Investigation of the knowledge and understanding of hygiene practices amongst small-scale farmers producing ready to eat vegetables in the three regions of the Gauteng Province. Gauteng Province THE GAUTENG PROVINCE

INVESTIGATION OF THE KNOWLEDGE AND THE UNDERSTANDING OF HYGIENE PRACTICES AMONGST SMALL-SCALE FARMERS PRODUCING READY TO EAT VEGETABLES IN THE THREE REGIONS OF THE GAUTENG PROVINCE

by

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DECLARATION

“I hereby declare that the dissertation submitted for the master’s degree: Environmental Health, at Tshwane University of Technology, is my original work and has not previously been submitted to any other institution of higher education. I further declare that all sources cited or quoted are indicated and acknowledged using a comprehensive list of references”.

Velile Zolile Sibiya

DEDICATION

This study is dedicated to:

- My sister, Vuyisile Mtaka Mah this one is for you and Sistella our mother.
- My Aunt Hlalakahle, Ayanda our Queen, and Julius the best father in the world, for all the love, the support, your words of encouragement and prayers.
- My entire family (Sibiya, Khumalo and Sithole) for all the support.
- To all my lovely and amazing friends who stood by me and supported me.

Jeremiah 1:5 “Before I formed you in the womb, I knew you, before you were born, I set you apart”.

All honor and glory to the highest GOD.

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ABSTRACT

INTRODUCTION:

Ready-to-eat vegetables are an essential part of a healthy, balanced diet. They provide significant nutritional benefits; however, they also pose serious challenges due to their susceptibility to contamination. These vegetables are usually eaten without further processing, making food safety a major concern. Most fresh produce used in ready-to-eat dishes, such as salads, undergoes minimal handling, often just washing before consumption. This limited processing increases the risk of contamination and emphasizes the importance of stringent hygiene measures during production, handling, and distribution.

This study aims to establish the current state of knowledge regarding hygiene practices and their application among small-scale farmers in the three regions of Gauteng, South Africa. This study aimed to describe the current understanding of food hygiene in the handling and preparation of ready-to-eat vegetables. The objective was achieved through farm inspections and observational visits, as well as interviews with small-scale farmers. These methods were used to gather information on their knowledge, perceptions, and application of hygiene practices during the production of ready-to-eat vegetables in the study areas.

MATERIALS AND METHODS:

This study followed an empirical investigation setup, where a data-based collection approach was used to determine the population size (n=75) and the sample size from each region as follows: City of Tshwane (n=25), Ekurhuleni (n=25), and West Rand (n=25). Existing literature was consulted to compare and contextualise the observations made regarding hygiene practices. The participants were as follows: eighty percent (80%) came from the City of Tshwane, seventy-two percent (72%) from the City of Ekurhuleni, and eighty percent (80%) from the West Rand district. All interviews were conducted at the farms using a structured questionnaire, along with observations and inspections of each farm. All participants in all three regions answered the same questions.

To ensure informed consent, each farmer was asked to sign a consent form indicating their agreement to participate in the investigation. To ensure participants fully understood the study, consent forms were translated into Nguni languages (Zulu and Swati), which are commonly spoken by the target population. Farmers who agreed to take part in the investigation were also asked to grant permission for the researcher to capture still images as part of the data collection process. This was also clarified in the research participants' leaflet provided to the researcher during data collection.

RESULTS:

The results of this study were as follows: eighty-six percent (86%) of the farmers indicated that they had been trained in basic food hygiene by the Gauteng Department of Agriculture and Rural Development, with χ^2 =37.4533 and p=0.0001. During the inspection, the following was observed: eighty percent (80%) of the farmers adhered to the hygiene application, with χ^2 =3.8533 and p=0.0001. Ninety percent (90%) of the participants had a stage in the process flow for the removal of physical hazards prior to packaging, with χ^2 =111.4400 and p<0.0001. Participants used water to wash the products to remove dirt and soil, while the other ten percent (10%) did not use water, believing that it interferes with the shelf life of the ready-to-eat vegetables.

CONCLUSIONS:

The findings of this study revealed that small-scale farmers producing ready-to-eat vegetables in the three regions had predominantly received training in food hygiene and demonstrated a sound understanding. Farming support plays a significant role in equipping small-scale farmers, indicating that such interventions are effective in enhancing agricultural practices. However, there is still much more to be accomplished across the country, particularly in rural areas. The overall results indicated that most of the small-scale farmers producing ready-to-eat vegetables were trained in food hygiene, and that hygiene practices were observed. However, the minority that was not compliant had attitudes based more on beliefs than a lack of knowledge.

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INTRODUCTION

1.1. BACKGROUND AND JUSTIFICATION

1.1.1. Background

Worldwide fresh vegetables are crucial components for a healthy and balanced diet (Goodburn and Wallace, 2013). Ramos *et al* (2013) states that the consumption of fresh vegetables is encouraged in many countries by government health agencies to help prevent illnesses like cancer and cardiovascular diseases. The study further affirms that vegetables in particular leafy greens that are consumed raw and are increasingly recognized as important vehicles for transmission of human pathogens that were traditionally associated with foods of animal origin.

The fresh produce industry in many countries has responded to this by adopting various risk management practices designed to reduce the likelihood of contamination. These included the development of Hazard analysis critical control point (HACCP); inspections improvements fresh produce plants; auditing of plants or a combination of the intervention (Hurdle technology) and final testing of the produce (Wiederoder *et al*., 2012; Faour-Klingbeil *et al*., 2016). Even though of the interventions, there is a growing number of illnesses linked with the consumption of fresh produce (Sivapalasingam *et al*., 2004; Carstens *et al*., 2019). This is confirmed by Ziuzina *et al* (2014) where the study also reports a growing number of cases in developing

countries especially in Africa. According to Ziuzina *et.al* (2014) the high number of the microorganisms most frequently linked to produce-related outbreaks include bacteria (e.g. *Salmonella, Listeria monocytogenes, Escherichia coli and Shigella*), viruses and parasites.

In a study conducted by Bottichioet *et al* (2020) in South America it was revealed that out of 37 states, there were 240 cases which were reported of which 104 patients' were hospitalized and 28 of them developed haemolytic uremic syndrome and 5 of the cases were fatalities. A number of 109 patients were interviewed and confirmed to have consumed lettuce (a ready to eat vegetable) a week before the illness. The report further states that lettuce and water were further analysed for indicator microorganisms and a strain *of Escherichia coli (E. coli)* was identified as a main cause of the outbreak. According to Louw and Jordaan (2016) food borne illnesses continues to be a burden in South Africa, this is generally caused by the lack of control of general farming practices. This is also confirmed by Machado *et al.,* (2019) that changes in agricultural processing and distribution practices that have enhanced both the supply and range of products (e.g. triple-washing pre-packaged leafy greens) have increased the risk for more widespread outbreaks, this is because there are specific produce items that are more commonly linked to foodborne illness incidents; for example, leafy greens such as lettuce as well as fresh herbs like parsley and basil are proven to be conventional sources of bacterial infections when contaminated at farming level.

While Denis *et al* (2016) concluded that produce such as berries, green onions, melons, sprouted seeds, and tomatoes because of their nature of being ready to be consume and not requiring further processing, if contaminated these products were

having a high probability of causing to food borne illnesses. On the other hand, Balali *et al* (2016) lists the consumption of fresh cabbage, carrots and tomatoes as having the greater risk of food poisoning. All of the above fresh products are actively produced by small scale farmers in South Africa and hence the need to continuously improve this system. Researchers such as Landmann *et al*. (2020); Ricciardi *et al*. (2020) and Mdluli *et al*., (2013) stated that in developing countries including South Africa, small-scale farmers are increasingly becoming important in food production. This could be contributed not only by issues of food security but also due the value of nutrients ready to eat products offer in both urban and rural areas of South Africa.

As a result communities are encouraged to practice small scale farming so that communities also participate in local economies, the production of food and sustainable development in communities (Louw and Jordaan 2016). While the increase in the number of small-scale farmers and the positive attributes this may bring in terms of food security, the safety of ready to eat products produced by these processes is a concern for food authorities. This is mainly due to infrequent distribution of small scale farming practices; uncontrolled farming inputters, that may lead to food contamination; poor hygiene awareness during these processes and adoption of processes that my increase the risks of cross contamination during ready to eat vegetables production (Gemmell and Schmidt, 2012; Beharielal *et al*., 2018).

It is common cause that it is every stakeholders responsibility to play a role in food safety from farm to fork, however farmers (lack of knowledge) and poor farming practices controls, presents an opportunity to increase the occurrence and spread of food safety hazards to uncontrollable levels and thus greater harm to the consumer

(James, 2006). Many investigations have documented the risks associated with microorganism. It is however important to anticipate issues of chemical contamination and physical hazards present as possible intriguing challenges of the ready to eat industry in South Africa. Especially given the fact that it is in recent times that issues of food contamination are identified is a significant threat to food production (Nkosi, 2024; Mphaga., Moyo, & Rathebe, 2024).

1.1.2. Justification

The development of the agricultural industry and the introduction of small-scale farmers are seen as the future of the economy of the Republic of South Africa (Hlatshwayo *et al*., 2018). Although small scale farming bring food to the table and contribute to food security at local levels, it is important to note that there is limited information on safety of ready to eat vegetables produced by small-scale farmers in developing countries such as South Africa (Sinkel *et al*., 2018). While there are a few standards developed to capacitate the farmer and ensure that safer food is produced,

It is worth noting that, there are many farming practices that may contribute to the production of agricultural products suspected to be contaminated. The situation is not different from the 3 regions of Gauteng (Tshwane, Ekurhuleni, and West Rand) where small-scale farming has been practiced for many years under conditions that are observed but not documented. The results of this study may not be generalised for all other small-scale farming communities in South Africa. It is expected that, these findings will assist with giving policy direction on issues pertaining to small scale farming of ready to eat produce safety and related practices in a developing country like South Africa. It is for these reasons that an investigation into the safety of fresh produced vegetables must be commissioned at small scale farming areas in the

Gauteng province where a combination of traditional farming and westernised methods are used. Small scale farming is striving within these areas and more could be learned from these farmers and their farming activities, while also identifying gabs and means of interventions.

South Africa encourages the participation of small-scale farming in improving food security in communities it is important to note that these areas of farming are not effectively investigated and reported (Tesfai *et al*., 2020). General focus has been and continues to be around formal farming and certification of formal farming establishments and because of that small-scale farming is left behind in research; therefor the situation is not balanced as small-scale farmers are supplying a significant population within their communities with fresh produce (Lenzi *et al*., 2020). It is inevitable that these group of farmers and the practices are investigated for the benefit of future research, identification of gaps where possible and adoption of positive strides for implementation at other areas of South Africa.

1.1.3. Problem Statement

The South African economy encourages small-scale farming, including crops production (ready to eat vegetables) because it also forms an integral component of food security and poverty reduction programs. Small-scale vegetable farmers however find it hard to participate in the formal South African value chains because of specific food hygiene and safety rules that are applying to the formal chain. This is exacerbated by the fact that there is little documented knowledge around food safety that small-scale farmers have, and the hygiene practices followed to ensure that the ready to eat products do not pose food safety hazards when they reach the consumer.

1.2. HYPOTHESIS OF THE STUDY

H_0- Small Scale farmers within the three regions of Gauteng produce ready to eat vegetables that are safe for human consumption.

H_1- Small scale farmers in the three regions of Gauteng have limited knowledge and understanding of food safety requirements for ready-to-eat vegetable production.

1.3. AIMS AND OBJECTIVE OF THE STUDY

The aim of the study is to establish the current state of knowledge on farming as well as hygiene practices/application followed by small scale farmers within the three Gauteng province of South Africa. This investigation hopes to describe the farming practices followed by small scale farmers in relation to the production of safer ready to eat products. This will be done through conduction of the inspections/observations and interviewing of the farmers to obtain their knowledge and understanding as well as the application of the hygiene practices during production of ready to eat vegetables at these areas.

The objectives are to:

- To establish the current state of knowledge on farming practices followed by farmers when producing ready to eat vegetables within the 3 regions of Gauteng Province.
- To investigate the general hygiene practices applied during production, harvesting and transportation of produce by small scale famers.

1.4. STUDY AREA

Gauteng is one of the nine provinces in South Africa. The name in Sotho-Tswana languages means “place of gold” (McCarthy, 2010). Situated on the Highveld, Gauteng is the smallest province with total area of 18.176 km², population of 12,272,263 and it accounts for 1.5% the country’s land (Marathe and Eltrop,. 2014). It is highly urbanised with three metropolitan municipalities (Tshwane metropolitan municipality, Johannesburg metropolitan municipality and Ekurhuleni municipality) (Stats SA 2011).

Data will be collected in 75 small scale farms producing ready to eat vegetables within three districts. This is inspired by the fact that small scale farming has been practised for years and the small-scale farmers within the districts are actively supplying ready to eat vegetables all over the country.

1.4.1. Study Population

According to the database from Gauteng department of Agriculture and Rural development (DGDARD), there are 95 small scale farmers with at least 20×4 hectares of land that is utilised by farmers to produce crops. Some have been practising for over 20 years. While the study area can be applied in every small-scale farming, for the purpose of this study only farmers actively participating with producing ready to eat vegetables within the 3 districts of Gauteng will be involved with the study. These regions were selected based on the number of small-scale farmers, the experience in this type of farming and the interest in documenting the general practices followed during these processes.

It is proposed that for microbial analysis and given that during data collection some products may not be in season, a general picture will be drawn by comparing products available within the three regions of Gauteng Province at that time. Within these areas a mixture of traditional farming coupled with western ways of producing crops is used by small scale farmers. Data will be therefore collected in every consenting farm that is producing ready to eat vegetables and a descriptive analysis will be conducted.

A Convenient sampling method will be used for this study and the inclusion and exclusion criteria will be:

Inclusion criteria:

All farmers operating actively farming within the regions of Gauteng province and producing ready to eat vegetables for any market will be included in the study.

Exclusion criteria:

- Farmers not producing ready-to-eat vegetables.
- Farmers not farming within three districts.
- Commercial farmers (farmers with more than 4 Hectares).
- Farmers from City of Johannesburg and Mid-Vaal Municipality.

CHAPTER 2

LITERATURE REVIEW

2.1. INTRODUCTION

South African definitions of small-scale farming are often binary. According to Denison and Manona (2007), the South African agricultural sector is divided into two main categories subsistence farming and commercial or business farming. Commercial farmers often have financial resources and a good ability to access markets. They also have larger farms which produce higher yields that are often accompanied by higher risks (Denison and Manona, 2007). Small-scale or smallholder farmers often have diversified livelihood strategies. Small-scale farmers are often grouped as farmers who farm for household consumption, cash sale and even animal fodder. They participate in lower risk farming and frequently have a lower ability to access the farming markets because of their limited exposure (Denison and Manona, 2007).

Despite the implementation of produce safety practices, foodborne outbreaks associated with fresh produce continue to result in significant illnesses, hospitalizations, and deaths (Strawn *et al.,* 2013). Strawn *et al*., (2013) also highlights that while this increase in produce associated outbreaks may, in part, be due to improved surveillance of produce commodities, fresh produce will remain a vehicle for food-borne disease for two reasons: (i) the consumption of fresh produce commodities has increased due to promotion of a healthy lifestyle associated with eating fresh produce, and (ii) fresh produce commodities are often consumed raw. Three major bacterial food-borne pathogens, *Listeria monocytogenes*, Shiga toxin-producing

Escherichia coli (STEC), and *Salmonella*, have been associated with disease outbreaks linked to produce (Strawn *et al*., 2013).

In most developing countries this association between hygiene produce safety cannot be divorced or separated, studies have also shown that consistent intake of unprocessed vegetables is linked with reduced risks of heart diseases, cancer, stroke and many other health effects. Liu (2003), while other studies have also shown that their consumption was significantly associated with reductions in mortality, their consumption as a raw product may lead to the contamination and poisoning of the consumer (Oyebode *et al*., 2014). Scary as this may be fresh or ready to eat vegetables are vital in human nutrition as they contain high content of vitamins mainly B, C and K, minerals such as magnesium, potassium and calcium and also dietary fiber (Yahia *et al.*, 2019).

Even though ready to eat vegetables are good for human nutrition, yet due to microbial contamination, they pose a severe challenge that needs serious attention *(Abakari et al.*, 2018). Most of the ready to eat fresh produce are used in making salads and they need minimal processing and sometimes washing before consumed (Ababio and Lovatt, 2014), which results in them being highly vulnerable to contamination by microbial pathogens and also a key player in facilitating pathogen transmission (Machado-Moreira *et al.*, 2019).

If poor hygiene and quality criteria not met by the fresh produce not only causes health concerns on consumers but they also have negative effect in the market (Beharielal *et al., 2018)*. Even though fresh vegetables are important for human health due to the nutrients found, various pathogenic bacteria are found in them. The reason for

contamination with pathogen microbes has been due to high quantity production of fresh produce to meet the demand (Balali *et al*., 2020).

2.1.1. Crop production systems of ready- to-eat vegetables.

Increased consumption and importation of fresh leafy vegetables and large foodborne outbreaks linked to consumption of contaminated leafy greens make microbial safety a high priority for processors and consumers globally. Embracing development of new technologies and understanding production practices used throughout the world will markedly improve the microbiological safety of leafy vegetables (Matthew, 2014). According to Kamboj, *et al.* (2020) Foodborne diseases result from consumption of foods that contain infectious or toxic substances.

Kamboj, *et al.* (2020) further describes food hygiene as a practice that prevents microbial contamination of food at all points along the food chain from farm to folk and further indicates that food safety is also closely related but a broader concept that defines that food is free from all possible contaminants and hazards. Both terms can be used concurrently. It is of utmost importunate to note that food contamination can happen at any point in time; as a result the prerequisite programs are an essential element during food handling and production. High-risk foods like ready-to-eat foods are described as foods, which will under favourable conditions support the growth of pathogens and which will be consumed without further treatment intended to destroy pathogen (Makinde *et al.,* 2020).

As suggested by the name Ready-to-eat foods (RTEs) consumed without any further processing or preparations (Makinde *et al*., 2020). They could be traditionally or

industrially processed, packaged, or unpackaged and are usually considered to be comprised, rather than the foods that require further processing.

