78.3	22.42 ±14.07	69.6	14.77 ±7.63	95.7	30 ug/day AI
Vitamin A	479.63 ±237.53	69.6	502.35 ±214	56.5	446.26 ±165.24	65.2	452.09 ±213.65	60.9	500 mcg EAR
Vitamin C	28.8 ±17.62	95.7	53.87 ±159.39	95.7	30.15 ±21.7	95.7	24.41 ±13.51	100	60 mg/day EAR
Vitamin E	15.88 ±10.76	43.5	13.85 ±6.97	34.8	17.23 ±7.14	26.1	10.93 ±7.04	56.5	12 mg/day EAR
Vitamin B6	2.52 ±1.46	17.4	4.5 ±9.19	0	2.19 ±1.1	17.4	1.79 ±0.77	30.4	1.3 mg/day EAR
Vitamin B12	2.01 ±5.15	87	0.55 ±0.39	100	2.14 ±5.43	87	1.6 ±2.4	73.9	2 ug/day EAR
Thiamine	1.32 ±0.73	21.7	1.24 ±0.34	4.3	1.43 ±0.37	4.3	1.35 ±0.45	8.7	0.9 mg/day EAR
Riboflavin	0.67 ±0.39	82.6	0.6 ±0.19	95.7	0.71 ±0.3	69.6	0.8 ±0.63	73.9	0.9 mg/day EAR
Niacin	15.89 ±6.44	17.4	14.66 ±5.46	26.1	15.15 ±6.97	34.8	12.16 ±4.06	43.5	11 mg/day EAR
Folate	14.2 ±26.15	100	11.84 ±18.57	100	25.16 ±29.4	100	30.89 ±36.71	100	320 ug/day EAR

TABLE 4.24 NUTRIENT INTAKE (*FEMALES 51-70 YEARS OLD*) (*CONTINUED*)

Nutrients	Spring		Summer		Autumn		Summer		DRIs
	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	Mean ± SD	% <DRI	
Calcium	369.98 ±188.12	100	315.93 ±134.5	100	332.67 ±180.74	100	309.37 ±139.16	100	1200 mg/day AI
Iron	12.4 ±5.48	0	21.26 ±49.04	0	12.2 ±3.88	0	11.07 ±2.78	0	5 mg/day EAR
Zinc	8.78 ±4.76	34.8	8.52 ±1.61	17.4	8.1 ±3.27	47.8	8.1 ±2.56	39.1	6.8 mg/day EAR
Magnesium	218.37 ±52.44	82.6	223.74 ±67.99	69.6	230.87 ±78.41	73.9	242.09 ±84.33	73.9	265 mg/day EAR
Phosphorus	637.96 ±224.94	47.8	687.46 ±413.38	43.5	656.87 ±187.84	43.5	700.13 ±223.87	30.4	580 mg/day EAR
Selenium	26.42 ±11.7	95.7	30.97 ±67.26	95.7	21.14 ±13.98	95.7	28.18 ±34.55	95.7	55 ug/day EAR
Potassium	1383.5 ±475.41	100	1292.65 ±483.9	100	1685.37 ±840.03	100	1717.54 ±1040.18	95.7	4700 mg/day EAR

Table 4.18 indicates that the energy intake requirements were not met as the reported mean intake was 6195.52 kJ in spring, 6394.46 kJ in summer, 6371.72 kJ in autumn, and 6077.15 kJ in winter compared to the recommended EER intake of 10093 kJ/day. The protein intake was below the required amounts at 37.93 g in spring, 33.22 g in summer, 37.25 g in autumn, and 39.1 g in winter compared to the RDA of 46 g/day. Carbohydrate intake was high and double the recommended EAR amounts of 100 g/day. The mean intake for CHO was 222.58 g in spring, 228.87 g in summer, 266.9 g in autumn and 264.78g in winter. Dietary fibre intake was above the recommended AI at 22.7 g in spring, 26.7 g in summer, 27.38g in autumn and 27.6 g in winter compared to the recommended AI of 21 g/day.

Biotin intake was low in all seasons with a reported mean intake of 17.13 µg in spring, 22.43 µg in summer, 22.42 µg in autumn, and 14.77 µg in winter, compared to the recommended AI of 30 µg/day. Vitamin A intake requirements were met in the summer with a mean intake of 502.35 mcg. However, in other seasons the vitamin A intake was 479.63 mcg in spring, 446.26 mcg in autumn, and 452.09 mcg in winter and it was below the recommended EAR intake of 500 mcg/day. Vitamin C intake was slightly below the recommended intake in summer (5.87 mg), whereas in other seasons it was low at 28.8 mg in spring, 30.15 mg in autumn, and 24.41 mg in winter compared to the recommended EAR intake of 60 mg/day. Vitamin E intake exceeded the recommended intake in spring (15.88 mg), 13.85 mg in summer and 17.23 mg in autumn but in winter the mean intake was 10.93 mg and it was slightly below the recommended EAR intake of 12 mg/day. Vitamin B6 intake was high in all seasons at 2.52 mg in spring, 4.5 mg in summer, 2.19 mg in autumn, and 1.79 mg in winter, compared to the recommended EAR intake of 1.3 mg/day. Vitamin B12 intake was adequate in spring and autumn with 2.01 µg and 2.14 µg respectively but the intake was low in summer and winter with mean intakes of 0.55 µg and 1.6 µg respectively compared to the recommended EAR intake of 2 µg/day. Thiamine intake exceeded the recommended requirements and was 1.32 mg in spring, 1.24 mg in summer, 1.43 mg in autumn and 1.35 mg in winter compared to the recommended EAR intake of 0.9 mg/day. Riboflavin intake requirements were not met as they were below the recommended EAR intake of 0.9 mg/day. The riboflavin mean intake was 0.67 mg in spring, 0.6 mg in summer, 0.71 mg in autumn and 0.8 mg in winter. Niacin intake was high at 15.89 mg in spring, 14.66 mg in summer, 15.15 mg in autumn and 12.16 mg in winter, compared to the recommended EAR intake of 11 mg/day. Folate intake consumption was low, as the results show that it was 14.2 µg in spring, 11.84 µg in summer, 25.16 µg in autumn and 30.89 µg in winter compared to the recommended EAR intake of 320 µg/day.

A deficient calcium intake was noted in all seasons as the intake was 369.89mg in spring, 315.93 mg in summer, 332.67 mg in autumn and 309.37 mg in winter compared to the recommended AI of 1200 mg/day. Iron intake was found to be high and double the recommended amount as it was found to be 12.4 mg in spring, 21.26 mg in summer, 12.2 mg in autumn and 11.04 mg in winter compared to the recommended EAR intake of 5 mg/day. Zinc intake exceeded the requirements at 8.78 mg in spring, 8.52 mg in summer and 8.1 mg in autumn and winter respectively compared to the recommended EAR intake of 6.8mg/day. Magnesium intake was less than the required intake and was 218.37 mg in spring, 223.74 mg in summer, 230.87 mg in autumn and 242.09 mg in winter compared to the recommended EAR intake of 265 mg/day. Phosphorus intake was high at 637.96 mg in spring, 687.46 mg in summer, 656.87 mg in autumn and 700.13 mg in winter compared to the recommended EAR intake of 580 mg/day. Selenium intake was low at 26.42 µg in spring, 30.97 µg in summer, 21.14 µg in autumn and 28.18 µg in winter compared to the recommended AI of 55 µg/day. Potassium intake was low as the mean intake was 1383.5 mg in spring, 1292.6 mg in summer, 1685.37 mg in autumn and 1717.54 mg in winter compared to the recommended EAR intake of 4700mg/day.

4.4.3.1 Top 20 food items consumed per season

The tables in this section show the mean top 20 food products ranked by total consumption (portion size x number of respondents) for all four seasons as measured by 24-hour recalls (n=118). The tables indicate the frequency that the group consumed each food item, and the per capita intake is also reflected, indicating the mean intake if the whole group (n=100) consumed the food item.

TABLE 4.25 TOP 20 FOOD ITEMS CONSUMED MEASURED BY A 24-HOUR RECALL (N=118): SPRING SEASON

No.	Food Item	Total Intake(g)	Mean Intake(g)	Freq. for 2 days	Freq for 1 day	Per capita intake for 2 days	Per capita intake for 1 day
1	Soup powder beef and vegetable flavour	4992.5	28.37	176	88	42.31	21.15
2	Onion	2258	12.98	174	87	19.14	9.57
3	Sunflower oil	10299.6	61.67	167	83.5	87.28	43.64
4	Stock cubes	2735	18.11	151	75.5	23.18	11.59
5	Rice cooked	47092.5	331.64	142	71	399.09	199.54
6	Curry powder	4427	33.04	134	67	37.52	18.76
7	Maize soft porridge	93846.5	1623.35	119	59.5	795.31	397.65
8	Bread white/black	27320	232.74	117	58.5	231.53	115.76
9	Uphuthu (crumbly/ porridge	37940	686.81	116	58	321.53	160.76
10	Margarine. brick/hard	4432.5	38.21	116	58	37.56	18.78
11	Tea	15030	183.29	82	41	127.37	63.69

12	Sugar Brown/White	4099	51.24	80	40	34.74	17.37
13	Lemon	3185	54.91	58	29	26.99	13.50
14	Salt	643	11.69	55	27.5	5.45	2.72
15	Coffee creamer/ powdered milk	130.6	24.16	54	27	1.11	0.55
16	Chicken curry	21800	444.89	49	24.5	184.75	92.37
17	Sugar beans	16000	333.33	48	24	135.59	67.80
18	Daily's juice	10175	260.89	39	19.5	86.23	43.11
19	Tomatoes	10940	287.89	38	19	92.71	46.36
20	Maas	16587	473.91	35	32.5	140.57	70.28

Table 4.19 reflects that carbohydrate (CHO) based food items were consumed in higher amounts than other food items amongst the top 20 food items. The total intake of CHO ranged from 93 846.5 g with a mean intake of 1623.35 g consumed 119 times during two days to 4099 g for sugar with a mean intake of 51.24 g which was consumed 58 times in two days. Carbohydrates-rich foods appeared on numbers (5, 7, 8, 9, and 12 respectively). The high mean intake of CHO was above the intake of 100 g/day recommended by the Institute of Medicine (IoM) (IoM 2006).

The protein consumption was moderate because beef and vegetable flavoured soup powder are not rich in protein. Chicken and sugar beans were the only protein-rich food items consumed 49 and 48 times respectively with a per capita of 184.75 g for chicken curry and 135.59 g for sugar beans in two days. The protein content from stock cubes and *maas* is minimal. Vegetable intake was consumed in small amounts during spring as only tomatoes appeared on the top 20 food items with a total intake of 10940 g and a mean intake of 287.89 g consumed 38 times in two days. The World Health Organization (WHO) recommends consuming at least 400 grams of fruits and vegetables per day, which is about five servings. This includes a variety of fruits and vegetables to ensure a wide range of nutrients.

TABLE 4.26 TOP 20 FOOD ITEMS CONSUMED MEASURED BY A 24-HOUR RECALL (N=118):
Summer Season.

No.	Food Item	Total Intake(g)	Mean Intake(g)	Freq. for 2 days	Freq for 1 day	Per capita intake for 2 days	Per capita intake for 1 day
1	Sunflower oil	15220	79.69	191	95.5	128.98	64.49
2	Sugar white/brown	10815	57.83	187	93.5	91.65	45.83
3	Uphuthu crumbly/porridge	49573	558.26	165	82.5	420.11	210.06
4	Soup prepared with water	1304.45	31.19	138	69	11.05	5.53
5	Curry powder	3065	23.05	133	66.5	25.97	12.99
6	Onion	182	13368	133	66.5	1.54	0.77
7	Bread Brown/white	32500	248.09	131	65.5	275.42	137.71
8	Rice cooked	36235	309.7	117	58.5	307.08	153.54
9	Stock cubes	2100	19.91	106	53	17.80	8.90
10	Maize soft porridge	90931.5	947.2	96	48	770.61	385.30
11	ILVs amaranth/pumpkin leaves	14580	182.25	80	40	123.56	61.78
12	Table Salt iodised	924	12	77	38.5	7.83	3.92
13	Tea	13860	189.86	73	36.5	117.46	58.73
14	Margarine brick hard	2007.5	28.68	70	35	17.01	8.51
15	Lemon	2747.5	56.07	49	24.5	23.28	11.64
16	Cold drink	17160	381.33	45	22.5	145.42	72.71
17	Maas	19386	430.8	45	22.5	164.29	82.14
18	Sugar beans	8450	234.72	36	18	71.61	35.81
19	Dairy-fruit soft drink	11200	329.41	34	17	94.92	47.46
20	Milk powder. full fat. reconstituted	812	25.38	32	16	6.88	3.44

During summer, carbohydrates and carbohydrate-based food products were consumed in higher amounts than any other macronutrients as five food items of the top 20 food items are carbohydrate-based. The total intake for carbohydrates was extremely high ranging from 90931.5 g for maize soft porridge with a mean intake of 947.2 g consumed 96 times in two days to crumbly porridge with a total intake of 49573 g with a mean intake of 558.26 g consumed 165 times in two days. The average and per capita carbohydrate consumption of the groups was above the recommended intake of 100g/day.

The vegetables were consumed in moderate amounts during summer as only ILVs appear on the top 20 food items which are Amaranths and pumpkin leaves with a total intake of 14580 g and the mean intake of 182.25 g consumed 80 times in two days. Lemon was consumed in moderate amounts with a total intake of 2747.5 g and a mean intake of 56.07 g consumed 49 times in two days. Lemon juice is rich in vitamin C, it contains a high concentration of this essential vitamin, which is important for immune function, skin health, and antioxidant protection. Just a small amount of lemon juice can provide a significant portion of the recommended daily intake of vitamin C. The soft drink total intake was 11200 g with a mean intake of 329.41 g consumed 34 times in two days. The portion sizes for fruit and vegetables were small and did not meet the WHO recommended intake of >400 g/day

The consumption of protein during autumn was low as only one (sugar beans) food item out of the top 20 food items is protein-based. Very few respondents consumed any protein-rich food. Sugar beans were the only protein food item consumed 36 times in two days with a total intake of 8450 g and a mean intake of 234.72 g. The Institute of Medicine recommends that adults consume a protein intake of about 46 grams per day for women and 56 grams per day for men.

