

**Economic analysis of conservation and sustainable use of indigenous medicinal plants  
by smallholder farmers**

by

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## DEDICATION

I dedicate this work to my parents Mrs O.N Mbelebele and the late Mr S.D Mbelebele who have been my pillar of strength throughout my academic journey and have supported me. I also dedicate it to my family and friends who have been patient with me throughout the journey and always there to help where they could. Lastly, I also dedicate it to my supervisor who has imparted knowledge to me and assisted me tirelessly.

### **DECLARATION 1: PLAGIARISM**

I, Zusiphe Mbelebele, declare that the findings of this thesis are due to my original efforts and work, except where stated otherwise.

The findings of the thesis have not been previously reported to the University of KwaZulu-Natal or elsewhere, according to my knowledge.

Where assistance is sought, it has been properly stated.

**Zusiphe Mbelebele**

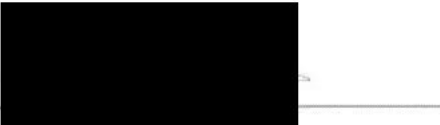
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As the candidate's supervisor, I, Dr L. Mdoda, agree to the submission of this thesis.

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Date: 07/12/2023

## **DECLARATION 2: PUBLICATION**

Author's contribution to publications that form part of the dissertation.

### Publication 1 – Chapter 3

Zusiphe Mbelebele, Lelethu Mdoda and Sesethu Ntlanga. Navigating the Herbal Landscape: An In-depth Exploration of Challenges Confronting Smallholder Farmers in the Production and Utilization of Indigenous Medicinal Plants. (Preparing to be submitted to a journal)

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### Publication 3 – Chapter 5

Zusiphe Mbelebele, Lelethu Mdoda and Sesethu Ntlanga. Cultivating Health and Wealth: An In-Depth Welfare Analysis of the Production of Medicinal Plants on the Participation of Smallholder Farmers. (Preparing to be submitted to a journal)

### Publication 4- Chapter 6

Zusiphe Mbelebele, Lelethu Mdoda and Sesethu Ntlanga. Sustainable Conservation Strategies for Indigenous Medicinal Plants: Balancing Traditional Knowledge and Environmental Preservation: Implication for food and nutrition security. (Preparing to be submitted to a journal)

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# **ECONOMIC ANALYSES OF CONSERVATION AND SUSTAINABLE USE OF INDIGENOUS MEDICINAL PLANTS BY SMALLHOLDER FARMERS**

## **ABSTRACT**

The agricultural sector is a lucrative pillar of survival for smallholder farmers worldwide for its determination to produce commodities that are key components in survival such as food. Farming is ideally one of the best means that has kept a significant number of smallholder farmers from poverty, malnourishment and food insecurity. African agriculture contributes merely 15% of the Gross Domestic Product (GDP) with smallholder farmers producing approximately 80% of the food from farms that are less than 2 hectares each. Smallholder farmers are involved in numerous direct and indirect methods of sustaining livelihoods such as passive income received from remittances from family, income from formal employment, and income from social grants. Medicinal plants have existed indigenously within the environments where smallholder farmers live for time immemorial. They have been great contributors to the livelihoods of smallholder farmers starting from health benefits greatly in bringing monetary value to household income through the development of trade arrangements of medicinal plants. There is a big market for medicinal plant products from people seeking traditional healthcare for themselves, livestock health and potential trade of high-value medicinal plants with pharmaceutical mega companies. However, smallholder farmers are faced with various impediments in the production of medicinal plants. Limited resources that are necessary for housing and sanitation, basic education, basic healthcare and crime prevention prohibit sustainable progress in the husbandry of and maintainable use of medicinal plants. Furthermore, the overharvesting of lucrative medicinal plant species without the desired amounts of propagation is depleting valuable species from existence and poses a threat to ecology and species diversity. The study investigates the conservation and sustainable use of indigenous medicinal plants by smallholder farmers of the Eastern Cape Province of South Africa. It seeks to identify and profile challenges faced by different indigenous smallholder farmers, establish the determinants of profitability for high-value medicinal plants, assess the effective production of household welfare, and examine conservation strategies of indigenous medicinal. A sample size of 150 smallholder farmers actively involved in medicinal plant extraction and trade was used to achieve the objectives of the study. Descriptive statistics and regression analyses were utilized to analyse the relationship between social demographics, economic factors, institutional, profitability and conservational factors of smallholder medicinal plant farmers. The Tobit regression model was used to identify and profile different

challenges faced by different indigenous medicinal plant farmers. The results portrayed an adverse relationship between challenges in adopting medicinal plant farming, age, gender and education. The knowledge about indigenous medicinal plants is vested with the old generation of the community that has little or no education, who are mostly females, therefore they are most eligible to reap economic benefits. The profitability and determinants of high-value medicinal plant farmers were established using the budgetary technique and multiple regression. The statistical evidence suggests that variable costs impact significantly on the level of profitability of a farmer. In the case of the study, analyses revealed that the cost of production is relatively low due to the abundance of valuable medicinal species in the wild and most of the farmers, extract for themselves without needing to hire labour. Moreover, the factors influencing the production output were measured with a Multiple regression model. The variable costs influence the gross value of the production level at a 1% significance. The effects of producing medicinal plants were measured using the Propensity Score Matching technique. The econometric results showed that the production of medicinal plants has strong conservational outcomes, income generation opportunities, livelihood enhancement and poverty alleviation. The conservation strategies of indigenous medicinal plants were generated using a Likert scale and were analysed using descriptive statistics. The results depicted that there is a negative relationship between over-exploitation and the conservation of medicinal plants. Furthermore, evidence showed that more smallholder farmers are in the habit of harvesting medicinal plant material without proper intentions to propagate. Given that the medicinal plant market is promising to be booming, smallholder farmers should be encouraged to participate and share written knowledge with each other such that information is not lost. The increased profitability of the enterprise impacts positively on the livelihoods, social welfare of smallholder farmers and food security. However, if farmers are not courteous about maintaining the species diversity they may face an endangerment problem in future. This will need conservational experts and extension officers to be directly involved in imparting knowledge and foreseeing that order is maintained accordingly.

**Keywords:** Smallholder farmer, Medicinal plants, Profitability and Conservation

## ACRONYMS

ADM Amatole District Municipality

ADMIDP Amatole District Municipality Integrated Development Plan

ATT Average effect of Treatment on the Treated

COGTA Department of Cooperative Governance and Traditional Affairs

ECP Eastern Cape Province

FAOSTAT Food and Agriculture Organization STATISTICS

GDP Gross domestic product

GM Gross Margin

IDP Integrated Development Plan

LM Local Municipality

NFI Net Farm Income

NGO Non- Governmental Organisation

PSM Propensity Score Matching

RRI Returns per Rand Invested

SLD Sustainable Livelihood Development

SSA Sub- Saharan Africa

TR Total Revenue

TVC Total Variable Cost

USD United States Dollars

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## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the study

Medicinal plants are globally valuable sources of new Health drug establishment (Chen et al., 2016). Recognizing the existence of medicinal plants has led to constructive outcomes in the livelihood of developing countries, especially Sub-Saharan Africa (SSA). According to Nwafor (2020), the importance of medicinal plants has been credited to their ancient therapeutic uses as well as their relevance to human culture and nutrition. Many indigenous people and communities have been documented to have used plants such as *Protorhus longifolia* (Red beech), *Bulbine abyssinica* (Bushy bulbine), *Curtisia dentata* (Assegaai), *Bidens bipinnata* (Spanish needle) and *Elephantorrhiza elephantina* (Elephant's roots) to mitigate health complications such as sore throat, coughs, syphilis, haemorrhage and many more (Bisi-Johnson et al., 2010; Panday and Singh, 2016; Lerotholi et al., 2017). In SSA, medicinal plants are primarily used for traditional healthcare medicines, utilized for their aromatic and disinfectant properties or sometimes used as sedative herbs. It is estimated that there are over 1300 medicinal plants used in Europe, of which 90% are harvested from wild resources in the United States, while about 118 of the top 150 prescription drugs are based on natural sources (Balunas and Kinghorn, 2005). Van Wyk and Gericke (2000) further stated that many countries in the world are home to these medicinal species of high value but the ones that can be used for medicine are only a bare minimum of 300 species. Alternatively, Mander (1998) postulated that 700 species are primarily used for personal benefit and trade. Hamilton (2004) and Chen et al., (2016) stated that about 80% of people in developing countries depend on herbal drugs for their primary healthcare. Over 25% of prescribed medicines in developed countries are derived from wild plant species. With the cumulative demand for herbal drugs, natural health products, and secondary metabolites of medicinal plants, the use of medicinal plants is growing throughout the world (Babich et al., 2020). Information is required to understand these medicinal plants' conservation and economic benefits.

Agriculture in Africa signifies an essential economic activity for farmers and contributes approximately 15% of the Gross Domestic Product (GDP) (World Bank, 2015). The sector is an employer of about 65% of the labor force that depends on it for an essential income of making a living (FAOSTAT, 2010; World Bank, 2013). Kamara et al., (2019) stated that

African agriculture is assumed to have the potential of alleviating poverty and starvation by creating jobs, trade and investment, and improving livelihood through individual smallholder farmer participation in agricultural production. Smallholder farmers are primarily distinguished by land ownership of 2 hectares (Ha) or less (Hruska, 2019).

However, the promising potential of the sector is tainted by prevalent shortcomings that are a primary root cause for the stunted development of sustainable progress. Smallholder agricultural systems are characterized by low input and low output. One factor prohibiting rural communal farmers from reaching maximum profitability is the issue of low yields, resulting from a lack of resources and skills that are lucrative to participate effectively in commercial agriculture (Kamara et al., 2019). While producers of local communities operate in a sector overwhelmed by extreme poverty, thus minimizing output because the outcome is driven by the input invested. However, Bejarano et al., (2020) argued that a vast amount of indigenous knowledge of medicinal plants is dominant among the communities of SSA, which is an important area to be explored in the quest to conserve indigenous medicinal plants.

Smallholder farmers have gained significant benefits from herbal medicine over their close engagement with nature (Mwale et al., 2005; Tali et al., 2020). For instance, Schipmann et al., (2002) and Akinnifesi et al., (2008) postulated that the use of *Aloe spicata* and *Aloe vera* in the health management of chicken had played a significant role in minimizing diseases such as Coccidiosis, Fowl typhoid and New castle disease. Traditional medicine is affordable to purchase and easy to access in rural communities; therefore, it becomes a reliable resort for the farmers to rely on for maintaining not just chicken but livestock as a whole and their livelihood in general (Mbuni, 2020). According to Kipkore et al., (2014); and Maroyi (2015), the biggest challenge of African communal societies is the untapped indigenous knowledge lost through little or no documentation of information about the conservation and sustainable use of indigenous medicinal plants which is passed orally through generations, and may pose a danger of its loss. According to Ahmad et al., (2016), knowledge is an underrated obstacle in the production of indigenous medicinal plants because it is in the custody of older community members. Depending on gender, ethnicity, age, and caste, it is passed through generations by oral means; thus, without proper records, it can be easily lost.

The extensive benefits of using medicinal plants for healthcare purposes have aroused widespread interest in domesticating and conserving valuable medicinal plant species (Bareestsing, 2015). The adoption of localizing medicinal plants to domestic settings has

brought significant economic well-being through the production, harvesting, utilization and marketing of medicinal plants (Sher and Bankworth, 2015; Laith and Sammar, 2016). Chitura (2018) argued that the milestone of extracting and spreading certain plant species from natural habitats could have a positive effect. Nwafor (2020) justified the reason for the domestication of medicinal plants to be because of their significance as trade commodities. Xego et al., (2016) further highlighted factors such as urbanization, population growth and the increasing interest in pursuing traditional medicine in people as influencers of market opportunities for smallholder medicinal plant farmers to trade significantly. The entrance of medicinal plant products into trade has led to a commencement of formal and informal entrepreneurial opportunities which is observed as a large and growing industry (Van Wyk and Prinsloo, 2018; Oyediji, 2018). Additionally, Peterson et al., (2017) acknowledged that an increase in the number of backyard plant gardens, smallholder farmers of certain medicinal plants, wild plant harvesters, small-scale processors and traders have great economic intervention. Thus, the development of the entire value chain is necessary to meet the accelerated growth of local, national and international demand.

Various challenges are affecting the production of medicinal plants. Climate unpredictability ranks high in the distractive factors of any smallholder project, thus according to Marandure (2016). Moreover, due to the dry climate and degraded soil conditions, the production of medicinal plants is difficult. The existence of global warming remains a vital contributor to the threats that inhibit positive progress in production. Therefore, there is an urgent need for sustainable production with innovative methods of improving the livelihoods of communal farmers and the food security level (Notenbaert, 2017).

Scholars and researchers have emphasized the importance of producing valuable medicinal plants as a conservation strategy and a poverty alleviation initiative through the establishment of open trading (Negi et al., 2018; Van Wyk and Prinsloo, 2018; Tali et al., 2019). The marketing and commercialization of these pharmacological plant resources is a prospective stream of prestige income for smallholder farmers. However, the process is guided by policy infringements such as the customary right to access, use, and control medicinal plants. In support of the policy barriers, Volenzo and Odiyo (2020) suggest that the integration of traditional medicinal plants into the world-vast value chains could negatively impact the genetic resource base and ecological sustainability due to high demand and may lead to destructive harvest practices.

Be that as it may, there is a limited number of empirical studies showing evidence of the challenges of smallholder farmers in the production of medicinal plants. Volenzo and Odiyo (2020) cautioned people about the ecological conservation risks and challenges of domesticating medicinal plants but also enlightened briefly about the enormous benefit of the commercialization of high-value medicinal plants. Potentially, smallholder farmer production of medicinal plants can positively affect welfare. However, these effects have never been assessed widely in disadvantaged rural communities. Thus, this study needs to investigate smallholder farmers' conservation and sustainable use of indigenous medicinal plants.

## **1.2 Problem statement**

In the past, plants were the world's main source of medicinal materials. Van Wyk and Prinsloo (2018) argued that since ancient times, plants continued to provide humans with new medicines as 50% of all herbal drugs in clinical use in the world are derived from natural products (Van Wyk et al., 2018). Medicinal plants are integral to primary healthcare in many developing countries, including South Africa (Fullas, 2007). In developing countries, approximately 80% of people use traditional medicines because of their affordability and cultural acceptability (Maroyi, 2013). There are numerous risks and challenges involved in the production of medicinal plants, which Volenzo and Odiyo (2020) claim require further understanding. Smallholder farmers face competition in their production of medicinal plants as they have limited resources necessary for housing, sanitation, primary education, basic health care, and crime prevention, moreover, this restricts the progress and implementation of effective and sustainable conservation strategies for overexploited medicinal species. Smallholder farmers lack financial support, which would assist them in building storage of suitable standards for medicinal plants. According to Nwafor (2020), smallholder farmers face barriers to producing medicinal plants due to a lack of availability of suitable land, irrigation facilities, and start-up capital. Additionally, farmers face inadequate access to markets and the unavailability of seeds or propagation materials.

According to Gomez et al., (2020), smallholder farmers need to have an in-depth understanding of risk management tools and strategies to increase their capacity for conservational tactics and species management. Although Nwafor (2020) stated that South Africa is one of the countries with recognizable national policies on the conservation of medicinal plants, the country has no policy that supports or encourages the sustainability of their use. The existence of the laws should minimize the loophole of exploitation induced by those harvesting critically endangered

species. Legislative and policy bottlenecks as the international treaty called the Convention for Biological Diversity and Global Strategy for Plant Diversity assist in strengthening legislation for the conservation of medicinal plants while supporting the commercial production of medicinal plants to benefit the actively growing global market of herbal medicine (Moshi and Mhame, 2013).

The actual contribution of medicinal plants to household benefits has not yet been fully recognized. There is still limited scientific documentation or information about the contribution of medicinal plants to households (Marshall, 2011). In the absence of empirical studies, little is known about smallholder farmers' conservation and sustainable use of medicinal plants to improve social welfare and rural livelihoods. Despite the positive contribution of medicinal plants to household livelihoods, medicinal plants have been associated with various significant challenges that hinder their full potential, such as low participation by relevant institutions, and a lack of technological skills, and knowledge. Obi and Seleka (2011) stated that farmers face different challenges in their pursuit of medicinal plant production. Still, the extent of these in terms of how they affect their livelihoods has not been systematically assessed. Based on this gap, the study intends to contribute to the empirical literature by providing pragmatic insight into the economic benefits of high-value medicinal plants and the effects of producing them on the household welfare of smallholder farmers. The government has no intervention through implementing numerous developmental programs to encourage household participation in medicinal plant production (Pyakurel et al., 2018). The lack of support programs has brought uncertainties in terms of management and thus fails to address the actual dynamics of development.

### **1.3 Main Objective**

To investigate the economic analysis of conservation and sustainable use of indigenous medicinal plants by smallholder farmers in the Eastern Cape Province

### **1.4 Specific objectives**

1. To identify and profile different challenges faced by different indigenous medicinal plant farmers.
2. To establish the profitability and determinants of high-value medicinal plants in farmers.

3. To assess farmers' effects of producing medicinal plants on the household welfare of farmers.
4. To examine the conservation strategies that can be used to sustain the use of indigenous medicinal plants.

### **1.5 Research questions**

1. What are the identified and profiled different challenges faced by different smallholder farmers?
2. What is the profitability and determinants of high-value medicinal plants?
3. What are the effects of producing medicinal plants on the household welfare of farmers?
4. What are the conservation strategies that can be used to sustain the use of indigenous medicinal plants?

### **1.6 Scope and delineation of the study**

The study determined and investigated the production and sustainable use of indigenous medicinal plants for smallholder farmers of the Amatole District of the Eastern Cape Province of South Africa. The study was limited to the current trends in the production and sustainable use of indigenous medicinal plants for smallholder farmers of the Eastern Cape. This was achieved through the specific emphasis on the identification and profiling of different challenges faced by different smallholder farmers, establishing the profitability and determinants of high-value medicinal plants in farmers, assessing the effects of producing medicinal plants by farmers on household welfare and lastly assessing the conservation strategies that can be used to sustain the use of indigenous medicinal plants.

This study was conducted in the Amatole District Municipality of the Eastern Cape, South Africa. The study was restricted to smallholder medicinal plant participants of the district municipality mentioned above. The information on the assets of farmers, socioeconomic, marketing, technical and institutional factors was gathered through the use of a questionnaire. Due to the lack of record keeping from smallholder farmers, the study gave way for farmers to recite the information needed from their memory. Budget constraints and logistical issues have forced the investigator not to consider all the local municipalities of the district but to select

two local municipalities to investigate. The results of this study were used to generalize the performance of the medicinal plant participants as opposed to non-participants, and the effects of adopting medicinal plants on livelihood improvement of the smallholder farmers.

### **1.7 Importance of the study**

The existence and the use of medicinal plants to invent traditional medicine have been documented widely in literature throughout all continents of the globe. The information about these plants differs depending on the region that they are indigenous or adapted to. The impact of medicinal plants on the livelihoods of smallholder farmers is very crucial due to their ability to serve as traditional medicine not only to people but to large stock, small stock, piggery and poultry. Medicinal plants are also utilized in smallholder crop agriculture for pest breaking through aromatic properties. Therefore, their existence has been an important accessory in conducting daily smallholder agricultural activities.

The study intended to supplement to existing literature through a close assessment of the production and sustainable use of medicinal plants by smallholder farmers. Medicinal plants have provided an economy of their own through the buying and selling of medicinal plants (leaf, bark, stem, root and flower) for traditional healing and used as inputs in the production of synthetic drugs. The information generated by the study provided valuable input in equipping smallholder farmers with identifying opportunities to exploit the rising demand for medicinal plant commodities. Smallholder farmers have often had the neck for production but face difficulties in the stage of distribution of produce and this is imposed on them by challenges such as distance to the markets, lack of market information, and market dynamics such as (quality of produce, and lack of network). Therefore, the study deemed it necessary to contribute various ways to counteract on these predominant challenges that smallholder farmers face in competing in domestic markets. The study provided evidence of literature on strategies used by smallholder farmers globally to improve quality to be acceptable in the market of medicinal plants. Evidence was not limited to exploring domestic trade, but it suggested measures to be taken by smallholder farmers to qualify to conduct business internationally.

