ECONOMIC ASSESSMENT OF INDIGENOUS LEAFY VEGETABLES (ILVs) PRODUCTION FOR INCOME GENERATION AND FOOD SECURITY IN THE EASTERN CAPE PROVINCE, SOUTH AFRICA

By

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DECLARATION

I, Anele Mayekiso, declare that the thesis: **Economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa** is my own work, and has not previously been submitted for any degree to any other university, moreover, all the sources used have been indicated, cited and acknowledged in complete references.

Mayekiso, A (Ms) Date: 19/04/2021

Signature:

DEDICATION

This thesis is dedicated to my late grandmother, Nomathamsanqa Norah Mayekiso, may your beautiful soul continue to rest in peace, my daughter Liso Iminathi Mayekiso and to all the people affected by poverty in South Africa and all around the world.

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ABSTRACT

Regardless of the strategies adopted globally and nationwide to fight food insecurity within communities, particularly in the rural context, poverty becomes a major constituent which translates to most rural households experiencing food insecurity shocks. Given the high unemployment rate in South Africa which triggers several household's vulnerability to food insecurity, the country has diverse natural resources which include indigenous plants such as Indigenous Leafy Vegetables (ILVs), which can be used as food and for business purposes by its residents. Irrespective of the diversity of ILVs in South Africa, there is a significant decline in the production and consumption of ILVs particularly in rural areas where these vegetables are mostly available. In addition, production and consumption of ILVs may not only address food insecurity but these vegetables may benefit households through the income obtained from their sales. The income generated from sales of ILVs may therefore assist towards improving and sustaining rural livelihood needs.

Given this background information, the study aimed at assessing ILV production for income generation and food security among rural households in the Eastern Cape Province (ECP) of South Africa. The study was conducted within the three district municipalities of the ECP which were selected because statistics report these districts to be the most affected areas by poverty within the province. These districts are OR Tambo District Municipality (ORTDM), Alfred Nzo District Municipality (ANDM) and Joe Gqabi District Municipality (JGDM). Multistage and proportional random sampling procedures were employed to select households which could participate in the study. Thus, 407 households within these three (3) districts municipalities were used for the purposes of the study. The study also included interviewing role players within the ILV production value chain, thus a snowball sampling procedure was used to select role players. Sixteen hawkers and three input suppliers were interviewed from the three district municipalities. In addition, from the 407 households that were interviewed, 260 households from the three district municipalities reported to be producers of ILVs. A structured questionnaire was therefore used to collect pertaining data allied in achieving the aim of the study.

The collected data was captured using Excel 2016, after data cleaning, it was then exported to Statistical Package for Social Sciences (SPSS) version 25 for analysis.

Numerous analytical models were used from SPSS 25. For instance, to identify and describe socio-economic characteristics of households, to assess the most produced ILVs from the study areas and to identify role players within the ILV production value chain, descriptive statistics in a form of means, percentages, frequencies, and standard deviation was used. To determine factors which influence production of ILVs, a Binary Logistic Regression Model was used. A Multinomial Logistic Regression model was used to determine factors which influence different uses of ILVs by households and to determine factors influencing food security status among households. A gross margin analysis was used to estimate viability from each ILV produced, harvested and sold, while Household Food Insecurity Access Scale (HFIAS) was used to measure food security status among households. Lastly, a correlation matrix was also used to determine the relationship between the role players and their functions among the ILV production value chain.

Based on the results, the study therefore concluded that, from the three district municipalities used in the study, there are various ILVs growing naturally and produced. The production of ILVs from these municipalities is habituated by socio-economic characteristics of households, wherein households use ILVs for various purposes which include these vegetables as source of food, medicine and livestock feed. The use of ILVs among households is influenced by socio-economic characteristics and seasonal availability of ILVs in ORTDM, while in ANDM and JGDM, the use of ILVs by households is conditioned by socio-economic characteristics of households, knowledge/ awareness related to nutrition and health benefits of ILVs and seasonal production of ILVs. Furthermore, this research concludes that, ILVs have a potential of diversifying diets and addressing food insecurity problems within rural parts of the three districts. Given the positive gross margins from the three districts, production and selling of ILVs has a potential to contribute to rural household income. Lastly, the study concludes that, the ILV production value chain system lacks governmental support in the form of institutional engagement since there is no evidence of extension officer support from these three district municipalities concerning ILVs production.

To this end, the study recommends that, policy makers should further establish inclusion of ILVs in both farming and food systems. Also, government and related institutions which focus on sustainable rural development must intervene in promoting

production of ILVs particularly within rural contexts since production of these vegetables may alleviate poverty through job creation, addressing food insecurity and income generation. Thus, a successful intervention of government and policy makers in ILV production would have a potential of translating to sustainable rural livelihoods.

Keywords: Gross margin analysis, Household Food Insecurity Access Scale (HFIAS), Indigenous Leafy Vegetables (ILVs) production, Sustainable rural livelihoods.

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LIST OF ABBREVIATIONS

ALVs	African Leafy Vegetables
ANDM	Alfred Nzo District Municipality
ARC	Agricultural Research Council
ASGISA-EC	Accelerated and Shared Growth Institute for South Africa-Eastern Cape
AVRDC	Asian Vegetable Research and Development Centre
BLR	Binary Logistic Regression
Ca	Calcium
DAFF	Department of Agriculture, Forestry and Fisheries
DARD	Department of Agriculture and Rural Development
DOE	Department of Education
DOH	Department of Health
DSD	Department of Social Development
ECDC	Eastern Cape Development Corporation
ECP	Eastern Cape Province
FANTA	Food and Nutrition Technical Assistance
FAO	Food and Agriculture Organisation
Fe	Iron
GDP	Gross Domestic Product
GM	Gross Margin
GPV	Gross Production Value
Ha/ha	Hectare
HDDS	Household Dietary Diversity Score
HFIAP	Household Food Insecurity Access Prevalence
HFIAS	Household Food Insecurity Access Scale
HHS	Household Hunger Scale
ICP-OES	Inductively Coupled Plasma Optical Emission Spectrometry
IDP	Integrated Development Plan
ILV	Indigenous Leafy Vegetable
ILVs	Indigenous Leafy Vegetables

IGFRI	Indian Grassland Fodder Research Institute
ISRDP	Integrated Sustainable Rural Development Programme
ITPs	Indigenous Traditional Plants
JGDM	Joe Gqabi District Municipality
KFPM	Kei Fresh Produce Market
KSD	King Sabata Dalindyebo
KZN	KwaZulu Natal
LED	Local Economic Development
MEA	Multilateral Environmental Agreement
Mg	Magnesium
MLR	Multinomial Logistic Regression
MSS	Multistage Sampling
MRP	Morogo Research Programme
Na	Sodium
ORTDM	OR Tambo District Municipality
P	Phosphorus
PRS	Proportional Random Sampling
PSJ	Port St Johns
SANAS	South African National Accreditation System
SPSS	Statistical Package for Social Sciences
STATS SA	Statistics South Africa
TR	Total Revenue
TVC	Total Variable Cost
VC	Variable Cost
VCA	Value Chain Approach
WTP	Willingness to Pay
Zn	Zinc

CHAPTER ONE

INTRODUCTION

1.1 Background information

Over the past years, sectors such as manufacturing, mining and communication amongst others in the South African economy have grown faster than the agricultural, forestry, hunting and fishing sectors. This growth has resulted in a drop of agriculture's share of the Gross Domestic Product (GDP) from more than 6% in the 1970s to 2.0% in 2015 (Department of Agriculture, Forestry and fisheries, 2016). Despite the relatively small share of the agricultural sector to the total GDP, primary agriculture is still an important sector in the South African economy since it remains a crucial provider of employment, especially in the rural areas, and a major earner of foreign exchange (Department of Agriculture, Forestry and fisheries, 2016). Furthermore, the agricultural sector has the potential to employ 33% of the country's labour force (Louw *et al.,* 2008), accounting for South Africa's placement of agriculture in the New Growth Path as one of the drivers of economic growth through job creation in the smallholder and agro-processing sectors (South African Government Information**,** 2012). However, the environmental factors associated with global climate change are affecting agricultural production in South Africa. These factors include water shortages, unpredictable weather patterns and flooding. As a result, these factors maximise risk exposure for adaptation in local vulnerable households that mainly rely on agriculture as the source of livelihood (Jensen *et al.,* 2009; Quinn *et al.,* 2011; Beddington *et al.,* 2012; Zhu and Ringler, 2012).

Thus far, a need to shift into food consumption habits that are highly adapted to environmental and socioeconomic effects is necessary. The shift would be to adopt consumption of Indigenous Leafy Vegetables (ILVs), which are resistant to the effects of climate change, they can also be harvested in a short period and require minimal inputs for production (Vorster *et al.,* 2007; Misra *et al.,* 2008; Schönfeldt and Pretorius, 2011; Sikora and Bodziarczyk, 2012; Van Jaarsveld *et al.,* 2014). Ndawula *et al.* (2004) also emphasise that, adoption of consuming ILVs would be successful if it is complemented by preservation methods that could bridge seasonal availability gaps which are faced by households in food supply. The wild, indigenous and domesticated cultivated plants which referred to as Indigenous Leafy Vegetables (ILVs) in this study, are plants whose parts; that is leaves, shoots, seeds, flowers or fruits are consumed

either raw or cooked as vegetables by local communities and are naturalised to that region (World Health Organisation, 2003; Sithole and Chitja, 2011; Matenge *et al.,* 2012).

Oelofse and Van Averbeke (2012) refer to Indigenous Leafy Vegetables (ILVs) which are also called African Leafy vegetables (ALVs) or Traditional Leafy Vegetables (TLVs), as vegetables that have their origin in a country and are produced and found growing within the country under various weather conditions with a number of these vegetables harvested from the wild. The stems of leaves and petioles which are harvested are used in the preparation of vegetables as food which adds value to the nutrition and health status of households (Modi *et al.,* 2006). The common ILVs grown and available in South Africa, include Cleome, Cowpea, Amaranth, Blackjack, Jews mallow, Nightshade, Cassava, Marama bean, living potato C to mention few (South African Department of Agriculture, 2004).

In the presence of ILVs, South Africa is reported to have a problem of malnutrition and hunger; limited employment opportunities which make it difficult for people to have adequate purchasing power to meet their nutritional needs. A state of food security is achieved when conditions that support the availability of food resources, access to such resources, adequate consumption and appropriate utilisation of food in a nutritious and hygienic manner are always attained for all people (Clover, 2003; Baro and Deubel, 2006). This means that, without affordable and easily accessible interventions, the problem of malnutrition and hunger may escalate into a bigger socio-economic issue for government and other food security relevant stakeholders (Nyembe, 2015).

At household level, food security refers to the availability and accessibility of food in a home. This explains that, a household is regarded as food secure when the members of the family do not live in hunger or fear of starvation (Department of Agriculture, Forestry and Fisheries, 2011). At household level, food security exists when all people, at all times have physical and economic access to sufficient, safe and nutritious food that meet their dietary needs and food preferences for an active and healthy life (Food Agriculture Organization, 2013). Nevertheless, previous research reports that, there is high prevalence of malnutrition, particularly micronutrient deficiencies, among the low-income group of the South African population (Mavengahama *et al.,* 2013). The

prevalence of malnutrition has been reported to be more common in rural communities of the Eastern Cape Province, which is one of the poorest provinces in South Africa, with a high percentage of the population living in rural areas linked to poverty, inequality, food insecurity and under-nutrition (Puoane *et al.,* 2013; Chopra *et al.,* 2014).

With the given background information, this study attempts to conduct an economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa.

1.2 Problem statement

Several researchers have reported that ILV production has been shown to be important in so many ways, for example, ILVs can generate income for households, however, there seem to be constraints in the production of these vegetables (Mahlangu, 2014; Maseko *et al.,* 2017; Nyaruwata, 2019). These constraints include farmers' lack of financial resources, technical knowledge and adequate technical support to invest in their farming activities and this hinders growth in ILV production (Nya *et al.,* 2010; Mahlangu, 2014). A study conducted by Mpala *et al.* (2013) in the rural Hwange district in Zimbabwe, confirmed that, there is no support from government and other organisations that train the farmers on how to grow ILVs. This has resulted to both limited production and marketing of ILVs with most farmers producing for their own consumption with little produce reaching the informal or formal market (Lyatuu *et al.,* 2009; Senyolo *et al.,* 2018).

The Department of Agriculture, Forestry and Fisheries (2013) also confirm a decline in the use of indigenous and wild vegetables by many rural communities in South Africa; this has contributed to poor diets and increased incidences of nutritional deficiencies. The current utilisation and dynamic consumption patterns of ILVs by households led to production of ILVs to be more common on a small-scale level in rural areas and being used primarily for subsistence purposes with minor informal trade record (Department of Agriculture, Forestry and Fisheries, 2013; Mbhenyane, 2017). Although, there is a high and significant level of agreement regarding several nutritional and health benefits associated with ILVs, households have opted not to include these vegetables in their farming systems. This has affected production

volumes and availability of ILVs in the market (Vorster *et al.,* 2007; Maseko *et al.,* 2017).

The availability of ILVs is noted to be seasonal and this trigger inferior production or availability of these vegetables because most ILV farmers only rely on rains for production (Ayanwale *et al.,* 2014). This enlightens that, the limited production of ILVs deprives household farmers from generating income and from supplementing their diets to address the malnutrition problems amongst their households. In addition, households selling ILVs, reported spoilage and transportation as major problems because markets are far off communities (Ayanwale *et al.,* 2014). In this regard, Mpala *et al.* (2013) argues that improving the condition of roads could potentially reduce transportation costs for ILV producers who stand to gain better income from selling these vegetables**.**

Looking at the food security in South Africa, as De Cock *et al.* (2013) reports South African households to be food insecure, the importance of ILVs in alleviating food insecurity and malnutrition has been noted, but these vegetables remain unrecognised, unappreciated and undervalued (Aju *et al.,* 2013; Maseko *et al.,* 2017). The decline in knowledge of the benefits associated with ILVs is one of the reasons among other reasons that led to low or no consumption of these vegetables which also prompt lower production; this has been observed in some parts of Africa as well (Van der Hoeven, 2013). The current manner of production and utilisation of ILVs relies on harvesting without cultivation in a commercial manner (Maseko *et al.,* 2017). This may be observed as exploitative and, therefore, difficult to sustain in view of the growing population, which could lead to loss of indigenous vegetable species as well as possible loss of biodiversity (Masarirambi *et al.,* 2010; Maseko *et al.,* 2017; Nyaruwata, 2019).

Regardless of the low production and consumption, ILVs have been reported to be good in nutritional qualities and have a potential to contribute towards household food security and households' income (Otieno *et al.,* 2016). Despite the nutritional and economic value which ILVs offer, these vegetables and their products are not commercialised and the surplus of the produce of ILVs is only traded informally within communities to generate income for the producers (Wemali, 2015; Maseko *et al.,* 2017). Furthermore, regardless of the claim that ILVs have several benefits, the

production of ILVs is characterised by low volumes (Abugre, 2011) and is currently in decline (Manyelo, 2015; Mayekiso, 2016; Maseko *et al.,* 2017). In the light of the above information, a need therefore arises to assess ILV production for income generation and food security among rural households in the Eastern Cape Province of South Africa.

1.3 Rationale of the study

Surveys indicate that, there are over 7000 plant species across the world which are cultivated or harvested from the wild for food including the ILVs (Schönfeldt and Pretorius, 2011). From the 150-plant species commonly consumed by people, 115 are indigenous African species (Kiambi and Atta-krah, 2003). In South Africa, ILVs are consumed by poor households residing in rural areas who depend on food collected from the wild or harvested from home gardens (Faber *et al.,* 2010). Most common examples of ILVs that grow around the Eastern Cape Province are *Amaranthus species, Bidens pilosa L., Chenopodium album L., Corchorus olitorius L., Sonchus oleraceus L., Taraxacum officinale Weber, Urtica urens L., and Solanum nigrum L* (Department of Agriculture, Forestry and Fisheries, 2013; Njume *et al.,* 2014).

Several studies observe that ILVs are neglected and underutilised, whereas these vegetables could play a crucial role in food security and income generation of the rural poor (Adebooye and Opabode, 2004; Schönfeldt and Pretorius, 2011; Mavengahama *et al.,* 2013). Wemali (2015) also authenticates that, ILVs are threatened by a rapid adoption of highly improved varieties of commercial crops and their loss result to the loss of knowledge linked to production, utilisation and conservation of these vegetables hence their production is lower. In South Africa, ILVs are commonly harvested freely from the wild and those that are cultivated require less inputs than conventional vegetables (Muhanji *et al.,* 2011). Therefore, an increased production due to their minimal input requirements would be expected, unfortunately ILVs are rarely grown in South Africa (Bvenura and Afolayan, 2015). Singh *et al.* (2013) confirm that, ILVs are an easily accessible, inexpensive food source for poor people, and contain minerals and vitamins in levels exceeding those found in most exotic vegetables such as spinach, cabbage. These minerals and vitamins include among others vitamin A, C, iron, zinc and magnesium and also contain significant levels of micro-nutrients that are essential for health (Uusuku *et al.,* 2010). For example,

Amaranth is a rich source of protein, vitamins, minerals dietary fibre, lipids, unsaturated fatty acids and bioactive compounds which are essential for human health (Chivenge *et al.,* 2015).

Irrespective of the potential value ILVs may offer, their production is in lower volumes (Maseko *et al.,* 2017). This study therefore has a potential to bring information explaining the exclusion or lower production of ILVs by farmers. This information could bring awareness to the government, researchers and policy makers about the existence of ILVs that are not formally included in the South African farming system. Consequently, the generated information could be used as a strategy in enhancing production of ILVs by farmers. In summary, an enhanced production of ILVs could simultaneously address food security and formal production (commercialisation) of ILVs by rural farmers; this could help in generating income from the sales of ILVs. The income generated may therefore assist towards sustaining other livelihoods such as education fees, hospital/medical bills, clothing expenses and others.

1.4 Purpose of the study

1.4.1 Aim

The aim of the study is to assess Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape province of South Africa.

1.4.2 Objectives

The objectives of the study were to:

i. identify and describe the socio-economic characteristics of ILV producers and non-producers.
ii. assess the most produced ILVs and factors that influence production of ILVs
iii. identify uses of ILVs and factors that influence the different uses of ILVs.
iv. determine the contribution of ILVs to household income and food security.
v. identify different role players and their functions along the ILV value chain.

1.4.3 Research hypotheses

i. Socio-economic factors do not influence whether rural farmers should produce ILVs or not.

ii. Socio-economic factors do not influence different uses of ILVs among rural households.
iii. ILVs do not contribute to income generation of rural households and household food security.
iv. Producers and consumers are the only role players in the ILV production value chain.

1.5 Organisation of the study

Chapter one presents the introduction which entails the background of the study, the chapter further discusses the problem statement and rationale of the study. Chapter two looks at the general overview of ILVs in South Africa, by appraising production of ILVs and income generation, ILVs and food security, benefits associated with consuming ILVs and role players in ILV production value chain within South Africa. The chapter further reviews the relevant literature on food production status in South Africa and the cultivation status of ILVs in South Africa. Lastly, the chapter looks at socioeconomic factors affecting production of ILVs, contribution of ILVs to income generation, contribution of ILVs to dietary diversity and dietary quality (food security) and ILV production value chain.

Chapter three highlights the description of the study areas from which respondents were selected. The key issues highlighted in this chapter included economic activities practised, an agro-ecological survey of the study area that is; rainfall, temperatures, soil and vegetation. Chapter three further outlines the research design for the purposes of the study by explaining how the study was conducted. The methods and analytical tools that were used for data collection and analysis in the study are also discussed in this chapter. The chapter also provides a conceptual framework for the study and lastly gives a detailed review of analytical methods used in the study.

Chapter four begins by presenting the study results from OR Tambo district municipality (ORTDM), Alfred Nzo District Municipality (ANDM) and Joe Gqabi District Municipality (JGDM) by discussing the results based on descriptive statistics and empirical results. The implicit goal at this stage was to ascertain whether conclusions could be made based on a descriptive analysis pertaining set of operational objectives. The chapter further presents and discusses the results based on inferred findings about statistical models that were used to estimate conjectured hypotheses from

OTRDM, ANDM and JGDM. Chapter five wraps up the study by presenting a summary of the research findings from all the district municipalities (ORTDM, ANDM and JGDM) as well as conclusions and policy recommendations within these three district municipalities.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents the literature reviewed on the economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province of South Africa. The literature reviewed included an overview on ILV production in South Africa as well as issues related to:

a) the food production in South Africa.
b) the cultivation status of ILVs in South Africa.
c) the socioeconomic factors affecting production of Indigenous Leafy Vegetables (ILVs).
d) the contribution of ILVs to income generation.
e) the contribution of ILVs to household food security.
f) the ILVs production value chain in South Africa.

2.1 Overview on ILV production in South Africa

The major issues addressed in this section included production of ILVs and income generation, ILVs and food security, benefits associated with consumption of ILVs and role players in ILV production value chain within South Africa.

2.1.1 Production of Indigenous Leafy Vegetables and income generation in South Africa

South Africa has more than 100 different species of ILVs that have been identified; however, only a few groups of leafy vegetable species are still utilised (Van Rensburg *et al.,* 2007). These vegetables include *C. olitorius* (jute mallow), *Amaranthus cruentus* (pigweed), *Citrullus lanatus* (bitter melon), *Vigna unguiculata* (cowpea), *Cleome gynandra* (spider plant), *Cucurbita spp.* (pumpkin), *Brassica rapasubsp* and *Chinensis* (Chinese cabbage). Amaranth is one of the most common ILVs in South Africa belonging to the *Amaranthaceae* family and is an extremely flexible, upright to spreading herb (Olelofse and van Averbeke, 2012). Different species of Amaranth are available all-over South Africa, and these various Amaranth species are tolerant to adverse climatic conditions (Olelofse and van Averbeke, 2012; Mavengahama, 2013).

Regardless of the diversity of ILVs in South Africa, there is a reported decline in the consumption of these vegetables partly due to low availability and negative perceptions that households have towards ILVs. The low availability of ILVs is a result of the production which continues to be on small scale level and ILVs are considered as wild species hence they have never been commercialised (Maseko *et al.,* 2017). Maseko *et al.* (2017) also indicate that, the availability of ILVs depends on means of collection rather than cultivation that is why they face threats of over-exploitation. In addition, Hughes and Ebert (2013) confirm a commercial value of ILVs which can make a significant contribution to household income. Because of ILVs' potential to contribute towards income generation, these vegetables attract a strong market demand, thus seed companies are beginning to explore and develop these now popular crops which strengthens the formal seed sector of ILVs (Maseko *et al.,* 2017; Senyolo *et al.,* 2018). Currently, ILVs are recognised for their commercial value as they attracted a strong market demand. Seed companies are beginning to explore and develop these vegetables, thus establishing the formal seed sector particularly within the African continent (Asian Vegetable Research and Development Centre, 2008; Gido *et al.,* 2016).

Several studies which were reviewed on the contribution and marketing of ILVs in South Africa and other African countries confirmed that, women were the main participants in the selling of ILVs since they require very little income to start the business of selling these vegetables when compared to starting exotic vegetable production businesses (Gockowski *et al.,* 2003; Shackleton *et al.,* 2010). For example, a study on comparing the value of wild plants and those of domesticated plants by High and Shackleton (2000) quantifies the contribution of ILVs to households' income and the results revealed that, lLVs' value amounted to 31% of the total value of the income received by households per annum. A similar study was also conducted by Shackleton *et al.* (2010) discovering that ILVs are a flourishing business for women who sell these vegetables as street vendors. Therefore, to this end, if males were also involved in the production of ILVs it may translate to increased production which may mean more income generated from the sales of ILVs.

A study conducted by Vorster *et al.* (2007) from different provinces and among different ethnic groups in South Africa discovered that, the contribution of ILVs in terms of income generation should not be underestimated. This is because, most

households have constant income benefit from the sales of ILVs. The income that is derived from sales of ILVs may cover costs such as hospital bills and education fees (Shonshai, 2016). Shonshai (2016) further emphasises that, various studies in South Africa indicated that ILVs play a dual role; firstly, they provide money to poor households and secondly, households that sell these vegetables can also save their money by consuming ILVs rather than purchasing exotic vegetables. This means that, ILVs cannot only generate income but can also be inexpensive food source for poorer households hence increased production is necessary. The contribution of ILVs to income generation is also evident in other countries, as indicated by Gockowski *et al.* (2003); Oladele (2011). For example, Pouliot and Treue (2013) also reach a similar conclusion in West Africa on the value of non-forest products research conducted. Non-forest products refer to all biological materials other than timber, which are extracted from forests for human use (Shackleton and Gumbo, 2010). The study results indicated that, non-forest products contribute 30%-35% of total income amongst the poor segments. This infers that ILVs have a potential to contribute towards household income since they also form part of non-forest products.

2.1.2 Indigenous Leafy Vegetables and food security in South Africa

South Africa is generally referred to as a middle-income developing country and is reported to be food secure at national level (National Planning Commission South Africa, 2013). However, according to Oni *et al.* (2011), there is a significant food insecurity challenge at household level in both rural and peri-urban areas. As reported by STATS SA (2017) over 48% of people in South Africa live below the poverty line. This is a result of adverse socioeconomic conditions, such as the prominent level of unemployment, high living costs which include energy, food, transport, lack of stable income and poverty that put pressure on households, rendering such households less capable of providing themselves with basic needs (Vorster *et al.,* 2007; Labadarios *et al.,* 2011; Beddington *et al.,* 2012). Such conditions limit household production capacity and affect the ability to purchase nutritious food which results in household's susceptibility to disease and other social vulnerabilities (Oni *et al.,* 2011).

A household is referred to as food secure when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Food and Agriculture Organisation, 2012). Food security consists of four pillars, which are also considered

as factors affecting food security. These pillars include the availability of food, the accessibility of food, the utilisation of food and the stability of food supplies (Department of Agriculture, Forestry and Fisheries, 2013). This means that, food security includes at a minimum, the ready availability of nutritionally adequate and safe foods and an assured ability to acquire acceptable foods in socially acceptable ways; that is, without resorting to emergency food supplies, scavenging, stealing, or other coping strategies (World Food Programme, 2012). Although South Africa demonstrates a growth potential, the country consists of a high number of vulnerable households and this limits the country's socioeconomic development potential which can be stimulated by utilising the natural and wild vegetables which include ILVs.

There is evidence from numerous studies conducted in South Africa and around the world, that indigenous foods are consumed by many households especially in areas where they are available, and thus can play a significant role in alleviating food insecurity and contribute to dietary diversity. Many varieties of ILVs that are consumed as vegetable sources have been identified (Nesamvuni *et al.,* 2001; Tshukudu, 2005; Vorster *et al.,* 2005; Mbhatsani *et al.,* 2011; Mbhenyane *et al.,* 2012; Bvenura and Afolayan, 2015). These vegetables include Amaranthus, Cowpeas (*Vigna unguiculata*), African nightshade (*Solanum species*), Spider plant (*Cleome gynandra*) and Ethiopian kale (*Brassica carinata*). A study conducted by Kebede and Bokelmann (2017) used seed source, type of fertiliser and irrigation methods to assess sustainability in the production of ILVs. The study revealed that, most producers used local seeds, most intercropped ILVs with maize, and very few irrigate their vegetables; and further indicated that there was no need to irrigate ILVs. Thus far, Mbhenyane (2017) confirms that the production of ILVs, even though is practised in smaller quantities, is sustainable and could be used to ease the food insecurity tensions and generate income for households. Similar comparable findings were earlier discovered by Mkhawani *et al.* (2016) stating that, eating indigenous and traditional foods that grow in the wild is one of the coping strategies used by rural households.

With the given background information, literature highlights that, most communities affected by poverty and under nutrition in South Africa live in areas that are rich in biodiversity including wild and indigenous vegetables (Reinten and Coetzee, 2002). It is of interest to note that ILVs have been reported to be good in nutritional qualities such as macro and micronutrients (Mavengahama, 2013). Furthermore, ILVs have

been utilised as food for centuries and in spite of their noted good nutritional value, these vegetables have not been widely domesticated and are not cultivated on a large commercial scale. This has affected the production volumes and income that could be generated from sales of ILVs especially in South Africa (Vorster *et al.,* 2007; Shackleton *et al.,* 2009). With the given nutrition benefits associated with ILVs, the use of ILVs has been proposed as part of the solution to the problems of micronutrients and malnutrition among the population group of low-income households (Mavengahama *et al.,* 2013). Although ILVs are consumed in small quantities, they influence the intake of cereal staples, manage hunger and play a vital role in household food security for poorer rural communities (Mavengahama, 2013). This explains that, mixing numerous ILVs in one meal could contribute to dietary diversity in terms of more vegetable types and in terms of choice of relish. For some poor families, ILVs are substitutes for some food crops such as swiss chard or spinach (Flyman and Afolayan, 2006; Matenge *et al.,* 2012; Mavengahama, 2013; Mayekiso *et al.,* 2017).

2.1.3 Benefits from consumption of Indigenous Leafy Vegetables

Indigenous Leafy Vegetables are known to commonly grow spontaneously in natural ecosystems and have been serving humankind for food and medicinal purposes in almost all societies for generations (Battacharjee *et al.,* 2009; Kuhnllein *et al.,* 2009). There is a recognition of ILVs as diversifying diets and being the powerful sources of nutrients for poorer households for better diets and health (Gosh-Jerath *et al.,* 2016). This recognition, therefore, prompts a proposition of using indigenous foods by commercialising ILVs so as to increase their production and utilisation since they have potential in enhancing the quality of diets and improving food and nutrition security (Kruger *et al.,* 2015). Despite this assertion, the use of ILVs has declined due to the non-availability of these vegetables in modern commercialised and industrialised markets including lack of investment in research and development (Maseko *et al.,* 2017). Indigenous Leafy Vegetables have been largely ignored by commercial farming as well as research and development, thus becoming less competitive than well-established major crops, and gradually losing their diversity (Padulosi *et al.,* 2013). To bring awareness about ILVs, Vorster *et al.* (2013) report that, the new South African Food Based Dietary Guidelines emphasise the food value of indigenous crops by the message they communicate “utilisation of ILVs must be realistic, do-able, promoting

indigenous and traditional foods". This was done as a way of increasing production to enhance nutrition security and generate income through the trade of these vegetables.

Hunger and under-nutrition are recorded to occur because of insufficient food consumption. Hunger is caused by not having enough quantities of food to eat while under-nutrition is the lack of enough micronutrients which include important vitamins, iron and zinc (Altman *et al.,* 2009). The consumption of a variety of food groups that contain different micronutrients is therefore vital (Kennedy, 2004). Since 2002, there has been a decrease in the number of people in South Africa who experience hunger, but under-nutrition continues to be a problem (Altman *et al.*, 2009). Previous research reports that, South Africa faces Vitamin A and Iron deficiencies, while the utilisation of ILVs is documented to assuage malnutrition problems. In such cases, one would expect an increased uptake of ILVs. However, there is a decreased tendency in the utilisation of ILVs due to the limited knowledge of their nutritional content (Modi *et al.,* 2006; Abugre, 2011; Department of Agriculture, Forestry and Fisheries, 2013; Heywood, 2013). Indigenous Leafy Vegetables are progressively recognised as possible contributors of both micronutrients and bioactive compounds to diets (Smith and Eyzaguirre, 2007; Njume *et al.,* 2014).

Numerous studies have been conducted on ILVs owing to their perceived potential to contribute positively to improving household food security. Several authors believe that, these vegetables are readily accessible in rural communities, have a high nutritional value and contain antioxidants and other compounds which are beneficial for health (Kahlon *et al.,* 2008; Cartea *et al.,* 2011; Sithole and Chitja, 2011; Sikora and Bodziarczyk, 2012; Akeredolu and Adebajo, 2013). With the given nutrient characteristics found in ILVs, these vegetables therefore become a valuable source of food and medicine particularly for rural residents since they contribute substantially to protein, mineral and vitamin intake together with fibre; they also add diversity to the rural household diets. Singh *et al.* (2013) recommend that, ILVs should be included in diets to overcome various nutritional problems such as iron and vitamin A deficiency that are prevalent in South Africa.

Nesamvuni *et al.* (2001) also confirm the nutritive value of ILVs in a manner that, the minerals and vitamins found in ILVs exceed the levels found in exotic vegetables such as cabbage and spinach. In addition, ILVs are also compatible to use with starchy

staple food since they contain ascorbic acid, which enhance iron absorption (Nesamvuni *et al.,* 2001; Abukutsa, 2007; Uusiku *et al.,* 2010). Studies on the antioxidant properties of ILVs have also revealed that, ILVs are good dietary sources of antioxidants such as flavonoids, tannins and other polyphenolic elements (Afolayan and Jimoh, 2009; Njume *et al.,* 2014). Furthermore, Matenge *et al.* (2012) suggest that, one way to promote nutritional uptake of ILVs in South Africa is childhood exposure and education on ILVs at primary school level by incorporating these products into school feeding programmes. With the given nutrition and wellbeing benefits associated with consuming ILVs, an increased production of ILVs would be expected not only to address the malnutrition problems but also to generate income through sales of ILVs so that, households may be able to sustain other household needs which may ultimately translate to food secured households.

2.1.4 Role players in ILV production value chain

Kaplinsky and Morris (2001) describe a value chain as a range of activities which are required to bring a product or service from conception, through the distinct phases of production, transformation and delivery to final consumers. This means that, a value chain defines how producers, processors, buyers, sellers, and consumers separated by time and space gradually add value to products as they pass from one link in the chain to the next. In a typical agricultural or food value chain, the chain actors who transact a product as it moves through the value chain includes input (For example: seed, fertilizer) suppliers, farmers, traders, processors, transporters, wholesalers, retailers and final consumers (United Nations Industrial Development Organisation, 2009).

Indigenous Leafy Vegetables form part of a food chain in agricultural system and are found to have more advantages when compared to exotic vegetables (Nyathi *et al.,* 2016). These advantages include the fact that, they are drought tolerant, require minimum inputs, less prone to pests and diseases, higher water use efficiency and contribute substantially to nutrition and household income, especially in rural areas (Nyathi *et al.,* 2016). To increase production of these vegetables so to benefit on the advantages they offer, there is a need to understand the interactions among various actors in the value chain in order to determine ways of maintaining and adding value to produce and improve market efficiency (Chagomoka *et al.,* 2014; Ngugi *et al.,*

2017). Also, the growing demand for ILVs has not been met with adequate supply due to the restraints that producers are facing. These restraints include lack of access to high-value markets, water scarcity, limited knowledge of their supply chain and lack of innovation (Ngugi *et al.,* 2017).

The recent available literature on the ILV value chain identifies different role players in ILVs' production value chain and record the value chain challenges amongst the role players. For instance, a study conducted by Senyolo *et al.* (2018) on analysing the value chain for African Leafy Vegetables in the Limpopo Province of South Africa, identifies input suppliers, smallholder farmers, traders, and consumers as role players in the ILV chain. The study further revealed that, smallholder farmers are currently making high gross margins as compared to other participants in the value chain and more returns were to be realised if government services (such as training, seed production and distribution) could either be decentralised or privatised. Similarly, Weingberger and Pichop (2009) conducted a study on the marketing of African Indigenous Leafy Vegetables (AILVs) along urban and peri-urban supply chains in Sub-Saharan Africa and the study recorded producers, intermediaries; which include collectors of ILVs, brokers, wholesalers and transport and retailers as the actors in the ILV value chain.

Chagomoka *et al.* (2014) argue that, a value chain analysis of ILVs supply chain provides an opportunity to assess the efficiency of value-added operations and a systematic competitiveness along the value chain. Chagomoka *et al.* (2014) further investigate value chain analysis of traditional vegetable production in Malawi and Mozambique. The value chain actors from input suppliers, farmers, middlemen, retailers, and consumers were mapped in both countries. The results of the study identified vegetables that were common in each country which were all cultivated under rain-fed conditions. These vegetables included Amaranth, Ethiopian mustard and Jute mallow. Links between value chain actors were found to be weak, mostly based on sport markets transactions except for retailers and supermarkets under relationship marketing (Chagomoka *et al.,* 2014).

Senyolo *et al.* (2018) argue that, even if farmers make higher margins compared to other value chain actors, it is still difficult for them to enter the mainstream market. Lack of production advice, lack of packaging and processing services, poor

infrastructure, absence of contractual agreements between the value chain actors are identified as challenges which are faced by role players in ILV value chain (Senyolo *et al.,* 2018). Similar comparable findings were earlier noted by Ngugi *et al.* (2007) stating that, farmers who benefited from innovation of ILV production are making bigger profit margins per kilogram of ILVs sold compared to those selling on local markets.

Ngugi *et al.* (2007) also investigate access to high markets by smallholder farmers of African Indigenous Vegetables in Kenya. The main aim of the study was to look at various ways in which farmers can be integrated into emerging and restructured markets such as supermarkets. The study discovered that, certain production practices were adopted to minimise production risks, for instance, farmers grow their vegetables on lowlands along rivers and streams to make it easier for irrigation of their vegetables. The value chain of ILVs for these production practices consisted of input suppliers, small-scale farmers, transporters, supermarkets/green groceries and informal markets. Other external participants that affected the performance of the value chain included the government, development agencies and rising demand from urban dwellers. To this end, policy interventions focusing on promoting value addition along the ILV chain so to achieve employment creation, nutrition security, and diversified food collections along the value chain are suggested as solutions to encounter the challenges faced by role players in ILV value chain.

2.2 The food production in South Africa

South Africa is a rich and diverse country with vibrant cultural diversity and a spectacular range of vegetation types, biodiversity, climates and soil types (Department of Agriculture, Forestry and Fisheries, 2016). Thus, making its residents benefiting from the natural resources which the country offers. The country practises various farming activities, meaning that it can be divided into distinct farming regions and these farming activities range from intensive crop production in winter rainfall and high summer rainfall areas, to cattle ranching in the bushveld and sheep farming in the more arid regions (Agriculture: facts and trends South Africa, 2018).

Given the background information about South Africa, according to Bureau for Food and Agricultural Policy baseline (2018), investment in agriculture is broadly recognised as a key condition in achieving goals linked towards improving food security, creating jobs and creating wealth, thereby reducing poverty. Thus, making the agricultural

sector a key driving force of the South African economy and addressing food security. However, this sector is affected by several factors to perform to its desired potential and these factors include among others, socio-economic conditions, institutional settings as well as environmental conditions within the country. For instance, the Worldwide Fund for Nature (2018) report mentioned several challenges to food security in South Africa, these challenges included smallholder farmers without support, market dominance squeezing out smaller players; and the cost of healthy food as key hurdles to food security. Additionally, the impact of climate change, population increase, and food demand are likely to place serious demands on the food system.

So far, South Africans have shown interesting changes in food consumption since the 1970s and this has been a result of increased wealth and post-apartheid restructurings leading to the country's middle class increasing by 30% between 2001 and 2004. However, the country's population is growing at almost 2% per year, thus a population of 49 million in 2009 is expected to grow to 67.3 million by the year 2035 (Mail & Guardian: business report, 2019). This means that, food production or imports must be more than double to feed the expanding population, and production needs to increase by using the same or fewer natural resources. Also, the demand for certain food types will shift as more people become wealthier or changes in social characteristics such as education and employment status (Worldwide Fund for Nature, 2018).

The Worldwide Fund for Nature (2018) reports that, South Africa currently faces a looming food security crisis and if there is no urgent action taken to correct unsustainable food production practices, the country will suffer. The Worldwide Fund for Nature (2018) further predicts that, South Africa will have to produce 50% more food by 2050 to feed an estimated population of 73 million people as compared to the current food production. Agri food systems (2018) report that, farming in South Africa needs all-inclusive reform in order to meet the needs of a growing population but it does not mean that focusing on farming only will bring about the necessary structural change which is needed for a resilient and secure food system. Thus far, Agri food systems suggest that, a complex adaptive system for food production needs to follow

a socio-ecological approach, where the social, economic and political dimensions (the actors) are implanted within the ecological component (nature).

With the given background information on food production system in South Africa and the abundancy of natural vegetation which includes ILVs within the country, conserving these vegetables would have been vital to meet the demand of food supplies by the country. Literature also highlights that; these vegetables have a potential of addressing food security problems and contribute to sustainable livelihoods through income generation. Thus, inclusion of these vegetables in both farming and food systems within the country may substantially contribute towards addressing the problem of food security particularly at household level.

2.3 The cultivation status of ILVs in South Africa

Cienci Agro (2010) contends that, ILVs are threatened by rapid adoption of highly improved varieties of commercial crops hence their production is not popular. The non-popularity of ILVs is recorded as a result of the loss of Indigenous Knowledge (IK) associated with the cultivation, utilisation and conservation of these vegetables (Cienci Agro, 2010). Also, the Multilateral Environmental Agreement (MEA) report predicts that, due to intense expansion of agriculture and the farming systems, there will be rapid conversion of grassland and forestland by 10-20% of current areas through to the year 2050. This explains that, inclusion of ILVs in the farming system may be a success in sustaining the livelihoods of various population groups around the world.