TABLE 4.27 TOP 20 FOOD ITEMS CONSUMED MEASURED BY A 24-HOUR RECALL (N=118): AUTUMN SEASON

No.	Food Item	Total Intake(g)	Mean Intake(g)	Freq. for 2 days	Freq for 1 day	Per capita intake for 2 days	Per capita intake for 1 day
1	Sugar brown/white	11420.5	51.68	221	110.5	96.78	48.39
2	Sunflower oil	14338.5	74.29	193	96.5	121.51	60.76
3	Curry powder	2623	15.61	168	84	22.23	11.11
4	Table salt	1612	9.77	165	82.5	13.66	6.83

Table 4.21 Top 20 food items consumed measured by a 24-hour recall (n=118): Autumn Season *(Continued)*

No.	Food Item	Total Intake(g)	Mean Intake(g)	Freq. for 2 days	Freq for 1 day	Per capita intake for 2 days	Per capita intake for 1 day
5	*Uphuthu*	35420	301.16	126	63	300.17	150.08
6	Rice	31785	264.88	120	60	269.36	134.68
7	Onion	1145	10.9	105	52.5	9.70	4.85
8	Maize porridge soft	59945	587.69	102	51	508.01	254.00
9	Soup powder	2444.5	24.2	101	50.5	20.72	10.36
Table	**4.21 Continued**						
10	Tea	16290	185.11	88	44	138.05	69.03
11	Stock cubes	10710	13.05	82	41	90.76	45.38
12	Sugar beans cooked	71200	232.43	74	37	603.39	301.69
13	Bread white/brown	16014	222.42	72	36	135.71	67.86
14	Polony	332	23.71	71	35.5	2.81	1.41
15	Dairy fruit juice	20500	313.38	65	32.5	173.73	86.86
16	Pumpkin	14133.75	288.44	49	24.5	1197.74	598.87
17	Ujeqe steamed bread	11990	292.43	41	20.5	101.61	50.81
18	Avocado. raw (peeled)	10010	294.41	34	17	84.83	42.42
19	Coffee	6136	180.47	34	17	52.00	26.00
20	Potatoes	9435	304.35	31	15.5	79.96	39.98

During autumn carbohydrate-based food items were consumed in higher amounts than any other macronutrients as ten of the top 20 food items are carbohydrate-based. The total intake for carbohydrates was high, ranging from 59945 g for maize meal porridge with a mean intake of 587.69 g consumed 102 times in two days to 9435 g total intake for potatoes with a mean intake of 304.35 g consumed 31 times in two days. The per-capita and mean intake of carbohydrates in this group is also above the DRIs of 100 g/day (IoM 2006).

Fruits and vegetables were consumed in moderate amounts as 5 fruits and vegetables appeared on the top 20 list. Onions were consumed 105 times in two days with a total intake of 1145g and a mean intake of 10.5g while pumpkin was consumed 49 times in two days with a total intake of 14133.75 g and a mean intake of 288.44 g respectively. Dairy fruit juice was consumed 65 times in two days by the group with a total intake of 20500 g and a mean intake of 313.38 g while avocado was consumed 34 times in two days with a total intake of 10010 g and a mean intake of 294.41 g respectively, and the per capita intake for avocado was 42.42 g/day. The intake of fruit and vegetables was not met as WHO recommends an intake of >400 g/day. The consumption of protein during autumn was low as only one (sugar beans) food item out of the top 20 food items is protein-based. Sugar beans were consumed 74 times in two days with a total intake of 71200 g and a mean intake of 232.43 g and the per capita intake was 301.69 g per day.

TABLE 4.28 TOP 20 FOOD ITEMS CONSUMED MEASURED BY A 24-HOUR RECALL (N=118): WINTER SEASON

No.	Food Item	Total Intake(g)	Mean Intake(g)	Freq. for 2 days	Freq for 1 day	Per capita intake for 2 days	Per capita intake for 1 day
1	Sugar	13721.5	58.14	236	118	116.28	58.14
2	*Uphuthu*	40390	480	175	87.5	342.29	171.14
3	Salt	1789.5	10.65	168	84	15.17	7.58
4	Sunflower oil	10108.25	63.18	160	80	85.66	42.83
5	Curry powder	2842.5	20.9	136	68	24.09	12.04
6	Sugar beans	27087.5	211.62	128	64	229.56	114.78
7	Rice	26165	241.13	111	55.5	221.74	110.87
8	Soft porridge	53243	502.29	106	53	451.21	225.61
9	Tea	16270	184.89	88	44	137.88	68.94
10	Soup Powder	1881	23.81	79	39.5	15.94	7.97
11	Onion	1005	15.22	66	33	8.52	4.26
12	Pumpkin boiled	15367.5	240.12	64	32	130.23	65.12
13	Ujeqe steam bread	10905	242.33	45	22.5	92.42	46.21
14	Bread/ Brown/white	9470	215.23	44	22	80.25	40.13
15	Coffee. brewed	85201	198.14	43	21.5	722.04	361.02

TABLE 4.29 TOP 20 FOOD ITEMS CONSUMED MEASURED BY A 24-HOUR RECALL (N=118): WINTER SEASON (*CONTINUED*)

No.	Food Item	Total Intake(g)	Mean Intake(g)	Freq. for 2 days	Freq for 1 day	Per capita intake for 2 days	Per capita intake for 1 day
16	Dairy-fruit juice mix	14380	350.73	41	20.5	121.86	60.93
17	Stock cubes	475	11.88	40	20	4.03	2.01
18	Avocado	11300	313.89	36	18	95.76	47.88
19	Coffee creamer milk powder	1284.5	38.92	33	16.5	10.89	5.44
20	Maas	12474	415.8	30	15	105.71	52.86

Table 4.22 reflects that carbohydrate-based food items were consumed in higher amounts than any other macronutrients as nine food items amongst the top 20 food items are carbohydrate-based. The total intake for carbohydrates was extremely high ranging from a total intake of 53243 g with a mean intake of 502.29 g for maize soft porridge consumed 106 times in two days to a 9470 g total intake of bread with a mean intake of 215.23 g consumed 44 times in two days and a per capita of 225.61 g/day and 46.21 g/day respectively. The high mean and per capita intake of carbohydrates in this group is above the recommended intake of 100 g/day.

The consumption of protein was moderate as food items on the top 20 show sugar beans and avocado as protein sources. However, avocados are not a high-protein food. Sugar beans are high in proteins and are listed as the number 6 frequently consumed food item during winter. Sugar beans were only consumed 128 times in two days with a total intake of 27087.5 g and the mean intake of 211.62 g with a per capita of 114.78 g a day.

4.5 Food security and coping strategies

This section presents the food coping strategies implemented by the community at times when they did not have access to food or enough money to buy food. The coping strategies were determined through a Focus Group discussion in the village and the eight coping strategies used in the village are reflected in the Table (Maxwell *et al.* 2003). The higher the score recorded, the higher the level of food insecurity and the lower the score, the less food insecure the households were.

This section reports on the food coping strategies implemented by the village population (n=118) to have access to food. The maximum food security score that could have been generated was 176, which would indicate severe food insecurity with the minimum as 0, which indicates food security. The higher the score, the greater the prevalence of food insecurity, and the lower the score, the less food insecure the households were. Individual coping strategies were determined through a focus group discussion in the village and the eight coping strategies used are reflected in the table below. These coping strategies are reflected per season, as the data was collected seasonally. The main coping strategy that was used by rural households across all seasons was to “rely on less preferred and less expensive foods” and the main severity score was four (4).

TABLE 4.30 NUMBER OF HOUSEHOLDS APPLYING FOOD COPING STRATEGIES PER SEASON (N=118 PER SEASON)

	Rely on less preferred and less expensive foods	Borrow food, or rely on help from a friend or relative	Purchase food on credit	Gather wild food, hunt, or harvest immature crops	Consume seed stock held for next season	Limit portion size at mealtimes	Reduce number of meals eaten in a day	Make beads and sell them	Total household score
Frequency x severity									
	(0-7) x4 (max score 28	(0-7) x4 (max score 28	(0-7) x4 (max score 28	(0-7) x4 (max score 28	(0-7) x1(max score 7	(0-7) x2 (max score 14	(0-7) x2 (max score 14	(0-7) x4 (max score 28	Mean (SD+-) Max score=176
Spring	11.81 ±7,797	0.97 ±1,095	1.49 ±0,894	2.86 ±2,191	0.12 ±0,000	2.20 ±1,517	2.86 ±3,033	3.10 ±3,033	25.35 ±6,602
Summer	14.92 ±6,602	0.42 ±0,821	0.31 ±0,722	3.59 ±2,635	0.28 ±2,728	0.41 ±1,373	2.85 ±3,309	3.60 ±2,592	25.72 ±7,996+-
Autumn	10.29 ±7,577	0.53 ±0,993	0.71 ±1,241	1.68 ±2,338	0.25 ±0,000	1.03 ±1,802	2.93 ±0,428	2.95 ±3,305	20.30 ±7,735
Winter	16.83 ±6,402	0.88 ±1,185	1.15 ±1,418	0.95 ±1,351	1.40 ±0,267	0.74 ±1,086	1.93 ±2,007	3.56 ±2,550	27.46 ±5,091

Frequency scoring: 0 never (zero times per week); 0.5 hardly at all (once or fewer times per week); 1.5 occasionally (1 to 2 per week); 4.5 often (3-6 times per week); 7 (all the time/every day). **Severity weight:** Based on ordinal ranking by focus group respondents (1 least severe and 4 most severe).

The coping strategies for food security mean intake and ±SD were determined, and the results are expressed in Table 4.23. The maximum score that could have been generated if the households used the coping strategies daily was 176, which was going to indicate severe food insecurity and vice versa. The most utilised coping strategy was “Rely on less preferred and less expensive foods” with a mean score of 11.81 (±7.797) and the least used coping strategy was “Consume seed stock held for next season” with the mean score of 0.12 (±0.000). Other coping strategies that the community utilised included “Reduce the number of meals eaten in a day”, “Gather wild food, hunt, or harvest immature crops”, “Reduce the number of meals eaten in a day”, “Limit portion size at mealtimes”, “Purchase food on credit”, “Borrow food, or rely on help from a friend or relative” and “Make beads and sell them”. The spring total mean score generated was 25.35 (±6.602). During summer, the most used coping strategy was “Rely on less preferred and less expensive foods” with a mean score of 14.92 (±6.602) and the least used coping strategy was “Consume seed stock held for next season” with a mean score of 0.28 (±2.728). The total mean score for summer was 25.72 (±7.996). In autumn, the most used coping strategy was “Rely on less preferred and less expensive foods” with a mean score of 10.29 (±7.577) and the least used coping strategy was “Consume seed stock held for next season” with a mean score of 0.25 (±0.000). The total mean score in autumn was 20.30 (±7.735). In winter, the most used coping strategy was “Rely on less preferred and less expensive foods” with a mean score of 16.83 (±6.402) and the least used strategy was “Limit portion size at mealtimes” with a mean score of 0.74 (±1.086). The total mean score in winter was 27.46 (±5.091) by the total group of (n=118).

4.6 Discussion of results

All South African citizens have a constitutional right to food and nutrition security (Nkrumah 2019: 47). The results analysed in this chapter indicate the seasonal consumption and contribution of ILVs to household food security. The results showed that ILV peak consumption is prevalent in spring and summer. The consumption then declines in autumn and winter due to reduced or no availability. The dietary diversity shows that as much as households consumed food from most food groups with medium to high FVS across all seasons, it lacked diversity within those food groups. For example, if there are ten fruits within a fruit group, households consumed only two or three types of fruits within that fruit group. This means that a moderate number of different foods were consumed but not the entire variety. Nutrient intake from dietary intake analysis of nutrients indicated imbalances across all seasons for all age groups. The results show that food insecurity was not high in rural households as the coping strategies recorded a low score. The following section will discuss all the results starting with the sociodemographic profile, indigenous leafy vegetables perceptions, sourcing, and consumption, dietary diversity, nutrient intake, and coping strategies utilised by the participants during times of food scarcity.

4.6.1 Socio-demographic profile

The socio-demographic profile results from this study showed that the households were from a low socioeconomic background. A higher proportion of women participated compared to men. The results further indicated that most women were responsible for food preparation and consumption practices within the household. These results are similar to a study done by Dlamini and Viljoen (2020: 62) amongst Eluyengweni rural women in Eswatini which found that women are knowledgeable and play a central role in household management and agricultural practices that included ILV consumption and rural household food preparation.

The household living conditions and family composition in this study indicated that most rural participants lived with their extended family members which included children and grandchildren. A larger household size is more likely to experience food insecurity than a smaller one (Mncube, Ojo and Nyam 2023: 7). This means that as the household size increases, the demand for food increases (Ngidi *et al.* 2023: 10). This aligns with a study by Zulu *et al.* (2022:8) carried out in Limpopo and Mpumalanga in rural communities where communities heavily rely on agriculture, who reported that household size negatively influences the food consumption of rural dwellers.

More than half of the respondents had matric as the highest qualification. The literature indicates that consumers are more likely to change their food preferences when a household member becomes more educated. This implies that they tend to consume more nutritious food from various food groups (Ngidi *et al*. 2023: 11; Zulu *et al.* 2022: 8).

