

**Contribution of *Biden pilosa* (Blackjack) to the welfare of households in ward 23 of Mt  
Darwin, Zimbabwe**

**A dissertation submitted in partial fulfilment of the requirements for the Master of Science  
Degree in Food Security and Sustainable Agricultural (Policy Option)**

**Bindura University of Science Education**



**Faculty of Agriculture and Environmental Science  
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The undersigned certified that they have supervised and recommended to Bindura University of Science Education for acceptance of dissertation entitled '**Contribution of *B. pilosa* (Black Jack) to the welfare of small holder farmers in ward 23 of Mt Darwin, Zimbabwe**' submitted in partial fulfillment of a Master of Science Degree in Food Security and Sustainable Agriculture.

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## DECLARATION

I hereby declare that the research project entitled “**Contribution of *B. pilosa* (Black Jack) to the welfare of small holder farmers in ward 23 of Mt Darwin, Zimbabwe**” submitted to Bindura University of Science Education, Department of Agricultural Economics, Education and Extension is a record of an original work done by me under the guidance and supervision of **Dr Chimvurahwe** and this work is submitted in partial fulfilment of the requirements for the award of a Master of Science Degree in Food Security and Sustainable Agriculture. The results embodied in this thesis have not been submitted to any University or Institute for the award of any degree of diploma.

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## **DEDICATION**

This research project to my son Travis Akudzweishe Tserenga

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## ABSTRACT

The reliance of rural households on underutilised vegetables (including *Biden pilosa*) for sustainability is largely recognized in the literature reviews. Although the production, marketing and consuming of this vegetable have historically been not considered rural households. The consumption is high during the lean season and serves as a coping method in times of insufficiency. Hence this research study was done in Mt Darwin district aims to assess the contributions of *B. pilosa* to the welfare of households in ward 23. The objectives were to assess availability and accessibility, knowledge and practices, consumption preferences, the benefits as well as to investigate socioeconomic factors characterising the production of *Biden Pilosa* and the impact of its production on farmer welfare. The study data was collected from 45 households using a questionnaire and for triangulation key informant interviews were conducted from 3 village heads. The later were collected from other research journals and documents. Excel, SPSS 21 and content analysis was applied for data analysis. The findings indicated that that age, health and income had an impact on rate of consumption during the growing season only. The study therefore concludes that *B. pilosa* may be a reliable household income source. Farmers are urged to combine new technologies and local knowhow to increase the production and consumption of local vegetables. Farmers and other sectors showed do awareness education and advocacy about the welfare and trading potential of underutilized vegetables are crucial. The government extension officers need expand its technical delivery along the *B. pilosa* vegetables value chain. It is hoped that combined efforts will ease the commercialization of *B. pilosa*, thereby increasing household welfare.

*(B. pilosa, underutilized, welfare, socioeconomic, income)*

## **LIST OF ACRONYMS AND ABBREVIATIONS**

B. pilosa	Biden Pilosa
COVID 19	Corona Virus Disease of 2019
FAO	Food and Agriculture Organisation
HIV	Human Immunodeficiency Virus
IFAD	International Fund for Agricultural Development
SDGs	Sustainable Development Goals
SPSS	Statistical Package for Social Sciences
UNICEF	United Nations Children’s Emergency Fund
ZIMSTATS	Zimbabwe National Statistical Agency
ZIMVAC	Zimbabwe Vulnerability Assessment Committee

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## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the study

Underutilized crops are considered to be one of the groups of indigenous or neglected crops because of their limited use. They are used to signify food types that are underutilised to a place, they can be underutilized in certain place but not in another (Agulanna, 2020). These crops are also known to be poor man's food and mostly eaten in times of hunger, social unrest and wars. They have potential have been in disuse due to any reasons (Padulosi, Hoeschle-Zeledon, & Bordoni, 2007). Underutilized crops have potential contribution refer to crop species that have the potential but are not fully utilized to contribute to food security and poverty reduction, also having strong link to cultural heritage, poor researched or documented, adopting to specific agro-ecological places less or nonexistent seed supply systems, traditional use while producing little or no external inputs(Aboagye, Obirih-Opareh, Amissah, & Adu-Dapaah, 2007).

According to Kahane et al. (2013), underutilized crops have been discovered to be as valuable for sustainable agricultural productivity. The cultivation of these crops gives a larger genetic biodiversity and improves food security (Chivenge, Mabhaudhi, Modi, & Mafongoya, 2015). Studies mentioned in Agulanna (2020), have emphasized high nutritional value of underutilized vegetables and their function in promoting health and food security. In both rural and urban communities, underutilized vegetables offer a potential source to food diversity resulting in household food insecurity (Alfred, 2011). Underutilised vegetables are usually associated with tradition, custom and habit. They are plants whose fruits, roots and leaves are used as vegetables by communities. This study focuses on *Bidens Pilosa* which originates from Southern countries of America and spread in equatorial and subequatorial areas such as Zimbabwe (Mboya, 2019; Mtenga & Ripanda, 2022). *Bidens Pilosa* is a perennial plant that involuntarily grows in the field through farming, it is often considered a weed (Arthur, Naidoo, & Coopoosamy, 2012). It is a threat to other plants because of its nature as an incursion weed and therefore removed to protect other plants. *Bidens Pilosa* has capability to flourish in all conditions and have an eruptive reproduction ability (Mboya, 2019).

Other than its inconvenient characteristics the plant is grown on a small scale in Benin, Zimbabwe and Nigeria for medicines and food (Mtenga & Ripanda, 2022). The medicinal uses include treating various illness that include diarrhea, indigestion, wounds, dysentery and respiratory infections (Arthur et al., 2012). In some of the countries in Africa such as Congo, Botswana, Zimbabwe, Kenya, Zambia, Mozambique and South Africa it is used as indigenous vegetable (Otang-Mbeng & Mashabela, 2020; Shayanowako et al., 2021). Above all these *Biden Pilosa* is not widely used in sub-Saharan Africa because of its wild unwanted crop category which gives the community a negative perception and concern (Mtenga & Ripanda, 2022). Due to this perception, it is only used at the time of vegetable scarcity only. To date there is no literature on the contribution of *Biden Pilosa* to welfare of communities. Therefore, the study seeks to provide information to scientist, researchers, policy making and communities the Contribution of *B. pilosa* to welfare of households in ward 23 of Mt Darwin, Zimbabwe.

## **1.2 Problem Statement**

According to Tsolakis and Srari (2017) the sustainability of food security systems is a main world problem due to increase population to 9.1 billion by 2050. Hence food demand is estimated to rise by 70%, thus giving pressure to food systems to fulfill the future needs. The global is experiencing food stressors such as food price instability due to scramble of food for eating and biofuels, climate change and consumption of food above physical need (Sage, 2013; Tadasse, Algeri, Kalkuhl, & Braun, 2016; Tsolakis & Srari, 2017).

More successful methods are urgently needed to support the farmers' ability to look for responses to the numerous challenges that they face. Exploring options to guarantee continued supply of their households' basic domestic consumption pressing needs is urgently needed (Pannell et al., 2014). The sustainable development goals (SDGs) such as achieving food security, ending hunger, improved nutrition and promoting sustainable agriculture by 2030. In search for ways to alleviate poverty and hunger relies not only on scientifically developed, new crop varieties, but also on reviving interest in indigenous foods that improve nutrition, increase income levels, promote agricultural biodiversity and local cultures preserve (World Watch Institute, 2011). Interest in underutilized crop species arises from a number of factors, including their contribution to agricultural diversification, land use, dietary diversification and economic potential. Despite their local importance, there is limited knowledge about their production,

consumption and contribution to welfare. Hence this research seeks to assess the contribution of *B. pilosa* to the welfare of small holder farmers in ward 23 of Mt Darwin, Zimbabwe.

### **1.3 Objectives of the study**

#### **1.3.1 Main objective**

- To assess contribution of *B. pilosa* to welfare of households in ward 23 of Mt Darwin, Zimbabwe

#### **1.3.2 Specific objectives**

- To determine availability and accessibility of *B. pilosa* in ward 23
- To assess knowledge and practices of *B. pilosa* that exists within the community.
- To determine consumption preferences of *B. pilosa* among communities and how it varies between age groups.
- To determine the benefits of including *B. pilosa* in household diets in comparative to more utilized vegetables.
- To investigate the socioeconomic issues that characterize the production of *B. pilosa* and the influence of its production on farmer welfare.

### **1.4 Research Questions**

- Is *B. pilosa* available around the ward 23 community? How many varieties found in the area?
- What *B. pilosa* knowledge and practices exist within the community and how does that influence the utilization of *B. pilosa*? Are there significant differences in these responses between gender groups or between age groups?
- What are the consumption patterns of *B. pilosa* among ward 23 community? Does the consumption pattern differ between different age groups?
- What are the benefits of including *B. pilosa* in household diets? Does *B. pilosa* have superior micronutrient composition compared to more utilized vegetables?
- What are the possible welfare benefits of utilization of *B. Pilosa*? Besides consumption are their other welfare benefits from *B. pilosa*?

- How can *B. pilosa* contribute to communities' welfare through its consumption and commercialization? Is there potential for their increased utilization in the subsistence farming sector?

### **1.5 Significance of the study /Justification**

There is no literature addressing the contribution of *B. pilosa* to the welfare of communities. The data from this research will bring forth the contribution of *B. pilosa* to the welfare of communities in Mt Darwin. There will generation of recommendations for the consumption and commercialization of *B. pilosa* to the welfare of communities in Zimbabwe from this research. The data gathered from this research will be useful to policy makers and other development practitioners to make a more informed decision in *B. pilosa* production and consumption. The successful completion of this research will be a part of the requirements of the Masters degree in Food Security and sustainable Agriculture Policy.

### **1.6 Delimitation and limitation of the study**

Households had issues in recalling *B. pilosa* collection and income figures, hence the information given is based on estimates. At first the respondents were hesitant to respond, this was resolved when the researcher explained the purpose of the research. This study was limited to one district and focused on *B. pilosa* only.

### **1.7 Outline of Thesis**

This research document consists of six chapters. Chapter 1 is the introduction of the thesis contribution of *B. pilosa* to the welfare of small holder farmers in ward 23 of Mt Darwin, Zimbabwe. Chapter 2 (Literature Review) reviews literature from other researcher and a study conceptual frame. Chapter 3(Methodology) elaborated on the research design, data collection and analysis. Chapter 4 & 5 are two manuscripts of the study each compromising of results and discussion of results, recommendations, conclusion and references. Finally, Chapter 6 consists of research summary, conclusions, policy implication and recommendations, further research areas, and appendices.

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## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

Chapter two indicates an outline of *B. pilosa* in Africa. Taxonomical classifications and Morphological presentation of genus *Biden* and *B. pilosa* L were elaborated. This chapter also explained application of *B. pilosa* and its safety for consumption. It further explores the domestication and economic importance of *B. pilosa* including the value chain. Finally the chapter discusses a series of empirical studies conducted to evaluate the conceptual frame connecting availability and production of *B. pilosa* contributing to household income and food availability.

#### 2.2.1 Overview of *B. pilosa* plants in Africa

Cosmopolitan distribution of *B. pilosa* is a weed originally from South America and distributed in arid and sub arid areas global climate (Mtenga & Ripanda, 2022). Its hardiness, eruptive breeding potential, and capability to bloom in almost all environments have allowed it to spread itself around the globe. *B. pilosa* is broadly introduced unconsciously by agriculture, or occasionally consciously for flowering purposes, and is an important weed, a threat to traditional wildlife, and a physical annoyance. In the Africa continent, many countries have indicated that *B. pilosa* is a weed and is probably present in all its countries, inclusive of the islands in the Indian Ocean (Mboya, 2019). It is also known as a herb and vegetable in Nigeria, Sierra Leone, Cameroon, Liberia, Ivory Coast, Benin, Democratic Republic of the Congo, Kenya, Uganda, Tanzania, Mozambique, Botswana, Malawi, Zambia, and Zimbabwe, among others (Mtenga & Ripanda, 2022). This plant is a weed in the field and estates cultivation. It is recorded as problematic to almost 30 crops in 40 countries more, 20 amongst those are in African. In East Africa it is regarded as one of the most harmful year-round weeds in (Grombone-Guaratini, Silva-Brandão, Solferini, Semir, & Trigo, 2005). After removing recurring grasses, it often becomes assertive and reduces growth of most crops. It potentially contains healthy significant properties that are used to cure a variety of conditions. In most developing countries, financial issues burden effective environmental management. However, the health effects of crops like

Bidens can limit their spread while having an impact on pristine ecosystems (Mtenga & Ripanda, 2022).

### **2.2.2 Scientific classifications of genus *Biden* and *B. pilosa* L**

According to Bartolome, Villasenor, and Yang (2013), *B. pilosa* was first collected and named by Carl Linnaeus in 1753. As given in Table 2.1 it is taxonomically assigned to the genus *Bidens* (Asteraceae). There are about 230 to 240 species around the world of the genus. According to Chien (2009) *Biden pilosa* has many cultivars such as *pilosa* var. *minor*, var. *radiata*, var. *bisetosa* and var. *pilosa*. The verification of pilosa can be supported by chemosystematics and molecular identification in addition of the morphological features (Chien et al., 2009).

<b>Kingdom</b>	<b>Plantae</b>
Clade	Tracheophytes
Clade	Angiosperms
Clade	Eudicots
Clade	Asterids
Order	Asterales
Family	Asteraceae
Subfamily	Helianthodae
Tribe	Coreopsideae
Genus	Bidens
<b>Kingdom</b>	<b>Plantae</b>
Division	Magnoliophyta
Class	Magnoliosida
Order	Asterales
Family	Asteraceae
Genus	Biden
Species	<i>B. pilosa</i> L.

**Figure 2.1** Scientific categories of genus *Biden* and *B. pilosa*. Source (Mtenga & Ripanda, 2022).

### 2.2.3 Presentation of the phytomorphology of *B. pilosa*

Morphologically, *B. pilosa* have lobate, notched or unconnected opposite leaves which are green, and also have yellow and white flowers and spiked achenes.



**Figure 2.2** shows the phytomorphology of *B. pilosa*. *Source Primary data*

*B. pilosa* plants prefer hot climate temperatures between 25 and 38 °C. They do not tolerate frost and prefer to thrive in sunny or slightly shady locations (Mtenga & Ripanda, 2022). Abundant rainfall ranging from 500mm to 800mm is required for its optimal growth. According to Taffner, Laggner, Wolfgang, Coyne, and Berg (2020), this plant thrives better in all types of rainfall and prefers loam soil with high manure. Additionally, *B. pilosa* thrives in saline soils as it can survive pH levels between 4 and 9. It grows early everywhere in the wild and plants fields and home gardens as well as on river banks all year round (Faber, Van Jaarsveld, Wenhold, & Van Rensburg, 2010)

### 2.2.4 Application of *B. pilosa* plants

According to (Mtenga & Ripanda, 2022) About 240 *Biden* species are known worldwide. Traditional food and drug uses of *B. pilosa* have been reported with no apparent side effects. The possibility of further researching the benefits of this plant for humans and animals' consumption, health and uses can be attained. All the parts of *B. pilosa* are important to man, like the sap and flower. The perennial parts are the leaves and roots, vitamins are found in the yellow-flowering

plant. Before the plant blooms the leaves have a good amount of vitamins A, E, and, while the roots are used as coffee substitute when oven dried and percolated (C. L. Chang et al., 2016), plant liquid is used as latex (Dimo et al., 2002), and flowers are high in provitamin A (Mtenga & Ripanda, 2022). Despite these underutilized plants such as, *B. pilosa* plants are under-exploited in countries of sub-Saharan Africa.

#### **2.2.4.1 Use of *B. pilosa* plants as vegetables**

Eating vegetables is protects the body because of various nutrient content which are both trace nutrients and vitamins to the everyday food. *B. pilosa* loaded with bioactive compounds, which reduce the threat of non-communicable and other immune-related diseases. Inclusion of vegetables in diets is good for the body as well as providing the body the different nutrients contained. They have abundant phytonutrients, associated with a reduced risk and danger of non-communicable and communicable (Odhav, Beekrum, Akula, & Baijnath, 2007). The 2002 World Health Report found that a poor diet of fruits and vegetables is the cause of about thirty one percent of ischemic heart disease and eleven of strokes worldwide (WHO, 2007). In general, it was projected that up to two million and seven hundred thousand people could be saved each year if there is significant increase in fruit and vegetable consumption (Ramya V, 2019).

*B. pilosa* plants are among the underutilised vegetables, they are greatly consumed in rural areas globally. It grows unintentionally as weed or sowed in the garden Mtenga & Ripanda, (2022), due to its availability can also be commercialized. It is one of Africa's underutilised vegetables; it is rich in nutrients, easily collected in the field or gardens and less costly for poor communities. It contains micronutrients (Faber et al., 2010; Uusiku, Oelofse, Duodu, Bester, & Faber, 2010). Therefore, eating *B. pilosa* as a vegetable adheres to WHO global initiatives calling for an increase in fruit and vegetable consumption in African countries (Faber et al., 2010). *B. pilosa* has been used as a vegetable globally and regularly consumed, for example in South Africa and other as vegetable in droughts (Faber et al., 2010). It contains many essential nutrients including vitamins and proteins, therefore acting as a protective food (Mboya, 2019). Furthermore, the occurrence of various minerals in *B. pilosa* as reported (Odhav et al., 2007). In addition, *B. pilosa* is used as a spice, tea, vegetable or medicine. Its leaves are used to brew *B. pilosa* tea and make juice (Singh, Singh, Singh, Chand, & Dam, 2013). It is also used to treat diseases nutritionally such as anemia, improve blood circulation, prevent malaria, relieve toothache,

improve eye health and heal wounds, including wounds in HIV patients (Rodas-Moya, 2016). There is need to more utilization of natural biodegradable herbs from synthetic drugs for sustainability (Arthur, 2012 and Benli, 2008).