Ready to eat (RTE) products can be defined as foods that can be consumed immediately at the point of sell without preperation (cooking and boiling) and treatment. This is directly linked to risks of foodborne outbreaks that may be high due to food safety that might be comprimised as well as the shelf life.Most of the leafy vegetables are usually minimally processed, packed in air or modified atmosphere, refrigerated and consumed within a short period of time from harvest (Tomasi *et al*., 2015). Ready to eat vegetables are globally produced and commercialized all year and have been accompanied by new food safety threats since they are eaten raw and usually without proper decontamination practices (De Oliveira *et al*., 2011, Stephan *et al*., 2015).

Alegbeleye *et al*., (2018), points out that sources and routes of fresh produce contamination differs for each production zone as each farm has different grouping of environmental risk factors such as climate, land use interactions and topography. Gil *et al*., (2015) group sources of contamination into two:

a) Pre-harvest

Balali *et al*. (2020) based on the previous studies done, summarize that water used for irrigation soil used, improperly composted manure, human handling, dust, etc. are possible sources of contamination. Most of the small scale farmers may not have provision of running water due to various reasons as a results, there is water scarcity leading to use of water that is not meant for human consumption in trying to compensate water required for mostly irrigation purposes.

b) Postharvest

Gil *et al*. (2015) indicate that sources of contamination include methods of transportation, human handling, processing equipment dust, faeces, wild and domestic animals etc. According to Steele *at al.,* (2004) the use of wastewater irrigation can increase the available water supply and provide important nutrients for crops, but improperly treated wastewater can contain high levels of foodborne pathogens. Farming chain of fresh produce exposes them to contamination yet complying with the good agriculture practice and conducting proper risk assessment assist with reduction of fresh produce contamination (Iwu and Okoh, 2019).

2.1.2. Application of Food Safety and Food Hygiene

Food hygiene refers to the practices and conditions that ensure food is handled, prepared, and stored in a clean environment to prevent contamination and foodborne illnesses. It focuses on the cleanliness of people, equipment, surfaces, and the environment involved in food handling. Food safety on the other hand, is a broader concept that includes food hygiene. It involves the overall system of managing hazards in the food chain to ensure that food will not cause harm to the consumers when it is prepared and eaten as intended. This includes biological, chemical, and physical hazard control throughout production, processing, distribution, and preparation Food safety remains a critical issue with outbreaks of foodborne illness resulting in substantial costs to individuals, the food industry and the economy (WHO, 2010; FAO, 2003 ;Kaferstein, Motarjemi, & Bettcher, 1997).

Food can become contaminated at any point during harvesting, processing, storage, distribution, transportation and preparation. Proper food preparation can prevent most food borne diseases (Five keys to safer food manual). More than 200 known diseases are transmitted through food (WHO 2020; Newell *et al*., 2010).

According to Mwamakamba *et al*.,(2012), education of food handlers, including consumers is recognized as an important strategy to improve food safety and reduce the impact of foodborne diseases. The fall in the incidence of foodborne diseases observed in some countries after the outbreak of cholera in the early 1990s, has been attributed to the intensive educational activities that took place in response to the epidemic certain groups, either because of their direct role in food preparation and/or increased vulnerability to foodborne diseases need to receive greater emphasis in food safety education programmes. These groups include:

- Domestic food handlers. Domestic food handlers are persons who prepare food for consumption by their families. Education of this target group will help them to protect themselves and their family members (Al-Sakkaf *et al*., 2015).
- Professional food handlers. Professional food handlers such as street food vendors, catering personnel and those working in the food processing industry are a critical group for food hygiene education in view of the large numbers of people they feed and the potential impact on food safety (Kibret and Abera, 2012).

2.1.3. The World Health Organization

Food is essential to life, hence food safety is a basic human right. according to Fung *et al*., (2018) Billions of people in the world are at risk of unsafe food, Many millions become sick while hundreds of thousands die every year because they consume unsafe food. Therefore, safe food saves lives. Safe food enhances individual and population health. Safe food improves economic growth of the region where food safety is practiced and enhanced. Safe food supply depends on both sound science and equitable law enforcement. With the current technological advances, new regulations must be enacted to protect a continuing supply of food products that are safe and wholesome for the health and wellness of people (Fung *et al.,*2018).

WHO Places emphasis on health promotion targeting food handlers, including consumers about their responsibilities for food safety. After nearly a year of consultation with food safety experts and risk communicators, WHO introduced, in 2001, a global health message with five steps to prevent foodborne disease, the "five keys to safer food." The WHO five keys to safer food message are based on scientific evidence and can be promoted in all settings. Food safety health promotion campaigns using the WHO five keys to safer food are being implemented in settings such as homes, schools, food markets, food establishments and vending sites.

2.1.4. Five Key Principles of Food Safety

Many cases of foodborne disease occur because of basic errors in food preparation, either in restaurants or at home. Good food hygiene can prevent the transmission of pathogens responsible for many foodborne diseases. The importance of food safety education in prevention of foodborne illness is universally recognized. Educating small

scale farmer's handlers including consumers can result in improved food safety practices and can significantly reduce the chances of contracting food-borne illnesses and the effects of outbreaks.

The WHO five keys to safer food comprises simple messages on food hygiene which are easily comprehensible by all including domestic and professional food handlers. The WHO five keys to safer food messages have been applied to different settings and target groups. The WHO five keys to safer food must be used as a tool to raise awareness of consumers, food handlers and policy makers to ensure the safety of the foo d supply and individual responsibility for food safety.

2.1.5. Personnel Hygiene

Food safety begins on the farm and proceeds over the supply chain. Thus, to provide safe products, food producers must follow specific procedures to avoid food hazards along the supply chain (Marcierira, Barbosa & Teixeira, 2021). According to WHO (2001) and the five keys to safer food, people working with produce are known to be a source and direct contact vector of microorganisms of significant public health concern. Hygiene practices, from land preparation, planting, weeding, and pruning, to harvest, influence whether produce becomes contaminated from direct human transfer. Personnel who come directly in contact with fresh produce should be properly trained and advised to follow hygiene and health requirements as preventive measures. It is recommended to have standard enforceable policies and provide training in sanitation to all employees working in primary production (EC 852, 2004). To support this training, hygiene and sanitation facilities should be available to ensure that an appropriate degree of personal hygiene can be maintained. Growers may use

portable toilet facilities that are placed in appropriate locations for workers in large fields to provide sanitary facilities. If human activity is the reason for contamination, interventions aimed to control microbial risk will be necessary. People known, or suspected, to be suffering from, or to be a carrier of a disease or illness likely to be transmitted through fresh leafy vegetables should not be allowed to enter any food handling area. Any person affected should immediately report illness or symptoms of illness to the management. If a worker has a potential source of contamination such as cuts or wounds, the cut or wound should be covered by suitable waterproof dressings.

2.1.6. Ways to maintain food safety and hygiene.

According to Kaferstein, Motarjemi, & Buttcher, (1997) there are possible ways to maintain food safety and hygiene and they are as follows:

- Good Manufacturing Practices (GMP)
- Sanitation Standard Operating Procedure (SSOP)
- Good Hygiene Practices (GHP)
- Hazard Analysis of Critical Control Points (HACCP)

2.1.7. Good Manufacturing/Agricultural Practices (GMP)

Good agricultural practices (GAPs) should also be employed to minimize these hazards Center for Food Safety and Applied Nutrition, (1998). Specifically, they address potential contamination from water sources, fertilizer use (manure or compost), worker health and hygiene, and field and packing shed sanitation, and calls for the development of trace-back procedures for fresh produce.

According to Harris & Blackwell, (1999) Good Manufacturing Practices (GMPs) should be used i.e. the minimum sanitary and processing requirements necessary to insure the production of wholesome food. Requirements for GMPs are building and facilities, equipment and utensils, employee practices, pest control, production and process controls and warehousing practices. GMPs are broadly written, general in nature, and not intended to be plant specific. GMPs can be used to explain tasks that are part of many jobs (e.g., GMPs are written for personal hygiene and dress regardless of job title, management, production, quality assurance, maintenance, etc.).

Harris & Blackwell, (1999) further mentions that GMPs differ from HACCP in several ways. Firstly, they are not designed to control specific hazards, secondly, they do not provide methods for monitoring hazards and thirdly, they do not require specific record-keeping procedures. GMPs are not used to establish deviation limits and do not describe corrective action requirements.

2.1.8. Sanitation Standard Operating Procedure (SSOP)

Sanitation is one of the most important aspects of food manufacturing. It is the beginning, not the end, of food processing. It is an important part of Good Manufacturing Practice (GMP). Sanitation provides the hygienic conditions required to produce safe food. Improper sanitation of equipment can potentially introduce hazardous contamination to food and enhance pathogen harborage in the food-processing environment. Sanitation Standard Operating Procedures (SSOPs) are detailed procedures specifying what to clean, how to clean, how frequently to clean, and what records to use for monitoring the cleaning procedures. SSOPs could be written for the cleaning process of direct food-contact surfaces.

Sanitation SOP's focus more narrowly on specific procedures that allow fresh cut processing areas to achieve sanitary process control in its daily operation. SSOPS can be categorized as two types. SSOP refers to the sanitary procedures used prior to the start of production. Operational sanitation operating procedures refer to sanitary actions taken during production to prevent product contamination or adulteration (Strawn *et al*., 2013). Principles of Good Agricultural Practices (GAP) and Good Handling Practices (GHP) remain the prerequisite cornerstones of food safety management strategies to address challenges posed by climate change.

2.1.9. Hazard Analysis of Critical Control Points (HACCP)

Ho and Sandoval, (2020) mentions that hazards in food can be control and where possible eliminated by the hazard analysis of critical control points methods. Hazard Analysis of Critical Control Points (HACCP). It is a systematic set of activities used to control food production to ensure food safety and prevent changes in foodstuffs. The system is based upon the use of control practices in given production steps where there is a greater probability of occurrence of health hazards. The prerequisite programs for HACCP implementation in food industries are good manufacturing practices and sanitation standard operating procedure, which involves several aspects of the food industry, such as physical structure and maintenance, water supply, personal hygiene, pest control, sanitization techniques and equipment, calibration of instruments, and quality control of raw material and ingredients, among others (Barendz, 1998).

Prerequisite Programs (PRPs) provide a hygienic foundation for the HACCP system (NACMCF, 1997) by enabling environmental conditions that are favorable to produce safe food (CFIA, 1998). The system is applied to all steps of the food chain, from the

production of raw material to the final product, including aspects related to consumer demands, such as processed products that do not have negative effects on their health (World Health Organization, 1997).

Using the process flow diagram(s)/ steps, the HACCP considers each process activity in turn and a potential hazard that might occur, then an analysis is done to identify the significant hazards and suitable control measures. Several key HACCP terms are introduced and are defined by Codex (2009). In addition, determination of control measures is crucial and includes an evaluation of the measures currently in place to decide whether they are strong enough or if additional control is necessary.

2.1.10. Process Control

Small scale farming, when practiced correctly, may positively contribute to food security, generate employment, has positive effects on the rural economy and contributes to reducing poverty (GTZ Sustained, 2006; UNEP-UNCTAD, 2008; Wegner and Zwart, 2011). Furthermore, implementing small-scale organic farming may better ensure household food security and have greater potential in improving the quality of life of people (UNEP-UNCTAD, 2008).

2.1.11. Portable water

In accordance with SANS 241, water is critical resource, and access to safe, good quality water remains a global challenge. Although South Africa has established regulatory frameworks and guidelines such as the South Africa National Standard (SANS 241) for drinking water quality to safeguard water resources and protect public

health, the quality of water in many regions continues to deteriorate. This is largely attributed to poor governance, inadequate infrastructure maintenance, and ineffective water resource management (SANS, 2015; DWS, 2023; CSIR, 2022)

2.1.12. Storage conditions

Contamination of ready to eat vegetables may occur through various routes from farm to fork. The contamination may occur from human, animal and environmental sources. The unit operations of vegetable salads are also responsible for the contamination of these products which may affect the quality and lead to safety threats. At farm level, the use of unsafe water contaminated with faecal matter, or contaminated manure and access of livestock or wild animals in the field lead to gastrointestinal diseases.The role of fresh ready to eat vegetables in a healthy diet is well recognized in nutrition research as it ensures an adequate intake of vitamins, minerals, fibres and antioxidants (Giugliano and Esposito, 2008).

The increasing demand for fresh vegetables and for convenience food has resulted in a growth of the market share for fresh ready to eat (RTE) vegetables. In Italy, the consumption of RTE vegetables has shown a significant increased (ISMEA, 2009). These products received some degree of minimal technological processing before commercial distribution. This processing, in most cases, is inadequate in ensuring sterility or even microbiological stability. The initial quality and subsequent handling of these products appear to strongly influence the microbiology safety and Keywords bacterial contamination, GAP-GMP-HACCP integrated system, microbial food safety, ready-to-eat vegetables, viral contamination.The factors that may affect the occurrence of pathogen contaminations in vegetables include poor agricultural water quality, the use of manure as a fertilizer and the incorrect application of Good

Manufacturing Practice (GMP) and Hazard Analysis and Critical Control Point (HACCP) systems during production, processing, packaging and distribution. The presence of pathogenic micro-organisms in these products, mainly in leafy green vegetables, constitutes a potential problem for consumer health and is a public health issue (FAO and WHO, 2008). The presence and prevalence of pathogenic micro-organisms in RTE salads have been recognized in previous studies (Beuchat 1996; Wells and Butterfield 1997; de Curtis *et al.,* 2002; Froder *et al.,* 2007; Little *et al*., 2007).

According to Matangue *et al.,* (2018) Another issue to take into consideration to ensure the quality of products, is the way products are stored and transported. The fact that horticultural products are stored and transported in propylene raffia bags and plastic bags, covered and tied, can reduce their freshness and quality. The lack of proper store boxes and the transportation of vegetables with straw bags or traditional ones are typical of developing countries.

2.1.13. Traceability Systems

Traceability is defined as the ability to access any or all information relating to that which is under consideration, throughout its entire life cycle, by means of recorded data (ISO, 2007). For agricultural products, traceability means that when quality problems occur, the raw materials or processing links that have problems can be quickly and effectively checked, product recalls are carried out when necessary, and targeted penalties are implemented to improve the quality and safety of agricultural products (FAO, 2011). Traceability has become a critical challenge for all food and food related companies, and traceability systems are now recognised as essential

tools for quality management within the agricultural supply chain (Charlebois et al., 2014)

It is challenging to control or destroy fresh produce contaminants at both pre-harvest and postharvest stage, hence identification of routes of contamination on the farm and after harvest becomes very crucial to the control of fresh produce disease outbreak (Iwu and Okoh, 2019). Contamination can take place during the cultivation of fresh produce, at harvest, during preparation/washing, within distribution chains and transport to shops, and even at the final step in the consumers' kitchen (Machado-Moreira *et al.,* 2019).

2.1.14. Water Source and Water Quality (Pre-Requisite)

Water quality guidelines DWAF, (1996) stipulates the effect of fecal coliforms on crop quality. The WHO guideline for grey water and excreta suggests that fecal coliforms should not exceed 1000/100ml (WHO, 2006). Suggestions to decrease possible transfer of human and animal contamination are identified, these include Only irrigating crops that will be cooked prior to consumption with questionable water sources if this cannot be avoided, One should allow sufficiently long intervals between the last irrigation and harvesting to allow for the natural die-off of pathogens. Studies in Ghana suggest at least a 4–5-day interval after irrigation with wastewater even though this may result in the reduction of the fresh weight of the vegetable (Qadir *et al.,* 2010).

According to Keraita *et al.,* (2007), this method is most beneficial during the dry seasons as the wet seasons result in splatters that may result in recontamination. The use of drip irrigation, a method that avoids wetting the leaves especially when irrigating

leafy vegetables. The cooking of vegetables at high temperatures before ingestion is the most effective way of reducing the numbers of pathogens in and on vegetables However for ready to eat vegetables through thoroughly washing with clean water is important (Qadir *et al.,* 2010). It is also reliable as internalization of pathogens is known to occur (Deering *et al.,* 2010). Also peeling outer leaves or covering of vegetables is important as most of the microbiological contamination is exogenic (Qadir *et al.,* 2010) given that no internalization took place.

2.1.15. Structural Requirements

Everything in the farming environment that is in contact with the plant has the potential to be a source of contamination Brackett, (1999) and all the different stages of farming introduce factors which may influence the hygienic quality of the final product. Hence, the areas of handling pre-harvest (seed handling, fertilization, and irrigation) and post-harvest, processing, packaging, and distribution should receive attention in a bid to curb microbial contamination (Beuchat, 1996).

The identification of the source of microbial contamination is important to minimize future outbreaks. During pre-harvest one possible source of contamination is the soil. For example, an area where livestock previously grazed is likely to be contaminated with enteric pathogens (Brackett, 1999).

Other sources of contamination are the incorrect storage of seeds (contamination by rodents etc.), insects and snails that can spread pathogenic bacteria as they move from plant to plant (Berger *et al.,* 2010). Manure that has not been properly composted may also be dangerous (Berger *et al.,* 2010; Buck *et al.,* 2003). However, one of the most important causes of contamination identified in the literature (Buck *et al.,* 2003) is

the use of microbial polluted irrigation water. It is therefore important to know the history, distribution, and origin of the water source. Also, the mechanism used for irrigation (drip, bucket, or sprinkler irrigation) is important. Overhead sprinklers result in droplets of water on the surface of the fruit and leaves of the produce. Should the water be microbiologically contaminated, bacterial internalization can take place thus rendering thorough rinsing post-harvest ineffective (Berger *et al.,* 2010).

It is very difficult to remove pathogens such as E. coli and Salmonella spp. once they have attached themselves to the surface of the produce and have formed biofilms (Berger *et al.,* 2010). It is for these reasons that experts encourage drip irrigation although this irrigation may not be a cost-effective option for small scale farmers. Farmers may instead employ bucket irrigation but take care to water at the root of their produce. It is also important that all farm workers practice good personal hygiene as most foodborne pathogens are transmitted by humans (Brackett, 1999; Ko, 2010; Martins *et al.,* 2012). Ensuring that post-harvest equipment, containers and processing equipment are all sanitized is important in reducing post-harvest contamination (Brackett, 1999; Buck *et al.,* 2010).

2.1.16. Challenges

Satisfying the consumer is the ultimate goal of postharvest handling. To best understand the challenges in handling of ready to eat vegetables, it helps to trace those items in the home back through retail outlets, food service providers, distribution centers, transport, packing, harvest, and production practices. Unlike a supply chain which seeks to optimize efficiency between harvest and market, a value chain seeks to deliver high-quality product to the market. Of increasing interest in the management of postharvest chains is sustainability of produce from farm to market and reduction of

food waste. Challenges in handling within a value chain include marketing equitably, handling items in stores, ensuring food safety, developing quality management plans, coping with constrained handling, minimizing physiological stress, and understanding transitions at purchase and harvest. Management programs must include an understanding of product flow from farm to home as well as money flow back through the chain. Simulation models (games) have been developed to better understand these flows and how to improve postharvest handling of fresh produce using systems-thinking practices (Barrow, 2006).