According to the study's findings, there was a greater proportion of unemployed participants which means they were dependent on other family members to provide basic needs within the households. Within rural households, there are elderly individuals who may depend on government assistance. A study conducted by Lloyd-Sherlock, Agrawal, and Gomez-Olive (2020: 5) investigated the effects of pension receipt and identified food scarcity within a rural community in Mpumalanga. The findings indicated that although a small fraction of rural households experienced hunger, a significant number of participants receiving the government old-age pension encountered a lower likelihood of food insecurity.

A two-thirds majority of the Mangangeni residents indicated that the household income ranged from R3 501-R10 000 monthly. Similarly, a South African national food and nutrition security study by Simelane *et al.* (2023: 42) found that 19.6% of respondents had a household income of R3001-R4500, 11.7% had a household income of R4501-R6000, and 21.1% had a household income above R6000 in the iLembe region. Ngema, Sibanda and Musenwa (2018: 9) reported that the total household income in rural areas, which includes wages, government social transfers, and remittances, plays a role in determining overall household income. A higher household income can enhance the level of food security for the family. This study suggests that the low employment rate and limited household income found in this study may be an indication that certain households in this community are susceptible to food insecurity. Khumalo and Sibanda (2019: 11) validated that the high unemployment rate can make households vulnerable to poverty and food insecurity. Cheteni, Khamfula and Mah (2020: 14) concur that income is a determining factor in fighting food insecurity.

A high rate of unemployment in the Mangangeni village community was found with a total of 66.9% unemployed people. These results closely resemble that of the KZN province that is reported at 67.8% (Simelane *et al.* 2023: 40). Similarly, a high unemployment rate at local municipal level was found by Simelane *et al.* (2023: 41) who reported that Ndwedwe was amongst the municipalities in KZN that had the highest percentage of (85.5%) unemployment. The high rate of unemployment reflects that the villagers heavily rely on household members receiving government elderly pensions, other government grants and income generated from selling handwork (bead craft and agricultural activities).

4.6.2 Indigenous leafy vegetables perceptions, sourcing, and consumption status

With regards to ILVs, a positive perception was found among all participants who confirmed their availability, accessibility and consumption in the village; the participants further noted that they have a good knowledge of ILVs. The positive perceptions from both young and older males and females were not limited to perceptions that ILVs are considered healthy, are cheaper than other vegetables, have a pleasant taste, can prevent and regulate illnesses, are high in nutrients, cook faster, and give energy. Similarly, a study on perceptions and determinants of ILV production conducted in a rural area in Coffee Bay, Eastern Cape by Mayekiso, Taruvinga and Mushunje (2017: 283) reported a positive perception as a large proportion of households indicated that ILVs are palatable, nutritious and have health benefits. Conversely, the positive perception of ILVs reported from this study's findings contradicts a study on the role of ILVs conducted in the Ntuze rural community in KZN by Qwabe and Pittawaty (2022: 146). The latter study indicated that ILVs are associated with negative perceptions such as being ‘rural’, ‘food for the poor’ or ‘hunger and low-status food’ and further noted that ILVs are consumed based on preference and convenience rather than regarding conditions of adverse poverty. Qwabe and Pittawaty (2022: 178) further asserted that the elders are concerned about younger generations who are not educated about ILVs and that Western education and social media have contributed to the youth's rejection of ILVs. Furthermore, a study on awareness and perceptions towards indigenous foods conducted in Eastern Cape in Port St Johns by Ntlanga, Jiba, Christian and Mdoda (2023: 122) highlighted a positive perception towards ILVs in terms of their nutritious, healthy advantages, which could positively affect the consumption of these vegetables. However, Ntlanga *et al.* (2023: 122) indicated that most participants did not believe that ILVs are easy to prepare and have a pleasant taste. Additionally, Ntlanga *et al.* (2023: 123) reported that the participants in their study recognised that ILVs are cheaper than exotic vegetables.

Moreover, a large proportion of participants from this study who were primarily older women from the low-income households indicated that they obtain ILVs such as *Bidens Pilosa*, blackjack, black nightshade, pumpkin leaves and amaranths from their farms while some obtain them from their household gardens, on river banks (*colocasia esculenta)* and the wild. Most of the participants indicated that they cultivate pumpkin leaves. Only one participant indicated that they grow *colocasia esculenta*. These results align with the findings of van Rensburg, van Averbeke, Slabbert, Faber, van Jaarsveld, van Heerden and Oelofse (2007: 317) that In South Africa, indigenous leafy vegetables are gathered from the wild and from cultivated lands where they often grow as weeds. The authors also mentioned that this practice has a rich history closely tied to women and their traditional roles in sustaining their livelihoods. This is in line with the Agricultural Research Council (2014: para. 1 line 5) report which indicated that most of these crops are wild harvested, while few are cultivated. Additionally, Zulu *et al.* (2022: 6) highlighted that ILVs are easily available as they grow in the wild and in uncultivated areas.

The pumpkin leaf cultivation adheres to a distinct seasonal cycle, as two-thirds of participants indicated that cultivation takes place mostly during spring in October, while a smaller proportion indicated they cultivate ILVs in August and September. In contrast, a study on indigenous knowledge of traditional vegetables conducted in a rural community in Manicaland province in rural districts in Zimbabwe by Ndoro, Madakadze, Kageler and Mashingaidze (2007: 649) found that pumpkin leaves are grown mostly in summer. Mayekiso (2024: 26714) reported that ILVs are available on a seasonal basis and there is a higher possibility of utilising these ILVs as a source of income rather than food sources for the household. The timing of the cultivation guarantees that the vegetables can be harvested for consumption during the peak of the season, which is crucial for ensuring a consistent supply of fresh produce. These results correlate with Ntlanga *et al.* (2023: 123) who reported that ILVs are available mostly during rainy seasons.

Furthermore, most participants consisting of men and women of all age groups from the low-income households highlighted that they do not buy ILVs, whereas a smaller proportion of elderly females from a low-income household responded that they buy ILVs from roadside vendors. The persons responsible for the collection of ILVs were all women. Similarly, a study on knowledge of ILVs amongst rural women in Eswatini by Dlamini and Viljoen (2020: 59) found that women had a higher understanding of ILV identification, accessibility, and preparation.

Approximately six ILVs are frequently consumed by rural households. These include blackjack, amaranth, pumpkin leaves, black nightshade, balsma pear leaves, and *colocasia esculenta.* As depicted in Figure 4.1, pumpkin leaves, amaranths, and blackjacks were the most eaten, while Balsam pear and gallant soldier were the least favoured options among the rural households. These results correlate with Ntuli *et al.* (2012: 6034) who reported that among the various vegetables, amaranths, blackjack, and pumpkin leaves were the most favoured ILVs in KZN. Similarly, a study on the role of ILVs in household food security conducted in Dlangezwa in rural KZN by Ngidi (2023: 6) found that pumpkin leaves and blackjack were the most commonly consumed in a surveyed rural area of KZN. A study by Ndoro, Madakadze, Kageler and Mashingaidze (2007: 649) conducted in the rural districts of Manicaland province further asserted that pumpkin leaves are consumed three to four times per week during summer in Zimbabwe. The results correspond with Jere, Mwangwela, Mlotha, Phan and Adhikhari (2020: 1) who reported that in Malawi pumpkin leaves are the most commonly consumed ILV.

A significant number of the participants indicated that they consume ILVs at least once or twice a week. A minority of participants indicated that they consume ILVs three times per week, and only a few indicated to consume ILVs four times a week which may be related to preferences. These results align with a study on consumption dynamics of ILVs conducted in KwaMbonambi, a rural community in KZN, by Mncwango, Mavengahama and Ntuli (2020: 1040) who found that 59% of the surveyed population consumed ILVs more than once a week, 16% ate them daily, and 41% ate them once a week.

Regarding ILV preparation, the data from this study suggested that women were primarily in charge of collecting and preparing the vegetables. Similar remarks were made by Dlamini and Viljoen (2020: 60) who highlighted that women were familiar with the collection sites and preparation of ILVs. A study on determinants of consumer acceptance of ILVs conducted in rural communities in Limpopo and Mpumalanga by Zulu *et al.* (2022: 5) also noted that women are found to consume ILVs more than males. Dlamini and Viljoen (2020: 63) further reported that elderly women possessed a greater understanding of ILVs, particularly in species identification, accessibility, and preparation, compared to younger individuals.

Indigenous leafy vegetables were consumed mostly with *phuthu* and the parts eaten included the stems and leaves that are either boiled or cooked in cooking oil. These results link with Rankoana (2021: 4) who stated that fresh young leaves are harvested, washed, seasoned with salt, and boiled. Similarly, a study by Mncwango *et al.* (2020: 1204) found that most respondents prefer ILVs with a staple dish such as pap. Mushapi, Magoro, and Tshiambara (2022: 200) also concurred that ILVs are usually consumed with staple foods as a relish.

4.6.3 Dietary assessment

In this section, dietary intake using a 24-hour recall and dietary diversity using a FFQ was recorded. The 24-hr recall yielded results on macro- and micronutrient intakes and the FFQ produced results on the dietary diversity of the participants. The World Health Organization (2024: para. 1 line 1) underscores the importance of nutrition for health and development, linking better nutrition to improved health outcomes. Downer, Berkowitz, Harlan, Olstad and Mozaffarian (2020: 1) also highlighted that food and nutrition are fundamental to health and well-being, with an unbalanced diet potentially causing adverse clinical outcomes.

4.6.3.1 Dietary diversity

Analysis of individual food item consumption across seasons revealed a clear relationship between household dietary diversity and seasonal food availability. Specifically, a greater variety of individual food items, indicative of FVS, was observed during spring and autumn (66 items each) compared to summer (58 items) and winter (53 items). This seasonal fluctuation suggests that households are more successful at achieving dietary diversity when a broader range of foods are naturally accessible or culturally preferred during certain times of the year. The higher FVS in spring and autumn likely reflects increased availability of fresh produce from harvests or foraging, while the moderate FVS in summer and winter may point to greater reliance on more limited, stored, or less diverse food sources during these periods. This underscores the significant impact of local food systems and seasonal cycles on the nutritional landscape of households within this context. These results can be linked to a study on food consumption patterns conducted in a rural community in KwaNdengezi by Gumede and Napier (2022: 20122) who clarified that the FVS for all food items consumed from different food groups over a week showed a medium score of 30-60 individual food items where the vegetables group had the highest FVS. The medium-high FVS across all seasons identified in this study can also be aligned with a study on the dietary diversity status of agricultural households conducted in a rural community of the Nkomazi local municipality in Mpumalanga by Sambo, Oguttu and Mbombo-Dweba (2022: 5) who reported that half of the households had a medium FVS, while a small portion of participants had a high FVS. In contrast, a study on food security and household dietary diversity conducted in rural communities in Eastern Cape by Cheteni, Khamfula and Mah (2022: 9) indicated that a larger proportion of the households consumed a lower FVS while a small proportion of participants had a medium and high dietary diversity respectively.

The FVS measured by the FFQ in this study showed that the top 20 foods listed for all seasons were mostly carbohydrates-based staple foods. The top six foods were sunflower oil, rice, maize, onions, potatoes, and all kinds of dried beans. These results are in line with Cheteni, Khamfula and Mah (2022: 11) who found that starchy staples such as maize, beans, rice and potatoes were mostly consumed by the participants. The high intake of starchy foods aligns with a study conducted in a rural community of KwaNdengezi by Gumede and Napier (2022: 20129) who highlighted that starchy staple foods appeared as the main source of food consumption.

Dietary diversity is crucial for evaluating nutritional quality and ensuring a varied food intake particularly for the elderly, who face the risk of nutritional imbalances and malnutrition from inadequate diets (Edmisten 2023: 106). Diets that lack variety and are high in refined grains are linked to a higher risk of overweight and obesity (Jakobsen, Brader and Bruun 2023: 10). Zhao *et al*. (2022: 1) highlighted that in low-income countries, impoverished communities often experience limited dietary diversity, relying predominantly on starchy staples while having minimal access to animal products and experiencing a scarcity of fresh fruits and vegetables.

The outcomes of this study showed a medium to high FGDS was observed across all seasons because households consumed food from five to ten food groups. Similarly, Gumede and Napier (2022: 20131) found a higher FGDS on food groups consumption

Indigenous leafy vegetable consumption varied in different seasons where a high intake was reported in summer and spring, while their intake declined in autumn and winter. Indigenous leafy vegetables intake contributed less dietary diversity in winter due to a lower number of seasonal ILVs available. This highlights that the variety of foods available in different seasons significantly influences dietary variety. Indigenous leafy vegetables were listed number 18 on the top 20 list of food consumed. The seasonal top 20 foods in summer measured by the 24-hour recall show that indigenous leafy vegetables were at number 11 (Table 4.20). This suggests that the availability of ILVs during summer improves their consumption and contributes to the diversity of the diets. However, these ILVs did not appear on the top 20 food lists from other seasons. Garekae and Shackleton (2020:14) highlighted that wild foods may help to diversify diets on a small scale, specifically within certain categories of food consumed, including vegetables, fruits, meat, and fish and seafood. Garekae and Shackleton (2020: 9) also revealed that foraging plays a crucial role in sustaining livelihoods and cultural practices, providing energy, a dietary diversity, health benefits, and a sense of cultural identity, among other things. Additionally, Tanimonure, Naziri, Codjoe and Ayanwale (2021: 10) highlighted the importance of consuming ILV as they promote dietary diversity within households.

The reported seasonal availability of ILVs in this study aligns with a study on indigenous plant foods conducted in Dikgale traditional village in Limpopo by Rankoana (2021: 4), who reported that indigenous leafy vegetables are available from September to March. Ntlanga *et al*. (2023: 115) determined that due to their availability, particularly throughout the summer, the consumption of ILVs declines during other seasons. The increased intake of ILVs during summer promotes the dietary diversity of the rural households' diets. It can be therefore concluded that seasonal food variety has a direct effect on the dietary diversity of rural households.