The overharvesting of medicinal plant species from the wild and domestic settings has exerted a lot of pressure on the species' biodiversity. This exaggerated harvesting is difficult to prohibit because to some families it is the only means of survival. Therefore, it made it necessary for

the study to prescribe conservational practices that will safeguard medicinal plant species so that generations to come can benefit. New ways of farming practises that will be adopted by smallholder farmers were discussed. Complex techniques such as seed propagation, grafting, layering and budding brought light to alternative ways of perpetuating plant material such that it can be multiplied by our smallholder farmers in the fields of their comfort is an assertive tool to the production of medicinal plants. However, these biodiversity threats arise from management issues, factors such as camp rotation, no record keeping of species diversity and lack of supervision. Partly, the conservation of nature, rangelands and wildlife (fauna and flora) is a governmental responsibility and there should be a visibility of officers in that regard. Therefore, the study added integrated and advanced evidence to the literature that will assist relevantly to the socio-dynamics of smallholder farmers of the Amathole District Municipality of the Eastern Cape.

Every country is governed by laws, rules and regulations, as principles that are imposed on people to conduct themselves prudently and law abidingly on certain specific subjects. Moreover, there are policies in place to regulate the agricultural sector against any unjust conduct from the government, industries and ordinary civilians. Traditional usage of medicinal plants is often practiced in secrecy thus the limited documentation of indigenous knowledge. The study suggested a patent to the medicinal plant participant so that they can own exclusive rights to their contribution to philosophy, this may cause a symbiotic benefit for both academia and its subjects. The study considered it essential to contribute policies to prohibit medicinal plant users from over-harvesting plant material from nature. Moreover, the study deemed it necessary to impose policies on the production of medicinal plants. This entails the extraction of plant material from the wild for domestication in adequate quantities, allowing smallholder farmers the right to disperse the seed material for domestication so that they can benefit from production and marketing.

### **1.8 Outline of the study**

This study consists of seven chapters. Chapter one is the introduction to the study which consists of the introduction, the background, problem statement, research objectives and justification of the study. The second chapter is the literature review, which reviews information comprised of other studies on challenges, profitability, effects and conservation strategies. Chapter three addresses the first objective of the study which is an in-depth exploration of challenges confronting smallholder farmers in the production and utilization of

indigenous medicinal plants in the ADM with results and policy recommendations. The fourth chapter addresses the second objective of the study; analysing the profitability and determinants of high-value medicinal plants in smallholder production systems, it includes the methodology, empirical results and policy recommendations. The fifth chapter addresses the objective of the study; an in-depth analysis of medicinal plant production's impact on the household welfare of smallholder farmers it includes the methodology, empirical results and policy recommendations. The sixth chapter addresses the objective of the study; and examines the conservation strategies that can be used to sustain the use of indigenous medicinal plants along with descriptive results and policy recommendations. The seventh chapter contains the summary, conclusion and policy recommendations of the study.

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## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This study derived and discussed at length the preliminary literature review of the topic under consideration in accordance with the objectives of the study. The chapter commenced by unpacking the overview of the conservation and sustainable use of the indigenous medicinal plants. The importance of medicinal plants was discussed in depth. The study proceeded to exploring the world-wide diversity of the medicinal plants. The discussion of the profitability and determinants of the high- value medicinal plants were thoroughly outlined and detailed. This chapter unpacked the challenges faced by smallholder and discuss in detail the conservation and sustainable strategies used to preserve indigenous medicinal plants.

#### 2.2 Overview of Conservation and sustainable use of indigenous Medicinal Plants

History portrays the existence of medicinal plants as a significant contributor in the healing methods of any smallholder farming practices (Rioba and Stevenson, 2017). The early documentation of the usage of medicinal plants is evident in countries such as China, Iran, Greece and India as the countries that proactively partaken in their use (Jasmidi-Kia et al, 2017). The existence of medicinal plants is vital for assistance in many aspects of life. In support, Chan et al., (2016) recognized the existence of the medicinal plants as a preliminary source of healing for humans and various living organisms such as (domesticated non-agricultural animals, agricultural animals, game, and certain floral species). Kumar et al., (2016) determined that, plant species with aromatic properties are equally important as other medicinal plants to humans, in particular smallholder farmers because they play a crucial role in the pest management of crops through repelling them with aroma. However, Rajeswara (2016) proclaimed that aromatic plants are not only good for their aroma but also extracted for healing of many disorders for instance, aromatic therapy.

Lerotholi et al., (2017), raised a strong alarm about the extraction of indigenous medicine from the wilderness which is excessive and endangering crucial species. According to Kumar and Shakya (2016), the increasing population, cumulative exploitation of specie and fire are foremost causative factors that largely contribute to the endangerment of medicinal plants. Hence Rathore and Mathur (2018) emphasized on the importance of intensifying more on

protective measures. Strategies that will conserve significant species in their indigenous ecological areas, while providing opportunities for individual production of plant material as their parental ones.

Conservation is a term that is widely used in all the spheres and sectors that are involved in the production of the enterprises of any of the agricultural system. The main aim of the concept is to put in place farming practices that are well focused on maintainable production methods. This involves putting in place farming systems with perpetual protection of the diverse living and non-living material that is present in the production of medicinal plants. The increase of global population has exerted a lot of pressure in plant production of the world. This is because of the negative proportionality between the population and the available land, as more people emerge the arable land is compromised, leading to insufficient water and prevalent natural disasters (Chi et al., 2017).

### **2.3 Importance and use of medicinal plants**

Medicinal plants have been recorded in far history all around the globe to be extremely vital for the survival of humankind. Zubaidah et al., (2020) reinforced this with the obviously noticeable significance of medicinal plants such as being sources of medicine, food, aroma, clothing and flavours. The prevalent traditional usage of these plants was linked to treating ailments for human and domesticated animals (Seepe et al., 2021). In remote areas where there is a prevalence of scarcity in basic amenities such healthcare facilities and livestock veterinary services, people of the community often rely on indigenous medicinal plants (Nwafor, 2020). Opara (2016) theorized that, medicinal plants are convenient for use because they are locally accessible, culturally applicable and viable in terms of cost effectiveness (Shakya, 2016).

### **2.4 Diversity of medicinal plants used worldwide.**

The indigenous African population have relied on medicinal plants, and it is called in various names all over Africa depending on the languages of tribes such as muthi and amayeza. Aziz (2018) connoted that; rural communities play vital roles in the apparent uses of medicinal flora. The main reason is to provide an affordable access to personal healthcare and livestock ethno-veterinary means of redressing diseases (Nwafor and Inya- Agha, 2018). Opara (2016); Xego (2016); Oluwafemi et al., (2020) posited that, herbal medicine and ethno- veterinary systems are a backbone of locally accessible, culturally appropriate, and economically affordable healthcare options. The study depicts the commonly used medicinal plants as follows:

**Table 2.1:** The table depicts commonly used medicinal plants

Species	Family	Common Name	Uses
<i>Agasthosma betulina</i>	Rutaceae	Buchu	Anti- spasmodic, antipyretic, cough remedy, diuretic and to treat urinary tract infections.
<i>Agathosma crenulate</i> (L.) Pilans	Rutaceae	Buchu	Anti- spasmodic, antipyretic, diuretic, anti- microbial, anti-inflammatory anti- oxidant, and analgesic effects
<i>Aspalathus linearis</i> (Burm.f) Dahlg	Fabaceae	Rooibos	Anti- spasmodic, anti- oxidant, anti-ageing, and anti- eczema activities (tea)
<i>Sclerocarya birrea</i> (A. Rich.) Hochst	Anacardiaceae	Morula and Morula	Infertility in females, dysentery, diarrhea, rheumatism, malaria and proctitis, ear nose, and throat conditions
<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	Periwinkle	Urogenital infection, stomach ache, diabetes mellitus, unsuspected venereal diseases, and rheumatism.
<i>Aloe ferox</i> (Mill)	Xanthorrhoeaceae	Bitter aloe/ Cape aloe	Laxative, cuts and burns, emetics, arthritis, stomach pains, and hypertension
<i>Moringa oleifera</i> Lam.	Moringaceae	Moringa	Anti-oxidant, anti-inflammatory, and anti-diabetic properties are used to treat mainly diabetes, high blood pressure, and rheumatism.
<i>Cyclopia genistoides</i> (L.) Vent.	Fabaceae	Honeybush	Anti-cancer, anti-diabetic use, alleviates menopausal symptoms, stomach tonic, expectorant, decongestant.
<i>Harpagophytum procumbens</i> (Burch.) DC.	Pedaliaceae	Devils claw	Treats rheumatism, arthritis, diabetes, gastrointestinal disturbances, menstrual difficulties, neuralgia, headache, heartburn, and gout.
<i>Pelargonium sidoides</i> DC	Geraniaceae	Umckaloabo	Disorders of the respiratory tract, gastrointestinal tract infections, diarrhea and dysentery, HIV complications.
<i>Pelargonium reniforme</i> Curt.	Geraniaceae	Kidney-leaved pelargonium, Rooirabas	Stomach ailments, bronchitis, dysentery, bloody stool.
<i>Siphonoculus aethiopicus</i> (Schweinf) B.L. Burt	Zingiberaceae	Cancer bush	Stomach ailments, backache, diabetes, stress, fever, and wounds, HIV management.
<i>Artemisia afra</i> Jacq. ex Wild	Asteraceae	African wormwood	Anthelmintic, anti-inflammatory. Anti-plasmodial, useful for coughs, colds, and fever.
<i>Hypoxis hemerocallidea</i> Fisch., C.A.Mey. & Avé-Lall.	Hypoxidaceae	African potato	Common cold, flu, hypertension, adult-onset diabetes, psoriasis, urinary infections, testicular tumors, prostate hypertrophy.
<i>Helichrysum odoratissimum</i> (L.) Sweet.	Asteraceae	Everlasting (imphepho)	Insomnia, menstrual pain and sterility, wounds and respiratory problems, intestinal worms, pain, skin infections, stomach problems, and toothache, anti-oxidant, cytotoxic

			activity towards cancer cells, colonic cleanser, fever symptoms.
<i>Hoodia gordonii</i> (Masson) Sweet ex Decne.	Apocynaceae	Milkweed, Bushman's hat, Kalahari cactus	Appetite-suppressant.

**Source:** Adopted from (Nwafor et al., 2021)

## 2.5 Economic benefits of high-value medicinal plants

The use of medicinal plants for herbal healing purposes has increased by a drastic percentage (He, 2018). It is estimated that over 70% of the world's population rely exclusively on the medicinal plants and their use, is not limited to regions or countries that pride themselves with prominence in indigenous cultures such as in North America, Australia, Asia and Africa (Karunamoorthi et al., 2013; Jeelani et al., 2018; Astutik et al., 2019). Jamshidi-Kia et al., (2018) stated that, even the industrialized nations equally depend indirectly on the Medicinal plants for the manufacturing of their pharmaceutical products. The contribution of medicinal plants to the livelihood statuses is not only through the availability of herbal medicine but the vital role it plays in being a trade commodity for large rural communities (Nwafor et al., 2021).

The exponentially increasing population growth, urbanization, strong cultural values regarding medicinal plant use, medicinal plant enterprise development has been experienced considerably. Van Wyk and Prinsloo (2018) has identified the prior mentioned statement to be the root cause of the induced over- harvesting of valuable plant material. The shift from subsistence use of medicinal plants to commercial curiosity, is initiated by the escalating demand of these plants or root, flower, bark, leaves, stems, bulb, and tubers to treat illnesses or to perform rituals (Maroyi, 2013). Evidence to over- harvesting as per the Red data list is given by species such as *Siphonochilus aethiopicus* commonly known as 'wild ginger', which has multiple uses that the society is interested in and the farmers are encouraged to farm the species (Moyo, 2014).

### 2.5.1 Contribution to local economies

Communal economies are some of the phenomenal innovations of enterprise development in all local spheres. According to Chirisa et al., (2020), indigenous grown economies are more reliable options of trade to smallholder farmers. Their existence contributes significantly towards bringing a sustainable income flow to disadvantaged farmers with intense difficulties in making the ends meet. In the case of medicinal plants and their prolific nature of reproduction, Fitzgerald et al., (2020) hypothesized that, the high reproductive properties of

medicinal plants without human influence are the ultimate survival advantage for smallholder farmers.

### **2.5.2 Trade commodity**

Medicinal plants are a special asset to rural inhabitants because of their capacity to be within reach to access, extraction and creation of enterprise through trade exchanges. According to Iskandar et al., (2020), integrating medicinal plants with trade allows smallholder farmers to participate in a diversified strategy that intertwines indigenous knowledge, economic development, and eco-mindful production techniques that are sustenance driven. Numerous researchers stated that, smallholder farmers in rural areas commonly resort to growing and selling medicinal plants to reinforce their financial stability and livelihood nourishment (Chandra et al., 2019; Iskandar et al., 2021; Singh et al., 2022). Indigenous medicinal plants are extremely admired for their health-benefiting properties, these domestic plants are pursued domestically and globally, opening a wide variety of income streams. Armed with generations of indigenous wisdom that was inherited verbally from forefathers, Volenzo and Odiyo (2020) concluded through evidence in literature that, smallholder farmers are the ones that possess access to the key to preserving and sustainably utilizing plant species. Not only does the medicinal plant trade bring economic security to farmers, but it also contributes to the conservation of biodiversity (Nwafor et al., 2021).

Through the interest to sell these plants, smallholders promote conservation while protecting sensitive ecosystems and threatened flora. The adoption of this approach can secure the continued growth and conservation of medicinal plants for posterity (Rathore and Mathur, 2018). Lerotholi et al., (2017) presumed that, while economic profit and environmental conservation are vital, they must be balanced to avoid overuse and habitat deterioration. Bridging the gap between age-old practices and modern sustainability, smallholder farmers can bind the power of medicinal plants to reap economic benefits and promote environmental stewardship (Chandra et al., 2019).

### **2.5.3 Diversification of income source**

In modern smallholder agricultural practices, where income generation is in the centre of all the objectives that need to be achieved rather than social status, diversification of income sources becomes paramount to adopt and implement. Tafesse (2023) described farm- level income diversification as, adding income generating enterprise ventures to the mixed

household level, including livestock, cop, non- farm and off farm activities. These enterprise ventures produce a set of revenue portfolios with various degrees of expected risk, returns, liquidity and seasonality (Adeoye et al., 2019; Atiso et al., 2020).

Income from medicinally plants is not optimally taken advantage of by smallholder farmers due lack of diversified knowledge. A significant amount of evidence is visible in literature that only a few species are grown and commercialized (Sydara et al., 2014; Chen et al., 2016; Chi et al., 2017; Astutik et al., 2019). However, Rashid et al., (2014) supposed that, there is a lack of precision in the economic contribution of medicinal plants in the household and national economies. This is due to the stigma that, medicinal plants are often used by society for witchcraft or traditional sorcery for charms and magic. Therefore, trade is mostly done in secrecy, rendering the measure of economic value of trade exchanges ambiguous.

## **2.6 The profitability of medicinal plants**

Medicinal plants have attracted worldwide attention from humankind through their ability to provide healing, especially for the financially constrained. It is estimated that 80% of the global population uses traditional medicine for the management of various diseases such as cancer, skin conditions and diabetes (Ndhlovu et al., 2021). In developing countries, the demand for medicinal plants increased proportionately due to the claims that pharmaceutical medicine is too expensive than traditional medicine (Randriamihariso et al., 2015). According to Sen and Chakraborty (2017), the demand for medicinal plants instigated commercial streams for large pharmaceuticals and traditional medicine extractors, particularly in rural areas.

The prevalent use of medicinal plants in developing countries has seen the use of traditional medicine a profitable business for multinational business entities, who have discovered the active ingredients and established a lucrative business in medicinal plants (Van Wyk, 2015). The commercialization of traditional medicine has created export opportunities for different countries. However, medicinal plants contribute both directly and indirectly to the economy of rural households through the provision of welfare and economic status (Omotayo et al., 2020). In rural settings, traditional markets around the globe have been recognized as an avenue of trade of medicinal plants and their derived products. Medicinal plant extractors and buyers meet in these markets to initiate financial-based exchanges of medicinal plant products such as in the Durban markets and street vending outlets (Tinitana et al., 2016). The drive to maintain profits sustainably has led to an intervention of production of medicinal plants. In Sub- Sahara

Africa, the production of medicinal plants by smallholder farmers intervened strongly with the motive of ensuring a sustainable income flow for their households (Ndhlovu et al., 2021).

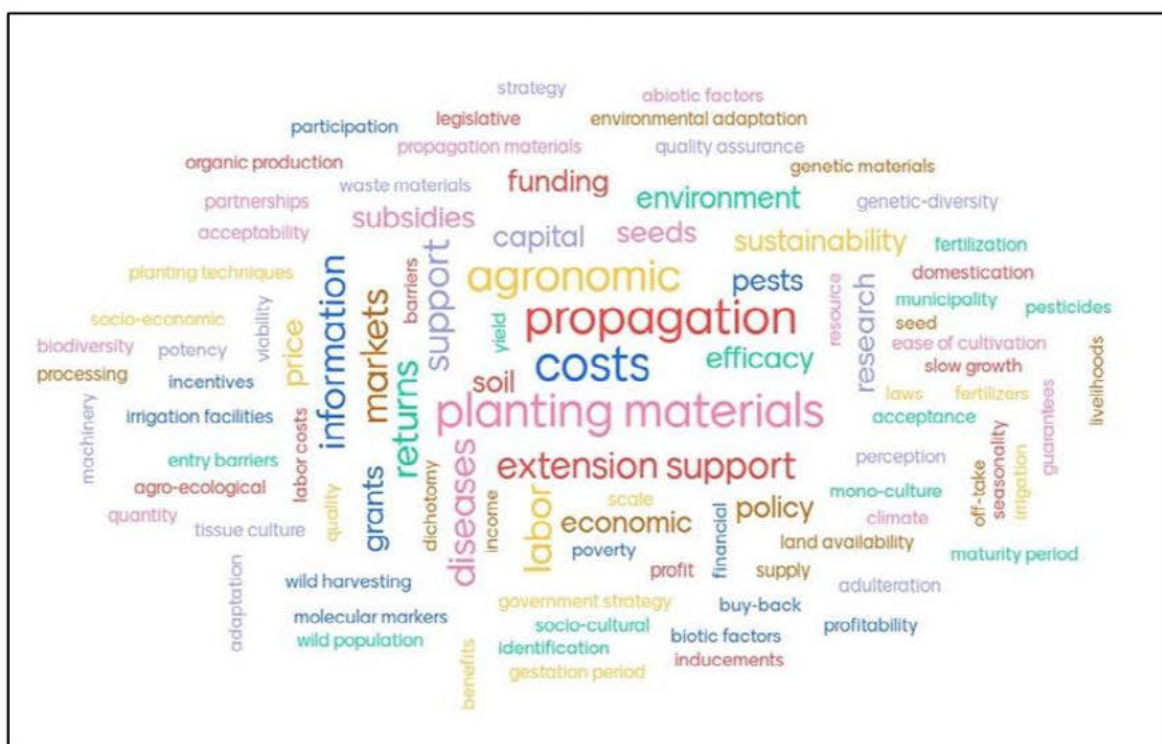
Profitability plays an important role in the farmer's decision-making and is a key contributor to economic efficiency. Profitability is influenced by numerous factors such as yield, prices, farm size, and location, cost of production and the level of output. Arguably, profitability is the main objective of every producer in any economic activity; it must be measured and evaluated. Dutta et al., (2020) suggested that it develops from the difference between the surplus of total revenue (money generated from sales) and the cost of production of the good. Additionally, it can be defined as the ability of a business to generate profit from its economic activities through the efficient use of resources (Asqar et al., 2022).

Furthermore, Perisa et al., (2017) stated that a company's financial performance is its profitability as measured by financial indicators. This refers to a company's ability to operate efficiently, and profitably, be competitive amongst others and flourish. A firm's financial performance is typically assessed using a combination of financial ratio analyses, benchmarking, performance against a budget, or a combination of all these approaches. Financial performance has been a common source of concern for the performance of most agricultural enterprises because it embodies the state of their development. Venance et al., (2016) claimed that solid financial performance is a requirement for agricultural enterprises to attain sustainability.