Small-scale farmers often face a number of challenges when attempting to access markets. Small-scale farmers are often inexperienced; they are unaware of strict market requirement, are unable to afford organic certification and are often unaware of niche markets. Given the policy drive to support and develop small-scale farmers in order to improve household food security and reduce poverty, finding solutions to these barriers is important in order for farmers to begin accessing fresh produce markets (Barrow, 2006).

A lot of barriers exist in the proper implementation and execution of these programmes with lack of knowledge being one of the main constraints. Communities interested in pursuing small-scale farming often do not know of the existence of institutions that can assist them when farming and have limited knowledge of the different farming techniques and agricultural standards. There have been a number of interventions aiming to overcome such constraints; however, interventions targeted at improving farmer knowledge on issues such as correct composting techniques, Integrated Pest Management (IPM) and the hygienic quality of vegetable produce have been limited. Possessing skills that include composting and IPM would go a long way as South Africa has a growing number of organic farming consumers. The organic produce

market is rapidly growing and is the second fastest growing division in the country's food sector (Barrow, 2006).

Challenges in small-scale organic farming Small-scale farming is exposed to a number of challenges when compared to larger scale conventional farming. These include lack of access to capital, informal operations, vulnerability to price shocks, sub-standard quality (due to lack of training and skills) of produce and lack of relationships with the buyers in the market chain (Louw *et al.,* 2007; Thamaga-Chitja and Hendriks, 2008; Wegner and Zwart, 2011).

Literature suggests that measures to improve farmer's capacity in increasing food production, quality, productivity as well as link to markets will result in their higher purchasing power (GTZ Sustainet, 2006; Thamaga-Chitja and Hendriks, 2008) and at the same time lead to increased food availability and food security. Interventions promoting small-scale sustainable agriculture are therefore challenged with providing intensive capacity building exercises (Digbo and Momoh, 2007; Martins *et al.,* 2012).

One of the areas for capacity building is the improvement of the hygienic quality of organic produce where the possible points of contaminant entry are scrutinized and systematically dealt with (Brackett, 1999; Ko, 2010; Martins *et al.,* 2012).

Looking at the broader picture, small-scale farmers need to be informed on the possible ways of dealing with other issues associated with small-scale farming which include the daunting task of accessing markets and seeking support (Chitja *et al.,* 2009; Louw *et al.,* 2007).

General focus has been and continues to be around formal farming and certification of formal farming establishments and because of that small-scale farming is left behind in research, therefor the situation is not balanced as small-scale farmers are supplying a

significant population within their communities with fresh produce (Lenzi *et al.,* 2020). It is inevitable that these group of farmers and the practices are investigated for the benefit of future research, identification of gaps where possible and adoption of positive strides for implementation at other areas of South Africa.

The impact of climate change on agriculture has been related to variations in the seasons, modifications of areas suitable for growing crops, alterations of crop yields, and changes in soil quality, such as an increase in losses of soil minerals, variation in their bioavailability, and alteration in soil microorganism ecosystems. Climate change has been identified as having potential for increasing bacterial contamination of food and water and variation in levels of certain pathogens in agricultural land and water with extreme weather events such as alternating periods of floods and droughts (Rose *et al.,* 2001; Tirado *et al.,* 2010).

Because of compaction, heavy rainfall after drought can result in more severe run-off and an increased risk of certain types of contamination. Temperature variations may also affect the safety of the food chain on the basis of changing survival or multiplication of some food-borne pathogens (FAO, 2008). For instance, increased water and air temperatures could stimulate an increase in growth potential or the dissemination of harmful pathogens. According to (Matangue *et al.,* 2018) the previous studies have proven that In developing countries, markets are the main supply of horticultural products to populations, but this can pose a public health challenge due to the risk of the faecal-oral transmission of gut pathogens. This transmission is strongly associated with inadequate public sanitation or low standards of personal and domestic hygiene, and their prevalence can cause gastrointestinal diseases, (Matangue *et al.,* 2018) Contamination by microorganisms from fresh crops mainly

green leafy vegetables and those growing close to the ground, such as lettuce, cabbage and tomatoes, is high when compared with other types of vegetables.

2.1.17. Ready to Eat Vegetables Farming Methods

Farming practices such as accessing good quality and uncontaminated seeds, the use and proper treatment of animal manure, knowledge of sources of contamination, personal hygiene and production hygiene are important as they influence the quality of the end product. These practices have recently come under the spotlight as fresh produce has been identified as a reputable vehicle for the transmission of pathogenic bacteria (EFSA, 2011; Deering *et al.,* 2012).

There is a raging debate about the differences between the quality and safety of organic versus that of conventional farming produce. Several investigations have proven that organic produce such as tomatoes and potatoes contain less nitrites and pesticides but more vitamin C and potassium when compared to conventional farming produce (Hallmann *et al.,* 2010; Lairon, 2010). However, other investigations refute the perception that organic farming produce is of superior nutritional quality when compared to conventionally produced vegetables.

Trewavas (2001), goes as far as stating that organic farming is an ideology that has no relevance in the world today as the world's problems require agricultural pragmatism and not ideology. Although both conventional and organic farming have been reported to use manure as fertiliser, organic produce is considered to be a greater risk to public health (Gong, 2007; Oliveria *et al.,* 2010). This is mainly due to the absence of physical and chemical treatments of manure in organic farming which when employed may reduce microbial load (Oliveria *et al.,* 2010).

Conventional agriculture uses a variety of highly technological fossil-fuelled machinery to produce food in large quantities and at cheaper prices (Thompson, 2001). Conventional agriculture feeds most of the world (Connor, 2008), but is considered unsustainable because of its potential contribution to producing greenhouse gases. Although conventional agriculture is thought to disfavour ecological well-being (GTZ Sustainet, 2006), a number of strides have been made towards efforts to ensure soil and water quality protection. Most people regard organic agriculture as synonymous with sustainable agriculture (Rigby and Cáceres, 2001). This is because organic farming is the most popular method of sustainable agriculture and is gentle on the environment (Rigby and Cáceres, 2001).

The low input costs and added value of organic produce make organic agriculture more appealing to farmers. The questioning of organic farming's ability to feed the world (Connor, 2008) is irrelevant in this context, as organic farming is seen as more of a sustainable livelihood and less as a sole measure applied to correct and restore ecological harmony, manure and other animal wastes are widely used in agriculture, both organic and conventional. The use of manure as fertiliser, whether in organic or conventional agriculture, gives rise to concern about the possible contamination of produce with microbial pathogens, especially *Escherichia coli O157* (IFST, 1999).

However, the Soil Association recommendations for manure storage and treatment on organic farms may lead to enhanced reductions to the levels of pathogens in stored manures that are to be spread to land (Soil Association 1999).

2.1.18. Causes of microbial contamination in ready to eat vegetables.

In their paper, Strawn *et al.,* (2013) identified the following as the possible causes for contamination

a. The prevalence of key food-borne pathogens is higher in water and fecal samples.
b. Soil properties and topographic features were identified as constraints on pathogen prevalence in produce fields.
c. Weather plays a role in pathogen prevalence in the pre-harvest environment.
d. Identifying the nature and source of microbial contamination of these foodstuffs is critical for developing appropriate mitigation measures to be implemented by food producers (Machado-Moreira *et al.,* 2019). When considering the farm-to-fork chain, microbial contamination of fresh produce can occur at multiple steps (Matthews, 2013). Microbial contamination of produce has also been shown to be dependent on growth season (Marine *et al.,* 2015).

The growing popularity of farmers' producing ready to eat vegetables, coupled with an increased number of produce related foodborne outbreaks, highlights the need to ensure proper food handler practices by small produce farmers to protect the farmers, patrons and local economies. The absence of proper food safety practices may increase contamination or microbial growth opportunities in the farmers' market sector (Marine *et al.,* 2015).

Most of the small-scale farmers producing ready to eat vegetables that either receives food safety training and those that does not receive any training may be ignorant which may endanger the consumers' lives. Therefore, regardless of training, numerous

risky food safety behaviors may still be observed, including temperature abuse, cross contamination opportunities, and poor personal hygiene and sanitation if there are no implementations of the measures to ensure safe food handling practices (Marine *et al.,* 2015).

2.1.19. Possible biological hazards that are most likely to occur in ready to eat vegetables

Machado-Moreira *et al.,* (2019) highlights that the awareness of healthier lifestyles has contributed to the increase of fresh produce consumption. When procuring fresh produce, Consumers accept the fresh-cut vegetable products based on their color, flavor, texture, and the nutritional value (Barrett *et al.,* 2010). As healthy as the fresh produce are, it has been observed that they pose a risk of increasing food borne disease to human (Machado-Moreira *et al.,* 2019). Iwu and Okoh (2019) agree that consuming contaminated vegetables has caused disease outbreaks which have resulted to major problems to human health. One of the vegetables that has causes significant outbreak is lettuce 2016 which was connected to pre-harvest contamination (Strawn *et al.,* 2013).

Machado-Moreira *et al.,* (2019) highlight the challenge that ready-to-eat fruit and vegetable related disease outbreak reports or information is often not readily available. STEC and Salmonella have been responsible for most produce-associated outbreaks. Many of these outbreaks were traced back to environmental reservoirs located on the implicated farms (Strawn *et al.,* 2013).

Machado-Moreira *et al.,* (2019) as often they are not subjected to processing steps to ensure effective removal or inactivation of pathogenic microorganisms before consumption. Consequently, reports of ready-to eat vegetable related disease outbreak occurrences have increased substantially in recent years, and information regarding these events is often not readily available (Machado-Moreira *et al.,* 2019).

2.1.20. Food Safety Attitude

It is estimated that 84% of the farms worldwide are small-scale farms, defined as under two hectares in size, which occupy only 12% of the total agricultural land (Lowder *et al.,* 2016). Vegetable farming has been shown to be a viable option for small farms, generating positive economic impacts and increasing resilience to external risks like climate change. It also has the potential to improve the nutritional quality of the food supply (Schleiermacher's *et al.,* 2018).

The benefits of smallholder vegetable production merit studies that help policymakers explore ways to promote it. According to FAO (2015), those policies should address farmers' attitudes in addition to their objective situation. Attitudes result from the interaction of affective, cognitive, and behavioral factors. Affective factors are feelings or emotions, cognitive factors are thoughts, beliefs and attributes, and behavioral factors relate to past behavior. This subjective approach will assess farmers' evaluation of their business, and, to a large extent, their expected behavior (Haddock & Maio, 2008).

In general, farmers find the production techniques they currently employ to be adequate. The results show a low willingness to pay (WTP) for specialized consulting on technical aspects, and even less in management and marketing. These responses

may also be influenced by the free or very low-cost public extension services that small-scale farmers receive frequently (Haddock & Maio, 2008).

The development of the agricultural industry and the introduction of small-scale farmers are seen as the future of the economy of the Republic of South Africa (Hlatshwayo *et al.,* 2018). Although small scale farming bring food to the table and contribute to food security at local levels, it is important to note that there is limited information on safety of ready to eat vegetables produced by small-scale farmers in developing countries such as South Africa (Sinkel *et al.,* 2018). While there are a few standards developed to capacitate the farmer and ensure that safer food is produced, it is worth noting that, there are many farming practices that may contribute to the production of agricultural products suspected to be contaminated.

2.1.21. Possible consequences of the microbial contamination on ready to eat vegetables

Strawn *et al.,* (2013) highlights that *L. monocytogenes* has the potential to cause outbreaks in 2011, this outbreak caused 146 illnesses, 30 deaths, and 1 miscarriage in 28 United .Statesd of America (Alegbeleye *et al.,* 2018). Foodborne illness resulting from the consumption of contaminated fresh produce is a common phenomenon and has severe effects on human health together with severe economic and social impacts. The implications of foodborne diseases associated with fresh produce have urged research into the numerous ways and mechanisms through which pathogens may gain access to produce, thereby compromising microbiological safety (Alegbeleye *et al.,* 2018). Numerous studies revealed that outbreaks of diseases like typhoid fever,

dysentery, diarrhea, and even cholera are a result of the consumption of pathogenic microbes or their toxins (Bhunia, 2018).

The consumption of raw and minimally processed fruit and vegetables is an increasing trend as consumers become more aware of the benefits of healthy eating (Barrow, 2006; Buck *et al.,* 2003). Ready-to-eat vegetables not requiring cooking prior to consumption are increasingly being recognized as key vehicles of the transmission of food borne illness (Little and Gillespie, 2008; Nou and Luo, 2010). This is largely since they fail to benefit from the heating of food, as proper cooking can achieve an almost quantitative reduction of pathogens (WHO, 2015).

Acknowledging the potential link between fresh produce and disease outbreaks is imperative (Beuchat, 1996), especially as fresh produce is frequently identified as being a culprit in many outbreaks (Buck *et al.,* 2003; Frank *et al.,* 2011). The role of fresh produce in disease transmission has been documented (Brackett, 1999) gastroenteritis, traveler's diarrhea and salmonellosis have been closely linked to fresh produce contamination (Buck *et al.,* 2003). Recently, Germany and France saw the deaths of 47 people because of contaminated sprouts. The German EHEC Task Force1 later traced the contamination to contaminated fenugreek seeds imported from Egypt (EFSA, 2011). This case not only shows the role of fresh produce in the disease outbreak chain, but also that seeds are prone to bacterial contamination.

Leafy vegetables are regularly colonized by diverse microbiota and can become contaminated with human pathogens and parasites while growing in the field or during harvesting, postharvest handling, processing, and distribution (Gil *et al,* 2015).

Gil *et al.,* (2015) mentioned that with increasing populations and high demand for land, fresh produce is often grown in close proximity to urban areas or land used for other

types of agriculture, such as livestock production. If vegetables are grown next to an animal-rearing operation, there is a potential for product to become contaminated, directly, or indirectly, by animals, run-off, bio-aerosols,

Contamination of leafy vegetables with pathogenic organisms of human health significance can occur directly or indirectly via animals. Animals can shed foodborne pathogens in the absence of signs of illness, acting as vectors of pathogens such as *E. coli* O157:H7, *Salmonella*, *Listeria*, and *Campylobacte*r (Moncrief and Bloom, 2005). Domestic animals such as chickens, dogs, cats, and horses can contaminate crops with faecal droppings if they pass through growing areas. However, while domestic animals may be separated from growing operations, wild animals (e.g., frogs, lizards, snakes, rodents, foxes, boars) and birds can only be controlled to a limited extend (Harris *et al.,* 2003; Lowell *et al.,* 2010). Preventive measures such as avoiding access of farm and wild animals to the site and to water sources should be developed and monitored for integrity, particularly near the time of harvest.

2.1.22. Existing Regulations/Guidance with Regards to Farming of Ready to Eat Vegetables

Laws governing food safety in South Africa Food manufactured, processed and sold in South Africa and all imported foodstuffs are governed by the FDC act of 1972, which aims to control the sale, manufacture and importation of foodstuff, cosmetics and disinfectants and to address incidental matters. The foodstuffs, cosmetics, and disinfectants (FCD) Act 54, 1972 has two sets regulations dictating the microbial safety standards for foodstuff. These regulations are R.638 of 16 May 2018 and R.1555 of 21 November 1997 (DOH, 2002). Regulations under this act that govern microbiological

standards for foodstuffs and related matters (South Africa, 2018) R.638 of 16 May 1997).

According to DOH (2002), this regulation (R.638 under FCD act) stipulates the microbiological standards for commodities such as: desiccated coconuts, sugars for canning, edible gelatine, seafood, poultry, bottled water, spices, and dried aromatic plants (herbs and egg products). The other regulation under the FCD act, R.1555 of 21 November 1997 is specific to milk and milk products. Unfortunately, regulations for raw fruit and vegetables are not sufficiently covered by the current legislation. In such a case the rule of thumb is that foodstuff should ideally not contain any microorganisms (DOH, 2002). Should it contain microorganisms which is normally the case, their levels should be such that they cause no harm to humans upon consumption. There are however recommended guidelines for raw fruits and vegetables including fresh fruit salad, salad dressing and peanut butter (DOH, 2002).

Like many low-income countries of the world, South Africa has various training and extension programs that focus on farming crops and leafy vegetables. These programs are aimed at providing farmers with the necessary knowledge, skills, and resources to improve their agricultural practices and increase productivity and safety of the produce and food sure that the quality is of high standard for the market. However, the applicability of these training and extension in areas like Gauteng remains a challenge. As it may be, small scale farmers could be encouraged to apply relative skills to improve their knowledge base, to comply to regulatory frameworks and to satisfy customer needs. These trainings and certifications remain challenging for lay man or farmers wannabes. The below bullets list some of the providers tasked with training and extension support in South Africa as indicated by Louw & Jordaan (2016).

- Agricultural Research Council ARC: The ARC offers training and extension services to farmers in various agricultural sectors, including crop farming. They provide technical support, conduct research, and offer training programs on crop production techniques, soil management, pest and disease control, and more,
- Department of Agriculture, Land Reform, and Rural Development (DALRRD): The DALRRD provides extension services to farmers across the country. They offer training programs, workshops, and farm visits to assist farmers in improving their farming practices, including crop farming and vegetable production.
- Agricultural Colleges and Universities: Several agricultural colleges and universities in South Africa offer training programs and courses in crop farming and vegetable production. These programs cover various aspects of farming, including crop selection, planting techniques, irrigation methods, pest and disease management, and post-harvest handling.
- Non-Governmental Organizations (NGOs): There are several NGOs in South Africa that focus on agricultural development and offer training and extension services to farmers. These organizations provide practical training, workshops, and mentoring programs to farmers, including those involved in crop farming and leafy vegetable production.
- Farmer Support Organizations: Accordingly, farmers organizations, such as farmer unions and cooperative societies, often provide training and extension services to their members. These organizations organize training workshops, field demonstrations, and knowledge-sharing platforms to help farmers improve their farming practices.

- Provincial and Local Government Initiatives: Provincial and local governments in South Africa also implement various training and extension programs for farmers. These initiatives aim to provide farmers with the necessary skills and knowledge to enhance crop farming and vegetable production in their respective regions.

In these basis farmers keen on learning the ropes of farming for commercial purposes are encouraged to contact the training provider within their area, while these may be seen as easy to access in a country such as South Africa. Its implementation varies from different area.