The nutrition value of ILVs, their collection, consumption, harvesting and preservation, marketing, and perceptions of people towards them and their role in addressing food insecurity have received an increasing amount of attention from several studies globally (Shonshai, 2016). As evidence of attention given to ILVs, research in the fields of agriculture and development has been concerned with the cultivation of ILVs, their marketability and their use in improving the livelihoods of local communities. Previous research studies have investigated the potential of ILVs on food security (Gockowski *et al.,* 2003; Modi *et al.,* 2006; Kaschula, 2008; Legwaila *et al.,* 2011) as well as their marketability (Shackleton *et al.,* 2010; Muhanji, *et al.,* 2011). Regardless of the research conducted on ILVs; to this end, in South Africa, there is limited if no information that currently indicates or confirms the production and consumption level of ILVs as well as the marketing status of these vegetables.

In South Africa, ILVs are popularly harvested freely from the wild and those that are cultivated require less inputs than conventional vegetables (Shackleton and Gumbo, 2010; Muhanji *et al.,* 2011). Irrespective of the ILVs' low input requirements for production, these vegetables are rarely grown in South Africa (Bvenura and Afoloyan, 2015). Similar findings were earlier discovered by Van Rensburg *et al.* (2007) stating that, in South Africa, the cultivation of ILVs is very limited. This is because most ILVs are left to grow in the fields as volunteer crops whilst sometimes they are broadcasted (Hart and Vorster, 2006). Shackleton *et al.* (2010) also conducted a study in the peri-urban areas in Durban KwaZulu-Natal on the production of ILVs. A descriptive statistic using Statistical Package for Social Sciences (SPSS) was used to analyse data and the study revealed that, 96,9% people indicated that they were growing ILVs for their own consumption whilst 50,3% grew them for income generation. The study further indicated that, cultivation of ILVs was limited to popular species which included *Blackjack bidens spp* (90,9%) and wild *Amaranthus spp* (57,6%). The limitation in the production of ILVs to certain vegetable species may have affected the production volumes of ILVs, although it is evident that these vegetables may diversify dietary quality and generate income for households.

One of the major reasons why ILVs were never included in the South African farming system is that; in the past years, research and modern agriculture practices have discouraged the growing of ILVs, labelling them as weeds, whilst promoting the production of exotic vegetables (Vorster *et al.,* 2007; Vorster *et al.,* 2008). Adebooye and Opabode (2005) pointed out the non-availability of improved seeds as a one of the constraints that limits widespread cultivation of ILVs. However, recent interest in ILVs has prompted their promotion by various organisations in South Africa. These organisations include the Agricultural Research Council (ARC), the Morogo Research Programme (MRP) and Department of Agriculture, Forestry and fisheries (DAFF).

2.4 The socio-economic factors affecting the production of ILVs

Farming households have differences in their demographic and socio-economic characteristics such as education level, age of a household head, gender of a household head, farm size and household size. On one hand, the socio-economic factors determine the success and development of an enterprise (Guzman and Santos, 2001). On the other hand, food security is influenced by household structure,

income, savings behaviour, socio-cultural orientation and nutrition awareness (Nyangweso *et al.,* 2007). The ILV production system in South Africa is not popular, to this end, socio-economic or demographic characteristics of each farmer/producer are the recorded factors that affect the exclusion of ILVs to the farming system in South Africa (Muchara *et al.,* 2018). For example, Vorster *et al*. (2008) conducted a study on the role and production of ILVs (*morogo/ miroho/ imifino*) in three culturally and agro-ecologically diverse rural communities of South Africa. The study discovered that, women were dominating in the production of ILVs to sustain immediate household food security in South Africa. This explains women domination in the production system of ILVs when compared to their male counterparts. This could be the reason that, the use of indigenous vegetables is influenced by their availability, taste preferences, regions, economic status, culture and gender differences (Weinberger and Swai, 2006; Vorster *et al.,* 2008; Faber *et al.*, 2010; Dweba and Mearns, 2011).

In addition, Shackleton *et al.* (2009); Mpala *et al.* (2013) indicate a lack of IK particularly among the young generation as one of the major contributing factors towards the recognition of ILVs in terms of production and consumption. Faber *et al.* (2010) argue that, substantiated decline in the production of ILVs is a result of multiplicity of environmental, political, and socio-economic factors; and the exact factors were never specified. The multiplicity of these factors may explain the current decline in the ILV production and consumption over the years as well as their availability in the markets.

2.5 The contribution of ILVs to income generation

The diversity of ILVs is declining in modern farming systems and consequently in households' diet, yet these vegetables contain adequate nutrients which may assist in addressing malnutrition among households. Furthermore, ILVs are not produced in a conventional manner in South Africa; they are rather collected in their season, grown in home gardens or intercropped with other food crops. Be it as it may, ILVs are found to have significant economic potentials. This is evident by the commercialisation of ILVs in some African countries such as Uganda, Ghana, Kenya and Nigeria; and the commercialisation is gradually increasing with numerous advantages of improvement in household income and job opportunities along the vegetable value chain of rural farmers (Gido *et al.,* 2016). Previously, several authors also confirmed the contribution

of ILVs to household income. For example, Abukutsa-Onyango (2003); Vorster *et al*. (2007); Habwe *et al.* (2009) state that, ILVs have a potential to contribute towards income generation and self-employment, which are suited to environmentally friendly farming systems such as intercropping and organic farming.

A study conducted by Habwe *et al.* (2009) used a desktop study to analyse the supply chain of ILVs so as to determine their availability which could reduce poverty in rural communities through income generation and diverse diets from the consumption of ILVs. Furthermore, Vorster *et al.* (2007) report that, ILVs are regarded as weeds in some communities; in fact, some extension officers label these vegetables as not worth the space they occupy in the fields and home gardens. Regardless of the label given to these vegetables, households with many members who do not supplement income for the household tend to rely more on ILVs (Vorster *et al.,* 2007; Wemali, 2015).

According to Vaitla *et al.* (2009), rural livelihood development initiatives that focus on agriculture aim to improve and stabilise household incomes. For instance, a similar initiative on ILVs conducted in East Africa for smallholder farmers was found to address food security and income needs at household level. In addition, farmers also indicated that, ILVs are low in cost, usable during off-season through preservation and value-addition, generate income for women and their market availability increased demand for ILVs in Kenya and Tanzania (Muhanji *et al.,* 2011). This explains the increased production of these vegetables, hence the increased demand in East African markets which ultimately increases consumption of ILVs. The production ILVs was enhanced through awareness campaigns which targeted both the farmers' and consumers' perceptions in some areas to achieve success of production.

In another study by Chelang'a *et al.* (2013), research confirms that, urban consumers in Kenya, preferred, and were willing to pay a premium cost for ILVs instead of exotic vegetables. Between 2003 and 2006, research also recorded that, the consumption and farm gate value of ILVs increased from 31 tonnes (US$ 6 000) to 600 tonnes (US$ 142 000) respectively, drastically improving the income of smallholder farmers. Converted to South African Rands, this is between R89 000 and R2 114 00. The aim of the study was to determine the willingness to pay (WTP) a premium for African Leafy Vegetables (ALVs) and the underlying determinants; the semi-double bounded

contingent valuation choice and logit models were used respectively to measure the WTP. The study discovered that, in South Africa, the trading of ILVs is popular in the informal markets of Limpopo and Kwa-Zulu Natal (KZN) provinces. This indicates that, there could be a potential for commercial value (Nyembe, 2015), only if the production of ILVs could be enhanced in order to promote the market availability of these vegetables not only to informal markets but to formal market as well. Table 2.1 below gives the list of ILVs grown within selected countries in Africa.

Table 2.1: Indigenous Leafy Vegetables grown within selected countries of Africa

South Africa	Kenya	Nigeria	Uganda	Ghana	Tanzania
Amaranth	Amaranth	Fluted pumpkin	African egg plant	Cocoyam	Amaranth
Spider plant leaves	Nightshade	Garden egg	Ethiopian Mustards	Water leaf	African nightshade
Chinese cabbage	Slender leaf	Glossy nightshade	Amaranth	Amaranth	African egg plant
Nightshade	Cowpea leaves	Fire weed	Cowpea	Moringa Oleifera	Cowpea
Jew's mallow	Pumpkin leaves	Snake tomato	African nightshade	Jews marrow	Ethiopian Mustard
Pumpkin, Melon leaves	Spider plant leaves	Huckleberry	Spider plant	Sweet potato leaves	Okra
Cowpea		Bitter leaf	Jute mallow	Cassava	Pumpkin leaves
Common Purslane		Field pumpkin	Hibiscus	Bitter leaf	Sweet potato leaves
Blackjack		Amaranth	Okra	Purslane	
		Bologi		Wild lettuce	
				Okra	
				African cucumber	
				Egg plant	
				Pumpkin leaves	

Sources: Jansen Van Rensburg et al., 2007; DAFF, 2014; Mungofa, 2016 (South Africa); Gido et al., 2016 (Kenya); Ayinde et al., 2016 (Nigeria); Aleni, 2017 (Uganda); Kwenin et al., 2011 (Ghana); IndigenoVeg survey data, 2006; Weinberger and Pichop, 2009 (Tanzania).

To conclude on the ILVs grown in selected countries of Africa, Amaranth is the most common vegetable that is grown in all these countries. This may be because, this vegetable uses the carbon fixation pathway which makes it adapted to high light

intensities, temperatures and drier conditions which are mostly the case within African countries (Kolberg, 2011). Such conditions enable the Amaranth vegetable to grow well in warm climates in spring and summer and become more tolerant of drought than most ILVs (United States Department of Agriculture, 2011).

Uganda is the only country that is not popularly growing Pumpkins and Pumpkin leaves, and this could be because, the availability of these leaves depends on rainfall which varies from one season to another or it becomes scarce in most cases (Abukutsa, 2011). Nigeria does not commonly grow Jute mallow nor Jews' mallow since this vegetable requires warm, humid conditions and performs well in areas with high rainfall (600 to 2 000 mm per annum) and high temperature. Jew's mallow requires an annual temperature ranging from 16 to 25 degrees Celsius (°C) and temperatures in Nigeria are frequently above the annual temperatures that is recommended to grow Jutes' mallow/Jews' mallow (Van Rensburg *et al.,* 2007). Temperatures below 15°C are detrimental to this vegetable as it is also sensitive to drought. Furthermore, Jutes' mallow/Jews' mallow cannot grow in the shade and requires moist soil but cannot tolerate being water-logged (Shackleton *et al.,* 2009).

Blackjack is only grown in South Africa, this could be the reason why Blackjack prefers hot weather conditions and it grows well in temperatures ranging from 25 to 38°C. Temperatures above 45°C are not favourable for this vegetable, and it does not tolerate frost, which is always the case in most African countries where temperatures rise above 40 to 45°C. This makes this vegetable grow well in sunny or slightly shaded areas and it thrives with abundant rainfall, but it can also withstand droughts (Taleni and Gouduka, 2013).

Huckleberry is popularly grown in Nigeria, this could be due to the fact that, this vegetable is commonly consumed by female producers and women are known to be more involved in ILV production when compared to men (Vorster *et al.,* 2007; Ayinde *et al.,* 2016). Lastly, Cocoyam, Cassava and Moringa Oleifera are popularly grown in Ghana. For Cocoyam, it could be popularly grown because of its high protein content when compared to meat and meat is regarded as an expensive source of protein therefore, households are rather opting for Cocoyam as it is labelled as an inexpensive food source particularly protein (Fugile, 2001). Cassava and Moringa are highly used as natural medicine and natural oil in Ghana. These two products are known to be

expensive and only financially stable households afford them on a frequent basis, hence Cassava and Moringa are used by poor households for medicine and oil purposes (Food and Agriculture Organisation, 2003).

2.6 The contribution of ILVs to household food security

2.6.1 Indigenous Leafy Vegetables

Accelerated growth in the agricultural sector would be an effective means of reducing poverty because in comparison to other sectors of economic development; agriculture has a greater effect on poverty alleviation efforts as it provides a source of income, employment and livelihood for resource-poor households (Lyne *et al*., 2009). This means that, ILVs become an opportunity for a niche market for smallholder farmers to supplement onto their livelihoods, but also for households to cultivate for domestic consumption as these vegetables are nutrient rich and require minimal inputs for production (Sikora and Bodziarczyk, 2012). In addition, seasonal availability of ILVs presents an opportunity to add-value to these vegetables during times of abundance so that in a preserved form, they can be made available off-season, their availability may not only address nutrition security, but it may also enhance income for households. Nyembe (2015) lists sun drying as a method that is convenient for almost all producers who are willing to attempt preservation of ILVs. To this end, Nyembe (2015) points out that, the research challenge is finding ways to minimise the loss of nutrients which are associated with sun-drying technologies/methods that the producers may already be familiar with.

Shisanya and Hendriks (2014) argue that, rural areas are commonly characterised by food insecurity, which is a violation of human rights since every human being has a right to food on a daily basis. Ihab *et al.* (2013) identify inconsistent food supply, food quantity and quality, running out of food, lacking money to buy food, skipping meals and ongoing hunger as elements of being food insecure. These elements lead to people in rural areas developing strategies to survive. It is of interest that, South Africa is food secure at a national level; however, research indicates that, this is not the case at household level particularly in rural areas (De Cock *et al.,* 2013). As a strategy to address the problem of food insecurity and sustaining rural livelihoods, surveys indicate that, there are over 7000 plant species across the world that are cultivated or harvested from the wild for food purposes (IGFRI, 2005). These underutilised plant

species which include ILVs play a crucial role in food security, income generation, food culture and can contribute to nutrient requirements of households (Mbhenyane, 2017).

Although ILVs may not be included in the farming system of South Africa, these vegetables are recognised for their contribution to food security and income generation (Schippers, 2000; Abukutsa-Onyango, 2003; Ngugi *et al.,* 2007; Abukutsa, 2011). Besides their diversity in household diets, the consumption of ILVs ensures essential micronutrients that are required to curing and shielding humans against chronic diseases (Hilou *et al.,* 2006; Abukutsa, 2007; Yang and Keding, 2009; Kamga *et al.,* 2013). Even though a few studies have assessed ILVs' consumption patterns (Ruel *et al.,* 2005; Kimiywe *et al.,* 2007; Amaza, 2009; Bundi, 2012; Taruvinga and Nengovhela, 2015), their share in a diet at household level has not been adequately evaluated in African countries which include South Africa. Croft *et al.* (2014) highlight that, the consumption of varying ILVs is influenced by the cultural backgrounds, hence some varieties are only found in certain communities. Up to this point, Gido *et al.* (2016) suggest that, there is a need to promote ILV consumption and marketing through extensive production and knowledge sharing regarding their nutritional importance. This would therefore improve household nutrition status thereby reducing micronutrient deficiency which is common in most rural communities.

2.6.2 Production and contribution of ILVs to dietary diversity

In South Africa, the establishment of ILVs as a business venture is seen by many specialists as not only critically important for the economy of rural dwellers, economically depressed areas, but also for the wellbeing of their inhabitants. Several authors have acknowledged the importance of ILVs in general, particularly in the rural parts of South Africa (Shackleton, 2003; Modi *et al.,* 2006; Jansen van Rensburg *et al.,* 2007; Vorster *et al.,* 2007; Vorster *et al.,* 2008). Shei (2008) argues that, the production and utilisation of ILVs can make a much-needed contribution to better nutrition and income in many African countries. However, there is a serious threat that, many species will fall into negligence in some areas if appropriate countermeasures are not taken. This means that, if these threats could be attended to, the increased production and utilisation of ILVs may be a success and this could lead to diverse diets for producers and their households. Shei (2008) further emphasises that, understanding the nutritional, medicinal, and economic value of ILVs could certainly

add value to the production, consumption, conservation, and regional/ international commercialisation of these vegetables.

Mavengahama (2013) conducted a study on the contribution of ILVs to food security and nutrition with selected sites in South Africa. The study used a desktop study method to review 40 papers from accredited journals by using the search “Household food security in South Africa”. From the 40 reviewed papers, a content analysis was employed to measure the contribution of ILVs to household’s food security. Furthermore, to determine the contribution of ILVs to nutrition, secondary data was used through literature search on “nutritional composition of wild vegetables”. The papers that were reviewed were limited between the years of 2000 to 2010; and content analysis was employed to measure the contribution of ILVs to nutrition security. Therefore, the study concluded that, mixing several indigenous vegetables species in one meal contributes to dietary diversity in terms of more vegetable types as well as in terms of choice of relish. Also, for some very poor families, ILVs become substitutes for some food crops. The study also revealed that, ILVs were important in the diets of most rural people and are consumed as relish although they were not cultivated on large scale.

Bua and Onang (2017) conducted a study on validating the role of African Indigenous Vegetables for food and nutrition security in Uganda. The study used 60 respondents which included farmers, extension officers, opinions and political leadership to validate the role of African Indigenous Vegetables for food and nutrition security in Uganda. The data obtained from the respondents was analysed using SPSS and the results were presented in the form of tables, percentages and frequencies. The study findings revealed that, ILVs form an important part of the diets of the local populace both during the normal and off seasons as well as tough times in other households. Several constraints were however, reported to hinder the ILVs value chain and these constraints included lack of quality seed, competition from exotic vegetables, low market demand, pests and diseases infestation. Msuya and Kyewalyanga (2010) also conducted a study on availability, preference, and consumption of indigenous forest foods in the Eastern Arc Mountains, Tanzania. The primary data was collected through focus group discussions, household interviews, participant observation and botanical surveys. Data from the focus group discussion, the questionnaires and botanical identification was compiled and analysed using SPSS 12.5 (SPSS Inc., 2335 Wacker

Drive, Chicago, IL 60606) and Microsoft Excel. Descriptive statistics such as means, percentages, frequencies and variances were computed and used to describe the data. The study discovered that, the indigenous trees and other plants producing edible products contribute indirectly to household food security by improving the climate, improving soil fertility, and enhancing water conservation and, therefore, increasing land productivity for indigenous forest foods which include ILVs.

Research done in South Africa and other countries shows that, the role of ILVs in improving food security is more significant in vulnerable communities, for several reasons. For instance, ILVs are considered more valuable in enhancing food security for poor people because they are a cheaper source of food (Faber *et al.,* 2010). This is because, these vegetables are typically harvested freely from the wild (Shackleton and Gumbo, 2010). This, therefore, explains easy access of ILVs by rural dwellers, which may translate to diverse diets among households. For grown ILVs, less inputs are required when compared to conventional vegetables (Muhanji *et al.,* 2011). Faber *et al.* (2010) further indicate that, in South Africa, ILVs are more popular in Limpopo and in the KwaZulu-Natal provinces. This explains lack of attention linked to ILVs within the Eastern Cape province. The limited attention may perhaps develop since previous research attributed the difference to the existence of more poverty in the Limpopo province when compared to KwaZulu-Natal and other provinces within the country. Orech *et al.* (2007); Muhanji *et al.* (2011) also argue that, ILVs have a great potential in addressing poverty in vulnerable communities because of their adaptability to the climate, making them more resistant to drought and pests.

2.6.3 Production and contribution of ILVs to Dietary Quality

In South Africa and other countries particularly within the African continent, ILVs are becoming daily food (Vorster *et al.,* 2007). The knowledge of indigenous food has been lost in many South African communities (Lwoga *et al.,* 2010) due to factors such as politics, changes in lifestyle, and stigma associated with the use of indigenous food (Musinguzi *et al.,* 2006). The dietary shift from ILVs to exotic vegetable food sources increased the risk of malnutrition and other nutrition-related non-communicable diseases, especially in poor rural communities. Thus far, farm communities in South Africa have been associated with poor nutritional status and extreme poverty (Mbhenyane, 2017). Given the nutritional status in South Africa, ILVs have been found

to be affordable sources of several micronutrients. However, knowledge of and the use of ILVs is declining (Van der Hoeven, 2013).

Indigenous Leafy Vegetables have long been regarded as minor crops and thus have attracted little marketing attention, with most research and development effort going to major and cash crops (Lyatuu *et al.,* 2009). Yet, many vegetable species of ILVs are known, and are only used locally (Shei, 2008). These vegetables are extremely important for nutrition and farming income throughout Africa, often supplying most of the daily requirements of vitamins A, B complex, and C (ascorbic acid) that are required by a person. In addition, several studies have shown that, utilisation of ILVs is highly valuable because of its substantial contribution to nutrition. Indigenous Leafy Vegetables are noted to contain high levels of minerals especially calcium, iron and phosphorus; they also contain significant amounts of vitamins and proteins (Abukutsa-Onyango, 2003; Habwe *et al.,* 2011). This makes ILVs a valuable source of nutrition in rural areas since they contribute substantially to protein, mineral and vitamin intake (Abukutsa-Onyango, 2003; Chetty, 2013). Makokha and Ombwara (2005) further explain that, ILVs are compatible to use with starchy staple foods and represent affordable but quality nutrient source to the poor segment of the population in both urban and rural areas where malnutrition is most predominant.

Mavengahama (2013) states that, South Africa is rich in biodiversity among the diversity, there are semi-domesticated vegetable species which are known as wild or indigenous vegetables. These vegetables have been reported to be good in nutritional qualities such as macro and micronutrients. However, in the presence of ILVs, there is still a high prevalence of malnutrition; particularly micronutrient deficiencies among low- or marginal-income bracket of the population. Hughes (2008) also confirms that, ILVs are useful in combating hidden hunger by providing the micro-nutrients which are necessary to prevent malnutrition. Previous research validates that, the nutritional value of many ILVs and other indigenous foods including fruits, cereals tubers and roots is no doubt (Hamlin and Latunde-Dada, 2011; Nyembe, 2015). Several authors also recorded ILVs to be containing nutrients such as proteins, copper, iron, potassium, calcium riboflavin, nicotinic acid, vitamins A, B and C, and thiamine (Steyn *et al.,* 2001; Faber *et al.,* 2007; Odhav *et al.,* 2007; Ndlovu and Afolayan, 2008; Afolayan and Jimoh, 2009).

Later, Uusiku *et al.* (2010) conducted a study on the nutritional value of ILVs and their contribution to human health, and the study results confirm that, many ILVs are good sources of micronutrients, particularly vitamin C, iron, zinc, calcium and magnesium. The study used a proximate analysis to determine the amount of nutrient content that is available in ILVs which were grown from the study area. The study results also confirmed that, ILVs may also help to meet daily nutritional requirements, particularly for rural and urban poor communities. Indigenous Leafy Vegetables are also reported to contain levels of micronutrients which are higher than those found in exotic vegetables such as spinach and cabbage (Uusiku *et al.,* 2010). Similarly, Van Jaarsveld *et al.* (2014) conducted a study on the nutrient content of eight ILVs and their potential contribution to dietary reference intake. The ILVs counted included Chinese cabbage, Black nightshade, Pigweed, Jews' mallow, Spider plant, Cowpea, Pumpkin leaves and Tsamma melon. The eight ILVs were planted in one field at the same time and after three weeks these vegetables were harvested at the same time.

The study used a double-blind basis in a South African National Accreditation System (SANAS) accredited laboratory to keep the ILVs samples. Various analytical techniques using proximate analysis were employed to determine macronutrients such as fat, protein, dietary fibre and carbohydrates. To determine micronutrients; that is minerals and vitamins, Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) using proximate analysis was used. The study concluded that, ILVs can potentially make a considerable contribution towards the requirements for nutrients, particularly vitamin A and iron, which are micronutrients of public health significance in South Africa. Similar findings were earlier shared by Steyn *et al.* (2001), arguing that, malnutrition could be addressed by ILVs, given their high nutritional status. Shrestha and Dhilion (2006) also highlight that, the nutritional and health benefits of ILVs as well as indigenous food are well known. Singh and Garg (2006) also confirm that, ILVs are important dietary supplements and sources of elements such as minerals, proteins, folic acid and vitamins for resource poor communities. To address the challenges of malnutrition and nutrition, literature highlights the potential to improve micronutrient intake by increasing the production of ILVs (Modi *et al.,* 2006; Mayekiso *et al.,* 2017).

Also, van der Hoeven *et al.* (2013) conducted research on the Indigenous and Traditional Plants: South African parents' knowledge, perceptions and uses and their

children's sensory acceptance. The study was conducted in two phases. The first phase used qualitative interpretive description approach to explore and describe parents' knowledge and perceptions as well as their use of Indigenous Traditional Plants (ITPs). The second phase used quantitative cross-sectional approach in the form of sensory evaluation to assess children's acceptance of and preference for dishes made with ILVs and Swiss chard. The data was analysed by means of descriptive statistics using SPSS 20 and Atlas.ti6 using the framework as described by Rabiee (2004). The study concluded that, ILVs can be used as a strategy to reduce malnutrition in rural farm communities and inclusion of these micronutrient rich ILVs in school feeding programmes can further improve the nutritional status of children hence increased production should be promoted so as to increase market availability and utilisation of ILVs. Therefore, improved production and use of ILVs have been proposed as part of the solution to the problems of micronutrients and malnutrition particularly among the low-income population groups (Mavengahama, 2013).

Table 2.2: Indigenous Leafy Vegetables and their Macro and Micronutrient components

Table 2.2(a): Macronutrients' availability on ILVs

ILVs	Fibre	Starch	Proteins	Fats	References
Amaranth	■	■	■	■	Habwe *et al.,* 2011; DAFF, 2014
Spider plant leaves	■	■	■	■	Uusuku *et al.,* 2010; Van Jaarsveld *et al.,* 2014
Night shade	■	—	■	—	Uusuku *et al.,* 2010; Van Jaarsveld *et al.,* 2014
Jews mallow	—	■	■	■	Uusuku *et al.,* 2010; Van Jaarsveld *et al.,* 2014
Pumpkin leaves	■	—	■	—	Uusuku *et al.,* 2010; Van Jaarsveld *et al.,* 2014
Cowpea	—	■	■	■	Uusuku *et al.,* 2010; Van Jaarsveld *et al.,* 2014
Purslane	—	—	—	—	DAFF, 2014; Mungofa, 2016
Blackjack	■	■	■	■	Chetty, 2013; Mungofa, 2016

Chinese cabbage	■	■	■	■	Uusuku *et al.,* 2010; Van Jaarsveld *et al.,* 2014
Ethiopian mustard	■	■	■	■	IndigenoVeg, 2006; Weinberger and Pichop, 2009
Slender leaf	■	—	■	—	Gido *et al.,* 2016
Garden egg	■	—	—	—	Habwe *et al.,* 2009; Ayinde *et al.,* 2016
Glossy nightshade	■	—	—	■	Habwe *et al.,* 2009; Ayinde *et al.,* 2016
Fireweed	■	■	—	■	Habwe *et al.,* 2009; Ayinde *et al.,* 2016
Snake tomato	■	■	■	■	Habwe *et al.,* 2009; Ayinde *et al.,* 2016
Huckleberry	—	—	—	—	Habwe *et al.,* 2009; Ayinde *et al.,* 2016
Bitter leaf	■	—	■	—	Habwe *et al.,* 2009; Ayinde *et al.,* 2016
Bologi	*	*	*	*	Ayinde *et al.,* 2016
African cucumber	■	■	■	■	Kwenin *et al.,* 2011
Hibiscus	■	■	■	■	Kwenin *et al.,* 2011
Okra	■	■	■	■	Habwe *et al.,* 2009; Kwenin *et al.,* 2011
Cocoyam	■	■	■	■	Kwenin *et al.,* 2011
Waterleaf	—	—	■	■	Kwenin *et al.,* 2011
Moringa Oleifera	■	■	■	■	Kwenin *et al.,* 2011; Taleni and Goduka 2012
Sweet potato leaves	■	■	■	■	Kwenin *et al.,* 2011; Taleni and Goduka 2012
Cassava	■	■	■	■	Kwenin *et al.,* 2011
Wild lettuce	■	■	■	■	Kwenin *et al.,* 2011

Key: *Presence of nutrient in ILV = ■; Absence of nutrient in ILV = —; Unknown components=**

Source: Author's compilation

Table 2.2(b): Micronutrients' (Vitamins) availability on ILVs

ILVs	Vit. A	Vit. B	Vit. C	Vit. D	Vit. E	Vit. K	References
Amaranth	—	■	■	—	■	■	Odhav *et al.,* 2007; Uusuku *et al.,* 2010; Mungofa, 2016
Spider plant leaves	—	■	■	—	—	■	Kwenin *et al.,* 2011; Gido *et al.,* 2016

Night shade	—	■	■	—	—	■	Uusuku *et al.,* 2010; Gido *et al.,* 2016
Jews mallow	■	■	■	—	—	■	Kwenin *et al.,* 2011; Mungofa, 2016
Pumpkin leaves	■	■	■	—	■	■	Kwenin *et al.,* 2011; Gido *et al.,* 2016
Cowpea	■	—	■	—	—	■	Kwenin *et al.,* 2011; DAFF, 2014; Gido *et al.,* 2016
Purslane	■	■	■	—	■	■	Jansen Van Rensburg *et al.*, 2007; Kwenin *et al.,* 2011
Blackjack	—	■	■	—	—	—	Mishra *et al.,* 2011; DAFF, 2014
Chinese cabbage	■	—	■	—	—	■	Odhav *et al.,* 2007; Shackelton *et al.,* 2010; Mungofa, 2016
Ethiopian mustard	■	■	■	—	—	—	Kwenin *et al.,* 2011
Slender leaf	—	—	■	—	—	■	Habwe *et al.,* 2009; Gido *et al.,* 2016
Garden egg plant	—	■	■	—	—	■	Otitoju *et al.,* 2014; Ayinde *et al.,* 2016
Glossy nightshade	—	■	■	—	—	■	Odhav *et al.,* 2007; Njume *et al.,* 2014
Fireweed	■	■	■	■	—	■	Otitoju *et al.,* 2014; Ayinde *et al.,* 2016
Snake tomato	■	—	■	—	■	■	Otitoju *et al.,* 2014; Njume *et al.,* 2014; Ayinde *et al.,* 2016
Huckleberry	■	■	■	—	—	■	Ayinde *et al.,* 2016
Bitter leaf	■	■	■	—	■	■	Ayinde *et al.,* 2016; Gido *et al.,* 2016
Bologi	*	*	*	*	*	*	Ayinde *et al.,* 2016

African cucumber	■	■	■	—	—	■	Kwenin *et al.,* 2011
Hibiscus	■	■	■	■	—	■	Aleni, 2017
Okra	■	■	■	■	—	■	Weinberger and Pichop, 2009; Aleni, 2017
Cocoyam	■	■	■	—	—	■	Kwenin *et al.,* 2011
Waterleaf	■	—	■	—	—	—	Odhav *et al.,* 2007; Uusuku *et al.,* 2010
Moringa Oleifera	■	■	■	—	—	—	Odhav *et al.,* 2007; Kwenin *et al.,* 2011; Manyelo *et al.,* 2015
Sweet potato leaves	■	■	■	—	—	■	Weinberger and Pichop, 2009; Kwenin *et al.,* 2011; Chetty, 2013
Cassava	—	■	■	—	—	■	Ndlovu and Afolayan, 2008; Kwenin *et al.,* 2011
Wild lettuce	—	■	■	—	—	■	Kwenin *et al.,* 2011

Key: *Presence of nutrient in ILV = ■; Absence of nutrient in ILV = —; Unknown components=**

Source: Author's compilation

Table 2.2(c): Micronutrients' (Minerals) availability on ILVs

ILVs	Fe	Ca	P	Na	Zn	Mg	References
Amaranth	■	■	■	■	■	■	Weinberger and Pichop, 2009; Mungofa, 2016
Spider plant leaves	■	■	■	■	■	■	Kwenin *et al.,* 2011; Aleni, 2017
Night shade	■	■	■	■	■	■	Weinberger and Pichop, 2009; Njume *et al.,* 2014; Aleni, 2017
Jews mallow	■	■	■	—	■	■	Aleni, 2017
Pumpkin leaves	■	■	■	■	■	■	Weinberger and Pichop, 2009; Otitoju *et al.,* 2014
Cowpea	■	■	■	■	■	■	Weinberger and Pichop, 2009; Aleni, 2017

Purslane	■	■	■	—	■	■	Kwenin *et al.,* 2011
Blackjack	■	—	—	—	■	—	DAFF, 2014; Mungofa, 2016
Chinese cabbage	■	■	■	■	—	■	Jansen Van Rensburg *et al.,* 2007
Ethiopian mustard	■	■	—	■	■	—	Weinberger and Pichop, 2009; Aleni, 2017
Slender leaf	■	■	■	■	■	■	Gido *et al.,* 2016
Garden egg	■		■	—	—	■	Otitoju *et al.,* 2014; Ayinde *et al.,* 2016
Glossy nightshade	■	■	■	■	■	■	Weinberger and Pichop, 2009, Kwenin *et al.,* 2011
Fireweed	■	—	—	■	—	■	Otitoju *et al.,* 2014; Ayinde *et al.,* 2016
Snake tomato	■	■	■	■	■	■	Ayinde *et al.,* 2016
Huckleberry	—	—	—	—	—	—	Otitoju *et al.,* 2014; Ayinde *et al.,* 2016
Bitter leaf	■	■	■	—	■	■	Ayinde *et al.,* 2016
Bologi	*	*	*	*	*	*	Ayinde *et al.,* 2016
African cucumber	■	■	■	—	—	■	Kwenin *et al.,* 2011
Hibiscus	■	■	—	■	—	■	Aleni, 2017
Okra	■	■	■	—	—	■	Weinberger and Pichop, 2009; Kwenin *et al.,* 2011
Cocoyam	■	■	■	■	—	—	Kwenin *et al.,* 2011
Waterleaf	■	—	■	—	—	—	Kwenin *et al.,* 2011
Moringa Oleifera	■	—	■	—	■	—	Kwenin *et al.,* 2011
Sweet potato leaves	■	■	■	■	■	■	Weinberger and Pichop, 2009; Kwenin *et al.,* 2011
Cassava	■	■	■	■	■	■	Kwenin *et al.,* 2011
Wild lettuce	■	—	■	—	—	—	Kwenin *et al.,* 2011

***Key**: Presence of nutrient in ILV = ■; Absence of nutrient in ILV = ▬; Unknown components=**

Source: Author's compilation

2.7 Indigenous Leafy Vegetables production value chain in South Africa

The importance of ILVs is increasing because these vegetables have a potential to address nutrition and food security. It is therefore important for producers to understand interactions of various actors that take part in the value chains to find ways to add value to their production systems in order to maximise returns experienced from producing ILVs (Chagomoka *et al.,* 2014). Also, producers need to understand how ILV markets operate, how these marketplaces can be positioned to operate efficiently and how to position their products strategically within a marketing chain (Lundy *et al.,* 2004). Shackleton *et al.* (2009) also report that, in South Africa, most of the ILVs that are in the market are collected, they are not cultivated, and such collection activities occur from people's own fields, disturbed sites or on commercial farms where landowners permit harvesting of what they consider to be weeds. Thus far, this makes it difficult to identify the exact role players in the ILV chain since the production of these vegetables is not done in a conventional manner.

Indigenous Leafy Vegetable's production is mostly done on a subsistence level by small-scale farmers and women play an important role at this level. Muchara *et al.* (2018) show from a survey of advanced agricultural systems in the world that, a quarter of the production system has both male and female sharing equally while half is the exclusive domain of females and about one fifth is the exclusive domain of males. The women's role in food production, water and fuel supply cannot be underestimated as they are the original producers of food in the world. Generally, men tend to prefer producing crops exclusively for sale (cash crops) due to gender roles and power structures, while most women hope for welfare returns for their families. Stokoe (2000); Nguni and Mwila (2007) suggest that, women should be the target group for discovering the utilisation and production of ILVs because these vegetables are still mainly subsistence crops. To this end, this explains that women are the reliable role players in the production system of ILVs which translate them to belong to the ILV chain as dominant producers of ILVs when compared to males.

According to Abukutsa-Onyango (2007), ILVs are known for their potential as commercial vegetables and the realisation of their potential has renewed interest in

these vegetables with policy makers increasingly recognising them as vegetable sources. These vegetables are produced in different communities in Africa and for various reasons. However, South Africa experiences a lack of readily available vegetables as a result of seasonality unlike other countries such as Kenya, Tanzania (Muchoki *et al.,* 2007). In addition, South African communities have made use of ILVs for many generations (Grubben and Denton, 2004) yet, these vegetables and the products that are made from them remain in the informal markets and at small-scale level of production within South Africa (Senyolo *et al.,* 2018). Muchara *et al.* (2018) record common challenges experienced in the production of ILVs and these challenges included pests, poor seed quality, drought, lack of transport to markets, lack of agronomic and utilisation information and poor marketing channels. With the given ILVs production challenges, it evident that, these challenges inhibit production and lower the supply of these vegetables to the consumers hence they are commonly available in the informal markets and limited to certain vegetables.

There are few studies which are conducted to investigate ILV production value chains and related subjects in Southern Africa (Lenné and Ward, 2010; Shackleton *et al.,* 2010; Weinberger *et al.,* 2011; Chagomoka *et al.,* 2014; Bidogeza *et al.,* 2016). Previous research on ILVs focuses on production systems' characteristics of ILVs, nutritional attributes of ILVs, the nature of ILV marketing outlets, and women participation in the production and marketing of ILVs, rather than the entire value chain, particularly from seed production and distribution through to produce marketing (Chagomoka *et al.,* 2014). In South Africa, little research has been done to assess and investigate the relationship between the value chain actors along the ILV production value chains. A study recently conducted by Senyolo *et al.* (2018) used a Value Chain Approach (VCA), which reflects on the various activities from production to the delivery of ILVs to final consumers. This approach was used with an aim to discover unexploited possibilities and line up interventions that might improve operations at various levels of the ILV production chain (Chitundu *et al.,* 2009). The aim of the study was to analyse the value chain of African Leafy Vegetables (ALVs) in the Limpopo Province with a special emphasis on value chain actors, institutions governing the chain, and the infrastructural endowments. To this end, the study identified input suppliers, farmer traders and consumers as actors in the ILV production value chain. The study further mapped out value chain interventions that are needed to improve

the production, processing, and marketing of ALVs in the province and beyond. These interventions included awareness of ILV production to commercial farmers, promotion and dissemination of information on production techniques of ILVs, informing consumers about the health and environmental benefits of ILVs, production of quality ILVs and creation of strong farmer associations for consistent supply, encouraging all actors to participate in marketing of ILVs and encouraging public and private sectors to invest in processing activities.

2.8 Summary

In summary, literature highlights that in South Africa, the production of ILVs is women dominated. This explains that gender is one of the producer's characteristics which affect production of ILVs. The literature further generalises other socio-economic factors such as the loss of indigenous knowledge, level of education, level of income and age as factors which limits production of ILVs. Given the cultivation status of ILVs in South Africa, literature states that, the availability of ILVs depends mostly on collection rather than cultivation. The few that are cultivated are recorded to require less inputs when compared to exotic vegetable production.

According to the literature, ILVs are not largely included in the farming system of South Africa, yet these vegetables are known to have a potential towards contribution to income and food security. Also, the production of ILVs remains in lower volumes and this necessitates policy makers, government and agricultural farming system in South Africa to develop and implement ways which may authenticate increased production of ILVs. In this manner, ILVs may be commonly used as on one of the available natural resources to improve rural livelihoods through income generation and food security. In addition, previous research indicates that, there is limited literature which is available concerning ILV production value chain. This gives a rise to a need for further research relating to ILV value chain by researchers. The available literature only identifies the role players in ILV production value chain and the challenges that are encountered in the production of ILVs by the role players. To conclude, the literature is not specifically presenting the functions of the ILV role players so to enhance production of ILVs. This therefore calls for further research on the subject matter so to fill the missing gap concerning the functions of ILV role players. The following chapter

presents a detailed description of the study area together with research methodology and analytical procedures used in the study.

CHAPTER THREE

DESCRIPTION OF THE STUDY AREA, RESEARCH METHODOLOGY AND ANALYTICAL PROCEDURES

3.0 Introduction

This chapter gives a detailed description of the study area and further outlines the specific areas which the study focused on, including their geographical locations. The chapter also presents in detail, the environmental condition for the areas which the study focused on; that is the rainfall, temperatures, the vegetation, biodiversity and hydrology. The chapter further presents the research methods and design used in this study. This means that the details of the research techniques used in the study are explained and thereafter followed by the instruments that were used to gather different types of data for the study. This section further discusses the sampling procedure, data sources and statistical analytical techniques employed by the study.

3.1 Description of the study area

This study was conducted in the Eastern Cape Province of South Africa. Eastern Cape Province (ECP) is located on the south-eastern part of South Africa and is the second largest province in the country. The province has a population of about 7 million and is divided into six district municipalities, namely OR Tambo, Alfred Nzo, Chris Hani, Amatole, Joe Gqabi and Sarah Baartman as well as two metropoles of Nelson Mandela Bay and Buffalo City (Eastern Cape Development Corporation, 2018). According to the South African Department of Agriculture (2004), most people in the province largely depend on the land and its natural resources which include ILVs to supplement their household needs and this trend does not seem to change even now (Eastern Cape Development Corporation, 2018). The study focused on three district municipalities within the province; which were OR Tambo, Alfred Nzo and Joe Gqabi. According to the Eastern Cape Development Corporation (2018), these three district municipalities are among the districts that are affected by poverty and food insecurity shocks within the province, while these districts are noted to be rich in several ILVs which could assist residents of the district municipalities in sustaining their livelihoods. Hence these three district municipalities were chosen for the purposes of the study. A map showing the Eastern Cape Province with its district and metro municipalities is presented in Figure 3.1 below with study areas highlighted in the map.