Nwafor et al., (2021) have indicated that the production of medicinal plants by smallholder farmers is profitable. The relation between the cost incurred in running the medicinal plant business and the returns accrued to it can be used to determine the profitability of any business (Mariyono, 2018). The profitability of medicinal plants is investigated by analysing the total average cost of medicinal plant production, average total revenue, and net farm income. If the scale of production is increased and the management techniques are improved, the profitability of medicinal plants can be improved (Astutik et al., 2023).

## 2.7 Challenges faced by medicinal plants farmers.

Medicinal plants and plant- derived medicinal materials are widely used in various traditional systems throughout the globe and their use as alternative natural medicine or supplement to synthetic medicine is becoming increasingly popular (Van Wyk and Prinsloo, 2018). Chen et al., (2016); Shakya (2016) proclaimed that, in as much that these plants play a significant role in the societal health and medicine cost, there are fundamental constraints that may hinder a smallholder farmer from producing these plants. Lerotholi et al., (2017) postulated that, more binding challenges include capital, lack of resources, knowledge barriers, access to land and access to markets. Other frequently mention challenges are provided in figure 2.1 below.



**Figure 2.1:** A word cloud depicting various challenges present in literature

**Source:** Adopted from (Nwafor et al., 2021)

The existence of the above-mentioned words in the figure makes it obvious that it will be difficult for a farmer to overcome the odds given that they possess personal shortcomings that slows their progress in production. Chen et al., (2016) highlighted that, although these threats are known, there is still a big gap between the problem and the solution. The major issue is related to the availability of planting material, cost involved, suitability and adaptability of cultivars, extension visits and propagation (Sharma and Thokchom, 2014).

### **2.7.1 Socio- cultural dynamics**

The use of medicinal plants in African communities is often associated to cultural beliefs. The heterogeneity in cultural groups brings differences in the people's knowledge, perceptions and practices of the usage of natural plants to treat ailments (Weckmüller et al.,2019). Absurdly, as the academic interest to study medicinal plants in smallholder farming is rising, indigenous people's knowledge and participation is declining (Etana et al., 2020). Weckmüller et al., (2019) presumed that, comprehensive knowledge is vested with the older community generation than youth. However, the disparities in knowledge might not be because of greater life experiences in elders, but alternative socio- economic factors.

Astutik et al., (2019) emphasized that, showing knowledgeability on the subject is a sensitive societal issue. Only a few societal members that can attest to having information (intellectual property) because of stigmatization, of which it is appropriate for knowledge and commerce (Nambisan, 2017). Bibon (2022) detailed that, most educational systems are grounded to cultural characteristics as a foundation of instruction. Hence the use and disuse of medicinal plants is often influenced by cultural indoctrinations adopted from either formal or informal education.

### **2.7.2 Wild harvesting**

In the history of traditional medicine, Africa is appearing to be proactively involved in harvesting and inclusion of medicinal plants into to daily routines. Traditional healers are piloting the extraction process for the mere reason of creating concoctions and remedies to heal people and livestock for civilians depending on it for primary healthcare. According to Oguntibeju (2018), in 1995 the number of traditional healers practicing in South Africa was over 200 000 compared to orthodox doctors. The rising number of active participants in the harvesting and trading of plant parts is increasingly threatening wild medicinal plant population. For instance, one of the most extensively traded wild medicinal plant in South Africa's informal markets is the Natal Lilly (*Clivia miniata*) and Groner et al., (2022) estimated that, over the past 90 years the natal lily has lost over 40% of its wild population.

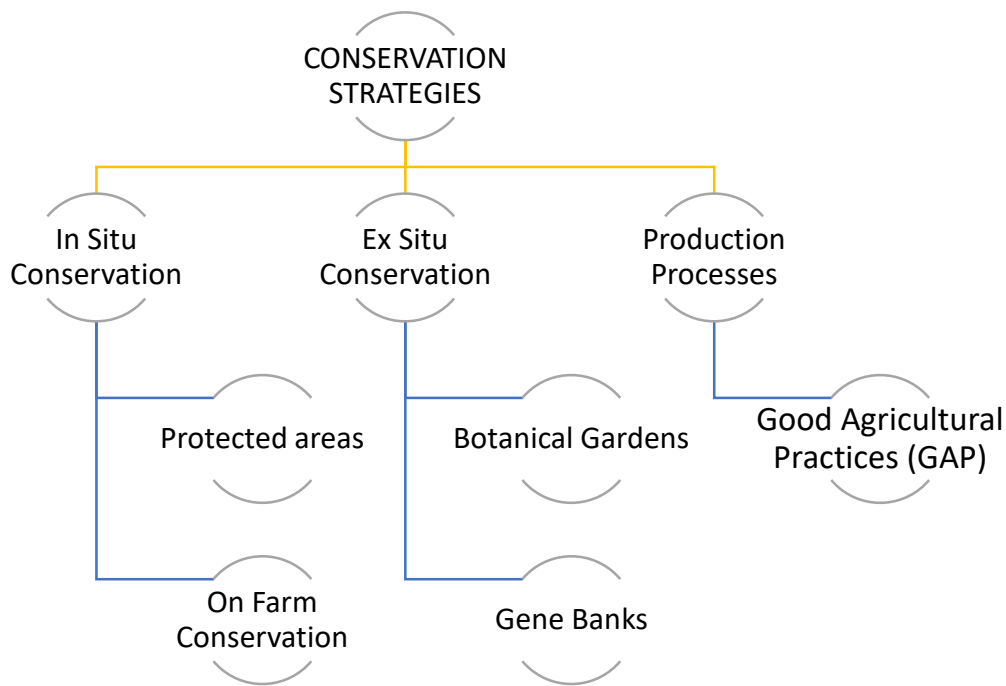
Indigenous knowledge is an in integral part in the utilization of medicinal plants as indigenous medicine. Seile et al., (2022) stated that, this phenomenon influences a variety of cultural systems such as traditional healing, herbalism and knowledge owners. A significant bundle of the black population consults local traditional health practitioners for fundamental healthcare

issues such as, tuberculosis, cancer, asthma, mental disturbance, HIV and AIDS and for cultural reasons (Chen et al., 2016; Weckmüller et al., 2019; Seile et al., 2022). Therefore, the vigorous extractive demand of plant resources from the wilderness is as a result of mitigating healthcare issues of the local inhabitants and their animals (Moyo et al., 2015). Therefore, it is for the prior mentioned reasons that there is an exaggerated decline in a variety of medicinal plant species that could live a number plant biodiversity endangered (Nwafor et al., 2021; Sing et al., 2022).

## **2.8 Conservation and sustainable strategies used to preserve indigenous medicinal plants.**

According to Kadam and Pawar (2020), the fundamental purpose of conservation is to endorse sustainable development by extension of biological resources in ways that does not reduce the world's variety of species or destroy the natural continuity of ecosystems. It entails approaches such as collection, propagation, evaluation, disease identification and elimination, storage and distribution. Pandey et al., (2021) stated that, controlled growing environments play a crucial role in the protection of endangered species such that it makes it easy for researchers to probe analysis and contribute output on valuable research information and monitor them from reachable distances.

Alternatively, rural inhabitants have their traditional conservation methods that are put in place to discourage the excessive exploitation of resources in the wild. Some methods can start as simple as discouraging people from cutting down trees and encourage them to plant fast growing trees to their domestic territories (Shukla, 2023). However, traditional efforts alone are not sufficient to mitigate the ecological losses, thus other biotechnological procedures need to be brought into play (Shafi et al., 2021). The figure below depicts the conservation strategies that are evident in literature that the study is sought empirically explore.



**Figure 2.2:** Conservation strategies of medicinal plants

**Source:** Adopted from (Mir et al., 2021)

### 2.8.1 *In- Situ* Conservation

The method of in situ conservation involves “on- site conservation” of the wild genetic diversity in natural habitat. Furthermore, Kadam and Pawar (2020) describe it as a build-up of wild nurseries and natural reserves maintaining the efficacy of traditional medicinal plants. The formation of these reserves plays a formidable part in the protection and restoration of biodiversity (Gupta et al., 2022). In countries such as India, conservation is orchestrated in areas such national parks, wildlife sanctuaries and biosphere reserves.

#### 2.8.1.1 Protected areas

Protected areas are areas that resemble natural parks, wild nurseries and biosphere reserves. In the case of conservation through natural parks, important wild resources are given stringent protective measures to preserve them in their natural habitat and this requires evaluating the contribution and eco system roles of individual habitat (Cahyaningsih et al., 2021). In the instance of conservation through Wild nurseries, this is an effective approach since it redresses the over- exploitation and habit degradation of lucrative medicinal plant species by propagation of endemic, endangered and in- demand species (Ayuso, 2019). On farm conservation, this conservation strategy is ideally focused on ensuring that a decent number of wild species in

managed habitats such as plantation forests and farms include the growth of medicinal plants in existing farming systems.

### **2.8.2 *Ex- Situ* Conservation**

The concept of *ex situ* conservation of medicinal plants is strongly based on the conservation of plants outside their natural habitat, to protect the deterioration, disruption, and replacement of plant population in the wilderness, sometimes referred to as “off- site” conservation (Kadam and Pawar, 2020). The concept includes procedures such as seed and DNA storage, gene banks and botanical gardens (Biswas et al., 2017). This conservation approach plays an extremely crucial role in the conservation of very rare and endangered medicinal plant species because they assist in popularizing of regularly used medicinal plants amongst people (Pandey et al., 2021). Herewith stated below, is some of the *ex situ* conservation strategies used to alleviate life threatening diminish in species of medicinal plants.

#### **2.8.2.1 Botanical gardens**

Botanical gardens are an extension of *ex situ* conservation of medicinal plants that serves as alternative safeguarding option to utilize for species that cannot be stored in seedbanks (Kaur et al., 2022). Botanical gardens are facilities that are often piloted by institutions such as universities that are interested in scientific research of endangered medicinal plant species with the intention of perpetuating plant material in semi- controlled environment outside their natural habitat (Dey et al., 2021).

#### **2.8.2.2 Seed banks**

There are multiple reasons that would make one to preserve seed. Mir (2020) stated that, some of the reasons is to preserve genes, resistance from diseases and drought tolerance of medicinal plants. In the case of rural platforms, forestall loss of valuable plant material is a genuine concern, living no option but to resort to intensified measures of protecting biodiversity in medicinal plants (Rashid et al., 2021). Seedbanks propose a better alternative of preserving genetic biodiversity of medicinal plants through botanical gardens. However, the most challenging issue about seed banking is the process of reintroducing the plant species back into the wilderness and how to assist actively in the restoration of wild populations (Porceddu et al., 2020).

## **2.9 Chapter summary**

The medicinal plant industry is a lucrative business environment with a potential of endorsing economic growth and economic development especially in rural areas of the Sub-Saharan Africa. In South Africa, the extraction of medicinal plant material has developed the poverty-stricken rural communities for the better. The main benefits that smallholder farmers have exploited from medicinal plants is contributing to the health of their communities, well-being of their animals and financial benefit for themselves through sales of medicinal plants. The exaggerated interest in medicinal plant products is driven by their affordability over manufactured medicine. Therefore, the lurking demand creates an opportunity for smallholder farmers to participate in the extraction of medicinal plants to trade with consumers. The extractions are practiced unrestricted of regulations, without rules to protect biodiversity. Hence, numerous studies confirm the depletion of plant resources from the wild, which in turn poses a threat to the sustainability of smallholder income. The shortage of plant resources in the wild, calls for a strengthened intervention of smallholder farmers in the production of these plant materials. This production intensification secures the incomes of smallholder farmers and capacitates them with sufficient yield quantities to diversify into new markets. Medicinal plants are also a buzz word in this country, such that South Africa is contributing about 20 000 tons of produce to domestic markets. Therefore, there is plenty to be benefited by smallholder farmers through medicinal plants, it becomes apparent that they need to be conserved for future generations.

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## CHAPTER THREE

### ASSESSMENT OF CHALLENGES CONFRONTING SMALLHOLDER FARMERS IN THE PRODUCTION AND UTILIZATION OF INDIGENOUS MEDICINAL PLANTS

#### **Abstract**

Conservation and sustainable use of indigenous medicinal plants by smallholder farmers play an important role in the rural societies of the Amatole District of the Eastern Cape. These plants contribute significantly to providing affordable herbal medicine alternatives to expensive orthodox medication. They also provide income opportunities for smallholder farmers, as the demand for herbal medicine among fellow rural dwellers of the district rises, it creates an opportunity for smallholder farmers to Produce medicinal plants with the idea of taking advantage of that market opportunity. However, the production of medicinal plants is relatively low due to several factors that contribute to the low yield (including lack of capital, lack of machinery and implements, knowledge barriers, limited institutional support and cultural backgrounds). Medicinal plant farmers have no access to formal markets which may reduce the profitability of their enterprises. Additionally, while many studies have been conducted on the remedial benefits of medicinal plants, very little is known about the production and utilization of indigenous medicinal plants in this country. At the same time, efforts to commercialize indigenous medicinal plant production have not been exhausted to their full potential. Therefore, this study investigated the challenges faced by smallholder farmers in producing and utilizing indigenous medicinal plants in the Amatole District Municipality of the Eastern Cape. Primary data for the study was collected through the use of well-structured questionnaires from smallholder medicinal plant farmers. A multi-stage stratified sampling procedure technique was used to draw an appropriate sample of 150 smallholder medicinal plant farmers for this study. Descriptive statistics and the Tobit model were used for analysis. The study results revealed that female farmers with an average age of 44 years and an average of 10 years in school participate more in the production of indigenous medicinal plants. The average farm size per household was 1 ha and is produced by an average of 5 members per household. The study concludes that factors such as age, gender, household size, education level, farm size, lack of capital, knowledge barriers and cultural differences are factors influencing the production and utilization of medicinal plants. Therefore, the study recommends the intensification of male figures to counter gender imbalance, the intervention

of government in offering capital assistance and educational empowerment to smallholder farmers through extension services. Furthermore, the study suggests the need for upscaling the bio-diversity conservation measures of plant material as they are fundamental to the production and utilization of medicinal plants.

### 3.1 Introduction

Medicinal plants are defined as plants that are used for healthcare purposes in allopathic and traditional means (Astutik et al., 2019). Medicinal plants have existed for time immemorial and have been acknowledged globally especially in continents such as Asia and Africa for their contribution to affordable healthcare and livelihood enhancement capability (Chen et al., 2016). Historical evidence of traditional medicinal practices in Asia suggests that these plants have been known for centuries; classical examples are *Ayurveda* (Himalaya, 4500- 1600 BC), *Jamu* (Indonesia, 800 AD), *Traditional Chinese Medicine* (China, 3000 BC), *Thai medicine* (Thailand, 4500- 1600 BC) and *Herbal Medicine* (Bangladesh, 4500- 1600) (Chen et al., 2016; Astutik, 2019; Ullah et al., 2020; Süntar, 2020). Reasons for use and methods of application of these plants vary throughout all the continents but they are all rooted in the treatment of diseases and livelihood enhancement. In Africa, the use of traditional medicine has been acknowledged for centuries, out of 40 000- 45 000 plant species existing in the continent, 5000 are recognized as medicinal plants (Sadeer et al., 2019).

In developing countries of Sub-Saharan Africa, the extensive use of traditional medicine has resulted in a profitable business opportunity for multinational corporations that have identified the active ingredients and found lucrative business in medicinal plant distribution (Chen et al., 2016; Lerotholi, et al., 2017; Zahra et al., 2020). Traditional medicine is commercialized and distributed to different countries for product development (Ndlovu et al., 2021). This implies that medicinal plants have a direct and indirect influence on the economy of rural households by contributing greatly to social welfare and economic status. According to Seile et al., (2022), South Africa has high demand for medicinal plants with approximately 27 million inhabitants relying on herbal medicine for welfare. This leads to an estimated 20,000 tons of medicinal plants to be harvested from the wild to meet the increasing demand for medicinal plants in the markets (Ndlovu et al., 2021; Seile et al., 2022). Furthermore, this unregulated industry of medicinal plants accounts for an estimated contribution of ZAR 2.9 billion to the economy per annum (Ndlovu et al., 2021). These competitive markets of medicinal plants are influenced by the rising population of the country and the inflated preference of consumers to substitute synthetic medicine with traditional medicine due to affordability and easy access.

In many rural areas where poverty is high and access to health facilities is a challenge, medicinal plants play a vital role in providing affordable medicine for the poor (Chen et al., 2016). Nwafor, (2021) stated that the dire need for affordable medicinal options has created an

income opportunity for rural smallholder farmers to explore. Smallholder farmers contributed immensely to the sustainable use of indigenous medicinal plants through the extracting of medicinal plants from the wild for selling. Furthermore, it became a need for smallholder farmers to adopt medicinal plants as an enterprise in their farming systems. The impact of medicinal plants is not limited only to human consumption, numerous studies show evidence that medicinal plants are used extensively to heal livestock, especially from internal parasites such as roundworms, tapeworms and fluke nematodes (Shahrajabian et al., 2021; Abebe et al., 2021; Pratama et al., 2021).

However, there is limited documentation of the participation of smallholder farmers in the production of indigenous medicinal plants. Little is known about the contribution of smallholder farmers in the production factor of indigenous medicinal plants, hence the need for this study. The study is sought to assess the extent to which smallholder farmers have included indigenous medicinal plants in their farming land. The pattern of extraction of plant resources from the wild without proper propagation measures endangers the species diversity of natural plant resources in the wild (Bisht et al., 2020, Volenzo and Odiyo, 2020). This imbalance between the extraction and production of medicinal plants threatens to degrade ecosystems, destabilize welfare and deprive smallholder farmers of an income stream (Shennan-Farpón et al., 2022). Therefore, it is necessary to investigate the challenges that affect smallholder farmers in producing and utilizing medicinal plants sustainably.

Additionally, smallholder farmers face considerable challenges such, as limited access to land, access to agricultural inputs, institutional supports and knowledge barriers. Moreover, there are additional factors such as climate risk, urbanization and over-harvesting of plant material that threaten medicinal plants and agriculture (Nwafor, 2021). These factors play a crucial role in instilling uncertainty in smallholder farming systems since smallholder farmers are averse to the risk of participating in risky production periods. Therefore, it was significant to measure the contribution of the challenges confronting smallholder farmers in the production and sustainable use of indigenous medicinal plants (Astutik et al., 2019).

## **3.2 Methodology**

### **3.2.1 Theoretical framework**

The study adopted the Sustainable Livelihood Development (SLD) framework and this framework provides a necessary understanding in conducting an in-depth exploration of challenges confronting smallholder farmers in the production and utilization of indigenous medicinal plants to maintain a livelihood. The Sustainable Livelihood Development framework has gained considerable momentum during the years of 1970s as a planning approach that is within the broader category of sustainable development (Gibbens et al., 2020). The Sustainable Livelihood Development framework is grounded on the conception that smallholder farmers depend on a range of capital inputs and assets as a way to secure a decent livelihood through the production of medicinal plants (Yang et al., 2023). Capital and assets contribute an integral role in counteracting the challenges that are opposing smallholder farmer's sustainable productivity. Based on the sustainable livelihood framework, livelihood capital is broken down into five categories: human, natural, financial, physical, and social.

#### **Human capital**

The theory suggests that the knowledge and health of smallholder farmers have a positive effect on welfare. Often smallholder farmers need valuable knowledge about specific plant species, appropriate production techniques and sustainable collection methods to be equipped with skills to address challenges in the future. To counteract the challenges presented by the utilization of indigenous medicinal plants, training programs to enhance human capital become necessary to blend indigenous traditional knowledge with modern techniques for sustainable production. Furthermore, the health of a farmer is an underrated and important aspect to be well looked after to prolong the longevity of a key farmer's life (Volenzo and Odiyo, 2020).