4.6.3.2 Macro and micronutrient intake

Nutritional screening and evaluation help maintain individual well-being and enhance quality of life (Reber, Gomes, Vasiloglou, Schuetz and Stanga 2019: 1). Dietary consumption is a pivotal element in assessing nutritional status (Govender *et al*. 2021: 18). Cherege and Stage (2020: 10) reported that availability and access to a sufficient quantity and a range of food are crucial factors influencing nutritional health. Macronutrients and micronutrients are vital for human health. Imbalances in nutrient intake can lead to undernutrition or overnutrition, both of which have detrimental effects on health (Fisberg, Batista, Prevdelli, Ferrari and Fisberg 2024: 12). Nutrient intake recommendations, varying by age and gender, were compared with DRIs such as RDAs and AIs (National Health Institute 2024). The nutrient imbalances characterised by a low and excessive intake of nutrients found in this study can be correlated with the findings of Gumede and Napier (2022: 20129) who found that there were nutrient imbalances in the participants' dietary intake.

a) Macronutrients distribution

The consistently low energy intake across all four seasons, well below the recommended DRIs of 12,881 kJ/day for sedentary men and 10,093 kJ/day for women, indicates a persistent inadequacy in the respondents' diets. This trend appears to stem from systemic issues, such as limited access to energy-dense foods, economic constraints, and inadequate meal frequency and portion sizes, rather than temporary seasonal fluctuations. Notably, this suggests that even with dietary diversity, total caloric intake may still be insufficient to meet basic metabolic and activity needs, potentially compromising overall health and well-being. These results align with Gumede and Napier (2022: 20128) who found that there was a low intake of energy among surveyed participants, and they did not meet the EER recommended intake.

Moreover, large quantities of food high in carbohydrates were consumed as no participants consumed less than 100% of the EAR for carbohydrates. As shown in Table 4.9, four out six food items consumed in each season were primarily carbohydrate sources. The FVS further confirmed the high intake of starchy staples, which contributed significantly to the overall carbohydrate consumption. Additionally, Tables 4.21, 4.22, and 4.23 listing the top 20 foods for summer, autumn, and winter, show that refined carbohydrate such as sugar were ranked on top of the FVS food lists, indicating their predominant role in the high carbohydrate intake. Other refined carbohydrate food sources such as white rice and steamed bread appeared on the top 20 food list across all seasons (see Tables 4.19-4.22). Clemente-Suarez *et al.* (2022: 1) highlighted that although refined carbohydrates offer energy, a high consumption can lead to health issues. The high intake of starchy staples aligns with a study on nutritional status assessment conducted in four rural communities in KZN by Govender *et al.* (2021: 16) who discovered that starchy staples like *phutu* are a predominant part of the diet in disadvantaged communities and that participants consumed large quantities of food containing carbohydrates. Similarly, Gumede and Napier (2022: 20129) identified that carbohydrates appeared as the main source of food consumption.

Although the South African FBDGs stipulate that consumers should make starchy foods the basis of most meals, the IoM (2006: 103) highlighted that the intake should not exceed the recommended 100g per day. According to Clemente-Suarez *et al.* (2022: 18), carbohydrate consumption should remain below 65% of total daily energy intake to fulfil energy needs while preserving other nutrients.

This study's results indicated that dietary intake of both fibre and protein was low across all age groups and seasons, as shown in Tables 4.13 to 4.18, with most participants consuming dietary fibre below 100% of the EAR. This aligns with findings from a study conducted in rural communities by Govender *et al.* (2021: 16), who reported households did not consume adequate amounts of dietary fibre in most age groups. Additionally, the low dietary fibre intake in this study is consistent with findings by Gumede and Napier (2022: 20139) who clarified that the surveyed participants consumed dietary fibre less than the recommended intake.

Joye (2020: 12) noted that although increased fibre intake may offer health benefits, many people consume insufficient amounts and fail to meet the recommended intake.

Conversely, the reported low protein intake in this study contradicts the Gumede and Napier (2022: 20139) observation of high protein intake. Moreover, the inadequate protein intake in this study contrasts with Govender *et al.* (2021: 16) who reported that large quantities of foods containing proteins were consumed and further stated that although protein intake was high, it was from plant sources compared to the low intake of animal protein sources across all age groups. This study's results, as depicted on Table 4.9, indicate that chicken (ranked number nine) and sugar beans (ranked number six) were prominent sources of protein. Health experts recommend a balanced diet rich in fruits, vegetables, whole grains, nuts, dairy, and lean proteins (Neufingerl and Eilander 2022: 1). *Sá,* Moreno and Carciofi (2020: 1) concurred that proteins are vital macronutrients.

b) Micronutrient intake

A well-balanced diet is essential for maintaining optimal levels of micronutrients. Achieving the right micronutrient levels is vital for preventing numerous chronic diseases (WHO 2020: para. 1 line 1). In this study, the dietary intake was analysed to indicate the intake of various vitamins and minerals. In the 19-30 male group, the results showed suboptimal intake of biotin, vitamin A, and vitamin C in young adult males, across all seasons. The majority of participants consumed these vitamins at less than 100% of the DRI. In contrast, vitamins E, B6 and B12, and thiamine were often consumed in excess. Riboflavin and folate intake were notably lower than the recommended levels for all seasons emphasizing the need to improve the intake. For females aged 19-30, this study's results highlighted deficiencies in biotin, vitamin A, and vitamin C in young females across all seasons with the majority consuming less than 100% of the DRI. Vitamin E, B6, thiamine, and niacin were often consumed at higher than recommended DRI levels. Folate and riboflavin intake remained a concern, as inadequate intake of these nutrients was reported in young adult females, reinforcing the need for dietary interventions.

In the 31-50 male group, vitamin A (except for spring), and vitamin C deficiencies were common in middle-aged males, with the majority consuming less than 100% of the DRI. Vitamin E, B6, thiamine, and niacin were consumed at higher levels than recommended. Riboflavin and folate intake remained a concern, as consistent under-consumption of these nutrients was noted indicating a need for targeted nutritional interventions. For females aged 31-50, this study's findings highlighted deficiencies in biotin, vitamin A (except spring), vitamin C, and folate among middle-aged females in most seasons, with most participants consuming less than 100% of the DRI. Vitamin E, vitamin B6, thiamine, and niacin were consumed in excess, while riboflavin intake was notably low, reflecting broader concerns in nutrient deficiency among this age group. The seasonal variation in vitamin B12 intake showed fluctuations in nutrient consumption throughout the year.

In the 51-70 male group, the low intake of biotin, vitamin A, vitamin C, riboflavin, and folate in this age group reported consistent deficiencies in these vitamins across seasons, with the majority consuming less than 100% of the recommended DRI. The seasonal variation in vitamin B6, thiamine, and vitamin B12 intake highlighted fluctuations in nutrient consumption over the whole year while Vitamin E intake was notably higher in non-summer seasons. Niacin intake was generally above the recommended levels but still showed some individuals falling short. For females aged 51-70, biotin, vitamin A (except summer), vitamin C, riboflavin, and folate intake were consistently below the recommended dietary intake across all seasons, with most participants consuming less than 100% of the DRI. There was a seasonal variation in vitamin B12 and vitamin E intake, showing fluctuations in nutrient consumption throughout the year.

The imbalances in the vitamin intake findings discussed above align with a study by Gumede and Napier (2022: 20129) who reported that some participants met DRIs nutrient recommendations, but some did not, while other participants exceeded the recommendations for nutrients such as niacin and vitamin B12. This study's results can be further aligned with Govender *et al* (2021: 16) who reported that more than half of participants showed an inadequate intake of riboflavin, niacin, folate, vitamin B12, vitamin A, vitamin C and vitamin E for most age groups. A study on food insecurity and diet quality conducted in Soweto by Kehoe (2021: 1634) indicated that diets of poor quality that are high in energy and low in micronutrients may lead to issues such as underweight and obesity. It is important to note that prolonged food insecurity can result in deficiencies of critical vitamins and minerals like Vitamin A, iron, and zinc (Awuchi, Igwe and Amagwula 2021: 1). Casterla-Forte *et al.* (2022: 9) further clarified that deficiencies in vitamins and minerals are common in both low and high socioeconomic communities.

The mineral intake young adults (19-30 years) revealed both consistent deficiencies and surpluses, with some seasonal variations. The mineral intake of young adults (19-30 years) consistently showed a complex pattern of widespread deficiencies alongside specific excesses, highlighting significant nutritional imbalances. Across both genders and all seasons, there was a concerning and persistent under-consumption of critical minerals including calcium, magnesium, selenium, and potassium. These chronic deficiencies collectively pose risks to bone health, immune function, and overall metabolic regulation, suggesting a systemic inadequacy in the dietary supply of these micronutrients.

In contrast, iron intake was notably high for both males and females across all seasons, often exceeding recommended levels. While essential, this consistent over-consumption warrants further investigation into dietary sources and potential long-term implications. Zinc intake exhibited seasonal variability for both genders, with suboptimal consumption frequently observed during cooler months, suggesting seasonal vulnerabilities in immune support. Phosphorus presented a mixed picture: generally adequate but with concerning seasonal fluctuations for some male participants and a pervasive, consistent under-consumption among females. This distinct gender difference in phosphorus adequacy points to a specific and chronic dietary challenge for young adult women.

The 31-50 age group showed deficiencies in calcium, magnesium, selenium, and potassium for middle-aged males. The higher iron intake was consistent across all seasons. Seasonal variation in zinc intake was noted with higher intake in spring and autumn. The high phosphorus intake was often observed across all seasons. For the 31-50 female age group, the results showed consistent deficiencies in calcium, magnesium, selenium, and potassium among women in this age group. Iron intake was higher than the recommended DRI, and Zinc intake also had a higher consumption during all seasons. The seasonal variation in phosphorus intake, with higher intake in spring and autumn, suggested nutrient intake fluctuations due to seasonal food availability.

This study's findings indicated deficiencies in calcium, selenium, and potassium among middle-aged and older men (51-70 males). The higher iron intake indicated that men in this age group often meet or exceed their iron requirements. Zinc intake was slightly higher than the recommended DRIs for a minority of participants, but a majority did not meet the DRI. The seasonal variation in magnesium and phosphorus intake showed that the intake was low during certain seasons. For females aged 51-70, calcium, magnesium, potassium, and selenium intake were low across all seasons, with most participants consuming less than 100% of the recommended DRI. Iron, zinc and phosphorus intake was consistently high across all seasons, with few to no participants consuming less than the recommended DRI. These results align with a study by Govender *et al.* (2021: 16) who reported a low intake of magnesium. The high intake of zinc and phosphorus is contrary to results by Govender *et al.* (2021: 16) who reported a low intake for zinc and phosphorus for most age groups. The minerals result in this study showed consistent high intake of iron for most age groups. In contrast, Govender *et al.* (2021: 17) reported an inadequate intake of iron. As mentioned above, this study found a low intake of magnesium and calcium, and these results link with a study by Gumede and Napier (2022: 20129) who reported a low intake of calcium and imbalances in the magnesium and phosphorus intake. Gumede and Napier (2022: 20129) highlighted that the primary source of thiamine, vitamin B6, iron, and zinc in the diet came from the starchy staple food group, as grains were consumed in significant amounts. In addition, various other food groups contributed a notable quantity of additional vitamins and minerals (Gumede and Napier 2022: 20129).

The consumption of ILVs such as amaranths, black nightshade, and pumpkin leaves may have contributed to the intake of iron, zinc, phosphorus, and magnesium, although there were intake imbalances when comparing across seasons in all age groups. Van Jaarsveld, Faber and van Heerden (2012: 233) concur that ILVs such as pumpkin leaves, black nightshade leaves, and amaranth leaves are used for their leaves, which provide vitamin A, phosphorus, zinc, and iron. *Amasi (maas)* is rich in calcium and appears as number 15 as depicted on the top 20 list of foods consumed across all seasons (Table 4.9). However, the low calcium intake reported in different seasons may be due to limited access to dairy products, while low potassium, selenium, and folate could be attributed to a lack of diverse food sources. A limited variety of the foods on the Top 20 food items were sources of iron. These include chicken, processed meat (polony and sausages, which contain heme-iron) (Table 4.9), ILVs (contain non-heme iron), other vegetables (cabbage), and dried beans explaining the high iron intake in different age groups.

Overall, the results of this study imply that rural households, which often grapple with a limited income, tend to have repetitive and inadequate diets that lack variety of vegetables, fruits, and animal-based foods. These dietary diversity trends uncover substantial challenges associated with nutrient intake imbalances where some nutrients were in excess, and others were deficient. Lopes *et al.* (2023: 11) linked poor dietary diversity and micronutrient deficiencies to food insecurity. The imbalances in the nutrient intake found in this study stem from various factors, including food insecurity, limited dietary diversity, financial constraints, poverty, inadequate access to nutrition education, unfavourable geographical factors, and dependence on staple foods. Modjadji and Madiba (2019: 1) noted that families with low socio-economic status often consumed unbalanced diets high in starchy staples that promote obesity. Similarly, Simelane *et al.* (2023: 126) found a higher occurrence of obesity in KZN, further corroborating this observation. The observed imbalances in nutrient consumption in rural households underline the necessity for improved dietary diversity and nutrition education. Including seasonal Indigenous leafy vegetables could improve the nutrient density of diets and tackle malnutrition, especially considering the significant occurrence of under-overnutrition in rural communities (Govender *et al.* 2017: 16).

Takaidza (2023: 15) highlighted that ILVs provide notable nutritional advantages that can assist in improving the nutrient quality of meals for rural households. Additionally, ILVs can promote sustainable diets and enhance agricultural practices, rendering them an important asset for food systems (Mudau, Chimonyo, Modi and Mabhaudhi 2022: 26).