#### **2.2.4.2 Medicinal application**

Worldwide researchers have reported anti-diabetic, anti-obesity, and anti-hypertensive characteristics of *B. pilosa*, in alleviating non communicable diseases. Therefore, incorporating *B. pilosa* into the diet can decrease metabolic and lead to a community which is healthier. Although in most of sub-Saharan Africa there is little information on the medical use of *B. pilosa* phytochemical compounds. The later knowledge is important as it encourages reductions in the use of synthetic drugs, which becomes drug resistant and cause environmental pollution. *B. pilosa* has been used to alleviate various diseases in people and organisms. Like findings that are available on identification and measurements of a compound with anti-cancer properties, from *B. pilosa* leaf extract (Singh G., 2017). *B. pilosa* extracts have also demonstrated pharmacological activities such as antiulcer, anti-fungal and anti-bacterial effects (Ndiege M.L., 2021); indicates a gap further research. Sigh and Coallegues (2017) stated that antimicrobial properties *B. pilosa* against *E. coli*; findings showed an MIC antimicrobial property which is highest of 80 g/ml and an IC50 of 110.04 g/ml, indicating its use as or in together with the antimicrobial properties (Singh G., 2017). Another report studied the effectiveness of *B. pilosa* against Eimeriasis on a chicken farm (Chang et al., 2015). The results showed that dietary supplementation with *B. pilosa* at a dose of 0.025% of the diet or greater caused a greater Eimeria infection reduction (Chang et al., 2015). Besides reducing contamination, treatment increased body weight with a decreased feed conversion ratio, resulting in increased growth. It reduced mortality, reduced oocysts per gram of feces and intestinal pathology, and increased anticoccidial indication (Chang, Yang, Muthamilselvan, & Yang, 2016). Taken together, it reported the capacity of *B. pilosa* to reduce chicken bucket disease. *B. pilosa* can then be utilized as an effective tool that reduces eimeriosis in chickens as a feed supplement enhancing good health.

#### **2.2.4.3 Application of *B. pilosa* in agriculture**

Agricultural benefits of *B. pilosa* include the use of its phytochemicals compounds, such as alkaloids, as herbicide in organic farming (Wu et al., 2021). The urge to investigate alkaloids in

plant pesticides has increased because of the environmental protection, reduced levels of toxins and are biodegradable than available chemical pesticides, whereas having the same time higher potency after certain structural modifications (M.H. George, 2020; Wu et al., 2021). This is important for the ecosystem sustainability to have products that help reduce the chemical amounts on the environment. Research done by Deba and other researchers investigated possibility of using *B. pilosa* extracts for weed control and plant fungus. The findings showed that the compounds of *B. pilosa* exhibited potent plant toxin functionality against the production of toxins Echinochloa, Crus-galli and Raphanus Sativus in bioassays and antifungal properties against plant pathogens. Hence, the findings showed that the compounds of this plant can be utilized to treat plant diseases, replacing chemical substances that pollute the environment. In addition, the plant production inhibiting effect of compounds can be used to reduce other weeds (Mtenga & Ripanda, 2022).

#### **2.2.4.4 Customary uses and remedies of *B. pilosa***

From prehistoric era, people used natural products to treat diseases. For example, traditional Korean medicine, traditional Chinese medicine, Ayurveda, Unani, and Kampo are practiced in different areas in the globe and have developed into recognized medical systems (Bartolome et al., 2013; Bunalema, Obakiro, Tabuti, & Waako, 2014; Moshi, Otieno, & Weisheit, 2012; Yuan, Ma, Ye, & Piao, 2016). Due to new technologies in there is need to obtain functional extracts for the development of drug, studies focusing on safety, pharmacological properties and compound composition become more crucial. The research revealed that compounds from natural products have pharmacicritical properties that traditional doctors use due to their indigenous knowhow (Yadav, Singh, Singh, & Kumar, 2017) and attempts resolve social problems. The use of traditional curing remedies can influence by the lack of a clinical framework (Bodeker, 2005) and perception of the community. Recently the resistant of drugs is one of the driving forces behind the use of other or plant medicine. However, the capacity of traditional doctors cure certain illnesses by the use of plant products, early researches indicated that medicinal leads are present in plant products, and the possession of bioactivities in natural products have interested the doctors to the develop of new technologically made medicine from plant products (Moshi et al., 2012). Hence, these studies indicated that the old use of plant product compounds exploited

the diverse biological potential of these compounds. Natural plant compounds are used in different regions, using the whole plant or parts such as roots, leaves, flowers, bark, and shoots.

The following is a summary of various types of traditional use of *B. pilosa* in named locations. In West Africa it is used to relieve dizziness (Mtenga & Ripanda, 2022). In South Africa *B. pilosa* is used to mitigate migraines, infections which are sexually spread and TB (Lawal, Grierson, & Afolayan, 2014; Maema, Potgieter, & Samie, 2019). In some tropical areas it is used as mitigation of headache and rheumatism. The flowers or whole plant *B. pilosa* is also used for treatment of TB in South Africa, Uganda and Ghana, (Nguta, Appiah-Opong, Nyarko, Yeboah-Manu, & Addo, 2015). In Tanzania they use it to induce labor and abortion Tanzania (Rasch, Sørensen, Wang, Tibazarwa, & Jäger, 2014). Most countries like Mozambique, Congo, Zimbabwe, Zambia, Botswana, South Africa and Kenya use *B. pilosa* as vegetables (Mushagalusa Kasali et al., 2021). In Uganda, Tanzania, Malawi it is used as management strategy of AIDS in clients (Nyamukuru et al., 2017). *B. pilosa* roots are used to treat malaria, tuberculosis and related symptoms in Uganda (Tabuti, Kukunda, & Waako, 2010). Grounded leaves are used as insecticides and for the relief of influenza urinary tract infections, infected skin wounds and upper respiratory tract infections in Kenya (Mtenga & Ripanda, 2022).

Squashed leaves, leaf Juice, Seed pound, leaf compounds. Dysentery, heat wounds, anesthetic and inflammation spleen. Ivory Coast, Tanzania, Nigeria. In the Congo they use a mixture of the whole plant as an antidote to poison; facilitating the delivery of the child; hernia relieving pain. The Zulus people in South Africa use the powdered leaf suspension, the leaf mixture, for stomach pains, arthritis and malaria. The Manyika in Zimbabwe use leaves to relieve abdomen and mouth wounds, diarrhea, head pains and alcohol aftereffects hangovers. using shredded leaves. (Ndhlovu, Omotayo, Otang-Mbeng & Aremu, 2021; Tabuti et al., 2010)

### **2.2.5 Safety of *B. pilosa* consumption**

*B. Pilosa* is considered not toxic humans and other animals to consume. Furthermore, *B. pilosa* considered a safe plant medicine for various type of disease treating diseases in humans and other animals. Even though there is no evidence of human or animal toxicology studies to control *B. pilosa* conducted in sub-topical Africa, other many landmarks that supports *B. pilosa* as safe food and medicinal purposes for consumption. Below are researches that have been carried out to

demonstrate the safety levels of *B. pilosa*. In a trial for 90 days, *B. pilosa* health products were administered three times a day at a dose of 400 mg per each mouse per daily intake. Findings showed no unfavorable effects on intensifying insulin amount and reduced overall cholesterol level and no potential toxicity when all measures were within the physiological scope (Lai et al., 2015; Liang et al., 2020). In mice, the whole plant *Pilosa* was administered at 1g/kg body weight, which corresponds to a dose of almost 10% in the diet, for 24 weeks. No levels toxicity was found as indicated by maintaining their daily lifestyle so recommended trends were observed indicating no toxic effects (Liang et al., 2020). An experiment in which rats were given a liquid compound of the plant leaves (10 g/kg body weight). The results showed that no deaths or changes were observed in rats, indicating no toxicity (de Ávila et al., 2015). Rats were given a dose of 0.8 g/kg body weight of the aqueous extract from *B. pilosa* leaves (Mtenga & Ripanda, 2022). Rats showed no significant toxicity after twenty-eight days as evidenced surviving rate, examination of body weight and vital parts, indicating that none of the toxicities mentioned are present (Mtenga & Ripanda, 2022). A six month course of oral therapy with blood pressure doses of 02.5%; 5% and 10% were studied. There is no big significance implying no toxicity found (Liang et al., 2020).

### **2.2.6 Domestication of *B. pilosa***

According to (Nyaruwata, 2019), domestication is a way of adapting forest plants for human use. Domesticated plants can be used for eating, treatments, and other purposes, so the utmost care is given to them to achieve satisfactory results. Underutilised *B. pilosa* have been used for centuries, particularly in Zimbabwe, but have not become widespread and are not grown on a larger scale, particularly Zimbabwe (Maroyi, 2013). *B. pilosa* flourish in many parts of the country and are which makes it less costly to produce (Arthur et al., 2012). Due to varying of farming regions overtime and this has caused reduced consumption of underutilised vegetables including *B. pilosa* by young people leading to lack of domestication. *B. pilosa* relies on harvesting without cultivation (Karki, Fasse, & Grote, 2015). Shackleton, Pasquini, and Drescher (2009) noted that it is viewed as exploitative, which is unsustainable given the growing population, there can cause genetic erosion and biodiversity losses. During the rainy season, most of the underutilised vegetables, including *B. pilosa*, Galant Soldier and Jude Mallow, are harvested from the bush. Few underutilised vegetables are domesticated in Zimbabwe. Most of

the few are cover crops, not evenly spaced, making calculation of plant population impossible. *B. pilosa* is rarely planted but grown as a volunteer plant that persists later through the growing season and therefore self-propagates through casing for the next season. In Zimbabwe households grow underutilised vegetables using old farming systems where there is present intercropping and few inputs are applied. In addition, the area earmarked for domestic vegetables is very small (Arthur et al., 2012). Other parts of African countries have successfully domesticated some of the indigenous vegetables. According to Mwaura, Muluvi, and Mathenge (2013), indigenous vegetables are now a good trading opportunity Kenyan household focusing to their farming and selling. Nevertheless, households in Zimbabwe rural areas of have not fully domestication of *B. pilosa*. Meaning that it is mostly available in the raining season and become distinct during the non-raining seasons (Maroyi, 2013). There is a policy framework to support domestication and production of indigenous vegetables but have weakly adopted (Nyaruwata, 2019). The available framework in agricultural policy slightly supports the indigenous vegetable production

### **2.2.7 Economic importance of indigenous vegetables**

Mahlangu (2014) stated that despite the consensus that domestic vegetables make only a marginal contribution to the income, they have the ability to be greatly profitable, provide employment, source of income and drive commercialization of the rural areas. Many vegetables in Zimbabwe are imported from South Africa, suggesting that local vegetables are not considered. This can limit the use of foreign exchange can be used to buy local supplied products (Nyaruwata, 2019). According to Xaba and Masuku (2013) foreign vegetables require more inputs for cultivation, yet production is often low and variable, while underutilised vegetables have similar or better nutritional status may thrive better when grown with little or no inputs. Local vegetables have been identified as a potential option to diversify the economy due to their greater demand in local markets (Mavengahama, 2013). Most underutilised vegetables, including *B. pilosa*, can be preserved and have better shelf life, are distributed easily, and have lesser exposure to spoiling when preparing and storing comparison with foreign vegetables (Chagomoka, Afari-Sefa, & Pitoro, 2014). Due to the urgency of pandemic diseases, the domestic vegetable market is developing in the cities. According to Maroyi (2013), the supply of locally available vegetables is failing to feed local people and marketing is not organized.

Therefore, the exploitation of local vegetable in rural areas, is crucial because they are part of household income especially to those who are unemployed.

As highlighted by Shackleton et al. (2009), local vegetables are of economic importance for generation of income and as well livelihood variety. In another analysis of Shackleton et al. (2009) and Mavengahama (2013) comparatively indicated that homegrown vegetables from home gardens, fields and farmland added thirty one percent to the total of all crops farmed by a household. Analysis of the two studies found the value of adopted traditional vegetables, grown naturally, or grown at households has a greater average salary to farm workers locally. Underutilised vegetables are of economic importance for income generation and the diversity of livelihoods. Although Karki et al. (2015) observed that the trade was done locally; demand for growing and supplying is increasing. A study in Tanzania by Osano (2010) investigating the production and commercialization factors, 13% income of farmers' households came from indigenous vegetables. In Kenya Kiambu district Mwaura et al. (2013) indicated that the collaboration and group initiatives such as farmer collectives have fruitfully penetrated the market with high value for underutilised leafy greens. Shackleton et al. (2009)'s study showed that rather than being used for subsistence indigenous vegetables are being. Farmers who are part of farmer groups gained profit of thirty-five to seventy two percent as compared to farmers who are not part of groups.

In Zimbabwe, a similar trend was observed on farmers and vendors in Mutare by (Ngwerume et al., 2000). There is a need for added value, in the application of cultivating and post-harvest technology which makes sure that products are of high quality in the market and meet customers' demand. In some countries in East Africa and Southeast Asia, a few select underutilised vegetables have increasingly become part of the diet for the more affluent sections of the citizens and are slowly migrating from the traditional ways to profit oriented ways (Nyaruwata, 2019). The strong market demand has attracted seed producing companies consider researching and develop these crops hence strengthening the seed industry.

#### **2.2.8 Value chain of indigenous vegetables.**

High engagement of women farmers and vendors in local vegetable marketing is highly recommended because little seed is needed to get started, so that even the poorest households can

participate (Nyaruwata, 2019). Thus, domestic vegetables have made a significant contribution to household income. Shackleton et al. (2009) indicated that strengthening institutional and cultural systems were used to satisfy food, medicine, and cultural needs. The traditional elderly relied on plant medicine (and insects and animal) for their health care to treat certain diseases, for beauty, nutrition, and spiritual and culture issues (Kimiye, Waudo, Mbithe, & Maundu, 2007). Due to globalization the growing generations has changed and more focused on exotic vegetables like rape, covo and spinach. While farmers are more focusing on cash crops such as cotton, tobacco and maize in Zimbabwe. Institutional and policy framework that slightly support local vegetables have made the growing of indigenous vegetables deteriorate. Shackleton et al. (2009) stated that Sub Saharan he agricultural education of Africa, both commercial and communal, is primarily geared towards the production of cash crops.

According to Nyaruwata (2019) cash crop agriculture encourages intensive agriculture and emphasizes the removal of all weed plant from the farmland. In Zimbabwe vegetables have not been supported, but at the same time supports the cultivation of tobacco and the implementation of fully funded programs that support grain production by providing inputs to incentivize farmers. The use of herbicides, which destroy wild and semi-cultivated underutilised vegetables, is also envisaged, and leads to biodiversity erosion (Nyaruwata, 2019). There is an attitude among advisors and researchers which is the same, of encouraging farmers to eliminate underutilized crops from their fields as weeds. With the same attitude it will lead to the gradual reduction of traditional knowhow and biological diversity. (Antonaci, Demeke, & Vezzani, 2014; Ayanwale & Amusan, 2014; Bakewell-Stone, 2013) explained Kenya, Ghana, Tanzania, Uganda, Cameroon and Nigeria have adopted at all levels for framework policies that support the conservation, production and marketing of underutilised vegetables. These policies have been implemented in these countries and have proven effective and produced results in all country households.

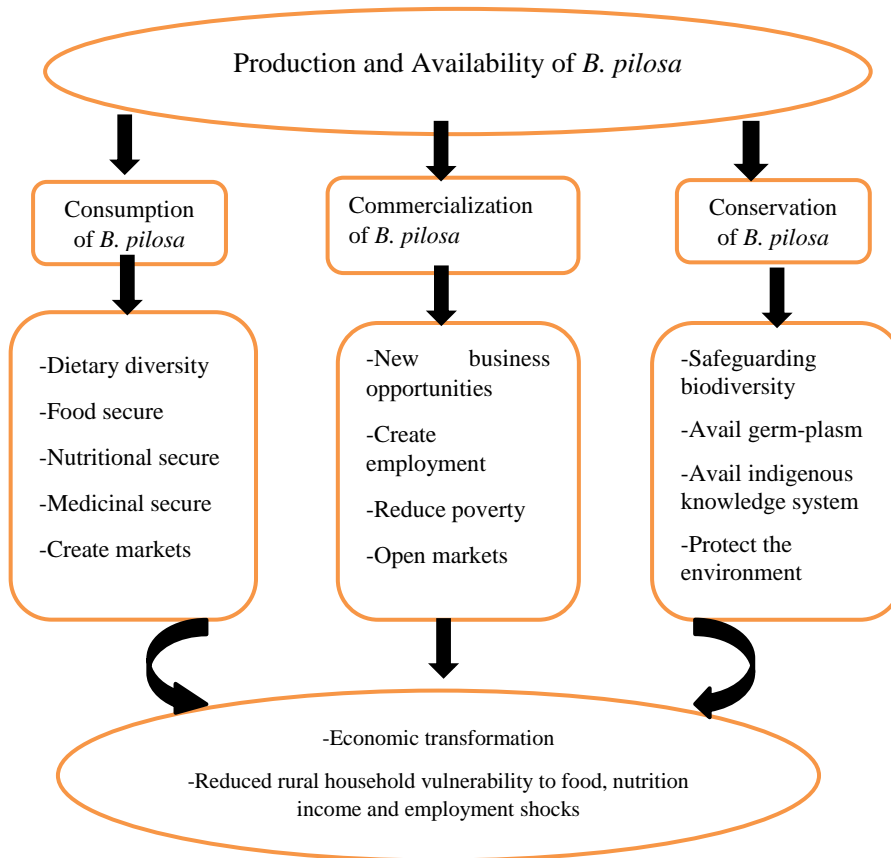
### **2.2.9 Factors determining increased consumption of underutilized vegetables.**

The perceptions of many households affect the consumption of underutilised vegetables (Vorster, 2009). Therefore, the times consumption of underutilised vegetables has reduced compared to years ago. According to Kimiye et al. (2007) found that it caused by the perception of people that underutilised vegetables were perceived as different in taste compared to exotic vegetables.