#### **Natural capital**

Medicinal plants are a discipline of natural resources that contribute to the development of smallholder farmers. The long-term benefits can be ensured if the conservation and proper management of the resources are sustainable. Anyango et al., (2022) suggested that the natural capital can be protected in various methods such as agroforestry, organic farming, and wild plant harvesting management. The application of the Sustainable Livelihood Development theorem concerning the study advocates for the employment of preservation strategies. The

preservation strategies include establishing community- managed medicinal plant reserves and adhering to sustainable harvesting guidelines greatly in the conservation of natural capital. Medicinal plants should be adopted by smallholder farmers in their already existing agricultural systems through the integration of agroforestry practices that are aimed at enhancing biodiversity and promoting ecological balance (Eshete and Molla, 2021)

### **Social Capital**

The proficiency of smallholder farmers in the farming environment is determined by social networks, institutional linkages, and other related social relations. The theorem suggests that sustainable utilization of medicinal plants may be enhanced through collaboration between farmers, community organizations and governmental institutions. This can be done through collective action, resource- sharing and knowledge exchange that takes place benefiting all stakeholders. Establishing a social capital involves encouraging cooperation, as well as reinforcement of community institutions. Cooperatives and associations can assist greatly in helping farmers to make decisions together, share lucrative information and support in formation of policies. This can be done through engaging in dialogue with local governments and non-governmental organizations to mobilize resources and support for smallholder farmers (Woyesa and Kumar, 2021).

### **Financial Capital**

Smallholder farmers need access to financial resources and markets to invest in the production of medicinal plants, value addition and infrastructure. It is possible to achieve better financial and economic sustainability through microcredit schemes, market linkages, and fair pricing mechanisms. Microcredit, grants, and subsidies are avenues to improve access to financial resources in medicinal plant production. Smallholder farmer's economic sustainability can be strengthened by establishing linkages between them and markets, as well as fair trade initiatives involving value-added products (Anyango et al., 2022).

### **Physical Capital**

The efficient production of medicinal plants requires infrastructure, tools and technology to support smallholder farmers. Enhancing physical capital includes developing or upgrading infrastructure such as irrigation systems, storage facilities, and transformation networks. The value of medicinal plant products can be enhanced by investing in physical infrastructure, such

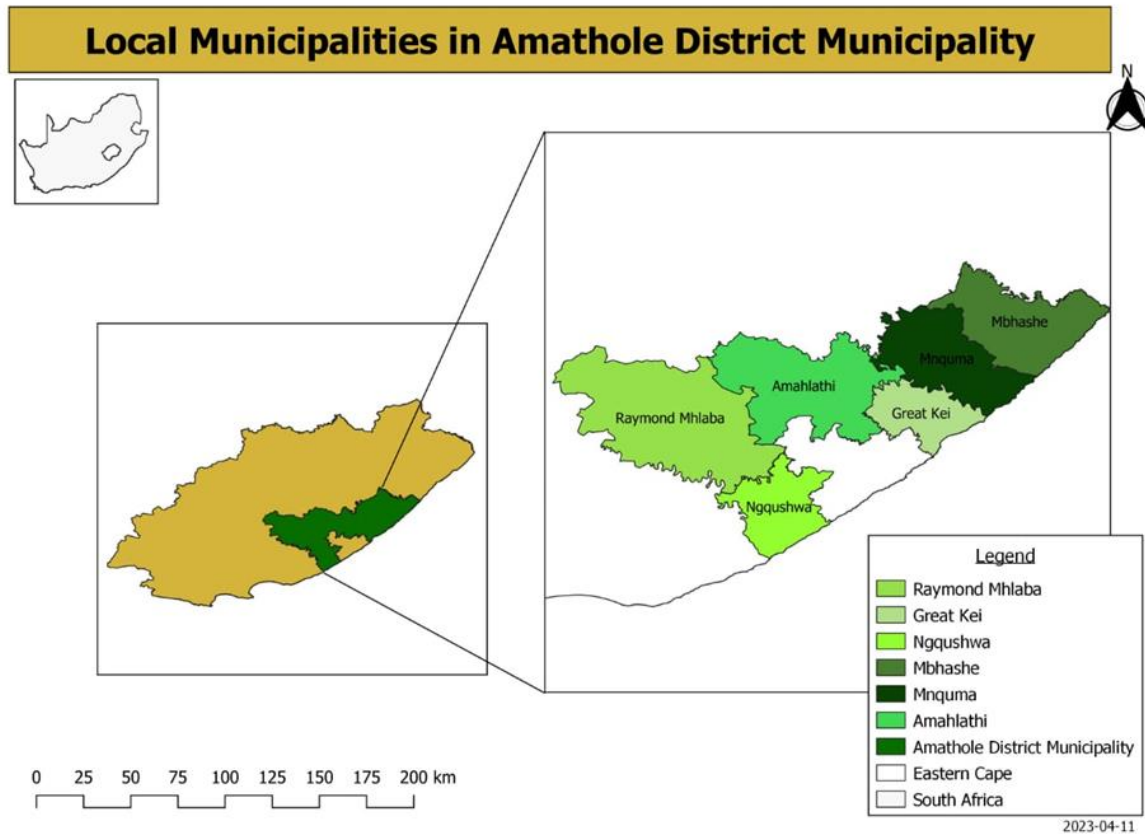
as drying and processing facilities, to minimize post-harvest losses. Good transport and storage facilities will facilitate in timely delivery of products to the market.

The challenges faced by smallholder farmers in utilizing indigenous medicinal plants effectively and efficiently are detrimental to their livelihood enhancement capacity. The Sustainable Livelihood Development theoretical framework presents a robust concept for the sustainable utilization of medicinal plants among smallholder farmers, conservation and sustainable use. This theoretical framework suggests that sustainable livelihood can only be achieved by considering the different types of capital such as human, natural, social, financial, and physical in accord. Smallholder farmers' knowledge and expertise should be enhanced; natural resources protected; social cohesion promoted; financial support provided; and physical infrastructure upgraded for sustainable use of medicinal plants and conservation objectives of safeguarding species diversity. From a long-term perspective, it is only through the adoption of a holistic approach such as the Sustainable Livelihood Development framework that the interests of both smallholder farmers and the environment can be safeguarded (Gibbens et al., 2020).

### **3.2.2 Description of the study**

The study was conducted in the Amatole District Municipality (ADM) of the Eastern Cape. The district municipality is situated in the former Transkei region which is mostly rural settlements and some minority parts of it being peri-urban settlements (Mujuru and Obi, 2020). The Amatole District Municipality is classified as a category C2 Municipality that is comprised of 6 Local Municipalities that are distinguished as follows: Amahlathi; Great Kei; Mquma; Ngqushwa; and Raymond Mhlaba. The district municipality is home to approximately 17 million people with 91% being African, 6% white, and 3% coloured (Afolayan and Wintola, 2014; Mudemba et al., 2018). Furthermore, females cover 52% of the population and the remaining 48% are males (Mudemba et al., 2018). The climate of ADM is characterised by average temperatures fluctuating between 7°C to 10°C in cool dry seasons when it can be snowy and from 18°C to 24°C in the hot humid season. Adequate rainfall ranges from 750 mm to 1050 mm per annum (Marume et al., 2013). Inside the boundaries of the ADM's territory, are richly endowed terrains bestowed with natural resources ranging from succulent grazing grasslands to forests, and marine life (Mdoda and Obi, 2019).

The Integrated Development Plan (IDP) estimates suggest that 54% of the population survives below the breadline (Amathole District Municipality Integrated Development Plan, 2016). Furthermore, 66% of the population lives through the assistance of social welfare grants because of the high levels of unemployment (ADM IDP, 2016). The majority of the dwellers of the district are involved in primary agriculture to alleviate poverty and sell surplus to obtain income. The predominant agricultural activities among smallholder farmers that are taking place in the Amatole District Municipality are seasonal maize production, poultry, horticulture, cattle (dairy and beef), small stock (sheep and goats) and forestry (Eastern Cape Development Corporation, 2015). Amongst the natural vegetation of forests and grasslands is the abundant availability of medicinal plants that are indigenous to the study area, whom the dominant Xhosa tribe calls “Amayeza” or “Umthi” (Nwafor, 2021). The study was conducted in this district to encourage farmers to participate in the production and sustainable use of indigenous medicinal plants to develop a sustainable livelihood. The plentiful availability of medicinal plant resources around them makes easy access to these medicinal plants without exhausting so many input resources. The study focus was on engaging smallholder farmers with the idea of increasing production outputs to meet the demands of the local markets where their production is sold, this would see a lot of households out of poverty. Thus, the increase in the production of medicinal plants in this region can be seen as a livelihood strategy to enhance income generation, employment opportunities, poverty alleviation and reducing rural-urban migration. Therefore, the production of indigenous medicinal plants has the potential to expand the rural economy of the Amatole District Municipality.



**Figure 3.1:** Map showing the Amathole District Municipality

**Source:** ARC- GIS 10.6 (2023)

### 3.2.3 Sampling Procedure, Frame and Sampling Size

A multi-stage stratified sampling procedure was adopted for conducting this study since it simplifies data collected from large groups of medicinal plant farmers from various locations of the Amathole District Municipality. The first stage was the purposive selection of the local Municipalities with the availability of medicinal plants. Mquma and Mbashe local municipalities were chosen purposively because of the availability of medicinal plants and smallholder farmers that are producing them. The second stage was stratification, where smallholder medicinal plant farmers were divided into strata based on similar characteristics, farming enterprise or variables such as socio-economic characteristics, outputs, sales, household size and institutional factors. The study categorized medicinal plant farmers into Strata A: medicinal plant farmers; Strata B: crop farmers; Strata C: livestock farmers. Therefore, after stratified sampling was employed, only smallholder rural medicinal plant farmers were considered for the study. Stage three and the last stage was a random selection of farmers who were part of the study. These farmers were part of the data collected and used for

the study. In this study, sample size was determined using Cochran's formula because the population size is unknown. Cochran's proportionate to size sampling methodology was used to determine the required sample size.

$$n_1 = \frac{Z^2 p(1-p)}{e^2} = \frac{1.95 \times 0.5 \times 0.5}{(0.08)^2} = 150$$

Where n= required sample size; Z= confidence level at 95% (standard value of 1.96), p= estimate of smallholder medicinal plant farmers which is at 0.89. This was an assumption that 89% of smallholder farmers participate in the production of indigenous medicinal plants in the study area; q= This is the weighting variable given by 1- p; e<sup>2</sup>= Margin of error at 5% (standard value of 0.05). The unadjusted sample size of the study was 150 smallholder medicinal plant farmers. The study used 125 medicinal plant farmers as participants and 25 were non-participants.

### **3.2.4 Data collection**

Questionnaire was used to collect primary data from smallholder medicinal plant farmers in the study. Data was obtained from the smallholder farmers through the use of structured questionnaires. The questionnaire was pre- tested to 20 medicinal plant farmers in the study area in order to increase its reliability. Enumerators were elected to assist the researcher with data collection. All enumerators were fluent in the local language, which is isiXhosa. These enumerators were well-trained, and experienced and had great knowledge about agricultural systems in rural areas. The interviewer read questions to respondents, and their answers were recorded. The distribution of interviews was equal between Mbashe and Mnquma smallholder farmers.

### **3.2.5 Analytical framework**

The study made use of the Tobit regression model to assess the factors affecting the production and utilization of indigenous medicinal plants by smallholder farmers. The Tobit model was introduced by Tobin in 1958 and argued that this model can be used when the dependent variable in a regression model equation has a lower and upper limit. The Tobit model is the most censored regression model appropriate for analysing dependent variables with upper and lower limits (McDonald and Moffitt, 1980; Debebe, 2022; Michels, 2022). The model answers both the question of factors influencing a decision and the factors that determine such a decision

(Mazibuko and Antwi, 2019). The Tobit model was used to quantify the magnitude of the utilization and production of traditional medicinal plants are assumed to be influenced jointly or factors affecting them are assumed to be the same (Debebe, 2022). Moreover, the Tobit model is more applicable in the truncated distribution of observations in the data set (Debebe, 2022). In this study, perceived utilization and production of traditional medicinal plants have censored distribution since a large number of farmers have participated in the utilization and production of traditional medicinal plants. The censored distribution is a combination of continuous and discrete distribution because of the mass of observations at zero (Adelekan and Omotayo, 2017). Since the latent variable had a normal distribution, strictly positive values of perceived utilization of traditional medicinal plants status have a continuous distribution (Nakhumwa & Hassan, 2003). The probability associated with latent variable values below the censoring point is summed to a single discrete value (Greene, 2000). Tobit model parameters do not directly correspond to changes in the dependent variable brought about by changes in independent variables. According to Greene (2003), the marginal effect on the magnitude of utilization and production of traditional medicinal plants is due to changes in the explanatory variable.

The model showed that the perceived utilization of traditional medicinal plants was observed for values greater than 0, but was not observed, that is no perceived utilization of traditional medicinal plants for values of 0 or less. Accordingly, the model is specified as

$$Y_* = \begin{cases} Y_i^* & \text{if } Y_i^* > 0 \\ 0 & \text{if } Y_i^* \leq 0 \end{cases} \dots\dots\dots (1)$$

Where  $Y_*$  is the observed variable and  $Y_i^*$  is the latent variable which is the perceived utilization of traditional medicinal plants and is explained by the following equation:

$$Y_i^* = \beta X_i + \mu_i, \dots\dots\dots (2)$$

Where  $X_i$  is the observed demographic, socio-economic and institutional variable and  $\beta$  a vector of parameters and,  $\mu_i$  is a normally distributed error term which is a normally distributed with zero and constant variance of  $\sigma^2$  which is explained by  $\mu_i \sim N(0, \sigma^2)$ . According to McDonald and Moffit (1980), three marginal effects of the model are specified below:

- i. The marginal effect on the latent variable (unconditional expected value):

$$\frac{\partial E(Y/X)}{\partial X_k} = \beta_k \Phi \left( \frac{X\beta}{\sigma} \right) \dots\dots\dots (3)$$

- ii. The marginal effect on the expected value of observations conditional on being uncensored:

$$\frac{\partial E(Y/X, Y > 0)}{\partial X_k}$$

$$= \beta_k + \beta_k \frac{\partial \lambda(c)}{\partial c}$$

$$= \beta_k [1 - \lambda(c)(c + \lambda(c))] < \beta_k , \dots\dots\dots (4)$$

Where  $\lambda(c)$  is the inverse mill's ratio.

- iii. The marginal effect on the probability that observations are uncensored:

$$\frac{\partial Pr(Y > 0/X)}{\partial X_k} = \varphi \left( \frac{X\beta}{\delta} \right) \frac{\beta_k}{\delta} \dots\dots\dots (5)$$

Tobit model parameters do not directly correspond to changes in the dependent variable brought about by changes in independent variables. According to Greene (2003), the marginal effect on the magnitude of utilization and production of traditional medicinal plants is due to changes in the explanatory variable. The empirical model for quantifying the factors which influence the magnitude of utilization and production of traditional medicinal plants is specified below:

$$Y_i^* = \beta_0 + \beta_1 Gend + \beta_2 Age + \beta_3 Educ + \beta_4 Marit + \beta_5 HouseSiz + \beta_6 MOA + \beta_7 Loc + \beta_8 Emply + \dots\dots\dots \beta_n X_n$$

**Table 3.1: Definition, measurement and summary statistics of variables used in the econometric model**

Variable	Description	Category	Signs
Dependant Variable: Utilization of medicinal plants	Participant= 1, Non- participants= 0	Continuous	+/-
Independent Variables			
Gender	Female= 0, Male= 1	Dummy	+/-
Age	Actual years	Continuous	+/-
Education	Actual years spent in school	Continuous	+/-

Marital status	Married= 1, Single= 0	Dummy	+/-
Household size	Actual number in the household	Continuous	+/-
Member of association	Yes= 1, No= 2	Dummy	+/-
Location	Originally from the study site Yes= 1, No= 0	Dummy	+/-
Employment	Categorical	Categorical	+/-
Level of income	Actual amount	Categorical	+/-
Extension	Number of visits by the extension officer	Continuous	+/-
Challenges faced by farmers	Categorical	Categorical	+/-
Economic Value of High-Value Medicinal Plants	Categorical	Categorical	+/-
Effects of producing medicinal plants	Categorical	Categorical	+/-

### 3.3 Findings and Discussion

The major findings of the study are discussed in this section. The section is twofold, first section is presenting demographic characteristics of medicinal plant farmers and their challenges faced. Second section deals with the determinants of the challenges of producing medicinal plants by farmers. The findings from the Tobit regression model are presented along with the discussion for each econometric finding.

#### 3.3.1 Demographic characteristics of smallholder farmers in the Amatole District

The challenges faced by smallholder farmers in the production and utilization of medicinal plants were measured from smallholder farmers who produce or extract medicinal plants to exchange them for cash incentives. Table 3.2 below shows the demographic characteristics of the medicinal plant production participants and non-participants. The demographic characteristics include age, gender, education, access to extension services, household size, farm size and farming experience.

**Table 3.2: Demographic characteristics of smallholder farmers**

<b>Characteristics</b>	<b>Medicinal plant participants (n= 125)</b>	<b>Non- Medicinal plant participants (n= 25)</b>	<b>Overall (n= 150)</b>
	<b>Mean</b>	<b>Mean</b>	<b>Mean</b>
<b>Age</b>	0.56	0.32	0.44
<b>Gender (female)</b>	0.59	0.74	0.67
<b>Educational level</b>	7.4	12.8	10.6
<b>Extension Visits</b>	0.57	0.58	0.56
<b>Household size</b>	6.00	5.00	5.62
<b>Farm size (Ha)</b>	0.92	0.98	0.95
<b>Farming experiences (year)</b>	16.44	4.36	10.42

**Source:** Field Survey (2023)

According to Table 3.2, the average age of smallholder medicinal plant farmers in the Amatole District Municipality was 44 years old. This generally means that the majority of the district's farmers were middle-aged farmers who have knowledge and experience when it comes to medicinal plants that are often used by people for their medicinal properties. Furthermore, the average age of 44 years suggests that the smallholder medicinal plant farmers were still active and able to source out information that can help the production of medicinal plants in the study area as well as they were focused and aware of the current trends happening in the field of medicinal plants (Liliane et al., 2020). Therefore, with the prior being mentioned, age is not expected to negatively affect the production and sustainable use of medicinal plants. These results contradict that of Nyang'au et al., (2020), who found that medicinal plants are mostly practiced by old age that is 70 years and above, which poses a threat to future operations because those people are close to ineffectiveness in terms of mobility and strength of participating due to age.

On, average, medicinal smallholder farmers inclusive of participants and non-participants in the Amatole District were found to be females with 67% compared to males with 33%. This gender disparity may be due to the common narrative that females are generally a larger population than males worldwide and they need to be the ones taking care of the households while the male counterparts work in non-agricultural industries. According to (COGTA), also confirmed that the female population in the Amatole District has a larger female population

than males, females were recorded at 52.7% than males at 47.3% (COGTA, 2020). To a certain extent, the migration of males from rural settlements to urbanized locations in search of jobs and better opportunities for living has decreased the male population from their homes (Tacoli, et al., 2015; Matysiak, 2022). There are more promising chances that the participation of females in medicinal plant production for sustainable livelihood creation will render more income opportunities due to their availability to practice actively. However, several studies share conflicting findings to that of this study, projecting that males dominate the practice of production of medicinal plants and a vast majority of lucrative commercial information and major decision-making lies with the male counterpart (Astutik et al., 2019; Tefera and Kim, 2019; Eshete and Molla, 2021).

The study found that the smallholder medicinal plant farmers were literate and had access to senior secondary school. On average, their education level was rated at 10 years spent in school meaning that they are knowledgeable and able to read as well as able to interpret new agricultural information for the benefit of their farming activities. Numerous evidences in the literature associate rural areas with marginalised locations that have a low standard of education, sometimes because of limited access to significant amenities (There are no nearby schools, there are no roads leading to a nearby school, and unconducive living conditions) (Du Plessis and Mestry, 2019; Dawadi, et al., 2019; Shaturaev, 2021). In some instances, cultural gender roles contribute significantly to biased gender roles, female was often prohibited from accessing education especially if it was to receive employment, the belief was that it is a man's role to be employed, Lembani et al., (2020) reported the cases as still happening till these years. However, this study found that females were literate and with sound communication and intellectual capacity. Therefore, that yields a positive relationship to the production of medicinal plants to improve well because they are capable of understanding how the market works and all its dynamics. The results of the study also revealed that on average, only 12% of the farmers practicing medicinal plants are formally employed which is such a low level of employment and in some instances may signify drastic poverty. Several studies have confidence that such unemployment rate of key farmers harms the farming activities of smallholders (Lopez-Ridaura et al., 2021; Charania and Li, 2020; Li et al., 2021). However, this study contradicts the previously mentioned narrative, the availability of females to take care of the medicinal plant enterprise while the males are at work has a positive relationship with the participation of smallholder farmers in the sustainable use of medicinal plants to establish a sound welfare status.