4.6.4 Coping strategies data

The Food and Agriculture Organization, European Union, CIRAD, and DSI-NRF Centre of Excellence in Food Security (CoE-FS) (2022: 13) reported that South Africa produces enough food for everyone. A key challenge for South African rural communities is food insecurity and limited access to high-quality food (Mbhenyane and Tambe 2024: 18).

According to the study results, it was revealed that rural households employ various food coping strategies when faced with insufficient funds for nutritious food. A lower score on these strategies would have indicated less food insecurity and a higher score would have indicated a higher prevalence of food insecurity. This study revealed a lower score on household coping strategies which indicated a lower prevalence of food insecurity recorded by the households. The overall weighting resulted in eight strategies which included: relying on less preferred and less expensive foods, borrowing food, relying on help from a friend or relative, purchasing food on credit, gathering wild food, hunting, or harvesting immature crops, consuming seed stock held for next season, limiting portion size at mealtimes, reducing the number of meals eaten in a day, and making beads and selling them. The most common strategy used across all seasons was relying on less preferred or less expensive foods because when a household has a restricted income, people tend to focus on affordable alternatives to ensure that they can provide enough meals. The strategy 'consume stock seed held for the next season' was the least utilised coping strategy during spring, summer, and autumn. These options, while not always the most favoured, aided in maximizing limited resources and fulfilling essential nutritional requirements during periods of economic strain or unpredictability. Similarly, a study on adapting coping strategies to measure food insecurity conducted by Drysdale, Moshabela and Bob (2019: 388) revealed that rural communities in the iLembe district use various strategies such as buying less preferred foods, purchasing food on credit, and consuming seed stock, often relying on natural resources for better food access. Militao *et al.* (2022: 1) reported that less preferred and less nutritious foods are consumed during low-income periods in Mozambique. Additionally, Amoah and Simatele (2021: 1) observed that Eastern Cape communities use various coping strategies to ensure food availability.

Food security in South Africa is influenced by various factors, including climate change and socio-economic disparities. Coping strategies, such as reducing the number of meals per day, and relying on less expensive foods, have been recognised as responses to food insecurity (Ndlovu and Zenda 2024: 173), illustrating the socio-economic difficulties encountered by rural populations. Akinsemolu, Onyeaka, and Tamasiga (2024: 5) stress that climate change has a substantial effect on global food security, while Rusere *et al.* (2024: 164) point out that socio-economic inequalities are major factors contributing to household food insecurity. The research indicates that rural households, typically from lower socio-economic backgrounds, have high unemployment rates leading to nutrition deficiencies, which exacerbate food insecurity. Simelane *et al.* (2023: 81) found that in Kwazulu-Natal, only 30% of households were food secure, whereas the remainder faced varying levels of food insecurity: 24% were mildly insecure, 29% moderately insecure, and 17% severely insecure. As a result, rural households frequently resort to indigenous leafy vegetables as a strategy to cope with food insecurity, employing techniques such as harvesting immature crops when they are accessible (Ndlovu and Zenda 2024: 172).

4.7 Conclusion

The findings discussed in this chapter underscore the significance of ILVs in the dietary patterns of the community. Although their seasonal availability poses a challenge, the residents of Mangangeni village continue to incorporate ILVs into their diverse diets. In this context, dietary diversity encompasses not just the inclusion of various food groups but also the range of food items within those groups. Nonetheless, the research revealed an occurrence of nutrient imbalances, which raises serious concerns regarding the dietary intake of the community. To address food insecurity during tough economic periods, participants indicated that they resort to multiple food coping strategies. Promoting nutrition education has the potential to empower the community to make more informed and balanced dietary decisions, thereby improving their overall food security.

CHAPTER FIVE CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The primary aim of this research was to investigate the contribution of the seasonal consumption of Indigenous Leafy Vegetables (ILVs) to food security in rural households, with a focus on a rural village at Mangangeni, Ndwedwe. This chapter will outline the limitations of the study, provide a summary of the main findings, and draw conclusions based on the analysis of the collected data. Furthermore, recommendations will be presented to enhance the perception, cultivation, sourcing, and consumption of ILVs to improve the food security and nutritional well-being of rural households.

5.2 Limitations

- A significant limitation of this research was the seasonal aspect of data gathering, which required visiting residences four times a year. As the only researcher performing fieldwork in a rural setting, it was crucial to ensure participant retention. To reduce the chance of dropouts, open communication was established with households from the initial visit, the significance of the study was clarified, and flexible scheduling options for the repeat visits were offered. In instances where participants were not available, efforts were made to rearrange visits to guarantee consistent data collection throughout the research.

- The coping strategies data had to be re-collected because the original questionnaire did not accurately capture the severity scores, or specific coping strategies used by the community over the four seasons of 2023-2024. This re-collection of data occurred at a time different to when the initial data was gathered. This timing discrepancy may have impacted the comparability of the results. To address this issue, the questionnaire was reviewed and adapted according to the Coping Strategy Index guidelines document (Maxwell *et al.* 2003). The researcher ensured that the re-collection of data occurred seasonally to align as closely as possible with the seasonal conditions experienced by the community at that time.

5.3 Main findings

This section highlights the significant findings of the study, combining various socio-demographic elements, perceptions, and food security practices to give a thorough overview of how rural families in South Africa approach food security. The connection between socio-economic status, living environments, gender, family dynamics, and the use of ILVs reveals crucial information about dietary behaviours and coping strategies.

5.3.1 Literature

The literature in this study clearly illustrates the contribution of ILVs to food security. The persisting food insecurity in rural households and underutilisation of ILVs is a problem in rural communities in South Africa. Food insecurity is a big threat to rural communities due to socio-economic disparities. Gaining insight into how people perceive food and their experiences with food insecurity can inform the development of culturally relevant and community-centered food security initiatives. The challenges of accessing food security in sub-Saharan Africa are highlighted by the various coping strategies employed by households facing food insecurity. To reduce food insecurity on a global scale, it is essential to focus resources on promoting nutritious food and agricultural practices while implementing effective measures to address climate change. Indigenous leafy vegetables are crucial for household food security, particularly in economically disadvantaged rural communities. A lack of awareness about their nutritional value and preparation methods, along with the belief that they are of lower quality compared to exotic vegetables, prevents their widespread adoption. Increased cultivation of a larger variety of indigenous leafy vegetables can significantly enhance food security for families.

5.3.2 Socio-demographic indicators and their impact on food practices

The study indicated that socio-demographic elements, including socio-economic status, living conditions and family dynamics significantly affected practices related to food security. For example, households from a low socio-economic background often relied primarily on diets rich in carbohydrates. This dependency was exacerbated by unemployment and the resultant low household income, which limited access to a variety of foods.

Additionally, family dynamics were found to be crucial in determining food security. Many participants resided in extended family units, commonly encompassing children and grandchildren. This family set-up was facilitated by resource-sharing, which influenced both the types of foods consumed and how frequently ILVs were eaten. Gender roles were also relevant, as women were typically in charge of managing household food and showed a higher inclination to grow and prepare ILVs because of their perceived cost-effectiveness and nutritional value.

5.3.3 Indigenous leafy vegetables consumption

The consumption of ILVs positively aligned with the sociodemographic data of the participants. The findings indicated a favourable perception of the cultivation and consumption of ILVs. This positive outlook correlates with the inherent benefits provided by ILVs, which include their affordability, easy accessibility, simple method of preparation, nutrient-rich profile, and energy-boosting properties. In terms of awareness, all participants in this study expressed familiarity with ILVs, noting their prevalence in the local area. It was observed that ILVs primarily grow or are grown during the spring and summer months, hence there was a higher consumption of ILVs during these two seasons. Results showed that most individuals cultivated pumpkins in October and hence there was a high level of pumpkin leaves consumption during the summer season. Participants reported obtaining these ILVs from both wild sources and cultivated regions, with the cultivated varieties being grown in private farms, backyards, or home gardens. The study revealed that six types of ILVs are well-known and consumed in the region, with a significant portion of the participants indicating that they consume ILVs at least once or twice a week.

5.3.4 Dietary diversity and dietary intake

The study's findings identified the overall range of individual food items eaten by all participants over seven days. While the participants' diet included a satisfactory variety of food groups, they did not consume sufficient amounts to meet the essential levels of individual nutrient intake. For instance, participants consumed the same food item repeatedly within a specific food category rather than incorporating a range of foods from that category. The results indicated a low intake of fruits and vegetables. Overall, the findings suggested that this community's diet was predominantly carbohydrate-based, heavily reliant on starchy staple foods, and demonstrated an inadequate consumption of animal products such as eggs and dairy.

The 24-hour recall nutrient analysis confirmed the FFQ results, showing high carbohydrate consumption and a varied intake of micronutrients, with both an excess and a deficiency in macro and micronutrients.

5.3.5 Food coping strategies

The study's results showed that households in this rural community use eight distinct strategies when facing food shortages. Across all seasons, the most frequently used approach was to rely on less desirable or cheaper food options. In contrast, consuming seed stocks was the least common strategy during spring, summer and autumn. This suggests that these households experience food insecurity due to the limited access of a variety of food. Consequently, their diets predominantly consisted of carbohydrates such as *phuthu* (maize crumbly porridge), maize soft porridge, and rice. The study confirmed that lower income levels resulted in minimal dietary diversity, contributing to inadequate dietary intake.

5.4 Conclusion

Socio-demographic factors have played a significant role in influencing the use of ILVs, the diversity of diets, and the food coping strategies in rural families. Examining these factors underscores the intricate relationship between economic circumstances, family structures, and food security measures, providing important perspectives for developing community-focused food security initiatives. The research indicated that rural households utilise ILVs, with half of the respondents stating they eat ILVs twice weekly when they are available. However, these vegetables can only be obtained during specific seasons, with the highest intake occurring in the spring and summer months. Although respondents recognize the nutritional value of ILVs, there are few organised initiatives to grow them, particularly in the off-season, which worsens food insecurity at these times of the year. The high unemployment rate contributed to insufficient dietary intake and limited diversity. While a wide variety of food from different groups was consumed, there was a lack of diversity within those groups. Most participants' dietary intake levels for various nutrients were either below or above the DRIs, indicating imbalances in their nutrient consumption. Regarding coping mechanisms, financial constraints forced participants to depend on less expensive and less preferred food options, which further intensified food insecurity. This underscores the necessity for increased efforts to promote and advocate for ILVs as a sustainable nutritional resource, especially during times when other food options might be limited.

5.5 Recommendations

The literature indicates that most consumers of ILVs reside in rural areas and it is crucial to educate these households about the nutritional value and benefits of ILVs. This education can contribute to improving the overall nutritional status of this rural population. Evidence shows that nutrient intake among respondents is often either insufficient or excessive compared to the DRIs, highlighting the need for comprehensive nutrition initiatives in rural areas.

To combat hunger and enhance food security, it is seen as essential to disseminate knowledge about ILVs nation-wide. Understanding the nutritional advantages of ILVs can help foster positive perceptions among rural communities, emphasizing the benefits of incorporating ILVs into their diets. Addressing negative perceptions, such as the belief that ILVs are only suitable for the poor or low-income individuals, is vital to increasing their consumption.

Promoting sustainable agriculture is beneficial for rural communities, as they rely heavily on food produced by small-scale farmers. Therefore, encouraging both rural and urban communities to implement programmes that support small-scale farming will be advantageous. These programmes can help ensure a steady supply of nutritious ILVs, contributing to better health outcomes and food security.

5.5.1 Recommendations to policymakers

- **Government initiatives:** Sustainability and quality: A national certification initiative for ILVs that allows farmers and sellers to obtain certification for nutrient-rich and sustainably cultivated indigenous produce could be established. This programme could enhance quality assurance, build consumer confidence, and expand market access. Additionally, it could include educational campaigns highlighting the environmental benefits of growing ILVs, such as their resilience and low resource demands. This initiative would promote a wider adoption of these nutrient-dense foods.
- **Integrated nutrition programmes:** To tackle nutritional issues, the Department of Health's initial INP targeted women and children, especially in rural regions. When formulating nutrition strategies to combat both overnutrition and undernutrition, INP administrators should customise these approaches to meet the particular requirements of rural populations, where access to a variety of nutritious foods may be restricted. The focus should be on boosting the availability of nutrient-rich foods, such as ILVs. Furthermore, the INPs should strengthen initiatives to increase awareness of, and improve access to these foods, and promote nutrition education programmes within the community. Promoting the cultivation and consumption of ILVs could provide a sustainable, locally-sourced nutritional option to help enhance overall dietary habits in these regions.
- **Non-government organizations**

  Non-governmental organizations (NGOs) are generally acknowledged as an important institutional resource for revitalising communities, motivating individuals, and effectively executing social welfare programmes at the community level. They ought to promote the growth of local markets and help residents achieve access to a range of affordable, nutritious foods. Furthermore, addressing food insecurity necessitates teaching communities about healthy dietary habits and nutrition and NGOs are well positioned to do this.

5.5.2 Recommendations for agricultural interventions

A National Agricultural Mentorship and Innovation Initiative for smallholder farmers in agriculture could be established as it will address the difficulties encountered by smallholder farmers in South Africa. This initiative could aim to improve the skills, knowledge, and entrepreneurial abilities of smallholder farmers, while promoting innovation and providing access to emerging agricultural markets. Promote ILV cultivation in home gardens, strengthening local markets, and integrating ILVs into school feeding programmes.

5.5.3 Recommendations for nutrition education

To address the prevalence of micronutrient deficiencies, it is essential to implement a sustainable nutrition education programme in rural communities. This programme should focus on helping households make healthy food choices, enhancing their dietary patterns, food habits, food preparation, and meal planning abilities within constrained household budgets.

To ensure the effectiveness and rapid dissemination of nutrition information, even in remote areas, the programme should utilise a variety of communication methods. These could include posters, practical sessions, radio broadcasts, and television advertisements or educational programmes. By reinforcing nutrition education across different target groups across multiple media, the programme could effectively reach and benefit a wider audience.