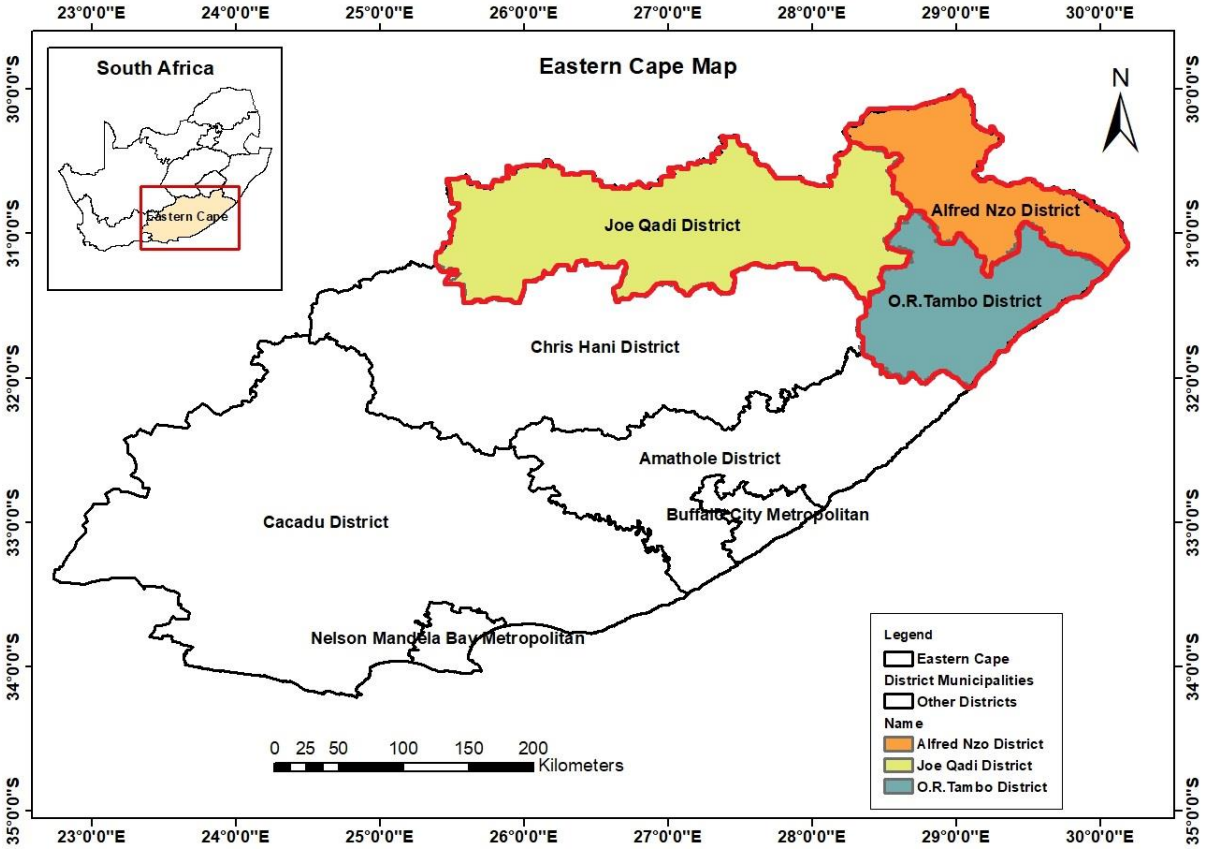

Figure 3.1: Map of the Eastern Cape Province

Source: ARC-GIS 10.6

3.2 Climate of the Eastern Cape Province

The Eastern Cape is situated between Kwa-Zulu Natal and the Western Cape and its climate is a mixture of the two provinces. Its coastal cities experiences both a subtropical and Mediterranean climate while inland areas get a bit hotter. The province is quite large, and it stretches from the coast to more mountainous escarpment regions inland, resulting in a climate that varies from one place to another (ORTDM IDP, 2017).

The main factor that influences the various towns and cities in the Eastern Cape Province is the topographical features which can be found in the province. The inland areas are separated by a great escarpment which easily divides the region into northern and southern areas. The northern areas generally have a high altitude and little water, which results in semi-arid conditions that characterise regions such as the Karoo. On the southern part of the province, the climate is quite different since several rivers trickle down from the mountains and provide an ample supply of water (Eastern Cape Development Corporation, 2018).

These well-watered areas feature wetland fauna and flora, and many consider them to be more inviting than the northern areas. The northern areas generally have hotter days and colder nights while the southern areas experience a higher rainfall (Eastern Cape Development Corporation, 2018).

In general, the coastal areas experience more wind and higher levels of humidity. The humidity increases the closer one gets to Kwa-Zulu Natal and decreases closer to the Western Cape. The inland areas are usually drier and hotter and there is a lower rainfall level as compared to the coastal areas. In summer, temperatures range from 16º to 26º C while winter temperatures range from 7º to 20º C (Eastern Cape Development Corporation, 2018). Winter months fall between April and August while summer temperatures are usually highest between November and April. The three district municipalities in the Eastern Cape province which the study focused on, are discussed in detail as follows.

3.3 OR Tambo District Municipality

The OR Tambo District Municipality (ORTDM) is located to the east of the Eastern Cape Province, on the coastline. It is bordered by the Alfred Nzo District Municipality to the north, the Joe Gqabi District Municipality to the north-west, the Amathole District Municipality to the south-west, and the Chris Hani District Municipality to the west. The municipality is formed by five local municipalities which include King Sabata Dalindyebo, Nyandeni, Mhlontlo, Port St Johns and Ingquza Hill. Furthermore, the ORTDM covers about 80% (ORTDM IDP, 2017) of what used to be marginalised homeland in the Transkei and is one of the four Integrated Sustainable Rural Development Programme (ISRDP) nodes in the province. A map showing the ORTDM with its local municipalities (inclusive the number of wards found per each local municipality) is presented in Figure 3.2 below.

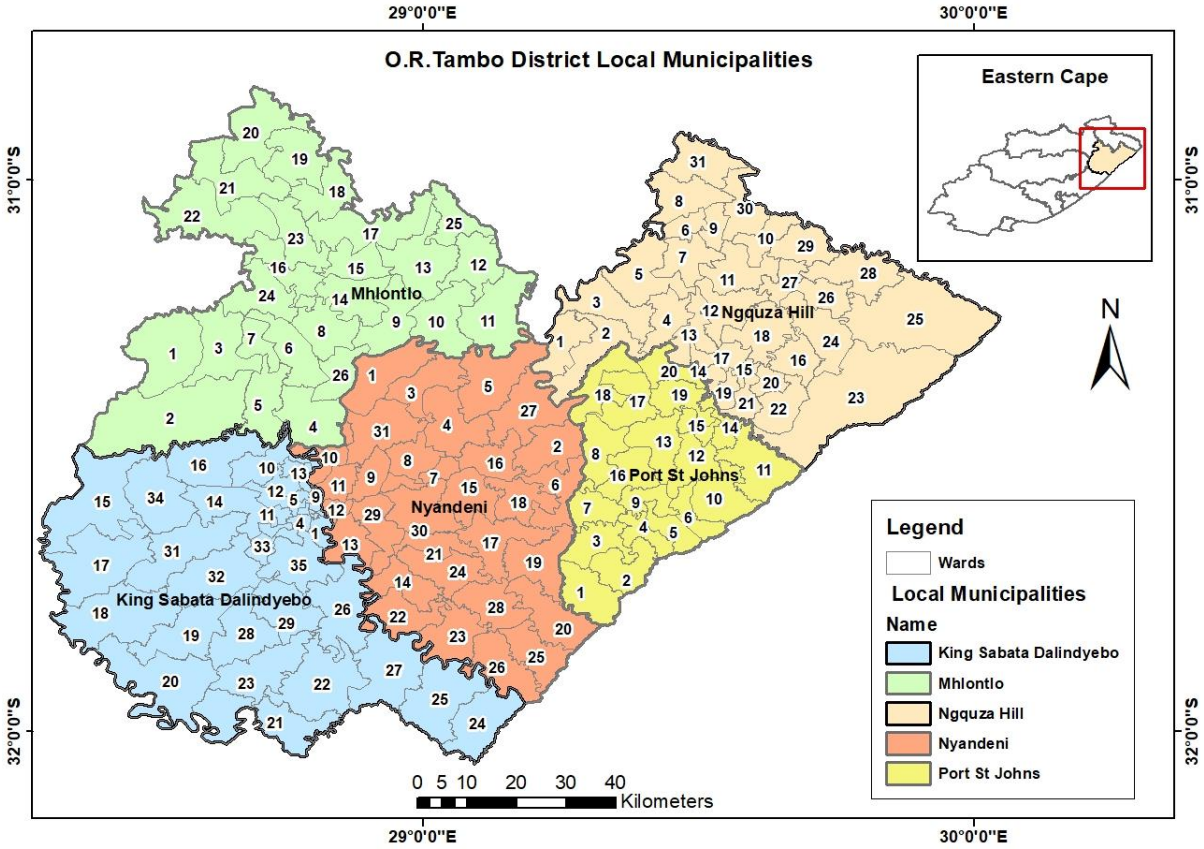

Figure 3.2: OR Tambo Municipality District Map

Source: ARC-GIS 10.6

3.3.1 Economic activities practised by residents of OR Tambo District municipality

According to the (ORTDM IDP, 2017), the OR Tambo District Municipality's vision is that of a municipality which is responsive to social aspirations and for an economically vibrant, healthy and sustainable community. However, the District faces a declining economy, high levels of poverty, underdevelopment, infrastructure backlogs, as well as reliance on the government sector (Eastern Cape Development Corporation, 2018). As a strategy to address these challenges, the municipality established a development agency which was later converted into Municipal entity in 2003 and was named Ntinga OR Tambo Development agency. This entity became an implementing agent which focuses on agriculture and food production, mari-culture and tourism, social infrastructure and services, institutional building, strategic infrastructure such as rail, dams, electrification, roads (priority surfaced and rural roads; and any other functions delegated to Ntinga by the ORTDM. To this end, the economy of the district centres on the following four key economic drivers and these are agriculture, tourism, forestry, mari-culture and aquaculture (ORTDM IDP, 2017).

The municipality has identified, amongst other economic drivers, agriculture, as a key driver for local economic development in the district. Although the agricultural sector does not largely contribute to the district's GDP yet, it still maintains a small contribution of 1.7% of the district's GDP (ORTDM IDP, 2017). Despite this, the agricultural sector retains its position as the backbone of rural livelihoods in large rural areas of the district. Hence the district's population is largely in rural settlements and is considered to have rich natural resources, which gives it a competitive advantage, whilst creating developmental opportunities in agriculture (Eastern Cape Development Corporation, 2017). These natural resources include ILVs which may be used to improve the district's economy if they were to be included in the farming system. Therefore, the importance of agriculture in the district cannot be underestimated as an informal rural based activity. This is because, if the consideration is taken on the rural based agriculture in the district, the sector becomes an integral component of the ORTDM's Local Economic Development (LED) landscape through its ability to provide for community livelihoods, generating employment and fighting prevalent poverty in the District (ORTDM IDP, 2017).

With regards to crop production within the district, research trials have been conducted for high value crops such as Cotton, Sunflower and Cassava. The Kei Fresh Produce Market (KFPM) seeks to increase Potato and Banana production in the district while working in partnership with ASGISA-EC. A farmer support unit has also been established within the KFPM to assist local farmers with the development of quality produce and the ability to market their products in the region. As evidence to improve the economy of the district through agriculture, in April 2008 the district municipality purchased seven farms (Adam Kok Farms) in the juristic area of Kokstad, KwaZulu Natal, namely: Woodville 1; Woodville 2; Shallom, Erin; The Lease; Fairfield and Llewellyn (ORTDM IDP, 2017). The main purpose for the acquisition of these farms, was to generate revenue and be an incubator for the development and training of local emerging farmers. Currently, these farms are operating with the equipment that was originally acquired when the farms were bought (ORTDM IDP, 2017). A study has been conducted on the viability proposals for full use of the farms. The district municipality plans to implement a turnaround strategy for effective and efficient use of the farms with the recommendations from the study.

It is also reported that, agriculture comprises approximately up to 50% of the Eastern Cape province GDP and provides 12% of the Province's formal sector employment (Eastern Cape Development Corporation, 2017). Within the Eastern Cape agricultural economy, livestock and livestock products are the single biggest sub-sectors with an estimated gross income value of R2.4 billion per annum (Department of Agriculture, Forestry and Fisheries, 2015). This represents 70% of the Eastern Cape's gross agricultural income. Livestock farming within the ORTDM is by far the biggest livestock farming practice in communal farming in South Africa, incorporating 631 674 cattle, 732 478 goats and 1 225 244 sheep (Eastern Cape Department of Agriculture and Land Affairs, 2016) In recognition of this, the municipality has a Livestock Improvement Programme (LIP), which encompasses of the following programmes: Beef Development Programme; Iqhayiya Sheep and Wool Production and Laphumilanga Goat Production Programme.

The aim of the programme is to increase the income of communal cattle farmers by assisting them to realise higher prices for their livestock by increasing their participation in the formal marketing channels. The programme is also aiming on improving the quality of the animals marketed, by increasing farmer's access to veterinary and feed input markets, facilitating exchange of bulls, heifers and goats within the local livestock farmers. This is believed to improve the genetic make-up and appointing mentors from within communities to provide technical advice to ensure care, safety, and access to information through community participation (Eastern Cape Development Corporation, 2018).

Given the economic background of the district, seems like the district mostly invests in the agricultural sector as the sector has a potential to boost the economy of the Municipality. This means that, the inclusion of ILVs in the farming system of the district may also have a potential to improve revenues realised by the farmers which may ultimately translate to improved economy for ORTDM as well as enhanced food security for the district.

3.3.2 Agro-ecological survey of OR Tambo District Municipality

a) Rainfall

The ORTDM receives an annual rainfall of above 800 mm and the rainfall steadily decreases in inlands and is particularly low in major river valleys. There is appreciable

rain fall during winter months in the coastal areas, but inland areas receive 80% or more of their precipitation from October to March for example, Mthatha receives about 81% rainfall per annum (ORTDM IDP, 2017).

b) Temperature

The temperatures of ORTDM range from a mean minimum of 14.3 to 19.8°C in January and 1.8 to 13.4°C in July to a mean maximum of 14.3 to 25.3°C in January and 19.5 to 21.4°C in July (ORTDM IDP, 2017).

c) Vegetation

The environment of the ORTDM area has a wide range of habitats including inland and coastal grassland, afromontane and coastal forest, valley thicket, thorny bushveld, coastal and marine habitats. The area has two components that are of interest to tourists. The coastal forests, bushveld and grassland of the Pondoland area north of Mbotyi have been identified as a “centre of plant endemism”, with more than 130 species of plants that are not found anywhere else in the world including the Pondoland coconut palm (Eastern Cape Development Corporation, 2018). These plants can be used as vegetables, fruit or medicine by local residencies. This terrestrial biodiversity is matched by extremely rich marine biodiversity and by many endemic fish species. In summary, given the annual rainfall, temperatures, and vegetation nature in ORTDM, larger production of ILVs is highly possible from the district as previous reviews acknowledge that ILVs strive well in different climatic conditions. This is because, previous literature also reports that these vegetables can depend only on rain feed to grow. Additionally, vegetation in the district is also diverse with some of the vegetation classified as ILVs, this could possibly promote seed availability of these vegetables. This is because input markets for ILVs are still limited and seed availability may perhaps improve production of ILVs in the district.

3.3.3 Biodiversity Conservation and hydrology

The district has an international and well renowned wild coast identified as a biodiversity priority area in National Spatial Biodiversity Assessment for South Africa (Eastern Cape Development Corporation, 2017). In addition, there are five protected areas in the ORTDM, namely Mkambati, Silaka, Hluleka, Nduli and Luchaba (ORTDM IDP, 2017). Numerous indigenous coastal forests and mist belt and affromontane

forests can be found as well as wetland areas particularly along the coast. The district is also characterised by major rivers and supporting abundant aquatic life associated with these rivers are pristine estuarine environment. Biodiversity provides goods and services particularly for the subsistence rural people in terms of food, fuel wood, grazing, as well as consumptive value such as grasses, reeds, forests produce, marine resources and estuarine (ORTDM IDP, 2017).

3.4 Alfred Nzo District Municipality

The Alfred Nzo District Municipality (ANDM) is in the north-eastern corner of the Eastern Cape Province. It stretches from the Drakensberg Mountains, bordering the former Harry Gwala District Municipality to the north, OR Tambo District Municipality in the south and east, and Lesotho in the west. Alfred Nzo is the smallest district in the province, covering only 6% of the geographical area (ANDM IDP, 2016). The municipality is comprised of the Matatiele, Ntabankulu, Mbizana and Umzimvubu local Municipalities. The map showing the ANDM inclusive the number of wards found per each local municipality is presented in Figure 3.3 below.

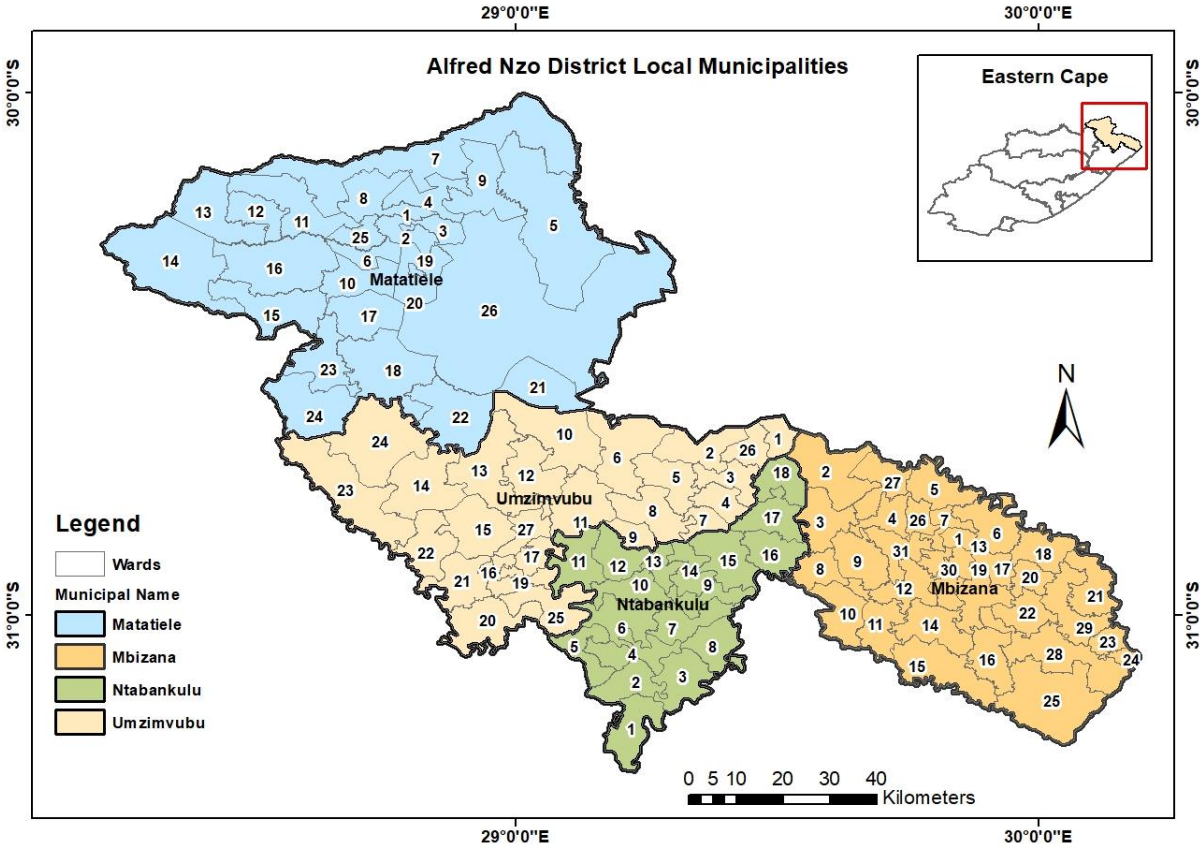

Figure 3.3: Map of Alfred Nzo District Municipality

Source: ARC-GIS 10.6

3.4.1 Economic activities practised by residents of Alfred Nzo District Municipality

Looking at the size of Alfred Nzo's economy, recent research discovered that, the district has the lowest contribution (5%) to the Eastern Cape economy and this contribution is mostly generated by Government, Trade and finance sectors (Department of Trade and Industry, 2017). Regardless of the contribution from other sectors, agriculture is the main economic activity in the district. Currently, it has a limited base for economic expansion since most of the farming is traditional subsistence farming. Commercial farming is limited to the Cedarville area in the north east of the district (ANDM IDP, 2016).

The district has favourable conditions for the development of the agricultural sector, and it is therefore vital to assess the potential of this industry and invent methods of exploiting this unexploited potential (ANDM IDP, 2016). The district has also been selected as one of the regions to undertake the implementation of Agri Parks initiative since it is one of the 27 poorest district municipalities in the country (ANDM IDP, 2016). This initiative came as one of the South African president's interventions to transform rural economies. Furthermore, this initiative is directly in line with the Agricultural Policy Action Plan and the district Grain Production Master Plan which has the envisaged objective of increasing the level of production within the agricultural sector. These initiatives may therefore reduce unemployment and increase economic growth and development. It is predicted that, ILV production can be considered as one of the strategies to increase economic growth and development in the district. This is true since ILVs have the potential to boost the economic growth as these vegetables require minimal inputs for production and producing ILVs could also be an advantage because the district is reported to have unfavourable conditions for agriculture in terms of crop production. This would only be a success if the production of ILVs was to be included in the vegetable production system.

3.4.2 Agro-ecological survey of Alfred Nzo District Municipality

a) Rainfall

ANDM climatic conditions are influenced by the orographic effect of the Drakensberg Mountains. Rainfall is high with an average between 900mm-1500mm annually. Rainfall decreases gradually easterly away from the escarpment. The ANDM is

summer rainfall region that, it receives rainfall from October to March (ANDM IDP, 2016).

b) Temperatures

The area is characterised by cold winter seasons with snow in high-lying areas. The average temperatures range between 7 to 10°C in winter and 18 to 24°C in summer (ANDM IDP, 2016).

c) Vegetation

The vegetation of the ANDM is mostly grassland with pockets of indigenous forest. About 5% of the district's land area (or 50,000 ha) is judged to have high potential for arable farming and ANDM is very scenic (ANDM IDP, 2016). Looking at rainfall, temperatures, and vegetation from ANDM, the district has harsh climatic conditions, and these climatic conditions are likely to cause failure of crops such as commercial/exotic crops. Therefore, it would be of advantage to focus on greater production of ILVs as these vegetables are known to withstand harsh climatic conditions to grow and require minimal inputs for production when compared to exotic crops. The vegetation for the district is limited to specific vegetation types and this may possibly hamper the availability of ILVs in larger scale.

3.4.3 Biodiversity conservation and hydrology

The high human population density in the communal areas of ANDM resulted to negative impacts on biodiversity since habitat transformation is a key driver of biodiversity change which becomes an important indicator to measure biodiversity loss. Thus far, ANDM has 0–10% threatened plant species; which endangered quarter degree coverage and 10%–20% vulnerable plant species; that is vulnerable quarter degree coverage (ANDM IDP, 2016). The northern parts of the municipality which are at high altitude fall within the Drakensberg centre of endemism, which is almost exclusively in the Grassland biome with overall endemism around 18% (Eastern Cape Development Corporation, 2018). This means that, ANDM is one of the municipalities within the ECP which are under threat in terms of habitat loss which in turn exercise pressures on the environment.

To this end, there are three main vegetation types that occur around the ANDM, these include Savanna, Grassland and Coastal belt biomes (Eastern Cape Development Corporation, 2017). Of these vegetation types, the most threatened vegetation type is the Grassland as it predominantly occurs across the district. The mountainous character of the district has given rise to a reticulation of deeply incised valleys many of which have rivers and perennial streams. Apart from this network of rivers and streams, there are areas of vast wetlands (in the north west of the district) which are not associated with any stream or river systems (Eastern Cape Development Corporation, 2017).

Rivers originate from the Drakensburg Mountain in mainly a south easterly direction. The health of the river systems within the district are described as vulnerable and endangered due to poor land use and development pressures. The sources of these rivers are particularly threatened by these poor land uses and do not only impact on water quality but also affect aquatic biodiversity wetlands of ecological significance which are mainly found in the north western part of the district (ANDM IDP, 2016). Wetlands are important habitats for freshwater as well as terrestrial animals and are therefore protected areas under environmental legislation of the country. Alien plants have a major impact on biodiversity and are one of the major threats to biodiversity within the ANDM.

3.5 Joe Gqabi District Municipality

The Joe Gqabi District Municipality (previously Ukhahlamba District Municipality) is located within the Eastern Cape Province. It borders the Free State Province and Lesotho to the north. The municipality is located to the north of the OR Tambo and Chris Hani District Municipalities, to the east of the Northern Cape, and to the west of Alfred Nzo District Municipality (JGDM IDP, 2016).

The Joe Gqabi District Municipality (JGDM) lies approximately 34km north of Komani (Queenstown) and its northern border is formed by the Orange River, which also forms the southern boundary of the Free State (JGDM IDP, 2016). It consists of three local municipalities; Elundini, Walter Sisulu (formed by previously known as Gariep and Maletswai local municipalities) and Senqu. Aliwal North is the main commercial and tourism centre of district. A map showing JGDM and its local municipalities (with number of wards found per each local municipality) is presented in Figure 3.4 below.

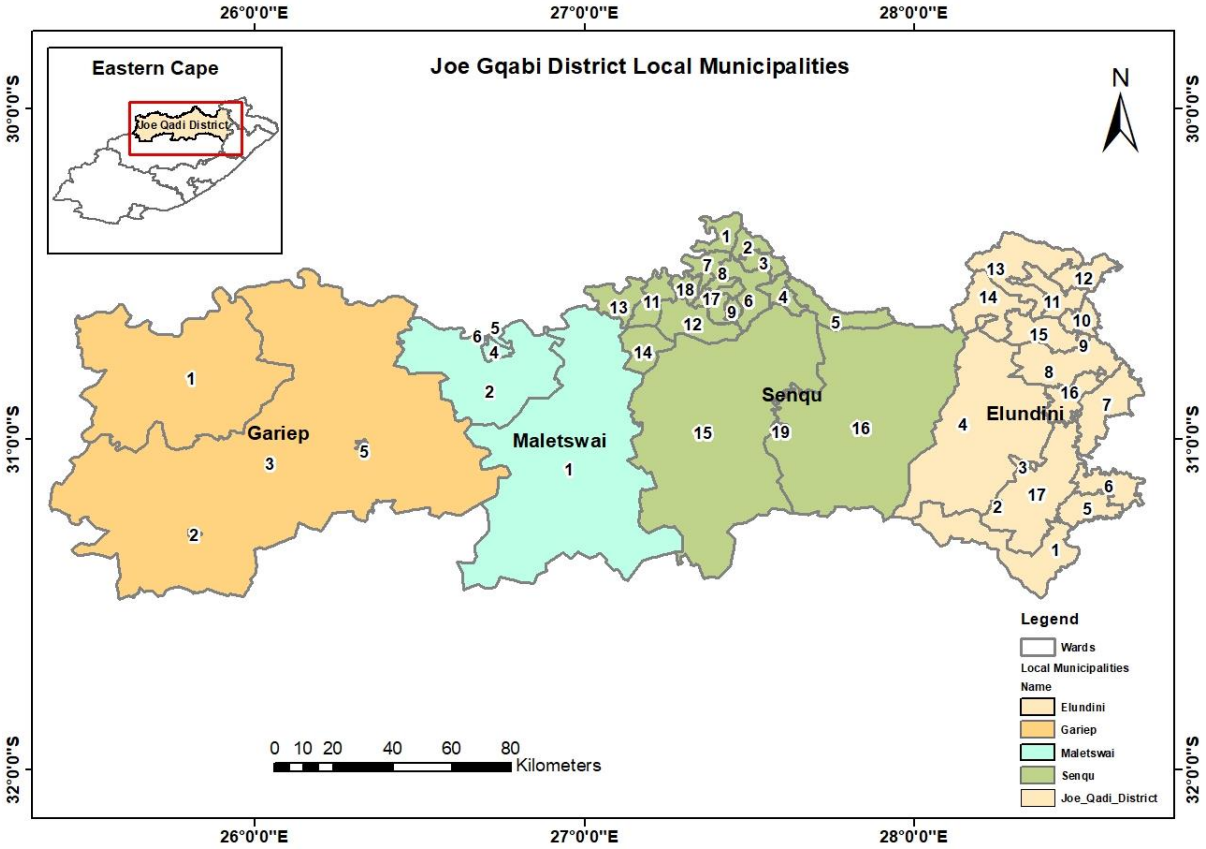

Figure 3.4: Map of Joe Gqabi District Municipality

Source: ARC-GIS 10.6

3.5.1 Economic activities practised by residents of Joe Gqabi District Municipality

Joe Gqabi District Municipality formerly known as Ukhahlamba, is overwhelmingly rural with land issues which include access to land and limited land that can sustain intensive farming (Eastern Cape Development Corporation, 2018). Thus far, within the three local municipalities in the district, the government is the largest employer with social grants being an important component of household income (Department of Cooperative Governance and Traditional Affairs, 2017). According to the JGDM IDP (2016), agriculture is the largest contributor to the economy of this district. However, of the 25666300 hectares of land within JGDM, only 233 hectares is of high potential arable land with limited rain-fed arable land for crop production, irrigation schemes and stock farming playing a significant role in agriculture (JGDM, 2017). Furthermore, intensive farming only occurs in areas where water and infrastructure are available. The limited land which can sustain intensive farming and the land which has been identified as having a high agricultural potential is currently reserved for farming with an aim to enhance food security and subsequently economic welfare since agriculture is the largest contributor to the district's economy (JGDM, 2017).

To this end, given the agricultural contribution to the district's economy in the presence of the benefits associated with ILVs in terms of production, there would be an expectation to consider producing ILVs on a larger scale. This is because literature concerning the production of ILVs highlights that, these vegetables require minimal inputs for production, and they can resist harsh climatic conditions where most exotic vegetables fail to grow as the district is mostly characterised by harsh climatic conditions. An advantage therefore needs to be taken to produce ILVs particularly now that the district is reserving some of the land available for agricultural use. This could possibly sustain the livelihoods not only by addressing food insecurity crisis but to sustain other livelihood needs for the communities through income generation and employment opportunities.

3.5.2 Agro-ecological survey of Joe Gqabi District Municipality

a) Rainfall

The JGDM is divided into four rainfall zones that is, some of the higher mountain peaks have between 800mm and 1200 mm of rainfall per year. The eastern part of the district has between 600mm and 800mm of rainfall per annum, the central area has between 400mm and 500mm, and the western area (Venterstad, Steynsburg and most of Burgersdorp) has less than 500mm per year. For this district, 500mm of rain a year is regarded as the minimum amount required for sustainable (dry land) crop production (JGDM IDP, 2016). The inconsistency of rainfall from the district allows the area to be limited only to dry land crop production. With the inconsistency of rainfall from the district, residents should consider focusing on production of ILVs over other crop production practices in the area. This may not only improve production of ILVs, but this may also help residents to minimise costs of production when comparing to production expenses of exotic vegetables in the area.

b) Temperature

The district is well known for its temperature fluctuations, with temperatures ranging between 42°C and minus 11°C. On average, there are 150 days of frost during the year, usually between March and November, including snow, particularly in Senqu and Elundini (JGDM IDP, 2016). Snow has also been known to fall on the higher lying areas of the Walter Sisulu Local Municipality. The district is affected by unseasonal

frost and cold which have a negative impact on agriculture (JGDM, 2017). The area is only suitable for less sensitive crops due to this harsh climate (JGDM, 2017). Elundini is lower in altitude and experiences warmer winters and this enables this part of the district to be more suitable for cultivation of certain crops.

c) Vegetation

Vegetation types represent an integration of the climate, soils and biological factors in a region which are useful basis for land-use and conservation planning. There are nine vegetation types found in JGDM covering three biomes (Eastern Cape Development Corporation, 2018). Two of these biomes are of some national significance, namely the Alpine/Maluti mountain-type grasslands in the east and Eastern Mixed Nama Karoo in the west and all provide an interest in tourism development (Eastern Cape Development Corporation, 2018). The different biomes also have an impact on the type of agriculture practiced in the area. Given the diversity of vegetation in the district, the communal areas may benefit from harvesting the seeds and some indigenous plants for food consumption and selling. In this manner, the population of the district may benefit from sales and increase production of these vegetables. Also, this activity may have a potential to boost the economy of the district.

3.5.3 Biodiversity conservation and hydrology

The JGDM is characterised by a variety of vegetation types and land features. The eastern and northern areas (Senqu and Elundini) are featured by high lying mountainous landscape associated with high species diversity and unique wetlands (Eastern Cape Development Corporation, 2017). These areas are more specifically, covered by Southern Drakensberg and Lesotho Highland Basalt Grasslands (in the east) as well as Zastron Moist Grassland and Senqu Montane shrubland (in the north). The western parts of JGDM are dominated by Karoo Escarpment Grassland, Aliwal North Dry Grassland, Besemkaree Koppies Shrubland and Eastern Upper Karoo vegetation. All these vegetation covers are classified as less damageable species, but they are poorly conserved by residents (JGDM, 2017).

Thus, an opportunity exists to formally protect the remaining undamaged vegetation, especially those classified as vulnerable and threatened, to ensure the important ecological functions they play in this area, be preserved and to build on the attractive and ecologically important landscape for tourism. An opportunity to apply Payment for

Ecosystem Principles (JGDM, 2017) for water resource protection therefore exists to ensure the protection of vegetation types which are dominated by wetlands.

The southern Drakensberg Mountains form a watershed that separates the eastern and western parts of the JGDM. The Orange River is the most important source of water in the district and it covers most of the Walter Sisulu and Senqu Local Municipalities (JGDM IDP, 2016). This catchment area drains towards the Atlantic Ocean. Elundini falls within the Umzimvubu catchment area, draining towards the Indian Ocean. The Gariep dam is the largest dam in South Africa and is a major source of water for irrigation in the district (JGDM IDP, 2016) as well as for the Fish River scheme (to the south west of the district). There are also smaller dams which provide the district with water, both for agricultural purposes and human consumption.

Dams have a secondary usage and potential for recreational and other economic purposes. Boreholes are used by Barkly East, Burgersdorp and Steynsburg to augment supplies, and Jamestown and Mount Fletcher use boreholes for all their water requirements. Many commercial irrigation ventures are fed from groundwater. A study conducted for the JGDM on water supply issues concluded that, many places in Senqu and Elundini have very high groundwater development potential (Eastern Cape Development Corporation, 2018).

Based on the information provided about the three district municipalities, it can be concluded that these three municipalities are heterogeneous in terms of the economic activities practised, rainfall, temperature, vegetation, biodiversity conservation and hydrology.

3.6 Summary

Given the economic activities practised from the study areas, agriculture becomes the main economic activity which is practised to improve and sustain livelihoods. However, there is reported limitation of arable land from the study areas which inhibits the extension of agricultural activities. An opportunity therefore stands for ILVs to be conserved and harvested from the available arable land so to promote economic development. Also, with the given agro-ecological survey from the study areas, limited agricultural potential and harsh climatic conditions in some parts of the district municipalities; a consideration of increased conservation and production of ILVs would be expected. This is because literature highlights that, ILVs can withstand harsh

climatic conditions and require minimal inputs to be produced. Lastly, the study areas are diverse in ILVs given the nature of vegetation from the study areas, so a need therefore arises for these vegetables to be protected by local and government authorities. From this manner, ILVs can be utilised as one of the natural resources which may assist in boosting the economies by venturing business opportunities for these vegetables which eventually improves food security.

3.7 Research methodology and analytical procedures

3.7.1 Research Design

Cross-sectional survey is a type of research study where either the entire population or a subset thereof is selected and from these individuals, data is collected to help answer research questions of interest (Tourangeau *et al.,* 2000). In this study, a cross sectional approach was used to capture detailed information regarding the economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province of South Africa.

3.7.1.1 Methods and research instruments

The approach that was used was through participatory rural appraisal surveys (respondents were given a platform to explore their views concerning the study topic through focus group discussion), observations and interviews focusing on data regarding the following matters:

a) Demographics and socio-economic characteristic of the households
b) Production of ILVs and their uses
c) Contribution of ILVs to household income and food security
d) Role players in ILV production value chain

A questionnaire was used as the main data collection instrument to gather data pertaining to the above-mentioned information, this questionnaire was administered through face-to-face interviews.

3.7.1.2 Sampling frame

The study encompassed all the ILV production and non-production rural areas of the OR Tambo, Alfred Nzo and Joe Gqabi District Municipalities of the Eastern Cape Province in South Africa as its sampling frame. The study also included role players in ILV production value chain as its sampling frame; these role players included input suppliers, producers, hawkers and consumers. This means that, primary sampling units were taken as participants and non-participants in the production of ILVs and role players in ILV production value chain. Also, the study pre-tested the questionnaire using 36 households; however, this data was not included during analysis as errors were captured during pre-testing, afterwards the questionnaire was adjusted accordingly for actual data collection.

a) Sampling procedure for household participants

Three district municipalities were used for the purposes of this study, and these municipalities included OR Tambo, Aflred Nzo and Joe Gqabi district municipalities. Every local municipality under these three district municipalities was considered for the study. The OR Tambo district municipality consists of five local municipalities, with Alfred Nzo district municipality comprising of four local municipalities and Joe Gqabi district municipality covering three local municipalities, thus, making 12 local municipalities under these district municipalities. The study therefore used the Multi-Stage Sampling (MSS) and Proportional Random Sampling (PRS) as its sampling procedures to select rural households with household heads as a unit of analysis. The MSS divides a large population into groups to make the sampling process more practical. A combination of stratified sampling or cluster sampling and simple random sampling is usually used when employing the MSS procedure (Statistics handbook, 2018). For the purposes of this study, the first stage was dividing the Eastern Cape Province (ECP) population into its six district municipalities and its two metros. From the district municipalities, three district municipalities were selected for the study which made it the second stage of dividing the large of population of the ECP. The three districts were selected because the Department of Agriculture, Forestry and Fisheries in 2016 reported that, these three district municipalities are living in poverty as compared to other municipalities within the province. Also, these district municipalities have a diverse population of ILVs, and most people make use of these vegetables,

particularly poor people who depend quite heavily on them as their source of vegetables (Eastern Cape Development Corporation, 2018). Therefore, a better representation of assessing ILV production for income generation and food security was better estimated from these district municipalities.

The third stage was to divide the three district Municipalities into their local municipalities and ward areas from there, a PRS was employed up until household level to select the households to participate in the study. This means that, ward areas that are classified as rural were used to select households for the study.

Table 3.1: Number of rural households per each local municipality within the OR Tambo, Alfred Nzo and Joe Gqabi District Municipalities.

District Municipalities	OR Tambo	No. of households	Alfred Nzo	No. of households	Joe Gqabi	No. of households
Local Municipalities	Ingquza Hill	56 096	Matatiele	24 374	Elundini	23 000
	KSD	75 331	Mbizana	33 146	Sengqu	8 310
	Mhlontlo	27 320	Ntabankulu	19 384	Walter Sisulu	92
	Nyandeni	58 773	Umzimvubu	30 198		
	PSJ	30 555				
Total		248 075		107 102		31 402

Source: Author's compilation

As can be seen from Table 3.1 above, the OR Tambo has five local municipalities with 248 075 rural households, Alfred Nzo has four local municipalities with 107 102 rural households and Joe Gqabi has three local municipalities with 31 402 rural households.

The sample size was determined by using the following formula:

$$n = \frac{z^2.p.q.N}{e^2\ (N-1)+z^2.p.q} \quad \text{..........1}$$

According to Kothari (2004), Where; n = desired sample size, z = value of standard deviation at 95% confidence level (in this case 1.96), e = desired level of precision (±5%), p = sample proportion in target population, q = 1 – p and N = size of population.

This gave a total sample of 407 households for the study, comprising of 136 households in each of the ORTDM and ANDM districts respectively; and 135 households in JGDM. From the total sample size of 407 households, a proportional random sampling technique was therefore employed to select households to participate in the study under each local municipality as shown in Table 3.2 below. The proportional random sampling was calculated per total number of rural households per each local municipality over a total number of rural households of the district. After this, the observed value was multiplied by the sample size obtained using equation one above from ORTDM ANDM and JGDM respectively. The obtained sample sizes are indicated under each local municipality in Table 3.2.