He asserted that reduced consumption of underutilised vegetables was linked to poor and pre-historical actions. Eating of traditional vegetables is gradually decreasing due to increasing pressure due social backwardness and poverty (Kimiye et al., 2007). (Vorster, 2009) explained that the general perception that these underutilized vegetables are impoverished explains the reason young people avoid underutilized vegetables. Majority of the underutilized vegetables have a unique flavor which is bitter (Ebert, 2014). As a result, the elderly tends to eat more local vegetables than young people. Studies have also shown that youth are not interested in eating local vegetables, believing them to be backward and outdated. Young people are less likely to prefer local vegetables due to the restricted methods of preparation, such as cooking, which is the most common. Intensity of consumption of underutilized vegetables is determined by socioeconomic determinants, such education, gender and years of head of house, market opportunities and monthly income of the family. (Vorster, 2009) pointed out that males are less likely to prefer eating local vegetables than females. Although, (Kimiye et al., 2007) found that choices for underutilised vegetables varies according to geographical location and cultural norms.

A study conducted by (Mthombeni, 2013) in South Africa found that means of living determines the preference and eating of vegetables. It has been found that more casual workers and the inactive consume more vegetables than employees (Nyaruwata, 2019). The type of livelihood affects time to purchase, prepare, and cook underutilised vegetables. Monthly household income has been found to affect consumption rates of underutilised vegetables (Kar, Bandyopadhyay, and Chatterjee, 2016). It showed that the low-income groups consumed more those that have a higher income (Nyaruwata, 2019). This is supported by a study done by Mpala, Dlamini, and Sibanda (2015) that further suggests that being available and accessible of underutilized vegetables affects their eating trends. The finding showed that eating of underutilized vegetables was restricted during scarcity times of what to eat and they were used supplement to essential usual foods.

## 2.3 Conceptual/theoretical framework/s



**Figure 2.2** conceptual framework for production and availability result in consumption, commercialization, and conservation contribution of *B. pilosa*.

## 2.4 Summary of literature Review

Chapter 2 has highlighted a vast of literature of *B. pilosa*. Firstly, an overview of *B. pilosa* in Africa discussed. Taxonomical classifications and Morphological presentation of genus *Biden* and *B. pilosa* L were elaborated. This chapter also explained application of *B. pilosa* and its safety for consumption. This chapter also explained application of *B. pilosa* and its safety for consumption. The domestication of domestication and economic importance of *B. pilosa* including the value chain was also explored. Different roles of indigenous vegetables were highlighted. Finally, reviews a number of empirical studies that have been done to assess the conceptual model linking production and availability of *B. pilosa* contributing to household income and food availability.

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## CHAPTER 3

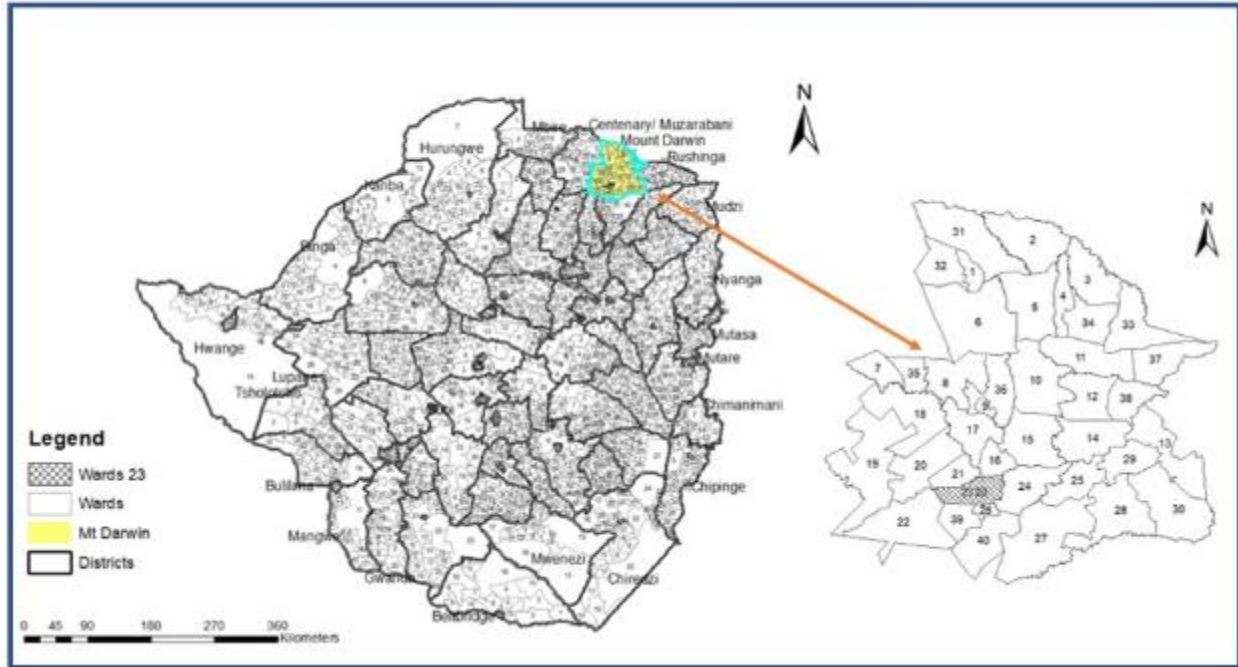
### METHODOLOGY

#### 3.1 Introduction

Chapter three develops methodology framework that was used to answer the research questions that were suggested in chapter one. This chapter firstly describes the study site of the research. Then the research design which was used then follows. This chapter then logically describes the sampling procedure, data collection procedure and data analysis procedure. Lastly the ethical considerations of the study were mentioned.

#### 3.2 Description of study site/s

The study was conducted in Zimbabwe, a country in southern Africa. In Zimbabwe, the study was conducted in Mt. Darwin, one of eight districts in Mashonaland Central Province in Zimbabwe. Mount Darwin is in the north-eastern part of Zimbabwe and is about 156 km north of Harare. It is bordered by Rushinga District to the east and Shamva to the south, Muzarabani to the west and Mozambique to the north. The district is the largest in central Mashonaland and is divided into 40 districts with six agricultural sectors. The specific study area for the purpose of this study was Ward 23. This community has a population of 2120 households. The zone is classified in Agroecological Region IV, which is characterized by low annual rainfall and very high temperatures. Soils are composed of loamy clay that is fertile for agricultural production. Minimum winter temperatures in the zone range from 15 to 25 °C in June–July, and summer maximum temperatures range from 35 to 40 °C in September–October (Tanyanyiwa & Kanyepi, 2015).



**Figure 3.1** Mt Darwin ward 23

### 3.3 Research design

This research used a survey research design because it a design that is used to gain greater understanding about a group perspective relative to a particular concept or topic of interest (Mills, 2021). The primary data is collected by a survey, which consist of a specific piece of information to be researched. Considering that the population is too large to observe, it then considered the best method to use (Nyaruwata, 2019). The population of ward 23 in Mt Darwin is 8,712 people and 2,120 households (ZIMSTAT, 2022). According to Babchuk and Badiee (2010), a descriptive survey aids to see things in their natural settings to get meanings. They also added that the descriptive survey design is most suitable to obtain and gather information where little is known about a phenomenon. The aim of the research was to assess the contribution of *B. pilosa* to the welfare of households in ward 23 of Mt Darwin, Zimbabwe. It needed collection of raw data from a sample of the communities in Mt Darwin. Mavengahama (2013) indicated that a survey research design is best for original data generation. The later also stated that it does not influence the research respondents, but it observes and describes the opinions and perceptions of the defined group. The results from the sample were generalized to the whole population. Hence the research design was cheap to collect data and completed in a short period of time.

### **3.4 Sampling procedure**

For this study, nonprobability methods were used to set out the sample. This study used a multistage sampling method. Firstly, nonprobability purposive sampling was used to select Mt Darwin district where *Biden Pilosa* is present and consumed by communal people in the area. Ward 23 was also purposively selected because it is near the business center and most farmers sell their produce at the market with the guidance of the District Agriculture Extension Officer. Then three villages were randomly selected in the ward. Snowballing sampling technique was used to identify farmers who produce *B. pilosa* and vegetable farmers. These farmers identified other farmers until the sample size was reached. 45 households in the three villages administered the questionnaire.

### **3.5 Data collection procedure**

The study combined both quantitative and qualitative data collection techniques. A structured questionnaire was used to collect data through personal interviews. Questionnaire is defined as a document with set of research information from a participant that is used for data synthesis (Best & Kahn, 2014). It is also a tool which is important to gather information from participants within a short space of time (Cohen, Manion, & Morrison, 2000). KOBO collect survey tool was used to collect data. Responses were assured because there were collected directly from the unit of analysis. The questionnaire did not require names hence promoting anonymity making respondent to respond freely.

Key informant interviews were conducted to village heads to get information regarding the contribution of *B. pilosa* to the welfare of households in ward 23. It is a survey of a select group of people who are likely to provide the information, ideas and insights needed on a specific topic. A feature of key informant interviews is particularly noteworthy when general, descriptive data is adequate for making decisions. Information like that relates to institutions and organizations, the socio-economic situations of a village or community or town or the general characteristics of the population's occupations, religion, practices and knowledge. Overall, information discription is crucial during when carrying out evaluations (Kumar, 1989).

The researcher visited all the sampled households one after another. The first thing was to do self-introduction, followed by explaining the purpose of the visit and lastly sought informed consent from the respondents. The consent was either signed or verbal. Then administer the questionnaire and lastly thank the respondents for taking their time on the survey.

### **3.5.1 Data reliability and validity**

#### **3.5.1.1 Reliability**

Validity, as defined by MacMillan and Schumacher (2001), is the extent to which the interpretations and concepts have mutual meanings between the researcher and the participants. On the other hand, according to Silverman (2004), reliability is an extent of research findings are unaffected by accidental occurrences. According to Joppe (2001), reliability is defined as the degree to which results are stable over time and are an accurate representation of the entire population that is the subject of the study. If the findings of a study can be replicated using the same research procedures, then the instrument in question is considered to have high levels of reliability. A pilot study was also used to guarantee the accuracy of the content by determining the degree to which the questions that were asked successfully elicited the required information. The reliability of the data was also ensured by obtaining permission to access the data and the complaints registry, as well as allowing members to freely participate in the research. This was done in conjunction with allowing members to access the data.

#### **3.5.1.2 Validity**

For the purpose of maintaining a high level of trust, particularly when dealing with the information that was provided by participants, the researcher wrote and documented the participants' responses. This ensured the validity of the qualitative data. The reliability of the research was not compromised in any way by the incorporation of additional opportunities for participants to be interviewed. The researcher vouched for the veracity of the survey's findings by establishing that they were derived from information obtained legitimately from the respondents themselves. The researcher understood the success of their investigation was dependent on the participation of volunteers. In order to verify the reliability of the study, the researcher also utilized triangulation. Triangulation is a method of verification that involves

researchers searching for concurrence among many and distinct sources of information to form topics or categories within a study. Triangulation is viewed as a verification procedure.

### **3.5.2 Pilot study**

The research conducted a pilot study to evaluate the validity and reliability of the research tools. In order to avoid potential pitfalls and make sure that the tools and methods used are appropriate for the study being conducted, this kind of pre-test data collection is used (Teijlingen & Hundley, 2001). Before releasing the main questionnaire, pilot studies are also conducted to make sure that respondents understand the questions and the wording used. This study aided the researcher in identifying and improving perplexing questions so that data collection would go smoothly. The results of the pilot study may also provide a definite indication of the reliability and validity of the collected data. According to Saunders, et al. (2009), more than 10 responses are needed for a pilot study to be valid. Eight people, or 10% of the required sample size of respondents, received the pilot study that was used for this study. The pilot study gave the researcher immediate feedback and helped her identify any questions that were unclear or ambiguous.

### **3.5.3 Triangulation**

In order to gather information relevant to this study, the researcher also used triangulation. In Ward 23 of Mount Darwin, the researcher interviewed three village heads using interviews. Triangulation is the process of studying a specific phenomenon using two or more data collection methods, according to Cohen, Manion, and Morrison (2000). As a method of verification known as triangulation, researchers look for patterns of convergence among numerous, disparate sources of data to create themes or categories for a study.

Babbie (2013) defended the use of the mixed or triangulation approach in research methodology by claiming that the other approach will be able to mitigate the shortcomings of the first. To gain insight into the rules governing whistleblowing as a way to combat corruption in Zimbabwean state-owned enterprises, the triangulation method was used for this research to collect and analyse data. The literature review, questionnaires, and interviews will serve as the study's three primary data sources. To combine qualitative and quantitative data, the researcher used methodological triangulation. To investigate a subject, methodological triangulation uses multiple types of procedures (Creswell and Clarke, 2011). There are two categories of

methodological triangulation: across method and inside the method. The researcher used an across-method to combine qualitative and quantitative data.

### **3.6 Data analysis procedure**

Research questions and objectives were validated with the help of the data that was collected. The process of validating the research involves determining whether the research questions and objectives can be confirmed or disproved based on how the results are presented. The data were manipulated using Excel and Statistical Package for the Social Sciences (SPSS) 21. The researcher made use of SPSS to conduct an analysis of quantitative data. Excel was used to input data and imported to SPSS, code it, and draw statistical graphs. The researcher used of content analysis to conduct qualitative data analysis. The purpose of content analysis, as a method of conducting research, is to ascertain the existence of particular words, themes, or concepts within a particular set of qualitative data (i.e. text). Researchers have the ability to quantify and analyse the presence of particular words, themes, or concepts by using content analysis. This analysis can also be used to investigate the relationships between these elements. To establish the consumption of *Biden Pilosa* and the frequency with which it was consumed, descriptive summary statistics were utilized. These statistics were also used to describe the demographic and socioeconomic profiles of the study population. Chi-square analyses were carried out to determine the nature of the connection that existed between certain socioeconomic and demographic factors, as well as household food security and dietary diversity.

### 3.6.1 Data presentation and analysis procedure

**Table 3.1 Data presentation and analysis procedure**

<b>OBJECIVE</b>	<b>Analytical tool</b>	<b>Data to analyse</b>
To determine availability and accessibility of <i>B. pilosa</i> in ward 23.	Excel	The availability and accessibility of <i>B. pilosa</i> .
To assess knowledge and practices of <i>B. pilosa</i> that exists within the community.	SPSS	Knowledge and practices of <i>B. pilosa</i> .
To determine consumption preferences of <i>B. pilosa</i> among communities and how it varies between age groups.	Excel	Consumption preferences of <i>B. pilosa</i> .
To determine the benefits of including <i>B. pilosa</i> in household diets in comparative to more utilized vegetables.	Content analysis	Advantages of consuming <i>B. pilosa</i> .
To investigate the socio-economic factors characterizing the production of <i>B. pilosa</i> and the impact of its production on farmers' welfare.	Content analysis	Socio-economic factors

### 3.7 Ethical considerations

Concerns of an ethical nature may arise during conducting a research study. According to Resnik (2011), the definition of ethics could be described as "the norms of conduct that distinguish between acceptable and unacceptable behaviour." As a result, ethical concerns were taken into consideration before, during, and after the actual research process in this study. The researcher began by requesting authorization from Bindura University of Science Education, and then moved on to requesting the consent of each individual respondent, which was demonstrated by signed consent forms that were inserted into the questionnaire. According to Bryman (2012), the identities of those who participated in the survey were always shielded from public view. In particular, the researcher was the only person who had access to the surveyed questionnaire, and the names of the participants were kept confidential throughout the research process. By citations

and references, the researcher demonstrated both academic integrity and honesty when acknowledging information that was taken from other sources.

Permission was sought from the area village heads of the study area. The questionnaires were administered to the respondents upon obtaining their written or verbal informed consent. Respondents were also told that the data collected will be confidential and private. The questionnaire did not require names hence promoting anonymity making respondent to respond freely. The researcher also made sure that the data is kept confidentially and only used for this research.

### **3.8 Summary**

Chapter three or methodology started by describing the study site of the research. Then the survey research methodology was justified. Sampling of the population was explained. Research instruments, which are the questionnaires, were explained with their relevance and strength. Then data collection procedure and data analysis procedure were discussed. Lastly the ethical considerations of the study were mentioned.