Launch community-focused educational initiatives, potentially utilising local health clinics or community centres, to raise awareness about the nutritional benefits of various ILVs. These initiatives should also incorporate hands-on cooking demonstrations showcasing a variety of ILV-based dishes, addressing negative perceptions and gaps in cooking knowledge.

Develop initiatives that engage young people in cultivating ILV and transferring traditional knowledge, ensuring these vital practices are preserved for future generations.

5.6 Recommendations for future research

- **Community-driven strategies and assistance for the elderly:** Future studies should investigate targeted community-driven methods that could improve food security and nutrition for the elderly. This includes examining the impact of local food-sharing initiatives, community gardens, and nutrition education initiatives specifically designed for the elderly in rural areas. Research should also evaluate how community support networks and systems, like caregiver programmes or local volunteer efforts, can alleviate the nutritional issues experienced by rural communities.

- **Possible future interventions:** Current research on key topics such as sustainable agricultural practices, climate change, and market access for smallholder farmers is insufficient. To address these knowledge gaps and build a strong evidence base, it's seen as essential to integrate research-driven recommendations into policymaking. Targeted research in these under-explored areas is essential for achieving meaningful progress in the agricultural sector, particularly for smallholder farmers.

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ANNEXURES

Annexure A: Sociodemographic Questionnaire

Food and Nutrition Consumer Sciences

SOCIO-DEMOGRAPHIC QUESTIONNAIRE

This questionnaire covers certain aspects of your life, including work and personal details. The answers to these questions will be kept strictly confidential and the information will not be identifiable on any reports or publications. Please answer all questions by marking the correct answer with **X,** except where otherwise indicated.

1. **GENERAL INFORMATION.**

2. Respondent number:		

For office use

Please note: ALL INFORMATION WILL REMAIN CONFIDENTIAL

For any queries, please feel free to contact me: Ayanda Hlekwane @0710042788 or ayandahlekwane@gmail.com or Heleen Grobbelaar @ heleeng@dut.ac.za or contact 0313732328.

Time taken (from)………………… (to)................................Month………….

District: **ILembe**

Municipality: **Ndwedwe Municipality.**

Induna: **Sanele Shortman Shozi**

Municipal Ward: **Ward 19**

Traditional Sub- ward: **Mangangeni Area Tribal Authority**

2. PERSONAL INFORMATION

2.1 Your role in the family

Mother	Grandmother	Father	Grandfather	Other, specify……………………..

2.2 When were you born?**..**

2.3 How old are you? years

2.4 Gender:

Male		Female	

2.5 what is your marital status?

1 Single	
2 Married	
3 Divorced	
4 Widowed	
5 Never married	
Other?Specify….	

3. ACCOMMODATION AND FAMILY COMPOSITION

3.1 Do you live in?

1. Rural village	
3. Township	

3.2 How are you currently living?

Living with relatives	
Living with friends	
Squatter home	
Rented house/	
Own house	
Other, specify………………………	

3.3 Do other people live in the house with you?

Yes		No	

3.4 How many people are in your household?

1	2	3	4	5	6	7	8	9	1	10

3.4.1 Are there children living in your household? Yes/No…………

3.5 How many children live in the household?

Male		Female	

3.6 In what type of house are you staying?

Brick	Clay	Grass	Wood	Zinc/shack

3.7 How many rooms does your house have?

1 room	2 rooms	3 rooms	4 room	>5 rooms

3.8 Are there other houses/shacks within the same yard of the main house?

Yes	No

3.9 Do you have the following facilities/ services at home?

3.9.1 Water

Tap in the house	
Tap outside the house (in yard)	

Borehole	
Spring / river / dam water	
Fetch water from elsewhere	

3.9.2 Toilet facilities

None	
Pit latrine	
Flush / sewage	
Bucket system	
Other, specify………………………	

3.9.3

Access to electricity	Yes	No

4. **WORK STATUS AND INCOME**

4.1. Are you currently employed?

Yes	No

If YES, go to Question 4.5.

4.2. If NO, how would you describe your current status (tick one box only)?

Unemployed	Retired	Housewife	Student	Other, specify…………………

4.3. Are you actively looking for paid employment at the moment?

Yes	No

4.4. How long have you been unemployed?

< 6 months	6-12 months	1-3 years	> 3 years

4.5. If YES (question 4.1) is your current job a:

Permanent position	Temporary position	Fixed term contract	Other, specify…………………..

4.6. Are you doing part time jobs as a second job on weekends and school vacations?

Yes	No

4.7 What is the exact title of your current job?
(Including self-employed)

4.8. What is the total income in the household per month?

R0- R500	R501-R1000	R1001-R1500	R1501-R2000	R2001-R2500	R2501-R3000
R3001-R3500	R3501-R4000	R4001-R4500	R4501-R5000	R5001-R6000	R6001- R7000
R7001- R8000	R8001- R9000	R9001- R10 000	>R10 000		

4.9 What type of transport do you use to get around?

Taxi	
Bus	
Train	
Own car	
Bicycle/ Motorbike	
Other Specify	

5 EDUCATION AND LANGUAGE

5.1. What is your highest education level?

None	Primary School	Standard 8	Standard 10	College/FET	Other post school

5.2 What language is spoken mostly in the house?

Zulu	Xhosa	English	Afrikaans	Other, specify……………………………

Food practices in the household

Tick one block for every question:	Father	Mother	Sibling	Grandma	Grandpa	Aunt	Uncle	Cousin	Friend	Other
5.10 Who is mainly responsible for food preparation in the house?										
5.11 Who decides on what type of food is bought for the household?										
5.12 Who is mainly responsible for feeding/serving the children?										
5.13 Who is the head of this household?										
5.14 Who decides how much is spent on food?										

5.15 How many meals do you eat per day?

0	1	2	3	> 3

5.16 Where do you eat most of your meals?

Home	Friends	Work	School	Other, specify……………………

6. ASSETS

6.1 Does your home have the following items?

	Yes
Electrical stove	
Gas stove	
Primus or paraffin stove	
Microwave	

Hot plate	
Radio	
Television	
Refrigerator	
Freezer	
Telephone/ Cell phone	
Bed with mattress	
Mattress only	
Lounge suite	
Dining room suite	
Electrical iron	
Electrical, kettle	
Car	
Bicycle	
Motorbike	

6.2 What type of fuel do you usually use for food preparation?

Wood fire	Paraffin	Electricity	Gas	Coal/Charcoal	Other, specify……………

Thank you very much for your time.

Section B: Indigenous leafy vegetables survey questionnaire.

Indigenous Leafy vegetables Awareness, perception, knowledge and accessibility.

1. Do you know what indigenous vegetables are? Yes/No……………

1.1 Please list/state what you understand/perceive as indigenous leafy vegetables……………………

2. Do you have access to Indigenous leafy vegetables? Yes/No…………

3. Do you eat indigenous leafy vegetables?..............................

5. If you don't eat indigenous leafy vegetables State the reason…………………………..

1	**2**	**3**	**4**	**5**
Dislike them	**Cannot get them (not available)**	**Cannot cook them**	**Do not know them**	**other**

1. If yes, which ones do you eat?........... Please state the reason.

ILVs	Please Tick	Reason
Uqadolo (black jack)		
Ugabolo (amaranth)		
Intshungu (Balsma pear)		
Izintanga (pumpkin leaves		
Isishukweyana (black nighshade)		
Imithebe (Colocasia esculenta)		
Other? Specify...................		

7. If yes, which part do you eat?

Name of vegetable	**Leaves**	**Stem**	**Roots**
Uqadolo			
Ugabolo			
Intshungu			

Izintanga			
Isishukweyana			
Imithebe			
Other:			

8. How do you obtain indigenous leafy vegetables? Please indicate on the table below. Please include the frequency per day/week/month.

Response	Frequency
Buy	
Collect	
Grow	
Other:	

9. If collected?

Response	Please tick
Own garden	
Wild	
Wetlands	
Field	
Roadside	
Other:	

9.1 If you grow indigenous leafy vegetables, where do you grow them?

Response	**Please tick**
Backyard	
Own/home garden	

10. Do you have a home garden? Yes/No...........................

11. Which ILVS do you cultivate?

Indigenous leafy vegetables	**Cultivated (please tick)**	**Month**
1. uqadolo		
2. ugabolo		
3. intshungu		
4. izintanga		
5. Noshukela		
6. Imithebe		

Other (specify) ____

12. List Vegetables collected from the wild

……………………

…………………..

…………………..

……………………

…………………….

13. If purchased, from where?

1 Supermarket	
2 Local market	
3 Roadside vendors	
4 Neighbours.	
Other:	

14. How often do you collect and cook these vegetables per week?

Indigenous Foods	Once	Twice	Thrice	Other
1.uqadolo				
2. ugabolo				
3. intshungu				
4. izintanga				
5. Noshukela				
6. Imithebe				
Other? Specify				

15. Who is responsible for cooking and collection these vegetables at home? Please tick.

	Cooking	**Collection**
1. Grandmother		
2. Mother		
3. Sister		
4. Aunt		
5. Brother		
6. Father		
7. Uncle		
Other:		

16. What do you serve indigenous leafy vegetables with?

	Please tick
Rice	
Phuthu (Crumbly porridge)	
Amadumbe	
Batata	
Steam bread (Ujeqe, Isinkwa sombila)	
Potatoes	
Other? Specify………..	

17. Please indicate your ILVs preparation method

	Please tick
Boiling	
Sautéing/Frying	
Simmering	
Other?............	

Section C: Questions regarding perceptions of indigenous vegetables perceptions: please indicate Yes/No.

	Yes/No
Do you perceive ILVs as healthy?...........	
Do you think they contain more nutrients?...........	
Are ILVs cheaper than other vegetables?..................................	
Do ILVs taste good?...............................	
Are ILVs easily accessible?....................	
Do ILVs prevent illnesses?...................	
Are ILVs easy to prepare?..........................	
Do ILVs cook faster?.................................	
Do ILVs gives energy and strength to live longer?....................	

Annexure A

Food and Nutrition Consumer Sciences

IMBUZO YOCWANINGO

Lolu luhla lwemibuzo lubandakanya ezinye izinto zempilo yakho ukuhlanganisa imininingwane yakho. Izimpendulo zakho zizoba imfihlo futhi kuzoqinisekiswa ukuba akekho omunye umuntu oba nemvume yokuzibona kuyo yonke imininingwane eshicilelwe. Ngicela uphendule yonke imibuzo ngokufaka ugxa X lapho uyalelwe khona.

Imininingwane ejwayelekile

Inombolo yophendulayo:		

Isikhala se hhovisi

Please note: ALL INFORMATION WILL REMAIN CONFIDENTIAL

Yazi lokhu: Yonke iminingwane oyinikezele iyimfihlo:

Uma unemibuzo, cela ushayele u Ayanda hlekwane ku @0710042788 noma umthinte nge meyili ku ayandahlekwane@gmail.com. Noma uxhumane no Dkt Heleen Grobellar ku @ heleeng@dut.ac.za noma ufonele u 0313732328.

isikhathi………………… usuku..............................unyaka…………..inyanga

Umkhandlu: **ILembe**

UMaspala: **Ndwedwe Municipality.**

Induna: **Sanele Shortman Shozi**

Iwadi: **Ward 19**

Isigodi: **Mangangeni Area Tribal Authority**

2. IMININGWANE YAKHO
2.1. isikhundla sakho emndenini

Mama	Ugogo	Ubaba	Umkhulu	Okunye? cacisa……………………..

2.2 Uzalelwe kuphi?..
2.3 Uneminyaka emingaki?

2.4 Ubulili bakho:

Isilisa		Isifazane	

2.5 Ukusiphi isimo kulesi ezingezansi?

1 Awunamlingani	
2 Ushadile	
3 Uhlukanisile	
4 Umfelokazi	
5.awukaze wagcagca	
Okunye?Chaza….	

4. Indawo/ isimo senhlalo

3.2 Uhlala kuphi?

1. Emaphandleni	
4. Edolobheni	

3.2 uhlala nobani futhi endaweni ekanjani?

Nezihlobo	
Nomngani	
Ikamu	
emqashweni	
Emzini wakho/Ekhaya	
Okunye?Chaza………………………. .	

3.3 Kungabe uhlala nabanye abantu endlini?

Yebo		Cha	

3.4 Bangaki abantu ohlala nabo?

1	2	3	4	5	6	7	8	9	1	10

3.4.1 Kungabe zikhona izingane kwakho? Yebo noma Cha…………

3.5 Zingaki izingane ezikhona kwakho?

Izinsizwa		Izintombi	

3.6 Iuhlala endlini yakhiwe kanjani?

Izitin a	Udaka/ubumba	Utshani	Izibonda	emkhukhwini

3.7 Mangaki amagumbi kwakho?

Linye	Mabili	Mathathu	Mane	>ayisihlanu nangaphezulu

3.8 Zikhona ezinye izindlu/imkhukhu egcekeni?

Yebo	Cha

3.9 unakho lokhu okulandelayo kwakho?

3.9.1 Amanzi

Umpompi endlini	
Umpompi egcekeni	
Isiphethu	
Amanzi omvula noma emvula	
Uwalanda kwenye indawo amanzi? Chaza	

3.9.2 Izindlu zangasese

Azikho	
Elimbiwayo lomgodi	
Elishawayo	
Elebhakede	
Okunye? Chaza………………………	

3.9.3

Ninawo ugesi	Yebo	Cha

5. **Umsebenzi ne Holo.**

5.1. Uyasebenza?

Yebo	Cha

Uma impendulo kungu Yebo iya kumbuzo 4.5.