2.2. AUTHORITIES AND ORGANISATIONS RESPONSIBLE FOR FARMING

In most countries the agriculture industry follows specific standards and regulations to ensure the quality and safety of agricultural produce are adhered to. In this thesis we look at some of the key standards and regulations applicable is South Africa. The Agricultural Product Standards Act (Act No. 119 of 1990): This act establishes the Agricultural Product Standards Board, which is responsible for setting and maintaining standards for agricultural products. It covers various aspects such as grading, packaging, labeling, and quality control. It is important that fresh produce is generally sold as is. While this phenomenon is linked to good health practices. A few key factors could drive its acceptability. As a result, all leafy products produced must have some form of acceptability and compliance to generic requirements adoptable internationally.

First in first out (FIFO) is one the act that governs perishable products, application of these act can assist in ensuring the proper handling of ready to eat vegetables during production, packaging, and transportation. This will further assist in engagement of the handling of the other products such as fertilizers, pesticides, and overall good housekeeping techniques during the prerequisite phases. Foodstuffs, Cosmetics, and Disinfectants Act (Act No. 54 of 1972): This act regulates the production, sale, and importation of foodstuffs, including agricultural products. It sets standards for food safety, labeling, and hygiene practices.

Global Good Agricultural Practice (Global GAP): Global GAP is an internationally recognized certification system that sets voluntary standards for agricultural production. Many South African farmers and producers adhere to Global GAP standards to ensure their products meet international market requirements. It is important for farmers and fresh vegetables producers to comply with these regulations and standards to ensure the quality, safety, and marketability of their agricultural products both local and internationally. It must be noted that also customers would generally have a specific standard that requires monitoring. These could also be when importing or exporting as required (Nkosi, 2024).

2.2.1. Interventions

Ongoing reinforcement of the hygiene messages on the small-scale farmers is essential for desired food handling practices are to be sustained. Improvement in food hygiene practices can also be fostered by provision of a physical and social environment which supports the application of appropriate food handling behaviors. Training activities closely associated with such an environment would be more

appropriate than food hygiene courses which operate in settings divorced from small scale farmers activities and use solely knowledge-based assessment techniques. Reliable work site evaluation techniques should also be introduced taking account of the fact that knowledge alone does not lead to changes in food handling practices.

2.3. CONCLUSION

Vegetables attract high applications of pesticides, and farmers in developing countries use many acutely toxic insecticides to control pests on these crops. With the liberalization of agricultural markets in developing countries, the number of small-scale farmers growing vegetables for both domestic and export markets is increasing. Demand for supplies of year-round and vegetables has grown in industrialized countries, but with rising quality standards and traceability requirements it is difficult for small-scale farmers to benefit from this lucrative non-traditional agricultural export trade.

The demand is high for vegetables in the expanding cities in developing countries, and farmers in peri-urban areas, or rural areas with good access to the cities, can find a growing market for their produce. Poor storage facilities will often mean that farmers are forced to sell at peak times when prices are low. Farmers rarely have access to training in pesticide use and have only limited or no access to advice on the complicated management of pesticides. It is without a doubt that without training, farmers are unable to make good crop decisions: recognition of pests and their predators is generally low, leading to decisions to spray to kill any insect; knowledge of product selection, application rates and timing is poor; different products are often combined in the belief that the effect will be greater; re-entry periods after spraying

and essential harvest intervals are not known; and without knowledge of alternatives, farmers will often assume that the only solution to pest problems is to spray more frequently.

Balali, (2020) concludes that ready-to-eat vegetables are convenience foods consumed by millions of people either at home or in schools and university canteens, hospitals, and care homes for elderly and during their life, people can be susceptible of infections due to their immune system state, and they would expect to ingest a healthy kind of aliment with ready to eat vegetables. Current study revealed that high microbial content of ready to eat vegetables analyzed were mainly caused by microbial multiplication which occurred during storage and transport from the producer onwards, till home transport, and not by high microbial concentration in just-packed ready to eat vegetables. Hence, more frequent monitoring of storage and transport temperatures would be necessary to ensure the necessary hygienic quality of this kind of “convenience food” (Balali *et al,.* 2020).

To increase the awareness of the risk of microbial growth in consumers, it would also be helpful to write clearly on the packaging that the product should be kept at refrigeration temperatures lower than 8°C until use. Furthermore, in Italy on the packaging of ready salad it is written “already washed, ready for consumption” providing an indication of total safety of the product which does not always correspond to reality, as shown in this study. Keeping salads at low temperature, together with rinsing them before their consumption, will ensure most safety for consumers especially for people such as elderly, children and those with immune deficiencies (Balali *et al,.* 2020).

Calonico *et al,.* (2019) further agrees that to decrease the microbial content in ready to eat vegetables, they must be washed during the production phases with chlorinated potable water Furthermore, the machinery used must be sanitized daily, since the cutting operation is one of the Critical Points of the industrial process of ready to eat vegetables production. Cutting causes an increase of respiratory activity and metabolic reactions; furthermore the release of leaves cellular fluids from the damaged tissues provides a nutrient-rich medium and an ideal substrate for the growth of microorganisms (Calonico *et al.,* 2019).

Bacteria can penetrate the tissues through the cut surfaces, that are hydrophobic, so it becomes difficult to reach the microorganism during the subsequent washing phases. Microbial multiplication after the cutting operation depends mainly on the time between cutting and washing and on the temperature of processing: short time and low temperatures inhibit bacterial multiplication (Calonico *et al.,* 2019).

When it comes to small-scale farmers producing leafy vegetables, maintaining hygiene is crucial to ensure the safety and quality of the produce. Here are some hygiene practices that small-scale farmers should follow:

- Personal hygiene: Farmers should maintain good personal hygiene by washing their hands thoroughly with soap and clean water before handling any vegetables. They should also wear clean and appropriate clothing while working in the field.
- Field and equipment cleanliness: It is important to keep the field and equipment clean to prevent the spread of diseases and contamination. Farmers should

regularly clean and sanitize tools, equipment, and containers used for harvesting, pruning, and processing vegetables.

- Water quality: Farmers should ensure that the water used for irrigation or washing vegetables is clean and free from contaminants. Regular testing of water sources is recommended to ensure its quality.
- Pest and disease control: Implementing integrated pest management practices can help prevent the infestation of pests and diseases in the field. This includes monitoring the crops regularly, using organic pest control methods, and removing any diseased plants to prevent the spread.
- Proper waste management: Farmers should have a proper waste management system in place to dispose of any plant debris or waste materials. This can help prevent the accumulation of pests and diseases in the field.
- Harvesting and handling practices: Leafy vegetables should be harvested at the right maturity stage and handled carefully to minimize damage and contamination. Farmers should avoid harvesting vegetables when they are wet to prevent the growth of bacteria and fungi.
- Post-harvest handling and storage: Leafy vegetables should be properly washed, sorted, and stored in clean containers or packaging to maintain their freshness and quality. Farmers should also ensure proper temperature control during transportation and storage to prevent spoilage.

By following these hygiene practices, small-scale farmers can produce safe and high-quality leafy vegetables for consumers. The outstanding issue that must be addressed is the idea that local or small scale farmers must be able to supply the local market and food supply chain. While these are identified as challenges it is evident that more

should be done to set up the structures of food control system and each farm should technically meet the local food production and management systems. Evidently in this literature review, basic control plans are known and are endorsable, it is however not clear if local application of these ideas and their applicability in environmental health is not clarified.

CHAPTER 3

MATERIAL AND METHODOLOGY

3.1. INTRODUCTION

This study followed an empirical investigation setup, where a data-based approach was used to determine the sample size from each region as shown in table 3.1. Emphatically studies are generally used to compare and report on the observations of the practices (Carver *et al.,* 2010). Table one and figure one Indicates that each sample group as represented by a specific percentage of participation. Specifically, Eighty percent 80% came from City of Tshwane, Seventy two percent (72%) from City of Ekurhuleni, and Eighty percent (82%) from the West Rand district. It is important to note that this study was approved by the Tshwane University of Technology and granted a reference number (PGS01).

3.2 STUDY DESIGN

This study followed a two pillared approach that looked at qualitative and quantitative data collection of farmers that were actively participating in the production of ready to eat vegetables on a small scale level was followed. It was imperative to separate between the ready to eat products such as tomatoes, lettuce, green beans, papers, carrots and many other products that are classified as ready to eat.

3.3 STUDY AREA

The study areas selected is three regions of Gauteng province, that were actively supporting small scale farmers and their farming practices. It must be noted that, these

regions were selected on the basis that they were within reach and had provided a meaning full packaging of faming contributions within the Province of Gauteng in South Africa.

3.4 STUDY POPULATION

The population of these farmers is unknown as farming and their practices would be generally not registered, some of these farming practices represented a meaningful interest on subsistence food production, small scale trading and interest in government's food security programs.

3.5 SAMPLING STRATEGY

A convenient sampling plan was adopted in this study, where farmers trading with or sharing information was coupled with technical interest such as local supplying plans and food production strategies was employed. Data was collected through researcher-administered structured questionnaires. Participants were given the opportunity to complete the questionnaires at their own convenience. All completed questionnaires were coded by the researcher and entered into an SPSS statistical program named IBM SPSS Statistics for windows, version 26.0 Armonk, NY:IBM Corp 2019.Similarly, inspections and evaluations of the farming environment were conducted using checklists, with each farm having its own coded checklist. In total, n=75 farmers participated in the research and their data was captured as is. The captured data was transferred to Excel and sent to the statistician at the ARC for inferential analysis, statistical significance testing, and thematic coding using the (SAS, 2023).

3.6. DATA COLLECTION INSTRUMENTS

As stated under the study design two sets of data tools were used for this investigation. These included structural compliances, knowledge and practices of farmer's in relation to hygiene applications and interests (Annexure 4 and 5 respectively). These sets of annexures provided sufficient qualitative data to conclude on the requirements of traditional qualitative information and setting versus quantitative data on the levels of experiences.

3.7 VALIDITY AND RELIABILITY OF INFORMATION

To ensure that the tools developed provided sufficient information that is relevant and valid, regulations supporting the production of crops and compliances as part of the local gab, R638 and ISO standard of technical standards requirements for basic food production were used to come up with the questions as articulated or packaged. While these data con not be generalized for a country such as South Africa, it must be noted that this investigation provided a unique angle into the views and practices of farmers that produced ready to eat vegetables. To support this inclusion and level of practices a statistician from Agricultural Research Council (ARC) used basic data collection estimation for the three regions of Gauteng province. This usage resulted in the estimation of a minimum of sixty three famers' involvement in the study region. The below Table on the minimum numbers to be involved is included as part of the structured approach of the research.

Table 3.1 Sampling numbers and representation

Regions	Population	Minimum Sample required	Actual achieved per region
P= 0.01 DF= 2 χ^2 = 8.7200 n= 75			
City of Tshwane	25	18	20
City of Ekurhuleni	25	20	18
West Rand	45	25	37
Total	95	63	75

3.8 PILOT STUDY

The study was piloted on three farmers that were actively participating on leafy vegetables in Tshwane Metropolitan, these farmers data was not included as part of the final outcome or data collection tool. This process was particularly important as it gave direction on the directness of the packaging and interest in the particular field as expected. Adjustments were further made to the tools to ensure their ability to extract relevant information for the purpose of hygiene compliance packaging.

3.9 ETHICAL CLEARANCES

To ensure informed consent, each farmer was requested to sign a consent form indicating their agreement to participate in the investigation. To facilitate effective communication, consent forms were translated into Nguni languages (Zulu, Swati), which are the native languages of the researchers (see Annexure 3). Farmers who agreed to take part in the investigation were also asked to grant permission for the researcher to capture still images as part of the data collection process. This was also

clarified in the research participants' leaflet provided to the researcher during data collection.

3.10 RESULTS PACKAGING

The researchers analyzed the results and presented them in the form of tables and graphs. The results were grouped and interpreted as necessary and relevant. Statistical significance was determined using a P-value threshold of $P<0.05$. The results are presented in the following order:

- Demographics and farming experiences as collected.
- Practices and farmers' knowledge of important environmental health inputs to promote food safety and farming compliance.
- Inspections as a snapshot observed during or on the day of data collection.

The results have been combined to facilitate an enhanced presentation and to answer the basic questions intended by the research protocol and chapter 1 of this thesis. It is worth noting that while bulk of the results are presented in frequencies an effort to also interpret these findings in percentages has been done where possible.

3.11 CONCLUSIONS

This research followed methods adopted by Mdluli *et al.,* (2013). Similar investigations conducted at three Gauteng regions where small-scale farmers producing ready to eat vegetables were used as a guide. Trustworthiness and reliability were ensured by adhering to prescribed ethical principles. Documents such as the local gap, the global gap, and client-specific guidelines were used to determine the relevant questions that would uncover farmer practices. To ensure the privacy and confidentiality of the

participants, all pictures and identities of farmers were removed from the research study.

CHAPTER 4

RESULTS

4.1. INTRODUCTION

In a country such as South Africa, where the redistribution of land equal past imbalances has been done and is prioritized. In this redistribution environment we anticipate a significant new ownership of previously producing farms and new unallocated land to be used as small-scale farmers or even close corporations that operated to produce small to medium volumes of crops for the immediate market. These movements were not only observed as a significant balancing act or one of the good drivers of economic changes, however these policies had not provided sufficient entries to intervene decisively on other issues such as the control of food safety, customer audits responsibility, capacity buildings and executions by food authorities where such farms could be operating. Likewise, the dynamic pressures observable in local spheres included the access to formal markets by the farmers producing crops in small land sizes, challenges of pest control access to funding and security assurance of produce. While the situation has looked greener from outside or from the point of access to food or financial control or spaces of entrepreneurship the entire prospect remained challenging or challenged as such the idea that has been spread has always been the support structure of a product that is ready for market. This readiness is refined or redefined as improved quality and products safety traits as accepted by the markets and is highlighted by the results presented below. Where the knowledge and the structural compliance where these ready to consume products are also investigated.

4.2. RESULTS OF FARMING PRACTICES

The results of this investigation are packaged below from the knowledge and understanding of food safety and quality improvements traits that could add value in the overall product specification as well as the general structural compliances of these farmers so as to enable the production of products trusted by consumers, retailers and end users in general. The below figures were interpreted from the interviews conducted on the structured questionnaires and checklist tool that was used by the researcher to observe the farming practices.

The study was conducted in three regions of the Gauteng province namely City of Tshwane, City of Ekurhuleni and West Rand. The total number of farms visited were n=75. The respondents were interviewed using structured questionnaires and observations were made in every farm that gave consent. Eighty percent (80%) of the population from the City of Tshwane responded, while the population of seventy-two (72%) percent from City of Ekurhuleni responded and eighty two (82%) percent of the population from West Rand responded.

The dynamics of these investigations reside in the ability of structures to comply with processes designed to ensure extensive production of good products. The results from Table 4.2. Highlights the cross tabulation of level of education, the reason for farming and influenced the farmer into farming Cross tabulation. Table 4.2 Area compared to age of participants and the farming experience**.**

Table 4.2: Cross tabulation between reasons for farming and farming influence.

What influenced you into farming			1.9 What is the reason for farming			
			Business purposes	Business and Private	Other	Total
Family activity	Level of education	No schooling	1	3		4
		ade 9	2	2		4
		Post matric	6	0		6
		College / Varsity	3	2		5
	Total		12	7		19
Friends and village	Level of education	No schooling		2		2
		Post matric		1		1
	Total			3		3
Cultural Practise	Level of education	Secondary school below grade 9		2	0	2
		Grade 9		1	1	2
		Matric		1	0	1
		College / Varsity		1	0	1
	Total			5	1	6
Means to make money	Level of education	No schooling	1	1		2
		Secondary school below grade 9	2	6		8
		Grade 9	0	1		1
		Matric	4	4		8
		Post matric	5	6		11
		College / Varsity	13	3		16
	Total		25	21		46
Other	Level of education	Post matric	1			1
	Total		1			1
Total	Level of education	No schooling	2	6	0	8
		Secondary school below grade 9	2	8	0	10
		Grade 9	2	4	1	7
		Matric	4	5	0	9
		Post matric	12	7	0	19
		College / Varsity	16	6	0	22
	Total		38	36	1	75

Table 4.3 Area of farming compared to age of participants and the farming experience.

			Age of participants			
Years of farming			18-35	36 - 60	61 +	Total
5 and less	Where am i based	Tshwane	3	7	1	11
		Ekurhuleni	1	6	1	8
		West rand	2	6	1	9
	Total		6	19	3	28
6-10 years	Where am i based	Tshwane	1	3	2	6
		Ekurhuleni	2	2	1	5
		West rand	3	18	2	23
	Total		6	23	5	34
11 to 20 years	Where am i based	Tshwane	0	0	3	3
		Ekurhuleni	0	3	2	5
		West rand	2	3	0	5
	Total		2	6	5	13
Total	Where am i based	Tshwane	4	10	6	20
		Ekurhuleni	3	11	4	18
		West rand	7	27	3	37
	Total		14	48	13	75

As depicted in the table 4.2 more small scale farmers were from the west rand district of Gauteng province (49%) and where between the ages of (36) – (60) years thus occupying a percentage of (64%) of the entire population being studied. This was followed by the category termed the youth (18-35) years being represented by about 14 farmers representing (18.6%) and the group generally termed the retired group was represented by 13 farmers representing (17%) across the regions and with the highest numbers being recorded from Tshwane region 6 famers or (8%), Ekurhuleni 4 (5.3%) and West Rand being only 3 (4%) of the total retired grouping or older than 61 years as depicted in the table. .

Table 4.4 Area of farming compared to hygiene application and cleaning schedule

		Is the cleaning schedule in place			
		Yes	No	Not Applicable	Total
District	City of Tshwane	11	9	0	20
	Ekurhuleni	5	12	1	18
	West Rand	9	28	0	37
Total		25	49	1	75

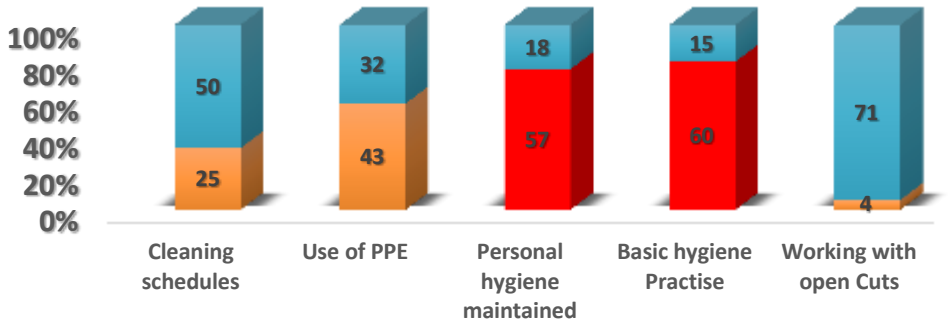
4.2.1 Farmers demographics

The study revealed that the majority (60%) of the farmers were males, while females were at fourth percent (40%). This implies that ready to eat vegetable farmers is male dominated within the three regions of Gauteng, It further implies that males might be having better market access than females.