Table 3.2: The distribution of the sample size with respect to each local municipality

Study Areas: O.R Tambo DM	Ingquza Hill	KSD LM	Mhlontlo	Nyandeni	PSJ	Total
Sample size/LM	27	50	18	26	15	136
Percentage	20	38	13	20	10	100%
Alfred Nzo	Matatiele	Mbizana	Ntabankulu	Umzimvubu		
Sample size/ LM	41	42	18	35		136
Percentage	29	31	13	26		100%
Joe Gqabi	Elundini	Sengqu	Walter Sisulu			
Sample size/ LM	51	52	32			135
Percentage	38	38	24			100%

Source: Author's compilation

b) Sampling procedure for the selection of role players in ILV production value chain

To select different role players in ILV production value chain, a snowball sampling technique was employed. According to the Statistics Handbook (2014), in a snowball sampling, research participants recruit other participants for a test or study. It is used where potential participants are hard to find and it is a non-probability sampling method. A Snowball sampling technique was employed because it was difficult to find the role players in the ILV production value chain particularly input suppliers and hawkers/traders for ILVs within the study areas. Therefore, the study interviewed 16 hawkers within the twelve local municipalities and three input suppliers from King Sabata Dalindyebo (KSD) and Port St Johns (PSJ) local municipalities as most of the

producers indicated that they harvest ILVs seedlings freely from the wild, fields or home gardens. From the 407 household heads interviewed, some indicated during the interviews that they were both producers and consumers of ILVs while on the other hand some household heads indicated that they were neither producers nor consumers of ILVs. Thus, from the 407 households, 260 households reported to be both producers and consumers of ILVs while 44 households reported to be only consumers of ILVs. Lastly, 103 households reported to be non-producers and non-consumers of ILVs, and this type of data was collected so to understand why other households do not get involved in activities associated with ILVs.

3.8 Enumerator Selection and Training

Seven enumerators were selected, all of which had received graduate training in agriculture, applied environmental science, natural science, and social sciences from various universities in South Africa. All enumerators were chosen from the Eastern Cape Province and were fluent in the local language which is isiXhosa. The team was trained over three days to familiarise themselves with the different sections of the questionnaires. On the second day, a pretesting exercise was conducted in one of the study areas. Each enumerator interviewed at least six households per day. The third day was for brainstorming and reflections on different sections of the questionnaire based on pre-test results. Several adjustments were made to the questionnaire and skills on how to approach households were also highlighted.

3.9 Justification for the selection of the study area

The ECP has a population of about 7 million or 12.6 % of total South African population, divided into six districts of OR Tambo, Alfred Nzo, Chris Hani, Amatole, Joe Gqabi and Sarah Baartman and two metropoles of Nelson Mandela Bay and Buffalo City (Eastern Cape Development Corporation, 2018). However, only three district municipalities were selected for the purpose of the study and these included OR Tambo, Alfred Nzo and Joe Gqabi district municipalities. According to the South African Department of Agriculture (2004), most people in these three districts largely rely on the land and its resources which include ILVs to supplement their household needs. Therefore, a better representation of ILV production for income generation and food security with a larger sample size could be better estimated from these areas. This is further supported by the fact that, the ECP has a variety of indigenous

vegetables which are used as food and medicine by the residents particularly from the selected district municipalities (Department of Agriculture, Forestry and Fisheries, 2016).

3.10 Conceptual framework

The concept adapted in this study is developed on the production and availability of ILVs since these vegetables require low technical management, low input and drought tolerant hence the potential of producing ILVs on larger scale should be advised. The framework further explains the contribution of ILVs to rural livelihoods if they were to be produced and utilised on a larger scale. In summary, the concept therefore explains the benefits that are associated with the production and consumption of ILVs; and explains the potential contribution of ILVs to rural livelihoods. The conceptual framework is shortly summarised in Figure 3.5 below.

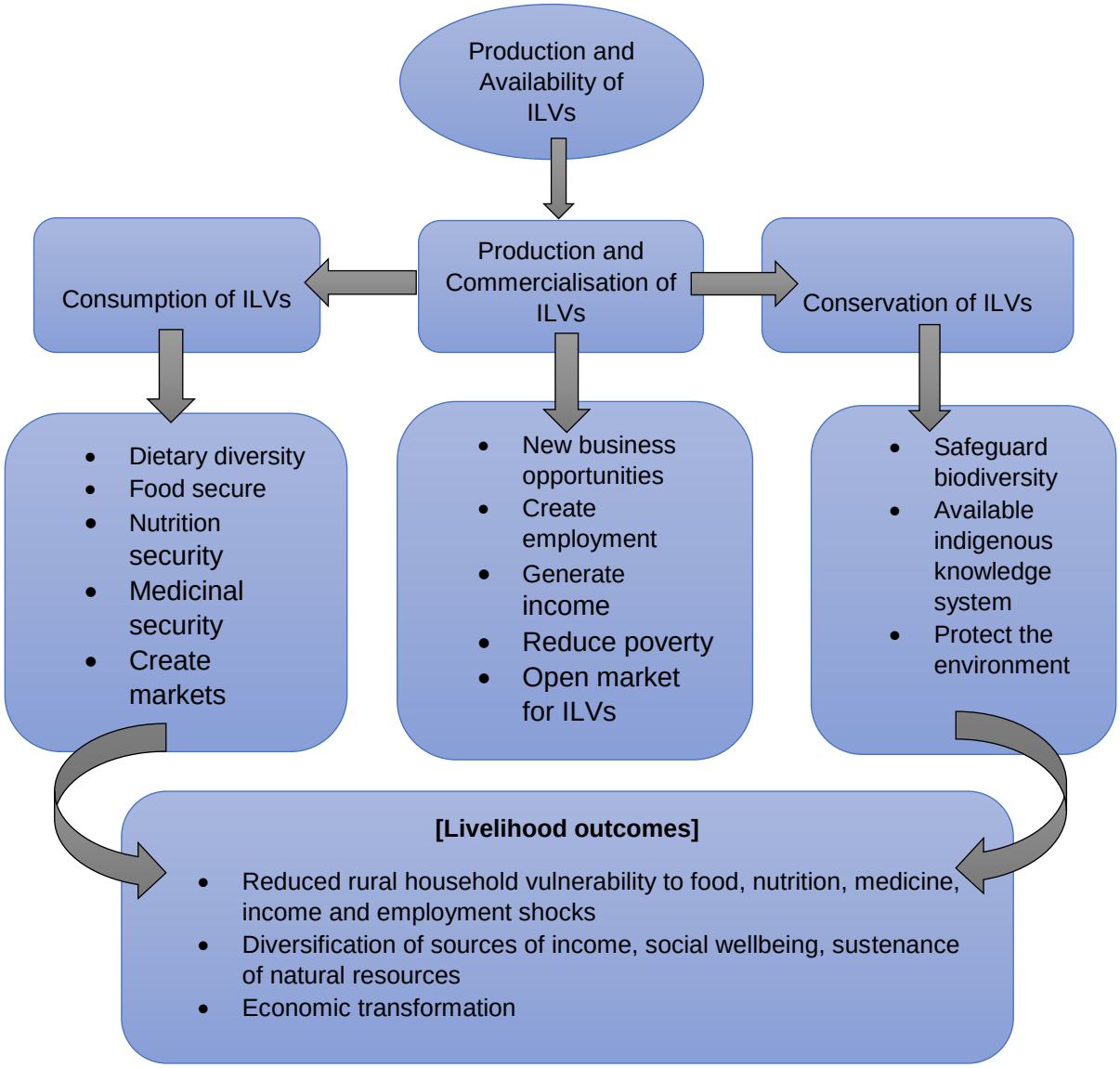

Figure 3.5: Conceptual framework

Sources: Author's compilation and Adopted from Wemali (2015); Nyaruwata (2019) framework

3.10.1 Production and availability of Indigenous Leafy Vegetables (ILVs)

Indigenous Leafy Vegetables are often easier to grow, resistant to pests and diseases and they are quite acceptable to local tastes (Ekesa *et al.,* 2009). Moyo *et al.* (2013) also confirm the same, noting that, ILVs hold high horticultural potential based on their long utilisation history by local communities across Africa. Furthermore, despite their lower production in some African countries such as South Africa, ILVs are noted to represent an affordable but quality nutrition to the poor both in urban and rural areas where malnutrition is common (Maseko and Dakora, 2013; Mavengahama, 2013). Keatinge *et*

al. (2010) observe that, ILVs have the potential to make a substantial contribution to food and nutrition security, to protect against internal and external market disruptions and climate uncertainties, and create employment opportunities, thus enhancing sustainability for both urban and rural dwellers.

Several authors such as Ebert (2014); Wemali (2015); Nyaruwata (2019) amongst others confirm that, many ILVs such as Amaranth (*Amaranthus spp*.), Jute mallow (*Corchorus olitorius*), African nightshade (*Solanum scabrum*), Asian (*Solanum melongena*) and African (*Solanum aethiopicum*) Eggplant, Drumstick tree (*Moringa oleifera*), Bitter gourd (*Momordica charantia*), Water spinach (*Ipomoea aquatica*), Chinese kale (*Brassica oleracea var. alboglabra*), Edible rape (*Brassica napus*), Roselle (*Hibiscus sabdariffa*), Malabar spinach (*Basella alba*), Slippery cabbage (*Abelmoschus manihot*), Winged bean (*Psophocarpus tetragonolobus*) are of considerable commercial value and can consequently contribute significantly to household income. Hughes and Ebert (2013) also cite several examples of profitable cultivation of ILVs in East and West Africa such as Worowo (*Solanacio biafrae*), Cockscomb (*Celosia argentea*), African eggplant (*Solanum macrocarpon*) and Amaranth. Ebert (2014) authenticates that, value addition in a form of applying appropriate production and postharvest techniques to ILVs could ensure high quality produce which reaches the market and satisfies consumer expectations.

A study conducted by Ngigi *et al.* (2011) on consumer's willingness to pay for ILVs, confirms a promising willingness to pay for ILVs and the level of willingness to pay was expected to increase in the upcoming years. For instance, the highest estimates of willingness to pay more for the safety attribute of ILVs were found in high-end specialty stores (68%), followed by open-air markets (39%), supermarkets (34%), and roadside markets (28%). In addition, in Eastern Africa and Southeast Asia, selected ILVs are becoming an increasingly attractive food group for the wealthier segments of the population and are slowly moving out of the underutilised category into the commercial mainstream (Weinberger, 2007; Ayinde, 2016; Aleni, 2017). Keatinge *et al.* (2010) also state that, ILVs are attracted by the strong market demand, seed companies are beginning to explore and develop these vegetables, thus strengthening the formal seed sector for ILVs.

With the given background, the production of ILVs could be of vital importance in livelihoods of many communities, particularly the rural communities. Production of ILVs

could create employment opportunities, generate income for households, open markets for these vegetables and reduce poverty and this may ultimately translate to sustainable livelihoods. Lastly, for some farmers; the production of ILVs could also venture new business opportunities.

3.10.2 Consumption of Indigenous Leafy Vegetables

Frison *et al.* (2010) report that, an important quantity of the diverse foods available in the environment has been neglected and this has narrowed the base for global food security. This resulted to the contribution of different food supply emergencies which cause hunger and malnutrition for most communities. Regardless of the efforts made towards reducing global hunger through increased productivity by technology-driven yield improvements, a large part of the world is still hungry, and the availability of inexpensive staple foods, such as cereal, has coincided with the erosion of agricultural biodiversity and a reduction in dietary diversity (Frison *et al.,* 2010; Mavhengahama *et al.,* 2013). Therefore, in the presence of ILVs and traditional food systems, the strategies adopted to address the ongoing problem of food insecurity, particularly in developing countries continue to narrow the diversity of the food supply (Frison *et al.,* 2010). Due to the consumption benefits associated with ILVs as confirmed by several authors such as Altman *et al.* (2009); Vorster *et al.* (2013); Kruger *et al.* (2015); Gosh-Jerath *et al.* (2016) who also suggest that, ILVs could be used as a solution to reduce hunger. Thus far, there is evidence from studies conducted in South Africa and around the world, that ILVs are consumed by many households particularly in areas where they are available (Nesamvuni *et al.,* 2001; Tshukudu, 2005; Vorster *et al.,* 2005; Mbhatsani *et al.,* 2011). Mbhenyane *et al.* (2012); Bvenura and Afolayan (2015) also confirm that, ILVs can play an important role in alleviating food insecurity and contribute to dietary diversity of households.

Authors such as Vorster *et al.* (2007); Habwe *et al.* (2009); Netondo *et al.* (2010) observe ILVs as substantial vegetables among low-income households, particularly in addressing malnutrition and loss of biological diversity. A study conducted by Vorster *et al.* (2007) on determining the importance, status, preference, cultivation and conservation of ILVs in South Africa, discovered that, ILVs are important in food security, especially as dried food sources during winter and in providing security against pests, diseases and varied environmental conditions. Relating to the consumption benefits obtained from consuming

ILVs, previous research by Engle and Altoveras (2000); Abukutsa-Onyango (2003); Schönfeldt and Pretorius (2011) confirms that, ILVs are inexpensive, easily accessible and provide health-promoting compounds such as vitamins, minerals, anti-oxidants and even anti-cancer; factors needed to maintain health and fight off infections. In addition, Abukutsa (2007); Odhav *et al.* (2007) also argue that, ILVs account for 10% of the world's higher plants which represent inexpensive but high-quality nutrition sources for the poor segment of the population, especially where malnutrition is prevalent.

Some ILVs are noted for their medicinal value in addition to serving as food and reduction of malnutrition incidences. For example, in South-west Nigeria, Adebooye *et al.* (2003) recognises the traditional medicine uses of twenty-four ILVs. However, modern technology system has isolated many natural products with active principles of medicinal importance from many indigenous plants. A study conducted by Kimiywe *et al.* (2007) also confirms that, ILVs can treat the most common illnesses such malaria, diarrhoea, anaemia, colds and coughs, skin infections, malnutrition, diabetes and high blood pressure; and they can also improve blood flow in additional to cleansing blood. To this end, with the given background regarding the consumption and utilisation of ILVs, an increased utilisation of ILVs by communities would be expected. The increased consumption would therefore have a potential to open larger markets for ILVs because, if the consumption would increase, ultimately the demand for these vegetables would be expected to increase. In addition, Mungofa *et al.* (2018) explicate that, the consumption and cultivation of ILVs has the potential to improve food security and boost income generation for households particularly in rural communities.

3.10.3 Conservation of Indigenous Leafy Vegetables

Fernandez *et al.* (2013); Tudge (2014); Adhikari *et al.* (2017) highlight that, producing ILVs in an inclusive food system has a potential to contribute significantly towards addressing environmental concerns. In addition, agro-ecological practices and other farming systems which mimic nature, have the potential to be instrumental in reducing environmental impacts (Tudge, 2014). Generally, such farming systems promote the growth of a diversity of edible and medicinal plants which are indigenous to a region (Fernandez *et al.*, 2013; Tudge, 2014; Adhikari *et al.,* 2017). However, ILVs have been referred to as alternative food systems but they are still not widely available, and they need to be introduced again and integrated into the dominant food system. The

increasing importance of ILVs in the food system could also serve as a means of nurturing their conservation, as these vegetables would vanish due to underutilisation and land use changes (Kuhnlein, 2015; Rotz and Fraser, 2015). Furthermore, a system which is based on the diversity of species such as ILVs could be resilient and can withstand different threats and shocks, climatic or otherwise (MacFall *et al.,* 2015; Rotz and Fraser, 2015).

The sustainability of ILVs could therefore extend to agricultural livelihoods in the occurrence of an environmental shock as some of ILVs would survive these events, and, thus, reduce farmer vulnerability (MacFall *et al.,* 2015). Such benefits would be appealing to farmers who are increasingly at risk of being affected by climate change events, without access to insurance (Magrini *et al.,* 2016). Another added benefit of growing ILVs is that, they provide dietary diversity, and these vegetables have a lower carbon footprint when compared to animal food sources (Meyback and Gitz, 2017). Indigenous Leafy Vegetables are agro ecologically adapted to their local environment, and often grow naturally with few added inputs, which significantly reduce the pollution of soil and water from the introduction of agricultural chemicals (Kuhnlein, 2015). This means that, the production of ILVs could be associated with little land disturbance which could then reduce the extent to which farmers disturb the ecosystem, reducing environmental degradation. Given the environmental benefits of including ILVs in the food system, there is also a significant constraint in the adoption of these strategies because of the diminishing knowledge surrounding their uses, and perceptions of low productivity (Fernandez *et al.*, 2013; Magrini *et al.,* 2016).

3.10.4 Potential contribution of ILVs to livelihoods

Regardless of the general decline in poverty between 2006 and 2011, poverty levels in South Africa increased again in 2015 (STATS SA, 2016). STATS SA further reports that, more than half of South Africans were poor in 2015, with the poverty headcount increasing to 55,5% from a series low of 53,2% in 2011. In addition, the South African economy in the last five years, that is, between the periods of 2011 and 2015, has been driven by a combination of international and domestic factors such as low and weak economic growth, continual high unemployment levels, lower commodity prices, higher consumer prices (especially for energy and food), lower investment levels, greater household dependency on credit, and policy uncertainty. These factors resulted in South

African households experiencing financial uncertainties and economic pressures which in turn pulled more households and individuals down into poverty (STATS SA, 2017). With the given background in the existence of diverse ILVs in South Africa, an increased production and utilisation of these vegetables should be advised. This is because, ILVs have a potential economic value that they could offer, particularly for rural economies to address the existing international and domestic factors which stimulate high poverty rates.

A study conducted by Oladele (2011) on contribution of indigenous vegetables and fruits to poverty alleviation in Oyo State, Nigeria, discovered that, the proportion of ILVs to farmers' income is significant and thus the interpretation is that, these vegetables help alleviate poverty. This means that, if they were to be produced on a larger scale and be commercialised, their commercialisation in the domestic markets would result in raising the standard of living to those involved in trading activities of ILVs, in both rural and urban contexts. For instance, the study also confirmed that, an increased production volume of vegetables such as *Vitex doniana, Calotropis procera* and *Phaseolus lunatu*, Bush mango, Mushroom and *Cururbita pepo* contributes to income through trade and thus helps alleviate poverty by increasing the disposable income available to farmers.

3.11 The descriptive analysis

Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summaries about the sample of the study. Together with simple graphics analysis, descriptive statistics form the basis of almost every quantitative analysis of data (Krishnan, 2010). For this study, a descriptive analysis was used to profile the socio-economic characteristics of households, to profile the produced ILVs from the study area, describe different uses of ILVs and food security status of households; and lastly, profile different role players and their functions in ILV production value chain. The descriptive statistics such as mean, standard deviation, frequency and percentages were used.

3.12 Econometric model specification

The Binary Logistic Regression (BLR) was used to determine factors which influence households to produce ILVs and Multinomial Logistic Regression (MLR) Model was used to determine factors which influence different uses of ILVs from the study area. For BLR model, this means that, the ILV production status was taken as a dependent variable in the BLR model and ILVs use as either food, medicine or livestock feed were taken as

dependent variables in the MLR model. Twelve independent variables were regressed against the binary dependent variable which is the ILV production status of households. Also, ten independent variables were regressed against the Multinomial Logistic Regression and variables of ILVs used as food, medicine or livestock feed by households were treated ad dependent variables.

The Binary Logistic Regression model is illustrated in equation 2 below (Gujarati, 1992).

$$In = \frac{[(p\left(y = \frac{1}{x}\right)]}{[1 - p\left(y = \frac{1}{x}\right)]} = \alpha + \beta_1 X_1 + \cdots + \beta_n X_n \ldots\ldots\ldots 2$$

Where: P= predicted probability of producing ILVs; 1−P = predicted probability of not producing ILVs; α = the constant of the equation; β = the coefficient of the independent variables; X= independent variables.

By fitting independent variables into the model, the model was presented as illustrated in the equation below:

$$In = \frac{[(p\left(y=\frac{1}{x}\right)]}{[1-p\left(y=\frac{1}{x}\right)]} = \alpha + \beta_{\text{Gender}} + \beta_{\text{Age}} + \beta_{\text{Household size}} + \beta_{\text{Level of education}} + \beta_{\text{Level of income}} + \beta_{\text{Employment status}} + \beta_{\text{Size of arable land}} + \beta_{\text{Labour}} + \beta_{\text{Availability of seeds}} + \beta_{\text{Fertilizer}} + \beta_{\text{Irrigation}} + \beta_{\text{Access to information about ILV production}} \ldots\ldots\ldots 3$$

Greene (2003) presents the reduced form of the MLR as summarised in equation 4 below.

$f\ (k, i) = \beta_k .\ X_i \ldots\ldots\ldots 4$

Where, β_k is the set of regression coefficients associated with outcome *k*, and X_i is the set of explanatory variables associated with observation *i*.

To determine the contribution of ILVs to household income, a Gross Margin (GM) analysis was used. The GM is a Gross Production Value (GPV) of a commodity less its directly allocable Variable Costs (VC). For this study, the GM was used to determine whether the producers are getting returns from selling the produced ILVs or not. The formula to calculate GM is presented as follow:

GM = GPV (yields X price) – VC……………………………………………………………5

Where, GM= Gross Margin, GPV= Gross Production Value and VC= Variable Costs.

3.13 Food security index estimates

3.13.1 Household Food Insecurity Access Scale (HFIAS)

The HFIAS is a brief survey instrument developed by the Food and Nutrition Technical Assistance (FANTA) body to assess whether households have experienced problems with food access during the last 30 days (Coates *et al.,* 2006) or not. The instrument consists of nine occurrence questions and nine frequency questions; these questions ask about the changes which households made in their diet or food consumption patterns as a result of limited resources with regard to acquiring food. The HFIAS measures the level of food insecurity during the past 30 days, as self-reported by the household. The measured results are then assigned categorical designations (food secure, or mildly/moderately, or severely food insecure) or given a numerical value (0-27), with higher numbers representing a greater level of food insecurity (Food and Nutrition Technical Assistance, 2004). Table 3.3 summarises the generic HFIAS questions used in this study.

Table 3.3: The generic HFIAS questions for households

Questions	Response options
	1= Rarely (once or twice in the past 30 days) **2= Sometimes** (three to ten times in the past 30 days) **3= Often** (more than 10 times in the past 30 days).
1. Did you worry that your household would not have enough food?	
2. Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	
3. Did you or any household member have to eat limited variety of foods due to lack of resources?	
4. Did you or any other household member eat some foods that you really do not want to eat because of lack of resources to obtain other types of food?	
5. Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	

6. Did you or any household member have to eat fewer meals in a day because there was not enough food?	
7. Was there ever no food at all in your household because there were not resources to get more food?	
8. Did you or any household member go to sleep at night hungry because there was not enough food?	
9. Did you or any household member go a whole day without eating anything because there was not enough food?	

Source: FAO (2013)

For each of the above questions, a respondent considered what has happened in the past 30 days. The respondent also indicated whether this never happened, rarely (once or twice), sometimes (3-10 times), or often (more than 10 times) in the past 30 days.

To measure HFIAS, the HFIAS score was used, as it measures the degree of food access in the household over the past 30 days. A HFIAS score variable is calculated for each household by totalling the codes for each frequency of occurrence question. The maximum score for a household is 27 (if the household's response to all 9 questions was "often", coded with a response code of 3); the minimum score is 0 (Coates *et al.,* 2007). The higher the score, the more food insecurity (access) the household experienced. The lower the score, the less food insecurity (access) a household experienced.

The HFIAS Score is between 0-27 and the sum of the frequency of experience during the past 30 days for the 9-food insecurity-related conditions: Sum frequency code (Q1 + Q2 + Q3 + Q4 + Q5 + Q6 + Q7 + Q8 + Q9) (Food and Nutrition Technical Assistance, 2004).

The HFIAS was therefore used to estimate food security status amongst households. The measured results were then assigned categorical designations (food secure, or mildly/moderately, or severely/more food insecure) or given a numerical value (0-27), with higher numbers representing a greater level of food insecurity (Coates *et al.,* 2006). For this study, the food security status among households from the study areas was estimated using HFIAS. Thereafter, an MLR was used to determine factors which influence food security status of households and less food insecure, moderately food insecure and more/severe food insecure were taken as dependent variables and regressed against several socio-economic explanatory variables.

To determine the relationship between the role players and their functions among the ILV production value chain, a correlation matrix was used. A correlation matrix is a table showing correlation coefficients between sets of variables. The diagonal of the table is always a set of ones, because the correlation between a variable and itself is always one (1) (Hall, 2015).

The correlation matrix was calculated by applying the Pearson correlation formula which is often referred to as Pearson R test. The Pearson R test is a statistical formula that measures the strength between variables and their relationships; this means that, it determines how strong the relationship between two variables is, by finding the coefficient values ranging between -1.00 and 1.00. A value of 0 indicates that, there is no association between the variables. A value greater than 0 indicates a positive association; that is, as the value of one variable increases, so does the value of the other variable (Hall, 2015).

The Pearson R formula that was used to calculate the significant values is presented below:

$$r(xy) = \sum \left(\frac{Zx.Zy}{N} \right) \quad \text{.....6}$$

r(*xy*)= Correlation coefficient for X and Y Variables; Z_x = The Z score for the X value; Z_y = The Z score for the Y value; N = The number of pairs for the scores.

3.14 Description of variables specified in the Binary Logistic Regression and Multinomial Logistic Regression models

This section focuses on a description of the variables specified in the Binary Logistic Regression and Multinomial Logistic Regression models. Using conclusions inferred from other studies, a priori influence of various household's characteristics was estimated.

Table 3.4: Description of variables specified in Binary and Multinomial Logistic Regression models.

Variables	Description	Units of measure
Production status of ILVs (Y) (Dependent variable in BLR model)	Producing ILVs=1; 0 otherwise	Dummy Variable
Gender of the household head	Male=1, Female=0	Dummy
Age of the Household head	Actual age	Years

Household size	Household size	Actual household size
Level of education	0= Never went to school 1= Primary education 2= Secondary education 3= Tertiary education	Categorized
Level of farm income	Household farm income per month	South African Rand
Employment status	Employed=1, Unemployed=0	Dummy
Land size for ILV production	Actual size	Hectares
Labour for producing ILVs	Hire labour=1; Do not hire labour=0	Dummy
Availability of seeds	Buy seeds=1; Harvest seeds from the wild=0	Dummy
Fertilizer application	Apply fertilizer=1; Do not apply fertilizer=0	Dummy
Irrigation for ILV production	Irrigate ILVs=1; Do not irrigate ILVs=0	Dummy
Access to information about ILV production	Access to information=1; 0 otherwise	Dummy
Uses of ILVs (Dependent variable in MLR model)	Food=0; Medicine=1; livestock feed=2	Categorized variable
Awareness about nutrition benefits	Aware=1; 0 otherwise	Dummy
Awareness about health benefits	Aware=1; 0 otherwise	Dummy
Seasonal availability	ILVs are seasonal=1; 0 otherwise	Dummy
Access to information about the uses of ILVs	Access to information=1; 0 otherwise	Dummy
Food security status (Dependent variable in MLR model)	Food secure=0; moderately food insecure=1; severe food insecure=2	Categorized variable

Source: Author's compilation

3.15 Review of the econometric models and approaches used for the study

This section presents models and approaches which were used in addressing the objectives of this study. The Binary Logistic Regression (BLR) model was used to assess the most produced ILVs in the study area and the ILV production status was taken as a dependent variable. A Multinomial Logistic Regression (MLR) model was used to assess factors influencing the different uses of ILVs by households and this was treated as a dependent variable. The MLR model estimated the association between different uses of ILVs and the socio-economic characteristics of households. A Gross Margin analysis

was used to determine the contribution of ILVs to household income and HFIAS was used as an approach to estimate food security status for households from the study areas. The HFIAS was further used in combination with MLR so as to determine factors influencing the food security status of households and less food insecure, moderately food insecure and severely/more food insecure were taken as dependent variables. In addition, the study further employed a correlation matrix to determine the relationship between role players and their functions along the ILV production value chain.

3.15.1 Binary Logistic Regression Model

According to William (2011), logistic regression is a statistical method for analysing a data set in which there is one or more independent variables that determine an outcome. For Binary Logistic Regression (BLR) model, the outcome is measured with a dichotomous variable; which means that, there are only two possible outcomes. This explains that, in the BLR model, the dependent variable is binary or dichotomous (Hosmer and Lemeshew 1989; Gujarati, 1992; Greene, 2008). In terms of the dichotomous analysis outcome variable, Hosmer and Lemeshew (1989) point out that, the logistic distribution (Binary Logistic Regression model) has an advantage over the other models because of its extreme flexibility and ease of use from a mathematical point of view, and results in a meaningful interpretation. One of the advantages of the BLR model is that, a Binary Logistic model can include more than one explanatory variable (independent variable), and these variables can be dichotomous, ordinal or continuous (Williams, 2011).

Binary regression techniques allow estimating the effects of the independent variables on the underlying dependent variable. Binary regression techniques can also be used to see how the independent variables affect the probability of being in one category of the observed dependent variable as opposed to another (Williams, 2011). Regarding this study, the dependent variable was coded as 1 if the household head is a participant in the production of ILVs and coded as 0 if the household head is not a participant in the production of ILVs.

To estimate the determinants of participation in the production of ILVs, the study used the Binary Logistic Regression model. The household's ILV participation status (Y) was taken as dependant variables while all the reviewed factors that influence participation in the production of ILVs were taken as predictor independent variables (X). The

independent variables were regressed against the binary dependant variable of the ILV participation status of households.

3.15.2 Multinomial Logistic Regression (MLR)

According to Bayaga (2010), Multinomial (polytomous) Logistic Regression model is a simple extension of the binomial (Binary) Logistic Regression model. It is used when the dependent variable has more than two nominal or unordered categories, in which dummy coding of independent variables is quite common (Falavigna, 2008). Therefore, the MLR model allows the simultaneous comparison of more than one contrast, that is, the log odds of three or more contrasts are estimated simultaneously (Garison, 2009). The advantage of MLR when compared to other models, is that, it can be extended to situations where the response variable has more than two values, and there is no natural ordering of the categories. For this study, the ILV's use as food, medicine and livestock feed, were taken as dependent variables in the MLR model as identified by Manyelo *et al.* (2015). This model estimated the association between different uses of ILVs and household socio-economic characteristics. For analysis purposes, livestock feed was used as a base/reference category and interpretation of the results was compared to food and medicine use. The model further estimated a relationship between different food security statuses experienced by households and their socio-economic characteristics. Less food insecure, moderately food insecure and severely/more food insecure were treated as dependent variables and regressed against explanatory variables as per review of the factors influencing household food security status. For analysis purposes, less food insecure was used as a base/reference term and interpretation of the results was compared to moderate and severe food insecure households. This model was recently used by Ntawuruhunga (2016) to analyse factors influencing farmers' knowledge, attitude and practices in African Indigenous Vegetables' (AIVs) production in Busia, Nyamira and Machakos Counties in Kenya. Hence the model was also adopted in this study.

3.15.3 The Gross Margin (GM)

According to Finance and Farmers (2005), Gross Margin (GM) of an enterprise is the Gross Production Value for such enterprise less its directly allocable Variable Costs. This means that, the GM is calculated by adding together the gross margins of all enterprises in a farm business. From this study, a GM analysis was therefore used to estimate the

costs, returns, profitability of ILVs produced and sold. The Gross Production Value (total revenue) represents the value of the output from the farm; that is the physical quantity of ILVs sold multiplied by the unit price of ILVs. The total cost on the other hand, is made up of the variable and fixed costs. For this study, GM was used to determine whether households gain any returns from participating in the production of ILVs. The GM analysis of ILVs was expressed as follows:

GM = TR-TVC

Where GM = Gross Margin, TR = Total Revenue, TVC = Total Variable Costs

This method was adopted following the recent Gross Margin analysis by Nyaruwata (2019); the study used Gross Margin and ratio analysis to determine the contribution of selected ILVs in Wedza District of Zimbabwe. These ILVs included; Indian mustard, Ethiopian mustard, Pumpkin leaves, Okra and Cowpea. Boateng *et al.* (2016) also used a Gross Margin analysis to determine the net return experienced by farmers participating in the production and marketing of ILVs in Tamale, Ghana. The same method of analysis was previously used by Momanyi (2016) to determine profitability and returns of ILVs by smallholder farmers in Nyamira County, Kenya. Therefore, for this study; a Gross Margin analysis was also adopted to determine the contribution of ILVs to household income.

3.15.4 Household Food Insecurity Access Scale (HFIAS)

The Food and Nutrition Technical Assistance (FANTA) project and its partners supported a series of research initiatives to explore and test different options on a suitable and possible analytical system to measure household food security using different population theories. FANTA identified a set of questions that are needed when distinguishing food-secure from food-insecure households (Coates *et al.,* 2006). According to Coates *et al.* (2006), the information gathered by the HFIAS is used to assess whether households had experienced problems accessing food in the past 30 days. The tool is composed of nine questions that ask about alterations that households made in their diet or food consumption patterns due to limited resources to acquire food. It measures the range of severity, that is, from food secure to severely food insecure households in the past 30 days.

From the nine questions, a household was expected to answer a question intending to discover how often or how many times the event happened in the past four weeks; a yes

or no was expected. If the respondent answers “yes” to an occurrence question, a frequency of occurrence question was asked to determine whether the condition happened rarely (once or twice), sometimes (three to ten times) or often (more than ten times) in the previous four weeks. The advantage of using HFIAS over other indexes such as Household Dietary Diversity Score (HDDS), Household Hunger Scale (HHS) to mention a few is that; two indicators of food security are extracted from the nine questions asked to the households by HFIAS.

Firstly, the HFIAS score is calculated by summing the codes for each frequency-of-occurrence question about the degree of food insecurity (access) in the household for the past 30 days. The researcher should code frequency of occurrence as 0 for all cases where the answer to the corresponding occurrence question is “no”, before summing the frequency-of-occurrence codes. The maximum score for a household is 27. The maximum score is when the household response to all nine frequency-of-occurrence questions is “often”, coded with the response code of three, which means more than ten times in the past four weeks. The minimum score is 0; this is when the household responds “no” to all occurrence questions, frequency-of-occurrence questions are skipped by the interviewer and subsequently coded as 0. The higher the total of codes, the more food insecurity the household experienced, and the lower the total of codes, the less food insecure the household (Coates *et al.,* 2007). The HFIAS score is calculated as indicated below:

HFIAS score = Q1 + Q2 + Q3 + Q4 + Q5 + Q6 + Q7 + Q8 + Q9

According to Coates *et al.* (2007) and De Cock *et al.* (2013), the second indicator, Household Food Insecurity Access Prevalence (HFIAP), which is an indicator that categorises households into four levels of household food insecurity (access): food secure, mild, moderately and severely food insecure. The researcher categorised households according to their affirmative responses to more severe conditions more frequently. The HFIAS score is a continuous variable and, as indicated above in the sum of HFIAS, the HFIAP indicator should be reported in addition to, rather than instead of, the average HFIAS score for programme monitoring and evaluation.

When the household does not experience any food insecurity or rarely worries about food, it is categorised as food secure. A mildly food insecure household worries about not having enough food sometimes or often or is unable to eat preferred foods and/or

eats the same diet rather than what is desired, or some foods considered undesirable but only rarely. However, HFIAS includes the quantity and experience of any of the three most severe conditions, which are running out of food, going to bed hungry and/or going a whole day and night without eating. When the quantity is more important than the quality of food, eating the same diet or undesirable foods sometimes or often, or even reducing the size of meals or number of meals, which happens rarely and sometimes, a household is categorised as moderately food insecure. A severely food insecure household cuts back on meal size, the number of meals often or runs out of food, going to bed hungry and/or going a whole day and night without eating. This means that households that have experienced these three conditions even once in the last 30 days are categorised as severely food insecure (Coates *et al.,* 2007; De Cock *et al.,* 2013).

Household Food Insecurity Access Scale (HFIAS) is an adaptation of the approach used to generate the annual number of food insecure and hungry people in the world as indicated by Coates *et al.* (2006). This method is based on the idea that, the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey and summarised in a scale (Food and Nutrition Technical Assistance, 2004). Four types of indicators can be calculated to help understand the characteristics of and changes in household food insecurity (access) in the surveyed population (Coates *et al.,* 2006). For this study, a HFIAS indicator was used to estimate food security status amongst households.

According to Coates *et al.* (2006), the HFIAS score is a continuous measure of the degree of food insecurity (access) in the household (in the past 30 days). Firstly, a HFIAS score variable is calculated for each household by summing the coded frequency of experience for each question. The maximum score for a household is 27 (for example, if the household response to all 9 questions was “often”, coded with a response code of 3); the minimum score is 0. The higher the score, the more food insecurity (access) the household experienced. The lower the score, the less food insecurity (access) the household experienced. Given the advantages of employing HFIAS to determine food security, this food security approach (HFIAS) was adopted following the research by several authors such as Ndobo (2013) using HFIAS to determine food security status of households in a South African Township. Musemwa (2015) also used HFIAS to determine food security status of households in the Eastern Cape Province of South

Africa. Recently, Matebeni (2018) also used HFIAS to measure household food security in the Nkonkobe local Municipality in the Eastern Cape province of South Africa.

3.15.5 The correlation matrix

A correlation matrix shows the correlation coefficients between sets of variables. This means that, each random variable is correlated with other variables which are generally expressed in values. This therefore allows a researcher to see which pairs of variables have the highest correlation. Johnson (1998) emphasises that, a correlation matrix plays an important role in multivariate analysis since it captures the pairwise degrees of relationship between different components of a random vector. Its presence is very visible in Principal Component Analysis and Factor Analysis, where in general, it gives results different from those obtained with the covariance matrix. Also, as a test criterion, it is used to test the independence of variables, or subsets of variables.

For this study a correlation matrix was used to determine the relationship between the role players and their functions along the ILV production value chain. The correlation matrix was calculated by applying the Pearson correlation formula which is often referred to as Pearson R test. The Pearson R test is a statistical formula which measures the strength between variables and their relationships; this means that it determines how strong the relationship is between two variables by finding the coefficient values ranging between -1.00 and 1.00. A value of 0 indicates that there is no association between the variables. A value greater than 0 indicates a positive association; that is, as the value of one variable increases, so does the value of the other variable (Hall, 2015).

The advantage of using a correlation matrix is that; using Pearson's R test becomes a simple way to assess the association between two variables; whether they share variance (covary), if the relationship is positive or negative, and the degree to which they correlate. This type of matrix further shows a matrix of differences which can be displayed to compare the two types of correlation matrices and this allows a researcher to determine which pairs of variables require further investigation (Friendly, 2002; Friendly and Kwan, 2003). For the case of this study, a correlation matrix was used following Ntawuruhunga (2016), who used a principal component analysis to compute an association between variables that are influencing farmer's knowledge, attitude and practices in AIVs production.

Table 3.5: Summary of objectives, data collection and analytical tools

Objectives	Hypotheses	Data collection tool	Data analysis
Identify and describe the socio-economic characteristics of ILV producers and non-producers.		Questionnaire: Interviews.	Descriptive statistics.
Assess the most produced ILVs and factors that influence production of ILVs.	Socio-economic factors do not influence whether rural farmers should produce ILVs or not.	Questionnaire: Interviews	Descriptive Statistics. Binary Logistic Regression model.
Identify uses of ILVs and factors that influence the different uses of ILVs.	Socio-economic factors do not influence different uses of ILVs among rural households.	Questionnaire: Interviews and focus group discussion	Descriptive statistics. Multinomial Logistic Regression model.
Determine the contribution of ILVs to household income and food security.	ILVs do not contribute to income generation of rural households and household food security.	Structured questionnaire: Interviews	HFIAS. Descriptive statistics. Multinomial Logistic Regression Model. Gross Margin Analysis.
Identify different role players and their functions along the ILV value chain.	Producers and consumers are the only role players in the ILV production value chain.	Questionnaire: Interviews and focus group discussion	Correlation Matrix

Source: Authors' compilation

The following chapter presents the descriptive and empirical results that were observed from ORTDM, ANDM and JGDM.

CHAPTER FOUR

DESCRIPTIVE STATISTICS, EMPIRICAL FINDINGS AND DISCUSSION

4.0 Introduction

This chapter presents the research findings from the OR Tambo District, Alfred Nzo and Joe Gqabi district municipalities in terms of descriptive results and empirical results. The chapter first presents the descriptive statistics on socio-economic characteristics of households from the three municipalities. The chapter further discusses the empirical results from the study areas and lastly gives a summary statements of the observed results from the three district municipalities.

4.1 Socio-economic characteristics of households in ORTDM, ANDM and JGDM

This section presents the socio-economic characteristics of households from ORTDM, ANDM and JGDM as indicated in Table 4.1, 4.2 and 4.3 respectively.