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## CHAPTER FOUR

### RESULTS AND DISCUSSION

(To determine availability, accessibility, knowledge and practices of *B. pilosa* in ward 23 Mt Darwin)

#### Abstract

*B. Pilosa* is regarded as an underutilized crop due to their limited use, it is regarded as one of the groups of indigenous or neglected crops. They serve as a symbol for regional food varieties that may be in some places but not in others. This study aimed to assess the contribution of *B. Pilosa* to the welfare of households in Ward 23 of Mt Darwin. Firstly, the study aimed to determine availability, accessibility, knowledge and perception of *B. pilosa* in ward 23 Mt Darwin. A structured questionnaire was used to gather information from 45 household heads and 3 village heads. According to research results from this study, 26% of respondents sell *B. pilosa*, while the majority (74%) do not. 53% of the respondents said they sell *B. pilosa* to the local market in their neighbourhoods, 26% to passersby at the road, and 21% to nearby restaurants. The study's findings indicate that most people living in Ward 23 of Mt Darwin do not consume *B. pilosa*. 74% of the total population is represented by this number. *B. pilosa* is frequently avoided by young people because they believe that doing so shows a lack of maturity or because the food is unavailable to them where they live. Because they are aware of the many health benefits connected with eating *B. pilosa*, the elderly particularly enjoys it. These advantages include *Biden Pilosa's* anti communicable diseases properties, which suggest the possibility of its use in the prevention of diabetes, hypertension, and obesity. These results suggest that the local market is where most of the *B. pilosa* sold in Mt. Darwin is sold. Today's children and adults generally learn about underutilised vegetables from their grandparents. This is because their grandparents first started consuming these vegetables a very long time ago. Most kids learned about underutilised vegetables from their grandparents as opposed to their parents. Underutilised vegetable production and consumption could increase because of the fusion of modern technology and traditional wisdom.

(*Biden Pilosa*, Underutilized, Welfare, Availability, Accessibility).

## 4.1 Introduction

*Bidens pilosa*, an annual broadleaf species, with a life cycle of one hundred and fifty to three hundred and sixty days, is described by Chauhan, Ali et al. (2019). It began in tropical America and had since aggressively spread throughout regions of the world with comparable climatic conditions (Mtenga and Ripanda, 2022). As a result, in addition to tropical America, they also grow in other regions of the world, including Africa (Conti et al., 2019). *Biden Pilosa* has turned into a troublesome weed in the field. According to Chauhan, Ali et al. (2019), it is typically found in gardens, along roadways, in crop fields, and in open waste areas. *B. pilosa* is accidentally introduced into the field during cultivating and knowingly to use in food and medicine. The economically vital crops of maize, cotton, rice, sugarcane, sorghum, and vegetables have been found to contain the common weed *Biden pilosa*. In some nations, including Nigeria, Benin, and Zimbabwe, it is grown on a small scale for food and medicine (Mtenga and Ripanda, 2022).

*B. pilosa* requires dry conditions for growth, but it can survive in low-humidity environments thanks to its sturdy taproot (Griffith et al., 2020). *B. pilosa* can tolerate dry conditions, but it does best in places that get between 500 and 3500 millimetres of rain a year (Rojas-Sandoval, 2020). This plant thrives in full sun and average annual temperatures between 25 and 38 degrees Celsius. The ideal germination temperature ranges from 25 to 30 degrees Celsius. Although it does not thrive in temperatures below 15°C or above 45°C, it is frost-tolerant and can recover from even -15°C temperatures at its roots. It does well in a wide range of pH soils (from 4 to 9), and it can withstand salinities of up to 100 mM NaCl. Seed germination and plant viability are both diminished by flooding. Though it is not fire-resistant, this species is notorious for rapidly colonising recently burned areas (ISSG 2018, PIER 2018).

## 4.2 Methodology

### 4.2.1 Description of study area

Research was done in the three villages depicted in Figure in ward 23 of the Mt. Darwin district in the province of Mashonaland Central. The average high in the summer is 24 C and the low in the winter is 15°C on Mt. Darwin. Summer months (primarily between November and February) see the bulk of the year's precipitation (an average of 650–800 millimetres). Tawodzera and

Ncube (2019) classify the area as falling between agro ecological Regions 4 and 5. The ward had an estimated population of 8712 people and 2120 households as of the 2022 census (ZIMSTAT 2022). In the previous section 3.2, an expanded description was provided alongside a study site map (figure 3.1).

#### **4.2.2 Research Design**

A survey was carried out to determine the extent to which *B. pilosa* had contributed to the economic well-being of small holder farmers located in ward 23 of Mt. Darwin, Zimbabwe. Please refer to the 3.3rd section of Chapter 3 for any additional information.

#### **4.2.3 Sampling procedure**

The research study used purposive and snowball sampling techniques to determine the individuals who will responded to the research questionnaire. The research study targeted people in the Mt. Darwin district. Please refer to section 3.4 for further information regarding the sample size as well as the sampling method.

#### **4.2.4 Data collection procedure**

The research study gathered both primary data (information collected in the survey and key informant interviews) and secondary data (empirical reviews from other scholars and researchers). Both types of data were used in the analysis. This information was subsequently utilized for data triangulation. Section 3.5 of the chapter provides further elaboration on the process of data collection and contains additional information.

#### **4.2.5 Data analysis procedure**

The procedure for data analysis starts with the data management process, which includes cleaning the data and exporting it for analysis using the Statistical Package for the Social Sciences version 21 (SPSS 21). The researcher also made use of the content analysis for qualitative data and Excel quantitative data analysis. Excel was used to input data, code it, and exported to SPSS. The purpose of content analysis, as a method of conducting research, is to ascertain the existence of particular words, themes, or concepts within a particular set of qualitative data (i.e. text). Researchers have the ability to quantify and analyse the presence of

particular words, themes, or concepts by using content analysis. This analysis can also be used to investigate the relationships between these elements.

#### **4.2.6 Challenges encountered during data collection.**

Because of the researcher's reliance on the recommendations of other people, the process of data collection was painfully slow. Another difficult task was establishing whether the sample size accurately reflected the total number of people in the population.

Researchers in Zimbabwe decided to communicate in English, Ndebele, and Shona despite the fact that a significant number of the country's immigrants have a limited command of the English language. People who were unable to communicate in their preferred language provided answers that were either inappropriate or incorrect, which led to the collection of inaccurate information. There is a need for interpreters to make translations wherever there is a requirement for them so that language barriers can be avoided.

#### **4.3 Response rate**

This investigation, like any other, received a variety of responses from the people who participated in the survey, which led to an overall response rate of 100%. According to Table 4.1, a total of 45 questionnaires were administered to the farmers in Ward 23 of Mount Darwin; however, 45 of those questionnaires were deemed appropriate for analysis. Two different questionnaires were disqualified from the study for one of two reasons: either they contained multiple responses in areas that only accepted a single response, or some of the questions were unanswered in those questionnaires. The researcher had to redo two questionnaires to meet the sample size. Because of this, the overall response rate ended up being 100% after everything was said and done.

**Table 4.1** Response rate

	Issued Out	Returned	Response rate
Questionnaire	45	45	100%
TOTAL	45	45	100%

*Source: Primary data*

According to Saunders et al. (2011), a response rate of 80 percent or higher is considered to be both excellent and valid for the purpose of generalising findings. Considering this recommendation, a response rate of 80 percent is considered to be outstanding; consequently, the researcher considered the responses that were provided in the study to be appropriate for analysis. Sifile, Mazikana, Bhebhe and Chavunduka (2018) noted that a response rate of 50% or above is appropriate for data analysis and reporting. Response rate of 60% is good and a response rate of 70% and over is excellent, therefore, this justifies the response rate of 100% for this study.

#### **4.4 Reliability test**

Cronbach's Alpha was used by the researcher to determine the reliability of the research instrument in order to ensure that adequate and reliable data were collected. This was done after the researcher had determined the reliability of the research instrument. In the following section, Table 4.2, it can be seen that a Cronbach's Coefficient Alpha of 0.911 was achieved. Scales of 0.7 and above indicate that the reliability of the instrument is satisfactory, which accords with the findings that were discovered by Saunders, Lewis, and Thornhill (2009). These findings are consistent with those that were discovered by those researchers. High alpha figures, as stated by Zach (2021), indicate that the reliability is very good. It is because of this recommendation that the statements regarding the availability and accessibility of *B. pilosa*, consumption preferences of *B. pilosa*, benefits of *B. pilosa*, socio-economic factors, and community's knowledge and practises of *B. pilosa* were found to be reliable for analysis and generalisation on the population that was the focus of the study.

**Table 4.1** Reliability test

Construct	Cronbach's Alpha if Item Deleted
Reliability Test for availability and accessibility of <i>B. pilosa</i>	.935
Reliability Test for knowledge and practices of <i>B. pilosa</i>	.995
Reliability Test for consumption preferences of <i>B. pilosa</i>	.929
Reliability Test for benefits of <i>B. pilosa</i>	.962
Reliability test for socio-economic factors of <i>Biden Pilosa</i>	.963
Number of items	20
Cronbach's Alpha	.911

Source: Primary data

Cronbach's Alpha	Internal consistency
$0.9 \leq \alpha$	Excellent
$0.8 \leq \alpha < 0.9$	Good
$0.7 \leq \alpha < 0.8$	Acceptable
$0.6 \leq \alpha < 0.7$	Questionable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

**Figure 4.1** Cronbach's alpha interpretations. Source: Zach (2021)

#### 4.5 Sampling adequacy

The researcher performed the sampling adequacy test by Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity in order to determine whether or not the data collected was sufficient and suitable for hypothetical analyses such as ANOVA. According to Table 4.3, the KMO statistic of 0.832 was achieved, which is noticeably greater than the critical significance level of 0.5 (Field, 2000). According to Field (2000), an adequate and appropriate data set is supposed to have a value that is greater than 0.5. In addition to this, Bartlett's Test of Sphericity achieved a Chi-Square value of 421.912 with 27% of freedom, indicating that it was significantly higher

than expected. For the purposes of this investigation, the findings concerning the appropriateness of the sampling offer an excellent justification for the continuation of the statistical analysis that has been planned.

**Table 4.2** Sampling adequacy

Test	Coefficient
Kaiser-Meyer-Olkin Measure	0.832
Bartlett's Chi-Square	421.912
Bartlett's df	27
Bartlett's Sig.	0

*Source: Primary data*

## **4.6 Results and Discussion**

### **4.6.1 Demographic factors**

#### **4.6.1.1 Distribution of respondents by gender**

In this section, the researcher will outline and discuss about the demographic characteristics of the 45 households that were sampled. As can be seen in table 4.4, the gender distribution of those in charge of households is not balanced. This was distinguished by a high proportion of male heads of households, which made up 62% of all households, compared to only 38% of female heads of households. This male dominance of household heads was consistent across all three of the different villages. According to Dube (2016), males in Zimbabwe hold a relatively high share of the country's formal occupations, while women hold a relatively high part of Zimbabwe informal jobs, with a ratio of 6:4, male to female, respectively.

**Table 4.3 Gender of household heads distribution in 3 Villages**

Gender of household head		Frequency	Percent	Valid Percent	Cumulative Percent
Female Valid	Chitenda	8	47.1	47.1	47.1
	Mushonganzou	5	29.4	29.4	76.5
	Zebhedia	4	23.5	23.5	100.0
	Total	17	100.0	100.0	
Male Valid	Chitenda	7	25.0	25.0	25.0
	Mushonganzou	10	35.7	35.7	60.7
	Zebhedia	11	39.3	39.3	100.0
	Total	28	100.0	100.0	

*Source: Primary data*

#### **4.6.1.2 Distribution of head households by level of education and gender**

The level of education the area under study was dispersed across all levels of education, with 42.2% of heads of households having reached the primary level of education, 46.7% having reached the secondary level of education, and 11.1% having reached the tertiary level of education. According to what is shown in table 4.2, the distribution of female education was as follows: 52.9% of reached at least the primary level of education, 35.3% reached at least the secondary level of education, and 11.8% reached the tertiary level of education. Although only 10.7% of the men in the sample had tertiary education, 53.6% of the males in the sample had at least a primary education, 35.7% had an elementary education, and 53.6% had a secondary education. The respondents' educational backgrounds indicate that they have a thorough understanding of the topic at hand and are able to provide information in a condensed form. Kothari (2014) continues by saying that respondents with a basic education have a greater chance of providing reliable and objective findings in the event that a survey is conducted. As a result, this investigation was able to obtain information that was objective on the subject matter thanks to the respondents.

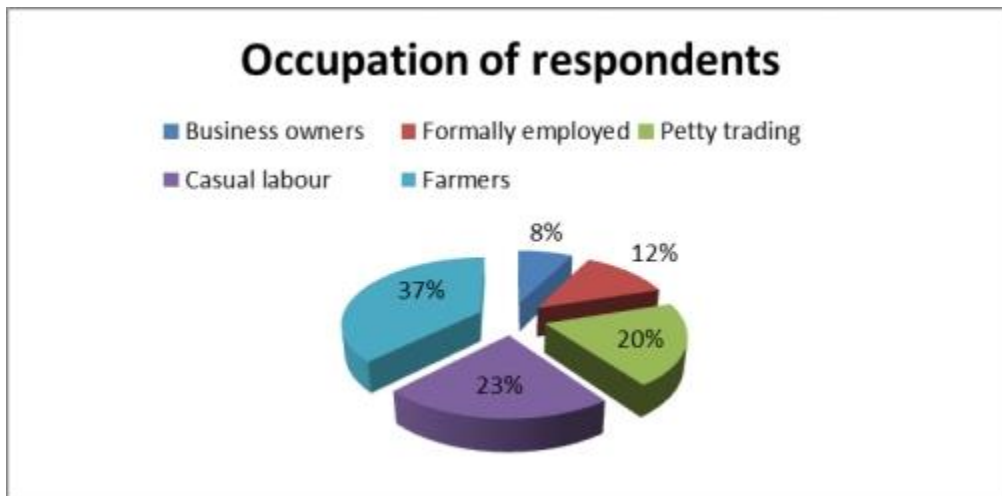
**Table 4.4 Distribution of respondents by level of education**

Level of Education of household heads		Frequency	Per cent	Valid Percent	Cumulative Percent
Female Valid	Primary	9	52.9	52.9	52.9
	secondary	6	35.3	35.3	88.2
	Tertiary	2	11.8	11.8	100.0
	Total	17	100.0	100.0	
Male Valid	Primary	10	35.7	35.7	35.7
	secondary	15	53.6	53.6	89.3
	Tertiary	3	10.7	10.7	100.0
	Total	28	100.0	100.0	

Source: Primary data

#### 4.6.1.3 Distribution of respondents by occupation

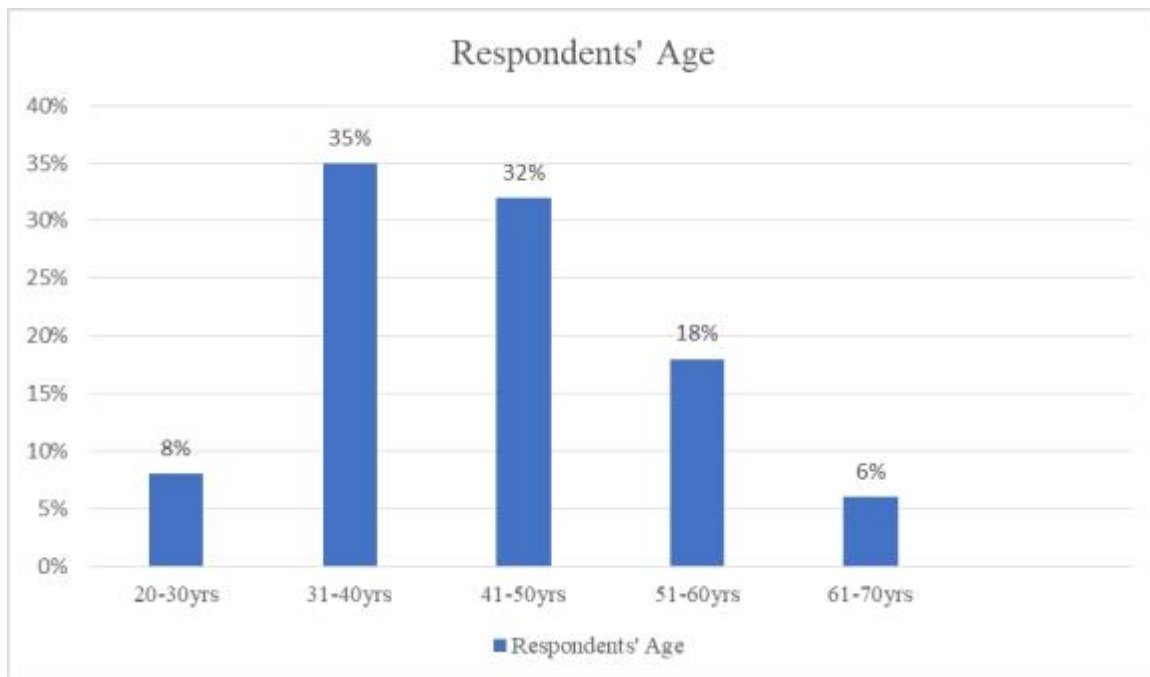
8% of the head of households owned a business, those that were formally employed and getting help from children were 12% each of the sample, 20% do petty trading, 23% engage into casual labor whilst the remaining 37% are farmers.



**Figure 4.2** Distribution of respondents by occupation. Source: Primary data.

#### 4.6.1.4 Distribution of respondents by age

In addition, the participants were questioned further about their age range. The researcher wanted to find out how old the respondents were on average and whether or not their age would be a good indicator of the quality of the findings that would be obtained. Figure 4.3 shows that 35% of the respondents fell into the age range of 31-40 years old, 32% of the respondents fit into the age range of 41-50 years old, 18% of the respondents fit into the age range of 51-60 years old, 8% of the respondents fit into the age range of 20-30 years old, and 6% of the respondents fit into the age range of 61-70 years old. The vast majority of those who participated were still in their younger years. These findings lend credence to the assertion made by Smith (2017), which states that the age bracket of 20 to 45 years old is knowledgeable about various farming techniques.