There are many factors that can influence small scale farmers to start farming e.g., addressing issues of food security (Mdoda *et al.,* 2024). This study indicates that fourth five percent (45%) of the farmers especially between ages 37- 60 years indicates that the major influence into farming was to make means to earn money. This reason for farming is also playing a crucial role in poverty eradication, therefor with the support from the government, small scale farmers can play a very significant role in the South African economy as they will be creating employment and addressing the issues of food security concurrently.

4.3 RESULTS OF FARMS HYGIENE INSPECTIONS

As alluded by the 3rd of objective of the investigation, general compliance issues where packaged to investigate the inspector involved plan and execution of hygiene or environmental health related practices that generally impacts on the safety of the produce. These inspections results are presented on graphs below where the Yes (meaning it is available) and a no (meaning it is not available) answer options where granted.

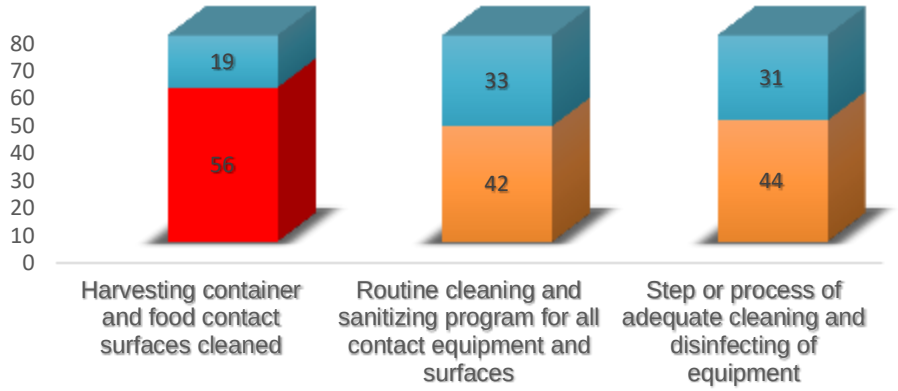


P= 0.0496 DF= 4 χ^2 =3.8533 n= 75

Figure 4.1 Pre-required food safety programs inspection checklist

The results on the aspects of personal hygiene indicated that fifty seven percent (57%) of the participants were well informed on the importance of personal hygiene, while the basic hygiene practices were observed from sixty percent (60%) of the participants. This was an indication that small scale farmers producing ready to eat vegetables did receive the training on food hygiene practices and are able to apply it throughout the processes of farming, to harvesting and handling of the ready to eat vegetables. This means that the participants are well informed on their role in ensuring that the

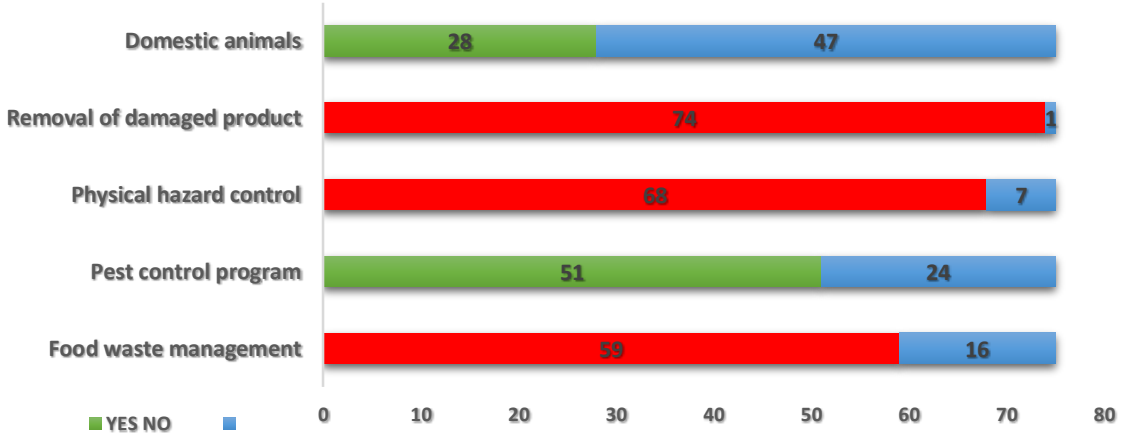
vegetables they produce are not in any conditions that will compromise the health of the consumers.



P=0.0004 DF= 2 χ^2 = 15.6800 n= 75

Figure 4.2 Product safety and harvesting plans GMP requirements.

Fifty six percent (56%) of the participants were having steps of cleaning all their harvesting containers and food contact surfaces in between the harvesting, handling, and packaging as means of minimizing possible cross contamination as shown. This means that the farmers can apply hygiene practices through-out the chain of vegetable handling. This implies that the knowledge they have is applied which can prevent the cross contamination which to a certain extend creates comfort/trust to the final product.

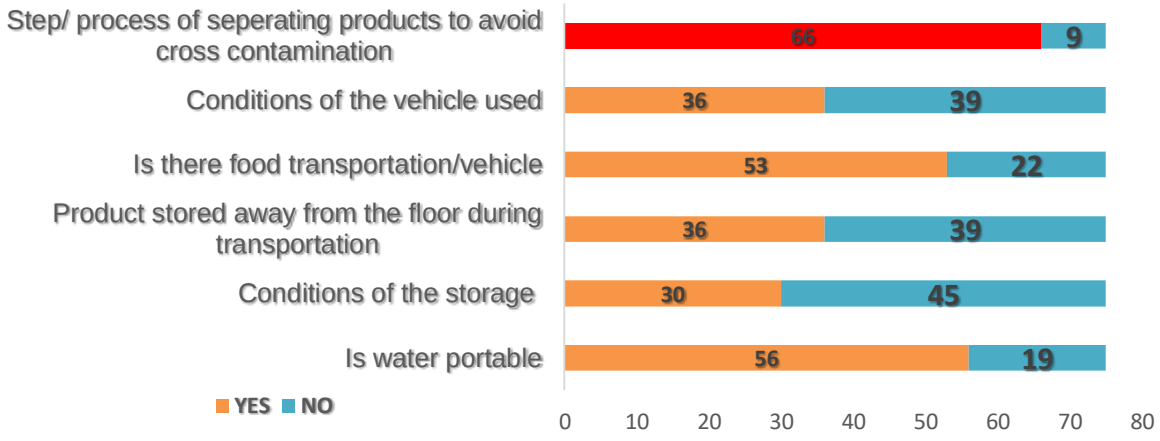


χ^2 73.2800 P<0.0001

Figure 4.3 Responding to the question of Hazard control plans.

As part of hazard control observations, the hazard control results in indicated that seventy-eight (78%) of the participants had a system in place that was ensuring the proper handling of waste in order to address the issues of pest control and infestations.

Most of the farmers were re-using their waste as decompose while others were discarding it off. Ninety eight percent (98%) of the participants were removing the damaged products as part of the quality control and that is where the waste was mostly generated, however as mentioned the waste was further re-use for other purposes that were beneficial to crop production. There were other stages of the hazard control that included physical inspections which also included the removal of the waste/ physical properties that was part of generation of waste.



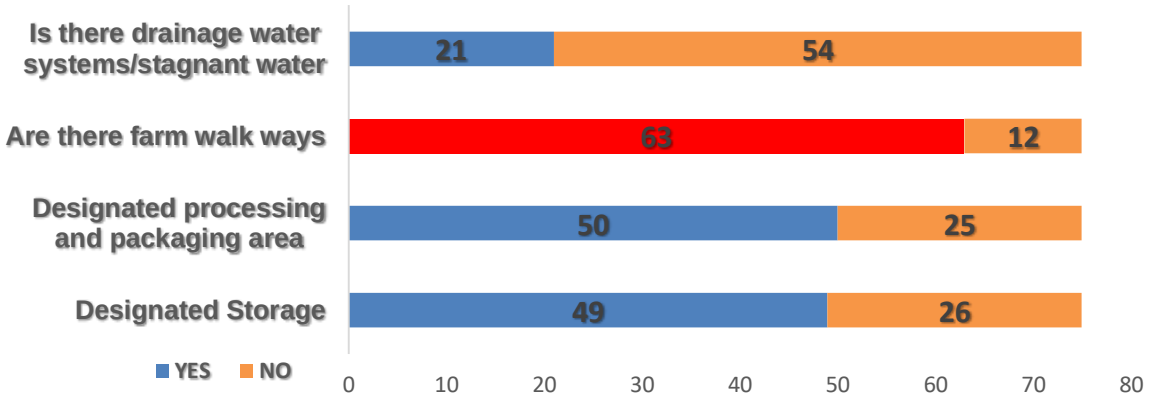
$\chi^2$101.3600 P<0.0001

Figure 4.4 Safer food production plans practices (good hygiene) requirements

On the process control aspect, more than eighty eight percent (88%) of the participants have a step of separating the products to minimize the cross contamination from harvest, handling to distribution of the product as shown in. The study further shows that seventy five percent (75%) of the participants were having portable water that was using for irrigation purposes and washing of the vegetables as shown in the picture below. Some of the participants indicated that they do not wash the vegetables because they believe that water has a potential to decrease the quality of the vegetables especially the leafy greens however there was a step of physically removing the hazards by wiping off the dirt Figure 4.5.

Figure 4.5 Lettuce washing process in one of the farms

Generally, crop production has direct exposure to physical hazards like soil; the step of washing off the vegetables is very significant in minimizing the exposure to physical hazards. While other participants were only wiping off the vegetables a majority of the participants were washing them thoroughly, some did not have running water, but the washing of vegetables was not compromised.

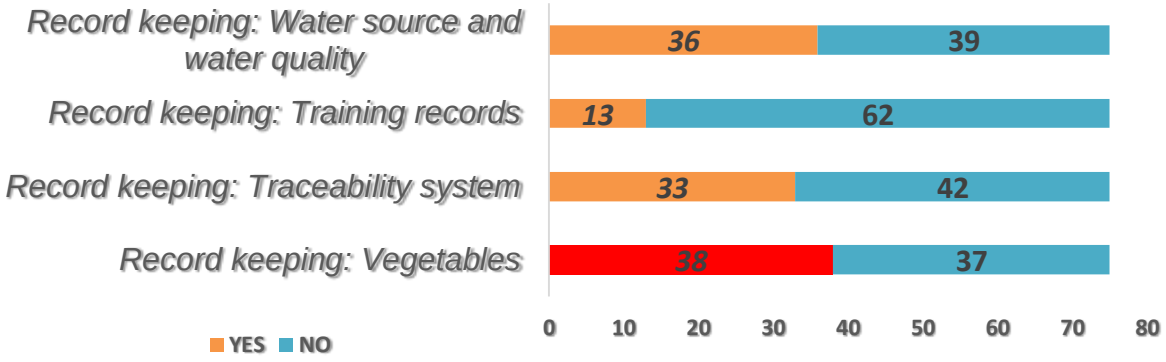


χ^2 88.6400 P<0.0001

Figure 4.6 Structural requirements of a crop production

Most small-scale farmers often living in remote areas with poor infrastructure, face many constraints that impede them from taking advantage of market opportunities (Ha,

Bosch & Nguyen, 2015). Figure 4.6 illustrates that eighty four percent (84%) of the farms had walkways, it was further observed that not all the farms had pavement, and however there were means of constantly clearing walkways (χ^2=88.6400 P<0.0001). Sixty five percent (65%) of the farms had a designated storage for all their produce and sixty six percent (66%) of the farms had processing areas where they were also packaging before transportation χ^2= 48.0800 P<0.0001.



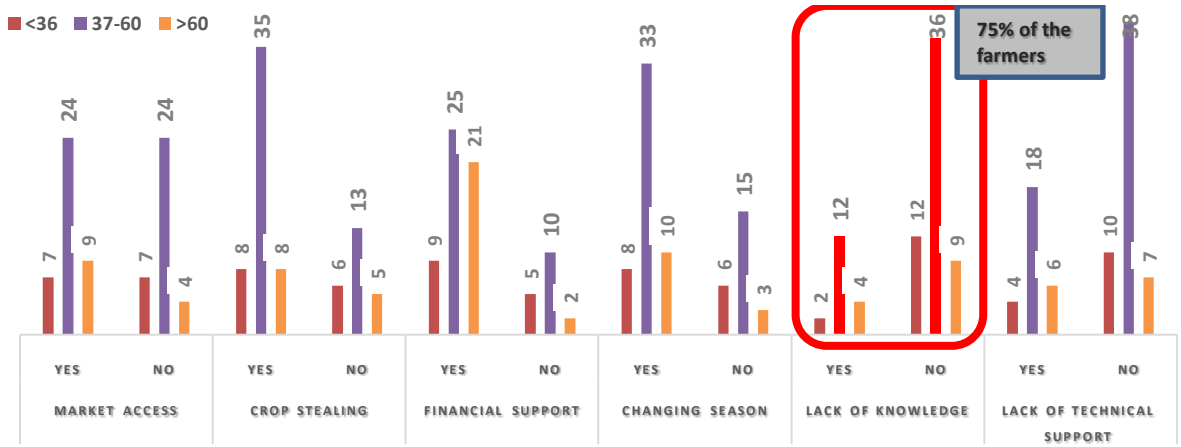
χ^2 36.6400 P<0.0001

Figure 4.7 Evidence of record keeping by farmers.

There was partial record keeping in place especially that of the ready to eat vegetables this might be influence by unavailability of resources. However, it was observed that almost fifty percent (50%) of the farmers made means to keep the records of their produce which is crucial for tracing of the vegetables where applicable as shown **Error! Reference source not found.** and 4.8. this was however not sufficiently implemented across the regions. This was an indicator that to a certain extent, there is a level of understand of the importance of traceability systems and the role of the farmers as further shown in the picture below where a farmer was able to record all the

products that were distributed (lot numbers, dates, and customer/supplier that the ready to eat vegetables were distributed to etc.).

Figure 4.8: A picture illustrating the means of record keeping by some of the small-scale farmers.



P= 0.0001 DF= 5 χ^2= 20.2800 n= 75

Figure 4.9: Farming challenges as reported by farmers.

There is a sudden increase of emerging farmers that are producing ready to eat/leafy vegetables from small scale sizes/hectors of land in South Africa however there is restrictions to market access or market channels (Mdluli, Thamaga-Chitja, and Schmidt, 2013) and (Musa, Van Niekerk, and Retief, 2018).

Imperative as it may have been, the farmers within the three regions would experiences several challenges, these challenges had or are continuously contributing to the poor production or marketability of its products. However, the research indicates that seventy five percent (75%) of the farmers did not lack knowledge and understanding of food hygiene irrespective of the age and their experience as shown in **Error! Reference source not found.**. All these results raised a question that poked a view and a general acceptance of the ready to eat leafy vegetables as produced by famers are covered. These results indicate that seventy-two percentages (72%) of the farmers between the ages thirty seven (37) to sixty (60) did not lack the knowledge and understanding of hygiene practices as part of the prerequisite when producing ready to eat vegetables. This is a clear indicator that to a certain extent, there is good response to the trainings provided by the government.

Sixty eight percent (68%) however indicated that crop stealing was a challenge amongst the three regions. This was further supported by the sixty eight percent (68%) of the lack of technical support. According to the farmers the lack of technical support which includes financial support eventually leads to small scale farmers inability to hire security in the farms that will be there to minimize crop stealing.

4.4 CONCLUSION

The above results support the idea that food production by small scale farmers accepting below 4 hectors of land and farming for market purposes could achieve remarkable strengths. These strengths are directly linked to the support or economic development drivers as outlined in the South African development goals.

CHAPTER 5

DISCUSSIONS

5.1. INTRODUCTION

The reality is that the South African economy encourages small-scale farming, including crops production as it forms an integral component of food security and poverty reduction programs, However the small-scale vegetable farmers find it hard to participate in the formal South African value chains because of specific food hygiene & safety rules and requirements that are applying to the formal chain. As a results, many small-scale farmers find it more convenient to sell their produce (ready to eat vegetables) to the nearest small markets, within their communities and by the side of the road. This is further influenced by factors such as the compliance requirements and untrustworthiness of their product by the big supermarket which can be seen as the “red tape”. The resistance/ gate keeping from the supermarkets may be influenced by the consequences of consuming ready to eat vegetables that were not investigated before with no knowledge of the small-scale farmers processes during preparations as it may be detrimental to human health. Ramos *et al.,* 2013 affirms that vegetables in particular leafy greens that are consumed raw are increasingly recognized as important vehicles for transmission of human pathogens that were traditionally associated with foods of animal origin. According to Louw and Jordaan (2016) food borne illnesses continues to be a burden in South Africa, this is generally caused by the lack of control of general farming practices. One of the reasons for contamination with pathogen microbes has been due to high quantity production of fresh produce to meet the demand (Balali *et al.,* 2020).

5.2 THE GENERAL RESULTS:

The results indicate strong correlation, as a result that there was no relationship between the inferential statistics as p=0,133. If the study is to be conducted, there might be different results. The population of seventy-five (75) small-scale farmers response could have been by chance and not linear. Therefor there is an exception for more studies to be conducted in future.

The findings also addressed both the null and alternative hypothesis of the study.

H0- Small Scale farmers within the three regions of Gauteng produce ready to eat vegetables for human consumption:

- The findings from the study indicated that small scale farmers within the three regions were indeed producing the ready to eat vegetables that were to some extent eatable by end users.
- This was observed through the inspection of the preparation areas, the hygiene application as well as the personal hygiene of the farmers during food handling and processing.

This conclusion was purely based on the availability of means within the farming spaces or production system exposure to a hazard that may render a produce unsafe for human consumption. The researchers are aware that for a definite conclusion on the safety of a product, specific analysis should be done on each produce and thus a determination of biological or chemical presence may then be concluded. It must be noted that while these were good to have avenues, the primary objective of this research excluded testing of produce as the project was going to become expensive.

H1- There is lack of information and understanding of food safety requirements from the small-scale farmers producing ready to eat vegetables in 3 regions in Gauteng.