Table 4.1: Descriptive statistics of socioeconomic characteristics from ORTDM

Variable	Age	Household size
N	136	136
Mean	51.56	7.33
Std deviation	14.217	2.631
Minimum	21	3
Maximum	78	15
Index	Outcome	Percentage (%)
Gender	Male Female	36.2% 63.8%
Level of education	Never went to school Primary education Secondary education Tertiary education	28.3% 46.4% 16.7% 8.7%
Farm income	No income R1000-R3000 Income from exotic vegetable sales Income from livestock sales >R3000	43.5% 14.5% 15.2% 3.6% 23.2%
Employment status	Employed Unemployed	27.5% 72.5%
ILVs production status	Produce ILVs Do not produce ILVs	63.8% 36.2%
Size of land for ILV production	0ha to 0.5ha 0.6ha to 2ha Exotic vegetable production land size	52.8% 11.6% 35.5%

Reasons for not producing	Do not eat ILVs ILVs grow naturally Old to participate in ILV farming	32.7% 63.3% 4.1%
Hiring of labour for ILVs	Hire labour Do not hire labour	3.4% 96.6%
Labour force size	One to three people Three people and more	33.3% 66.7%
Source of seedlings/seeds	Purchase ILVs seeds Harvest seeds freely Purchase and harvest seeds	1.1% 51.7% 47.2%
Irrigation of ILVs	Irrigate ILVs Do not irrigate ILVs	16.9% 83.1%
Sources of water	Community tap Community tap and River Community tap and Dam	81.3% 12.5% 6.3%
Reasons for not irrigating	Require no irrigation Rain feed is enough to grow ILVs Scarcity of water	46.6% 50.7% 2.7%

Source: Research Survey

In ORTDM, descriptive results in Table 4.1 show that, the respondents from the study area were between a minimum age of 21 years and a maximum age of 78 years, with an average age of 52 years. Regarding the household size, the descriptive results revealed that, on average, households have 7 members with a minimum size of 3 members and a maximum size of 15 members within a household.

From the sampled households, Table 4.1 above indicates that, a majority (63.8%) of the household heads were females while 36.2% were males. These results suggest women dominance from the study area concerning production of ILVs. Similar findings were also revealed by Shackleton *et al.* (2010) stating that, women commonly dominate in the cultivation of ILVs since these vegetables are a flourishing business for women who sell them as street vendors. Descriptive results indicate that when it comes to the level of education of household heads, a majority (46.4%) of household heads were educated up to primary education, while 28.8% of the household heads never attended school. Also, descriptive results further show that, 16.7% of household heads were educated up to secondary education while 8.7% were educated up to tertiary education. These results revealed that, most household heads who are participating in the production of ILVs are educated to primary education. This could

be a reason that, ILVs are associated with lower class people who cannot afford to buy exotic vegetables, so such people rather opt to produce ILVs since they require minimal inputs for production. Vorster *et al*. (2007); Vorster *et al.* (2008) similarly argue that, a reason why ILVs were never included in the South African farming system in the past years is that; research and modern agriculture practices have discouraged the growing of these vegetables, labelling them as weeds, whilst promoting the production of exotic vegetables.

Concerning farm income generated by households, most households (43.5%) indicated that, they do not have any farm/farming income while 14.5% of the households indicated to generate income between R1000 and R3000 per month from ILVs sales. Descriptive results further show that, 15.2% of households earn income from exotic vegetables sales rather than ILVs sales, while 3.6% of households indicated that, they earn income from livestock sales not from selling ILVs. Lastly, 23.2% of households indicated that, they have farm/farming income that is over R3000 per month from ILVs sales. These results suggest that, households focus more on exotic vegetable production and livestock farming as they claimed that; these two enterprises seem to be generating income. In addition, household heads did not specify the amount that they generate from these enterprises and they claimed that income generated varies from one season to another. Descriptive results revealed that with regard to employment status of household heads, about 72.5% of household heads are unemployed while 27.5% are employed. These results therefore suggest that most household heads from the study area are unemployed.

Regarding the production status of ILVs from the sampled households, 63.8% of household claimed to be producing ILVs, while 36.2% claimed to be producing exotic vegetables instead of ILVs. These results imply that, there is dominance of ILV producers from the study area. Most households (52.8%) indicated that when it comes to land size for production, they produce ILVs from land size ranging between 0 and 0.5 hectares (ha) while 11.6% are producing ILVs from land size ranging between 0.6ha and 2ha. Lastly, 35.5% of household heads reported that they use all the available land to produce exotic vegetables rather than ILVs. For households which are not producing ILVs, 63.3% of household heads reported that, they never thought of growing ILVs since they commonly grow naturally in the area. In addition, 32.7% of household heads reported that, they do not eat ILVs and this gave such households a

capacity not to produce ILVs; while 4.1% of household heads indicated that, they do not participate in any kind of farming because of older age.

For households which are producing ILVs, descriptive results show that, few households (3.4%) are hiring labour for production of ILVs while 93.6% of households are not hiring labour for production of ILVs. For households which are hiring labour, 66.7% claimed to hire three people or more per production cycle, while 33.3% claimed to hire one to three people per production cycle. About the source of seeds/seedlings, descriptive results indicate that, most households (51.7%) are only harvesting seeds/seedling from the wild/home gardens while 47.2% of households are purchasing and harvesting ILVs seeds from the wild/home gardens. From the sampled households, only, few households (1.1%) are purchasing seeds/seedlings.

Concerning irrigation of ILVs, descriptive results from Table 4.1 shows that, few households (16.9%) irrigate ILVs while majority of households (83.1%) do not irrigate ILVs. From households that irrigate ILVs, 81.2% claim to be using community taps to irrigate ILVs while 12.5% of households claim to use community taps and river as their source of water for irrigation and lastly, 6.3% claim to be using community taps and dams as their source of water for irrigation. For households who are not irrigating ILVs, 46.6% indicate that, ILVs do not require irrigation to grow, while 50.7% (majority) indicate that, rain feed is enough to grow ILVs, lastly, 2.7% of households indicated that they do not irrigate ILVs due to scarcity of water. The next table (Table 4.2) gives the descriptive statistics of socio-economic characteristics from ANDM and the description is provided in detail accordingly.

Table 4.2: Descriptive statistics of socioeconomic characteristics from ANDM

Variable	Age	Household size
N	136	136
Mean	51.30	7.09
Std deviation	13.068	2.479
Minimum	28	3
Maximum	77	14
Index	Outcome	Percentage (%)
Gender	Male Female	42% 58%
Level of education	Never went to school Primary education Secondary education Tertiary education	23.2% 54.3% 18.1% 4.3%

Farm income	No income R1000-R3000 Income from exotic vegetable sales Income from livestock sales Greater than R3000	67.4% 5.8% 7.2% 1.4% 18.1%
Employment status	Employed Unemployed	23.9% 76.1%
ILVs production status	Produce ILVs Do not produce ILVs	61.3% 38.7%
Size of land for ILV production	0ha to 0.5ha 0.6ha to 2ha Exotic vegetable production land size	57.4% 3.7% 38.8%
Reasons for not producing	Do not eat ILVs ILVs grow naturally	37.7% 62.3%
Source of seedlings/seeds	Harvest seeds freely Purchase and harvest seeds	57.6% 42.4%
Irrigation of ILVs	Irrigate ILVs Do not irrigate ILVs	18.8% 81.2%
Sources of water	Community tap Community tap and River Community tap and Dam River only	12.5% 43.8% 18.8% 25%
Reasons for not irrigating	Require no irrigation Rain feed is enough to grow ILVs	43.3% 56.7%

Source: Research Survey

Table 4.2 indicates that, on average, the respondents were 53 years old, with a minimum age of 28 years and a maximum age of 77 years. Regarding household size, descriptive results show that, households have a minimum size of 3 members and a maximum size of 14 members, with an average size of 7 members within a household.

Table 4.2 shows that, a majority (58%) of household heads were females while 42% were males. These results imply that, females are dominant when compared to males in relation to production of ILVs from the study area. Similar findings were also revealed by Vorster *et al.* (2007) uttering that, although both men and women have knowledge of the different groups of indigenous vegetables, women tend to be domain regarding participation in the production of ILVs particularly within rural contexts. With reference to level of education, descriptive results indicate that, a majority (54.3%) of household heads are educated up to primary education, while 23.2% of the household

heads never attended school. Also, descriptive results show that, 18.1% of household heads were educated up to secondary education while only 4.3% were educated up to tertiary education. These results therefore suggest that, most respondents who are participating in the production of ILVs are educated to primary education.

Regarding farm income generated by the respondents, most respondents (67.4%) indicated that, they do not have any farm/farming income while 5.8% of the household heads indicated to generate income between R1000 and R3000 per month from ILV sales. Descriptive results further show that, about 7.2% of household heads were earning income from exotic vegetables sales rather than ILVs sales, while 1.4% of household heads indicated that they earn income from livestock sales not from selling ILVs. Lastly, 18.1% of household heads indicated that, they have farm/farming income which is over R3000 per month from ILV sales. These results revealed that, many households do not have farm/farming income, however, households which are involved in farming seem to be focusing more on exotic vegetable production and livestock farming and income generated from these two enterprises differs with seasons. Table 4.2 further shows that, from the sampled households, about 76.1% of household heads are unemployed while 23.9% are employed. These results therefore suggest high unemployment rate from rural households of ANDM.

With reference to ILV production status, Table 4.2 shows that, about 61.3% of households produce ILVs, while 38.7% produce only exotic vegetables instead of ILVs. These results therefore imply that, there is a dominance of ILVs producers from the study area. Regarding the size of land used for ILV production, Table 4.2 shows that, 57.4% of households are producing ILVs from a land size ranging between 0 and 0.5 (ha) while 3.7% are producing ILVs from land size ranging between 0.6ha and 2ha and lastly, 38.8% of household heads conveyed that, they use all the available land to produce exotic vegetables rather than producing ILVs. Descriptive results from Table 4.2 shows that, for households which do not produce ILVs, 62.3% of households reported that, they never thought of growing ILVs since these vegetables commonly grow naturally. Also, 37.7% of household heads reported that, they do not eat ILVs and this gave a reason for such households to not participate in ILV production.

Descriptive results indicate that, majority of producers (57.6%) only harvest seeds/seedlings from the wild/home gardens and this makes these areas major

sources of seeds/seedlings while 42.4% of producers are both purchasing and harvesting ILVs seeds. Furthermore, descriptive results from Table 6.2 shows that, most producers (81.2%) do not irrigate ILVs during production while few producers (18.8%) irrigate ILVs during production. Table 4.2 shows that, 43.8% of producers use community taps and river as their source of water, while 25% of producers use only a river as their source of water, also 18.8% of producers use both community taps and dams as their source of water and lastly, only 12.5% of producers are using community taps as a source of water. For producers who are not irrigating ILVs, Table 4.2 shows that, 43.3% of ILVs do not require irrigation to grow, while 56.7% (majority) indicated that, rain feed is enough to grow ILVs. The descriptive statistics on socioeconomic characteristics for JGDM are presented in Table 4.3 and discussed accordingly.

Table 4.3: Descriptive statistics of socioeconomic characteristics from JGDM

Variable	Age	Household size
N	135	135
Mean	53.23	7.35
Std deviation	12.728	2.251
Minimum	27	3
Maximum	76	13
Index	Outcome	Percentage (%)
Gender	Male Female	42.3% 57.7%
Level of education	Never went to school Primary education Secondary education Tertiary education	17.5% 48.9% 29.2% 4.4%
Farm income	No income R1000-R3000 Income from exotic vegetable sales Income from livestock sales Greater than R3000	56.9% 3.6% 10.2% 2.2% 27%
Employment status	Employed Unemployed	29.2% 70.8%
ILVs production status	Produce ILVs Do not produce ILVs	64.2% 35.8%
Size of land for ILV production	0ha to 0.5ha 0.6ha to 2ha Exotic vegetable production land size	56.2% 8.8% 35%
Reasons for not producing	Do not eat ILVs ILVs grow naturally	27.1% 72.9%

Source of seedlings/seeds	Purchase ILVs seeds Harvest seeds freely Purchase and harvest seeds	1.1% 41.6% 57.3%
Irrigation of ILVs	Irrigate ILVs Do not irrigate ILVs	14.6% 85.4%
Sources of water	Community tap Community tap and River Community tap and Dam	46.2% 23.1% 30.8%
Reasons for not irrigating	Require no irrigation Rain feed is enough to grow ILVs Scarcity of water	43.1% 55.6% 1.4%

Source: Research Survey

Table 4.3 shows that, households from the study area were ranging between a minimum age of 27 years to a maximum age of 76 years with an average age of 53 years. Regarding size of a household, descriptive results indicate that, households have a minimum size of 3 members and a maximum size of 13 members with an average size of 7 members within a household.

Descriptive results from Table 4.3 show that, 57.7% of the household heads were female while 42.3% were male. These results indicate domination of women from the sampled households regarding the production of ILVs. Maseko *et al.* (2017) also share similar findings, stating that, the availability of ILVs depends on means of collection rather than cultivation and women commonly collect ILVs. Descriptive results further show that, about 48.9% of household heads from the sampled households are educated up to primary education, while 17.5% of household heads never attended school. Also, Table 4.3 shows that, 29.2% of household heads are educated up to secondary education and 4.4% of the household heads are educated up to tertiary education. These results imply that, most household heads who participate in the production of ILVs are educated up to primary education.

Relating to farm income generated by households, Table 4.3 shows that, about 56.9% of households do not have any farm/farming income while 3.6% of the households have farm income ranging between R1000 and R3000 per month from ILVs. Table 4.3 further shows that, 10.2% of households earn income from exotic vegetables sales rather than sales from ILVs, while 2.2% of households earn income from livestock sales and not from selling ILVs. Lastly, 27% of households earn farm/farming income which is over R3000 per month from ILVs. These results reveal that, most households

from the study area do not generate any farm/farming income. However, such households are involved in farming, but they seem to focus more on exotic vegetable production and livestock farming since they claim better revenues from these two farming activities. In addition, household heads did not specify the amount that they generate from these farming activities, but they instead claimed that, the income generated varies per season. With regard to the employment status of household heads, Table 4.3 shows that, 70.8% of household heads are unemployed while 29.2% are employed. These results therefore indicate that, most household heads from the study area are unemployed.

Regarding ILV production status, Table 4.3 shows that, 64.2% of households produce ILVs, while 35.8% of households produce only exotic vegetables rather than ILVs. These results indicate a dominance of ILVs' producers from the study area. For non-producers of ILVs, descriptive results indicate that, 72.9% of households do not produce ILVs since they grow naturally, while 27.1% of households do not produce ILVs since they do not eat them. Table 4.3 further shows that, about 56.2% of producers produce ILVs from a land size ranging between 0 and 0.5 ha while 8.8% produce ILVs from land size ranging between 0.6ha and 2ha. Lastly, 35% of household heads conveyed that, they use all the available land to produce exotic vegetables instead of ILVs.

Concerning the source of seeds/seedlings for ILVs, descriptive results revealed that, 57.3% of producers purchase and harvest seeds/seedlings from wild/home gardens (for those who are harvesting) and this makes these areas as key sources of seeds/seedlings while 41.6% of producers only harvest seeds/seedlings from the wild/home gardens. Lastly, only few producers (1.1%) purchase seeds/seedlings for ILVs. Relating to irrigation of ILVs, Table 4.3 shows that, about 85.4% of producers do not irrigate their ILVs while only 14.6% of producers irrigate their ILVs. Descriptive results revealed that, 46.2% of producers use community taps as their source of water, while 23% of producers use both community taps and the river as their sources of water, also 30.8% of producers use only the river as their source of water. For producers which do not irrigate ILVs, Table 4.3 shows that, 43.1% of producers claimed that, ILVs do not require irrigation to grow, while 55.6% (majority) reported that, rain feed within the district is enough to grow ILVs. Lastly, 1.4% of the producers

reported water scarcity in the study area as a reason for not irrigating these vegetables.

The next section provides descriptive statistics on the ILVs produced and grown from the three district municipalities.

Table 4.4: Most produced and grown ILVs in ORTDM, ANDM and JGDM

Indigenous Leafy Vegetables (ORTDM)	Number of times mentioned	Rank
Amaranth	84	1
Nightshade, Blackjack	64	2
Pumpkin leaves	41	3
Sonchus asper L. (Irwabe)	23	4
Common sow thistle (Ihlaba)	21	5
Lambs quarter, Hog plum (Iyeye)	18	6
Turnip	13	7
Pigweed	6	8
Sweet potato leaves, *Coriacea Nannfd., Laportea peduncularis*	5	9
Spider plant	2	10
Chinese cabbage, Melon leaves, *Physalis peruviana L., Caudatus L.*	1	11
Indigenous Leafy Vegetables (ANDM)	Number of times mentioned	Rank
Amaranth	83	1
Nightshade	68	2
Blackjack	43	3
Pumpkin leaves	41	4
Physalis peruviana L.	28	5
Hog plum	23	6
Lambs quarter	20	7
Common sow thistle	17	8
Sweet potato leaves	12	9
Sonchus asper L., Coriacea Nannfd.	9	10
Turnip	7	11
Laportea peduncularis	6	12
Cucurbitaceae, Caudatus L.	3	13
Tomato leaves, Pigweed	2	14
Chinese cabbage	1	15
Indigenous Leafy Vegetables (JGDM)	Number of times mentioned	Rank
Amaranth	86	1
Nightshade	78	2
Blackjack	55	3
Pumpkin leaves	49	4
Lambs quarter	34	5
Caudatus L.	13	6

Sweet potato leaves	11	7
Turnip	6	8
Pigweed	3	9
Laportea peduncularis	1	10

Source: Research Survey

Table 4.4 presents the produced and naturally growing ILVs from ORTDM. These vegetables are presented in a rank manner, thus, number one represents the most produced ILVs and the last number of the rank representing the least produced ILVs from the district. Within the 18 ILVs which are produced from the study area, Amaranth is the most produced ILV with Chinese cabbage, Melon leaves, *Physalis peruviana L., Caudatus L.* being the least produced ILVs from the study area as indicated in Table 4.4 above.

Table 4.4 further shows the produced and growing ILVs from ANDM. The table indicates the ranking of ILVs with number one indicating the most produced ILVs and the last number of the rank representing the least produced ILVs. From the 18 ILVs which are produced from the study area, Amaranth became the most produced vegetable with Chinese cabbage being the least produced ILV from the study area as indicated in Table 4.4 above.

Lastly, Table 4.4 shows the produced and existing ILVs from JGDM. Table 4.4 further indicates the ranking of ILVs with number one representing the most produced ILVs and the last number of the rank representing the least produced ILVs. From the ten (10) ILVs that are produced from the study area, Amaranth is the most produced vegetable with *Laportea peduncularis* as the least produced ILV from the study area as shown in Table 4.4.

4.2 Factors influencing production of ILVs from ORTDM, ANDM and JGDM

This section presents factors which influence household's participation in the production of ILVs from the ORTDM, ANDM and JGDM as shown in Table 4.5, 4.6 and 4.7 respectively as confirmed by Binary Logistic Regression estimates.

Table 4.5: Factors influencing production of ILVs in OR Tambo District Municipality

Independent variables	B	Std Error	Wald	Significance
Gender	-.605	.405	2.238	.013**
Age	-.002	.017	.019	.890
Education:				
Primary education	-.532	.881	.365	.546

Secondary education	-1.292	.691	3.498	.061*
Tertiary education	-1.820	.874	4.342	.037**
Household size	.079	.075	1.115	.291
Employment status	-.777	.527	2.173	.014**
Constant	.621	.983	.399	.528
Model summary:				
(-2) Log likelihood		171.124		
Cox & Snell R Square		.607		
Accuracy of prediction: Overall (%)		89.3		
Nagelkerke R Square		.902		

*Note: **and * indicate significance level at 5% and 10% respectively.*

Source: Research Survey

Regarding the model fit, the Lemeshow Godness-of-Fit (Chi- square) test statistics was 1.00 and this implies that, the model approximations fit the data at a satisfactory level. In this study, Nagelkerke R^2 of 0.902 was obtained, this indicates that more of the variation was explained by the model with an overall prediction percentage of 89.3, as shown in Table 4.5 above.

From the variables that were fitted in the model for analysis, four variables (Age, secondary education, tertiary education and employment status) were confirmed to be significant as discussed below.

4.2.1 Gender

A negative relationship between production of ILVs and gender was confirmed by binary regression estimates as indicated in Table 4.5 above. These results suggest that, as fewer females participate in the production of ILVs, there is a likelihood of decreased production of ILVs since women are the recognised gender to largely participate in the production of ILVs when compared to male counterparts. These results infer that, households which are headed by males are likely to discourage production of ILVs when compared to female headed households as most households are male regulated. Shackleton *et al.* (2010) also come to a similar conclusion, corroborating that, women are the main players in collection, production and selling of ILVs since very little income is required to start the business of selling these vegetables as compared to start the business of exotic vegetable production. Gender characterisation is one of the demographic characteristics which is likely to influence participation in the production of ILVs by producers in a negative direction (Ndengwa, 2016).

4.2.2 Secondary education

A negative correlation between household heads which are educated up to secondary education was confirmed by binary regression model. These results reveal that, the higher the education level, the higher the chances of decreased production of ILVs by producers, thus ultimately decreasing production of these vegetables. This means that, with the level of education that producers have so far, they still probably lack a better understanding or knowledge concerning production of ILVs which therefore inhibits household farmers not to consider production of ILVs. To this end, level of education negatively influences the production of ILVs amongst farmers. Similar findings were also shared by Gido *et al.* (2016) revealing that, lack of information concerning ILVs has an influence towards production of these vegetables and further suggested that, there is a need to promote ILVs' consumption and marketing through extensive production and knowledge sharing regarding their nutritional and economic importance.

4.2.3 Tertiary education

A negative association between production of ILVs and producers which are educated up to tertiary level was confirmed by binary regression estimates as shown in Table 5.4 above. This implies that, as the education level of ILVs producer increases, the less producers are likely to be involved in the production of ILVs. These results suggest that, as much as educated headed producers may understand all the benefits associated with the production of ILVs, there is a likelihood that, their level of education aided such producers to be job secured. The influence of job security is therefore likely to prevent producers from producing ILVs on larger amounts since they probably afford exotic vegetables and do not want to be labelled as lower-class population by producing ILVs in the existence of their job security. Hart and Vorster (2006) also share similar findings, arguing that, ILVs are commonly treated as weeds by many extension personnel and they advise farmers to keep this weed population under control. Thus, labelling this important food as not worthy of the space it occupies in households' gardens and farmers' fields.

4.2.4 Employment status

With reference to employment status of ILVs producers, a negative association between employment status and production of ILVs was confirmed by Binary Logistic

Regression model. These results suggest that, if the producers of ILVs are not employed, there is a prospective of decreased production of ILVs. This may perhaps hinder the development of new ideas concerning farming activities which include ILVs since these vegetables are not popularly grown. Similar comparable findings were earlier discovered by Labadarios *et al.* (2011); Beddington *et al.* (2012) pointing out employment status as a socio-economic condition which is probable determining affordability by households where in a case of employed producer there could be a capability of providing themselves with basic household needs. Thus far, such farmers would likely participate less or not at all in the production of ILVs since they could be affording purchasing exotic vegetables other than ILVs. Regardless of the high unemployment rate from ORTDM which leads to food insecurity shocks for certain households, the importance of ILVs in generating income and alleviating food insecurity; and malnutrition has been noted, but these vegetables have remained unrecognised, unappreciated and undervalued (Aju *et al.,* 2013; Nyembe, 2015). The next table presents observed results on factors influencing production of ILVs as confirmed by BLR model, and these results are also discussed in detail.

Table 4.6: Factors influencing production of ILVs in Alfred Nzo District Municipality

Independent variables	B	Std Error	Wald	Significance
Gender	1.930	.605	10.188	.001***
Age	-.091	.027	11.254	.001***
Education:				
Primary education	1.707	1.889	.817	.366
Secondary education	1.266	1.762	.516	.472
Tertiary education	-1.227	1.350	.826	.363
Household size	.113	.110	1.047	.306
Farm income	-16.705	2337.24	.000	.994
Employment status	-1.878	1.282	2.147	.014**
Constant	3.892	1.525	6.518	.011
Model summary:				
(-2) Log likelihood		93.465		
Cox & Snell R Square		.579		
Accuracy of prediction: Overall (%)		77.2		
Nagelkerke R Square		.650		

*Note: *** and ** indicate significance at 1% and 5% respectively*

Source: Research Survey

The model summary of the study as shown in Table 4.6 above, presents that, Nagelkerke R^2 of 0.650 was attained; this designates that, more of the variation from

explanatory variables was explained by the model with an overall prediction percentage of 77.2. Regarding (-2) Log likelihood, there is no absolute way to judge the likelihood value, but the higher the log likelihood value the better. The Cox and Snell R-Square is 0.579 which indicates that, about 58% of the variation in the dependent variable was explained by the model.

The variables that were fitted in the model and found to be significant are discussed below. These variables included gender, age, and employment status of the household heads.

4.2.5 Gender

Table 4.6 shows a positive association between gender and production of ILVs. These results reveal that, an increase in number of women involved in the production of ILVs is likely to increase the production of these vegetables. In relation to the results, several authors also highlighted that, production of ILVs is commonly practised by women when compared to men (Vorster *et al.,* 2008; Faber *et al.,* 2010; Shackleton *et al.,* 2010). This therefore explains gender categorization regarding production of ILVs is likely to decrease production of these vegetable hence gender equality regarding production of ILVs also needs to be encouraged. This is because, generally, men tend to prefer producing crops exclusively for sale (cash crops) due to gender roles and power structures, while mostly women hope for welfare returns for their families. Stokoe (2000); Nguni and Mwila (2007) further suggest that, women should be a target group for discovering an increased utilization and production of ILVs since these vegetables are still mainly subsistence crops.

4.2.6 Age

A negative relationship between age and production of ILVs was confirmed by Binary Logistic Regression estimates as shown in Table 4.6 above. These results suggest a negative influence regarding age, which simply means that, as producers' age is increasing, there is a likelihood of decreased production of ILVs. Shackleton *et al.* (2010) also validate that, production and collection of ILVs is commonly done by middle-age people and this may possibly lead to decreased production and utilization of ILVs by households. Previously, Jansen Van Rensburg *et al.* (2007) also explain that, the youth specifically do not consume nor participate in the production of ILVs because they do not want to be described as old fashioned.

4.2.7 Employment status

Table 4.6 indicates a negative association between employment status and production of ILVs. These results estimate that, as the number of employed producers increases, there exists a probability of decreased production of ILVs. This could be a result of that, producers with working members within a household likely have other means to purchase exotic vegetables rather than using ILVs for food purposes which may perhaps lower production of ILVs. Shackleton (2003) also comes to a related conclusion stating that, during periods of drought, or when a breadwinner within a household becomes unemployed, affected rural households rely on the collection of ILVs for food purposes. This therefore explains that if any household member is employed; there could be a possibility of decreased production of ILVs by such households. Factors influencing production of ILVs in JGDM are presented in Table 4.7 and discussed accordingly.

Table 4.7: Factors influencing production of ILVs in Joe Gqabi District Municipality

Independent variables	B	Std Error	Wald	Significance
Gender	.911	.542	2.827	.093*
Age	-.122	.031	15.395	.000*
Education:			17.473	.001*
Primary education	1.425	1.224	1.354	.245
Secondary education	-1.085	1.005	1.164	.281
Tertiary education	-1.873	1.023	3.350	.067*
Household size	.307	.140	4.787	.029**
Farm income	-1.077	.261	17.046	.000***
Employment	.744	.860	.748	.387
Constant	4.400	1.676	6.887	.009
Model summary:				
(-2) Log likelihood		96.317		
Cox & Snell R Square		.552		
Accuracy of prediction: Overall (%)		85.2		
Nagelkerke R Square		.620		

*Note: ***, ** and * indicate significance level at 1%; 5% and 10% respectively.*

Source: Research Survey

About the model fit, the Chi-square test statistics were below 1.00, implying that, the model estimates fit the data at an acceptable level as shown in the model summary from Table 4.7 above. From the study, Nagelkerke R^2 of .620 was obtained, which indicates that, more of the variation was explained by the model with an overall prediction percentage of 85.2 as shown in Table 4.7 above.

The variables which were discovered by the Binary Regression Model to be significant are discussed below. These variables included gender, age of a household head, tertiary education, household size and farm income.

4.2.8 Gender

Table 4.7 indicates a positive association between gender and participation in the production of ILVs. These results suggest that, the more women are involved in the production of ILVs, there could be a chance of increased production of these vegetables, since previous literature highlights that, women are the recognised gender in the production of ILVs. Previous studies also highlight that, associating the production of ILVs to a specific gender could have a potential to decrease the production of ILVs. This inversely means that, if all genders were involved in the production, there may be a likelihood of increased production of ILVs and this could also trigger market demand for these vegetables. For instance, AVRDC (2008); Gido *et al.* (2016) also argue that, ILVs are currently noted for their commercial value, they are attracted by the strong market demand, companies are commencing to explore and develop these vegetables. This may therefore help in strengthening the formal sector of these vegetables. This may be helpful since Department of Agriculture, Forestry and Fisheries (2013); Maseko *et al.* (2017) report that, although there is recognisable economic value of ILVs, these vegetables and the products made from them are not commercialised and the surplus produce of these vegetables is only traded informally within communities to generate income for households.

4.2.9 Age

Regression estimates confirmed a negative relationship between age and the production of ILVs as shown in Table 4.7 above. This implies that, the higher the age of a producer, the higher is a likelihood of decreased production for ILVs. This means that, if there are specific age groups which are involved in the production, there could be a chance of decreased production of these vegetables. Contradictory, literature highlights that, older people tend to participate more in the production of ILVs as compared to young people. This may be due to the fact that, certain age groups possibly lack knowledge regarding the benefits which are associated with production of ILVs. Shackleton *et al.* (2009); Mpala *et al.* (2013) also share similar findings arguing

that, a lack of Indigenous Knowledge (IK), especially within the younger generation is one of the major reasons for the inability to recognise ILVs for production and consumption.

4.2.10 Tertiary education

Although education was found to be significant, tertiary education highly influenced the dependent variable as shown in Table 4.7. These results show a negative association between production of ILVs and producers which are educated up to tertiary level. These results also suggest that, as long as producers are educated up to tertiary education level, a probability of decreased production of ILVs exists. The level of education for such producers may lead them to be job secured and this may ultimately translate to affording producers who rather produce less of ILVs and purchase exotic vegetables instead of ILVs. Shackleton *et al.* (2010) also come to a similar supposition signifying that, most farmers who participate in the production of ILVs have limited formal education. In addition, Mayekiso (2016) contends that, educated households generally have better job skills which result in such households being able to obtain better job opportunities with a fair income. The fairness of income is therefore likely to prompt such households to not make informed decisions relating to their food choices.

4.2.11 Household size

A positive association between household size and production of ILVs was confirmed by binary regression estimates as shown in Table 4.7. This implies that, as a household size increases, there is a possibility of an increased production of ILVs. This could be a reason that, larger households probably share activities that need to be done within a household, and this could perhaps lead to such households sharing farming activities which include the production of ILVs.

4.2.12 Farm income

With reference to farm income, Table 4.7 shows a negative association between income and participation in the production of ILVs. These results suggest that, as farm income increases, there is a likelihood of decreased production of ILVs. The reason for this may be that, producers would rather opt for any enterprise which is likely to generate more income such as exotic/commercial vegetable production and livestock

farming instead of ILV production. Based on the study results, and the production of ILVs from the study area, it may be assumed that producers do not produce these vegetables on larger amounts since they believe that producing ILVs may generate a small income. This may therefore possibly discourage famers from producing these vegetables which also deprives such farmer's business opportunities which may have a potential of generating extra household income.

4.3 Summary statement for Binary Logistic Regression results in the study areas

From ORTDM, Binary Logistic Regression results confirmed that gender, secondary education, tertiary education, and employment status discourages households to be involved in the production of ILVs. This therefore explains that, if production of ILVs is tied to a specific gender it may limit the production of these vegetables. Just like households entailing members with formal education are discouraged to produce ILVs as they may be having skills which makes them enable to secure jobs.

From ANDM, Binary Logistic Regression estimates established, that gender encourages households to participate in the production of ILVs, while on the other hand employment status and age discourages households to participate in the production of ILVs. This explains that, if all genders are involved in the production of ILVs, the availability of these vegetables may be enhanced. Also, if production of ILVs is associated to a specific age group and if household have unemployed members, these may attract reduced production if no production of ILVs by households.

From JGDM, Binary regression estimates confirmed that, gender and the household size positively influence households to participate in the production of ILVs. In relation to gender, most producers of ILVs from the study area are women as also explained by the descriptive statistics results. Thus, a larger number of women's participation in the production of ILVs triggers an increased production of these vegetables since previous literature also highlights that, women tend to produce ILVs more when compared to men. The reason given was that, women have a better understanding of ILVs which belong to food groups and those that are characterised as weeds. A household size is also mentioned to positively influence a household production status, this means that, if a large household has its members involved in all activities done within a household this may also have a potential in promoting production of ILVs. Age, tertiary education and farm income were estimated to negatively influence

households to participate in the production of ILVs. Considering this, literature previously highlighted that, not all age groups are involved in the production of ILVs and descriptive results also indicate that, on average, people in their 50s' participate more in the production of ILVs when compared to the youth. Also, very few people from the study area are educated up to tertiary level, which possibly means that they are aware of the benefits related to the production of ILVs and still choose to focus on other farming activities to generate income. Thus, discouraging production of ILVs by households.

4.4 Uses of ILVs and determinants of different uses of ILVs by households from ORTDM, ANDM and JGDM

This section presents different uses of ILVs by households and further discusses the determinants of the different use of ILVs by households of ORTDM, ANDM and JGDM. The different uses of ILVs from the study areas are indicated in Figure 4.1, 4.2 and 4.3 respectively and the determinants of different uses by households towards ILVs are shown in Table 4.8, 4.9 and 4.10 below. This section begins by presenting descriptive results on uses of ILVs followed by the empirical results on the determinants of such uses.

To determine different uses of ILVs by households, the dependent variable (use of ILVs) had three outcomes, outcome one: Use of ILVs as food, outcome two: use of ILVs as medicine and outcome three use of ILVs as livestock feed. In the study, the third outcome of the dependent variable, "use of ILVs as livestock feed," was taken as the baseline outcome/category and the results were interpreted accordingly. According to Cheteni and Mokhele (2019), the sign interprets the coefficient of the MLR model, for example, a positive coefficient on independent variables means that the other outcome is more likely to be chosen than the base outcome. Therefore, the results obtained for this study are interpreted in this manner.

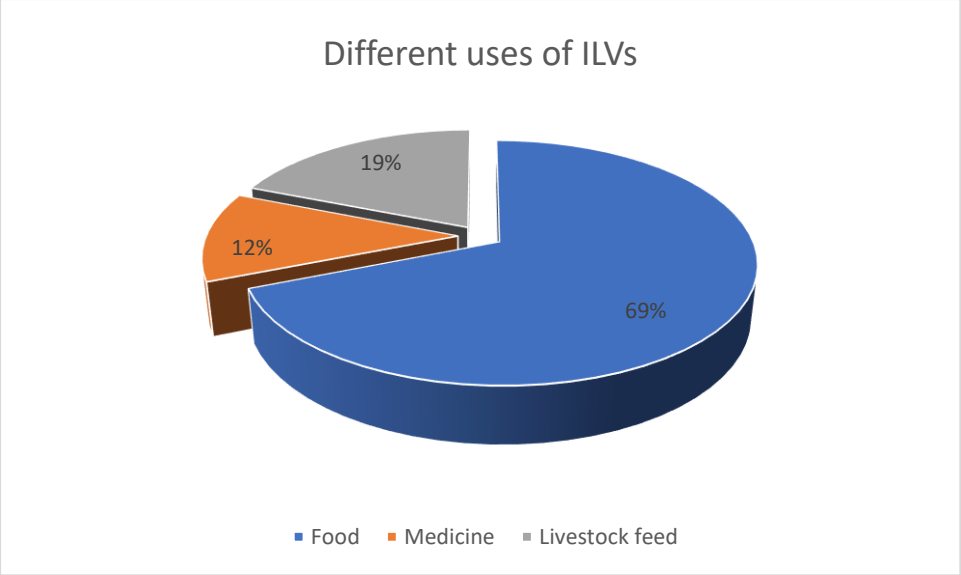

Figure 4.1: Uses of ILVs in ORTDM

Source: Research Survey

Figure 4.1 presents the descriptive statistics on different uses of ILVs by households from ORTDM. Descriptive results revealed that, many households (69%) from ORTDM are using ILVs for food purposes, while 12% of the households are using ILVs for medicine purposes. Figure 4.1 further reveals that, 19% of the households from ORTDM are using ILVs as livestock feed. These results suggest that, from the sampled households, the use of ILVs for food purposes is dominating among the households. This could be a reason that, households are aware and understand the benefits that are linked with consuming these vegetables. Kruger *et al.* (2015) also agrees, stating that, the importance of consuming ILVs is recognised hence a proposition of using indigenous foods by commercializing these vegetables is suggested. From this way, production and utilization of ILVs may be improved since they have potential in enhancing quality of diets and improving food and nutrition security.

Table 4.8: Factors influencing different uses of ILVs by households from ORTDM

Dependent variable: Use of ILVs as livestock feed vs Use of ILVs as food				
Independent variables	B	Std Error	Wald	Significance
Intercept	2.696	2.869	.939	.327
Age	.023	.033	.500	.479
Household size	-.194	.159	1.488	.223
Gender	-.259	.737	.123	.725
No farm income	3.698	1.061	12.142	.000***
R1000-R3000	1.612	.973	2.744	.098*

Income from exotic vegetable sales	2.652	1.621	2.667	.010***
Income from livestock sales	2.449	1.608	2.321	.012**
Employment status	.964	1.007	.926	.336
Aware about nutrition benefits	19.819	3805.609	.000	.996
Aware about health benefits	-2.031	2.158	.885	.347
Seasonal production of ILVs	2.000	1.146	3.048	.081*
Dependent variable: Use of ILVs as livestock feed vs Use of ILVs as medicine				
Intercept	5.006	2.142.	2.338	.196
Age	.012	.043	.085	.770
Household size	-.170	.214	.632	.427
Gender	-2.133	1.361	2.457	.071*
No farm income	3.089	1.349	5.245	.022**
R1000-R3000	1.096	1.387	.625	.429
Income from exotic vegetable sales	1.726	1.925	.804	.370
Income from livestock sales	-10.384	749.641	.000	.989
Employment status	-1.308	1.537	.724	.395
Aware about nutrition benefits	12.599	501.155	.001	.980
Aware about health benefits	1.475	1.554	.901	.342
Seasonal production of ILVs	-1.395	1.606	.755	.385
Model summary:				
(-2) Log Likelihood		151.778		
Chi-Square		266.029		
Pseudo R-Square:				
Cox and Snell		.855		
Nagelkerke		.898		

*Note: ***; ** and * indicate significance level at 1%; 5% and 10% respectively.*

Source: Research Survey

For the model summary, the -2Log likelihood of 151.778 indicates the probability at which the null hypothesis was rejected. The Cox and Snell R-Square was 0.855 and this means that, about 85.50% of the variation in the dependent variable was explained by the model. The Nagelkerke was 0.898 and this indicates a strong relationship of 89.80% between the independent and a dependent variable. Nagelkerke is also higher than the Cox and Snell which therefore indicates a more reliable measure of the relationship between the dependent variable and explanatory variables.