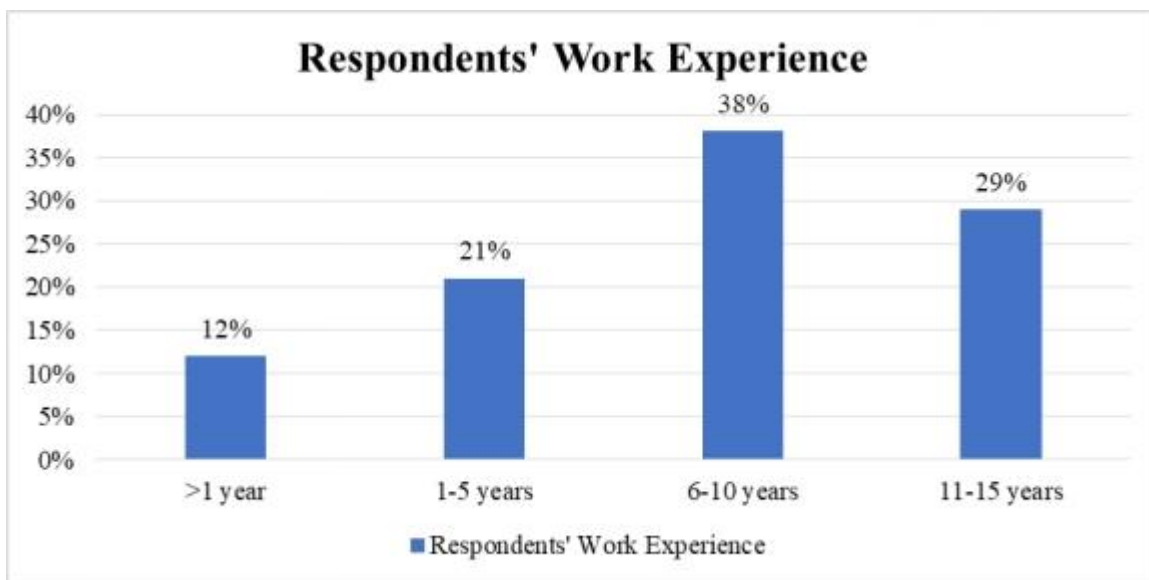


**Figure 4.2** Distribution of respondents by age. *Source: Primary data*

#### 4.6.1.5 Distribution of respondents by working experience

Since it was gathered that the respondents were well versed in the subject matter academic wise, the study then sought to determine if the respondents of the study had enough exposure or experience on the subject matter. In that case, therefore, the respondents were asked to indicate

their work experience. As presented in Figure 4.4, shows that 38% of the respondents had work experience that ranged from 6-to 10 years, 29% of the respondents had work experience that ranged from 11-15 years, 21% of the respondents had work experience that ranged from 1-5 years and 12% of the respondents had less than 1-year work experience. Mungenda and Mungenda (2010) postulate that experienced respondents have higher chances of providing factual findings than individuals that are not experienced in the research matter. In the context of the current investigation, therefore, the respondents were well experienced and capable of providing factual findings, thus enhancing the reliability of the investigation.

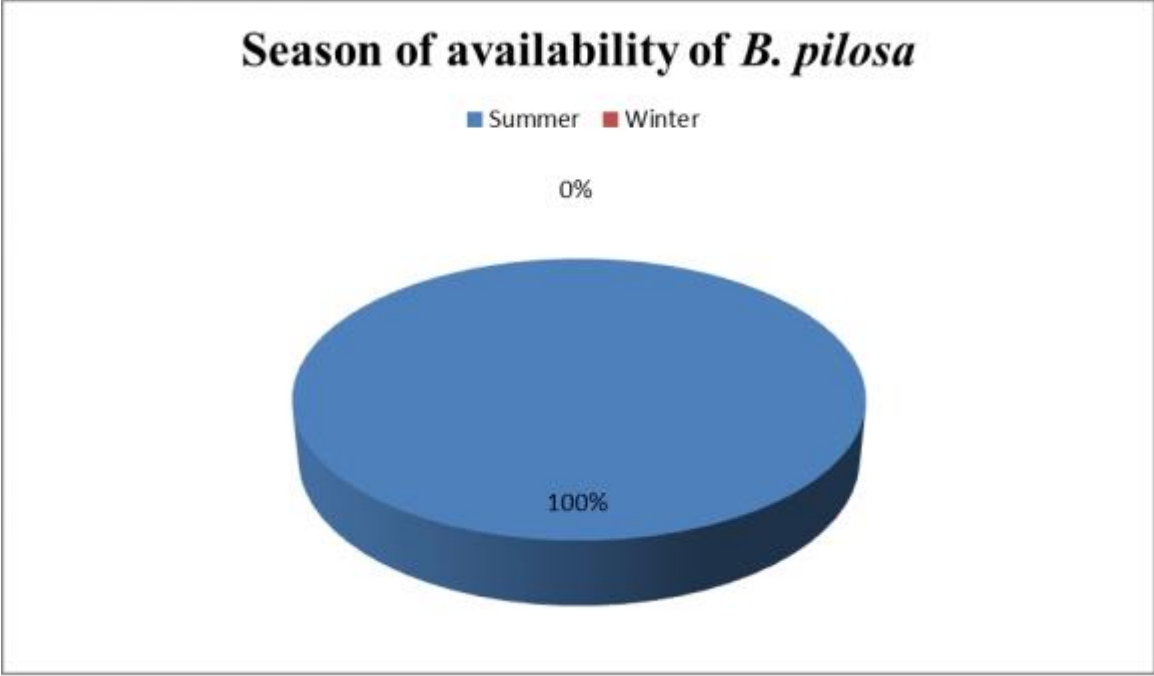


**Figure 4.4** Distribution of respondents by working experience. *Source: Primary data*

#### **4.6.2 Availability and accessibility of *B. pilosa* in Ward 23 of Mt Darwin**

##### **Season of availability**

Findings have indicated that respondents consume *B. pilosa* mostly during the summer season as compared to the winter when it will be scarce. All of the participants indicated that they consume and produce *B. pilosa* mostly during the summer season as compared to the winter season. The results of these findings are shown in the Figure 3.5.



**Figure 4.5** Availability season of *B. pilosa*. Source: Primary data

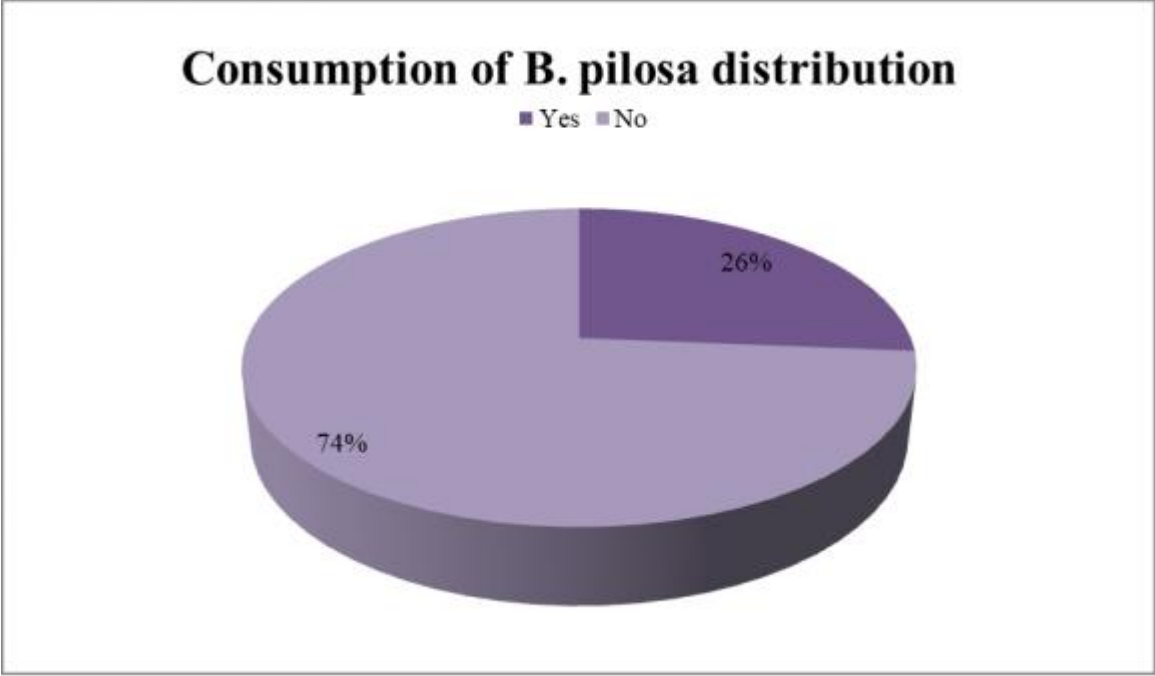
These results are consistent with those of Tarivunga and Nengovhela (2015), who found that *B. pilosa*, was hard to come by in the participant's homestead gardens during the data collection. Given that the data was gathered in the winter, this may have been a result of seasonal variations. Participants said that in the Vhembe District of South Africa, *B. pilosa* typically grows during the summer. Tarivunga and Nengovhela (2015) also reported that the Eastern Cape's rural residents had limited access to indigenous vegetables during the winter. *B. pilosa's* seasonal scarcity can lower demand because hypertensive patients may not have the funds to buy it or not find in the markets. *B. pilosa's* shortage also affects consumption because hypertensive players will consume the stipulated dosage. Regular eating of *B. pilosa* lessens the power to control hypertension because users may not be able to get enough of the drug's therapeutic activity. Although it has been found that South Africans who live in rural areas are likely consume underutilised vegetables, this trend is shifting due to a lack of supply (Bond et al., 2021). The extensive development that is taking place across the nation, in both rural and urban areas, may have an impact on unavailability.

This study found a small percentage of hypertensive participants who consumed preserved *B. pilosa*. This might be because people believe that dried vegetables or *B. pilosa* are linked with

being poor. Consuming both dried vegetables, however, is advantageous because they don't contain preservatives that could be harmful to your health. *B. pilosa* was being consumed by the hypertensive participants and their family members. *B. pilosa* consumption by the entire family may encourage hypertensive participants to eat more, leading to the achievement of the highest levels of health-beneficial compounds, which are necessary in the prevention of conditions like hypertension.

### **The consumption of *B. pilosa* distribution**

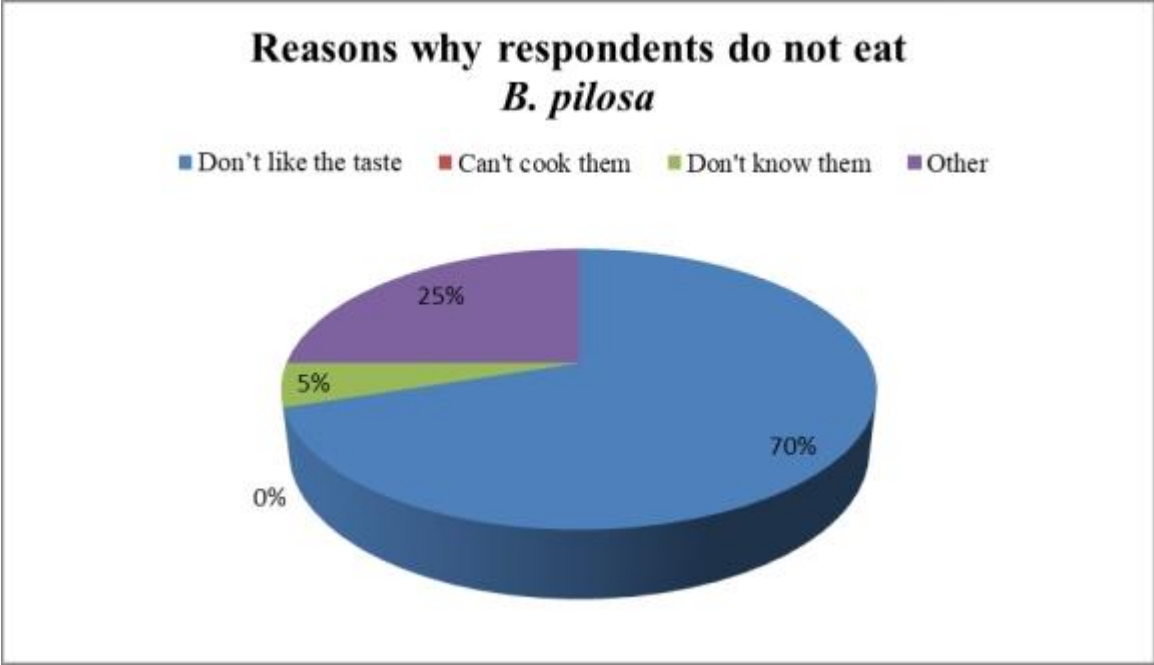
In order to determine whether or not the respondents partake in *B. pilosa*, they were asked if they eat *B. pilosa*. From the sample, 26% of the respondents indicated that they consume *B. pilosa* for several different reasons, whereas 74% of the respondents indicated that they do not consume *B. pilosa*. According to the findings, 26% of respondents who consume *B. pilosa* are between the ages of 51 and 70 years old. This finding suggests that older people, as opposed to younger people, are the primary consumers of *B. pilosa*. Children have active taste as a result; they avoid eating foods with a bitter taste (Zapata-Pérez et al., 2021). In contrast, adults do not have active taste buds and their taste buds are not replaced each time they grow. As a result, older people have a greater propensity to consume a greater quantity of indigenous vegetables than younger people do. From the 74% of respondents who do not eat *B. pilosa*, a variety of reasons why they do not eat *B. pilosa* were raised. The results are depicted in the Figure 5.6.



**Figure 4.6** The consumption trend of *B. pilosa*. Source: Primary data

**Reasons why respondents do not eat *B. pilosa***

The researcher aimed to determine the reason why respondents do not eat *B. pilosa*. The majority of respondents represented by 70% indicated that they don't like the taste, 25% other reasons for not eating *B. pilosa*, 5% indicated that they do not know them and none of them indicated that they cannot cook *B. pilosa*. The results are shown in the Figure 6.7.

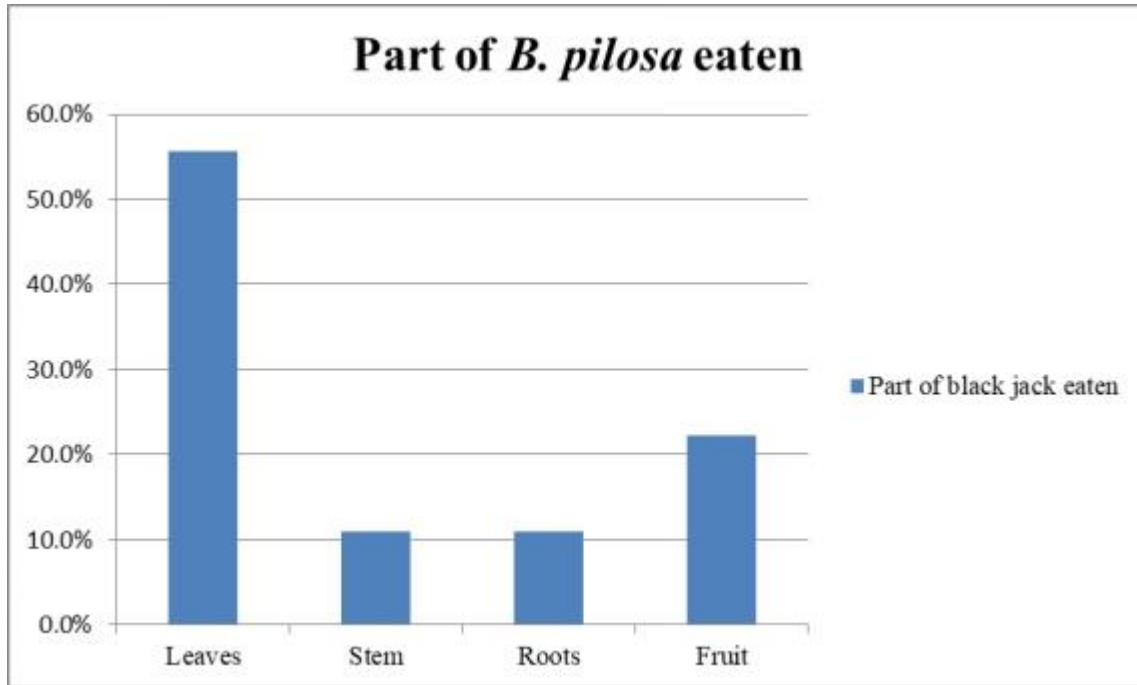


**Figure 4.7** Reasons why respondents do not eat *B. pilosa*. Source: Primary data

The majority of those who participated in the survey stated that they do not consume *B. pilosa* for a variety of reasons, the most common of which are the beliefs that *B. pilosa* is not fit for human consumption and that its flavor or taste is unpleasant. According to Vorster (2019), the eating of indigenous vegetables is influenced the perceptions that most households have. Therefore, there has been a gradual decline over time in the number of underutilised vegetables that are eaten on a regular basis. According to Kimiywe, Waudu, and others' (2017) research, the situation arose because of the perception people have towards indigenous vegetables are considered to have a taste that is inferior to that of foreign vegetables. He asserted that a low consumption of indigenous vegetables is linked to a lack of wealth and to practices that are considered archaic. Since indigenous vegetables are associated with the idea of social backwardness and poverty, their consumption is coming under increasing pressure (Bond et al., 2021). According to Vorster (2019), the overall perception is that it is for the poor or as evidence of historical culture explains why younger members of households avoid eating indigenous vegetables. The majority of underutilised vegetables have a distinct flavour that is often described as being bitter.