From the results, the medicinal plant farmers in the Amatole District Municipality had access to 5 extension and advisory visits per annum. Adequate access to extension services equips farmers with the necessary skills of medicinal plant production and market information for smallholder medicinal plant farmers to improve production and sales. These results correspond with Kassem et al., (2021) who found that having access to extension services was an important factor in production and marketing by imparting relevant input knowledge through training aided through information and demonstration strategies. The average household size was 5 people per household and was completely reliant on family labour and hiring externally. The results agree with Mdoda and Obi, (2019) that the average family size is 5 people per household and do not have the financial might to hire contract workers. Thankfully, results for land size are averaging at 1 hectare (ha) or less, therefore land that is less than a hectare is not big enough that 5 people would not manage. Results portrayed that on average, the farmers of medicinal plants had an average of 10 years of farming experience in the field of producing and selling medicinal plants. This kind of experience suggests that the farmers are well experienced and aware of the medicinal plant industry, able to make informed decisions with regard to the farming enterprise and probably made good relations in the market. This yields a positive relationship to the production of medicinal plants for sustainable welfare improvement.

### **3.5.2 Common medicinal plants produced in the study area and their respective uses**

The information about indigenous medicinal plants used by villagers of the Amatole District Municipality to treat sicknesses (human, cultural and livestock) was collected from 150 respondents. About 40% of the respondents were traditional healers and knowledgeable elders with more information to share in a clear way that made it easy to understand how they use and benefit from medicinal plants. The justification of how they were informed about the use of these medicinal plants were claims such as; that information was passed down from parents or experienced mentors to children through word of mouth. In the case of traditional healers, information was exposed to them in their dreams by their ancestors. Some of the traditional healers claimed that they are sceptical to use locally produced medicinal plants by farmers but would rather prefer sourcing them from the wild, these doubts come from no particular reason but an unjustifiable preference.

Table 3.3 shows the common medicinal plants that are sourced locally and their usage. The frequently used parts for medicinal purposes include bark, leaves, corm and roots. The methods of application differed considerably from one healer to another based on preference or due to

their teachings as well as region from region. Most remedies were prepared to be in the form of mixtures or fermentations through cooking in boiling water or soaking in cold water, although others could be consumed in their raw state or mixed partially with Western input to reduce the likes of bad taste. The study also revealed that the dosage was not consistent throughout, the direction for use and dosage is decided by a healer without any scientific research to justify the measure. The analyses showed that, although medicinal plants in Table 3.3 heal other illnesses as well the Amatole District Municipality usually uses them for the treatment of diarrhea as well as for profit generation.

**Table 3.3: Common medicinal plant species of the Amatole District Municipality**

Family/Scientific and common names	Local Names	Usage and preparation Human and Livestock	Percentage ( $n/150*100$ ) (%)
<b>ASPHODELACEAE</b> <i>Aloe candelabrum</i> Berger. Candelabrum Aloe	Ikhala	Human: Leaf decoction for diarrhea. Livestock: Boil leaves to cure gall sickness, and gastrointestinal parasites in cattle, as a charm.	88.67
<i>Bulbine abyssinica</i> , Bushy Bulbine,	Intelezi	Human: Boil bulb for Cracked lips, skin ailments, urinary complaints, Livestock: Treat Bilharzias, dysentery, skin ailments, rheumatism.	83.33
<b>FABACEAE</b> <b>(LEGUMINOSAE)</b> <i>Elephantorrhiza elephantina</i> (Burch.) Elephant's Root	Intolwane	Human: Infusion of ground stem alone for diarrhea and menstrual disorder. Livestock: For diarrhoea, stomach sickness.	74.59
<b>ASTERACEAE</b> <i>Artemisia afra</i> African Wormwood	Umhlonyane	Human: Boil leaves or blood purification, influenza, cold, coughs, clears nasal passages. Livestock: No knowledge from the study area.	69.62

<i>Helichrysum odoratissimum</i> (L.) Sweet.	Impepho	Human: Burn leaves for headache, insomnia, cleansing spirits and invoking ancestral spirits. Livestock: No knowledge from the study area.	52.71
<b>RUBIACEAE</b> <i>Pentanisia prunelloides</i> Walp Broad-leaved Pentanisia	Icishamlilo	Human: boil grated dried bulb, a spoon taken orally to stop vomiting, diarrhea in children. For adult, a wine shot 3 times daily. Expose face to steam from boiling herb for pimples. Rub leaves to soothe swollen body. Livestock: No knowledge from the study area.	46.77
<i>Psychotria capensis</i> (Eckl.) Black Bird-berry	Isithithibala, Umgonogono	Human: For diarrhea and vomiting. Livestock: No knowledge from the study area.	41.37
<b>ASCLEPIADACEAE</b> <i>Xysmalobium undulatum</i> (L.) Milkwort, Uzura	Ishongwe	Human: Boil root for diarrhea, stomach ailments or pain. Livestock: No knowledge from the study area.	37.48
<b>APOCYNACEAE</b> <i>Acokanthera oppositifolia</i> (Lam.) Codd= A. venenata Common Poison-bush	Intlungunyembe	Human: Leaf decoction for stomach ache, diarrhea, anthelmintic. Livestock: No knowledge from the study area.	23.02
<b>ASTERACEAE</b> <i>Bidens bipinnata</i> Spanish-black jack, Spanish needle	Uvelemampondweni	Human: Diarrhea, stomach ailments. Livestock: No knowledge from the study area.	19.62

**Source:** Field Survey (2023)

Indigenous medicinal plants are the most widely used medical option in rural settlements. All over the Amatole District Municipality, it is a viable option in terms of economic efficiency because orthodox medicine is expensive and often inaccessible. Medicinal plants need more attention particularly in rural areas where the major source of food, medicine and energy are forest medicinal plant species (Applequist et al., 2020). The result of the study shows that the most used medicinal plants of the Amatole District Municipality with a frequency score of above 50% per plant species are *Aloe candelabrum* (88.67%), *Bulbine abyssinica* (83.33%), *Elephantorrhiza elephantina* (74.59%), *Artemisia afra* (69.62%) and *Helichrysum odoratissimum* (52.71%). According to the results, these plants are the most produced and used for medicine, extracted and sold for money all around the study area. This suggests that the health status of the communities and livestock in the study area are strongly reliant on the above-mentioned plant species. Moreover, they have structured a commercial structure of demand and supply of medicinal plant species amongst the dwellers of the area through trade for money (Van Wyk, 2015; Astutik et al., 2019, Kurnaz and Kurnaz, 2021).

### **3.5.3 Factors influencing the utilization by smallholder medicinal plant farmers**

The Tobit model estimation gave a Pseud  $R^2$  of 0.6794 which suggests that the specification fits the model well and the explanatory variables used in the model explain 68% of the probability of a farmer's decision to utilize and produce medicinal plants. The results showed that the coefficients of most of the variables hypothesized to influence the utilization and production of medicinal plants have the expected signs. The model is appropriate given its significant chi-square as  $P < 0.0000$ , suggesting that all the model parameters were cohesively significant in explaining the dependent variable. This shows that the model approximately fits the data. The explanatory variables for factors influencing the utilization by smallholder medicinal plant farmers were found to be significant at 5% and 1%, represented by \*\*, and \*\*\* respectively.

**Table 3.4: Factors influencing the utilization by smallholder medicinal plant farmers**

Variables	Coefficient	Standard Error	P-value
Age	0.661	0.293	0.004***
Gender	0.590	0.320	0.046**
Household size	0.610	0.022	0.033**
Education	-0.010	0.032	0.007***
Farm size	0.7007	0.003	0.038**
Lack of capital	-0.027	0.018	0.008***
Knowledge Barriers	-0.268	0.081	0.024**
Cultural differences	0.267	0.089	0.029**
Constant	3.781	0.263	000

Pseudo R<sup>2</sup> = 0.6785; Wald chi<sup>2</sup> x<sup>2</sup>(8, df) = 321.67\*\*\*; Prob>chi2 = 0.0000; Number of observations =150

Log-likelihood Ratio = -10.6964

Where \*\*\*, \*\* and \* represents significance level at 1%, 5% and 10% level respectively.

**Note: \*\*\* and \*\* represents significance level at 1%, and 5% level respectively.**

Age was significant at 1% and positively influenced the utilization of medicinal plants. The results imply that the more people are getting older, the more they utilize medicinal plants and getting involved in the production of medicinal plant. This shows that age is strongly linked to knowledge and experience accumulated over the years. These findings are in line with a study by Thorsen and Pouliot (2016) who claimed that elderly households are found to have a high likelihood of consuming traditional medicinal plants to cure their ailments in rural areas.

Gender was captured as a social role which significantly (5%) and positively influenced the use of traditional medical plants. The results showed that female farmers are at the forefront in the utilization and production of traditional medicinal plants. In other words, more female farmers in the study area are more likely to participate in the utilization of traditional medicinal plants. These findings are supported by da Costa et al., (2021) who discovered that women use and Produce indigenous medicinal plants more frequently than men.

Household size affected the utilization of traditional medicinal plants. The results show that the household size has a positive influence on the utilization and production of traditional medicinal plants and is significant at 5%. The study results indicate that large households augment the utilization and production of traditional medicinal plants because they equally share duties in producing and harvesting the indigenous medicinal plants. These findings concurred with the results of a string of studies by Corronto et al., (2022); Bari et al., (2017) and Kutal et al., (2021) who shared that large household sizes serve as a source of readily available labour to meet the demands of harvesting, processing and marketing of indigenous medicinal plant. Similarly, Asigbasase et al., (2023) shared that large family sizes led to greater dependency on medicinal plants possibly because all members of the household were involved in the value chain of traditional medicinal plants.

The maximum level of education in the household had a negative influence on the utilization and production of traditional medicinal plants and is significant at 1 %. These results reveal that most educated households rarely utilize traditional medicinal plants. They tend to use Western medicines for traditional medicinal plants. These findings are in contradiction with the study of Nigussie et al., (2022) who showed that highly educated households are associated with higher use of traditional medicinal plants.

Farm size was found significant at 5% and positively influenced the utilization and production of traditional medicinal plants. The results indicate that households with large farmland tend to be involved in the utilization and production of traditional medicinal plants. Also, the households with large farmland produce some of the traditional medicinal plants. Similar findings were shared by Dadjo et al., (2018) who noted that household farmers with large farmland sizes participate in the production and conservation of indigenous medicinal plants.

In this study, lack of capital had a negative coefficient (-0.027) and was significant (1%). The results pointed out that lack of capital hindered the production of traditional medicinal plants. This may be because the production of traditional medicinal plants requires improved seeds and other inputs to produce good and high-quality indigenous medicinal plants. These findings are in line with the study of Timmermann and Smith-Hall (2019) who suggested that lack of capital hampered the participation of households in commercial production of indigenous medicinal plants.

Knowledge barriers negatively influenced the utilization and production of indigenous medicinal plants and were statistically significant at 5%. The results suggested that households

who had limited knowledge about the benefits associated with traditional medicinal plants recommend Western medicines rather than indigenous medicinal plants. In Addition, Weckmuller et al., (2019) found that lack of knowledge of medicinal plants had a negative correlation on the use and conservation of indigenous medicinal plants. Furthermore, households with knowledge about indigenous medicinal plants enhance their production and marketing of traditional medicinal plants (Kunwar et al., 2016).

The study found that the cultural differences of the household significantly (5%) and positively influenced the utilization and production of indigenous medicinal plants. The results convey that more households participated in the production and utilization of indigenous medicinal plants to perform their cultural rituals and traditional taboos. Also, some traditional medicinal plants are strongly associated with cultural customs and rituals. In agreement, Wanjohi et al., (2020) noted that cultural diversity plays a crucial role in the production, conservation, distribution, management and methods of extracting the useful properties of traditional medicinal plants. Further, Grasser et al., (2012) noted that cultural heterogeneity matches up with the local remedies used in different areas and shapes the use of traditional medicinal plants.

### **3.6 Conclusions and policy recommendations**

The study showed that active role players in the production of medicinal plants are 44-year-old females who spent 10 years in school. Such results are alarming, gender balance is not achieved and the number of years spent in school does not indicate a good educational level in this academic era. The evidence from the study showed that the use and production of medicinal plants are affected by various factors. Factors such as level of education, lack of capital and knowledge barrier negatively influenced the use and production of medicinal plants. These are the main challenges that inhibit the use and production of indigenous medicinal plants. One of the major challenges is the issue of extension visits, visiting medicinal plant farmers 5 times a year may not be enough and is not sufficient to contribute a sustainable impact in knowledge transfer. Based on the findings, the study recommends that lobbying youth with an emphasis on male empowerment would diminish the challenge of gender imbalance in medicinal plant farming. There is a need for educational empowerment as well to be intellectually competitive. The government need to enforce bio-diversity regulations in rural areas as well to safeguard the plant population. All the factors above mentioned have a significant effect in the utilization by smallholder medicinal plant farmers to impact negatively on their farming businesses.

Hence, if adopted and applied appropriately, can raise the incomes of smallholder medicinal plant farmers, minimise the rate at which challenges affect their business and lastly build them a sustainable livelihood.

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## CHAPTER FOUR

### ANALYZING THE PROFITABILITY AND DETERMINANTS OF MEDICINAL PLANTS IN SMALLHOLDER PRODUCTION SYSTEMS

#### Abstract

Conservation and sustainable use of indigenous medicinal plants by smallholder farmers play an important role in the rural societies of the Amatole District of the Eastern Cape. The adoption of the production of medicinal plants proves to be a highly profitable farming business for smallholder farmers of the ADM. They provide income opportunities for smallholder farmers through the commercialization of medicinal plants. However, the production of medicinal plants is relatively low due to several factors that contribute to the low yield (including lack of capital, lack of machinery and implements, knowledge barriers, limited institutional support, and cultural backgrounds). Moreover, medicinal plants have limited access to formal markets due to various reasons such as finance for value addition of products, distance to formal markets, and limited market information, and that hurts the profitability of smallholder farmers. There are limitless studies that acknowledge medicinal plants and their uses but little is known about the effect of their contribution to household income and livelihood enhancement. Hence, investigating the profitability and determinants of medicinal plants in smallholder production systems in Amatole District Municipality of the Eastern Cape. Primary data for the study was collected through the use of well-structured questionnaires from smallholder medicinal plant farmers. A multi-stage stratified sampling procedure technique was used to draw an appropriate sample of 150 smallholder medicinal plant farmers for this study. Descriptive statistics, Budgetary technique, and Multiple regression were used for analysis. The study results revealed that female farmers with an average age of 44 years and an average of 10 years in school participate more in the production of indigenous medicinal plants. The average farm size per household is 1 ha and is produced by an average of 5 members per household. The budgetary technique showed that net farm income of ZAR 19 091.72 and a rate of return on investment of 0.77 per growing period. These results showed that the medicinal plant enterprise was profitable and contributed significantly at the household level. The empirical results showed that age, household size, extension visits, farming size, and farming experience are factors that influence the profitability of medicinal plants. The study recommends that the government should support smallholder farmers financially and the intensification of extension. Financial assist and technical advice approach is crucial as it promotes new entry role players in medicinal plants that have capital and knowledge. The study

recommends market searches to widen the clientele base of smallholder medicinal plant farmers to explore more profits.

## 4.1 Introduction

Medicinal plants are regarded as one of the most important plants globally for their healing properties. Humans have held close contact with these plants in their societies for mere reasons of using them for healing diseases in humans and animal-related conditions (Chen et al., 2016; Almansour et al., 2021). These plants can be used in various methods and for multiple reasons such as healing diseases, maintaining a healthy diet or repelling insects and pests through their aroma. The wide range of applications of medicinal plants is what makes them appealing to the human community but more so, the best attraction that makes them preferable is being extremely affordable compared to manufactured medicine (Almansour et al., 2021). According to Astitik et al., (2019), the concept of using herbal medicine for therapeutic intentions is estimated to be adopted by 80% of the world's population and is more prevalent in poverty-stricken areas, where health is frequently an issue and access to health facilities is often unaffordable or unavailable.

In Africa, the increase in human interest in medicinal plants has opened opportunities for trade between the borders of the continent and beyond. Africa alone harvests approximately 700,000 tons of raw plant material valued at 150 \$ million from the wild to meet human demand (Seile et al., 2022). Furthermore, Ndhlovu et al., (2021) postulated that South Africa harvests about 20,000 tons of dried and processed material which is worth about R270 million (US\$60 million), this amount was achieved through the harvest of over 700 plant species to provide for the market of herbal medicine. In South Africa, medicinal plants are distributed through various channels including small and major markets. The informal markets of this country prove to be lucrative for local harvesters and are earning considerable amounts of profit (Nwafor et al., 2021). The inflated attention given by consumers to herbal medicine has invited numerous role players such as product developers, distributors, and extractors who are looking to make a profit. Therefore, there was an opportunity for rural farmers to produce medicinal plants and fill the gap that is in the production of herbal plants (Hilonga et al., 2019; Zahra, 2020). However, the over-harvesting of medicinal plants to meet human consumption imposes a strain on bio-diversity control due to the endangerment of vital plant species in the wild. Therefore, all medicinal plant species are at risk of extinction, including medicinal plants (Van Wyk and Prinsloo, 2018).

Medicinal plants play an integral part in sustaining the income of smallholder farmers Medicinal plants are determined by their importance to the consumers, how much it is

demanded in the market and how much consumers have access to it. For instance, *Agathosma betulina* (Buchu), *Aloe ferox* (Cape Aloe) and *Aspalathus linearis* (Rooibos) are highly lucrative plants that yield enormous profits, are recognized all over the world and are crucial export commodities. Street and Prinsloo, (2012) estimated that the first export of Cape Aloe was to Europe in 1761 and today is considered South Africa's main wild harvest commercially traded species. Therefore, it is evident that high-value medicinal plants are key constituents of a very profitable business (Pei et al., 2020; Gonfa et al., 2020). Potential key role players in this industry are smallholder rural farmers due to their convenience of living close to these natural resources. Perpetual production of medicinal plants would secure a regenerative income stream with large profit benefits and minimal input costs (Penot et al., 2019). However, biodiversity degradation in the wild is posing a threat to the amount of medicinal plants that are available to smallholder farmers. Several studies acknowledge the endangerment of medicinal plants and further highlight that very minimal medicinal plants are being produced to address over-harvesting (Ndhlovu et al., 2021; Seile et al., 2022; Astutik et al., 2023).

Smallholder farmers face considerable challenges in establishing themselves as crucial role players in the business of medicinal plants. Knowledge barriers contribute significantly to the loss of profitable opportunities due to a lack of awareness. Knowledge holders of medicinal plants are likely to be village elders and information is transmitted through word of mouth and thus vulnerable to loss (Nagothu, 2016). The medicinal plant industry is unregulated, therefore there is limited evidence as to how much smallholder farmers are contributing to livelihood enhancement, social welfare, and employment, which are significant economic indicators to measure impact (Chandra et al., 2020). Additionally, the lack of mechanical inputs in smallholder farms decreases the rate of production, depriving them of a competitive chance in the market (Tali et al., 2019).