4.4.1 Use of livestock feed vs Use of ILVs as food

Regarding the use of ILVs as food, regression estimates revealed that, various sources of farming income and seasonal production of ILVs positively influence

households to use ILVs for food purposes over livestock feed. Determinants which influence households to use ILVs for food purposes only are discussed below.

a) No farm income

Table 4.8 shows a positive significant (3.698) relationship at 1% level between households who are not generating any farm income when comparing households which use ILVs as food only from households using ILVs as livestock feed. These results suggest a higher probability for households with no farm income to use ILVs as source of food instead of using ILVs as livestock feed. This may be a reason that, households with no farm income possibly rely mostly on ILVs as their source of vegetables since such households do not afford to purchase other exotic vegetables such as spinach, cabbage. Given this, such households are likely to opt in using ILVs as sources of food and this may perhaps translate to recognition of ILVs as valid sources of food. Shonshai (2016) also shared similar findings, emphasizing that, various studies in South Africa indicated that, ILVs are likely to play a double role; firstly, they may provide cash to poor households and secondly, households which sell these vegetables may also save their money by consuming ILVs rather than purchasing exotic vegetables.

b) Farm income ranging between R1000-R3000 (ILVs income)

According to Table 4.8, farm income ranging between R1000-R3000 from ILVs is significant at 10% level with a positive coefficient of 1.612 towards use of ILVs as food. This implies that, as income from ILVs increases there is a higher likelihood that households may use ILVs for food purposes and not use ILVs as livestock feed. This means that, the farm income earned by households is probably not enough to acquire food, instead such households use the earned income to sustain other household's needs rather than acquiring food. Similar comparable findings were also revealed by Vorster *et al.* (2007); Shonshai (2016) stating that, most households who do not have constant income benefit from the sales of ILVs and the income that is generated from ILVs may also assist them in sustaining other livelihood needs. In addition, several authors came to a similar conclusion, validating that, for some poor families, ILVs could become substitutes for some food crops such as swiss chard or spinach (Flyman and Afolayan, 2006; Matenge *et al.,* 2012; Mavengahama, 2013; Mayekiso *et al.,* 2017).

c) Income from exotic vegetable production

Level of farm income has a direct influence towards the use of ILVs by households. Income from exotic vegetable production was statistically significant at 1% and had a positive coefficient of 2.652. These results suggest that, an increase in income from exotic vegetable sales is likely to increase use of ILVs as food over use of ILVs as livestock feed. This means that, households are probably using exotic vegetable production for business purposes so to maintain other needs of a household. Thus, choosing ILVs for food purposes since these vegetables are habitually harvested freely from home gardens, fields and from the wild. Mavengahama *et al.* (2013) also came to a similar conclusion, arguing that, ILVs are proposed to be part of the solution to the problems of hunger and malnutrition particularly among the population group of low-income households since they are inexpensive source of food. Shackleton and Gumbo (2010); Muhanji *et al.* (2011) further argue that, in South Africa, ILVs are popularly harvested freely from the wild and those that are cultivated require less inputs than conventional vegetables and thus making ILVs easily accessible and inexpensive food source.

d) Income from livestock farming

Income from livestock farming was found to be statistically significant at 5% level with a positive coefficient (2.449) as indicated in Table 4.8. The explanation for the positive coefficient could be that an increase in income from livestock sales is likely to increase use of ILVs for food purposes by households instead of households using ILVs as livestock feed. This may be a reason that, income generated from livestock sales does not come on regular basis, so households may lack resources to acquire food because of this. Thus, resulting to households by chance relying on ILVs as their source of food and ultimately increasing use of ILVs for food purposes. Similar comparable findings were also revealed by Bua and Onang (2017) conveying that, as much as ILVs form an important part of the diets of the local populace both during the normal and off seasons, some households tend to rely on ILVs during tough times.

e) Seasonal production of ILVs

Seasonal production of ILVs was significant among factors which influence households to use ILVs. This variable had a positive coefficient of (2.000) and the variable was found to be significant at 10% level. This positive relationship explains

that, if ILVs are not available on seasonal terms there is a higher probability that households may use ILVs for food purposes and opt not to use ILVs as livestock feed. These results further explain that, households may probably choose to use ILVs as food during times of food scarcity particularly in winter where most exotic vegetable fail to grow because of water scarcity and certain environmental conditions such as drought, frost. Consumption of these vegetables may therefore lead to diverse diets for households especially when there are food shortages. A study conducted by Gosh-Jerath *et al.* (2016) also came to a similar conclusion, uttering that, ILVs are recognized for diversifying diets and being the powerful sources of nutrients for poorer households in terms of better diets and health. Vorster *et al.* (2007) also contend that, ILVs are important in food security, especially as a dried food source during winter and in providing safety against pests, diseases and varied environmental conditions.

4.4.2 Use of ILVs as livestock feed vs Use of ILVs as medicine

With reference to use of ILVs for medicine purposes, gender and no farm income influence households' decision of using ILVs as medicine source over use of ILVs as livestock feed.

a) Gender

Gender was among factors which forces households to choose the use of ILVs for their families. This variable was statistically significant at 10% level with a negative coefficient of -2.133 as shown in Table 4.8. The explanation for the negative coefficient could be that, gender has a likelihood of determining the decision which influences household to use ILVs as medicine sources. This further explain that, if households may continue using gender as a determinant regarding the use of ILVs, there could be a probability that, the use of ILVs as medicine source may decrease and households may shift to using ILVs as livestock feed. Previous literature also highlights that, production or any activity relating to ILVs is commonly associated with women in South Africa. This could be one of the reasons which is likely to trigger different uses of ILVs to be associated to a specific gender; that is women to be exact. Vorster *et al.* (2008) also came to a similar conclusion, uttering that, women are dominating in the production and utilization of ILVs to sustain immediate household food security and health needs in South Africa. For instance, by Kansiime *et al.* (2018) convey that, ILVs are noted of their key health benefits which include improving vision, increasing

haemoglobin in the body (reduced anaemia), and increasing body resistance to diseases.

b) No farm income

According to Table 4.8, a positive and significant (3.089:5%) relationship was found between households with no farm income and use of ILVs as medicine. This implies that, for households with no farm income, the probability of using ILVs as medicine is higher with respect to use of ILVs as livestock feed. This may mean that, for households who do not have farm income there is a possible reliance on ILVs as source of medicine since such households are not affording to purchase medicine from retailers. Thus, making ILVs affordable sources of medicine for some households who may be lacking resources or money to obtain medicine. Oladele (2011); Shonshai (2016) also shared similar findings arguing that, ILVs do not only generate income for households but at the same time they may be inexpensive food and medicine sources particularly for poorer households. Njume *et al.* (2014) also mentioned benefits such as: ILVs gives the body energy, healthy skin development, repair body tissues, and help children to grow. Similar health benefits were also earlier reported by Yang and Keding (2009). The following section gives results and discussion on the use of ILVs and determinants towards use of ILVs by ANDM households.

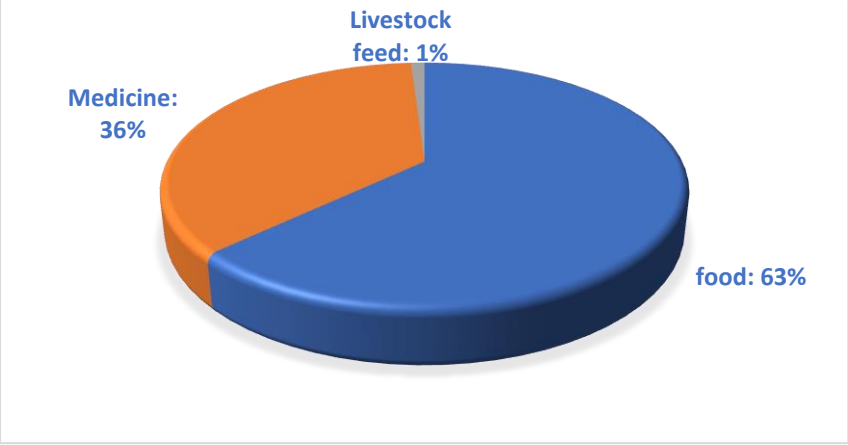

Figure 4.2: Uses of ILVs in ANDM

Source: Research Survey

Descriptive results from Figure 4.2 indicate that, most (63%) households from ANDM use ILVs for food purposes only, while 36% of households from ANDM use ILVs for medicinal purposes. Descriptive results further indicate that, only 1% of the households from ANDM are using ILVs as livestock feed. These results therefore

reveal that, from the study area, many households use ILVs for food purposes only. This may be due to the fact that, such households do not have means to acquire other kinds of food given the high unemployment rate from the district and thus prompting such households to rely on ILVs as their source of vegetables and food; and perhaps understand benefits linked to utilization of ILVs. Likewise, Singh *et al.* (2013) confirm that, ILVs are easily accessible, inexpensive food source expressly for households which are classified as poor and these vegetables contain higher minerals and vitamins levels exceeding those found in most exotic vegetables such as spinach, cabbage.

Table 4.9: Factors influencing different uses of ILVs by households from ANDM

Dependent variable: Use of ILVs as livestock vs Use of ILVs as food				
Independent variables	B	Std Error	Wald	Significance
Intercept	4.221	6.950	.607	.895
Age	.063	.046	1.869	.172
Household size	.122	.198	.382	.537
Gender	.659	1.034	.406	.524
No farm income	2.430	.953	6.506	.011**
R1000-R3000	3.659	1.474	6.163	.013**
Income from exotic vegetable sales	-1.864	2.062	.817	.366
Income from livestock sales	1.863	3.902	.447	1.000
Employment status	.115	1.098	.011	.917
Aware about nutrition benefits	-.860	2.566	.112	.738
Aware about health benefits	-.210	1.228	.029	.864
Seasonal production of ILVs	4.474	1.742	6.594	.010***
Dependent variable: Use of ILVs as livestock feed vs Use of ILVs as medicine				
Intercept	1.386	3.312	.418	.997
Age	-0.17	.083	.044	.835
Household size	.213	.292	.530	.466
Gender	2.111	1.730	1.488	.223
No farm income	4.891	2.044	5.728	.017**
R1000-R3000	2.501	3.944	.402	.526
Income from exotic vegetable sales	.986	2.704	.133	.715
Income from livestock sales	1.864	2.062	.817	.366
Employment status	-.121	2.393	.003	.960
Aware about nutrition benefits	-5.921	3.374	3.079	.079*
Aware about health benefits	1.888	3.113	1.148	.284
Seasonal production of ILVs	-6.635	4.156	2.549	.010***
Model summary:				
(-2) Log Likelihood		177.707		

Chi-Square	240.10
Pseudo R-Square:	
Cox and Snell	.824
Nagelkerke	.866

*Note: ***, ** and * indicate significance level at 1%; 5% and 10% respectively.*

Source: Research Survey

A -2Log likelihood of 177.707 from the model summary explains the probability at which the null hypothesis was rejected. The Cox and Snell R-Square was 0.824 and indicates a good data fit from the model. As it is previously explained that, any Cox and Snell R square value less than 1 indicates a good model fit of the data. The Nagelkerke was 0.866 and this indicates a strong relationship of 86.60% between the independent and a dependent variable. A higher Nagelkerke also indicates a more reliable measure of the relationship between dependent variable and explanatory variables.

4.4.3 Use of ILVs as livestock feed vs Use of ILVs as food

Regarding use of ILVs as food, Multinomial Logistic Regression results revealed that, no farm income, farm income ranging between R1000 and R3000; and seasonal production of ILVs positively influence the decision of households to use ILVs for food purposes only when compared to use of ILVs as livestock feed.

a) No farm income

Generally, income influence preferences of individuals when it comes to food choices. A positive (2.430) coefficient with 5% significance level was found from this variable (no farm income) when comparing households which are using ILVs for food purposes from households which are using ILVs as livestock feed. The positive coefficient could be explaining that, if households are not generating any farm income; there could be a higher probability of an increased use of ILVs for food purposes only. This may be a reason that, ILVs are easily accessible and affordable source of food; where in most rural household's lack money to purchase exotic vegetables. Such households are therefore likely to rely on ILVs as their source of vegetables and less likely to use ILVs as livestock feed. Similar findings were also shared by Shackleton *et al.* (2009) stating that, in South Africa, most of the ILVs that are in the market are collected, they are not cultivated, and such collection activities occur from people's own gardens and fields,

disturbed sites or on commercial farms where landowners permit harvesting of what they deem to be weeds. Mwaura *et al.* (2014) also note that, for poorer rural households, ILVs are perhaps an important contributor to household income so to sustain their livelihoods, as the producers sell these vegetables to local communities to generate income. Similarly, Fandohan *et al.* (2010) earlier discover that, ILVs play a role as one of the primary alternative sources of income particularly for rural communities.

b) Farm income between R1000-R3000 (ILVs income)

According to Table 4.9, a positive (3.659) and a significant relationship at 5% level was observed on farm income ranging between R1000-R3000 when comparing households which are using ILVs for food purposes from households which are using ILVs as livestock feed. This implies that, if households continue to generate income ranging between R1000-R3000 for ILVs, the probability of using ILVs as food will be on the higher side. This could be a reason that, the farm income generated is possibly not enough to acquire food types and this therefore results to households using ILVs as their source of food and not choosing to use ILVs as livestock feed. Several authors such as Flyman and Afolayan (2006); Matenge *et al.* (2012); Mavengahama (2013); Mayekiso *et al.* (2017) also concur by arguing that, for some poor households who do not afford to purchase commercial vegetables, ILVs may be substitutes for some food crops such as swiss chard or spinach.

c) Seasonal production of ILVs

Seasonal production of ILVs was significant among other factors which directs the use of ILVs by households. This variable was statistically significant at 10% level with a positive coefficient of 4.474 as shown in Table 4.9. The explanation for the positive coefficient could be that, if production of ILVs is seasonal, there could be a possibility of increased use of ILVs for food purposes by households. For this reason, if ILVs are available throughout all seasons, there could be a probability of increased availability of ILVs which may therefore prompt increased use of ILVs for food purposes. Similar comparable findings were also discovered by Sikora and Bodziarczyk (2012) stating that, seasonal availability of ILVs presents an opportunity to add-value to these vegetables during times of abundance so that in a preserved form, they can be made available throughout all seasons. The availability of these vegetables may therefore

be likely to diverse diets and address food shortage shocks where in exotic vegetables fail to grow in some seasons thus consequently enhancing utilization of ILVs for food purposes. Furthermore, Nyembe (2015) recommends sun drying as a method that is convenient for almost all households who are willing to attempt preservation of ILVs so to make these vegetables available during off seasons to supplement their daily diets.

4.4.4 Use of ILVs as livestock feed vs Use of ILVs as medicine

With reference to use of ILVs as source of medicine, Multinomial Logistic Regression estimates confirmed that, no farm income, awareness about nutrition benefits of ILVs and seasonal production of ILVs influence the decision of households to use ILVs for medicine purposes when compared to use of ILVs as livestock feed.

a) No farm income

A positive coefficient of 4.891 and a significant (5%) relationship was found on households with no farm income when comparing households which are using ILVs for medicine purposes from households which are using ILVs as livestock feed as indicated in Table 4.9. These results suggest that, if households are not earning any farm income, there could be a probability of increased use of ILVs for medicine purposes. This means that, households are likely to choose using ILVs as medicine sources since such households are possibly lacking resources to acquire medicine from retail stores. Also, several authors believe that, ILVs do not only have beneficial nutrition components, but they also contain antioxidants and other compounds that are valuable to health (Kahlon *et al.,* 2008; Cartea *et al.,* 2011; Sithole and Chitja, 2011; Sikora and Bodziarczyk, 2012; Akeredolu and Adebajo, 2013).

b) Awareness about the nutrition benefits associated with ILVs

Awareness about the nutrition benefits was found to be negatively (-5.921) and statistically significant at 10% when comparing households which are using ILVs as medicine from households which are using ILVs as livestock feed. The negative coefficient could be explaining that, as long as households are not aware of the nutrition benefits associated with ILVs, there could be a likelihood of decreased use of ILVs for medicine purposes and household are likely to use ILVs as livestock feed. This could be a reason that, households have a perception of labelling ILVs as weeds

instead of valuable sources of food and medicine and perhaps lack knowledge linked to utilization of these vegetables for wellbeing. This might have triggered poor utilization of ILVs by households since farmers and households were advised to keep this weed population under control (Vorster *et al.,* 2007; Mayekiso, 2016). Likewise, Modi *et al.* (2006); Abugre (2011); Heywood (2013) also discover a decreased tendency in the utilization of ILVs due to limited knowledge of their value by households particularly within the rural settings.

c) Seasonal production of ILVs

According to Table 4.9, seasonal production of ILVs was found to have a negative (-6.635) coefficient and statistically significant at 10% level when comparing households which are using ILVs as medicine from households which are using ILVs as livestock feed. This implies that, if production of ILVs is done on seasonal basis or ILVs are available seasonally, there could be a possibility of decreased use of ILVs for medicine purposes and a higher chance of households shifting to use of ILVs as livestock feed. This means that, availability of ILVs on seasonal basis may possibly lower or limit their availability which therefore prompt to a decreased utilization of these vegetables for medicinal purposes. Bvenura and Afoloyan (2015) comparably state that, ILVs are seldom grown in South Africa and cultivation of ILVs is very limited to specific vegetables which are available on seasonal terms (Van Rensburg *et al.,* 2007). In addition, Shackleton *et al.* (2010) also argue that, the limited availability of ILVs to certain vegetable species may have affected availability of ILVs which therefore eventually decreases utilization of ILVs by households. Results and discussion on different uses of ILVs and their determinants from JGDM is presented as follows.

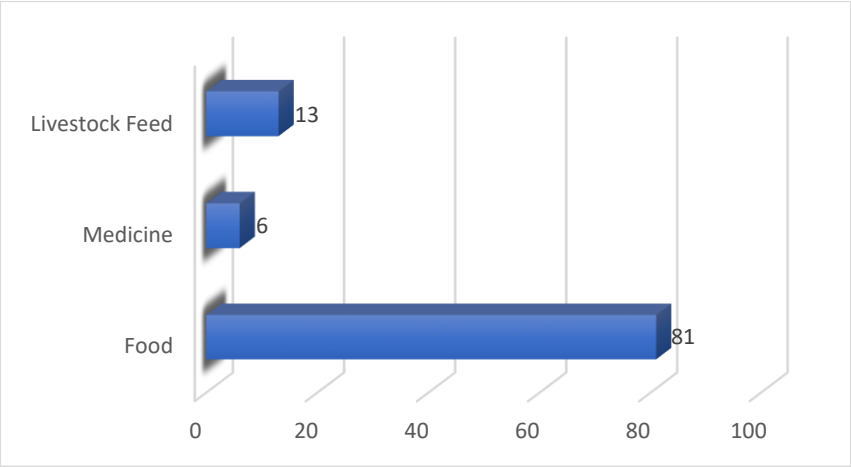

Figure 4.3: Uses of ILVs from JGDM

Source: Research Survey

Figure 4.3 shows descriptive statistics on different uses of ILVs amongst households from JGDM, and the results reveal that many (81%) households use ILVs for food purposes only, while 6% of households use ILVs for medicine purposes. The descriptive results further revealed that, 13% of the households from JGDM use ILVs as livestock feed. These results suggest a dominance of food use of ILVs by most households. Given the high unemployment rate recorded in JGDM, households may be dependent on ILVs for food since these vegetables are commonly harvested freely by most of ILVs consumers. Shackleton and Gumbo (2010); Muhanji *et al.* (2011) also share similar findings, stating that, in South Africa, ILVs are commonly harvested freely from the wild and open fields and those that are cultivated require less inputs for production when compared to conventional vegetables.

Table 4.10: Factors influencing different uses of ILVs by households from JGDM

Dependent variable: Use of ILVs as livestock feed vs Use of ILVs as food				
Independent variables	B	Std Error	Wald	Significance
Intercept	8.107	3.716	2.181	.053
Age	-.078	.044	3.180	.075*
Household size	.285	.200	2.034	.015**
Gender	2.005	1.188	2.849	.091*
No farm income	1.929	.815	5.604	.018**
R1000-R3000	16.953	1133.74	.000	.988
Income from exotic vegetable sales	-.385	.929	.172	.678
Income from livestock sales	11.261	7.527	1.496	.288
Employment status	-1.154	.842	2.001	.017**
Aware about health benefits	-2.054	1.390	2.185	.013**
Seasonal production of ILVs	1.961	1.232	2.532	.011**
Dependent variable: Use of ILVs as livestock feed vs Use of ILVs as medicine				
Intercept	3.783	1.408	2.686	.524
Age	-.002	.026	.008	.929
Household size	-.031	.160	.038	.846
Gender	-1.804	1.152	2.452	.017**
No farm income	3.162	1.576	4.025	.045**
R1000-R3000	-.096	1.297	.005	.941
Income from exotic vegetable sales	-.967	1.545	.391	.532
Income from livestock sales	1.382	2.572	.289	.591
Employment status	-2.254	2.798	.649	.420
Aware about health benefits	.593	1.371	.187	.665
Seasonal production of ILVs	-1.236	1.084	1.298	.255

Model summary:	
(-2) Log Likelihood	95.913
Chi-Square	251.608
Pseudo R-Square:	
Cox and Snell	.841
Nagelkerke	.913

*Note: ** and * indicate significance level at 5% and 10% respectively.*

Source: Research Survey

4.4.5 Use of ILVs as livestock feed vs Use of ILVs as food

For the model summary, a -2Log likelihood of 95.913 indicates the probability at which the null hypothesis was rejected. The Cox and Snell R-Square of 0.841 was observed by the model which means that, about 84.10% of the variation in the dependent variable was explained by the model. A Nagelkerke of 0.913 was also observed by the model and this indicates a strong relationship of 91.30% between the explanatory variables and the dependent variable. Higher Nagelkerke further indicates a more reliable quota of the relationship between dependent variable and explanatory variables.

Concerning the use of ILVs for food purposes from JGDM, study results revealed that, age, household size, no farm income, employment status, awareness about the health benefits associated with ILVs and seasonal production of ILVs influence the decision of households to use ILVs as food when comparing to use of ILVs as livestock. The influence of each variable is discussed in detail below.

a) Age

Table 4.10 indicates a negative relationship at 10% level between age and use of ILVs as food, when comparing to use of ILVs as livestock feed. The negative relationship could be revealing that, younger people are less likely to use or consume ILVs for food purposes, thus opting to may be use ILVs as livestock feed. This may mean that, not all age groups are aware of the benefits (nutrition and health) which are linked to the consumption of ILVs. This may perhaps prompt the consumption of ILVs to a specific age group which ultimately decreases utilisation of ILVs for food purposes. Similar findings were also revealed by Lekunze (2014) stating that, age negatively influences the production and utilisation of ILVs. Similar findings were also earlier established by

Enete and Igbokwe (2009) expressing that, information relating to the production and utilization of ILVs is available from a certain age group within the African continent.

b) Households size

Household size was found significant among other factors which influence use of ILVs for food when comparing to use of ILVs as livestock feed. This variable had a positive coefficient and was statistically significant at 5% level as shown in Table 4.10. The positive coefficient could be explaining that, the larger the households, the higher the possibility of using ILVs for food purposes instead of using ILVs as livestock feed. This could be a reason that, larger households do not have sufficient resources to acquire enough food for all the members and perhaps understand the benefits linked to consuming ILVs. This therefore results in such households considering the consumption of ILVs as vegetables which eventually increase the use of ILVs for food purposes. Similarly, Kimambo *et al.* (2018) also state that, the larger the household, the greater the probability that household members would access more nutrition knowledge and share it within the household.

c) Gender

Gender was found to be statistically significant at 10% level with a positive coefficient of 2.005 when comparing use of ILVs as food to use of ILVs for livestock feed as shown on Table 4.10. The positive relationship suggests that, the more females are involved in the utilisation of ILVs as food, there could be a chance of increased use of ILVs for food purposes by households. Likewise, Opiyo *et al.* (2015) observe that, females are the major utilisers of ILVs to an extent that, even within male headed households, females are the decision makers regarding production of ILVs. This therefore explains that women are the possible carriers of the knowledge linked to nutritional and health benefits of ILVs and they perhaps share the information with their families which eventually promotes consumption of ILVs as a food source.

d) No farm income

No farm income was found to be positively (1.929) and statistically significant at 10% level when comparing the use of ILVs for food purposes to use of ILVs as livestock feed. This means that, if households do not earn any farm income; there could be a chance of increased use of ILVs for food purposes, thus likely less use of ILVs as

livestock feed. This could be a reason that, such households are probable to limited or no sources of income which therefore limits them to acquire food. Again, such households are likely to opt using ILVs, which in most cases are harvested freely from home gardens, fields or from the wild which makes these vegetables valuable inexpensive food sources. Similar comparable findings were also discovered by Opiyo *et al.* (2015) reporting that, ILVs are edible vegetables which form a significant amount of the diet for most households, particularly those are classified under low or middle-income category.

e) Employment status

According to Table 4.10, a negative (-1.154) and a significant relationship at 5% level was observed on employment status when comparing use of ILVs as food from use of ILVs as livestock feed. These results suggest that, as the number of employed members within a household increases, there lies a possibility of decreased use of ILVs as food, hence households are more likely to use ILVs as livestock feed. This could be a result that, such households are conceivably not vulnerable to food insecurity shocks since they perhaps afford to purchase exotic vegetables and other types of food from the income that they earn from other activities besides farming. Similar findings were also shared by Kepe (2008) who argues that, the utilisation of ILVs is associated with poor households who are not able to afford purchasing exotic vegetables. Thus far, households that afford purchasing exotic vegetables seem to consume less ILVs.

f) Awareness about the health benefits associated with ILVs

Use of ILVs by households is directly influenced by the knowledge one holds towards these vegetables. Awareness about health benefits linked to ILVs was found to be statistically significant at 5% with a negative coefficient of -2 054 when comparing use of ILVs for food from use of ILVs as livestock feed. The negative coefficient could be explaining that, if households are not aware of the health benefits associated with ILVs, there is a higher chance of not using ILVs for food purposes hence households would rather use ILVs as livestock feed. Lack of knowledge may perhaps determine households classifying ILVs as just ordinary plants with no human value thus ultimately leading such households to prefer the consumption of other commercial crops instead of ILVs. Aju *et al.* (2013); Maseko *et al.* (2017) also observe that, the importance of

ILVs in easing food insecurity and malnutrition is notated by previous research, however, ILVs remain unrecognised, unappreciated and undervalued by many households particularly within peri-urban and rural contexts. In addition, Flyman and Afolayan (2006) argue that, dependence on exotic vegetables is the primary reason for the decline in utilisation of ILVs by households exclusively within the African continent.

g) Seasonal production of ILVs

Seasonal production of ILVs was significant at 5% level with a positive coefficient (1.961) when comparing use of ILVs for food purposes to use of ILVs as livestock feed. These results suggest that, as long as ILVs are not available on seasonal terms, there is an increased likelihood for ILVs to be used as food sources. This means that availability of ILVs may possibly be abundant in all seasons where in most cases exotic vegetables fail to grow in some seasons, particularly in winter. Therefore, households are probable to rely on using ILVs as food sources during times of food insufficiency. Similar comparable findings were also revealed by Nyathi *et al.* (2016) validating that, ILVs may form part of a food chain in agricultural system since these vegetables are found to have more advantages when compared to exotic vegetables. These advantages include, ILVs being drought tolerant, requiring minimum inputs, less prone to pests and diseases, higher water use efficiency and their significant contribution to nutrition and household income in rural areas particularly during times of food shocks (Nyathi *et al.,* 2016).

4.4.6 Use of ILVs as livestock feed vs Use of ILVs as medicine

The study results confirmed that, with regard to the use of ILVs as medicine, gender and households who earn no farm income influence a household's decision of using ILVs for medicinal purposes over the use of ILVs as livestock feed.

a) Gender

Gender is among the variables which controls the use of ILVs by households. This variable was found to be significant at 5% level and had a negative coefficient of (-1.804) when comparing use of ILVs as medicine from use of ILVs as livestock feed. These results implied that, when less women are involved in the utilisation of ILVs, there could be a likelihood of the decreased use of ILVs for medicine purposes, and

probably promoting use of ILVs as livestock feed. This could be a reason that, the use of ILVs by households is commonly associated with women and this could trigger a decreased use of ILVs for medicine purposes. Kimambo *et al.* (2018) also came to a similar conclusion, asserting that, knowledge related to nutritional/health benefits of ILVs is associated with gender. For instance, Kimambo *et al.* (2018) observes that, nutrition and health knowledge relating to ILVs was higher in women when compared to men. While on one hand, Millicent (2013) argues that, knowledge regarding ILVs had men having a better knowledge of the wild species when compared to women.

b) No farm income

No farm income was found to be statistically significant at 5% with a positive coefficient of 3.162 when comparing use of ILVs as medicine from use of ILVs as livestock feed as shown in Table 4.10. The explanation for the positive coefficient could be that, if households do not generate any farm income, there could be a possibility of increased utilisation of ILVs for medicinal purposes. This means that households which lack or have minimal resources to acquire medicine possibly use ILVs as medicine thus ultimately increasing the utilisation of these vegetables for medicine purposes. Abukutsa-Onyango (2003); Schönfeldt and Pretorius (2011) also revealed similar findings, stating that, ILVs are inexpensive, easily accessible and provide health-promoting compounds such as vitamins, minerals, antioxidants and sometimes anti-cancer which are required for good health and human well-being. Furthermore, Abukutsa (2007); Odhav *et al.* (2007) also contend that, ILVs account for 10% of the world's higher plants and represent inexpensive but high-quality nutrition sources of food and medicine especially within the poor population group where malnutrition becomes prime.

4.5 Summary statement for Multinomial Logistic Regression results in the study areas

In ORTDM, Multinomial Logistic Regression estimates confirmed that, households with no farm income, households with income ranging from R1000 to R3000, income from exotic vegetable sales, income from livestock sales and seasonal production of ILVs triggers households to use ILVs for food purposes only. In the light of this, the income generated by households from farming activities is not enough to obtain food, so households rely on consuming ILVs so that the income generated from other sources could be used to sustain other livelihood needs. In addition, availability of ILVs

throughout the year encourages households to depend on ILVs for food purposes, a reason may be that, most exotic vegetables fail to grow in some seasons particularly in winter.

Concerning the use of ILVs as medicine, regression results established that, gender discourages households to use ILVs for medicine purposes. While on the other hand, households which are generating no farm income tempts the use of ILVs for medicine purposes from the study area. Thus households, which are male dominated will lessen the use of ILVs for medicine purposes since activities linked to ILVs are mostly associated with women. Also, households with no farm income are utilizing ILVs as medicine and this could be possibly a way of minimizing costs for such households.

In ANDM, Multinomial Logistic Regression estimates confirmed that, the use of ILVs as a food source is encouraged by households with no farm income, farm income which is ranging from R1000 to R3000 and seasonal availability of ILVs. Thus, income generated from farming activities is used to maintain other household livelihoods and households with no farm income may also use ILVs as their food source hence increased use of these vegetables. Also, seasonal production of ILVs triggers households to use these vegetables for food purposes, this could be a reason that, certain exotic vegetables fail to grow in some seasons. This therefore calls for ILVs to become substitute vegetables where exotic vegetables fail to grow hence these vegetables are used as food source by many households.

Concerning the use of ILVs as medicine, households with no farm income find the use of ILVs for medicine purposes appealing. This explains that, such households may possibly not have any other sources of income to meet their medicine needs, hence their reliance on ILVs. The use of ILVs as medicine source is discouraged by awareness of the nutrition benefits associated with ILVs and seasonal production of ILVs. A decreased utilization of ILVs for this case could be a result of lack of knowledge regarding the value these vegetables may offer as well as belief that, ILVs are produced on seasonal terms. The lack of knowledge and negative beliefs households hold towards ILVs therefore prompts such households to be discouraged in using ILVs as medicine source.

In JGDM, Multinomial Logistic Regression estimates, gender, household size, no farm income and seasonal production of ILVs triggers households to use these vegetables

for food purposes only. Given the unemployment rate, minimal income and harvesting of ILVs and ILV seeds for free from the study area, it is necessary to promote the use of ILVs as food among households. In addition, age, employment status, awareness about health benefits linked to ILVs discourages households to use ILVs for food purposes only. Looking at the education level (primary education) which most of the population has attained from the study area, and age group which has a better knowledge regarding ILVs, these may attract poor utilisation of ILVs by households for food purposes.

No farm income promotes households to use ILVs for medicinal purposes from the study area. This may be a reason that, households from the study area are exposed to limited income which may possibly assist them in sustaining their livelihoods thus choosing to rely on ILVs for medicinal purposes. On the other hand, gender characterisation depresses the use of ILVs for medicinal purposes. This is explained by descriptive results that, women are more involved in activities concerning ILVs, thus as long as men are not highly involved like women, the utilization of ILVs may be discouraged.

4.6 Gross Margin analysis of ILVs from ORTDM, ANDM and JGDM

This section gives Gross Margin (GM) details that may be possibly gained from sales of each ILV produced and harvested per production season from the ORTDM, ANDM and JGDM respectively. This section starts by presenting all the harvested ILVs from the three districts with their selling price per kilogram (Kg) as recorded by traders as shown in Table 4.11. This is followed by calculations which shows gross income and Gross Margin from each ILV sold from each district municipality. In relation to the information provided, producers were asked to indicate the amount of ILVs harvested per production season and such amount was quantified in Kg. Furthermore, the amount indicated per harvested ILV on Table 4.11 was calculated based on averages, this means that, the total amount harvested from each local municipality from each ILV was summed up and averaged upon the local municipalities each district encompass and this is indicated in Table 4.11. The same method was followed when calculating the price per Kg for each ILV. In other words, it means that, both the amount and price of ILVs was calculated based on averages.

Table 4.11: Harvested ILVs from ORTDM, ANDM and JGDM with their selling prices per Kg

Indigenous Leafy Vegetables (ORTDM)	Amount harvested (Kg)/production cycle	Price per Kg (South African Rands)
Amaranth	17 525 kg	R15
Nightshade	4980 kg	R10
Lambs quarter	3900 kg	R10
Turnip	2800 kg	R15
Sonchus asper (L.)	625 kg	R7
Pumpkin leaves	9075 kg	R15
Pigweed	350 kg	R7
Common sow thistle	50 kg	R7
Laportea peduncularis	250 kg	R7
Melon leaves	100 kg	R15
Sweet potato leaves	1000 kg	R15
Hog plum	740 kg	R10
Blackjack	85 kg	R10
Coriacea Nannfd.	100 kg	R7
Chinese cabbage	100 kg	R15
Indigenous Leafy Vegetables (ANDM)	Amount harvested (Kg)/production cycle	Price per Kg (South Africa Rands)
Pumpkin leaves	16 650 kg	R15
Nightshade	9 900 kg	R15
Hog plum	2 700 kg	R10
Sweet potato leaves	4 450 kg	R15
Amaranth	22 200 kg	R10
Lambs quarter	1 400 kg	R10
Blackjack	50 kg	R7
Coriacea Nannfd.	550 kg	R7
Tomato leaves	100 kg	R15
Pigweed	300 kg	R7
Caudatus L.	350 kg	R7
Common sow thistle	50 kg	R7
Cucurbitaceae	250 kg	R7
Physalis peruviana L.	450 kg	R15
Sonchus asper (L.)	1 150 kg	R7
Laportea peduncularis	300 kg	R7
Chinese cabbage	300 kg	R15
Turnip	2 100 kg	R15
Indigenous Leafy Vegetables (JGDM)	Amount harvested (Kg)/production cycle	Price per Kg (South Africa Rands)
Amaranth	20 850 kg	R10
Nightshade	10 300 kg	R10
Pumpkin leaves	15 200 kg	R15
Turnip	1 200 kg	R15
Sweet potato leaves	3 100 kg	R15
Lambs quarter	4 950 kg	R10

Pigweed	50 kg	R10
Laportea peduncularis	50 kg	R10
Caudatus L.	750 kg	R10

Source: Research Survey

Regarding harvested ILVs from the study areas, in ORTDM fifteen (15) ILVs are harvested and each vegetable amount harvested is presented in Table 4.11. The prices of ILVs per Kg from ORTDM were ranging between the lowest price of seven South African Rands (R7.00) to a highest price of fifteen South African Rands (R15.00) as indicated by sellers. From the 15 ILVs harvested, the amount harvested by producers was between a minimum of 50Kg to a maximum of 17 525Kg per production season on average as indicated in Table 4.11, thus including all the five local municipalities found within the district. Also, on average, the land used for production of ILVs was 1.2 hectares (ha). Producers also mentioned that, they are commonly harvesting the seeds for free and other producers who have seeds, give them for free; and for producers who are purchasing seeds or seedlings for ILVs, the price is ranging between a minimum of R25 per Kg and to a maximum of R100 per Kg. Purchasing of seeds/seedling was the only production cost counted by producers as producers claimed to be selling ILVs locally and may be interchange ILVs to other households for other types of food. This explains that, there are only variable costs for production of ILVs and there are no fixed costs since it was difficult to gather data on fixed costs from producers.

From the eighteen (18) ILVs which are harvested from ANDM, the prices of these vegetables range between R7 per Kg and R15 per Kg as declared by the traders. From the eighteen ILVs produced, on average, the amount harvested by producers was ranging between a minimum of 50Kg to a maximum of 22 200Kg per production season inclusive of all the four local municipalities within the district. Furthermore, the land which was used for production of ILVs was one (1) hectare on average. Purchasing of seeds/seedlings was the only production cost reckoned by the producers and the price of seedlings was ranging between R50 and R100 per Kg. Producers further claimed that, from all the produced ILVs, they were only purchasing seeds/seedlings for potato leaves, lambs' quarter, Chinese cabbage and Turnip. Thus, looking at these observations, production of ILVs has only variable costs rather than fixed costs because there were difficulties in obtaining information pertaining to fixed costs from the producers.

From JGDM, there are ten ILVs which are produced by its dwellers, but only nine ILVs are harvested and the amount for each ILV harvested are indicated in Table 4.11. Traders charge their produce between the prices of R10 and R15 per Kg as shown in Table 4.11. On average, the harvested amount of ILVs produced from the study area, counting in all the three local municipalities found within the district was between a minimum of 50 Kg and a maximum of 20 850 Kg per production season as indicated in Table 4.11. The land used to produce ILVs was 1.5 ha on average. Most producers indicated that, instead of purchasing ILVs seeds/seedlings, they harvest seeds from home gardens and open fields. However, producers who purchase seeds/seedlings indicated that, prices of ILVs vary from one ILV to another. Thus, producers claimed to be purchasing ILVs seeds from a price of R50 per Kg to R100 per Kg per production cycle.

With the given information, a Gross Margin analysis was therefore used to estimate the possible revenues from selling of ILVs based on the variable costs and inclusive of all the local municipalities of ORTDM, ANDM and JGDM respectively as shown in Table 4.12 below. In other words, a physical amount of each ILV harvested was multiplied by the unit price of ILV sold to determine revenues.

The Total Revenue (TR) which is equivalent to ILVs gross income from each ILV was calculated as:

$TR_i = P_i \times Q_i$

Where: P_i- is the farmgate price of ILVs; Q_i - is the total quantity produced for each ILV.

Total Variable Cost (TVC) were calculated using the following expression:

$$TVC = \sum_{i=1}^{2}(K + S + L) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .7$$

Where: K – is fertilizer expenditure; S – is total expenditure on seeds/seedlings; L – is total labour expenditure in ILVs

The gross margin (GM) analysis of selling ILVs was expressed as:

GM= TR-TVC

Where GM= Gross Margin; TR= Total Revenue; TVC= Total Variable Cost

For this study, TVC was calculated based on the average price of seeds/seedlings per each ILV considering all the local municipalities in each district as well as the labour costs. This is because, purchasing of seedlings/seeds and labour costs were the only incurred costs parametrized by producers. Again, Gross Margin was estimated per production season because most ILV producers were utilising land which is less than one (1) hectare for production of ILVs, these observations are also expressed in the descriptive statistics results for the study. Very few producers claimed to be producing ILVs in more than one hectare of land, hence production season was considered to estimate the Gross Margin rather than size of the Land. This is because the information provided by producers on land size was not viable enough to estimate Gross Margin per hectare. In addition, Gross Margin only considers variable costs whereas profit considers both variable and fixed costs. This means that the point of using Gross Margin analysis was to estimate the potential revenues (income) that could be generated from selling ILVs rather than estimating profit for ILVs.

Table 4.12: Gross Margin of ILVs marketing per production season in ORTDM, ANDM and JGDM

ILVs grown in ORTDM	TVC/production season (South African Rands)	TR/production season (South African Rands)	Gross Margin/production season
Amaranth	R23 545	R262 875	R239 330
Nightshade	R4 050	R49 800	R45 750
Lambs quarter	R4 800	R39 000	R34 200
Turnip	R15 500	R42 000	R26 500
Sonchus asper L.	R 1 800	R 4 375	R 2 575
Pumpkin leaves	R15 500	R136 125	R120 625
Pigweed	R 900	R 2 450	R 1 550
Common sow thistle	R 150	R 350	R200
Laportea peduncularis	R 450	R 1 750	R 1 300
Melon leaves	R250	R 1 500	R 1 250
Sweet potato leaves	R5 450	R15 000	R9 550
Hog Plum	R1 800	R 7 400	R 5 600
Blackjack	R150	R 850	R700
Coriacea Nannfd.	R200	R 700	R 500
Chinese cabbage	R 750	R 1 500	R 750

ILVs grown in ANDM	TVC/production season (South African Rands)	TR/production season (South African Rands)	Gross Margin/production season
Pumpkin leaves	R75 000	R249 750	R174 750
Nightshade	R24 000	R148 500	R124 500
Hog Plum	R7 200	R27 000	R19 800
Sweet potato leaves	R34 020	R66 750	R32 730
Amaranth	R30 000	R222 000	R192 000
Lambs quarter	R3 080	R14 000	R10 920
Blackjack	R100	R350	R200
Coriacea Nannfd.	R1 200	R 3 850	R 2 650
Tomato leaves	R600	R 1 500	R 900
Pigweed	R1050	R 2 100	R1 050
Caudatus L.	R1200	R 2 450	R1 250
Common sow thistle	R150	R350	R200
Cucurbitaceae	R600	R1750	R1 150
Physcalis peruviana L.	R4050	R17 250	R13 200
Sonchus asper (L.)	R600	R 2 100	R1 500
Laportea peduncularis	R1050	R 3 150	R2 100
Chinese cabbage	R670	R 4 500	R 3 830
Turnip	R13 900	R31 500	R17 600
ILVs grown in JGDM	TVC/production season (South Africa Rands)	TR/production season (South African Rands)	Gross Margin/production season
Amaranth	R30 000	R208 500	R178 500
Nightshade	R37 405	R103 000	R65 595
Pumpkin leaves	R 101 050	R228 000	126 950
Turnip	R8 000	R18 000	R10 000
Sweet potato leaves	R21 000	R46 500	R25 500
Lambs quarter	R20 090	R49 500	R29 410
Pigweed	R200	R500	R300
Laportea peduncularis	R150	R500	R500
Caudatus L.	R1050	R7 500	R6 450

Source: Research Survey

For, ORTDM, based on the potential returns estimated by Gross Margin analysis, the most harvested Indigenous Leafy Vegetable (ILV) which is Amaranth, has a potential of generating an overall gross income (TR) of R262 875 per production season/cycle with the inclusion of all the local municipalities within ORTDM. An overall gross margin of R239 330 per production season may therefore be experienced by producers of this

vegetable since the production cost, which is purchasing of ILV seedlings was R7025, R4540, R3070, R2850, R6060 per season and per local municipality (LM), that is KSD, Nyandeni, Mhlontlo, PSJ and Ingquza hill respectively. This added up to R23 545 of production parameter for the district municipality. This method for calculating TVC was employed throughout the GM analysis for the study. Table 4.12 further shows that, the least harvested ILV (Common sow thistle) generates an overall gross income of R350 and Gross Margin of R200 inclusive of all the local municipalities of ORTDM. This is because producers claimed to be commonly reaping seeds of a Common sow thistle from the wild or from other people's fields freely. This means that, the only production costs incurred when producing this vegetable was perhaps labour, also given the positive gross margins from these vegetables, this therefore explains efficiency of production for producers within the district.