**Part of *B. pilosa* eaten by respondents**

The researcher sought to determine the part of *B. pilosa* that was eaten by the respondents. 55.6% of the respondents eat leaves, 11.1% of them eat the stem, 11.1% eat roots and the remaining 22.2% eat the *B. pilosa* fruit. The results are shown in the figure 4.8.



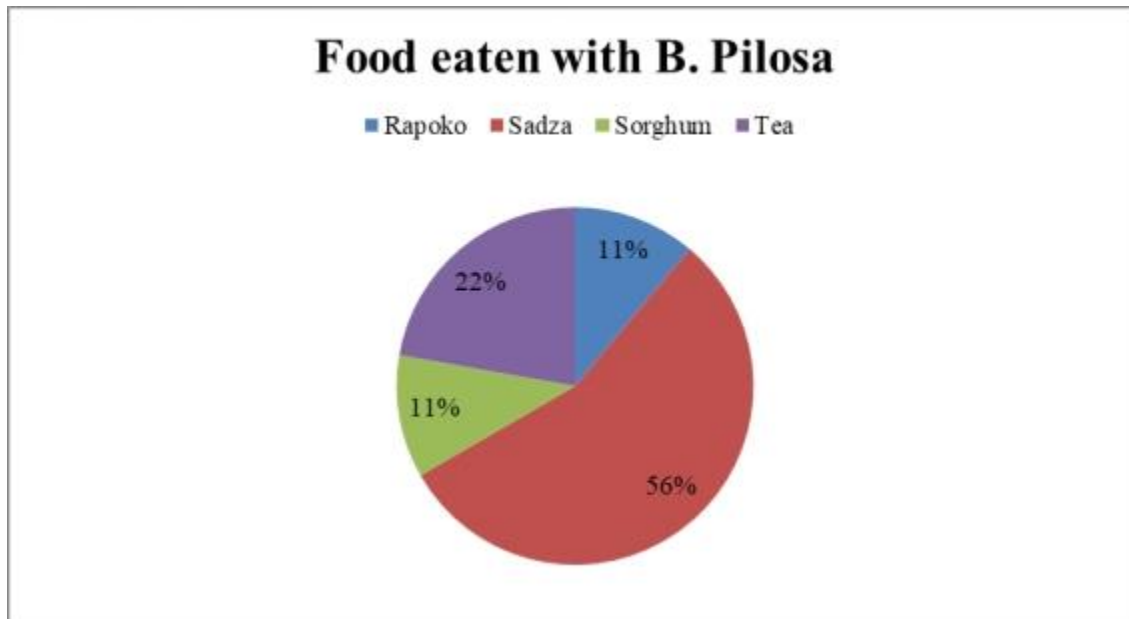
**Figure 4.8** Part of *B. pilosa* eaten by respondents. *Source: Primary data*

The majority of those who responded in the survey and eat leaves consider them to be vegetables. Because of the many different nutrients that they contain, eating vegetables is beneficial to one's health and helps to protect the body. Vegetables are "protective foods" due to the fact that they contribute necessary micronutrients and vitamins to the diet (Nyaruwata, 2019). They contain a high concentration of phytochemicals, which have been associated with a lower risk of cardiovascular, digestive, and colon cancer, as well as a reduced risk of anaemia, weariness, blindness, and other immune-related conditions. According to the findings of the World Health Report from the year 2002, a lack of fruit and vegetables in one's diet is to blame for approximately 31% of ischemic heart disease and 11% of strokes worldwide. If the consumption of fruits and vegetables were to significantly rise, it is approximated that up to 2.7 million lives could be saved annually. Underutilised vegetables are only found in a particular region, they have a low acceptance rate, and they are a part of the subculture. As a result, *B.*

*pilosa* plants are counted among the indigenous vegetables that are consumed primarily by rural communities in a variety of countries and regions across the globe.

### **Food eaten with *B. Pilosa*.**

This was to determine the type of food that respondents use to eat *B. pilosa* with. The respondents indicated that they eat *B. pilosa* with rapoko, sadza, sorghum and they used it for tea. The majority of respondents represented by 56% indicated that they eat *B. pilosa* with sadza, 11% eat it with rapoko, 11% eat it with sorghum and 22% use it for tea. The results are shown in figure 4.8 below.



**Figure 4.9** Food eaten with *B. pilosa*. Source: Primary data

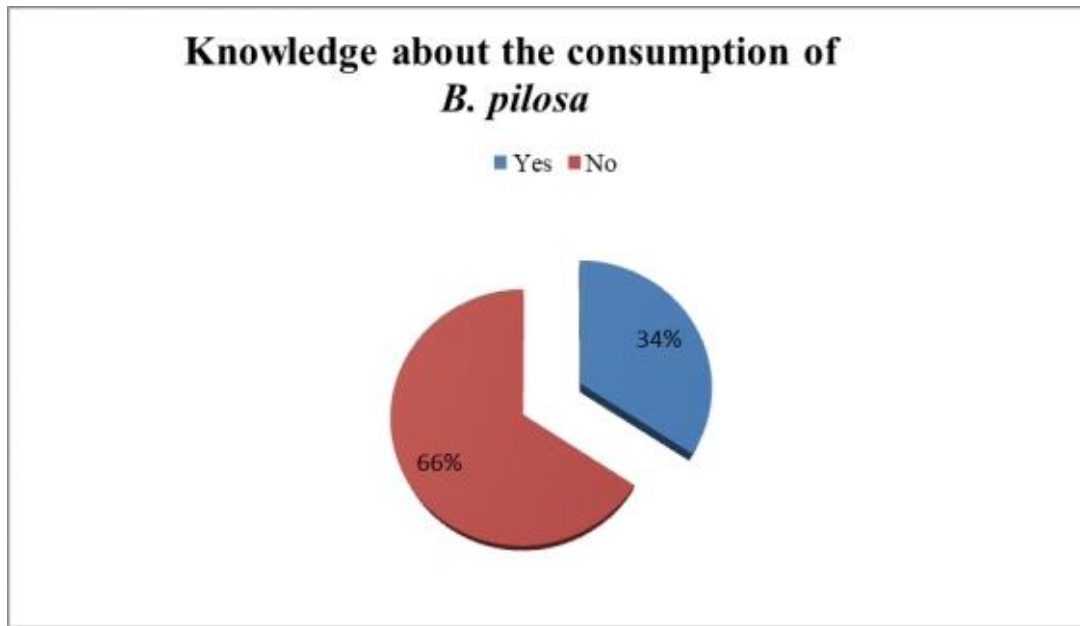
In some African countries, *B. pilosa* can also be used as a spice, vegetables for sadza and the leaves and stems can be used to make herbal tea (Amiri & Berndtsson, 2020). According to the findings of other researchers, the leaves can be used to make both tea and juice from the *B. pilosa* plant. The use of natural products that have medicinal properties has been used traditionally in a number of countries, most notably in Africa, for the treatment of nutritional anaemia, the improvement of blood flow, the prevention of malaria, the relief of toothache pain, the improvement of eye health, and the healing of wounds, including wounds that are experienced by HIV patients. According to Arthur et al. (2022) and Benli et al. (2018), the

current need on a global scale to transition away from synthetic drugs that have a long-lasting effect and towards naturally occurring herbs that break down quickly is preferable.

#### **4.6.3 An assessment of the knowledge and practices of *B. pilosa* that exists within the community.**

##### **Distribution of respondents' *B. pilosa* medicinal knowledge**

66% of the people who took the survey were unaware of the significance played by *B. pilosa*, while thirty-four percent of the people said they were aware of the significance of *B. pilosa*. 34% of the people who took part in the study were under the impression that *B. pilosa* have no medicinal properties. The number of participants who reported that *B. pilosa* can help with hypertension and diabetes, respectively, was 40.8% and 28.8% of those who said *B. pilosa* can help as disease treatment. Of the participants who indicated that more than one disease or condition, 9.6% said *B. pilosa* can aid with both diabetes and hypertension, and 6.4% said that *B. pilosa* can help with hypertension and constipation respectively. While 34.9% of the participants did not know how much *B. pilosa* a person should eat daily, 46.5% said that one cup of *B. pilosa* should be consumed every day. The results of the study are presented in the Figure 7.10 below.

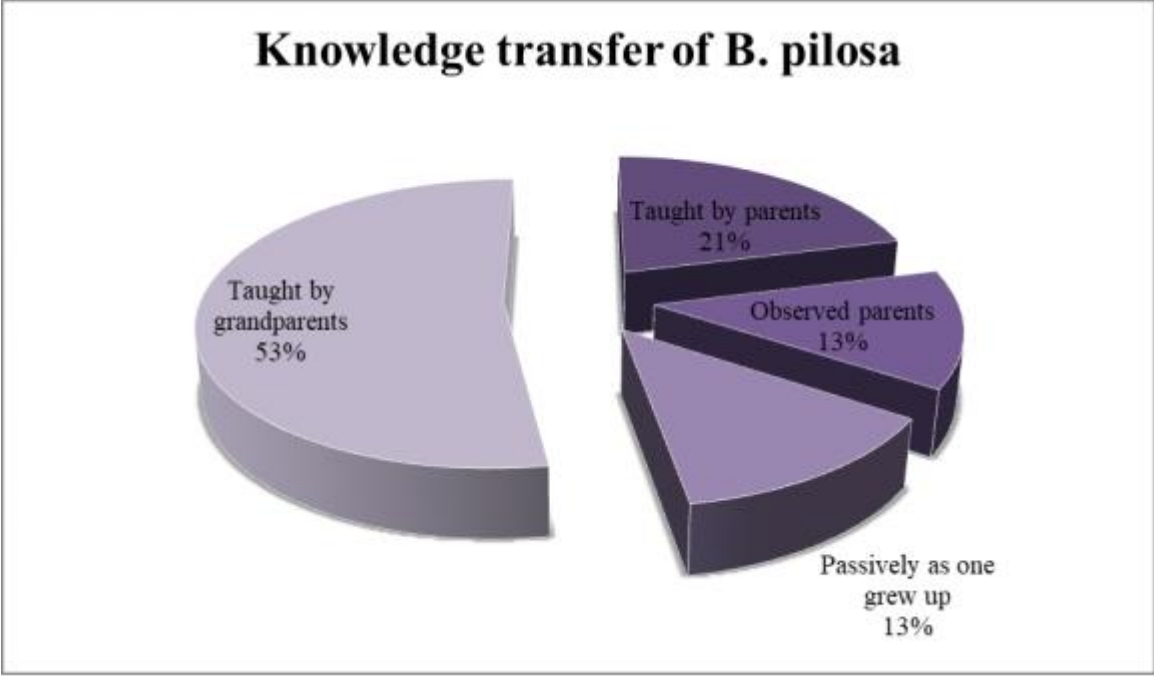


**Figure 4.10** Knowledge about the consumption of *B. pilosa*. *Source: Primary data*

**Knowledge about *B. pilosa***

**Knowledge transfer of *B. pilosa* for example how to cook them.**

The researcher aimed to determine how the respondents knew about how they knew about *B. pilosa* and how to cook them. 53% of the respondents indicated that they were taught about *B. pilosa* by their grandparents, 13% observed it from parents, 13% observed it passively as they grew up and 21% were taught by their parents. The result of this study is shown in the figure below.



**Figure 4.11** Knowledge transfer of *B. pilosa*. *Source: Primary data*

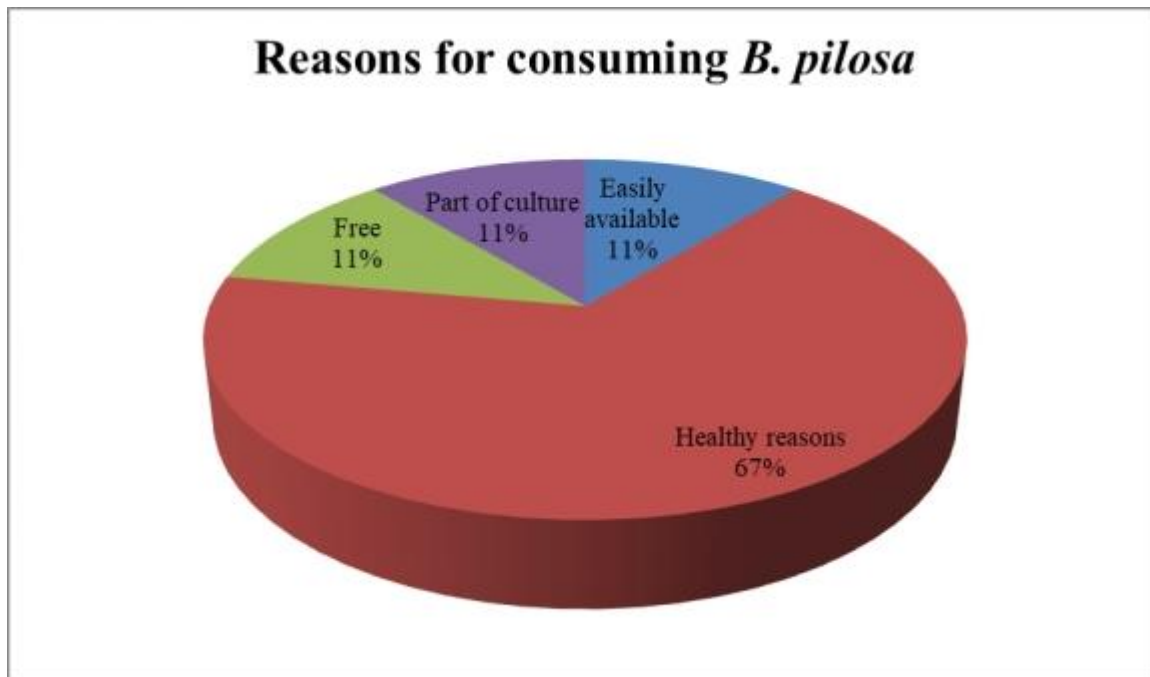
Consumption of vegetables is low among children overall, with the pre-school years appearing to be particularly difficult for picky eaters (Anitha et al., 2022). It is common knowledge that early in one's life, repeated exposure to a new vegetable will encourage greater consumption of that vegetable; however, recent research has revealed that individuals respond to familiarisation in a variety of ways. Vegetable consumption in children is significantly lower than what is recommended, even though there are clear health benefits associated with increased consumption. Children have a strong aversion to vegetables, and when they are given the choice, pre-scholers select something other than vegetables for their lunch. Children prefer foods that are high in energy density, and they appear to accept sweet taste more readily than bitter taste from the moment they are born (Voster, 2007). Because of this, most today's children and adults learn about underutilised vegetables from their grandparents. This is due to their grandparents began eating these vegetables a very long time ago. When compared to their parents, most children learned about underutilised vegetables from their grandparents (Liu & Modir, 2020).

#### 4.6.4 Determination of consumption preference of *B. pilosa* among communities in Ward 23 of Mt Darwin and how it varies between age groups.

##### Reasons for consuming *B. pilosa*

Participants in this study had a notable habit of consuming *B. pilosa* once per week when it was in season. The results are supported Duncan (2014) and Thamaga-Chitja, et al. (2011), who found that rural residents of the Eastern Cape and Kwazulu Natal provinces consumed underutilised vegetables like *B. pilosa* 1-2 times per week during the summer. Because of shortages within households or the availability of other local vegetables, *B. pilosa* consumption may only occur once a week.

Findings of the study show that 67% of *B. pilosa* consumers consume it for health reasons, 11% consume it because it is easily available, 11% consume it for health reasons and the remaining 11% consume it because it is free. These findings are shown in the Figure 8.10.