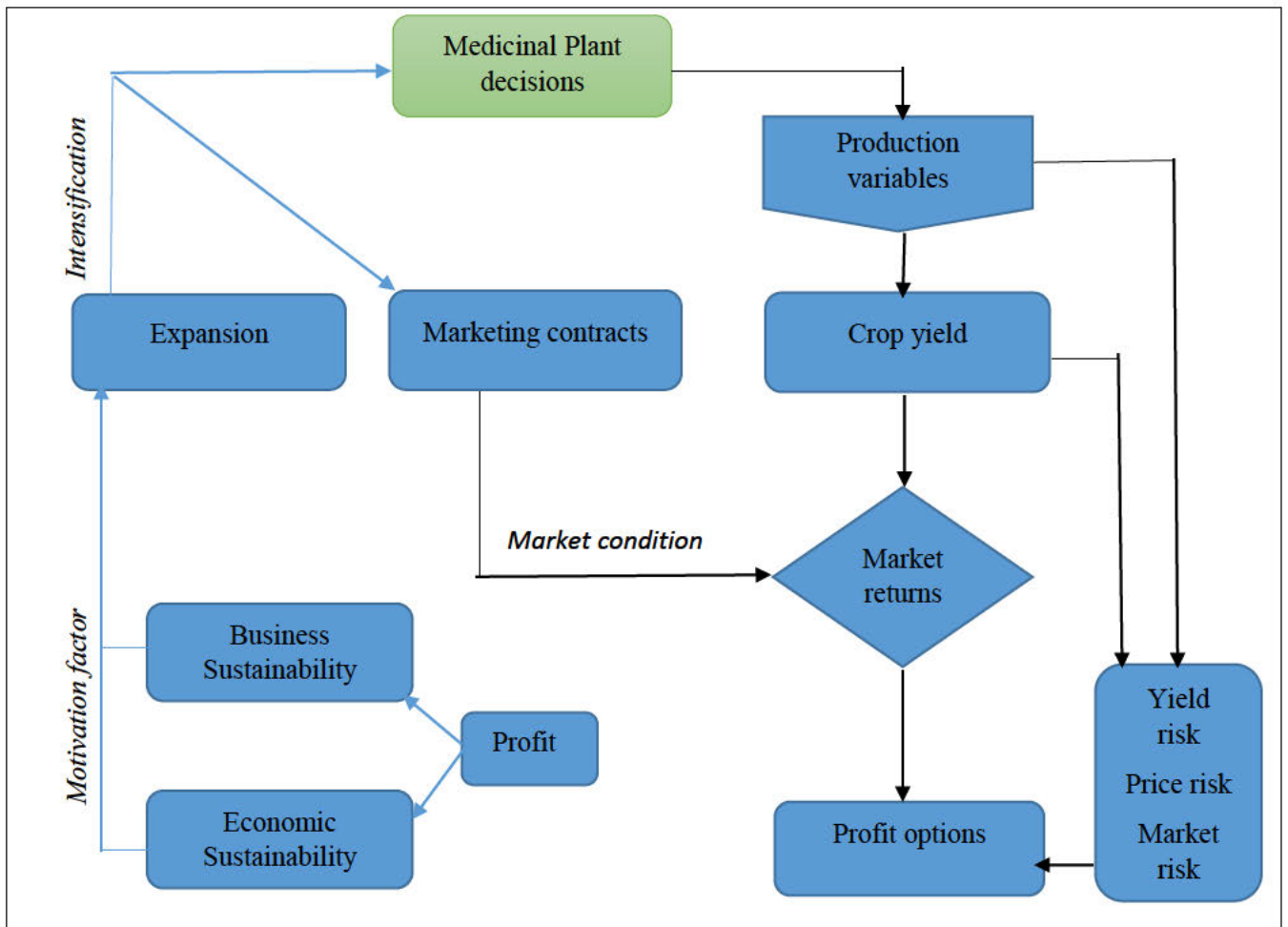
Therefore, the study seeks to contribute to existing academic works, on coping strategies to the overharvesting of medicinal plants. The study investigates the high-value medicinal plants of the study area. The extent of profitability of high-value medicinal plants by rural farmers and its effect on net farm income remains untapped. Hence, the analyses of the profitability and the determinants of indigenous medicinal plants.

## **4.2 Methodology**

### **4.2.1 Conceptual Framework**

The below-illustrated Figure 4.1 illustrates an interlinkage of the factors that contribute to the profitability of medicinal plants. The diagram starts with an arrow pointing to production variables. Like any agricultural commodity, medicinal plants also undergo the production phase where a farmer must plant a seed and nurture the plants until the end of the growing season (Atutik et al., 2019). The arrow proceeds to crop yield, Volenzo and Odiyo (2020) suggested that the amount of care you give to your plants as a smallholder medicinal plant farmer determines the amount of yield that will be harvested. The arrows diverge acknowledging that in the way from producer to consumer there is yield risk, price risk, and market risk. Farmers plant not knowing the actual yield they will reap but they can only estimate, price risk is always linked to most agricultural products as price is not determined by the produce but by the market. These concepts apply to the production of high-value medicinal plants (Ndhlovu et al., 2021).

The arrow continues pointing to the direction of market returns and profit options meaning in the context of the study, crop yield must be sent to the markets to be exchanged for money with potential customers to realise profits. According to Figure 4.1, Profit gives rise to economic sustainability and business stability. Seile et al., (2022) stated that, smallholder medicinal plant farmer needs to constantly make a profit to stay in business and afford to make enough market returns to be sustainable for the next growing season (Chen et al., 2016; Lerotholi et al., 2017; Nyang'ua et al., 2020). Business sustainability leads to economic sustainability through the provision of indicators such as sustainable employment. The illustrations show arrows move from business and economic sustainability to expansion through the motivation factor and this means the growth of a high-value medicinal plant smallholder business through profits. Expansion leads to intensification through market contracts that will result in a sustainable channel of market returns. Hence the study adopted this framework to conceptualise the profitability determinants of high-value medicinal plants (Ndhlovu et al., 2021).



**Figure 4.1:** Conceptual framework of profitability determinants of high value medicinal plants. **Source:** Adopted from (Saiyem et al., 2022)

#### 4.2.3 Description of the study

The study was conducted in the Amatole District Municipality of the Eastern Cape. Amatole District Municipality has a total of 31 wards and 279 villages. This study area is highly populated by mostly black tribal Africans 99.4 % and the local tribe that speaks isiXhosa 94 %, it has about 60 % of this province’s illiterate population and about 61 % of the local people fall into poverty (ADM IDP, 2016). It is the primary driver of the rural economy of the region as the majority of the households are into subsistence agriculture production. Rearing of cattle occupies the primary position of the agricultural economy of the region with maize, vegetables, goat and sheep coming close. There are also very lucrative prospects of intensive piggery and citrus production and medicinal plants (Mdoda and Obi, 2019). Whereas the region could skeptically obtain greater events of heat, rainstorms, and hails, outcomes such as floods, heat

waves, and drought become possibilities that negatively affect agricultural productivity in the region. A national survey revealed that annual rainfall in a country (450 mm) goes below the potential rainfall of 860 mm that occurs globally which is considered a natural water-stressed area. Several studies provide evidence of a greater temperature rise in the region for the same period, for example, up to 4.2 degrees Celsius by the year 2080, while global rainfall is anticipated to decrease by 9.5% by the same period (Sigigaba et al., 2021; Mujuru et al., 2022). Thus, the second consequence is a decreasing water supply, which is one of the most serious factors boosting the problem of scarcity of water in the country, primarily for farmers.

#### **4.2.4 Target population, sample size, and techniques**

The target population for this study were smallholder medicinal plant farmers in the Amatole District municipality. A multi-stage stratified sampling procedure was adopted to select 150 medicinal plant farmers for this study. The first stage involved the purposive selection of local municipalities and wards with the availability of medicinal plants in the Amatole District Municipality. The selected municipalities were Mquma and Mbashe Local Municipalities as they meet and suit the interests of the study. The study selected this non-probability sampling technique because it made it easy for the researcher to interview individuals who provided in-depth and precise inputs required by the study in a convenient area. (Raleting and Obi, 2015).

The second stage involved stratification, where smallholder medicinal plant farmers were divided into strata based on similar characteristics, farming enterprise or variables such as socio-economic characteristics, outputs, sales, household size and institutional factors. The study categorized medicinal plant farmers into Strata which included Strata A: medicinal plant farmers, Strata B crop farmers, and Strata C livestock farmers. Therefore, after stratified sampling was employed, only smallholder medicinal plant farmers were considered for the study. The last stage involved the random selection of medicinal plant farmers who were selected to be part of the study. a sample size of 150 smallholder medicinal plant farmers was obtained. The responses of the sampled representatives of the general population were on the basis from which analyses and discussions were concluded (Vasileiou, 2018). The study made use of the Cochran's proportion to determine the sample size of the study. The use of Cochran was because there was limited information about the medicinal plant farmer's population and the use of Cochran played an important role in determining the sample size. According to the equation below, the unadjusted sample size is required to be 150.

$$n_1 = \frac{Z^2 p(1-p)}{e^2}$$

Where;

n= required sample size

Z= confidence level at 95% (standard value of 1.96)

p= estimate of smallholder medicinal plant farmers which is at 0.89. This was an assumption that 89% of smallholder farmers participate in the Production of indigenous medicinal plants in the study area.

q= This is the weighting variable given by 1- p.

e<sup>2</sup>= Margin of error at 5% (standard value of 0.05)

$$= \frac{1.96^2 \times 0.11 \times 0.89}{0.05^2} = 150.4$$

According to the equation above, the unadjusted sample size is required to be 150. The sample size was chosen since a census would be costly, time-consuming and calculating would necessitate a population whose data was unavailable and unclear.

#### **4.2.5 Data collection**

Primary data was attained for the study through the use of well-designed structured questionnaires. The questionnaire was pre-tested on 20 medicinal plant farmers of the Amatole District Municipality to ensure that there would be no faults in the actual field survey. The researcher conducted the pre-test with the elected enumerator to also train them for the field investigation. The enumerators were fluent in the local language which is isiXhosa, to counteract the misunderstandings that may occur due to language barriers. Face-to-face interviews were conducted to achieve data collection for this study.

#### **4.2.6 Empirical model**

This section is focused on the analytical frameworks that were applied by the study. This section is divided into two sections, namely: the first section is the Budgetary technique (Gross Margin, Gross Profit Margin, Net Farm Income) used to estimate the profitability and the

second is Multiple regression used to estimate factors influencing smallholder medicinal plant profitability in Amathole District.

#### 4.2.6.1 Budgetary technique

The study adopted the gross margin to estimate the profitability of medicinal plants produced by smallholder farmers of the Amatole District of the Eastern Cape. The gross margin is a measure of enterprise feasibility and the difference between the gross income and total variable costs (Mdoda, 2017). The study adopted the gross margin method. It is a widely used measure of determining profitability in agriculture because it provides a simple method of comparing the performance of an enterprise that has related input requirements for capital and labour (Mdoda et al., 2023). The gross margin was used by Thibane (2022) to assess the economic and market analysis of smallholder farmer's broiler production in Amatole District Municipality in the Eastern Cape, South Africa. The study revealed that the smallholder broiler farmers were profitable.

This study concluded that gross margin is the most suitable method to estimate the profitability of an enterprise, easy and most used for its accuracy in estimating profitability (Mauki et al., 2023). However, the limitation of using the gross margin analysis is that it assumes a linear relation between inputs and outputs, which in the real world is not the case, they assume that enterprises are independent of each other, though enterprises do affect each other in the real world and that gross margins often result to short term solution because budgets are mostly done for a given period (Mdoda, 2017). The decision to use the gross margin was also because farmers do not have proper record keeping, in that case, gross margin becomes a proper estimation tool. Therefore, the study considered it fit to assess the profitability and the determinants of medicinal plants by smallholder farmers of the Amatole District Municipality of the Eastern Cape using the Budgetary technique.

The following formula was used to calculate the gross margin:

$$GM(\pi) = \sum(TR_i - TVC_i) \dots \dots \dots (1)$$

Where:

*GM* – means gross margin per medicinal plants

$TR$  – is the total revenue from the production of medicinal plant  $i$  measured in terms of  $TVC$  is the total variable cost of production of medicinal plant  $i$  measured in terms of direct and indirect costs. This included the hired labour, transport, water for irrigation, seeds, chemicals and fertilizer.

The total revenue, which is equivalent to the gross income of each medicinal plant is calculated as:

$$TR_i = P_i \times Q_i \dots\dots\dots (2)$$

Where:

$P_i$ - is the farmgate price of high-value medicinal plants,

$Q_i$ - is the total quantity produced.

Total variable costs calculation was expressed as follows:

$$TVC = \sum_{i=1}^2 (K_{it} + S_{it} + L_{it}) \dots\dots\dots (3)$$

Where:

$K_{it}$ - is the expenditure on seed,

$S_{it}$ - is the total expenditure on fertilizer,

$L_{it}$ - is the total labour expenditure in each enterprise.

After calculating the gross margin, the study moved on to calculate the Return per Rand Invested where the Gross Margin is divided by the Total Variable Cost multiplied. The study saw it significant to also look at the production cost of the farm as well as efficiency (Alabi and Safugha, 2023). The Return per Rand Invested is employed in the study to evaluate how efficient a medicinal plant enterprise is in terms of profit generation per investment made. A favourable profit indicator was shown by a higher margin and that value shows the profit that was made per every rand that is invested.

$$\text{Return per Rand Invested} = \frac{\text{Gross Margin}}{\text{Total Variable Cost}} \dots\dots\dots (4)$$

The study proceeded to calculate the Net Farm Income after the Gross Margin calculations, as it is a build-up of factors such as capital, land, and management. Net Farm Income is the difference between gross margin and fixed costs and production costs are deducted from farm gross margin. According to Tshiambe (2013) and Alabi et al., (2023), it is significant to include Net Farm Income in the profit estimation of medicinal plant farming by smallholder farmers as it considers the farmer’s production cost, hence it is employed by the study.

$$\text{Gross Margin} = \text{Total Revenue (TR)} - \text{Total Variable Cost (TVC)} \dots\dots\dots (5)$$

From the above equation, Net Farm Income is depicted as illustrated below.

$$NFI = GM - TFC \dots\dots\dots (6)$$

Where:

*NFI* – is the Net Farm Income/ Profit

*GM* – is the gross margin

*TFC* – is the total fixed cost of the farm

#### 4.2.6.2 Multiple Regression Model

The multiple regression model was used to examine the profitability determinants of medicinal plants by smallholder farmers of the Amatole District of the Eastern Cape. The reason why the study made use of the model is to evaluate the relationship between the set of hypothesized variables to understand the magnitude of their influence on the profitability of medicinal plants (Mdoda and Obi, 2019). Kuwato et al., (2020) depicted the relationship of the regression analysis as follows:

$$Y = f \sum_{i=1}^n X_1, X_2, \dots, X_n \dots\dots\dots (6)$$

Following conversion, the model can be specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_n X_n + \mu \dots\dots\dots (7)$$

Where:

$\beta_0$  – intercept term,

$\beta_1\beta_2\beta_3\beta_4\dots$  – regression coefficients,

$X_1X_2X_3X_4 \dots$  – explanatory or independent variables,

$\mu$  - error or disturbance term.

**Table 4.1: Variables in the regression model, as well as expected signs**

Variable	Description	Category	Signs
Dependant Variable: Profitability of medicinal plants	Participants=1, Non- participants= 0	Continuous	+/-
Independent Variables			
Gender	Female= 0, Male= 1	Dummy	+/-
Age	Actual years	Continuous	+/-
Education	Actual years spent in school	Continuous	+/-
Marital status	Married= 1, Single= 0	Dummy	+/-
Household size	Actual number in the household	Continuous	+/-
Member of association	Yes= 1, No= 2	Dummy	+/-
Location	Originally from the study site Yes= 1, No= 0	Dummy	+/-
Employment	Categorical	Categorical	+/-
Level of income	Actual amount	Categorical	+/-
Extension	Number of visits by the extension officer	Continuous	+/-
Challenges faced by farmers	Categorical	Categorical	+/-
Economic Value of Medicinal Plants	Categorical	Categorical	+/-

### 4.3 Results and Discussion

This section is divided into two. The first profiles smallholder high-value medicinal plant farmers with the use of the socio-demographic profile mean. The second section analyses the profitability of high-value medicinal plants using the budgetary technique as well as the multiple regression model, respectively.

#### 4.3.1 Socio-economic characteristics of smallholder farmers in the Amatole District Municipality

The sampled 150 medicinal plant farmers revealed that 125 farmers had participated in the production for marketing and 25 of the farmers acknowledged the production and use of medicinal plants but did not participate in selling their produce in market streams. The socio-economic characteristics include age, gender, education level, access to extension services, household size, farm size and farming experience. Table 4.2 shows the socio-economic characteristics that include age, gender, education level, access to extension services, household size, farm size and farming experience.

**Table 4.2: Socio-economic characteristics of smallholder farmers in Amatole District Municipality medicinal plant participants and non-participants**

Characteristics	Medicinal plant participants (n= 125)	Non- Medicinal plant participants (n= 25)	Overall (n= 150)
	Mean	Mean	Mean
Age	0.56	0.32	0.44
Gender (female)	0.59	0.74	0.67
Educational level	7.4	12.8	10.6
Extension Visits	0.57	0.58	0.56
Household size	6.00	5.00	5.62
Farm size (Ha)	0.92	0.98	0.95

<b>Farming experiences (year)</b>	16.44	4.36	10.42
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Table 4.2 illustrated above suggested the following results for this study, the majority of medicinal plant farmers were females 67%. This displays that, mainstream medicinal plant farmers are females, which can be credited to the conventional opinion that males are the head of the house, therefore they need to go to work, while females take care of household duties such as (gardening, housekeeping and nurturing children. The study findings correspond with those of Silong and Gadanakis (2020) who shared similar results, stating that the majority of farmers were females. The average age of medicinal plant female farmers is 44 years and they spent 10 years in school. This infers that most of them are still active and fall within the bracket of energetic, physically fit and literate people. These study results are in line with Alvi et al., (2021) who claimed that female farmers at this age actively participate in farming while Prokopy et al., (2019) confirm that, farmers with 10 years of formal education are capable of making better decisions on farming operation and can easily adopt modern technologies that intensify productivity and improve profitability. Household size plays a vital role in farming because most farmers depend on family members for labour which is fairly cost efficient in terms of profitability. The results reveal that the average household size is 5 members per household. The results suggest that the medicinal plant farmers of the study area own an average land size of 1 hectare of land or less. The findings of the study show that, on average, medicinal plant farmers of ADM have 10 years of experience in medicinal plant farming. This signifies that the higher the experience of a farmer is, there higher the chances of making informed decisions that improve the profitability of medicinal plant enterprise.

#### **4. 3. 2 The perceived high-value medicinal plants of the study area**

The information about high-value indigenous medicinal plants used by villagers of the Amatole District Municipality to treat sicknesses was collected from 150 respondents. Table 4.3 shows the high-value medicinal plants that are sourced locally and their usage. The frequently used portions for medicinal purposes include bark, leaves, corm and roots.

**Table 4.3: The high-value medicinal plants of Amatole District Municipality**

Family/Scientific and common names	Local Names	Usage and preparation	Percentage (n/150*100) (%)
<b>ASPHODELACEAE</b> <i>Aloe candelabrum</i> Berger. Candelabrum Aloe	Ikhala	Human: Leaf decoction for diarrhoea. Livestock: Boil leaves to cure gall sickness, and gastro- intestinal parasites in cattle, as a charm.	88.67
<i>Bulbine abyssinica</i> , Bushy Bulbine,	Intelezi	Human: Boil bulb for Cracked lips, skin ailments, urinary complaints, Livestock: Treat Bilharzias, dysentery, skin ailments, rheumatism.	83.33
<b>FABACEAE (LEGUMINOSAE)</b> <i>Elephantorrhiza elephantina</i> (Burch.) Elephant's Root	Intolwane	Human: Infusion of ground stem alone for diarrhoea and menstrual disorder. Livestock: For diarrhoea, stomach sickness.	74.59
<b>ASTERACEAE</b> <i>Artemisia afra</i> African Wormwood	Umhlonyane	Human: Boil leaves or blood purification, influenza, cold, coughs, clears nasal passages. Livestock: No knowledge from the study area.	69.62
<i>Helichrysum odoratissimum</i> (L.) Sweet.	Impepho	Human: Burn leaves for headache, insomnia, cleansing spirits and invoking ancestral spirits.  Livestock: No knowledge from the study area.	52.71

**Source:** Filed Survey (2023)

High-value medicinal plants are a discipline of medicinal plants that are considered to be more valuable than the others because of more potent healing capacities, endangerment status of plant species or high demand for a plant species from consumers. In the Amatole District Municipality, results on Table 4.3 revealed that high-value medicinal plants are those that have a high frequency in their order of importance to the dwellers of the study area. According to the smallholders of ADM, these are the most common plant species that are easily marketable, with high demand and with the most profit returns.

For instance, *Aloe candelabrum* (88.67%) is a globally important commodity with more than 500 species with immense market dominance resulting from its unique properties that feature almost in any remedy, be it cosmetics or stomach concoctions (Grace et al., 2015). The results of this study are in line with those of Grace et al., (2015) who found that *Aloe* is a highly marketable enterprise that yields high returns.