Concerning the returns from each ILV harvested from ANDM, Amaranth is the most harvested ILV from the district and this vegetable is followed by Pumpkin leaves as the second most harvested vegetable. Pumpkin leaves experience a gross income (TR) of R249 750 and a Gross Margin of R174 750 per production season including all the four local municipalities of the district when compared to Amaranth revenues. The production cost of purchasing seedlings/seeds for pumpkin leaves added up to R75 000 from the four local municipalities the district entails. However, for Amaranth, producers claimed that they do not purchase seedlings hence a higher Gross Margin of R192 000 per production season is experienced.

Regarding the least harvested ILVs from the district, Common sow thistle and Blackjack are the least harvested ILVs with an average gross income of R350 and Gross Margin of R350 per production season, respectively. There are no production costs incurred from cultivating these two vegetables, however, producers claimed that, in most cases these vegetables grow naturally, and producers wait to harvest them to sell the ILVs as medicine, hence labour costs for harvesting are indicated in Table 4.12. To this end, the positive gross earnings and margins obtained from producing ILVs explains efficiency of this enterprise from the district which may possibly enhance household income, improve development as well as boosting rural economies.

The Gross Margin analysis as presented in Table 4.12 shows that, Pumpkin leaves' sales experience greater returns when compared to other harvested ILVs from the

JGDM. The gross income (TR) of this vegetable is R228 000 with a Gross Margin of R126 950 per production season because of the incurred costs of purchasing seedlings/seeds which amounts to R37 405 for the district. Although Amaranth is the most harvested ILV from the district, its selling price of R10 per Kg makes this vegetable to experience lesser revenues when compared to Pumpkin leaves which are the second most produced ILV with a selling price of R15 per Kg. In comparison to this, Amaranth has a greater Gross Margin (R178 500) compared to Pumpkin leaves, this is because producers for Amaranth do not purchase seed/seedlings. The estimated gross margins are per production season inclusive of all the three local municipalities within the district. Thus, given the positive estimated gross margins from the study area as indicated in Table 4.12, efficacy concerning production of ILVs is evident. This therefore has a potential, to enhance income and directly improve the economy through employment opportunities and possible larger markets for these vegetables.

Pigweed and *Laportea peduncularis* are the least harvested ILVs from the study area, with the gross income of R500 per production season, respectively. These two vegetables do not have any production costs according to the producers, instead, these vegetables grow naturally. Producers also claimed to only be maintaining the growth of these vegetables so that when they are fully grown, they are harvested for subsistence use and sales hence labour costs for harvesting are included to estimate the Gross Margin. Producers who wish to grow these vegetables commonly harvest seeds for free from neighbours' home gardens and open fields.

4.7 Summary of Gross Margin analysis

The Gross Margin analysis revealed that, the highest returns from ORTDM are obtained from Amaranth and Pumpkin leaves sales and these vegetables are the most harvested ILVs from the district. Thus, making these vegetables as the most suitable vegetables which are growing well around the areas of ORTDM. The abundance of ILVs may not only diverse diets, but these vegetables also have a potential to generate gross income of R262 875 and R136 125 per production season from both Amaranth and Pumpkin leaves inclusive of all local municipalities of ORTDM. In addition, the positive revenues and gross margins indicates efficiency of these vegetables which has a potential towards income generation. Furthermore, Common sow thistle and

Coriacea Nanndfd are having less returns (R350 and R700 gross income respectively) when compared to other ILVs harvested from the district. This could be a result of low demand of these vegetables within the area or possibly lower harvests due to unresistant of these vegetables from the area which therefore prompts inconsistent supply and consequently triggers low gross margins.

The GM analysis from ANDM has shown that, Pumpkin leaves, Amaranth and Nightshade are the most ILVs which bring higher a gross income when compared to other vegetables harvested and sold. Thus, a gross income of R249 750, R222 000 and R148 500 per production season is estimated from Pumpkin leaves, Amaranth and Nightshade respectively inclusive of the four local municipalities of the district. These vegetables are also the most harvested from the district which therefore explains the possibility of a high demand for these vegetables hence larger amounts are harvested. Also, given the observed gross margins estimated by the study as presented in Table 4.12, the production of ILVs is efficient and this may possibly improve income for producers and their households. Lastly, Blackjack and Common sow thistle are the least vegetables which experience lesser gross income and Gross Margins. Thus far, these vegetables are not harvested on a larger scale which may possibly explain low demand or unfavourable production conditions such as environmental condition to list few, which may make these vegetables to not adapt well within the district.

The most harvested ILVs from JGDM generate higher gross income when compared to other harvested ILVs from the district. Therefore, Pumpkin leaves generate an estimated gross income of R228 000 per production season. Likewise, Amaranth generates a gross income of R208 500 and lastly, Nightshade generates a gross income of R103 000. Thus far, these three vegetables have the potential of contributing greatly to household income when compared to other ILVs which are produced and harvested for sales within the district since they experience positive gross margins. Additionally, Pigweed and *Laportea peduncularis* generate a gross income of R500 per production season (respectively) and are the least harvested ILVs from the district. The reason may be that; these vegetables do not grow in larger amounts from JGDM which therefore limits their availability. Limited availability of these vegetables may therefore result in a lower demand, hence less gross income is

realised in the comparison against other vegetables harvested and sold within the district.

4.8 Analysis of food security status among households and potential contribution of ILVs towards household food security status in ORTDM, ANDM and JGDM

This section presents food security status of households from ORTDM, ANDM and JGDM and further discusses the factors which influences food security status of households within the ORTDM, ANDM and JGDM.

For determining factors influencing food security status, the dependent variable (household food security status) has three categories of food security status and these categories included: (i) less food insecure, (ii) moderate food insecure, and (iii) severe or more food insecure. The separation of these three groups demanded a MLR because of these unique outcomes, and the first category (less food insecure) was used as a base/reference term to interpret the results.

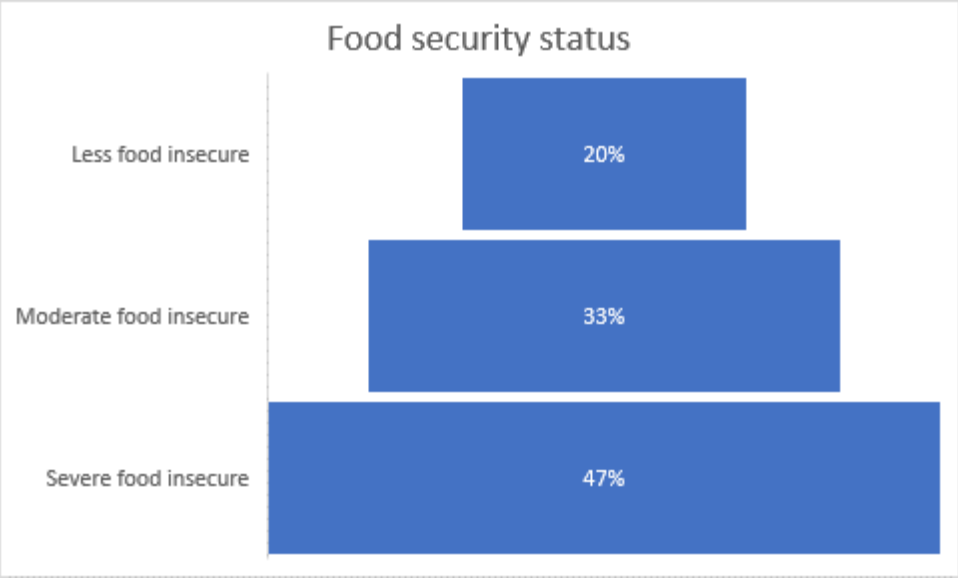

Figure 4.4: Household food security status of ORTDM

Source: Research Survey

Figure 4.4 indicates food statuses that are experienced by rural households of ORTDM as confirmed by the descriptive results. The descriptive results revealed that, a majority (47%) of rural households from the study area are more food insecure. These results suggest that, these households are experiencing severe food insecurity

shocks. Descriptive results further revealed that, few (33%) households from ORTDM are categorized as moderate food insecure. These results are suggesting that, few households are experiencing moderate food insecurity shocks from the study area. The study results further revealed that, about 20% of the households are less food insecure. Given the results on food security from rural households of ORTDM, the district is categorized by households who are moderate to severe food insecure. Thus, given the high unemployment rate from ORTDM and the food security statuses experienced by its residents, this therefore explains that, these households are perhaps not largely active in agricultural activities and this could possibly trigger food insecurity problems.

This is because, if households are not relying on vegetable production, they may end up suffering from food shortages and chances of generating income from sales of these vegetables so to enable sustenance of other household food needs. Similar findings were also shared by Ndobo (2013) establishing that, agriculture which includes crop production (inclusive of ILV production) is one of the factors affecting household food insecurity in South Africa and its importance has been emphasized in both commercial and small-scale subsistence farming. For instance, Van Braun (2007) records that, agricultural production reduces food prices, creates employment, and has an ability to improve income and wages of farm workers thus translating to food secured household and improved livelihoods respectively.

Table 4.13: Factors determining food security among households of ORTDM

Dependent variable: Less food insecure vs Moderately food insecure				
Independent variables	B	Std Error	Wald	Significance
Intercept	19.248	1.130	1.811	.000
Age	.034	.024	1.985	.159
Household size	-.220	.107	4.209	.040**
Gender	-.073	.592	.015	.902
No farm income	-3.057	1.158	6.972	.008***
R1000-R3000	-2.283	1.333	2.935	.087*
Income from exotic vegetable sales	-1.531	1.282	1.426	.232
Income from livestock sales	-3.782	1.753	4.656	.031**
Employment status	3.223	.923	12.191	.000***
Production status of ILVs	2.821	.718	15.429	.000***
Dependent variable: Less food insecure vs Severe food insecure				
Intercept	1.316	1.747	.567	.451
Age	.025	.021	1.373	.241

Household size	-.272	.105	6.715	.010***
Gender	-.025	.569	.002	.965
No farm income	-3.044	1.149	7.019	.008***
R1000-R3000	-2.099	1.274	2.716	.099*
Income from exotic vegetable sales	-1.625	1.274	1.627	.202
Income from livestock sales	-3.399	1.655	4.215	.040**
Employment status	3.743	.887	17.823	.000***
Production status of ILVs	2.760	.719	14.722	.000***
Model summary:				
(-2) Log Likelihood	122.732			
Chi-Square	177.032			
Pseudo R-Square:				
Cox and Snell	.548			
Nagelkerke	.620			

*Note: ***, ** and * indicate significance level at 1%; 5% and 10% respectively.*

Source: Research Survey

For the model summary, the -2Log likelihood of 122.732 indicates the probability at which the null hypothesis was rejected. The Cox and Snell R-Square was 0.548 and this means that, about 54.80% of the variation in the dependent variable was explained by the model. The Nagelkerke was 0.620 and this indicates a strong relationship of about 62.0% between the independent and a dependent variable. Nagelkerke is also higher than the Cox and Snell which therefore indicates a more reliable estimation of the relationship between dependent variable and explanatory variables.

4.8.1 Less food insecure vs Moderately food insecure households

Concerning households who are moderately food insecure, empirical results reveal that household size, no farm income, farm income ranging between R1000-R3000 from ILVs sales and income from livestock sales negatively influence households to be moderate food insecure over less food insecure households. Regression estimates also revealed that, employment status and production status of ILVs positively influence households to be moderately food insecure over less food insecure households.

a) Household size

A negative relationship at 5% significance level between household size and households who are moderately food insecure when compared to households who are less food insecure was found as shown in Table 4.13 above. These results therefore

suggest that, with larger household size there may be a chance of moderate food insecure households. For this reason, smaller households are likely to acquire enough nutritious food types which may sustain daily food needs when compared to larger households. A similar conclusion was also discovered by Aidoo *et al.* (2013) stating that, a household size may possibly have an influence on the food security status among households since an increase in one additional member of a household generally reduces income per head, expenditure per head and per capita food consumption. Ndobo (2013) also reports that, larger household sizes are perhaps demanding more food since food consumption increases with an increase in household members. In the presence of ILVs, households would be expected to utilize these vegetables on regular basis so to avoid being exposed to food insecurity shocks nor shortages.

b) No farm income

Households with no farm income were found to be negatively and statistically significant at 1% level when comparing moderately food insecure households from less food insecure households. The negative relationship may explain that, as long households are not generating any farm income, there is a possibility of moderate food insecure households. This simply reveals that, such households possibly do not have diverse sources of income or even secured jobs which may assist them to acquire enough nutritious food. Carter *et al.* (2005) also shares similar comparable findings uttering that, there is a negative correlation between income and food insecurity by four times the likelihoods of becoming food insecure for no income to lowest income households as compared to the highest income households. This therefore explains that, households with highest income are likely to be food secured when they are compared to households with no income or lower income.

c) Farm income between R1000-R3000 (ILVs income)

According to Table 14.13, a negative (-2.283) and a significant (10%) relationship between farm income ranging from R1000 to R3000 and households which are moderate food insecure when compared to households which are less food insecure was found. These results suggest that, an increase in farm income from ILVs is likely to promote moderate food insecure households. This may be a reason that, such households do not have other sources of income (such as salaries, wages and grants)

which may be sufficient to acquire food types to sustain the household. Hence income becomes one of the socio-economic factors which is prospective to influence household food security condition. Similar findings were also discovered by Ndobo (2013); Matebeni (2018) pointing out that, social grants and salaries within a household are mostly spent on food as compared to other grocery items thus making food an important item for households (Neves *et al.,* 2009). Samson *et al.* (2004) conducted a study on food security and concluded that, social grants positively contribute a share of household food expenditure through the improvement of household nutrition.

d) Income from livestock sales

When comparing moderately food insecure households from less food insecure households, a negative and statistically significant relationship at 5% level was found towards income generated from livestock sales. This means that, as an income from livestock sales increases there more households are likely to be moderate food insecure. This could be a reason that, such households are possible relying only on farming livestock for generating income, rather than opting for other enterprises to supplement their income so to maintain the household in terms of obtaining enough nutritious foods hence such households are moderate food insecure. Similar results were also discovered by Bashir *et al.* (2012) conveying that, a rise in income of a household may probably increase chances of being less food insecure.

e) Employment status

Employment status was found to be positively and statistically significant at 1% level when comparing moderately food insecure households from less food insecure households. This implies that, a rise in employment within a household is likely to trigger a moderate food insecure household. This may be a reason that, the employment status of such households probably prompts them to have resources in terms of money to obtain foods which may be able to maintain a healthy lifestyle. Dodd and Nyabvudzi (2014) also conclude that, households with employed members are likely to be moderately to less food insecure.

f) Production status of ILVs

The ILV production status was found to be positively and statistically significant at 1% level when comparing moderately food insecure households from less food insecure households. The positive relationship may infer that, households who are producing ILVs are probable to be moderate food insecure. This may be a reason that, such households may not only be producing ILVs, but they could be possibly consuming these vegetables as well so to supplement their household food needs. Similar comparable findings were also revealed by Mungofa (2016) claiming that, ILVs are not only contributing to income for a household but they may also assist households in addressing nutrition problems. Similarly, Aju *et al.* (2013) argue that, ILVs may have a potential in playing a very important nutritional and economic role which may possibly translate to food secure households.

4.8.2 Less food insecure vs Severe food insecure households

Regarding households which are severely/more food insecure, regression results confirmed that household size, no farm income, income generated from ILVs sales, income generated from livestock sales negatively influence households to be severe food insecure over less food insecure households. On one hand, regression estimates confirmed that, employment status and production status of households positively influence households to be severe food insecure.

a) Household size

Household size was found to be negatively and statistically significant at 1% level when distinguishing severe food insecure households from less food insecure households. The negative relationship means that, a larger household size is likely to experience a severe food insecure status. This may be a reason that, larger households are not easier to maintain in terms of acquiring food when compared to smaller households. Jacobs (2009) also points out that, households with many members are likely to consume more food than small households. Thus, making larger household sizes demanding more food since food consumption increases with a rise in household members (Ndobo, 2013). A study conducted by Olayemi (2012) also confirmed a negative correlation between household size and food security and concluded that household size increases as food security decreases.

b) No farm income

According to Table 4.13, a negative (-3.044) and significant (1%) relationship between households with no farm income and severe food insecure households when comparing less food insecure households was found. The negative influence from this variable suggests that, as household farm income decreases, there is a chance of severely food insecure households. This further suggests that such households may not have enough or other sources of income which may assist them in obtaining food so to maintain the daily needs of food to a person. Given these results in the presence of ILVs within the district, households would be expected not only to produce ILVs but also to sell these vegetables as a way of supplementing other sources of household income so to sustain their household food needs. Several authors confirmed that, ILVs are likely to offer a significant opportunity for the poorest people to earn a living as producers and traders without requiring huge capital investments when compared to commercial vegetables (Aju *et al.,* 2013; Oulai *et al.,* 2014).

c) Farm income ranging between R1000-R3000 (ILVs income)

Generally, farm income has a direct influence on a household food security status. Income ranging between R1000 to R3000 was found to be negatively and statistically significant at 1% level when comparing severe food insecure households from less food insecure households. The explanation for the negative relationship could be that, as long households are generating farm income ranging between R1000 and R3000 from ILVs, there may be a probability of severe food insecure households. This may be a reason that, such households are possibly relying on one source of income (farm income) to obtain food, which therefore makes these households to be still classified as severe food insecure. However, these households are producing and selling ILVs which therefore explains that, if the production of ILVs may be increased, the sales are also likely to increase. This therefore may have a potential in translating such households from being severe food insecure to be less food insecure. Maseko *et al.* (2017) also came to a similar conclusion, stating that, promoted production of ILVs in South Africa may attract several benefits such as unique opportunities to diversify farming systems, ensure food security and alleviate poverty while at the same time it may increase income and improve human health.

d) Income from livestock sales

Income from livestock sales was found to be negatively (-3.399) and statistically significant at 5% level when comparing severe food insecure households from less food insecure households. These results infer that, if households are generating income from livestock sales, there is a possibility of severe food insecure households. This therefore brings an opportunity to fit in ILVs in household's food system as a strategy of ensuring food security among households. This is because these vegetables may not only, diversity diets but they may also possibly address the issue of food shortages and malnutrition within households and consequently supplementing household farm income. Similar findings were recently established by Maseko *et al.* (2017); Nyaruwata (2019) suggesting that, promoting the cultivation and utilisation of ILVs by farmers, particularly women and other vulnerable groups is vital since a successful promotion of these vegetables may result in ILVs forming part of the daily staple diet of South Africans.

e) Employment status

Employment status of a household head or any member within a household influences the food security status of households. The variable was statistically significant at 1% level with a positive coefficient of 3.743 when comparing severe food insecure households from less food insecure households. The positive coefficient could be explaining that, households with employed members are likely to be severe food insecure. This may mean that, income received (salary) from being employed by chance slightly contribute to a household food security status hence households are still characterized as severe food insecure. Similar findings were also shared by Dodd and Nyabvudzi (2014) stating that, even households with full time employment are vulnerable to food security shocks because of high food prices, changes in food supplies to mention few. However, with the observed results and existence of ILVs from the study area, an increase in production and utilization of ILVs which may have a potential to improve diets and economic value offered by these vegetables may be expected.

f) Production status of ILVs

According to Table 4.13, a positive (2.760) and a significant (1%) relationship between production status of ILVs was found when comparing severe food secure households

from less food insecure households. These results revealed that, for households which are producing ILVs, there is a higher likelihood of severe food insecure households. This may be a reason that, households are probable producing ILVs only for market purposes rather than consumption and perhaps generate lower income which leads them to be vulnerable to food insecurity shocks. Maseko (2014) also observes a lower consumption of ILVs and argued that, human consumption of ILVs is not widespread and it has received limited research attention. Nevertheless, looking at the observed results and the benefits linked to ILVs particularly regarding food security, this may therefore call for higher utilization of ILVs and this utilization may probably trigger less food insecure households. Mayekiso *et al.* (2017) also came to a similar conclusion, corroborating that, ILVs have a potential to improve rural households' dietary diversity through improved intake of these vegetables and other food groups, thus reducing food insecurity particularly at household level. The next section presents results observed and discussion from ANDM regarding food security status of the district.

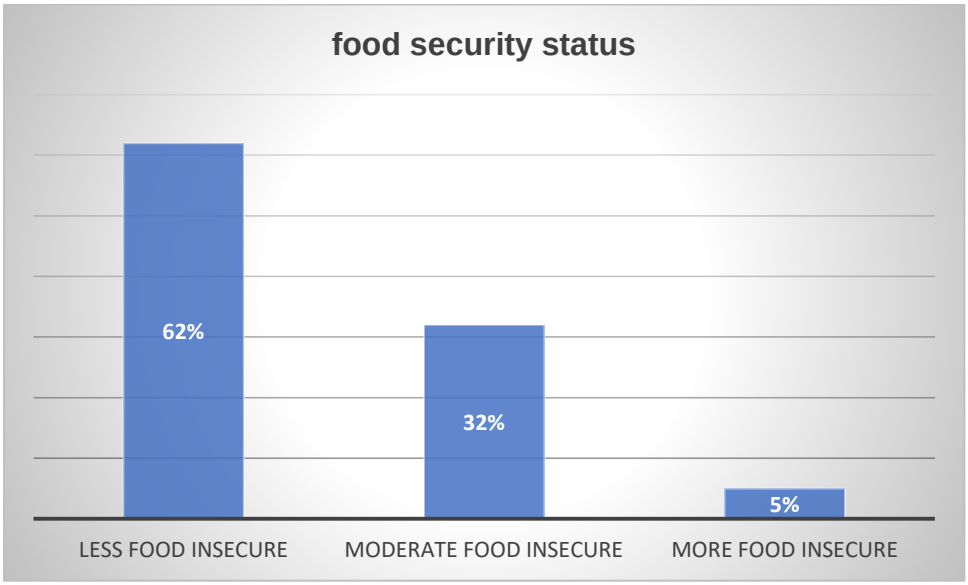

Figure 4.5: Household food security status from ANDM

Source: Research Survey

Descriptive results revealed that, a majority (62%) of rural households from ANDM are less food insecure, while 32% of households are classified as moderately food insecure as indicated in Figure 4.5. Descriptive results further revealed that, very few (5%) rural households from ANDM are classified as more/severely food insecure. These results suggest that, most rural households from the study area experience less to moderate food insecurity shocks while few (5%) households are vulnerable to

severe food insecurity shocks. This could be because, rural households mostly rely on farming as a way of obtaining food through production of vegetables and other field crops; and possibly generate income from selling these vegetables so to maintain other livelihood needs which may address food insecurity difficulties. STATS SA (2017) also reports that, agriculture in the Eastern Cape Province contributes to the development of the economy and significantly to household food security. For instance, Matebeni (2018) emphasises that, the main reasons for agricultural involvement in Eastern Cape Province are for an extra source of food (81.4%), main source of food for the household (7.2%), leisure activity (5.6%), main source of income (3.8%) and extra source of income (1.9%).

Table 4.14: Factors determining food security among households of ANDM

Dependent variable: Less food insecure vs Moderate food insecure				
Independent variables	B	Std Error	Wald	Significance
Intercept	.751	1.535	.239	.625
Age	-.043	.022	3.661	.056*
Household size	.229	.104	4.874	.027**
Gender	.188	.550	.117	.732
No farm income	1.302	.742	3.082	.079*
R1000-R3000	-15.496	2085.566	.000	.994
Income from exotic vegetable sales	-.705	1.327	.282	.595
Income from livestock sales	-15.846	4306.712	.000	.997
Employment status	-3.393	.350	15.942	.000***
Production status of ILVs	-1.776	.646	7.555	.006***
Dependent variable: Less food insecure vs Severe food insecure				
Intercept	4.823	2.543	1.896	.647
Age	-.040	.044	.827	.363
Household size	-.457	.289	2.499	.014**
Gender	-.671	1.089	.379	.538
No farm income	-.956	2.543	.376	1.000
R1000-R3000	14.732	5.591	2.634	.471
Income from exotic vegetable sales	1.196	3.989	.299	1.000
Income from livestock sales	15.877	.000	.000	1.000
Employment status	1.520	1.513	1.004	.663
Production status of ILVs	1.583	1.449	1.092	.754
Model summary:				
(-2) Log Likelihood	128. 875			
Chi-Square	137. 380			
Pseudo R-Square:				
Cox and Snell	.578			

Nagelkerke	.695

*Note: ***, ** and * indicate significance level at 1%; 5% and 10% respectively.*

Source: Research Survey

From the model summary as presented in Table 4.14, a -2Log likelihood of 128.875 indicates a probability at which the null hypothesis was rejected. The Cox and Snell R-Square was 0.578 and indicates a good model fit for the data. As it is previously explained by preceding research that, any Cox and Snell R square value less than 1 indicates a good model fit of the data. The Nagelkerke was 0.695 and this indicates a strong relationship of 69.50% between the independent variables and a dependent variable. A higher Nagelkerke also indicates a more consistent measure of the relationship between a dependent variable and independent variables.

4.8.3 Less food insecure vs Moderate food insecure households

Results revealed that age, employment status and production status of ILVs negatively influence households to be moderately food insecure when compared to less food insecure. On one hand, household size and no farm income positively influence households to be moderately food insecure when compared to less food insecure. All the significant variables are explained in detail below.

a) Age

Age was found to be negatively and statistically significant at 10% level when comparing moderate food insecure households from less food insecure households as indicated in Table 14.4. This infers that, as the age of a household head increases there is a higher likelihood of moderate food insecure household and a lower chance of less food insecure households. This means that, if a household head is not in their active age, they may likely not get a job which could assist in earning income to maintain day-to-day food needs. Bashir *et al.* (2012) also share similar findings, reporting that, there is a negative relationship between the age of household head and food insecurity in Pakistan. For instance, an increase in the age of the household head in a year was linked to a 4.5% decrease in the likelihood of being food secure. Thus, young people become economically active when compared to older people and can operate well within the labour market (Ndobo, 2013). Another reason may be that, such households possibly rely on social grants to acquire food, and these social grants

may not be enough to obtain different food types so to sustain household food daily needs.

In light of the study results and availability of ILVs from the study area, households would be expected to utilise more of these vegetables as their food source, as a way of supplementing and diversifying their diets. Literature also highlights that; these vegetables are inexpensive nutritious source of food especially for poor populations who cannot afford purchasing exotic vegetables hence increased consumption is necessary. Mungofa *et al.* (2018) also discovered similar findings in the Limpopo Province regarding consumption of ILVs and established that, respondents indicated that they consume ILVs and the primary reasons for the consumption were that these vegetables are a cheap, healthy and nutritious as well as easily available.

b) Household size

Household size directly influence food security status of households. This variable was found to be significant at 10% level with a positive coefficient of 0.229 when comparing moderate food insecure households from less food insecure households. The positive coefficient may be suggesting that, with larger sized households, there is a possibility of moderate food insecurity. This may be a reason that, it is easier to maintain a smaller household size in terms of obtaining food when compared to a larger household. Amaza (2009) similarly conclude that, a higher number of inactive individuals in a household may mean a higher problem for active individuals in the provision of food, which in turn increases a possibility of food insecurity within a household. This, therefore, results in such households being moderately food insecure rather than being less food insecure.

c) No farm income

Income was among the variables which influences the food security status of households. When comparing moderate food insecure households from less food insecure households, no farm income had a positive coefficient of 1.302 at 10% significance level. These results reveal that, if households do not generate any farm income, there is a higher probability of moderately food insecure households. Jacobs (2009) also conveys that, low-income households are more probable to suffer from food insecurity as compared to middle income and wealthier households. Thus, a wealthier household leads to, a minimal chance of food insecurity.

In the existence of ILVs and the observed results from the study area, an increased utilisation of ILVs should be advised to address the prevailing food insecurity. ILVs are not only noted for their economic value that they may offer, but these vegetables are also noted to be good sources of certain macro and micronutrients that are required by a person per day. Darkwa and Darkwa (2013) also observe similar findings, arguing that, the consumption of ILVs is a key in improving the health of many communities. This is because these vegetables are rich in sources of carotenoids to give an example and they should be promoted by nutritionists and public health workers worldwide in order to overcome vitamin A deficiencies and age-related macular degeneration which are most prevalent in South Africa (Djuikwo *et al.,* 2011).

d) Employment status

According to Table 4.14, employment status had a negative coefficient of -3.393 at 1% significance level when comparing moderate food insecure from less food insecure households. The negative coefficient could be explaining that, as the number of employed members within a household increases, there could be a chance of moderate food insecurity for such households. This could be a reason that, such households lack enough money to get nutritious food since there could be a possibility that such household members do not hold skills which may assist in the attainment of appropriate jobs. Thus far, from the observed results, the consumption of ILVs may be expected to be higher so to enhance food security. Also, several studies in the past years have confirmed that, ILVs have a potential of improving households' diets and addressing the food security problems which are commonly prime among households (Mayekiso *et al.,* 2017).

e) Production status of ILVs

For production status of ILVs, when comparing moderate food insecure households from less food insecure household, a negative coefficient of -1.776 at 1% significance level was observed as indicated in Table 4.14. These results suggest that, the less households are involved in the production of ILVs, the more likely households are to be moderately food insecure. This means that, households possibly produce and consume exotic vegetables, which in most cases are expensive in both production and utilisation manner. Thus, at some point, households may fail to purchase such vegetables while unaware that ILVs may still play the role of good sources of food for

better nutrients. Hence households which do not afford exotic vegetables become moderately food insecure due to the possible lack of knowledge which is linked to the benefits obtained from consuming ILVs. Muhanji *et al.* (2011) also share similar comparable findings stating that, most people do not consume ILVs due to a lack of reliable information regarding their nutritious value. In addition, limited availability of ILVs to certain areas hampers consumption. Loss of indigenous knowledge is identified as one of the major reasons which result in reduced consumption of ILVs thus triggering lack of diet diversity among households (Mungofa, 2016).

4.8.4 Less food insecure vs Severe food insecure households

From the study area, Multinomial Logistic Regression results revealed that, a household's size is the only factor that negatively influences households to be severely food insecure when compared to less food insecure.

a) Household size

For household size, a negative coefficient of -0.457 at 5% significance level was found when comparing severe food insecure households from less food insecure households. The negative relationship means that, a larger household size is likely to be more/severe food insecure. Olayemi (2012) also equivalently observes that, household size is expected to determine the food security status of a household. This may be a reason that, smaller households are easier to maintain when compared to larger households in terms of obtaining food. Thus, most households particularly within rural contexts are characterised by a larger number of household members which leads such households to experience continuous food insecurity shocks and food shortages. This, therefore, places ILVs in the line to be included in the food system because of their recognisable potential to address food insecurity particularly within rural settings (Mungofa, 2016; Maseko *et al.,* 2017). The next section of the results is based on observations from JGDM.

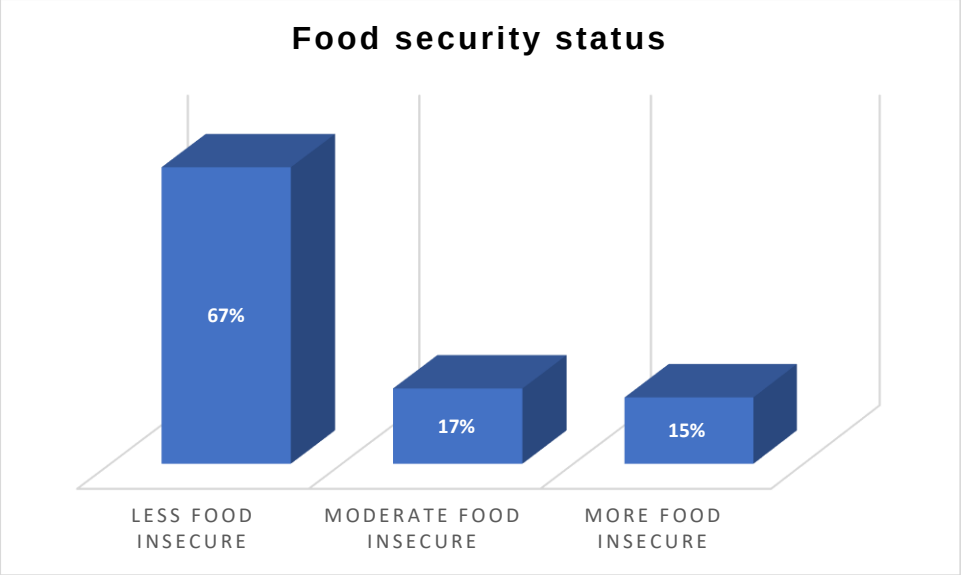

Figure 4.6: Household food security status from JGDM

Source: Research Survey

Figure 4.6 indicates different food security statuses experienced by rural households of JGDM. Thus, descriptive results revealed that, about 67% of rural households from the study area are characterised as being less food insecure, while 17% of households are described as moderately food insecure. Lastly, 15% of rural households from the study area are characterised as being more food insecure. These results suggest that, there are many households from the study area which are not vulnerable to food insecurity problems but, there are households which are still vulnerable to food insecurity shocks. Linking such households to income levels, education level and high unemployment rate from the study area, these households may fall under people with limited skills to acquire jobs. This, therefore, results in such households having limited if no resources at all, to purchase enough nutritious food for a household hence a moderate to more food insecure is characterised towards these households. Similar comparable findings were also discovered by Ndobo (2013) conveying that, a higher income earned within a household prompts a less food secure household, while a household with members having higher education levels, records lesser food insecurity shock. Similarly, less food insecurity is recorded with employed household members when compared to a household with unemployment members.

Table 4.15: Factors determining food security among households of JGDM

Dependent variable: Less food insecure vs Moderate food insecure				
Independent variables	B	Std Error	Wald	Significance
Intercept	19.248	1.811	113.003	.000
Age	-.034	.024	1.985	.159
Household size	.220	.107	4.209	.040**
Gender	.073	.592	.015	.902
No farm income	3.057	1.158	6.972	.008***
R1000-R3000	2.283	1.333	2.935	.087*
Income from exotic vegetable sales	1.531	1.282	1.426	.232
Income from livestock sales	3.782	1.753	4.656	.031**
Employment status	-3.223	.923	12.191	.000***
Production status of ILVs	-2.821	.718	15.429	.000***
Dependent variable: Less food insecure vs Severe food insecure				
Intercept	-1.316	1.747	.567	.451
Age	-.025	.021	1.373	.241
Household size	.272	.105	6.715	.010***
Gender	.025	.569	.002	.965
No farm income	3.044	1.149	7.019	.008***
R1000-R3000	2.099	1.274	2.716	.099*
Income from exotic vegetable sales	1.625	1.274	1.627	.202
Income from livestock sales	3.399	1.655	4.215	.040**
Employment status	-3.743	.887	17.823	.000***
Production status of ILVs	-2.760	.719	14.722	.000***
Model summary:				
(-2) Log Likelihood	74.105			
Chi-Square	161.407			
Pseudo R-Square:				
Cox and Snell	.692			
Nagelkerke	.840			

*Note: ***, ** and * indicate significance level at 1%; 5% and 10% respectively.*

Source: Research Survey

From the model summary as presented in Table 4.15, a -2Log likelihood of 74.105 indicates a probability at which the null hypothesis was rejected. The Cox and Snell R-Square observed was 0.692, which indicates a good model fit for the data. This is because previous research explained that, any Cox and Snell R square value less than 1 indicates a good model fit of the data. The Nagelkerke of 0.840 was observed and this indicates a strong relationship of about 84.0% between the independent variables and a dependent variable. A higher Nagelkerke also indicates a more reliable measure of the relationship between dependent variables and explanatory variables.

4.8.5 Less food insecure vs Moderate food insecure households

Concerning households which are moderate food insecure from the study area, Multinomial Logistic Regression estimates revealed that, household size, no farm income, farm income ranging between R1000 and R3000, farm income from livestock sales positively influence households to be moderate food insecure when comparing to less food insecure households. While on one hand, employment status and production status of ILVs are observed to negatively influence households to be moderate food insecure when comparing to less food insecure households.

a) Household size

Household size was among the variables which influence households to be moderate food insecure. For this variable, a positive coefficient of 0.220 at 5% significance level was observed when comparing moderate food insecure households from less food insecure households. These results reveal that, a household with a larger number of members is likely to be moderately food insecure. This means that, households do not have sufficient food and perhaps limited resources to acquire enough nutritious food, thus inhibiting households to be less food insecure. Also, given the observed results and relating them to benefits associated with ILVs, households would be expected to utilise ILVs in a larger manner to fill the gap of food insecurity since these vegetables are mostly harvested for free and do not need to be purchased, especially in rural segments (Faber *et al.,* 2010; Kruger *et al.,* 2015).

b) No farm income

Regarding households with no farm income, when comparing moderate food insecure households from less food insecure households, a positive (3.057) relationship at 1% level was found. The positive relationship could be explaining that, if households do not earn any farm income, there could be a higher probability of moderately food insecure households. This means that, households possibly rely on other sources of income to purchase food and the income which they use to purchase food is perhaps not enough to acquire adequate healthy food. This leads to such households being characterised as moderately food insecure rather than being less food insecure because of reliance on purchasing food instead of producing their own food in terms of vegetables.

In the presence of ILVs and several benefits allied with these vegetables, households are in a chance of adding ILVs on their daily diets since these vegetables are easy and require minimal inputs for production. These vegetables may also assist households to supplement their household income through sales. Similar findings were also shared by Kalaba *et al.* (2009) who suggest that, increasing production of ILVs by rural communities could be used as a strategy to improve food security and cash income for people living in rural areas.

c) Farm income ranging between R1000-R3000 (ILVs income)

According to Table 4.15, farm income ranging from R1000 to R3000 had a positive coefficient of 2. 283 at 10% significance level when comparing moderate food insecure from less food insecure households. The positive coefficient could be explaining that, if households are generating farm income ranging between R1000 and R3000, the more likely they are to be moderately food insecure. This may be a reason that, households focus on certain farming activities such as exotic vegetable production to supplement their daily food requirements, thus hindering households a chance to be less food insecure. This, therefore, possibly triggers the ignorance of such households to produce or even consider ILVs for food consumption purposes. Also, households may perhaps lack an understanding that, there are also possible economic returns from producing ILVs. Thus, ILVs may not only offer nutritious diets but the revenues obtained from selling these vegetables may also assist households to purchase nutritious food varieties which may be enough to sustain household food needs.

d) Income from livestock sales

Income from livestock sales was found to be positively and statistically significant at 5% level when comparing moderate food insecure households from less food insecure households. This implies that, if households continue depending on the income generated from livestock sales, there could be a likelihood of moderate food insecure households. This may be a reason that, the income that is generated from livestock sales is possibly inadequate to purchase enough food to sustain the household's daily needs hence, households remain moderately food insecure and not shifting to be less food insecure. From the observed results and the existence of ILVs, an improvement in the consumption of ILVs may be expected since several studies validate that ILVs have a potential contribution towards dietary diversity and food security among

households (Mungofa, 2016; Mayekiso *et al.,* 2017; Mbhenyane, 2017; Nyaruwata, 2019).

e) Employment status

Employment status had a negative coefficient of -3.223 at 1% significance level when comparing moderate food insecure households from less food insecure households. The negative coefficient could be explaining that, as the number of unemployed members increases within a household, there could be a higher possibility of moderately food insecure households. This may possibly mean that such households are likely not to have enough money to purchase different foods which are required as daily food needs, thus leaving such households vulnerable to moderate food insecurity shocks. In the light of pragmatic results from the study area, and ILVs being labelled as inexpensive but nutritious food, households should therefore opt to consume ILVs to supplement daily diets and address their experiences of food insecurity shocks. Mpala *et al.* (2013); Mungofa *et al.* (2018) also suggest the same, conveying that, consumption and cultivation of ILVs has the potential to improve food security and boost income generation in households predominantly within rural contexts.

f) Production status of ILVs

Concerning production of ILVs, a negative coefficient (-2.821) at 1% significance level was observed when comparing moderate food insecure households from less food insecure households. This implies that, the less households are involved in the production of ILVs the more such households are likely to be moderately food insecure. This may be a reason that, such households depend mostly on using exotic vegetables and conceivably lack resources to purchase enough vegetable foods which are meant for daily diets needs thus preventing a chance of less food insecure households. This may trigger such households to experience food shortages and consequently putting ILVs in line for increased/improved production so to enhance their utilisation among households for low-cost healthy diets as recorded by previous research. Mungofa *et al.* (2018) record similar findings, stating that, poorer people in the rural and informal areas are likely to cultivate ILVs as a source of their vegetable supply since they have limited cash to purchase exotic vegetable.