**Figure 4.12** Reasons for consuming *B. pilosa*. Source: Primary data

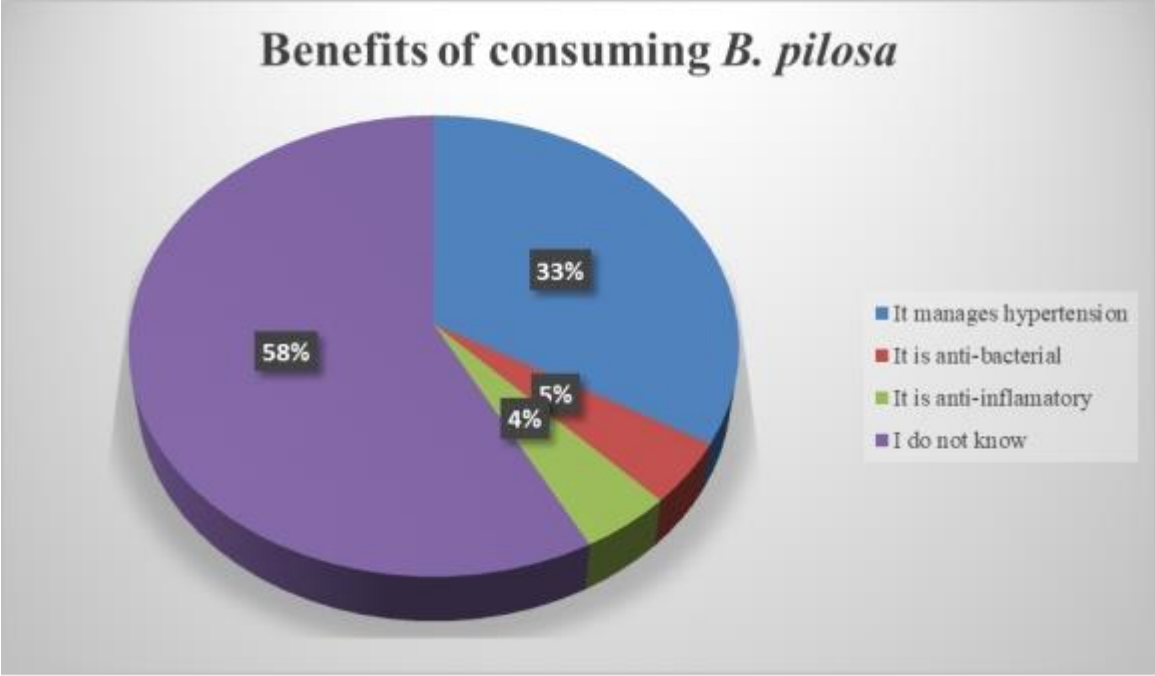
In a study by Sanoussi et al. (2015), participants' main reasons for eating *B. pilosa* in their study were that it is a readily available and easily to cook vegetable that is culturally acceptable and

easily accessible in the Vhembe district. In contrast, Sanoussi et al. (2015) stated that all participants in their study examining three underutilised vegetables in Benin reported consuming *B. pilosa* for health reasons. Differences in the results of this study and those of Sanoussi et al. (2015) may be due to a lack of awareness of *B. pilosa* consumption among hypertensive patients in Vhembe District, South Africa. Benin has a strategic plan for food and nutrition development that uses a multi-sectoral approach to raise awareness in communities about the consumption of indigenous foods, which includes *B. pilosa* (Liu & Modir, 2020). Educating hypertensive patients about the importance of *B. pilosa* can improve its consumption. With better nutritional knowledge of *B. pilosa* and improved consumption, blood pressure can be altered towards normal levels. This is consistent with the notion that health status can be determined by a person's level of knowledge (Conti et al., 2019). The higher the level of knowledge, the better the state of health.

#### **4.6.5 Determination of the benefits of including *B. pilosa* in household diets in comparative to more utilized vegetables**

##### **Medicinal Benefits of including *B. pilosa* in the diet.**

This was to test the knowledge of interviewees if they are aware of the health benefits of consuming *B. pilosa*. The majority of the respondents represented by 58% did not know the health benefits of including *B. pilosa* in their diet, 33% of them indicated that *B. pilosa* manages hypertension, 5% indicated that it is anti-bacterial and the remaining 4% indicated that it is anti-inflammatory. The findings of this study are shown in the Figure 9.13.



**Figure 4.13** Medicinal Benefits of including *B. pilosa* in the diet. *Source: Primary data*

The majority of the participants had a limited understanding of the nutritional advantages of *B. pilosa*. According to Taruvunga and Nengovhela (2015) and Gido, et al. (2017), people in the rural areas of in the South Africa and Kenya, respectively, had knowhow indigenous vegetables importance to one's health, including *B. pilosa*. Elders usually have indigenous knowledge; however, the respondents did not know anything about *B. pilosa* or the health benefits associated with it. It is possible that recent innovations and the stigma associated with the consumption of indigenous foods are to blame for the participants in this study lacking nutritional knowledge about *B. pilosa*. Because of its long-standing association with financial hardship, *B. pilosa* has a relatively low level of popularity among gamblers today. People have been substituting exotic vegetables, like covo, for underutilised vegetables like *B. pilosa* (Gautheron & Jéru, 2021). In addition, there may have been less information of the significance of *B. pilosa* to wellbeing in the Ward 23 area of Mount Darwin, which may have contributed to the participants' lack of knowledge regarding the significance of *B. pilosa* to nutrition.

According to Lewu and Mavengahama (2011), *B. pilosa* is scientifically proven to possess medicinal properties. It helps in the prevention and management non communicable diseases. The consumption of *B. pilosa* is significantly influencing by one's nutritional knowledge of the

game (Black & Fielding-Lloyd, 2019). It is anticipated that the level of knowledge about *B. pilosa* will directly correlate to the level of consumption. *B. pilosa* nutritional knowledge may be able to influence non communicable diseases patients to take part of daily changes such as decreasing their body weight and increasing their consumption of fruit and vegetables, including indigenous vegetables.

The people who took part in this research were unaware of the numerous diseases that can be avoided or managed with *B. pilosa*. Participants were only able to name constipation, diabetes, and high blood pressure as the three diseases or conditions that *B. pilosa* can treat and prevent. Participants were aware that hypertension was the disease that the study was most interested in, so it's possible that they could have mentioned hypertension as one of the diseases that can be prevented by *B. pilosa*. The findings of this study are in line with those obtained in China by Silva et al. (2011). In that study, participants reported diabetes and hypertension as diseases that can be managed by playing *B. pilosa*. Although in this study and the study by Silva et al. (2011), few health indications were brought up, studies by Sanoussi et al. (2015) and Subhuti (2013) showed participants' full awareness of the health benefits of *B. pilosa*, as there were many health conditions reported by the participants in those studies. Indigestion, aphrodisiac, wounds, sore throats and abscesses, headaches, ear infections, kidney problems, flatulence, malaria, stomach and mouth ulcers, diarrhoea, and hangovers are some of the health conditions that have been reported by Sanoussi, et al. (2015) and Subhuti (2013). Other conditions include hangovers, diarrhoea, and kidney problems. In addition, patients in Brazil who took part in a study led by Lee et al. (2013) reported using *B. pilosa* to treat inflammation, enteritis, bacillary, edoema, fever, dysentery, and pharyngitis.

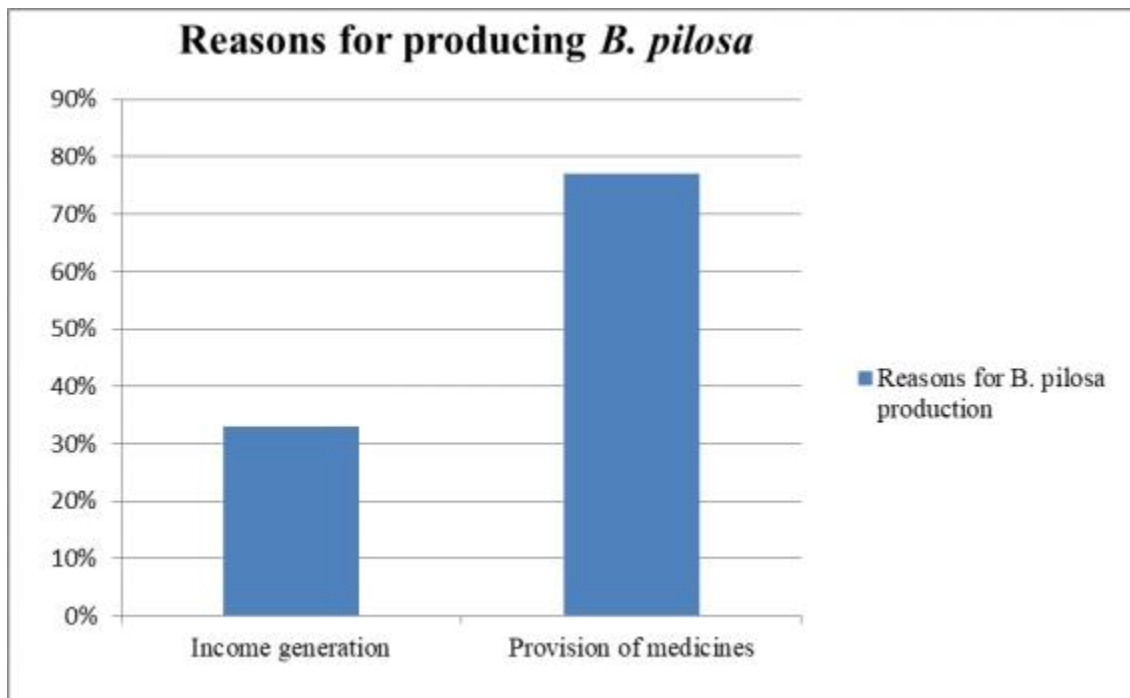
According to the findings of these studies, *B. pilosa* may be able to help prevent or treat a variety of diseases and health conditions, as well as manage existing ones. Several scientific studies have been conducted to investigate the possible medicinal uses of *B. pilosa*, and these studies have documented a variety of diseases (Kushwaha, 2016). These studies were conducted by researchers from countries all over the world. The results of this research indicate that there is a knowledge gap regarding the health benefits of *B. pilosa*, as the participants in the study were unaware of the many diseases that can be managed or prevented by *B. pilosa*. Because of the

lack of knowledge surrounding the topic, the use of *B. pilosa* for the management of hypertension may be hampered.

#### **4.6.5 An investigation of the socio-economic factors characterizing the production of *B. pilosa* and the impact of its production on farmers' welfare.**

##### ***Reasons for B. pilosa production***

33% of the respondents indicated that they use *B. pilosa* to provide employment and to generate income. The remaining 77% indicated that they use it for medicines. The results to the above findings are shown in the Figure 10.14.



**Figure 4.14** Reasons for producing *B. pilosa*. Source: Primary data.

The study findings are similar to those reported by Mahlangu (2014), who stated that in spite of the general consensus that indigenous vegetables make a negligible contribution to the financial situations, possess high profits, create jobs, source of income, and catalyse the commercialization of the rural. This study's findings were published in the journal *Agricultural Economics*. The fact that most vegetables in Zimbabwe come from South Africa indicates that the country does not value its indigenous vegetable production. According to Nyaruwata (2019), there is promotion of

local market by products that could be supplied locally. According to Xaba and Masuku (2013), the production of exotic vegetables requires high inputs, and the resulting yields are frequently low and inconsistent. On the other hand, indigenous vegetables with the same or a higher nutrition yield more under cultivation with low or no input. Because of their potential in the regional market, indigenous vegetables have been singled out as a candidate for consideration as a viable option for the diversification of the economy. According to Mavengahama (2013), they are very well liked in most rural communities.

Many indigenous vegetables, such as the *B. Pilosa*, can be stored for extended periods of time, transported with ease, and are less likely to become contaminated during the process of preparation or storage (Anitha et al., 2022). This is in comparison to foreign vegetables. The demand for indigenous vegetables is growing in towns and cities because of the pandemic of diseases that are currently sweeping the world. According to Maroyi (2013), the supply of locally available vegetables does not meet the demand of local consumers, and there is no organisation in the distribution of these vegetables. Therefore, the selling of indigenous vegetable resources is a source of income, particularly for unemployed people in rural areas.

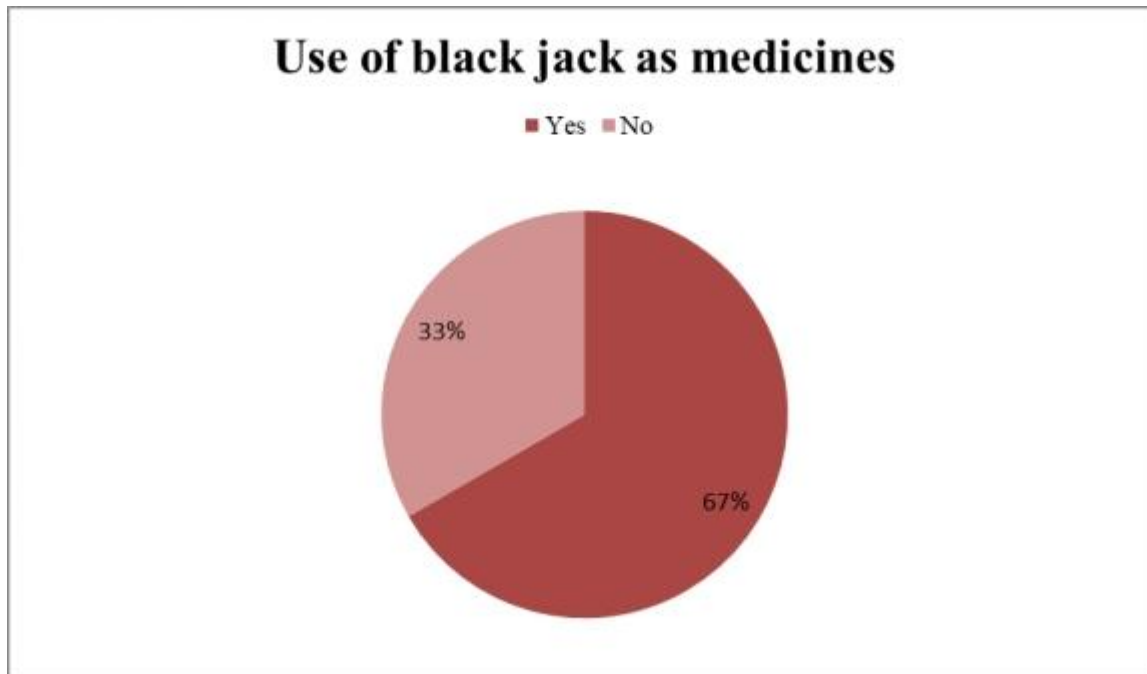
Indigenous vegetables have significant economic significance for the generation of income and the diversification of livelihoods, as Shackleton, Pasquini, and others (2009) have pointed out. Indigenous vegetables grown in home gardens, fields, and arable lands has a value of thirty one percent of all grown crops by a household, according to a comparative study conducted by Shackleton, Pasquini et al. (2009) and Mavengahama (2013). The results of the analysis of the two studies reported that the values of domesticated local vegetables, grown wild or in rural households, were even better than the average wage paid to farm workers in the region. Despite the fact that Karki, Fasse, and others (2015) found that the majority of trade took place within the region, there is an increasing amount of supply and trade with larger regional centres. According to a study that was conducted in Tanzania by Osano (2010) that looked at production and commercialization aspects, indigenous vegetables accounted for 13% of the household income of farmers.

Farmer groups in the Kiambu district of Kenya were able to successfully penetrate high-value market segments for leaf indigenous vegetables (Amiri & Berndtsson, 2020). This was

accomplished through collective action and collaboration with support systems. According to the findings of a study by Shackleton, Pasquini, and colleagues (2009), indigenous vegetables are increasingly being used for commercial purposes rather than just for subsistence. Small farmers have been able to circumvent the need for brokers by linking to high-value markets such as supermarkets. This has enabled them to ensure consistent sales of their produce throughout the year and increased their overall profits. Farmers who organised themselves into groups were able to increase their profits by anywhere from 35 to 72% when compared to farmers who were not organised. Gaupseth (2023) found that rural farmers and vendors in Mutare, Zimbabwe, exhibited behaviours that were comparable to those described above. There is a need for value addition, which can be defined as the application of production and postharvest techniques with the goal of ensuring that high-quality produce is sold on the market and satisfies the expectations of consumers. According to Nyaruwata (2019), in some nations in Eastern Africa and Southeast Asia, particular indigenous vegetables were becoming an increasingly important part of food groups for the more affluent segments of the population, and they are gradually making their way out of the category of being and into the commercial mainstream. The robust demand in the market has encouraged seed producing companies to investigate and cultivate these types of crops, which has resulted in a strengthening of the formal seed sector.

### **Use of *B. pilosa* as medicines**

The majority of respondents (67%) who produce *B. pilosa* use it for medicines and the rest (33%) use it for income generation through selling it. The results of this study are shown in the Figure 11.15.



**Figure 4.15** Use of *B. pilosa* as medicines *Source: Primary data*

The findings of this study are consistent with the findings of Moshi et al. (2012), who discovered that *B. pilosa* farmers use it for medicinal purposes. Extracts from plants and other natural sources have been used to treat a wide variety of ailments plaguing humans ever since prehistoric times. Research that focuses on safety, pharmacological activity, and extract composition is becoming increasingly important as science and technology continue to advance. This is partly due to the fact that medical drugs companies need to obtain lead compounds in order to develop new drugs.

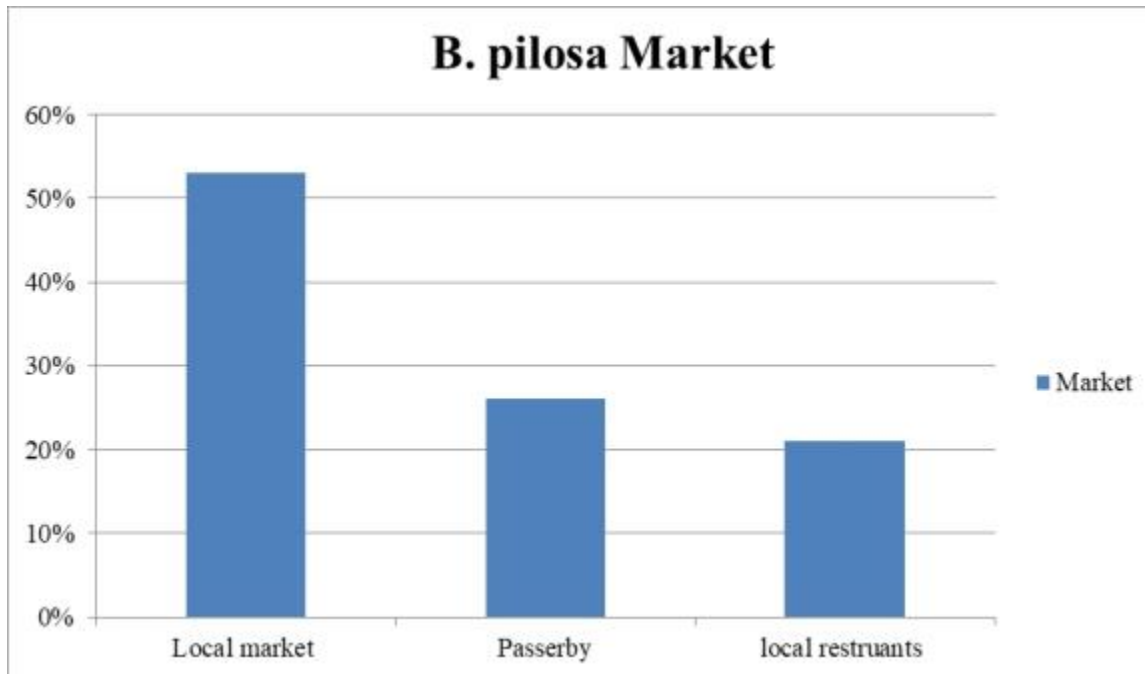
These studies found that natural product extracts have pharmacological properties that traditional healers use to solve social issues (Nyaruwata, 2019). Traditional medicine may be used due to lack of clinical settings and community perception (Bodeker, 2005). Drug resistance motivates alterunderutilised and traditional medicine use. However, traditional doctors' ability to cure illness with natural plant products, other studies showing phytochemical and bioactivities in natural products have led to the development of alterunderutilised medicine (Moshi, Otieno et al. 2012). Research showed that the use of natural product extracts utilized their biological potential.