This was only picked up when one dived into the food safety management system or small-scale farmers local gab compliance to ensure the development and implementation of programs that will assist with food safety production.

These results however can still change depending on an individual farmer since there is an increase of small-scale farmers within the regions, depending on the experience and attendance of the food safety trainings provided by the government. In Table 4.1, it is clear that sufficient farmers participated in the study as anticipated and of interest was the greater involvement of more farmers from West rand.

This study was strategically conducted within three regions of Gauteng that had the most small-scale farmers that were willing to participate. The other influence into conducting the study within these three regions was the observed increase/emerging of small-scale farmers that were producing ready to eat vegetables within the three regions. This was also observed through the number of attendances during the trainings from the department of agriculture, which was further proven by the good farming practices during the data collection.

This increase of emerging small-scale farmers was influenced other than “means of making income” by the land re-distribution within the three regions (Lebelo *et al.,* 2023). This was affirmed by the study conducted by Zondi *et al.,* (2022) in Limpopo, where the researcher was obtaining the understanding of the factors that influence the market participation of indigenous crops by smallholder farmers while also analyzing the extent of market participation in South Africa. The researcher also emphasized that factors such as household size and access to the market had statistical significance in the extent of market participation by smallholder farmers, however with the land

distribution it is anticipated that there will be a constant increase of the small-scale farmers emerging throughout south Africa.

It was noted that the response of the small-scale farmers from the three regions was not linear, however those who responded were able to assist in identifying other small-scale farmers that were producing ready to eat vegetables but were not on any database. One of the regions with high number of respondents was West Rand region. This was because most of the small-scale farmers were farming within the same farming area, it was easier for them to participate in the study as they could see the researcher interviewing other farmers and they were interested, and mostly because they have been trained on food safety. This great initiative of training the small-scale farmers was done by the Department of Agriculture. This therefore made it easier for farmers to engage in such a study.

5.3 DEMOGRAPHICS OF THE PARTICIPANTS

The demographics in general a suggestive of a country developing with newer policies trying with no win to incorporate women in the farming sector. Only 30 (40%) P= 0.1333 DF= 1 $\chi^2 = 2.2533$ n= 75 of the participants identified themselves as females. Though statistically not significant, the findings suggested a situation that could have occurred by chance. The fact that in 2024 agriculture or small-scale farmers in Gauteng South Africa was still dominated by males compared to the females is an indication of the drive to relook at the policy of inclusivity. This was further affirmed by Raleteng *et al.,* (2015) in the study that small-scale farming has been mostly done by population of male hence the government is enforcing gender balance though. It is worth noting findings by Witson (2008), where women were identified as critical players in agriculture and the findings of the study suggested a much more involved

approach that would address these issues and in the process capacitate women in developing countries. Realizing the potential of women in agriculture requires continues strengthening public institutions and NGOs to understand the changing roles of women as well as their access, to educate/equip, to market, ownership and control of economic and natural resources. This can be accomplished through legal measures, appropriate credit schemes, support for women's income generating activities, reinforcement of women's organizations and networks, and providing explicit priority to women's farmers groups in value-added chains so that they can benefit from market-based opportunities.

5.3.1 Level of education:

The results from the three regions indicated that, most of the small-scale farmers were observed to be compliant with some of the food safety requirements, even though they had different challenges the farmers were still able to ensure that they do not compromise the health of the end users/ customers. During inspection, it was evident that the farmers were using the given resources to its full capacity to ensure that their products are not compromised through proper handling during the production processes.

It was also evident that record keeping was a challenge because farmers did not have proper storage and a place to keep their documents. However, they were able to bring their file/documents upon request as they were keeping them at their home. This also indicated that the farmers were aware of the importance of record keeping and traceability systems, this also proved beyond reasonable doubt that trainings conducted were effective.

5.3.2 Influence into Farming:

The results indicated that close to fifty percent of the population were not farming for any other reason other than means of making money. One might argue that farming takes time for one to see the result, however with determination and correct farming methods including prioritizing food hygiene may result into a successful business. Small scale farmers are also contributing to food security and alleviating poverty. Mdoda et al, (2024) also affirms that farming addresses the issue of food security.

5.4 RECORD KEEPING REQUIREMENTS

Good and remarkable as it as it may look, not everyone was on board on the record keeping. Some of the small-scale farmers were not recording anything and others were not participating in any of the trainings. Which may pose a risk because one might assume that because of the research that has been done the ready to eat vegetables from small scale farmers within these regions are safe for human consumption while the few percentages does not participate in self-development programs that are at their disposal. The questions that these poses are interlinked to the current incidences of poisoning that claimed a number of lives in Gauteng province, there are a need to continuously trace food being produced and this could only be achieved by improved record keeping.

Though it must be noted that, through government intervention programs more than eighty percent (80%) of the population that participated were attending the trainings and participating in the required hygiene practices to minimize food outbreak as there is high outbreak due to contaminated ready to eat vegetables as indicated by the studies conducted by Todd *et al.,* (2007).

5.5 HYGIENE APPLICATION REQUIREMENTS

This study indicated that there were interventions by both the farmers and the government in minimizing any possible contamination of the ready to eat vegetables, on a lighter note for the farmers trained on food safety, there were no challenges observed in achieving both personal hygiene and the production because there was an understanding of importance of hygiene.

There following prerequisite were observed as good practice and an indication of the understanding of food hygiene and must be maintained. Other small-scale farmers producing ready to eat vegetables must adopt it to ensure that the final product is good for human consumption and the requirements for compliance to food safety to compete in commercial markets.

5.5.1 Personal hygiene

Farmers should maintain good personal hygiene by washing their hands thoroughly with soap and clean water before handling any vegetables. They should also wear clean and appropriate clothing while working in the field (Obadina *et al.,* 2024).

5.5.2 Equipment hygiene

Farmers should regularly clean and sanitize tools, equipment, and containers used for harvesting, pruning, and processing vegetables (Singh *et al.,* 2024).

5.5.3 Water quality hygiene

Farmers should ensure that the water used for irrigation or washing vegetables is clean and free from contaminants. Regular testing of water sources is recommended (Amankwah *et al.,* 2023).

5.5.4 Other hygiene pre-required programs

Implementing integrated pest management practices can help prevent the infestation of pests and diseases in the field (Ofuya *et al.,* 2023). While care must be implemented to ensure that pests control chemicals do not contaminate food products a situation that could lead to a disastrous nature of contamination as seen by the chemical incidences declared in a state of emergency in Gauteng on the 19th of November 2024.

5.5.5 Harvesting and handling practices

Ready to eat vegetables should be harvested at the right maturity stage and handled carefully to minimize damage and contamination. Farmers should avoid harvesting vegetables when they are wet to prevent the growth of bacteria and fungi (Wanjuku *et al.,* 2024).

5.5.6 Post-harvest handling and storages

As confirmed by Wanjukuku *et al.,* (2024) that ready to eat vegetables should further be properly washed, sorted, and stored in clean containers or packaging to maintain their freshness and quality. Farmers should also ensure proper temperature control during transportation and storage to prevent spoilage.

Lastly the department of agriculture must be viewed as multi-functional, there is a great need for increased emphasis on Agri-ecological approaches and use of appropriate technologies, support the small-scale farmer through policies and investments, empower women, integrate local and traditional knowledge with formal knowledge, equitable trade reform with national flexibility and increased investments.

5.6 HAZARD CONTROL

Upon observations and interviews using structured questionnaire, it was observed that the participants had a program suitable for their farm and their program of hazard control such as washing and sanitation of their contact surfaces, the produce and the containers during pre-harvest and packaging. It was also observed that other participants were not washing their final product but rather wiping it. This was because there was a belief that water will compromise the shelf life of the product. However, majority of the participants (80%) washing their product post-harvest.

It was also observed that some small-scale farms were utilizing water from the stream to irrigate and wash the ready to eat product. However, the farmer had a water sterilizer for the water coming from the steam to minimize the use of contaminated water. More studies have identified contaminated water as the main source of transferring of the pathogens into the ready to vegetables.

According to Balali *et al.,* (2020) during pre-harvest , the water used for irrigation soil used, improperly composted manure, human handling, dust, etc. are possible sources of contamination. Most of the small scale farmers may not have provision of running water due to various reasons as a results, there is water scarcity leading to use of water that is not meant for human consumption in trying to compensate water required for mostly irrigation purposes. (Beharielal *et al.,* 2018) further affirms that microbiological quality criteria not met by the fresh produce not only causes health concerns on consumers, but they also have negative effect in the market.

More studies by Gil *et al.,* (2015) also indicates that during post harvest sources of contamination include methods of transportation, human handling, processing equipment dust, faeces, wild and domestic animals etc. ccording to Steele *at al.,*

(2004) the use of wastewater irrigation can increase the available water supply and provide important nutrients for crops, but improperly treated wastewater can contain high levels of foodborne pathogens. Farming chain of fresh produce exposes them to contamination yet complying with the good agriculture practice and conducting proper risk assessment assist with reduction of fresh produce contamination (Iwu and Okoh, 2019).

5.7 STRUCTURAL REQUIREMENTS

It was observed that majority of the population were in remote areas, with poor infustructure, face many constraints that impede them from taking advantage of market opportunities. However, farmers made walkways in order to compesenate for one of the requirements of the structural requirements. There is a gap in the structural requirements that reqiures assistance and more insight as it forms crucial part of the good manufectering practises such as the minimum sanitary and processing requirements necessary to ensure the production of wholesome food, the buildings, and facilities to be kept in good conditions, equipment and utensils, employee practices as well as pest control. This gap can be addressed by the assistance if the government with provision of the resources and infrastructure.

5.8 CHALLENGES:

While studies conducted by Ndlovu and Masuku (2021) indicates that small scale farmers are faced with lack of production, marketing knowledge, information and skills that could enable them to compete with commercial farmers. Hlatshwayo *et al.,* (2021) also confirms that the small-scale farmers are illiterate, aged with lack of knowledge seen as a progressive capacity required for sustained level of hygiene compliances.

This study however proves that with adequate support and trainings from the government and the relevant stakeholders, small scale farmers can compete in the commercial space. This was proven by the results from the three regions in Gauteng, South Africa. Where small scale farmers were interviewed and the farming practices were observed as they have been trained by the government on the food safety. On other studies by Witson, (2008) there is a link between training the small-scale farmer producing ready to eat vegetables and enhancement in the farmer's ability to produce ready to eat vegetables that are safe for human consumption through the observed prerequisites.

5.9 CONCLUSIONS

It was clear on our study that these are the true reflection of the study. From the results obtained in this study, It is evident that the small-scale farmers were trained on food safety however each farmer indicated their challenges "individually" challenges like access to commercial market, theft, resources like storage and transportation of the ready to eat vegetables as well as issue of climate change. Some also raised a great concern on the cost at which some market buy their products at lower prices only to sell it at prices four to five time higher than the one they bought for them, and because of the challenge with having many fresh harvests with no market they end up selling at lower prices.

CHAPTER 6

RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

This research has underpinned the different needs for small scale farmers to be recognised as significant contributors to the economy and the general livelihood of communities, the inputs, and outputs costs of running a commercially viable farming system producing safer products for the immediate markets remains a vital survival route most local economy. As seen in Chapter 4, the South African small scale is ready to be supported. This has been seen with programs such as “masibuyele emasimini”. This was extensively discussed in Chapter 2 and the general approach of this investigation has suggested a massive interest on the how to improve the safety and quality of fresh produced. A number of suggestions have been stated in this line of thought and has in a way led to the development of a simple approach to incorporate needed knowledge of getting farmers interested in the mainstream market. Chapter 5 of this investigation has shown that a number of countries and families within those countries would generally gain from subsistence or small garden practices, however the general costs of small-scale farming with an aim of providing or supplying the market has not been further exhausted. It is recognized that the Republic of South African government is trying to meet the small-scale farmers halfway through the programs (Masibuyele Emasimini, Train the farmer and through land distribution plans). This study shows that the government interventions are of great significance and that the ready to eat vegetables produced by the small-scale farmers are generally supplied to communities and are safe for human consumption. Granted that

the presence and absence of hazards within this produce was never investigated, it is however recommended that more can be done to bridge the gap between formal and informal market supply and ready to eat vegetable products (Figure 6.1). Some of the suggested but not exhaustive pointers are:

- Financial Support: Cost of farming has increased with fuel raising costs and minimum wages, The government should be able to support the small-scale farmers.
- Formalize markets through compliance to HACCP and GLOBAL GAP or any food safety structure that is acceptable for the small-scale markets.
- Education and awareness campaigns to all small-scale farmers throughout the regions of Gauteng.
- Client engagement & auditing (internal & external), The clients should be able to audit the small-scale farmers that are providing with the ready to eat vegetables.
- Involve more stakeholders that will come into aid for the support of the small-scale farms producing vegetables and to close the gap of red tape.
- Involve Environmental Health Practitioner's initiatives of food safety management system development and compliances. This is inclusive of the relevant trainings and issuing of certificates. This will help put the customers at ease and further assure that the food is safe for human consumption.

Ongoing reinforcement of the hygiene messages on the small-scale farmers is essential for desired food handling practices are to be sustained. Improvement in food hygiene practices can also be fostered by provision of a physical and social environment which supports the application of appropriate food handling behaviors.

Training activities closely associated with such an environment would be more appropriate than food hygiene courses which operate in settings divorced from small scale farmers activities and use solely knowledge-based assessment techniques. Reliable work site evaluation techniques should also be introduced taking account of the fact that knowledge alone does not lead to changes in food handling practices.

When it comes to small-scale farmers producing leafy vegetables, maintaining hygiene is crucial to ensure the safety and quality of the produce. Here are some pre-required programs linked with the hygiene practices that small-scale farmers should follow:

- Personal hygiene: Farmers should maintain good personal hygiene by washing their hands thoroughly with soap and clean water before handling any vegetables. They should also wear clean and appropriate clothing while working in the field.
- Field and equipment cleanliness: It is important to keep the field and equipment clean to prevent the spread of diseases and contamination. Farmers should regularly clean and sanitize tools, equipment, and containers used for harvesting, pruning, and processing vegetables.
- Water quality: Farmers should ensure that the water used for irrigation or washing vegetables is clean and free from contaminants. Regular testing of water sources is recommended to ensure its quality.
- Pest and disease control: Implementing integrated pest management practices can help prevent the infestation of pests and diseases in the field. This includes monitoring the crops regularly, using organic pest control methods, and removing any diseased plants to prevent the spread.

- Proper waste management: Farmers should have a proper waste management system in place to dispose of any plant debris or waste materials. This can help prevent the accumulation of pests and diseases in the field.
- Harvesting and handling practices: Leafy vegetables should be harvested at the right maturity stage and handled carefully to minimize damage and contamination. Farmers should avoid harvesting vegetables when they are wet to prevent the growth of bacteria and fungi.
- Post-harvest handling and storage: Leafy vegetables should be properly washed, sorted, and stored in clean containers or packaging to maintain their freshness and quality. Farmers should also ensure proper temperature control during transportation and storage to prevent spoilage.

By following the above hygiene practices, small-scale farmers can produce safe and high-quality ready to eat vegetables for consumers. In this response and looking at the nature of South Africa, a fully flagged structure of response must be generated and be implemented to have a sustainable and sufficient response this structure presented in 6.1 is a suggestive of a food safety progressive environment that would not only assist with basic monitoring but also ensure that systems of food production are put in place in a standardized manner.

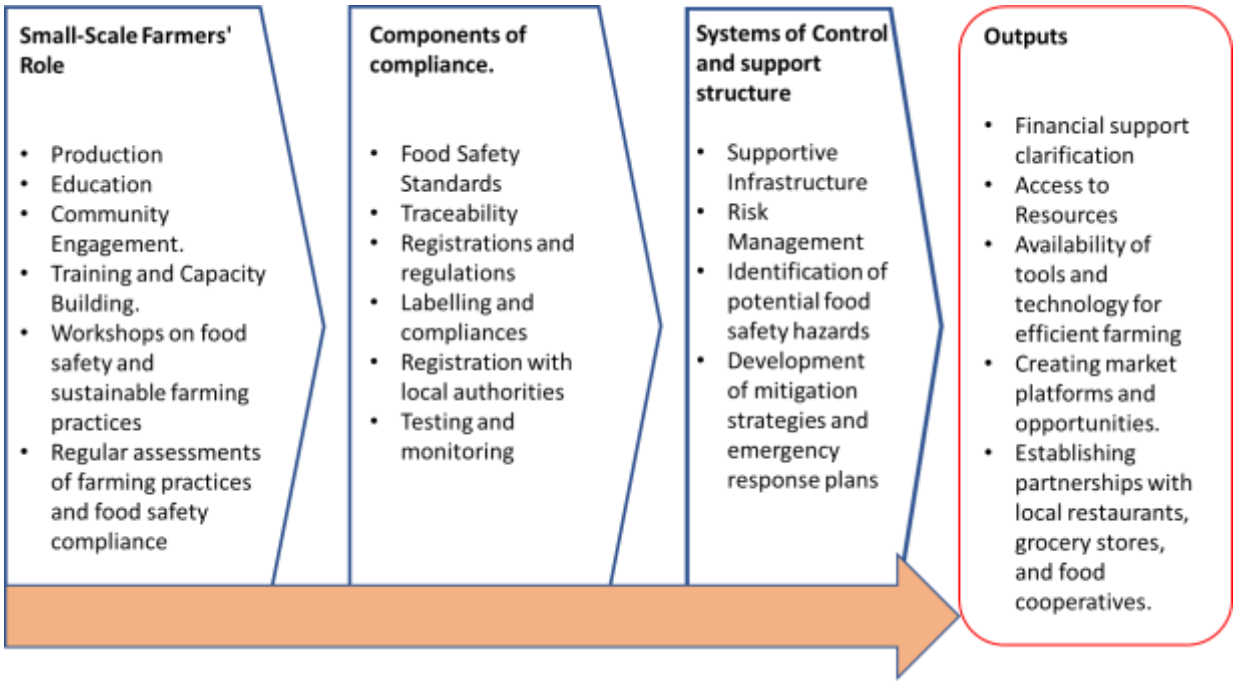


Figure 6.1: Basic framework for small scale leafy vegetables supply in South Africa

6.2 FRAMEWORK FOR SMALL-SCALE FARMERS IN SAFER FOOD PRODUCTION

The idea of a framework that is farmer enhancing and supporting of more similar kind is proposed. This idea notes the existences of other programs of funding that government has. However, issues of food safety control are pertinent to the producer and are producer driven to find market, to protect the end user, to comply with existing regulatory requirements. This investigation has identified five (5) important drivers that would exist to ensure end user ready production, these may include:

6.2.1 Small-Scale Farmers' Role

- Production: Cultivation of crops and raising livestock using sustainable and safe methods.