The results of the study reveal that *Bulbine abyssinica* (83.33%) is a high-yielding medicinal plant. According to the field survey, *Bulbine* is mostly sellable for charms that people claim it

possesses. However, some respondents claimed it has strong anti-oxidants for body detox, and for that, it yields high profits when sold to the markets. The study results were in line with those of Idamokoro and Afolayan (2020), who found that *Bulbine* has anti-oxidant properties that are capable of removing toxins from the human body, thus the high demand from people.

According to Table 4.3, the findings of the study reveal that *Elephantorrhiza elephantina* (Intolewane) is a high-value medicinal plant in the Amatole District as 79.59% of the smallholder medicinal plant farmers of the study area were convinced that this medicinal plant is profitable. These findings could be attributed to the fact that this plant has a dual benefit by healing both human and livestock illnesses such as stomach sicknesses and menstrual disorders. The study is in line to that of Maroyi (2017), who found that the use of *Elephantorrhiza elephantina* is widespread across Africa and is recommended for gastrointestinal system disorders and menstrual system functions

The results from the field presented that a high-value medicinal plant species that was not previously popular is *Artemisia afra* (umhlonyana), it was a domestic utility that could heal as mentioned in table 4.3 but after Covid- 19 happened, it gained quick popularity and smallholder medicinal plant farmers made huge sums of profits out of the misfortunes of the pandemic. The results of this study are in line with those of Olivier et al., (2023) who found that *Artemisia* was widely used for the prevention of acute respiratory syndrome of the coronavirus.

The study results suggest that 52.71% medicinal plant farmers deem the *Helichrysum odoratissimum* (Impepho) as a profitable medicinal plant. According to Table 4.3, the knowledge of smallholder medicinal plant farmers helps in healing headaches, and insomnia, cleansing spirits and invoking ancestral spirits. The profitability of this medicinal plant could result from the fact that it heals common illnesses in society and is assertive to people who are interested in spiritual beliefs. The Study is in line with that of Serabele et al., (2023), who gave insight into similar findings that this medicinal plant is used for ancestral awakening. Furthermore, the plant can be used for respiratory, fever and urinary infections, the demand for this plant because of these benefits renders it profitable for medicinal plant producers (Serabele et al., 2023).

#### **4.3.3 Measuring profitability of medicinal plant farmers in ADM**

The main goal of any enterprise is to make profits. To do so, the enterprise needs to develop strategies to improve its performance to remain competitive in the market environment. This

can be done to evaluate internal and external factors that may have an impact on the enterprise's profitability (Thibane, 2023). Table 4.4 below illustrates the profitability analysis of all smallholder medicinal plant farmers in the study and achieves the objective of profitability. The NFI results show that the province's medicinal plants enterprise is suitable for the agricultural sector.

**Table 4.4: Profitability of medicinal plant enterprises of smallholder production**

Plants produced	(TR)	(TVC)	Gross Margin(R)	RRI (GM/TVC)
	(R/ha)			
<i>Aloe candelabrum</i> (Ikhala)	21 750.52	10 350.69	11 399.83	1.10
<i>Bulbine abyssinica</i> (Intelezi)	9 620.61	4 406.81	5 213.80	1.18
<i>Elephantorrhiza elephantina</i> (Intolwane)	4 694.40	1 756.19	2 938.21	1.67
<i>Artemisia afra</i> (Umhlonyane)	9 960.94	2 640.32	7 320.62	2.77
Overall gross margin	46 026.47	19 154.01	26 872.46	1.40
Gross Margin (R)= 26 872.46 Less fixed cost (rent land, depreciation of farm assets and farm tools) Total Fixed Costs (R)= 7 780.74 Net Farm Income(R)= 19 091.72				

**Notes:** TR- Total Revenue; TVC- Total Variable Costs; RRI- Return per Rand Invested

**Source:** Field Survey (2023)

The results of the gross margin and net farm income analyses of smallholder medicinal plant farmers are presented in Table 4.4 and Table 4.5 respectively. The results present that Gross Margin and Gross Profit Margin were measured at R 26872.46. A positive Gross Margin signifies that smallholder medicinal plant farmers in the Amatole District Municipality of the Eastern Cape province generate sufficient income to run the farming enterprise and support their households (Thibane, 2022).

The profit ratio was calculated at 1.40, suggesting that for every Rand invested in the production of these four high-value medicinal plants (*Aloe candelabrum*, *Bulbine abyssinica*, *Elephantorrhiza elephantina* and *Artemisia afra*), farmers stand to profit R 1. 40. This indicates that the revenue generated from the sale of medicinal plants exceeds the costs incurred in their production, resulting in a profit margin. Thus, the analysis of gross margin suggests that medicinal plant farmers in the Amatole District are experiencing profitability in their operations. These findings align with previous studies by Oluwatayo et al. (2016), Mdoda and

Obi (2019), and Thibane (2022), which also observed similar trends of profitability and viability in investing in medicinal plant production.

### Net Farm income as a measurement of profit

The profit, referred to as Net Farm Income (NFI), arises from the operations conducted during the preceding production cycle. The calculation detailing the Net Farm Income can be found in Table 4.5. Both the Gross Margin and the Net Farm Income are delineated as follows:

$$\text{Gross Margin (GM)} = \text{Total Revenue (TR)} - \text{Total Variable Costs (TVC)}$$

$$\text{Net Farm Income (NFI)} = \text{Gross margin (GM)} - \text{Total Fixed Costs (TFC)}$$

$$\text{Return on Investment} = \frac{\text{NFI}}{\text{TC}}$$

$$\text{Total costs (TC)} = \text{Total Variable Cost (TVC)} + \text{Total Fixed Costs}$$

**Table 4.5: Net Farm Income of smallholder medicinal plant farmers in ADM**

Description	Rands (R)
Gross margin (computed in table 4.4)	26 872.46
Total Fixed Costs	7 780.74
<b>rent land, depreciation of farm assets or tools</b>	7 780.74
<b>Net Farm Income</b>	19 091.72
Return on Investment ( $\frac{\text{NFI}}{\text{TC}}$ )	0. 71

Source: Field survey (2023)

The data presented in Table 4.4 illustrates that smallholder medicinal plant farmers in the ADM (Amatole District Municipality) are realizing a net farm income of 19,091.72 per growing period. This figure serves as a testament to the profitability of medicinal plant production, indicating that farmers are achieving favourable returns on their investment in this agricultural endeavour. From a sustainability standpoint, the 150 medicinal plant farmers should continue their farming activities, as it stands as a significant source of income generation as well as assisting farmers in alleviating poverty and hunger at the household level by objective 1 (no

poverty) and objective 2 (end hunger) of Sustainable Development Goals were achieved. Moreover, those not currently engaged in this enterprise might consider adopting medicinal plant production to enhance their livelihoods and secure a sustainable income.

These findings resonate with the conclusions drawn by Muriuki et al., (2012), who similarly found that herbal products demonstrate profitability and possess the potential to encourage the production of medicinal plants in Kenya. The net return on investment value of 0.77 implies that for every Rand invested in the medicinal plant enterprise, ZAR 0.77 is returned as profit, underscoring the lucrative nature of this agricultural pursuit. This observation aligns with the findings of Franzel et al., (2014), who observed varying levels of profitability and a positive return on investment in their study of medicinal plant enterprises. Beyond economic benefits, the profitability of medicinal plant enterprises holds promise for job creation and has the potential to significantly improve the food security status of rural households engaged in medicinal plant production.

#### **4.3.4 Factors influencing the profitability of smallholder high medicinal plant farmers**

To determine the factors influencing the profitability of high-value medicinal plants, a multiple regression model was used to get regression parameters. The equations presented in Chapter Four were derived using the multiple regression technique. Specifically, a single multiple regression model was employed to determine the regression parameters. The selection of variables incorporated into the model was guided by both theoretical frameworks and empirical research discussed in Chapter Four. The variables used in the regression were age, household size, extension visits, farming size and farming experience. The  $R^2$  is 0.6419 and the adjusted  $R^2$  is 0.6144 respectively. This signifies that 64% of the variations in the profitability of medicinal plant farming are explained by the input variables of the smallholder medicinal plant farmers. The significance values describe a change in the independent variables that significantly influence the dependent variable at a given level. In the study, the variables were tested at 1% and 5% levels of significance.

The presence of multicollinearity and heteroscedasticity was detected by carrying out statistical tests. The results showed a mean VIF value of 4.16 which ranged between 1.08 and 8.33 depicting the presence of multicollinearity amongst some of the explanatory values. However, the Breusch Pagan test for heteroscedasticity shows an s-statistic value of 2.98 and a p-value of 0.0007. Since the p-value is below 1%, the model shows the presence of heteroscedasticity.

**Table 4.6: Factors influencing the profitability of smallholder medicinal plant farmers**

<b>Variables</b>	<b>Coefficient <math>\beta</math></b>	<b>T statistics</b>	<b>Significant</b>
<b>Age</b>	-0.212	-1.712	0.034**
<b>Household size</b>	0.231	-0.1924	0.000***
<b>Extension Visits</b>	0.210	1.816	0.001***
<b>Farming size</b>	0.198	1.953	0.006***
<b>Farming experience</b>	0.242	1.836	0.027**
<b>Constant</b>	-0.473	-1.207	0.291
<b>F- value 12.78</b> <b>Prob&gt; F 0.0000</b> <b>R- squared 0.6419</b> <b>Adjusted R- squared 0.6144</b> <b>Observations 150</b>			

**Notes:** \*\*\* and \*\* are significant at 1% and 5%, respectively

**Source:** Field Survey (2023)

The results of the multiple regression indicated that the age of the medicinal plant farmer is statistically significant at a 5% level and has a negative coefficient. This indicates that an increase in the age of a participant in the production of medicinal plants has a negative relationship to the production profitability of smallholder farmers. The production of medicinal plants by smallholder farmers is labor-intensive due to the lack of resources to adopt technological innovation to ease labor. Therefore, an increase in the age of a farmer decreases the activeness and strength of a farmer and that affects the production of medicinal plants in the Amatole District negatively. The results contradict those of Prakash et al., (2016) and da Silva et al., (2019), who found that farmers are more likely to be more active as they grow older.

The household size is found to be significant at 1% with a positive coefficient, this generally means there is a positive relationship between the profitability of medicinal plants and household size. This implies that an increase of one additional member of the household suggests an increase the profitability of smallholder farmers. Large households are expected to contribute more labour and that increases production as well. Mostly smallholder farms are family-owned and worked, so labour increase is relatively at a low cost if any because family members are often not expecting wages in return thereby increasing profitability at a low cost. These findings were in line with Khalil et al., (2021), who found that household size and profitability of medicinal plants have a significant and positive relationship.

The results illustrate extension services with a positive coefficient which is statistically significant at 1 %. The results suggest that with a unit increase in the extension and advisory services, there is an expected outcome of an increase in the participation in the production of medicinal plants that enhances the profitability of smallholder farmers. There is a positive correlation between the strengthening of extension services in the Amatole District. An increase in agricultural knowledge from agricultural extension agents is likely to positively influence the participation of farmers in the production of smallholder farmers. These results correspond to that of Nwafor et al., (2020) who noted that extension and advisory services are a great booster of rural medicinal plant farmers through dedicated impartment of knowledge and skills by extension officers. The close mentorship by extension officers increases their capacity to make informed decisions and solidifies their confidence to participate in medicinal plant production.

The farm size (ha) was found to be significant at 1 % with a positive coefficient, indicating a positive correlation between farm size and participation in the production of medicinal plants that enhance the profitability of smallholder farmers. An increase in the hectares of farmland leads to a positive outcome in the production of medicinal plants. Land is one of the most limiting factors in smallholder agriculture because on average, each family is entitled to a hectare or less for production. Therefore, smallholder farmers are likely to increase production in the event of more units of land at their disposal. The findings of the study correspond with those of Astutik et al., (2023) who found that more land results in increased productivity.

The results illustrate that farming experience is significant at 5% with a positive coefficient. This means that there is a direct proportionality between an increase in the years of experience and the participation of smallholder farmers in the production of medicinal plants. An increase in the experience of smallholder farmers capacitates the farmer of the benefit of hindsight, such that the farmer can avoid many farm decisions because he/ she knows from experience that the outcome is often not good. These findings correspond with those of Fitzgerald et al., (2020) who found that a smallholder farmer's decision-making gets better with time due to experience and so does the increase in participation of indigenous medicinal plants.

#### **4.4 Conclusion and Recommendations**

This study was done on the profitability of medicinal plants in smallholder production in the Amatole District Municipality. Primary data was collected through 150 structured

questionnaires among smallholder farmers. The study made use of descriptive statistics, budgetary, and multiple regression analyses. The budgetary technique (gross margin and net farm income) was used to estimate whether the Production of medicinal plants in ADM was profitable. The socio-economic factors showed gender imbalance with a dominance of females around 44 years of age and who spent 10 years in school. Extension visits were found to be at least 5 times a year. The budgetary technique analysis discovered that the production of medicinal plants is profitable with a value of average net farm income equalling ZAR 19 091.72 per growing period. The multiple regression showed that age, household size, extension visits, farming size and farming experience are factors influencing the profitability of medicinal plants. Therefore, the study recommends the Department of Agriculture should consider strengthening the force of extension officers to show more commitment to imparting knowledge about medicinal plants. The study further recommends financial support from the government and NGOs (Non- Governmental Organisations) to enable smallholder farmers to acquire more inputs. The study believes that smallholder farmers stand to benefit from more profits if investment can be made in their inputs of production. The study advises that family labour should be hands-on in the production of medicinal plants as this minimizes input cost and elevates profitability.

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## CHAPTER FIVE

### **CULTIVATING HEALTH AND WEALTH: AN IN-DEPTH WELFARE ANALYSIS OF THE PRODUCTION OF MEDICINAL PLANTS ON THE PARTICIPATION OF SMALLHOLDER FARMERS**

#### **Abstract**

Conservation and sustainable use of indigenous medicinal plants by smallholder farmers contribute imperatively to the rural societies of the Amatole District Municipality (ADM) of the Eastern Cape. The production of medicinal plants by rural smallholder farmers of the ADM demonstrates to be a crucial contributor to the welfare status of rural smallholder farmers. Though there are inherent challenges associated with smallholder farming such as lack of agricultural inputs, lack of capital, institutional support, cultural disparities and climate-related disasters. Furthermore, barriers to mainstream markets inhibit smallholder farmers from participating hugely. For instance, the incompliance to market quality standards, distance to markets, limited market information and financial constraints. There is an immeasurable availability of literature on the acknowledgement of medicinal plants and their uses in rural areas but limited contributions to the assessment of the production of medicinal plants by smallholder farmers. Hence the study sees the need to contribute a welfare assessment of the production of medicinal plants on smallholder farmers in the ADM of the Eastern Cape. Primary data for the study was collected through the use of well-structured questionnaires from smallholder medicinal plant farmers. A multi-stage stratified sampling technique was used in selecting the study participants and a sample of 150 smallholder medicinal plant farmers were chosen for this study. Descriptive statistics and the Propensity Score Method (PSM) were used for the analysis. The study results revealed that female farmers with an average age of 46 years and an average of 10 years in school participate more in the production of indigenous medicinal plants. The average farm size per household is 1 ha and is produced by an average of 5 members per household. The propensity score matching suggested that the production of medicinal plants had a substantial input influence on the welfare of smallholder farmers. The study recommends that the government and relevant stakeholders develop an effective smallholder funding framework and effective extension and advisory services.

## 5.1 Introduction

Medicinal plants are globally acknowledged valuable inputs of health drug establishments (Chen et al., 2016, Astutik et al., 2019). In developing countries, raw medicinal plants are more easily accessible in rural areas than in urban platforms, they often reach urban areas in pursuit of markets by rural smallholder farmers (Susanti and Zuhud, 2019; Nwafor, 2021). According to Omotilewa et al., (2021), smallholder farmers contribute greatly to the agricultural production industry with notable achievements to poverty reduction and eradication of hunger in Africa through production of medicinal plants. Smallholder farms are precisely small farms that are alleged to be more technical in terms of labour force which comes from the household to maximize production while minimizing costs. In Sub-Saharan Africa, smallholder farmers produce on land sizes of less than 2 ha, often characterized by their adoption of local methods, using native skills and experiences that were passed down from generations for farming activities (Chiaka et al., 2022). In South Africa, smallholder farmers often live in rural settlements, which are areas that are richly endowed with nature that is abundant in fauna and flora. Amongst the biodiversity that surrounds their settlements are also plenty of medicinal plants. Medicinal plants have been used extensively by the smallholder community as a traditional medicine for domestic use or extraction for sales (Quiroz et al., 2014; Mukherjee, 2019; Khan et al., 2020).

Rural people have relied on medicinal plants for hundreds of years as a vital source of natural healing therapies for the communities. Umeta Chali et al., (2021) stated that rural smallholder farmers are principal knowledge holders of medicinal plants and they preserve them to sustain their cultural identities. The farming of medical plants helps conserve biodiversity and also offers avenues for these farmers to make extra earnings (Jadhav et al., 2020). Herbal plants or medicinal plants are of particular relevance in healthcare and specifically low-resource settings, such as situations where modern medicine is hard to reach or expensive (Yeshiwas et al., 2019). These plants constitute crucial remedies for many diseases making drug medicine cheaper. Most importantly, smallholder farmers who do subsistence farming in local environment and mainly Produce medicinal plants are vital actors. It is the source of additional income as well as providing them with necessary health care. Therefore, the development of medicinal crops is a dynamic meeting point of farming, medicine, and survival (Xiong and Long, 2022).

It is highly significant for several reasons to understand the effects that the production of medicinal plants by smallholder farmers has on household welfare. From an economic

perspective, growing medicinal plants for income diversification will help smallholder farmers avoid income variability thus improving household income (Khasim et al., 2020). Additionally, the growing of medicinal plants increases the chances of local employment which makes welfare to a broader community. Petelka et al., (2020) postulated that medicinal herbs provide an income that can enable these households to meet the necessities of life including health care, food and education thus enhancing their standards of living. Moreover, conserving biodiversity is very important to raising medicinal plants (Susanti and Zuhud, 2019). Many smallholder farmers have vital insights on plants that grow well in local environments. Through planting medical plants, they can contribute to saving local biological variety and preserving the genetic diversity of such plants. Moreover, sustainable production can improve soil quality and lower environmental deterioration for a greater eco-healthy future (Ganie et al., 2019; Scartazza et al., 2020; Gowthami et al., 2021).

Nevertheless, planting medicinal plants is not an easy venture. Smallholder farmers encounter several difficulties such as limited inputs, lack of technical expertise, and poor market accessibility. Besides, they could also face the problem of excessive harvesting and destruction of local ecosystems (Yeshiwas et al., 2019). In addition to this, the unregulated nature as well as quality control within the medicinal plant market exposes smallholder farmers to market risks which affects their income stability. Therefore, it is important to investigate deep into these challenges so that appropriate interventions can be put in place for smallholder farmers who are participating in the production of medicinal plants.

Hence, the study sought to conduct an impact assessment of the production of medicinal plants on the welfare of smallholder farmers. There is minimal evidence in the literature that witnesses the impact of the production of medicinal plants on livelihood enhancement. Since the industry is unregulated, evidence of the employment rate, income generated, and measure of available resources in the wild is fairly inconclusive. Therefore, the study pursued to contribute to the literature and investigate the effects of the production of medicinal plants on household welfare.