Migraines, STDs, and TB are treated with *Biden Pilosa* in South Africa (Lawal, Grierson et al. 2014, Maema, Potgieter et al. 2019). It relieves headaches and rheumatism in tropical areas. Uganda, Ghana, and South Africa treat TB with the flowers or whole plant (Nguta, Appiah-Opong et al. 2015). Most countries in Africa use *Biden Pilosa* as a vegetable (Mushagalusa Kasali, Ahadi Irengi et al. 2021). It manages AIDS patients in Uganda, Tanzania, and Malawi (Zapata-Pérez et al., 2021). Ugandans treat malaria, TB, and related symptoms with *Biden pilosa* roots (Tabuti, Kukunda et al. 2010). Kenyans use ground leaves for insecticides, flu, skin infections, and upper respiratory tract infections (Griffith et al., 2020).

The ground up leaves, Leaf sap, Jaundice, dysentery, burns, anaesthesia, and swollen spleens are some of the conditions that powder made from the seeds and leaf extract can treat. Cote d' Ivoire Tanzania and Nigeria. In Congo, a mixture made from the *B. Pilosa* plant is used as an antidote to poison, to facilitate child delivery, and to alleviate the pain caused by a hernia. In South Africa, the Zulu people use a suspension of powdered leaves and a mixture of leaves to treat abdominal pain, arthritis, and malaria respectively (Nyaruwata, 2019). Tea made from the leaf is traditionally used by the Manyika people of Zimbabwe to treat a variety of ailments, including stomach and mouth.

### **Market for *B. Pilosa***

Research findings from this study have indicated that 26% of the respondents sell *B. pilosa* and the majority (74%) do not sell it. 53% of the respondents have indicated that they sell *B. pilosa* to the local market in their surrounding areas, 26% sell them to passerby at the road and 21% supply to local shops. These findings have indicated that most if the *B. pilosa* sold in Mt Darwin is sold at the local market.



**Figure 4.16** Markets for *B. Pilosa*. *Source: Primary data*

During the growing season of *B. pilosa*, market options are of great importance. This can be illustrated that market like, local market, passerby and local restaurants are convenient for the consumer and therefore consumption increases. Distances and associated access cost to vegetables are decreased, increasing consumptions. This almost like research conducted (Mahlangu, 2014) in Limpopo Province, which suggests local vegetable sales are strong at roadsides, local shops/growth points and neighbours.

#### 4.7 Recommendations

- The combination of contemporary technologies and traditional knowledge has the potential to boost both the production and consumption of indigenous vegetables (Black & Fielding-Lloyd, 2019). The combination of contemporary technologies and traditional knowledge will make it possible to increase consumption of underutilised vegetables, which in turn will expand the market and encourage participation by younger people in mainstream activities.
- It is essential to run awareness campaigns targeting rural and urban households to educate them on the benefits and business potential of indigenous vegetables (Gautheron & Jéru, 2021). The primary objective of the campaign should be to encourage more young people

to pursue careers in agriculture and to increase the amount of time spent teaching about underutilised vegetables in agricultural education programmes. Because of this, young people's negative perceptions of indigenous vegetables will shift, and as a result, they will be more likely to consume indigenous vegetables on a regular basis. In addition to this, the demand in the market will increase, which will simultaneously initiate the introduction of indigenous vegetables into the food systems.

- Elderly household heads with ages ranging from 51 and above have demonstrated that they have a good working knowledge of indigenous vegetables in terms of their nutritive value, medicinal use, food source, income source, and agronomic advantage. However, they have encountered difficulties in terms of handling, marketing, and utilising modern post-harvest equipment and technology. Because extension officers make follow-up visits and have a deeper familiarity with the local environment, the government, acting through its agents known as extension officers, should offer its services to indigenous vegetable farmers so that these farmers can improve their production methods, post-harvest handling procedures, processing methods, and marketing strategies. This will help the government win over the confidence and enthusiasm of its citizens.
- During the phase of raising awareness about these vegetables' development, participation from a variety of stakeholders is required. Microfinance institutions have the potential to become involved and to take the initiative of lending some money to households for them to purchase postharvest equipment. The food industry should also be involved so that it can come up with various recipes for preparing indigenous vegetables. This will help to introduce an appealing product into the market, the product that will be highly demanded rather than forcing a product into customers. In addition, the food industry should be involved so that it can create jobs. Additional research needs to be done on the various other potential uses.
- For farmers to effectively plan their cropping programmes and avoid information imbalances in the market, there is a need to conduct a market analysis of indigenous vegetables. In addition to this, prior to entering the market, it is essential to look for opportunities to explore other markets that are located behind borders as well as to add value to the product.

- Commercialization of production of *B. pilosa* might be necessary as they are low to no input crops. There should be facilitation of the commercialization of *B. pilosa*, as shown by the research that it has contributed significantly to welfare, household income, and food income. *B. pilosa* has great business potential and has been shown to add value to household life. They relieve households of financial burdens and unemployment and address nutritional and health problems.

#### **4.8 Conclusion**

According to the research findings, the many of residents in Ward 23 of Mount Darwin do not consume *B. pilosa*. This figure represents 52.7% of the total population. Young people often refrain from eating *B. pilosa* because they are under the impression that doing so demonstrates a lack of maturity or because they do not have access to the food in their region. The elderly is particularly fond of eating *B. pilosa* because they are aware of the numerous health advantages associated with doing so. These benefits include anti communicable diseases properties of Biden Pilosa all over the world, which indicates the possibility of its application in the mitigation of nn communicable diseases. As a result, incorporating *B. pilosa* into one's diet might assist in the treatment of metabolic syndrome, which would ultimately lead to a healthier society. In spite of this, the majority of countries in sub-Saharan Africa have a limited amount of information on the medicinal applications of bioactive compounds found in *B. pilosa*.

The researcher concludes that a number of socioeconomic factors, such as the availability of *B. pilosa* and a lack of appreciation for the benefits of eating *B. pilosa*, influence the intensity of *B. pilosa* consumption. It was discovered that age plays a significant role in the amount of *B. pilosa* that is consumed. Only during the given season did factors such as gender, income, and market options have any impact. Consuming *B. pilosa* was found to have a number of benefits, one of the most important of which was that it contributed significantly to the overall health of the community. Despite the fact that the availability of food varies from region to region, it is considered to be one of the three pillars of food security. Given the circumstances, it appeared that indigenous *B. pilosa* was both available and unavailable to farmers in Mt. Darwin. Due to the high rate of consumption that occurs during the summer, households are assured of their food, nutrition, and food security. However, the commercialization of indigenous vegetables is hampered by unreliable markets and informational disparities between different groups. As a

result of the market uncertainties, only a small area was dedicated to *B. pilosa*, and as a result, only 47% of the area was accounted for in Ward 23 of Mt. Darwin, Zimbabwe, in comparison to other countries such as Kenya.

#### **4.9 References**

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## CHAPTER 5

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

Chapter 6 will outline the research summary which summarises the introduction, objectives, problem statement, research methods and findings. This will be followed by the conclusion of the research. It also gives policy implications, recommendations and areas for further research. The references of this chapter will be stated, and appendices attached.

#### 5.2 Research summary

The research study focused on an assessment to find if *B. pilosa* contributes to the welfare of households in Mt Darwin ward 23. The assessment was to determine availability and accessibility, knowledge and practices, consumption preferences and benefits as well as to investigate the socio-economic factors characterising the production of *B. Pilosa* and the impact of its production on farmers' welfare. A descriptive survey research method was used to collect information on the above determinants. A questionnaire was administered using KOBO collect to collected demographic information, availability and accessibility, knowledge and practices, consumption preferences and benefits as well as to investigate the socio-economic factors to a sample size of 45 which was obtained by snowballing sampling. 3 key informant interviews were administered to village heads. The response rate was 100% as all questionnaires issued out were returned. The data was analysed using SPSS 21 and content analysis. The main findings were that *B. pilosa* is abundantly found in summer than in winter. Most households collect in their gardens and fields it is consumed once or twice a week. The elderly is more knowledgeable than the younger ones. Most respondents indicate that they consume *B. pilosa* because of its health benefits. In summary *B. pilosa* is contributing to socio economic, income and food welfare of communities of ward 23 Mt Darwin.

### 5.3 Conclusions

- a) Based on the research findings the following conclusions can be made
- b) Several socioeconomic factors influence consumption intensity during and after the growing season.
- c) Gender, income, and age options only had an impact on who consumes *B. pilosa*
- d) The study there cautiously concludes that *B. pilosa* can be a possible reliable source of income. Although food availability varies by region, it is one of the three pillars of food security. This association indicates that *B. pilosa* is abundant during the summer season, also known as the lean season, when food security will be low. Therefore, the high rate of consumption in the summer leads to households being food and nutritionally secure.
- e) However, unreliable markets and information asymmetries are obstacles to the commercialization of underutilised vegetables such as *B. pilosa*. The market uncertainties mean that only a few people choose *B. pilosa*.
- f) Households have recognized the nutritional and health implications of eating local vegetables. Therefore, agriculture, education, health and the food industry should work together to develop strategies to promote local vegetables.
- g) Therefore, research concludes that *B. pilosa* contributes to the well-being of small farmers in District 23 of Mt Darwin, Zimbabwe.

### 5.4 Policy implication and recommendations

- i. Social Welfare – based on study findings that factors such as education level, occupation, age and monthly income are critical factors in food security and household welfare. Therefore, policy makers should support new and existing investment policies to improve the quality of life standards of every household. This support would play an important role in improving household welfare.
- ii. Agriculture – As the nation works toward more production to feed the nation, there is a need for policies on underutilized vegetable production to improve welfare and food security at the household and national levels. For higher production, small farmers should consider production in their gardens and fields, using both new and underutilised knowledge. The government should intervene through agricultural consultants by providing production,

processing techniques, post-harvest techniques and marketing services to farmers of *B. pilosa* and other underutilised vegetables.

- iii. Education and awareness campaigns highlighting the potential of underutilised vegetables like *B. Pilosa* to improve food security and welfare will lead to increased adoption in both rural and urban areas. The campaigns integrate local vegetables such as *B. pilosa* in the curriculum of agricultural schools. This reduces negative perception and increases consumption of *B. pilosa* and other underutilised vegetables. Consumption will increase demand and thus penetrate the food system market and thus increase household welfare.
- iv. Nutrition- The research found that householders over the age of 51 indicated they were aware of *B. pilosa* through its nutritional and medicinal value, and its source of food and income. However, there is a need for production, handling, post-harvest technologies and marketing. Dieticians and nutritionists should provide nutrition education about the importance of diversification and the consumption of underutilized vegetables like *B. pilosa*.
- v. A holistic approach is needed, involving a range of stakeholders in the *B. pilosa* awareness development phase. For example, Ministry of Health and Childcare explains the nutritional benefits of *B. pilosa*. The Ministry of Agriculture gives technical advice on production, post-harvest and marketing. The food industry should be involved so that they can develop food products, preservation methods and recipes using *B. pilosa*. This will help to create demand through better tasting and more appealing products. Microfinance, which accompanies the initiative to borrow funds to purchase pre- and post-harvest equipment for households.

## **5.5 Areas for further research**

- To carry out market analysis of *B. pilosa* so that households can opt for production to avoid market asymmetries. In addition, it would help to explore regional and international markets.
- There is need to carry out value addition and chain analysis of *B. pilosa* before venturing in the market.
- As this study has that they contribute significantly to household welfare in terms of addressing nutrition, health and income issues. There is need to research on production and farming as a business for *B. pilosa*.

**APPENDICES**

**APPENDIX A-QUESTIONNAIRE**

Questionnaire number	
Date	
Name of Interviewer	

**INTRODUCTION**

Good (morning/afternoon/evening), I'm \_\_\_\_\_ and I am conducting a survey on the contribution of *B. pilosa* (guku/ mutsine) in this area. Your opinion and knowledge are very important in this research. To obtain reliable, scientific information we request that you answer the questions that follow as honestly as possible. There are no right or wrong answers. The area in which you live, and you have been selected randomly for the purpose of this survey. The fact that you have been chosen is thus quite coincidental. All the information you give to us will be kept confidential. You and your household members will not be identified by name or address in any of the reports we plan to write.

I also have a form with me that you can sign for to show that I have explained the purpose of my research and that you have agreed to be interviewed by me. However if you do not wish to sign it we can proceed with the interview after we have agreed verbally.

1.1 Time taken (from)..... (to).....

1.2 District .....

1.3 Ward .....

1.4 Village .....

**SECTION A: DEMOGRAPHIC INFORMATION**

1. What is your gender?

Male	
Female	

2. What is your level of education?

3. What is your occupation?

<b>OCCUPATION</b>	
Business owner	
Formally employed	
Petty trading	
Casual labour	
Farmer	

4. What is your age?

<b>AGE</b>	
20-30 years	
31-40 years	
41-50 years	
51-60 years	
61-70 years	

5. What is your working experience?

<b>WORKING EXPERIENCE</b>	
Less than 1 year	
1-5 years	
6-10 years	
11-15 years	

**SECTION B: THE CONTRIBUTION OF B. PILOSA TO THE WELFARE OF FARMERS**

6. Do you eat *B. pilosa*?

Yes	
No	

7. If not, why?

They are not available	
Can't cook them	
Don't know them	
Other	

Other (specify) \_\_\_\_\_  
 \_\_\_\_\_

8. If yes, which part of *B. pilosa* do you eat?

Leaves	
Stem	
Roots	
Fruits	

9. Which food do you eat with *B. pilosa*?

Rapoko	
Sadza	
Sorghum	
Tea	

10. Do you have knowledge about the consumption of *B. pilosa*?

Yes	
No	

11. How did you get knowledge about *B. pilosa* and to cook them?

Taught by grandparents	
Taught by parents	
Observed	
Passively as one grew up	

12. Do you sell *B. pilosa*?

Yes	
No	

13. What is your consumption pattern of *B. pilosa*?

Summer	
Winter	

14. What is your reason of consuming *B. pilosa*?

Health reasons	
Part of culture	
It is easily available	
It is for free	

15. What are the benefits of consuming *B. pilosa*?

It manages hypertension	
It is anti-bacterial	
It is anti-inflammatory	
I do not know	

16. What are the reasons why you produce *B. Pilosa*?

Income generation	
Provision of medicines	

17. Do you use *B. pilosa* as medicines?

Yes	
No	

18. Where do you sell *B. pilosa*?

Local market	
Passerby	
Restaurants	

## APPENDIX B- INTERVIEW GUIDE

1. Do you eat *B. pilosa*?
2. If not, why?
3. If yes, which part of *B. pilosa* do you eat?
4. Which food do you eat with *B. pilosa*?
5. Do you have knowledge about the consumption of *B. pilosa*?
6. How did you get knowledge about *B. pilosa* and to cook them?
7. Do you sell *B. pilosa*?
8. What is your consumption pattern of *B. pilosa*?
9. What is your reason of consuming *B. pilosa*?
10. What are the benefits of consuming *B. pilosa*?
11. What are the reasons why you produce *B. Pilosa*?
12. Do you use *B. pilosa* as medicines?
13. Where do you sell *B. pilosa*

“

## APPENDIX C-CONSENT FORM

### Contribution of *Biden pilosa* (Black Jack) to the welfare of households in ward 23 of Mt Darwin, Zimbabwe

Consent to take part in research

- I \_\_\_\_\_ voluntarily agree to participate in this research study.
- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.
- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
- I understand that participation involves answering questions and showing around
- I understand that I will not benefit directly from participating in this research.
- I agree to my interview being audio-recorded.
- I understand that all information I provide for this study will be treated confidentially.
- I understand that in any report on the results of this research my identity will remain anonymous. This will be done not using my name in any of the results and discussions.
- I understand that disguised extracts from my interview may be quoted in research project.

#### *Signature of participant*

\_\_\_\_\_

Signature of participant

\_\_\_\_\_

Date

#### *Signature of researcher*

I believe the participant is giving informed consent to participate in this study

\_\_\_\_\_

Signature of researcher

\_\_\_\_\_

Date