5.2. Uma impendulo kungu Cha, chaza isimo sakho

Awusebenzi	Umhlalaphansi	Mama wekhaya	Mfundi	Okunye? Chaza…………………

5.3. Ngabe ufuna umsebenzi ngentshisekelo nogqozi?

Yebo	Cha

5.4. Singakanani iskhathi usebenza?

< ngaphasi kwezinyanga eziyi-6	Izinyanga eziyi-6 kuya kweziyi-12	Unyaka o-1 kuya kwemi-3	Ngaphezu kweminyaka emi-3

5.5. Uma impendulo yakho bekungu yebo ku mbuzo 4.1 usebenza kanjani:

unomphela	Iskhashana	Isikhathi esikaliwe	Okunye? Chaza…………………..

5.6. Khona eminye imisebenzi osebenza kuyo?

Yebo	Cha

4.8 Isiphi iskhundla sakho emsebenzini)

4.8. kuloluhla olungezansi khetha umholo wasendlini wenyanga?

R0- R500	R501-R1000	R1001-R1500	R1501-R2000	R2001-R2500	R2501-R3000
R3001-R3500	R3501-R4000	R4001-R4500	R4501-R5000	R5001-R6000	R6001- R7000
R7001- R8000	R8001- R9000	R9001- R10 000	>R10 000		

4.9 Usebenzisa luphi uhlobo lwezithuthi?

Amatekisi	
Ibhasi	
Stimela	
Moto yakho	
Bhayisekili/Sthuthuthu	
Okunye? Chaza	

5 Ezemfundo no Lwimi

5.2. Ugcine kabana eskoleni?

Angiyanga	Amazinga aphansi	Ebangeni lesi-8	Matikuletsheni	Kolishi/Enyuvesi	Okunye?chaza

5.2 nikhuluma luphi ulimi endlini?

Zulu	Xhosa	English	Afrikaans	Okunye?chaza……………………………

Ezokudla zasendlini

Faka u gxa umbuzo ngamunye	Ubaba	Umama	Mfowethu /Dade	Ugogo	Mkhulu	Babekazi	malume	Mzala	Mngani	Omunye
5.10 Ubani ophekayo endlini?										
5.11 ubani oshoyo ukuthi kuthengwe kuphi ukudla ekhaya?										
5.12 Ubani ofunza abantwana?										
5.13 Ubani inhloko yomndeni?										
5.14 Ubani othatha isinqumo ngemali esetshenziswa ekudleni?										

5.15 Udla kangaki ngelanga?

lutho	kanye	kabili	kathathu	Kane nangaphezulu

5.16 ikuphi lapho udla khona kaningi?

Ekhaya	Kubangani	Msebenzini	Skoleni	Okunye? Chaza……

6. Amafa

6.1 Ikhaya lakho linako okulandelayo? Khetha okukhona.

	Yebo
Istofu sikagesi	
Stofu se gesi	
Stofu sa phalafini	

Microwave	
Hot plate	
umsakazo	
Umabonakude	
Isiqandisi	
ifuliji	
Umkahalekhukhwini	
umbhede	
Mantilasi	
Osofa	
Izihlalu netafula	
Ayina lesnimbi kagesi	
Ketelo lika gesi	
Imoto	
Bhayisekile	
Sthuthuthu	

6.2 Nipheka ngani?

Izinkuni	Phalafini	ugesi	Igesi	Amalahle	Okunye? Chaza……………

Siyabonga.

Ingxenye yesibili yemibuzo: Imibuzo ngemifino yomdabu

Ulwazi, nemibono kanye nokutholakala kwemifino yomdabu

1. Uyazi ukuthi iyini imifino yomdabu? Yebo noma cha……………

1.1 Isho ukuthi yini oyaziyo ngemifino yomdabu……………………

2. Iyatholakala endaweni yangakini? Yebo noma cha…………

3. Uyayidla imifino yomdabu? Yebo noma cha..............................

5. uma ungayidli kungani?…………………………..

1	**2**	**3**	**4**	**5**
awithandi	**Ayitholakali**	**Angikwazi ukuyipheka**	**Angiyazi**	**Okunye**

2. Uma uyidla, udla yiphi? Kungani uyidla?

ILVs	Faka ugxa	isizathu

Uqadolo (black jack)		
Ugabolo (amaranth)		
Intshungu (Balsma pear)		
Izintanga (pumpkin leaves		
Isishukweyana (black nighshade)		
Imithebe (Colocasia esculenta)		
Other? Specify..................		

7. uma uyidla, udla yiphi ingxenye?

Igama lemfino	amahlamvu	Isiqu	Izimpande
Uqadolo			
Ugabolo			
Intshungu			
Izintanga			
Isishukweyana			
Imithebe			
Other:			

8. How do you obtain indigenous leafy vegetables? Please indicate on the table below. Please include the frequency per day/week/month.

Uyithola kanjani imifino yomdabu? Isho uyidla kangaki?

Impendulo	Kaningi kangaki
Iyathengwa	
Iyakhiwa	
Iyatshalwa	
Okunye	

9. uma uyikha uyikha kuphi cacisa?

Impendulo	Faka ugxa
Engadini	
Endle	
Emfuleni	
Ensimini	
Eceleni komgwaqo	
Okunye	

9.1 uyitshala kuphi?

Impendulo	Faka ugxa
Emva kwendlu	
Ensimini/engadini	

10. Unayo ingadi ekhaya?..........................

11. Iyiphi imifino oyitshalayo? Ngasiphi skhathi

Imfino yomdabu	Etshalwayo faka u gxa	inyanga

1. uqadolo		
2. ugabolo		
3. intshungu		
4. izintanga		
5. Noshukela		
6. Imithebe		

Okunye? chaza ____

12. isho uhla lwemfino ekhiwa endle noma ensimini

……………………

…………………..

…………………..

……………………

……………………..

13. uma uyithenga uythenga kuphi?

1 Suphamakethe	
2 emakethe yendawo	
3 Kubadayisi basemgwaqweni	
4 makhelwane	
Okunye	

14. Uyikha kangaki ngeviki?

Imfino yomdabu	Kanye	Kabili	Kathathu	Okunye

1.uqadolo				
2. ugabolo				
3. intshungu				
4. izintanga				
5. Noshukela				
6. Imithebe				
Okunye? Chaza				

15. Ubani oyikhayo noyiphekayo? Faka ugxa

	Ukupheka	**Ukuyikha**
1. Gogo		
2. Mama		
3. Dadewethu		
4. Babekazi		
5. Mfowethu		
6. Baba		
7. Malume		
Omunye? chaza		

16. Idliwa nani imifino? Faka ugxa eceleni

Ilayisi	

Phuthu (Crumbly porridge)	
Amadumbe	
Batata	
(Ujeqe, Isinkwa sombila)	
Amazambane	
Okunye? Chaza………..	

17. uyipheka kanjani?

Bilisa	
Thoswa	
Okunye............	

Ingxenye yesthathu: Imibuzo mayelana nemizwa kanye nemicabango ngemifino yomdabu. Cela ufake uyebo noma cha.

Imifino yomdabu inempilo?............	
Kungabe imfino yomdabu inezakhamzimba?............	
Kungabe imfino yomdabu ishibhile?....................................	
Kungabe imfino yomdabu inambitheka kamnandi................................	
Kungabe itholakala kalula?.....................	
Kungabe ivikela izifo?....................	
Kungabe kulula ukuyipheka?...........................	
Kungabe imfino iyashesha ukuvuthwa?...................................	
Kungabe imfino ikunika Amandla futhi uphila iskhathi eside?.....................	

Annexure B: Food Frequency Questionnaire

FOOD AND NUTRITION CONSUMER SCIENCES

FFQ LIST OF FOODS AND FOOD GROUPS DIVERSITY

Subject number: ________________ **Interviewer:** ______________________

Date: _________________

PLEASE INDICATE THE FOOD YOU ATE DURING THE PAST SEVEN (7) DAYS BY AN (X)

GROUP 1: Flesh Foods (Meat, Poultry, Fish) Diversity	**Y**	**N**
Meat (Chicken)		
Meat (Beef)		
Meat (Mutton)		
Meat (Pork)		
Meat (Goat)		
Dried Meat (Biltong)		
All Mince		
All Tribe/Offals/Runners and Heads		

Fish (fresh / whole)		
Tinned Fish (Pilchards/Tuna)		
Processed Meats (Viennas / Polony, Russians, Boerewors Sausage)		
Seafood (Prawns, Mussel's, Calamari, Crab, Shrimp, Crayfish)		
GROUP 2: Eggs Diversity	**Y**	**N**
Eggs		
GROUP 3: Dairy Products Diversity	**Y**	**N**
All Milk		
Evaporated milk (Unsweetened)		
Condensed milk		
Maas/ Inkomasi		
All Cheese		
Custard		
Ice Cream		
GROUP 4: Cereals, Roots and Tubers Diversity	**Y**	**N**
All Rice		
Maize (Pap, Mealie Rice, Mealie Meal, Samp, Porridge, Corn on the cob, Popcorn, Sweet Corn)		
Macaroni/Pasta/Spaghetti		

All Bread (White/ Brown/ Whole Wheat)		
Dumpling/Steamed Bread/Fat Koek		
Scones/Biscuits		
Mageu		
Breakfast Cereals (Corn Flakes, Oats, Weet Bix, Matabela)		
All Tubers/Roots (Amadumbe, Sweet Potato)	**Y**	**N**
Potatoes		
GROUP 5: Legumes and Nuts	**Y**	**N**
All Beans Dried		
Dried Peas		
Lentils		
Peanuts and Nuts		
Soya		
GROUP 6: Vitamin A Rich Fruits and Vegetables Diversity	**Y**	**N**
Pumpkin		
Carrots		
Wild Leafy Vegetables Fresh and Dried		
Spinach		
Butternut		

Apricots (Appelkoos)		
Peach (yellow cling)		
Mango		
GROUP 7: Other Fruits (and juices) Diversity	**Y**	**N**
Deciduous Fruits		
Apple		
Peaches		
Pear		
Grapes (black/green)		
Plum		
Sub – Tropical Fruit	**Y**	**N**
Lemon		
Orange		
Naartjie		
Banana		
Pineapple		
Avocado		
Kiwi fruit		
Watermelon		
Guava		
Paw- Paw		

Juices	Y	N
Juice (100% pure juice e.g. Ceres/Liquifruit)		
GROUP 8: Other Vegetables Diversity	**Y**	**N**
Onions		
Cabbage		
Beetroot		
Tomatoes	**Y**	**N**
Green beans (fresh)		
Peas (fresh)		
Cauliflower		
Chili (red/green)		
Lettuce		
Green\ Yellow\ Red Pepper		
Frozen Vegetables (Mixed)		
Ginger & Garlic (Fresh)		
GROUP 9: Oils and Fats Diversity	**Y**	**N**
Butter		
Sunflower oil		
Margarine		
Lard		

Salad dressing/oil		
Potato Crisps		
Coffee Creamer (Cremora, Ellis Brown)		
Group 10: indigenous vegetables		
Uqadolo		
Ugabolo		
Intshungu		
Izintanga		
Isishukweyana		
Imithebe		
Other:		

Annexure C: Food Coping Strategies

In the past 30 days, if there have been times when you did not have enough food or money to buy food, how often has your household had to:	Relative Frequency						
	All the time? Every day	Pretty often? 3-6 */week	Once in awhile? 1-2 */week	Hardly at all? <1 */ week	Never 0*/week	Severity Ranking	Score
Relative frequency scores	7	4.5	1.5	0.5	0		
a. Rely on less preferred and less expensive foods?						4	
b. Borrow food, or rely on help from a friend or relative?						4	
c. Purchase food on credit?						4	
d. Gather wild food, hunt, or harvest immature crops?						4	
e. Consume seed stock held for next season?						1	
f. Limit portion size at mealtimes?						2	
g. Reduce the number of meals eaten in a day?						2	
h. Make beads and sell them every Friday?						4	
TOTAL							

Severity score: least severe=1 and most severe=4

Annexures D: 24-hour Food Recall

Section E: 24hr recall: An instrument used to recall a person to recall the recent food and beverages consumed in the previous 24hrs or the previous day. This is obtained by conducting an interview with the participant.

24 – HOURS RECALL

Subject ID number: ______________________ Interviewer: ____________________

Name: ________________________________ Date: ________ / _______/ _______

Address: ____

Tick what the day was yesterday:

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

Would you describe the food that you ate yesterday as typical of your habitual food intake?

Yes	1	No	2

If not, why? ____

I want to find out about everything you ate or drank yesterday, including food you pick from the veld. Please tell me everything you ate from the time you woke up to the time you went to sleep. I will also ask you where you ate the food and how much you ate.

Time (approximately)	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
From waking up to going to work, or starting day's activities					
During the morning at work or at home					

Time (approximately	Place (Home, school, etc)	Description of food and Preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
Middle of the day (Lunch time)					

During the afternoon					
At night (dinner time)					

Time (approximately	Place (Home, school, etc)	Description of food and preparation method.	Amount	Amount in g (office use Only)	Code (office use only)
After dinner, before going to sleep					
* Do you take any vitamins (tablets or syrup)		Yes	1	No	2
Give the brand name and dose of the vitamin/tonic:					

Annexure E: Gatekeepers letter

Isicelo sokwenza ucwaningo

Mr Sanele Shortman Shozi (Induna of the village)

Isicelo sokwenza ucwaningo endaweni

Igama lami ngingu Ayanda Sthabiso Hlekwane ngenza iziqu eskhungweni semfundo ephakeme eNyuvesi yezobuchwepheshe eThekwini. Ucwaningo engifuna ukulenza luhlanganisa ukudliwa kwemifino nokuthi isiza kanjani ekuqinisekiseni ukudla okwanele kubantu abahlala endaweni oyengamele.

Ngilapha ukuzocela imvume kuwe ukuba ngenze lolu cwaningo endaweni yakho. Imigomo yonke yobhubhane loKhuvethe izolandelwa yonke ukuqinisekisa ukuphepha kwabantu.