- Education: Engaging in continuous learning about safe farming practices, pest management, and food safety standards.
- Community Engagement: Participating in local food systems and community-supported agriculture (CSA) initiatives.

6.2.2 Key Components of Safer Food Production

- Sustainable Practices: Use of organic farming methods, crop rotation, and biodiversity to enhance soil health and reduce chemical use.
- Food Safety Standards: Adherence to local and international food safety regulations, including proper handling, storage, and processing of food products.
- Traceability: Implementing systems to trace the origin of food products, ensuring transparency in the supply chain.

6.2.3 Systems of Control

- Training and Capacity Building
- Workshops on food safety and sustainable farming practices.
- Access to resources and information sharing platforms.
- Monitoring and Evaluation
- Regular assessments of farming practices and food safety compliance.
- Feedback mechanisms for continuous improvement.
- Certification and Quality Assurance
- Establishing certification systems for organic or safe food production.
- Regular audits by relevant authorities or organizations.

6.2.4 General Hygiene Risk Management

- Identification of potential food safety hazards (e.g., contamination, pests). This could be expensive for emerging farmers, the plan to monitor randomly at source of production could give us a base line plan of action.
- Development of mitigation strategies and emergency response plans.
- Access to Resources
- Financial support, including microloans or grants for small-scale farmers.
- Availability of tools and technology for efficient farming.
- Market Access
- Creating platforms for small-scale farmers to connect with consumers, such as farmers' markets or online sales.
- Establishing partnerships with local restaurants, grocery stores, and food cooperatives.

6.2.5 Community and stakeholder collaboration

- Engagement with Local Authorities
- Collaboration with government agencies to support policy development for small-scale farmers.
- Partnerships with NGOs
- Working with non-governmental organizations for training, resources, and advocacy.

This framework can serve as a guideline for visual representation, illustrating the interconnected roles of small-scale farmers, the components of safer food production, and the necessary systems of control to ensure food safety and sustainability.

6.3 CONCLUSIONS

The implementation of the new plan aimed at supporting small-scale farmers aligns closely with the strategic development goals of eradicating poverty, achieving zero hunger, and ensuring clean water and sanitation. These goals are integral to fostering a balanced community sector. It's crucial that these strategic development objectives are woven into the broader framework for farmer development, encompassing training, information sharing, and the production of safer food. South Africa's commitment to this strategic initiative is vital, as small-scale farming plays a key role in promoting food supply and security. While the nation has made significant strides in encouraging and supporting agricultural practices, the on-going challenge lies in ensuring that these farmers can seamlessly integrate into the certified and formal food supply market. Research indicates that small-scale farmers have the potential to provide sustainable food to local communities. However, it is essential to address food safety hazards and establish a cohesive system for small-scale food supply.

Imperative as it may have been, the farmers within the three regions would experiences several challenges, these challenges had or are continuously contributing to the poor production or marketability of its products. However, the research indicates that seventy five percent (75%) of the farmers did not lack knowledge and understanding of food hygiene irrespective of the age and their experience as shown in. All these results raised a question that poked a view and a general acceptance of the ready to eat leafy vegetables as produced by famers are covered. These results indicate that seventy-two percentages (72%) of the farmers between the ages thirty

seven (37) to sixty (60) did not lack the knowledge and understanding of hygiene practices as part of the prerequisite when producing ready to eat vegetables. This is a clear indicator that to a certain extent, there is good response to the trainings provided by the government.

Sixty eight percent (68%) however indicated that crop stealing was a challenge amongst the three regions. This was further supported by the sixty eight percent (68%) of the lack of technical support. According to the farmers the lack of technical support which includes financial support eventually leads to small scale farmers' inability to hire security in the farms that will be there to minimize crop stealing. The above results support the idea that food production by small scale farmers accepting below 4 hectors of land and farming for market purposes could achieve remarkable strengths. These strengths are directly linked to the support or economic development drivers as outlined in the South African development goals.

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ANNEXURE 1

REQUEST FOR GATE KEEPERS PERMISSION

Tshwane University of Technology
We empower people

FACULTY OF SCIENCE

DEPARTMENT OF ENVIRONMENTAL HEALTH

Enquires:D V Nkosi, Tel no: 012 382 5283, Email: nkosidv@tut.ac.za

PO Box 8769
Gauteng Department of Agriculture and Rural Development
Johannesburg
2001

REQUEST FOR CONSENT TO CONDUCT RESEARCH

Dear Sir /Madam

I hereby request for permission to conduct a research in ready to eat vegetables small-scale farmers within the three districts. The research project is part of a qualification I am enrolled in at TUT. As part of the program or qualification I am expected to conduct a full research. Below is more information about the project:

PROJECT TITLE: Investigation of the knowledge and understanding of hygiene practices amongst small scale farmers producing ready to eat vegetables in the three regions of the Gauteng province.

Primary Researcher: VZ Sibiya (Master of Environmental Health. The student is a registered student with Tshwane University of Technology)
Study leader: Dr DV Nkosi, Department of Environmental Health, Tshwane University of Technology, Pretoria

Co-study leader: Dr TJ Morodi, Department of Environmental Health, Tshwane University of Technology, Pretoria.

Co-study leader: Mr E.J Mkhwebane, Department of Environmental Health, Tshwane University of Technology, Pretoria.

Your permission will assist in documenting current practices and knowledge by small scale farmers in 3 regions of Gauteng (Tshwane, Germiston and Randfontein) and investigate the general hygiene practises during production of these products. Samples will further be taken on the products to determine the state of microbial prevalence on ready to eat products.

Your assistance with a permission to conduct the study and the response in writing will be highly appreciated.

Regards,
Velile Zolile Sibiya.
Student and Researcher

ANNEXURE 2

REQUEST FOR CONSENT TO CONDUCT RESEARCH

FACULTY OF SCIENCE

DEPARTMENT OF ENVIRONMENTAL HEALTH

REQUEST FOR CONSENT TO CONDUCT RESEARCH

PROJECT TITLE:

Investigation of the knowledge and understanding of hygiene practices amongst small scale farmers producing ready to eat vegetables in the three regions of the Gauteng province.

Primary Researcher:

VZ Sibiya (Master of Health Sciences): Environmental Health. The student is a registered student with Tshwane University of Technology).

Study leader:

Dr DV Nkosi, Department of Environmental Health, Tshwane University of Technology, Pretoria

Co-study leader:

Mr TJ Morodi, Department of Environmental Health, Tshwane University of Technology, Pretoria

Co-study leader:

Mr E.J Mkhwebane, Department of Environmental Health, Tshwane University of

Technology, Pretoria

Dear Potential research participant,

You are invited to participate in a research study that forms part of a formal M. Tech study at the Tshwane University of Technology. This information below will help you to decide if you would like to participate or not, without any pressure or force.

PURPOSE OF THE STUDY:

It is to establish the current state of knowledge on farming practises regarding prevention of ready to eat product contamination, investigate the general hygiene practises during production and further determine the levels of microbiological hazards on ready to eat vegetables.

WHAT WILL YOU BE REQUIRED TO DO IN THE STUDY?

Should you agree to be part of this research, we would like you to sign after completion of the questionnaire as part of giving us your consent, this will be done in your farm and will not be more than 30 minutes and you will not be required to leave your farm as this will take place in your farm.

CAN ANY OF THE STUDY PROCEDURES RESULT IN PERSONAL RISK, DISCOMFORT OR INCONVENIENCE?

There will be no risks to your participation. Whenever you feel uncomfortable at responding some questions, please feel free to ask to skip the question.

WHAT ARE THE POTENTIAL BENEFITS THAT MAY COME FROM THE STUDY?

Your participation may assist the researcher to determine whether small scale farmers have any knowledge about microbiological hazards in general and hygiene practises in ready to eat vegetables. That may help prevent any possible illnesses related to

consumption of contaminated ready to eat vegetables.

WILL YOU RECEIVE ANY FINANCIAL COMPENSATION OR INCENTIVE FOR PARTICIPATING IN THE STUDY?

Please note that you **WILL NO*** receive any payment for your participation in this research study.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS STUDY?

Your decision to take part in this research study is entirely voluntary. You may refuse to take part in or you may withdraw from the study at any time irrespective of whether you have signed this consent form and all collected information will not be included in this study once you withdraw.

HOW WILL CONFIDENTIALITY AND ANONYMITY BE ENSURED IN THE STUDY?

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Your identity will be kept private. If the results of this study are written in a scientific journal or presented at a scientific meeting, your name will not be used. The information received during this research will only be used for research purposes.

IS THE RESEARCHER QUALIFIED TO CARRY OUT THE STUDY?

The researcher holds a B. Tech Degree in Environmental Health and is registered for master's degree in environmental health at the Tshwane University of Technology.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes. The Faculty Higher Degrees Committee and the Research Ethics Committee of the Tshwane University of Technology have approved the formal study proposal. All parts of the study will be conducted according to internationally accepted ethical principles.

WHO CAN YOU CONTACT FOR ADDITIONAL INFORMATION REGARDING THE STUDY?

The primary researcher in charge of this study Velile Zolile Sibiya, she can be contacted during office hours at Tel (081) 500 7965. Should you have any questions regarding the ethical aspects of the study, you can contact the chairperson of the TUT Ethics Committee, Dr. Lisa Rapsold, during office hours at Tel (012) 382-6169. E-mail rapsoldl@tut.ac.za alternatively, you can also report any serious unethical behaviour at the University's Toll Free Hotline 0800 21 23 41.

DECLARATION: CONFLICT OF INTEREST

The primary researcher is currently providing the funding and certain aspects of the research are funded by TUT therefore there won't be conflict of interests in this study.

A FINAL WORD

Your co-operation and participation in this research will be highly appreciated. Please sign the informed consent below if you agree to partake in the study.

CONSENT

I hereby declare that the researcher has explained to me all the information about the study that is conducted, and I fully understand and I am aware of the outcome. I am also aware that I am not obliged to answer any questions where I feel uncomfortable to do so unless I am willing to answer out of my own will

Research participant's name: _____

Research participant's signature: _____

Date: _____

Researcher's name: _____

Researcher's signature: _____

Date: _____

VERBAL CONSENT

I hereby declare that I have read and explained the contents of the information sheet to the research participant. The nature and purpose of the study were explained, as well as the possible risks and benefits of the study. The research participant has clearly indicated that he/she is aware of the right to withdraw from the study at any time, for any reason and without jeopardizing his/her relationship with the research team. I hereby certify that the research participant has verbally agreed to participate in this study.

Research participant's name: _____

Researcher's name: _____

Researcher's signature: _____

Date: _____

ANNEXURE 3

SICELO SEMVUMO YEKWENTA LUCWANINGO

INYUVESI YETEBUCWEPHESHA YASE-TSHWANE

UMNYANGO WETEMPHILO YEMVELO

SICELO SEMVUMO YEKWENTA LUCWANINGO

SIHLOKO SELUCWANINGO:

Kungcoliswa magciwane kwetibhidvo letilungele kudliwa letivela kubalimi labasebancane e- Gauteng, South Africa

Umcalisi welucwaningo loyinhloko:
VZ Sibiya (Ingcweti Yetebucwephesha Ngetemphilo Yemvelo. Lomfundzi ungumfundzi lobhalisiwe eNyuvesi Yetebucwephesha yase Tshwane, ePitoli).

Umholi wesifundvo
Siyazi DV Nkosi, Umnyango Wetemphilo Yemvelo, eNyuvesi Yetebucwephesha yaseTshwane, ePitoli

Siyazi TJ Morodi, Umnyango Wetemphilo Yemvelo, eNyuvesi Yetebucwephesha yaseTshwane, ePitoli

Lisekela lemholi wesifundvo:
UMnumzane J.E Mkhwebane, Umnyango Wetemphilo Yemvelo, eNyuvesi Yetebucwephesha yaseTshwane, ePitoli

Ngibingelela Bonkhe Labangadle babeyincenye yalolucwaningo,

Uyamenywa kudlala inzima elucwaningweni loluyincenye yekuceceshwa lesemtsetfweni esifundvweni seNgcweti Yetebucwephesha Ngetemphilo Yemvelo eNyuvesi Yetebucwephesha yase Tshwane. Lomniningwane lolandzelako utakusita ekutsatseni sincumo sekutsi ungatsandza yini kudlala lenzima noma cha, ngaphandle kwekucindzetelwa noma kuphocelelwa.

INHLOSO YELUCWANINGO

Lolucwaningo lufise kuchaziseleleka kabanti ngetindlela tekulima letisetjentiswa balimi mayelana nekuvikeleka kwemkhicito lolungele kudliwa kutsi ungangcoli, kuphenya tindlela tekuhloba nekuhlanteka letisetjentiswako kusakhicitwa, kanye nekutfola lizinga lebungoti bemagciwane etibhidvweni letilungele kudliwa.

YINI LOKUBHEKEKILE KULABO LABATONGENELE LOLUCWANINGO?

Kulabo labatongenela lolucwaningo, batawucelwa kusti ekubeni sebaphendvule imibuto yalolucwaningo bacedza ba-sayine noma bafunge ngesidladla kukhomba sivumelwano sekuba yincenye yalolucwaningo, lolucwaningo lutokwentiwa epulazini lakho, kubhekeke kutsi sikhatsi lesingatstfwa kungaba
imizuzu lengemashumi lamatsatfu (30) futsi angeke udzingeke kutsi ushiye lipulazi lakho njengoba kutawentiwa konkhe epulazini lakho.

KUNGENTEKA YINI INCHUBO YALOLUCWANINGO IBE NEMIPHUMELA LENGAHLE IKUBEKE ETFUBENI LENGOTI, KUNGAPHATSEKI KAHLE NOMA IKUPHAZAMISE?

Sinesiciniseko kwekutsi kutabate bungoti ekubeni yincenye yaloluncwaningo. Uma kwenteka utiva ungakhululeki ekuphendvuleni leminye yemibuto, sicela ukhululeke kutsi ucele kuweca lowo mubuto.

YINI LOKUNGAHLE KUZUZEKE NGALOLUCWANINGO?

Kuhlanganyela kwakho kungahle kusite lomcwaningi atfole kutsi ngabe balimi labancane banalo yini lwati ngebungoti bemagciwane jikelele kanye netindlela tekuhloba etibhidvweni letilungele kudliwa. Loko kungasita ekuvikeleni kugula lokungabangelwa kudla tibhidvo lesetingcolisiwe ngulamagciwane.

UTAWUKUTFOLA YINI KUNCEMPHETELWA NGEMALI NOMA NGABE NGETINSITA TEKUKUKHUTSATA NGENCA YEKUTSI UBE YINCENYE YALOLUCWANINGO NA?

Sicela unake kutsi **ANGEKE UTFOLE** kubhadalwa kutsi ube yincenye yalolucwaningo.

YINI EMALUNGELO AKHO NJENGEMHLANGANYELI WALOLUCWANINGO?

Uyatiswa kutsi awukaphoceleleki kuba yincenye yalolucwaningo sincumo sekuba yincenye yalolucwaningo kuncike ekutikhetseleni ngalokuphele kuwe.

Unayo imvumo yekwala nekuhlehlisa lusachubeka lolucwaningo noma ngabe kunini

ngemuva kwekuba u-sayinile noma utibophele ngesifungo sesidlaldla. Lonkhe lwati kanye nemniningwane losavele utsetfwe angeke uchubeke ube yincenye yalolucwaningo waze wancuma kuhlehlisa.

LOKUYIMFIHLO NEKUGCINEKA UNGATIWA KUTAWUCINISEKISWA KANJANI KULOLUCWANINGO?

Noma ngabe ngumuphi umniningwane lotawuzuzwa ngulolucwaningo uphindze ukhombakalise bunguwe utawugcinwa njengemfihlo uphindze futsi usetjentiswe ngemvumo yakho noma ngekudzingwa ngumtsetfo. Bunguwe bakho butawugcinwa bufihlakele. Uma imiphumela yalolucwaningo ibhalwa kuphephabhuku wesayensi noma yetfulwa emhlanganweni wetesayensi, libito lakho ngeke lisetjentiswe.

Umniningwane lototfolakala kulolucwaningo utawusetjentiselwa injongo yalolucwaningo kuphela

NGABE LOMCWANINGI UCECESHIWE YINI KUTSI AKHONE KWENTA LOLUCWANINGO?

Umcwaningi uneticu (B.Tech) Tebuchwephesha Ngetemphilo Yemvelo kani ubhalisele kuphotfulwa ngekuba Yingcweti (Masters) Kutebuchwephesha Ngetemphilo Yemvelo eNyuvesi Yetebucwephesha YaseTshwane (Tshwane University of Technology)

NGABE LOLUCWANINGO LUVUNYWELWE MACONDZANZANA NEKWAMUKELEKA NGEKUTIPHATSA?

Yebo. Ikomidi Yemnyango Weticu Letiphakeme (Faculty Higher Degree) kanye Nekomidi Lebuke kwamukeleka Ngekutiphatsa kwemacwaningo (Research Ethics Committee) ase Nyuvesi Yetebucwephesha YaseTshwane asivumile sicelo sekwenta lolucwaningo. Tonkhe tincenye talolucwaningo titawentiwa ngekulandzela timiso letamukelekile emhlabeni jikelele macondzana nekwamukeleka ngekutiphatsa.

NGUBANI LONGAMUTSINTSA MAWUFUNA LWATI LOLWENGETEKILE MAYELANA NALOLUCWANINGO?

Umcalisi walolucwaningo lophetse lesifundvo ngu Velile Zolile Sibiya, uyatfolakala ngetikhatsi tekusebenta kunayi inombolo Tel (081) 500 7965. Uma unemibuto lephatselene nekwamukeleka kwekutiphatsa ngalesifundvo, ungachumana na sihlalo wekomidi lebukete kwamukeleka kwekutiphatsa eNyuvesi (TUT Ethics Committee) Siyazi DR Katerere, lotfolakala ngetikhatsi tekusebenta kunayi inombolo letsi Tel (012) 382-6506, noma eposini lwelunyazi lolutsi katereredr@tut.ac.za , noma ubike noma ngabe ngukuphi kutiphatsa lokungamukeleki kahle enombolweni yeNyuvesi loyishayela mahhala (University toll Free Hotline) letsi 0800 21 2341

SIMEMETELO: KUSHAYISANA KWETINSHISEKELO

Umcalisi welucwaningo nguye lokhokhela kutsi kwentiwe lolucwaningo bese kutsi

letinye tincenye talolucwaningo tikhokhelwa yiNyuvesi yaseTshwane, yona ikhokhela letinye tincenye talolucwaningo, ngakoke kuyababete kushayisana kwetinshisekelo kusentiwa lolucwaningo.