4.8.6 Less food insecure vs Severe food insecure households

The study results revealed that, household size, no farm income, farm income ranging between R1000 to R3000 and farm income from livestock sales positively influence households to be more food insecure when comparing to less food insecure households. Also, employment status and production status of ILVs were estimated to negatively influence households to be more food insecure when comparing to less food insecure households.

a) Household size

Household size directly influence the food security status of households. For household size, a positive coefficient of 0.027 at 1% significance level was found when comparing severe food insecure households from less food insecure households. These results suggest that, households with a larger number of members are likely to be more food insecure. This may further mean that, although households purchase food, the food may still not be enough to sustain the household's daily food needs. This leads to difficulties in maintaining larger households regarding acquiring enough nutritious food on daily basis, which therefore prevents such households to be less food insecure. Similar findings were also shared by Ndobo (2013); Matebeni (2018) uttering that, larger households are likely to demand more food which therefore leaves such households experiencing food shortages sometimes. To this end, fitting in ILVs in the food production system would be vital as these vegetables are recognised for their potential to address food insecurity, particularly within rural communities (Mungofa, 2016).

b) No farm income

For households with no farm income, a positive relationship at 1% significance level was observed when comparing severe food insecure households from less food insecure households. The positive relationship could be explaining that, if households do not generate any farm income, there could be a higher chance of severe food insecurity. This could be a reason that such households possibly depend on other sources of income such as social grants or salaries which, therefore, constrains households to get enough food to sustain their household's daily food needs. This therefore presses such households to be vulnerable to food insecurity, thus inhibiting less food insecurity to households. Given the results and linking them to the benefits

connected to ILVs, production and consumption of ILVs may play a major role in fighting hunger and food insecurity shocks. This is because the production of ILVs may generate income for households and this may assist such households to sustain other livelihood needs while on the other hand, the consumption of ILVs may not only diversify diets, but can also improve both the nutrition and food security status of households (Mavengahama, 2013; Shonshai, 2016).

c) Farm income ranging between R1000 and R3000 (ILVs income)

The variable measured the amount of farm income obtained by households. This variable was found to be statistically significant at 1% level with a positive coefficient of 2.099 when comparing severe food insecure households from less food insecure households. This implies that, households who are generating farm income between R1000 and R3000 are likely to be more food insecure. This may be a reason that, the income which is generated from producing vegetables is possibly not adequate to sustain household food needs daily, which therefore leave such households experiencing food insecurity. Given the results, ILVs may therefore fill a gap in addressing the problem of food insecurity among households as these vegetables are noted as good sources of several macro and micronutrients which are required by a person on daily basis. Another advantage is that, ILVs are an affordable source of food when compared to other commercial or exotic vegetables (Njume *et al.,* 2014; Otitoju *et al.,* 2014).

d) Income generated from livestock sales

According to Table 4.15, a positive coefficient of 3.399 at 5% significance level was observed when comparing severe food insecure households from less food insecure households. The positive coefficient could be suggesting that, as long households generate income from livestock sales, there could be a higher probability of severe food insecure households. This means that, households possibly rely mostly on income derived from livestock sales which in most cases does not come on daily nor monthly bases. This therefore may result to households lacking resources to obtain food that may be able to sustain the household's food needs and triggering these households to be susceptible to food insecurity problems. In the light of observed results and existence of ILVs from the study area, production and consumption of ILVs

may be expected so as to address food insecurity through the income generated from sales of ILVs and increased utilisation of ILVs by households.

e) Employment status

Employment status was among the variables which influence food security status of households. This variable was found to be negatively and statistically significant at 1% level when comparing severe food insecure households from less food insecure households. These results suggest that, if there are fewer or no employed members within a household, there are chances of severe food insecurity in such households. Similar findings were also discovered by Dodd and Nyabvudzi (2014) arguing that, the higher the unemployment rate, the lower the living wage and the more likely households are to be food insecure. This could be a result of such households not having sources of income or if they do, the sources of income limit them to acquire enough food to meet household's daily food requirements. As a consequence, households experience food shortages and being exposed to food insecurity shocks. To this end, given the benefits of consuming ILVs and possible returns from the sales of these vegetables, an increased utilisation of ILVs should be advised. The increased or considered commercialisation of ILVs may introduce business opportunities and simultaneously create employment opportunities. On the other hand, increased consumption of ILVs may address malnutrition and food insecurity tremors.

f) Production status of ILVs

For ILV production status, a negative coefficient of -2.743 at 1% significance level was observed when comparing severe food insecure households from less food insecure households. The negative coefficient could be suggesting that, if households do not produce ILVs, there could be a likelihood of households who are severe food insecure. These results further reveal that, households possibly focus on the production of exotic vegetables other than ILVs, whereas exotic vegetables fail to grow in some seasons such as winter for example. The results of this failure could therefore prompt food shortages to such households which may perchance expose such households to be more food insecure. Thus far, if production of ILVs was to be considered by households it may have the potential to diversify diets, fill a gap during times of food scarcity and maintain consistent food supplies when exotic vegetables fail to grow. Similar findings were also shared by Bua and Onang (2017) who argue that some of

the reasons for production and consumption of ILVs included, source of food, high nutritive value and short maturity period. Other reasons included resistance to pests and diseases, source of cash income and resilient to harsh weather conditions where most exotic vegetables fail to withstand (Kebede and Bokelmann, 2017). This may not only diverse diets, but it may also translate to food secured households through increased production and income generation from these vegetables.

4.9 Summary statement of food security status from the study areas

Several households from ORTDM are characterized as being moderate food insecure to more food insecure with many households (47%) classified as severe/more food insecure and 33% classified as moderate food secure. Given the high statistics (63.8%) from the descriptive results of ORTDM, households are participating in the production of ILVs and this may possibly be contributing to household's food security status of households. This is because the food security status of households who are less to moderately food secure is higher than the number of households who are more/severely food insecure as confirmed by description results. In addition, a majority (69%) of households from ORTDM are using ILVs for food purposes only and this is the highest statistics when compared to other uses of ILVs by households within the district. This might have conceivable contributed to diversifying diets of households which therefore translated households to less and moderate food secure. On other hand, moderate food insecure households are positively influenced by employment status and production status of ILVs and household size, no farm income, farm income ranging between R1000 to R3000 and income from livestock sales negatively influence households to be moderately food insecurity.

From ANDM, food security of households from the district has most (62%) households as food secured, while 36% are moderately food secure with very few (5%) being more/severe food insecure as indicated by descriptive statistics. Thus, considering the production of ILVs from the district which is at 61.3%, the production must have contributed to household food security hence many households from the district are regarded as food secure with few households classified as more food insecure.

Furthermore, looking at the utilisation of ILVs by households as explained by descriptive results, a majority (63%) of households from ANDM use ILVs for food purposes only, while 36% of households use ILVs for medicinal purposes. This,

therefore, explains the contribution of ILVs to household diets, household food security as well as the wellbeing of households since these vegetables offer macro and micronutrients that are required on a daily basis by a person. To this end, from ANDM there are few households which are vulnerable to food insecurity, this stems from the high production status of ILVs within the district and high utilisation of these vegetables particularly as source of food. In summary, household size and no farm income positively influence households to be moderately food insecure, while age, employment status and production status of ILVs negatively influence households to be moderately food insecure. Also, household size negatively influences households to be more food insecure.

When it comes to the food security of households from JGDM, many (67%) households are less food insecure while 17% of households are classified as moderate food insecure and 15% of households are characterised as more/severe food insecure. From the observed results with majority of households from the district producing ILVs, it could be said that these vegetables have a potential of addressing food insecurity at household level. This is because, there are few households which experience food insecurity with few households susceptible to moderate food insecurity to more food insecure conditions. Utilisation of ILVs as food sources is high at 81% from the district with minimal (6%) households using ILVs as medicine source. Thus far, the consumption of ILVs may have been a contributing factor towards household food security within the district.

Households from JGDM are classified into three food security statuses, that is, households which are less food insecure, moderate food insecure and more food insecure. From the observed regression estimates, moderate food insecure and more food insecure households are positively influenced by household size, no farm income, farm income ranging between R1000 and R3000, income from livestock sales, while moderate food insecure households and more food insecure households are negatively influenced by employment status and the production status of ILVs within a household.

4.10 ILVs' role players and their functions along the ILV production value chain

This section presents ILVs role players and their functions within the ILV production value chain from ORTDM, ANDM and JGDM. This section firstly presents identified

role players within the value chain and further determine correlations between various role players and their function along the value chain.

Thus far, the study has identified 260 producers of ILVs who also claimed to be consumers of these vegetables, 44 households only consumed ILVs without producing them. Also, 16 hawkers were identified as role players in the ILV value chain with three input suppliers only found within the ORTDM. From ANDM and JGDM producers indicated that, they propagate their own seedlings/seeds or harvest seeds for free in their neighbours' home gardens and fields.

A Pearson R test was used to determine the correlation between the role players and their functions as presented in Table 4.16 below. According to Hall (2015), a Pearson R test is a statistical formula that measures the strength between variables and their relationships; this means that, it determines how strong the relationship between two variables is by finding the coefficient values ranging between -1.00 and 1.00. A value of 0 indicates that there is no association between the variables. A value greater than 0 indicates a positive association; that is, as the value of one variable increases, so does the value of the other variable. For the study, values which are closer to one were observed to have a strong relationship between two comparable variables as indicated in Table 4.16.

Table 4.16: Correlational analysis between role players in ILV production value chain and their functions

	IS	H	P	C	PI	PGP	DI	PM	PT	TS	DIC	DIH
IS												
H	0.999**											
P	0.404	0.388										
C	0.996**	0.994**	0.410									
PI	0.447	0.426	0.638	0.430								
PG	0.447	0.426	0.638	0.430	1.000**							
P												
DI	0.447	0.426	0.638	0.430	1.000**	1.000**						
PM	0.698	0.705	0.308	0.633	0.574	0.574	0.574					
PT	0.447	0.426	0.638	0.430	1.000**	1.000**	1.000**	0.574				
TS	0.447	0.426	0.638	0.430	1.000**	1.000**	1.000**	0.574	1.000**			
DIC	0.447	0.426	0.638	0.430	1.000**	1.000**	1.000**	0.574	1.000**	1.000**		
DIH	0.447	0.426	0.638	0.430	1.000**	1.000**	1.000**	0.574	1.000**	1.000**	1.000**	

*Note: ** Correlation is significant at <0.01 level*

Source: Research Survey

*Key: **IS** = Input supplier; **H**= Hawkers; **P**= Producers; **C**= Consumers; **PI**= Provide inputs; **PGP**= Provide guidelines on ILV production; **DI**= Deliver inputs;*

***PM**= Price maker; **PT**= Price taker; **TS**= Target sales; **DIC**= Distribute ILVs to consumers; **DIH**= Distribute ILVs to hawkers*

Table 4.16 shows a positively strong correlation between input suppliers and hawkers, thus, as the number of input suppliers for ILVs increases, the number of hawkers for ILVs may also increase. Similar to when there is an increase in the number of input suppliers for ILVs, there may be an increase in ILVs' consumers as presented in Table 4.16. The Pearson R test further confirms a positive correlation between hawkers and input suppliers and consumers. This means that, as hawkers increase, input suppliers and consumers for ILVs may also increase. A strong positive correlation between consumers and input suppliers, and hawkers was found, thus as the number of ILVs consumers increases, the number of input suppliers and hawkers may also increase. So far, input suppliers, consumers and hawkers are the major role players within the ILVs value chain from these three district municipalities (ORTDM, ANDM and JGDM). Although, producers experience higher gross margins from sales of ILVs as confirmed by Gross Margin analysis, their only clear role is producing these vegetables. In South Africa, there is limited research and information concerning ILVs value chain, however Senyolo *et al.* (2018) recently argue that, there is a weak relationship among the value chain actors of ILVs and smallholder farmers are accomplishing higher Gross Margin but there are several factors which inhibit farmers to participate in mainstream markets.

Regarding functions of role players in ILVs value chain, the Pearson R test confirms that, as input suppliers increase the provision of inputs, the number of producers that are providing guidelines on ILVs production may also increase, delivering of inputs by input suppliers to producers, producers, hawkers and consumers being price takers, producers being able to determine demand for ILVs and lastly, increase distribution of ILVs to consumers and hawkers. Table 4.16 shows a positive correlation on providing guidelines for producing ILVs, this means that, an increase from this variable activates an increased provision of inputs, deliverance of inputs by input suppliers, producers, consumers, hawkers as price takers, producers targeting sales for ILVs, and distributing ILVs to consumers and hawkers. The Pearson R test results further show that, an increase in the delivery of inputs by input suppliers increases provision of inputs by input suppliers, provision of guidelines on ILVs production by producers, consumers, hawkers as price takers, producers and hawkers determining demand for ILVs and lastly, distribution of ILVs to consumers and hawkers as shown in Table 4.16.

Producers, consumers and hawkers as price takers increase the provision of inputs and delivery inputs by input suppliers, providing guidelines on ILV production by producers, hawkers determining demand for ILVs and distribution of ILVs to consumers. Determining demand (target sales) for ILVs by producers and hawkers increases as the provision of inputs by input suppliers, provision of guidelines by ILV producers, delivering inputs, producers, hawkers and consumers as price takers and distribution of ILVs to consumers and hawkers increases. Lastly, the Pearson R test results confirmed that, as the distribution of ILVs to consumers and hawkers increases, provision of inputs by input suppliers, provision of guidelines by ILV producers, delivering of inputs by input suppliers, producers as price takers, producers determining demand for ILVs also increase.

From the identified role players within ILV value chain, these results initially suggest that, input suppliers are likely responsible for providing inputs such as seeds/ seedlings. On the other hand, producers determine the demand for the ILVs, become price takers, provide information on how to produce ILVs, distribute ILVs produce to consumers and hawkers. The study further infers that, hawkers can determine the demand for ILVs, be price takers and also distribute ILVs to consumers. To conclude, consumers purchase ILVs from both hawkers and producers where consumers seasonally purchase these vegetables. To this end, several authors confirmed that, there are limited studies which are conducted to examine ILV production value chains and related subjects in Southern Africa (Lenné and Ward, 2010; Shackleton *et al.,* 2010; Weinberger *et al.,* 2011; Chagomoka *et al.,* 2014; Bidogeza *et al.,* 2016). Previous research on ILVs focuses on production systems characteristics of ILVs, nutritional attributes of ILVs, the nature of ILV marketing outlets, and women's participation in the production and marketing of ILVs rather than the entire value chain of ILV production, particularly from seed production and distribution through to produce marketing (Chagomoka *et al.,* 2014; Senyolo *et al.,* 2018). Given the results and current literature regarding ILV value chain production, a need arises for a further research on the subject matter. The next chapter wraps up the study by presenting the summary, conclusion and policy recommendations for the study.

CHAPTER FIVE

RESEARCH SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.0 Introduction

This chapter presents summary of empirical results, conclusions drawn from the study as well as policy insights. The chapter is organized in a way that, it first presents a one-on-one mapping of the major objectives outlined in the first chapter to the major findings inferred from the analytical chapters. This will lead to the general conclusions of the study and lastly highlight policy recommendations based on the study results.

5.1 Research Summary

This section summarises the major findings from the ORTDM, ANDM and JGDM in order to make inferences regarding the major hypotheses of the study. The broad objective of this study was to assess the production of Indigenous Leafy Vegetables (ILVs) for income generation and food security. In pursuit of this objective, the study focused on the following specific objectives:

The first objective of the study was to identify and describe the socio-economic characteristics of ILV producers and non-producers from ORTDM, ANDM and JGDM.

The second objective of the study was to assess the most produced ILV and factors influencing production of ILVs. The fundamental hypothesis of this objective was that, households produce few ILVs and socio-economic factors are not determinants of the production of ILVs in households. Major findings drawn from the analytical results were that, from ORTDM there are several (18) ILVs produced and these included, Amaranth, Nightshade, Pumpkin leaves, Blackjack, Sweet potato leaves, *Sonchus asper (L)*, Hog plum, *Laportea peduncularis*, Common sow thistle, *Coriaacea Nannfd*, Pigweed, Lambs quarter, *Caudatus L.,* Turnip, Spider plant, Chinese cabbage, *Physalis peruviana L.* and Melon leaves. Socioeconomic characteristics such as gender, secondary education, tertiary education and employment status determine whether households produce ILVs or not.

From ANDM, there are also eighteen types of ILVs which are produced by the occupants, these vegetables included Amaranth, Nightshade, Pumpkin leaves, Pigweed, Lambs quarter, Blackjack, Sweet potato leaves, *Caudatus L., Sonchus*

asper (L), *Physalis peruviana L.,* Hog plum, Common sow thistle, *Laportea peduncularis, Coriaacea Nannfd,* Tomato leaves, *Cucurbitaceae*, Chinese cabbage and Turnip. Factors such as gender, age and employment status are the determinants which drive households to produce or not produce ILVs.

Lastly, JGDM produces about ten different ILVs and these ILVs include Amaranth, Nightshade, Pumpkin leaves, Sweet potato leaves, Turnip, Blackjack, Lambs quarter, Pigweed, *Laportea peduncularis* and *Caudatus L.* Furthermore, gender, age, tertiary education, household size and farm income are the factors influencing households to participate in the production of ILVs from the district. Thus, these results suggest that, from JGDM, a household's decision to grow lLVs is conditioned by the household's socioeconomic characteristics.

The third objective was to identify factors which influence the different uses of ILVs. The fundamental hypothesis to this objective was that, socio-economic factors do not influence different uses of ILVs. A major finding drawn from the analytical results was that, ILVs are used for various purposes in these three district municipalities. For instance, in ORTDM the use of lLVs for food purposes only, is influenced by farm income ranging from R1000 to R3000, no farm income, income from exotic vegetable sales, income from livestock sales and seasonal production of ILVs. The use of ILVs as a medicine source is influenced by gender and no farm income.

From ANDM, the use of ILVs as a source of food is inclined by households with no farm income, households earning farm income from R1000 to R3000 and seasonal production of ILVs. On the other hand, the use of ILVs as medicine is influenced by households with no farm income, awareness about the nutrition benefits of ILVs and seasonal production of ILVs. These findings suggest that, socio-economic characteristics of households, knowledge/awareness linked to nutrition and health benefits of ILVs, and seasonal production of ILVs influence the use of ILVs amongst households.

Within the JGDM, the use of ILVs as a food source is determined by age, household size, gender, no farm income for households, employment status, awareness about health benefits linked to ILVs and seasonal production of ILVs. The use of these vegetables as a medicine source is prompted by gender and households with no farm income. These results' inference is that, socio-economic characteristics of households

are not only the determinants towards ILV use but the knowledge/awareness associated with nutrition and health benefits of ILVs, also determines the use of ILVs amongst households.

Fourthly, the study focused on determining the contribution of ILVs to household income and food security through assessing its link to the production of ILVs and returns that may be experienced from the sales of these vegetables. The principal hypothesis to this objective was that, ILVs do not contribute to income generation in rural households and household food security. From ORTDM, descriptive results reveal that, households from this district are mostly characterised as moderate food insecure to more/severe food insecure with the majority (63.8%) of households participating in the production of ILVs and usage of these vegetables as sources of food. Thus far, these results convey that, ILVs have a potential to contribute towards household food security.

Households from ANDM are classified as less food insecure, moderate food insecure and more food insecure with many households categorised as being less food insecure while few households are categorised as being more food insecure as established by descriptive results. Therefore, ILVs must be contributing towards household food security given the production level of ILVs (61.3%) among households as well as high utilisation (63%) of these vegetables as a food source by its residents besides other uses for these vegetables.

The JGDM households are also categorised as less food insecure, moderate food insecure and more food insecure. The district records a larger number of households which are experiencing food security with few households susceptible to food insecurity as revealed by descriptive results. From all these three district municipalities, JGDM has the highest number of households producing ILVs (64.2%) and households who are utilising these vegetables for food purposes, these exclude other purposes which households may be using these vegetables for.

Concerning returns experienced from the ILVs produced and harvested from these three district municipalities, from ORTDM, of the harvested ILVs, Amaranth brings a higher gross income (R262 875) per production season when compared to other vegetables harvested and sold from the district. This means that, ILVs have a potential of contributing towards household income. The income generated from these

vegetables may not only address the problem of food insecurity among households, but it may also assist households in sustaining other livelihood needs. Thus far, the gross income generated from sales of ILVs was estimated to range between a minimum of R350 to a maximum of R262 875 per production season, with the gross income depending on the amount of ILV harvested, TVC and the price each ILV is sold per Kg.

From ANDM, Pumpkin leaves bring higher returns from its sales as compared to other vegetables grown and harvested from the area. The gross income generated from ILVs sales was within a minimum of R350 to a maximum of R249 750 per production season. Thus, sales of ILVs produced and harvested within the district have the potential to generate income for households and this may eventually translate not only to diverse diets but to sustainable rural livelihoods as well.

Furthermore, within the JGDM, Pumpkin leaves also have a higher gross income when compared to other vegetables which are produced and harvested within the district. From JGDM, the gross income generated was between a minimum of R500 to a maximum of 228 000 per production season. Given the positive gross income and gross margins which are realised from the sales of ILVs, these vegetables have a potential of contributing towards household income. To this end, from the three district municipalities, Amaranth, Pumpkin leaves and Nightshade are recognised as highly harvested vegetables which also generates a higher gross income when compared to other vegetables produced within these districts.

Objective five of the study was to identify different role players and their functions along the ILV value chain, the assumption for this objective was that, producers and consumers are the only role players in the ILV production value chain. So far, the study findings identified input suppliers, producers, consumers and hawkers as major role players in the ILV value chain from ORTDM, ANDM and JGDM.

Several functions were linked to each role player, for instance, input suppliers play a role in providing seeds and provide guidelines on how to use such seeds. Also, producers are responsible for targeting yields and demand for ILVs, price takers, disseminate information about the production of ILVs and distribute ILVs produce to consumers and hawkers. In addition, consumers play a role of purchasing ILVs from producers and hawkers on seasonal basis. Lastly, hawkers from these three district

municipalities are responsible for determining the demand for these vegetables as they are also price takers.

The study further checked the correlations between role players and their functions, thus far, as input suppliers for ILVs increases, a number of hawkers for ILVs may also increase. Likewise, when there is an increase in the number of input suppliers for ILVs, the number of consumers may also increase. Also, as hawkers increase, input suppliers and consumers of ILVs also increase. The correlation matrix further reveals that, as consumers of ILVs increase, the number of input suppliers and hawkers is likely to increase. These results therefore suggest that, input suppliers, consumers and hawkers of ILVs become the major role players in the ILVs value chain although the functions of each role player are not quite conclusive.

5.2 Conclusion

The study findings confirm that, the production of ILVs from ORTDM, ANDM and JGDM is mostly influenced by socioeconomic characteristics of a household. The fundamental hypothesis was that households produce few ILVs and socio-economic factors are not determinants of the production of ILVs in households. The study therefore rejects the hypothesis since there are socio-economic factors that influence households' participation in the production of ILVs. This study concludes that, from the three district municipalities, there are several ILVs growing and produced; and the production of ILVs is highly conditioned by socio-economic characteristics of households.

The results also establish that, uses of ILVs among households are not only influenced by household characteristics but seasonal availability of ILVs also determines the use of ILVs among households. The fundamental hypothesis was that socio-economic factors do not influence different uses of ILVs. This means that the hypothesis was rejected since the results confirmed that, the use of ILVs is influenced by socio-economic characteristics of households. Moreover, it is concluded that, households from ORTDM, ANDM and JGDM use ILVs for various purposes, these include ILVs as a source of food, medicine and livestock feed. The study further concludes that, from ORTDM, the use of ILVs among households is influenced by household socio-economic characteristics and seasonal availability of ILVs. While on one hand, the use of ILVs from ANDM and JGDM households is conditioned by socio-economic

characteristics of households, on the other hand knowledge/awareness related to the nutrition and health benefits of ILVs and seasonal production of ILVs influence the use of ILVs in the study areas.

The study observed higher production and the high utilisation of ILVs for food purposes and this contributes to household diets which ultimately translate to food secured households. The principal hypothesis was that, ILVs do not contribute to household food security. From the observed results within the three district municipalities regarding food security status, the hypothesis was therefore rejected since the results confirmed a potential contribution of ILVs towards household food security status. Also, given the food security status, the production status level of ILVs among households and utilisation of ILVs as a source of food by households, the study therefore concludes that, these vegetables have a potential in diversifying diets and addressing food insecurity problems within rural segments.

The positive gross income and gross margins were experienced as evidence of efficiency regarding the production of ILVs. For instance, the gross income generated from ILVs sales of Amaranth per production season from ORTDM, ANDM and JGDM was R262 875, R222 000 and R208 500 respectively. Thus, with the given gross incomes, the production and selling of ILVs has a potential towards contributing to household income. The income that is generated may not only assist households in acquiring enough food, but it may also assist in sustaining other livelihood needs such as clothing, education fees, electricity bills, medical bills among others. To this end, the study rejected a hypothesis that ILVs do not contribute to household income due to evidence of positive Gross Margins observed.

Thus far, the study findings identified input suppliers, producers, consumers and hawkers as major role players in the ILV value chain from ORTDM, ANDM and JGDM. The assumption was that, producers and consumers are the only role players in the ILV production value chain. The hypothesis was therefore rejected since there are several role players who are involved in the ILV production value chain as confirmed by the study results. The study concludes that, in the ILV production value chain, input suppliers, producers, hawkers and consumers are the role players. However, inputs suppliers, consumers and hawkers are the main role players in the ILV production value chain from all the three district municipalities. The study further concludes, there

are several functions which are played by each of the role players, thus, input suppliers are in charge for providing inputs such as seeds/seedlings for ILVs. Producers are responsible for determining demand for ILVs, price takers, providing information on how to produce ILVs and distributing ILVs' produce to consumers and hawkers. The study further infers that, hawkers can determine the demand for ILVs, be price takers and distribute ILVs to its consumers. Lastly, consumers play a role of purchasing ILVs from both hawkers and producers where they seasonally purchase these vegetables. These results therefore confirm that, there is a relationship among role players within the ILV production value chain. Thus far, the study concludes that, the ILV production value chain system lacks governmental support in the form of institutional engagement in ILV production. This is because there is no evidence of extension personnel support from these three district municipalities regarding ILV production as described by descriptive results from identifying role players in the ILV production value chain.

5.3 Policy recommendations

Based on the preceding reviews and the study results, there is evidence that, the production of ILVs does not only play a role in diversifying diets and addressing food insecurity problems, but these vegetables can also offer an important economic value through income generation. This may not only improve household income, but it may also enhance sustainable rural livelihoods. Given this information, the study recommends the following:

1. Production of ILVs within rural context is limited due to socio-economic conditions of households. This may be a reason that, producers are perhaps carrying knowledge that production of ILVs is associated to a specific population group. To address this issue, government intervention through extension personnel where government can provide information regarding production techniques of ILVs, information linked to the economic value, nutrition value and health benefits of ILVs is advised. This may therefore bring awareness not only to ILV producers but to farmers in general so they can consider production of ILVs on a larger scale to benefit from the returns of these vegetables.
2. There are several ILVs which are produced and some of these vegetables are growing naturally from the three district municipalities as proclaimed by the

producers and households. However, the availability of these vegetables is still at informal market level although most households are utilising ILVs for food purposes. This, therefore, calls for government officials such as the Department of Agriculture at national level to provide information or skills about producing these vegetables in a commercial manner to attract larger markets.

3. In regard to production nature and seed availability of ILVs in the study areas, some of ILVs seedlings/seeds are harvested freely from home gardens and sometimes open fields. Policy makers, government officials as well as institutions regarding poverty alleviation should introduce a proper system for propagation of these seedlings so that they can be available throughout the year instead of seasonal basis. Department of environmental services and other related departments as well as local authorises (Chiefs) within rural communities, should also encourage or adopt conservation strategies for these vegetables in order to improve their availability and access to its residents. Success of this may assist in improving the availability of ILVs and their seeds for larger consumption and market.
4. The study results confirmed a better utilisation of ILVs for food purposes by households and this has a potential of improving dietary diversity as well as addressing food insecurity problems. However, some of the households are still not consuming ILVs. This therefore calls for all relevant government departments to bring awareness on benefits obtained from using ILVs as sources of vegetables, transfer knowledge to school learners on nutrition and health benefits associated with ILVs so these learners can make use of the information even within a household setting (DoE). Some of the relevant departments include the Department of Agriculture and Rural Development (DARD), Department of Social Development (DSD), Department of Education (DoE) and Department of Health (DoH). Awareness and information about nutrition and health benefits should also be presented at local clinics (DoH). Poorer households, particularly those who depend only on social grants to acquire food should be encouraged to make use of ILVs to supplement their diets for healthy food habits (DSD). Success of this may not only contribute to rural livelihoods but this may entirely improve the ILV production system.
5. The ILVs which are grown and cultivated from the three district municipalities, particularly the vegetables which are highly harvested, show potential of greater

returns in terms of money. Amaranth, Nightshade and Pumpkin leaves are the highly harvested ILVs which bring higher returns, however, the production of ILVs is on small scale and commonly for subsistence consumption with informal trading of these vegetables by street vendors. The production and marketing channels of ILVs lack other system support such as input suppliers, extension services linked to ILV production and middlemen where existence of ILVs may be highly recognised. This therefore calls for investment interventions to provide training/workshops regarding production of ILVs, provide seedlings of ILVs where necessary and market information relating to ILVs. From this manner, producers of ILVs may be able to position ILVs and ILV products to larger markets as well.

6. The study identified input suppliers, producers, hawkers and consumers as role players in the ILV production value chain from ORTDM, ANDM and JGDM. Thus far, there is no evidence of institutional support nor government support regarding the ILV production value chain from these district municipalities. Also, the input suppliers for seeds are only limited to ORTDM, the other two districts (ANDM and JGDM) are commonly harvesting the seeds for free. Given the observations from these three district municipalities, institutional support in a form of investments regarding production of ILVs should be promoted so as to improve the production value chain system of ILVs. Successful support may also inspire the production of these vegetables on a larger scale. This may ultimately create employment opportunities as well because there is also a high rate of unemployment within these three districts.
7. Although there is evidence of a relationship among role players in the ILV production value chain, there is still a need of government support through extension personnel to provide information on input suppliers about how to make the seeds of ILVs available on larger amounts throughout all seasons. Also, to the district municipalities who do not have input suppliers, guidelines on how to preserve these vegetables to acquire seeds should be provided. In addition, there is a need for producers to understand how to attract markets for these vegetables and acquire funds/credit where necessary through extension personnel. Moreover, further research concerning ILV production value chain is advised in South Africa and globally so to improve the available data in the subject matter.

To this end, policy makers should further establish and strengthen the inclusion of ILVs in both farming and food system, government; and related institutions focusing on sustainable rural development should also intervene on promoting production of ILVs particularly within rural contexts. This is because the production of ILVs may alleviate poverty through job creation, addressing food insecurity and generate income. A successful intervention of government and policy makers in ILV production has a potential of translating to sustainable rural livelihoods. With the given recommendations which are based on the results of the study, further future research or follow up research should therefore look at the following aspects:

a) The influence of aspirations (both household and Societal aspirations) on the production and use of ILVs by rural households.
b) Major difference in the risk profile of the Gross Margins of ILV production when compared to high-input production system that are typically being advocated and promoted by government initiatives aimed at improving the livelihoods of rural households.

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APPENDIX A: Consent form

SCHOOL OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Department: Agricultural Economics and Animal Production

CONSENT FORM

TITLE OF RESEARCH PROJECT: Economic assessment of indigenous leafy vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa

Dear Participant

The aim of this study is to establish knowledge related to production of Indigenous Leafy Vegetables (ILVs) for better understanding of the nutrition and health benefits as well as the economic value these vegetables may offer for sustainable rural livelihoods.

Kindly be informed that, your participation in the study is voluntary. You have the right to be a part of the study, choose not to participate or to stop participating at any time without penalty. The responses given during this research will be treated as confidential information and the information obtained will be used for the purposes of this research only.

There are no direct benefits from participation in the study, however, the study can only provide gathered information pertaining the aim of the study given above.

For any enquiries concerning the study, you may contact the researcher via email at anelemayekiso@ymail.com or the supervisor at abenet.belete@ul.ac.za

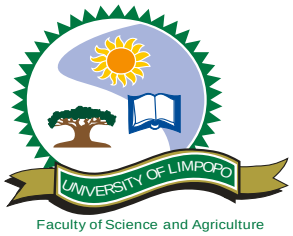
CONSENT

I have read and understood the above information relating to the research and I am willing to participate in the study.

Signature of participant.....Date.....

WITNESS……..

APPENDIX B: Household Questionnaire



SCHOOL OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Department: Agricultural Economics and Animal Production

Household Questionnaire

Research Title: Economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa.

Preamble:

Anele Mayekiso is a PhD student from University of Limpopo, Faculty of Science and Agriculture, School of Agricultural and Environmental Sciences under the Department of Agricultural Economics and Animal Production conducting research on "*Economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa".* The responses given during this research will be treated as confidential information and the information obtained will be used for the purposes of this research only.

General Information:

Enumerator's name:
Name of the District Municipality:
Name of the Local Municipality:
Name of the village:
Contact number:
Date:

SECTION A: DEMOGRAPHIC INFORMATION OF HOUSEHOLDS:

1. Gender

a. Male		b. Female	

2. Age…… years
3. Level of education

0. Never went to school		1. Primary school		2. Secondary school		3. Tertiary education	

4. Household size……Number
5. Household total farm income per annum R……
6. Employment status other than farming (off-farm employment):

a. Employed		b. Unemployed	

SECTION B: PRODUCTION OF ILVs AND THEIR USES:

1. Do you produce ILVs?

a. Yes		b. No	

2. If no, provide reasons why you are not producing ILVs.

3. If yes, what is the size of the land that you use to cultivate your ILVs?

hectares

4. What are the most cultivated ILVs in this area? List them:

5. What is the amount of ILVs that you harvest per production cycle?

ILVs harvested	Amount harvested (Kg)

6. Do you hire labour for producing your ILVs?

a. Yes		b. No	

7. If yes, how much do you pay them per month? R…….....
8. What is the labour force (both internal and external) size do you require per production cycle?.....Number.
9. Where do you get seeds or seedlings for ILVs?

a. Purchase them		b. Harvest from the wild		c. Purchase and harvest ILVs	

10. If you purchase them, how much do you spend on seeds/seedlings per production cycle?

R

11. Do you use fertilizers for your ILVs?

a. Yes		b. No	

12. If yes, how much do you buy per production cycle?

Kg

13. How much do you spend on purchasing fertilizers?

R

14. Do you irrigate your ILVs?

a. Yes		b. No	

15. If yes, what is/are sources of water? List them:

16. If no, please specify the reasons for not irrigating your ILVs

17. Do you have access to information about producing ILVs?

a. Yes		b. No	

18. If yes, what is the source of information? Please specify…….....
19. What do you use your ILVs for?

a. Food	
b. Medicine	

c. Livestock feed	
d. All the above	

20. Are you aware of the nutrition benefits associated with ILVs?

a. Yes		b. No	

If yes, please list the benefits:

21. Are you aware of the health benefits associated with ILVs?

a. Yes		b. No	

22. If yes, please list the benefits:

23. Is production of ILVs seasonal?

a. Yes		b. No	

If yes, which season do you cultivate ILVs?

a. Summer	
b. Winter	
c. Spring	
d. Autumn	

24. Do you have access to information about the use of ILVs?

a. Yes		b. No	

25. If yes, what is the source of information? Please specify…….

26. Do you encounter any problems when producing ILVs?

Yes		No	

27. If yes, please specify the problems.

SECTION C: CONTRIBUTION OF ILVs TO HOUSEHOLD INCOME:

1. What are the production inputs that you use to produce your ILVs and their costs? please list them:

Inputs	Costs (Rand)

2. How much do you harvest per production cycle?

ILVs harvested	Amount harvested (Kg)

3. How much do you sell per kilogram?

R

4. How much do you sell per annum?

Kg

5. How much do you generate from selling your ILVs per production cycle?

R

SECTION D: CONTRIBUTION OF ILVs TO FOOD SECURITY:

Questions	**Response options**	**Code**
1. Did you worry that your household would not have enough food?	0= No (skip to Q2) 1= Yes	
1(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	

2. Were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0= No (skip to Q3) 1= Yes	
2(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	
3. Did you or any household member have to eat limited variety of foods due to lack of resources?	0= No (skip to Q4) 1= Yes	
3(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	
4. Did you or any other household member eat some foods that you really do not want to eat because of lack of resources to obtain other types of food?	0= No (skip to Q5) 1= Yes	
4(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	
5. Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0= No (skip to Q6) 1= Yes	
5(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	
6. Did you or any household member have to eat fewer meals in a day because there was not enough food?	0= No (skip to Q7) 1= Yes	
6(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	
7. Was there ever no food at all in your household because there were not resources to get more food?	0= No (skip to Q8) 1= Yes	

7(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	
8. Did you or any household member go to sleep at night hungry because there was not enough food?	0= No (skip to Q9) 1= Yes	
8(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	
9. Did you or any household member go a whole day without eating anything because there was not enough food?	0= No (questionnaire is finished) 1= Yes	
9(a). How often did this happen?	1= Rarely (once or twice in the past 30 days) 2= Sometimes (three to ten times in the past 30 days) 3= Often (more than 10 times in the past 30 days).	

The End.

Thank you very much for your participation in this study.

APPENDIX C: Role Players Questionnaire

SCHOOL OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Department: Agricultural Economics and Animal Production

Role players in ILV production value chain

Research Title: Economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa.

Background Information:

Anele Mayekiso is a PhD student from University of Limpopo, Faculty of Science and Agriculture, School of Agricultural and Environmental Sciences under the Department of Agricultural Economics and Animal Production conducting research on ***"Economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa".*** The responses given during this research will be treated as confidential information and the information obtained will be used for purposes of research only.

General Information:

Enumerator's name:
Name of the District Municipality:
Name of the Local Municipality:
Name of the village:
Contact number:
Date:

SECTION A: DEMOGRAPHIC INFORMATION OF HOUSEHOLDS:

1. Gender

c. Male		d. Female	

2. Age…… years

3. Level of education

a. Never went to school	
b. Primary school	
c. Secondary school	
d. Tertiary education	

4. Household size……Number

5. Household total farm income per annum R……

6. Employment status other than farming (off-farm employment):

c. Employed		d. Unemployed	

SECTION B: ROLE PLAYERS IN THE ILV VALUE CHAIN AND THEIR FUNCTIONS

Role players		**Functions**	**Mark with an X**
Input suppliers		Provide inputs (seeds, fertilizers)	
		Provide guidelines on how to use the inputs	
		Deliver inputs to the producers	
Producers		Determine the supply of ILVs (Target yields)	
		Determine the demand for ILVs (Target sales)	
		Price maker	
		Price taker	
		Distribute ILVs to hawkers/ consumers	
		Disseminate information about ILV production to hawkers/consumers	
Hawkers		Determine the demand for ILVs (Target sales)	
		Price maker	

		Price taker	
		Distribute ILVs to consumers	
Consumers		Purchase ILVs from hawkers	
		Purchase ILVs from producers	
		Price takers	
		Seasonally purchase ILVs	
Extension Officers		Dissemination of information on ILV production (Trainings, workshop)	
		Provision of inputs (seeds, fertilizers)	
		Information about access to market	

The End.

Thank you very much for your participation in this study.

APPENDIX D: Ethical Clearance Certificate

University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE

ETHICS CLEARANCE CERTIFICATE

MEETING: **05 November 2019**

PROJECT NUMBER: **TREC/397/2019: PG**

PROJECT:

Title:	Economic assessment of indigenous leafy vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa.
Researcher:	A Mayekiso
Supervisor:	Prof A Belete
Co-Supervisor/s:	N/A
School:	Agricultural and Environmental Sciences
Degree:	Doctor of Science in Agricultural Economics

PP.
PROF P MASOKO
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

i) **This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.**

ii) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.**

iii) **PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

Finding solutions for Africa

APPENDIX E: Editor Certificate

University of Limpopo
Private Bag X1106, Sovenga, 0727, South Africa Tel: 015 268 2502
Email: lethabo.masha@ul.ac.za

28 May 2020

TO WHOM IT MAY CONCERN

RE: EDITING-REPORT

This serves as proof and confirmation that the thesis entitled: **Economic assessment of Indigenous Leafy Vegetables (ILVs) production for income generation and food security in the Eastern Cape Province, South Africa** by A. Mayekiso, has been edited by me and that, unless further tempered with, I am content that all grammatical elements of this report have been eliminated.

Yours Faithfully

Ms. L Masha (Editor)