Ngizokunikeza ikhophi yesicelo sami esithunyelwe enyuvesi Kanye namathuluzi okuqoqa ulwazi engizowasebenzisa.Kanye nencwadi engigunyazayo ukwenza lolu cwaningo eqhamuka kwi komiti lezimiso zokuziphatha ze Nyuvesi.

Uma unemibuzo ungaxhumana no mcwaningi ku 0710042788, ayandahlekwane@gmail.com. Noma u Dkt H Grobbelaar ku 0313732328, heleeng@dut.ac.za.

Ngiyabonga ngeskhathi sakho

Ozithobayo,

Ayanda Sthabiso Hlekwane

Nyuvesi yase Thekwini yezobuChwepheshe

Gatekeeper Letter

April 2022

Mr Sanele Shortman Shozi (Induna of the village)

Request for permission to conduct research

Dear Mr Shozi

My name is Ayanda Hlekwane a Master of Food and Nutrition Consumer Science student at the Durban University of Technology. The research I wish to conduct for my master's Dissertation involves Seasonal consumption and contribution of indigenous leafy vegetables to household food security and daily recommended intakes in a rural community in Ndwedwe, KwaZulu-Natal I am hereby seeking your consent to conduct a research study in your village regarding consumption of indigenous vegetables. All the COVID-19 protocols and regulations will be followed to ensure safety of the participants. I will provide you with the copy of my proposal which includes copies of the data collection tools and consent formsto be used in the research process, as well as a copy of the approval letter which I will receive from the Institutional Research Ethics Committee (IREC). If you have any queries please do not hesitate to contact me 0710042788, ayandahlekwane@gmail.com. Or Dr H Grobbelaar at heleeng@dut.ac.za. Or call 0313732328.

Thank you for your time and consideration in this matter.

Yours faithfully

Ayanda Hlekwane

Durban University of Technology

Annexures F: Information letter

Letter of Information

Dear prospective participant

Thank you for allowing me some time to explain my research to you. My name is Ayanda Hlekwane, I am a 2nd year Masters student at Durban University of Technology. I am doing research for my master's degree in Consumer Sciences Food and Nutrition. I would like to invite you to participate in this research.

The title of my research is Seasonal consumption and contribution of indigenous leafy vegetables to household food security and daily recommended intakes in a rural community in Ndwedwe, KwaZulu Natal.

The co-investigators//supervisors for this study is Dr Heleen Grobbelaar and Prof Carin Napier

Brief description of the study: Indigenous Leafy Vegetables (ILVs) like (qadolo, gabolo, izintanga, isishukweyana, intshungu,) can enhance food security and give a boost to revenue creation for the familyunit in rural communities. In addition, these vegetables contain more nutrients than commercial vegetables like spinach. Research has indicated that most indigenous leafy vegetables contain medicinal properties and therefore, protection against chronic diseases of lifestyle like Diabetes Mellitus.

There is a concern that many people no longer consume these vegetables due to lack of knowledge and low agricultural production. This study is undertaken to explore the existing indigenous leafy vegetables and their contribution towards household food security. The ethical clearance will be obtained from the Durban University ofTechnology.

We, therefore, request your participation in this research. Research is a systematic search or enquiry for generalized new knowledge. You are welcome to ask as many questions as you like to gain full understanding ofthe study. You are welcome to discuss this study with any member of your family.

The participant will be required to answer the questions from the questionnaire given, this will be done in terms ofinterviews and surveys where the researcher will self-visit all households who agreed to participate in the study. The questionnaire will be used to get the answers from the participants. The participants will be required to donate90 minutes of their time to answer the questions. The participants will be randomly selected prior the data collection to sign a consent form to participate in the study. A sample size of 118 Participants will be chosen to participate in the study.

The participants will not be exposed in any risks because the researcher will use hardcopy questionnaires and conduct interviews therefore there is no risk involved. COVID-19 rules and regulations will be followed precisely. To ensure the safety of all participants. Therefore, there are no risks involved.

You are entitled to withdraw from the study at any time should you wish to do so. No penalties or documents will be issued for withdrawal. There will be no adverse consequences for the participant should they choose to withdraw. If you are not feeling well or feel that you do not want to continue with participating, you may pull out anytime.

Benefits: This study will enhance consumer's knowledge and will benefit them. The researcher will learn more about consumer's perceptions, gain knowledge regarding indigenous leafy vegetable consumption and use it to educate people. Study will seek to probe food industries to apply awareness regarding consumption of ILVs. The study will produce positive effect to the community, this research will make them aware how important ILVs are.

Please note that you will not be paid to participate in this research. The participants will not receive any form of payment.

The participants will only be required to contribute their time to the study. There are no costs involved.

The researcher will ensure the participants that the information supplied will be strictly confidential. No personal details will be used in the study. The researcher will assign numbers to all participants. The data will be stored in the University cupboards and locked up for 5 years. The researcher and the supervisor are the only people who will have access to data. Electronic copies will be stored in a computer protected by the password and only the researcher and supervisor will have access to it. Data will be disposed by being shredded after 5 years.

The researcher will adhere to covid-19 protocols by frequently cleaning hands with soap and water ensuring thatthere are masks and sanitizers to sanitize participants before interviews.

The results of the study will be made available to participants interested to see them. Results will be disseminatedto all participants by reporting back to the community once the study is done.

The study will not involve any form of activities or food testing; therefore, safety of the participants is ensured.

Persons to contain the event of any problems or queries: The supervisor details are Dr H. Grobbelaar, heleeng@dut.ac.za, or contact the researcher Ayanda Hlekwane, 0710042788, my supervisor contact number is 0313732328 or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.a.za.

General: A copy of the information letter will be issued to all participants. The information letter and consent formwill be translated to IsiZulu, provided that the primary language spoken in the area is IsiZulu.

Incwadi yesaziso

Sawubona

Ngicela ukuqale ngibonge ukunginika ithuba nesikhathi sokuchaza ucwaningo lwami kuwena. Igama lami ngingu, Ayanda Hlekwane ngenza unyaka wesibili kwiziqu ze Masters enyuvesi yezobuchwepheshe eThekwini. Ngithanda ukukumema ukuthi ube ingxentye yocwaningo lwami. Isiholoko socwaningo sithi ukudliwa kwemifino kuzo zonke izikhathi zonyaka Kanye nomthelela ezinawo ukuqinisekisa ukuthi kunokudla okwanele emakhaya abantu abahlala emaphandleni ase Ndwedwe, eManagangeni, kwaZulu-Natali. Ngakho ke uyacelwa ukuba ube ingxenye yalolu cwaningo.

Imifino enjengo qadolo, gabolo, intshungu, noshukelwa nezintanga kungasiza ekuqinisekiseni ukuthi kunokudla okwanele ekhaya futhi kungasiza nase kuletheni imali endlini emphakathini yase makhaya. Le mifino inezakhamzimba ezibalulekile ukudlula imifino yase dolobheni. Ucwaningo luyaveza ukuthi imifino eminingi iyakwazi ukuvikela ezifweni ezingelapheki ezifana noshukela.

Kunokukhathazeka ukuthi iningi labantu alisayidli lemifino ngenxa yokwentula ulwazi nokuthitshwalwa kwayo le mifino. Lolulwazi lufuna ukuthola imifino yonke ekhona endaweni yangakini nakouthi isiza kanjani ekuqinisekiseni ukuthi kunokudla okwanele emakhaya. INyuvesi izokhipha imvume yokuqhubeka nocwaningo.

Ucwaningo indlela yokufuna ulwazi olusha. Wamkelekile ukubuza nanoma ngabe iyiphi imbuzo ongaba nayo ngocwaningo.Uvumelekile nokuxoxa ngowaningo namalunga omndeni wakho.

Uzocelwa ukuba uphendule imibuzo ezobe inikezelwe kwi phepha eliqukethe uhla lwemibuzo ekumele iphendulwe. Umcwaningi uzovakashela zonke izindlu zalabo abavumile ukuba ingxenye yalolu cwaningo. Uzocelwa isikhathi sakho esinganemizuzu engamashumi ayisishiyagalolunyenangaphezulu ukuphendula imibuzo.

Lona ocwaningwayo ayikho ingozi azozi faka kuyo ngokuba ingxenye yalolu cwaningo ngoba kuzosethsengiswa amaphephaanemibuzo ezophendulwa kuphela. Imigomo yokuqinisekisa ukuphepha ku bhubhane lo Khuvethe izoqinisekiswa ukuvikelalabo abayingxenye yocwaningo.

Imithelela **emihle/Inzuzo:** Lolu cwaningo luzokwengeza ulwazi futhi nomcwaningi uzothola ulwazi olunzulu mayelana nokuthi abathengi bacabangani, futhi uzozuza ulwazi mayelana nokudliwa kwemifino bese efundisa nabanye ukuba bagqugquzele ukudliwa nokutshalwa kwemifino.

Azikho izinyathelo ezizothathwelwa lowo okhetha ukwenyulwa kulolu cwaningo. Akukho Mali ezokhokhelwa aba cwaningwa. Abacwaningwa bazocelwa ukunikela ngesikhathi sabo kuphela.

Umcwaningi uzoqinisekisa ukuba ucwaningo luyimfihlo futhi alunikezeli imininingwane yakho esidlangalaleni. akukho ngozi engenzeka lokho kuqinisekisiwe ngoba ayikho imicikilisho ephoqa ukuba kwenziwe izinto ezinobungozi.

Umcwaningi uzoqinisekisa ukuba yonke imininingwane yomcwaningwa ivikelekile futhi ifihliwe. Bacwaningwa bazonikezwa izinombolo ezizoba ummeleli. Imininingwane yakho izogcinwa emakhabetheni akhiyiwe enyuvesi kanye nangobuchwepheshe besimanje obuvikelwe ngenombolo eyimfihlo.

Imigomo yesifop soKhuvethe: Umcwaningi uzoqinisekisa ukuba iyalandelwa imgomo ebekelwe isifo sobhubhane lwe Khuvethe.

Imiphumela: Imiphumela yocwaningo iyonikwa laba abayidingayo.

Abantu **ongabathinta uma unemibuzo noma inking ilaba:** Ayanda Sthabiso Hlekwane ku 0710042788 noma uDkt H Grobbelaar ku 0313732328. Ungathintana neskhungo socwaningo ku 0313732375. Izikhalazozingabhekiswa ku mphathi u L. linganiso ku 0313732577 noma ku researchdirector@dut.ac.za.

Okujwayelekile: Ikhophi yencwadi yesaziso izonikezwa wonke umcwaningwa. Lwe ncwadi izohumushelwa olwimini lwesiZulu ngoba umphakathi ukhuluma ulwimi lesiZulu.

Annexure G: Consent Form

Dear prospective participant
Full title of the study: Seasonal consumption and contribution of indigenous leafy vegetables to household food security and daily recommended intakes in a rural community in Ndwedwe, KwaZulu-Natal.

Names of Researcher: Ayanda Hlekwane

Co- investigator/supervisors: Dr Heleen Grobbelaar and Prof Carin Napier

I hereby confirm that I have been informed by the researcher, Ayanda Hlekwane about the nature, conduct, risks and benefits of this study: Research ethics clearance no: ………………

- I have also received read and understood the above written information (Participant letter ofinformation) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age,date of birth, initials and diagnosis will be anonymously processed into a study report.
- In a view of the requirements of research, I agree that that the data collected during this studycan be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask question and (of my own free will) declare myselfprepared to participate in the study.
- I understand that significant new findings developed during this research which may relate tomy participation will be made available to me.

…………………………….. …………………… ……………………

Prticipants Name date signature

I, Ayanda Hlekwane herewith confirm that above participants have been fully informed about nature, conduct and risks of the above study.

………………………… ……………………….. …………………………..

Researcher's full name date signature

Incwadi eyimvume yokuzibandajkanya ku cwaningo

Sawubona

Isishloko socwaningo: Imifino edliwa endaweni yakini kuzo zonke ikhathi zonyaka nokuthi niyidla kangaki futhi isiza kanjani ekuvikeni indlala Kanye nokuqinisekisa ukudla okwanele emakhaya enu.

Amagama omcwaningi: **Ayanda Sthabiso Hlekwane**

Abacwaningi abangabasizi: **Dokotela Heleen Grobelaar** Kanye no **Solwazi Carin Napier**

ISivumelwano sokuzibandakanya kulolu cwaningo: Ngilapha ukuzoqinisekisa ukuthi ngaziswe umcwaningi u **Ayanda Hlekwane** ngolwazi, ukuziphatha kanye nenzuzo nobungozi bokuzibandakanya kulolu cwaningo. Inombolo yocwaningo enikeziwe ithi: **042/22**

Ngiyaqinisekisa ukuthi:

- Sengilufundile ulwazi olunikeziwe ngalolu cwaningo.
- Ngiyakuqonda ukuthi imininingwane yami izofihlwa.
- Ngokubheka izimfuno zocwaningo, ngiyavuma ukuba ulwazi oluzothathwa kulolu cwaningo lusetshenziswe ngumcwaningi esebenzisa ubuchwepheshe besimanje.
- Ngiyaqonda ukuba ngingayeka nanoma inini uma ngifuna ukubangabi ingxenye yowaningo.
- Ngibe neskhathi esanele ukubuza ngocwaningo, ngakhonke sengikulungele ukuba ingxenyeyocwaningo.
- Ngiyaqonda ukuba ulwazi oluzotholwa kulolu cwaningo luzonikezwa kumina uma ngifisa.

…………………………….. ……………

……………………

Igama lomcwaningwa usuku ukusayina/isiginesha

Mina, **Ayanda Hlekwane ngiyaqinisekisa ukuthi lomband**
kabanzi ngalolu cwaningo

Ayanda Hlekwane ……………

Igama lomcwaningi usuku [redacted]