LIVI LEKUPHETSA

Kusebentisana nekuhlanganyela kwakho kulolucwaningo kutawutuseka kakhulu. Uyacelwa kutsi usayine noma ufunge ngesidlala nayi imvume lelandzelako uma uvuma kuhlanganyele kulolucwaningo.

IMVUMO

Ngiyamemetela kutsi umcwaningi sewuchazile wonkhe umniningwane walolucwaningo lelwentiwako futsi ngiyacondza ngiphindze ngiyati ngemiphumela. Ngiyati futsi kutsi angikabopheleleleki ekuphendvuleni imibuto lengitiva ngingakhululeki ngayo ngaphandle uma ngitimisele kuphendvula ngentsandvo yami.

Libito lwalohlanganyela kulolucwaningo: _____

Lohlanganyelako kulolucwaningo uyasayina: _____

Lusuku: _____

Libito lwemcwaningi: _____

Umcwaningi Uyasayina: _____

Lusuku: _____

IMVUMO LEKHULUNYIWE

Ngiyamemetelela kutsi ngifundzile ngaphindze ngachaza lokucuketfwe ngulomniningwane kulolohlanganyela kulolucwaningo. Indlela nehloso yalolucwaningo ichaziwe, kanye nalokungahle kube yingoti nalokungahle kuzuzeke kulolucwaningo. Lohlanganyelako kulolucwaningo ngalokucacile ukhombisile kutsi uyati ngelilungelo lekutikhokha kulolucwaningo nanoma ngabe ngusiphi sikhatsi, nanome ngabe ngusiphi sizatfu futsi loko ngeke kubeke engcophweni budlelwane nalabacwaningako. Ngiyacinisekisa kutsi lohlanganyelako kulolucwaningo uvumile ngemavi kutsi ahlanganyele kulolucwaningo.

Libito lwalohlanganyela kulolucwaningo: _____

Libito lwemcwaningi: _____

Umcwaningi Uyasayina _____

Lusuku: _____

ANNEXURE 4

QUESTIONNAIRES FOR FARMERS

Investigation of the knowledge and understanding of hygiene practices amongst small scale farmers producing ready to eat vegetables in the three regions of the Gauteng province.

Researcher:	**E-mail:**	**Cell:**	**Postal address:**
VZ Sibiya	**velilezolile.sibiya@gmail.com**	**0815007965**	**1 Bekker street The Reeds Centurion**

PART 1. SOCIO-DEMOGRAPHIC INFORMATION			
Questionnaire no:	**Date of interview:**	**District:**	**Function of the respondent:**

1.1	What is your age in years? 18 and 35 ☐ 36 and 60 ☐ 61 < ☐
1.2	How many years have you been farming? ☐

1.3 What is your gender? This is for an estimation on the gender distribution within the farming community.

1	Female	2	Male

1.4 What is your home language?

1	English	5	Afrikaans	9	SiSwati
2	Sesotho	6	IsiZulu	10	Ndebele
3	SePedi	7	Xhosa	11	Xitsonga
4	Venda	8	Tswana		
12	Other				

1.5 What, in your opinion is your home language competency?

Speak	1	Poor	2	Good	3	Very good	4	Outstanding
Read	1	Poor	2	Good	3	Very good	4	Outstanding
Write	1	Poor	2	Good	3	Very good	4	Outstanding

1.6 Second preferred language?

1	English	5	Afrikaans	9	SiSwati
2	Sesotho	6	IsiZulu	10	Ndebele
3	SePedi	7	Xhosa	11	Xitsonga
4	Venda	8	Tswana		
12	Other				

1.7 What, in your opinion is your second language competency?

Speak	1	Poor	2	Good	3	Very good	4	Outstanding
Read	1	Poor	2	Good	3	Very good	4	Outstanding
Write	1	Poor	2	Good	3	Very good	4	Outstanding

1.18 What is your highest level of educational?

1	No School attended	3	Grade 9	5	Post matric
2	Secondary school (below grade 9)	4	Matric	6	College/Varsity

1.9 The reason I'm doing farming is for

	Yes	**No**
Business purposes		
Private usage		
Business and Private		
Other please specify		

1.10 What influenced you into start farming?

		Yes	**No**
	Family activity		
	Friends and villages		
	Cultural practice		
	Means to earn money		
	Other		

1.11 How many permanent employees does your farm employ in total?

		Yes	**No**
a	2		
b	3-5		
c	5+		

1.12 Have you ever been trained or your employees on any of the following farming categories?

a	Land preparation	**Yes**	**No**
b	Use of fertilizers	**Yes**	**No**
c	Pesticides	**Yes**	**No**
d	General farming practices	**Yes**	**No**
e	Basic hygiene	**Yes**	**No**

PART 2: UNDERSTANDING AND KNOWLEDGE

2.1 How much land do you own? Hectares

2.2 Where do you sell your product? (Super market, on the streets or Door to door)

2.3 As a farmer, rate how often do you produce these crops:

CROP	**MOST LIKELY**	**LIKELY**	**LESS LIKELY**	**NEVER**
Lettuce				
Cabbage				
Tomatoes				
Pepper				
Carrot				

2.4 Which Crops do you harvest in Summer?

CROP	**MOST LIKELY**	**LIKELY**	**LESS LIKELY**	**NEVER**
Lettuce				
Cabbage				
Tomatoes				
Pepper				
Carrot				

2.5 Which Crops do you harvest in Winter?

CROP	MOST LIKELY	LIKELY	LESS LIKELY	NEVER
Lettuce				
Cabbage				
Tomatoes				
Pepper				
Carrot				

2.6 Which farming method do you use to plant your crops?, briefly explain

CROP	MOST LIKELY	LIKELY	LESS LIKELY	NEVER
Lettuce				
Cabbage				
Tomatoes				
Pepper				
Carrot				

2.7 As a farmer, rate how informed are you with basic hygiene requirements when producing.

CROP	MOST LIKELY	LIKELY	LESS LIKELY	NEVER
Lettuce				
Cabbage				
Tomatoes				
Pepper				
Carrot				

1	Know it very well	2	Have seen/heard about it	3	Have no clue

2.8 Do you have potable water available?

a	**Yes**	**No**

2.9 Has the soil been evaluated for any chemicals?

a	**Yes**	**No**

2.10	Have you ever analyzed your product for microbial content? a **Yes** **No**
2.11	Do you think vegetables can cause diseases? a **Yes** **No**
2.12	Do you clean/wash vegetables before packaging? a **Yes** **No**
2.13	If YES, how do you wash them? a **Yes** **No**
2.14	What packaging material is used for packaging the product? Boxes **Yes** **No** Crates **Yes** **No** Not packaging **Yes** **No** Plastics **Yes** **No**
2.15	How do you transport the product from the farm to the market? Vehicle **Yes** **No** Wheelbarrow **Yes** **No** Other **Yes** **No**
2.16	If the answer to **2.15** is by a vehicle, How often is it cleaned/washed? After use **Yes** **No** Daily **Yes** **No** Weekly **Yes** **No** Monthly **Yes** **No**

2.19	Where do you get information about the use of pesticides?		
	a	I get the information from our organization	**Agree** **Disagree**
	b	I have been trained on the use of pesticides	**Agree** **Disagree**
	c	I read all instructions on pesticides used	**Agree** **Disagree**
2.19	Which containers do you use for holding the product during harvest?		
2.20	How often do you wash containers and harvesting equipment?		

After use	**Yes**	**No**
Daily	**Yes**	**No**
Weekly	**Yes**	**No**
Monthly	**Yes**	**No**

2.21	How do you handle the product that is unfit for human consumption?	

Discard it	**Yes**	**No**
Give it away	**Yes**	**No**
Use it for other purposes	**Yes**	**No**
Other	**Yes**	**No**

2.22	Are there personal hygiene facilities and toilets available?
2.23	Is there a cleaning schedule for the premises, facilities, equipment's and containers?

2.24	How do you ensure that the conditions in the storage are not favorable for microbial growth? …… …… ……
2.25	How do you prevent people (personnel) to product contamination? …… …… ……
2.26	How do you prevent product to product contamination? …… …… ……
2.27	How do you prevent equipment to product contamination? …… …… ……
2.28	Is there a system used to trace the product? (Information from growers, lot numbers etc)
2.29	Is there implementation of Record keeping?
2.30	Is there implementation of pest management?
2.31	Do you know that the following poses a risk to human health?

a	Presence / absence of disease-causing	1	**Yes**	2	**No**	3	**Unsure**

	germs e.g. Salmonella						
b	Presence / absence of cleaning chemical residues	1	**Yes**	2	**No**	3	**Unsure**
c	Presence / absence of physical matter e.g. metal / plastic from processing equipment and utensils	1	**Yes**	2	**No**	3	**Unsure**
d	Presence of transparent (non-visible) wrapping material that can lead to choking	1	**Yes**	2	**No**	3	**Unsure**
e	Presence / absence of foreign material in plants(ready to eat vegetables) origin e.g. hair	1	**Yes**	2	**No**	3	**Unsure**

2.32 If and when I want more information than the above I will obtain it from:

a	The farmer	f	Local authorities
b	The farming Organization	g	Provincial or national authorities
c	Processing plants	h	Other: Specify
d	The Internet		

2.33 What challenges do you encounter in the process of ready to eat vegetables farming? Select any.

	Yes	**No**
Market access		
Crops stealing		
Financial support		
Changing seasons		
Lack of knowledge		
Lack of technical support		

Thank you!! Bae Dankie!! Siyabonga!!

ANNEXURE 5

Tshwane University of Technology

We empower people

INSPECTION CHECKLIST FOR FARMS

Investigation of the knowledge and understanding of hygiene practices amongst small scale farmers producing ready to eat vegetables in the three regions of the Gauteng province.

CHECKLIST		
1. HYGIENE	**Yes**	**No**
1. Are the cleaning schedules in place?		
2. Are the employees provided with PPE?		
3. Is the appropriate degree of personal hygiene maintained?		
4. Is there practicing of basic hygiene?		
5. Is there any worker that is working directly with the product with open cuts and wounds?		
6. Is there portable water?		
7. Are there insects, fecal contamination and other hazards in water?		
8. Is there a designated storage for the product?		
9. Is the storage in good condition, made of non-toxic material and permits easy through cleaning?		
10. Is the product stored at least 1 m from the floor in the storage?		
11. Is there any vehicle for transportation of the product?		
12. Is the vehicle in good condition, made of non-toxic material and		

permits easy through cleaning?		
13. Is the product stored at least 1 m from the floor to prevent contamination?		
14. If yes, are they next to the water source?		
2. PRODUCT HANDLING	**Yes**	**No**
2.1 Are there records of the following in place:		
2.1.1 Vegetable supplier in place?		
2.1.2 Traceability system (Product identification from the farm to the supplier)?		
2.1.3 Training records (Trainings on food safety, Occupational health and safety etc)?		
2.1.4 Pest control?		
2.1.5 Water quality and supply records?		
2.1.6 Vegetable supplier records?		
2.2 Is there washing of hands during product handling and packaging?		
2.3 Are all harvesting containers and food contact surfaces cleaned before use?		
2.4 Is there a step of identifying and eliminating all potential sources of contamination?		
2.5 Is there a step of removing damaged vegetables to the extent possible in the field?		
2.6 Are the packaging surfaces and equipment designed to minimize damage to the produce and maximize cleaning and sanitizing?		
2.7 Is there a routine of cleaning and sanitizing program for all food contact equipment and surfaces?		
2.8 Is there stage/process of adequate cleaning and disinfecting of equipment		
2.9 Is there a process of packaging the product?		
2.10 Is there a stage/process of removing physical hazards before packaging?		

2.11 Is there a stage/process of separating the products to avoid cross contamination?		
2.12 Are there any physical hazards on the packaged product?		
2.13 Are the Covid19 protocols observed?		
2.14 Is waste/unsafe products safely disposed?		
3. Environment	**Yes**	**No**
3.1 Is there a manure storage next to the water source?		
3.2 Are there any domestic or livestock present in the harvesting operations?		
3.3 Are there any holes or rodents faeces within the farm?		
3.4 Does the farm have any walk ways?		
3.5 Does the slope of the farm encourage the wash off or flow of waste water (with chemicals or during heavy rains) to flow to the water source?		
3.6 is the waste area properly managed?		
3.7 Is there any stagnant water that might encourage the breeding of pesticides next to the water source?		
3.8 Is there any stagnant water that might encourage the breeding of pesticides next to the storage?		
3.9 Is there long grass/ lawn next to the water source?		
3.10 Is there lawn next to the storage area?		

ANNEXURE 6

FUNDING: AGRI SETA

Project. (4)

AgriSETA

P O Box 26024, Arcadia, 0007
AgriSETA House
529 Belvedere Street, Arcadia, 0083
Tel: (012) 301 5600
Fax: (012) 325 1677
Website: www.agriseta.co.za

03 December 2019

Tshwane University of Technology
Dr J.L Bekker
Private Bag X680
Pretoria
0001

Dear Dr Bekker

BURSARY APPLICATION APPROVAL 2020

AgriSETA has pleasure in advising you that your application for Bursaries has been approved by the AgriSETA Governing Authority on 29 November 2019 as follows:

PROJECT REFERENCE NUMBER			BU20TT71	BU20TT71
	Under Graduate 18.1*	Under Graduate 18.2	Post Graduate 18.1*	Post Graduate 18.2
No of Beneficiaries Approved	0	0	1	3
Start Date	0	0	01 January 2020	01 January 2020
End Date	0	0	31 December 2020	31 December 2020
Grant Amount Per Beneficiary	0	0	R 63 600	R 63 600
TOTAL AMOUNT APPROVED	0	0	R 63 600	R 190 800

The amount approved for 18.1 Bursaries (if applicable) is a maximum amount and only directly related study expenses may be claimed.

Please refer to page two (2) of this letter for more information regarding contracts, forms and the next actions. Also note that the approval is subject to submission of the learner/s year end results as well as confirmation by the Stakeholder that the learner/s has passed and will proceed to the next study level (e.g. from 1st year to 2nd year).

We would like to take this opportunity in wishing you all the best with the implementation and would like to invite you to call on us should you require guidance and assistance at any time.

We look forward to be working with you during 2020 academic year.

Yours Sincerely

Z. Myeza
CEO: AgriSETA

ANNEXURE 7

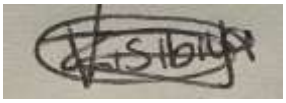
FUNDS DECLARATION

I, **VELILE ZOLILE SIBIYA**, ID number: **9501070341084**, student number: **214119633** hereby declare that in a case whereby the Agri SETA funding is unable to cover all the costs, I will continue to pay for the study.

I trust that this will suffice for the purpose of declaration to fund for my study.

Kind regards

Signature



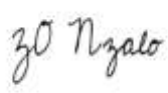
Date: 12/07/21

ANNEXURE 8

DECLARATION OF ACCURACY – TRANSLATION

I, Ziyanda Ottovia Nzalo hereby declare that I am Swati speaking and that I have translated the following documents, (GATE KEEPERS Annexure 1, and INFORMATION LEAFLET Annexure 2) from English to SiSwati language to the best of my ability and in my opinion is a true reflection of English version of the annexures.
I trust that this will suffice for the purpose of the translation.

Kind regards



Date: 12/07/21

ANNEXURE 9

Tshwane University of Technology
We empower people

Faculty Committee for Research Ethics-Science [FCRE-SCI]

The FCRE-SCI is a subcommittee of the TUT Senate Committee for Research Ethics.
The TUT Research Ethics Committee is a registered Institutional Review Board (IRB 00005968) with the US Office for Human Research Protections (IORG# 0004997) (Expires 14 January 2023). Also, it has Federal Wide Assurance for the Protection of Human Subjects for International Institutions (FWA 00011501). In South Africa it is registered with the National Health Research Ethics Council (REC-160509-21).

22 August 2022

Ref #: FCRE 2022/07/010 (SCI) (FCPS 02)
Name: Sibiya VZ
Student/Staff/ID #: 214119633

Sibiya VZ (214119633)
Environmental Health
Faculty of Science

FCRE Sibiya VZ (FA)

Dear Sibiya VZ,

Approved

Risk Status:	*Low*
Decision:	***FCRE Final Approval Granted.***

Name: Sibiya VZ
Project title: Microbial contamination of ready-to-eat vegetables from small-scale farmers in Gauteng, South Africa.
Qualification: Master of Environmental Health (_)
Supervisor/s: Supervisor: Dr TJ Morodi
Co-Supervisor: Mr DV Nkosi
Co-Supervisor: Mr EJ Mkhwebane

Thank you for submitting the **Master of Environmental Health** proposal for ethics clearance by the Faculty of Science Committee for Research Ethics (FCRE), Tshwane University of Technology (TUT). We acknowledge the amendments and/or documents submitted. In reviewing the proposal, the comments and notes below are tabled for your consideration, attention and/or notification:

Comments

The changes requested have been made.

…. Important ….

- In view of the Covid-19 pandemic, when applicable, please consider potential changes to:
  (a) The research design and/or research methods, and/or
  (a) The project timeline.
- Contemplate how the impact of the pandemic may be mitigated, particularly for the researcher(s).

*** Very Important: See notes (a) and (b) at the bottom of this letter.

Action

None.

Yours sincerely,

Dr Lisa Repsold
Chairperson: Faculty Committee for Research Ethics
Email: repsoldl@tut.ac.za Telephone: +27 12 382-6169

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[i] *The **reference number** [top right corner of this communiqué] should be clearly indicated on all forms of communication.*

A copy of this letter must be included in all correspondence.

PLEASE NOTE:

a) ***Time schedule:** Participant recruitment and/or data collection must not commence until ethics **Final Approval (FA)** has been obtained.*

b) ***Gatekeeper permission letter, where applicable:** When your research is conducted (i) within an institution/ organisation/workplace or public place, (ii) involves health and social care professionals working with participants such as patients, children or the elderly, and (iii) involves community leaders and/or family members of the participants, you need to obtain and submit a dated and signed permission letter from the relevant gatekeeper/s that allows you to undertake the planned research. This letter must be submitted to the FCRE prior to the commencement of the study.*