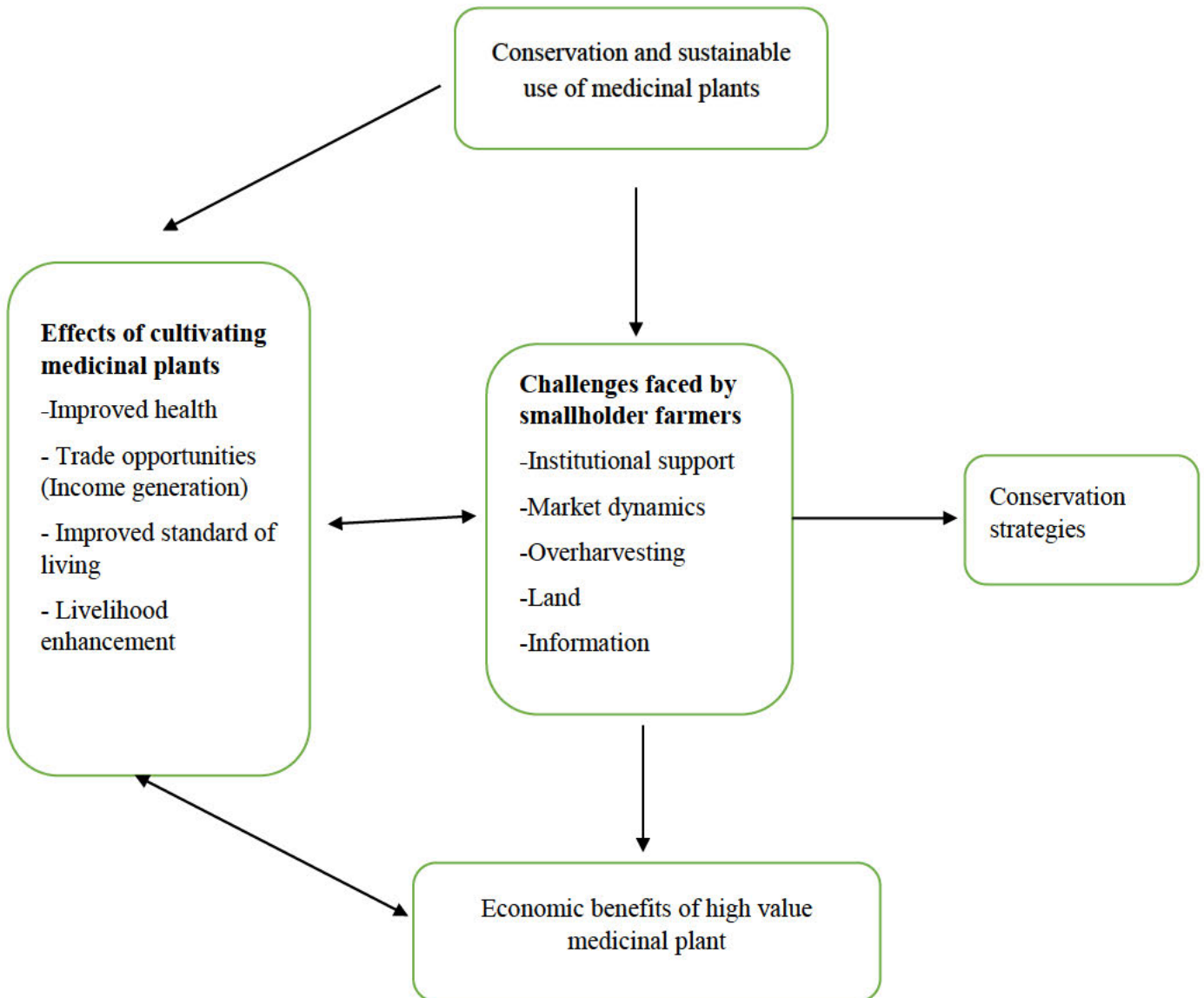
## **5.2 Methodology**

### **5.2.1 Conceptual framework of participation in production of medicinal plants**

The figure 5.1 below illustrates the interlinkage of the factors that are affected in the production and the sustainable usage of medicinal plants by smallholder farmers. These factors play a major role in the outcomes that arise from the participation of smallholder farmers in the production or wild harvesting of medicinal plants. These plants often play a pivotal role in their use as remedial agents for the societies where smallholder farmers live. The participation of smallholder farmers in the production and sustainable use of medicinal plants is highly influenced by socio-economic factors.

However, the diagram begins by highlighting that there are challenges that smallholder farmer faces in the use of medicinal plants. These challenges contribute greatly to drawing back progress in the development of smallholder farmers. For instance, factors such as access to land, access to agricultural information (indigenous or skilled knowledge), and market information are inhibiting positive outcomes in terms of the production and extraction of these plants from the wild. These prevailing challenges make it difficult for smallholder farmers to domesticate high-value medicinal plants because of access to land and resources for operational activities such as harvesting for selling. If these challenges are strongly defined in a certain area where these smallholder farmers live, they induce adverse externalities in the effects of producing medicinal plants on the welfare of smallholder farmers. Effects such as improved health, and standard of living become jeopardized because they need resources to be attained.

High-value medicinal plants are very important and can uplift smallholder farmers because of their demand and international importance. The inclusion of high-value medicinal plants can have positive benefits to the livelihood of these farmers. Hence, it becomes a matter of emergency to put in place conservation strategies to conserve the species diversity so that farmers can continue benefiting from these plants.



**Figure 5.1:** Conceptual framework of smallholder production of medicinal plants

**Source:** Author's own computation (2023)

### 5.2.1 Description of the study

The study was investigated in the Amatole District Municipality of the Eastern Cape. The district municipality is situated in the former Transkei region with abundantly rural settlements and some minority parts of it being peri-urban settlements (Mujuru and Obi, 2020). The majority of the dwellers of the districts are involved in agriculture to maintain a basic livelihood. The study area is rich with natural resources ranging from succulent grazing grasslands, forests, and marine life (Mdoda and Obi, 2019). The climate of the Amatole District Municipality is almost similar throughout but varies based on the distance to the sea (Thinnyane, 2019). The temperature fluctuates between the thresholds of 7°C to 10°C in the cool dry season,

when it can also be snowy and from 18°C to 24°C in the hot humid season. Adequate rainfall is received between October and March with the latter being the rainiest month and rainfall ranges from 750 mm to 1050 mm per annum (Marume et al., 2013; Thiyane, 2019)

The Amathole District Municipality is located within the Province of the Eastern Cape. It is classified as a Category C2 Municipality that is comprised of 6 local municipalities that are distinguished as follows, Amahlathi, Great Kei, Mbashe, Mquma, Ngqushwa, and Raymond Mhlaba local municipalities. The district is home to a population of approximately 1.7 million people with 91% African, 3% coloured and 6% white (Afolayan and Wintola, 2014; Mudemba et al., 2018). Furthermore, females cover 52% of the population and the remaining 48% are males (Mudemba et al., 2018). The Amatole District Municipality Integrated Development Plan (ADMIDP) estimations suggest that 54% of the population survives below the poverty line (ADMIDP, 2016). Furthermore, 66% make their living through the assistance of social welfare grants because of high levels of unemployment (ADMIDP, 2016).



**Figure 5.2:** Map showing the Amathole District Municipality

**Source:** AfriGIS (2024)

### 5.2.2 Data collection methods and sampling techniques

The research design for this research was cross-sectional where the data from smallholder medicinal plant farmers was collected at a single point in time without repetition of the sample. The research design is appropriate for descriptive study and determination of the relationships

amongst and between characteristics of each participant. The data was collected on several variables such as social demographics, the profitability of medicinal plants, challenges to adoption, production and welfare. It is also cost-effective in terms of financial resources and very considerate of time (Spector, 2019). According to Sharma, (2017), a sampling frame is defined as a list unit from which a sample is to be drawn. Information about the performance status of the smallholder medicinal plant farmers was unknown, hence the study made use of Cochran's proportion to size sample size calculator to determine the sample size for the study. This investigation selected its participants based on their voluntary willingness. Based on the information gathered, the municipalities where medicinal plants are produced were identified and the communities with the most medicinal plant farmers were further identified. The study depended on extension officers for assistance in identifying medicinal plant farmers in the different communities of the study area. The enumerators of the study made up of residents of the area were involved in the study of the effects of producing medicinal plants on household welfare of smallholder farmers in the Amatole District.

A multi-stage stratified sampling technique was used in selecting the study participants. A sample of 150 smallholder farmers was selected and was trusted to produce unbiased results. Interviews were conducted in areas where smallholder farmers who are producing medicinal plants were available until 150 interviews were reached from the sample. Primary data was collected by using a well-structured questionnaire administered by three enumerators, who fluently spoke in the local language. A pilot test was administered to 10% of the sample size to train the enumerators and well as to ascertain the viability of the questionnaire. The data was collected between July 2023 and August 2023.

### **5.2.3 Empirical Model Specification**

#### **Logit model**

The study made use of the Logit model to evaluate the factors influencing the participation of smallholder farmers in producing medicinal plants. The logit model enables a statistical evaluation of the influence of numerous variables in a dependant variable of dichotomous type. The dependent variable can be expressed at two levels: 1 (medicinal plant participant), 0 (non-participant) (Szafraniec-Siluta et al., 2022). The weakness of linear probability models makes the use of Ordinary Least Squares (OLS) null and void (Mokhnenko et al., 2020). According to Jaza et al., (2018), the logit or probit model could be more convenient to this study because the dependant variable (participation of smallholder farmers in producing medicinal plants) is

qualitative in nature, the explanatory variables are a mix of continuous and explanatory variables and the sample size is fairly manageable (N= 150).

The choice of using the logit over probit is the preference of the study. Logit offers the possibility to save the predicted values automatically whereas probit cannot compute the probability's predicted value. For the above reasons, the logit model has been deemed suitable to be used for this study. Jaza et al., (2018) stated that, the logit model uses the Maximum Likelihood Estimation (MLE) method in order to predict the logit of the probability of the occurrence of the event, that is, the natural log of the odds ratio of reaching one or the other alternative (participation of smallholder farmers in producing medicinal plants). By indicating  $P$  as the probability of reaching an alternative from the predictors  $X_1$  to  $X_{12}$ , the mathematical formulation of the binary logit model used in this study is expressed in as follows:

$$Y = \text{Logit}(P) = \ln\left(\frac{P}{1-P}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 \dots + \beta_{12} X_{12} \dots \dots \dots (1)$$

Where  $P$ : Probability that farmer produces medicinal plants

$1-P$ : Probability that farmer does not produce medicinal plants

$Y$ : Farmer's group (with 1= medicinal plant participant, 0=non- participant)

$\alpha$ : Intercept term (constant)

$\beta_1 \beta_2 \beta_3 \beta_4 \dots$ : Denote the slope coefficient

$X_1 X_2 X_3 X_4 \dots$ : Explanatory or independent variables.

### **Propensity Score Matching**

The study adopted the Propensity Score Matching (PSM) to conduct an in-depth welfare analysis of the production of medicinal plants on the participation of smallholder farmers. PSM method was good for its capacity to improve the ability of the regression to accumulate accurate causal evaluations by virtue of its non-parametric approach to balancing covariates between the participants and non- participant groups in the effects of the production of medicinal plants on household welfare (Aku et al., 2019). In order to measure impact evaluation, numerous econometric techniques have been studied, such as: reflexive comparison, instrumental variable methods (IV), matching methods, difference- in- difference (DD) methods.

The study employed the use of matching methods to compare the effects of producing medicinal plants on social welfare of participants and non- participants with similar characteristics. Matching only controls for differences on observed characteristics and there may be some biases developing from unobserved variables that have a potential of influencing the participation in program (Nyang'au et al., 2020). The Average effect of Treatment on the Treated (*ATT*) can be computed as follows (Kabunga, 2014):

$$ATT = E(y_{li} - y_{0i}|D_i = 1) = E(y_{li}|D_i = 1) - E(y_{0i}|D_i = 1)..... (1)$$

Where  $y_{li}$  denotes the farm income for  $i$ th smallholder farmer belonging to the production of medicinal plants group,  $y_{0i}$  is the income of the smallholder farmers that are not participating in the production of medicinal plants, and  $D_i$  is a treatment indicator equal to 1 (sustainable production of medicinal plants) and 0 (otherwise). Meanwhile, it was difficult to observe how the farm income would have been without participating in the sustainable production of medicinal plants, the key problem we were exposed to is that of determining the appropriate counterfactual:  $y_{li} | D_i = 0$ ). Due to the self-selection of non-random farmers, comparison between non-participants and participants may yield biased estimates. A suitable control group with non-participants that have similar comparable characteristics to those who are participating in the production of medicinal plants were constructed by using a propensity score matching (PSM) technique (Nyang'au et al., 2020). Empirically propensity score matching technique follows two stages. Firstly, a probability model is created to evaluate each smallholder farmer's probability  $p(x_i)$  to participate in the production of medicinal plants given observed characteristics,  $x_i$  (Luan, 2020).

$$\Pr(D_i = 1|x_i) \equiv p(x_i)..... (2)$$

Secondly, the *ATT* of production of medicinal plants on household welfare of smallholder farmers ( $y_i$ ) is calculated, using matched observations of participation and non-participants as follows:

$$ATT^{psm} = E[y_{li}|D_i = 1, p(x_i)] - E[y_{0i}|D_i = 0, p(x_i)]..... (3)$$

Where  $ATT^{psm}$  estimates mean difference of participants matched with non-participants who reside within the same region of similar socio-dynamics are balanced on their propensity scores (Luan, 2020).

### 5.3 Findings and Discussion

The major findings of the study are discussed in this section. The findings from Socioeconomic factors and the Propensity Score Matching (PSM) estimation are presented here along with the discussion for each econometric finding.

#### 5.3.1 Socio-economic characteristics of smallholder farmers in the Amatole District

The effect of producing medicinal plants on the household welfare of smallholder farmers was measured from smallholder farmers who produce or extract medicinal plants to exchange them in the market for cash incentives. The sampled 150 medicinal plant farmers revealed that 125 farmers had participated in the production for marketing and 25 of the farmers acknowledged the production and use of medicinal plants but did not participate in selling their produce in market streams.

**Table 5. 1: Socio-economic characteristics of smallholder farmers**

Characteristics	Medicinal plant participants (n= 125)	Non- Medicinal plant participants (n= 25)	Overall (n= 150)
	Mean	Mean	Mean
Age	0.56	0.32	0.44
Gender (female)	0.59	0.74	0.67
Educational level	7.4	12.8	10.6
Extension Visits	0.57	0.58	0.56
Household size	6.00	5.00	5.62
Farm size (Ha)	0.92	0.98	0.95
Farming experiences (year)	16.44	4.36	10.42

**Source:** Field Survey (2023)

The results show that the majority of medicinal plant farmers are women (67%) with an average age of 44 years. Similar findings were shared by Khoza et al., (2019) in their study, proclaiming that women are responsible for farming in rural households. Also, the results reveal that the medicinal plant farmers spent more than 10 years in school, placing them in a good position to understand the farm operation, and easily accumulate knowledge about the health benefits. These results are in line with the findings of Bonokwane and Ololade (2022) who realized that farmers with formal education are more than willing to adopt new technology

and increase their productivity. The study results show that the majority of households have an average of 5 members per household and own a land size of less than a hectare. This means that smallholder farmers must use self-labour in their farming activities to reduce labour costs. This is a worrisome factor in the progressive development of smallholder farming. This is consistent with Mazibuko, (2018) who highlighted that insufficient family labour is a limiting factor of smallholder production. Further, the results show that medicinal plant farmers have more than 10 years of experience in production. This means that medicinal plant farmers have a better understanding of the production challenges and health benefits of these medicinal plants.

### 5.3.2 Factors influencing the participation of smallholder farmers in producing medicinal plants

The study made use of logit regression model to estimate factors influencing participation of smallholder farmers in cultivating medicinal plants in the study area. Table 5.2 illustrates the valuation outcomes from the logit regression and model fit is also discussed. The main one is Pseudo-R<sup>2</sup> squared and the second one is Likelihood Ratio Chi-square which is a valuation of how well the model ordered defendants appropriately structures on assessed likelihoods. The likelihood ratio Chi-square of -194.007 with a p-value of 0.0000 denotes that the model is statistically substantial. The R<sup>2</sup> (83%) and the adjusted R<sup>2</sup> (78) suggest a good model fit.

**Table 5.2 Estimates of determinants of farmer's participation in the production of medicinal plants**

<b>Variables</b>	<b>Coefficient</b>	<b>SE</b>	<b>Significance</b>
<b>Age</b>	-0.078	-0.05	-0.002***
<b>Gender (female)</b>	0.434	0.82	0.004***
<b>Education</b>	-0.04	0.08	-0.037**
<b>Household size</b>	0.090	0.22	0.014**
<b>Farming Experience</b>	0.14	0.08	0.008***
<b>Extension Visits</b>	0.58	0.50	0.015**
<b>Protection of natural resources</b>	1.59	0.78	0.003***
<b>Constant</b>	0.047	0.082	1.976

<b>Number of observers</b>	<b>150</b>
<b>Log-likelihood</b>	<b>-194.007</b>
<b>Prob&gt; Chi<sup>2</sup></b>	<b>0.000***</b>
<b>R- squared</b>	<b>0.831</b>
<b>Adjusted R</b>	<b>0.782</b>

**Note: SE= Standard Error, \*, \*\*, \*\*\* represent significance at 5% and 1% respectively.**

**Source:** Field survey (2023)

Based on the results of the study, the age of a farmer plays an important role in the production of medicinal plants. The coefficient of the age of the farmer was established to have a negative effect on the production of medicinal plants and is significant at 1%. The outcomes suggest that when the age of the farmer increases, the likelihood of the production of medicinal plants decreases. This may be attributed to the fact that, as people become elderly, they tend to lose the strength they had in their prime years of farming. Therefore, these outcomes might affect the production of medicinal plants in the future. This finding is consistent with Rubhara and Mudhara (2019) who noted that smallholder farmers lose their mobility strength which makes them active for work in the production of medicinal plants. Such is a natural phenomenon; young people are generally stronger than old people. Gender (females) of the key farmer was found to be a positive influence on the smallholder production of indigenous medicinal plants at 1%. This signifies that an increase in the number of female participants is likely to trigger the output of produced medicinal plants. That trend contributes greatly to the household welfare of smallholder medicinal plant farmers. The study is in line with Assefa et al., (2022) where males yielded a negative probability in farming operations and females had a positive probability in their drive to participate in farming. Therefore, Amatole district females proved to be more reliable options than males that can participate in the production of medicinal plants in more economically viable manner.

Education was established to have a negative coefficient but significant at 5%. This implies that if a farmer acquires more education, there will be a decline in the participation of the production of medicinal plants. Justifications for that tendency may include sentiments such as, highly educated people view raw state medicinal plants as a thing for the poor and, therefore do not want to associate themselves with them. This narrative may impact negatively on the production of medicinal plants by smallholder farmers. The finding is consistent with numerous studies that estimated that educated people tend to accept medicinal plants more when they are processed products. Thus, this reluctance will see the production of medicinal plants being less

participated as farmers further their studies (Astutik et al., 2019; Tefera and Kim, 2019; Sidiq and Achmad, 2020).

Household size was significant at 5% and had a positive coefficient meaning that there is a positive relationship between the production of medicinal plants and an increase in household size. An increase in more household members that assist with farming activities is probable to increase productivity. The result of this study is in line with Mdoda and Obi, (2022) who noted that an increase in household size means an increase in labour. Therefore, the advantage of saving on casual labour consolidates a farmer's decision to participate in medicinal plant production to improve their welfare status.

Farming experience was established to have a positive impact on the production of medicinal plants by smallholder farmers and was significant at 1%. This suggests that an increase in the level of experience creates a good chance of a positive influence on the production of medicinal plants by smallholder farmers. The study results are parallel to those of Yeshiwas et al., (2019) who found that experience is a cornerstone to a productive smallholder medicinal plant farm since experienced farmers are more likely to make informed decisions based on hindsight. The results illustrate extension services with a positive coefficient which is statistically significant at 5%. The results suggest that with a unit increase in the extension and advisory services, there is a likelihood that it will yield a positive impact on the production of medicinal plants. There is a positive correlation between the intensification of extension services and an increase in productivity in the Amatole District. An increase in agricultural knowledge is likely to positively influence the participation of farmers in the production of medicinal plants by smallholder farmers. These results correspond to that of Nwafor et al., (2020) who noted that extension and advisory services are a great booster of the rural medicinal plant farmers through dedicated impartment of knowledge and skills by extension officers. The close mentorship by extension officers increases their capacity to make informed decisions and solidifies their confidence to participate in medicinal plant production.

The results show that the protection of natural resources has a positive coefficient and was significant at 1%, meaning that there is a positive relationship between the participation of smallholder farmers of the Amatole District in the production of medicinal plants and the protection of natural resources. This generally means the more natural resources are safeguarded from extinction, we are likely to experience an increase in the participation of smallholder farmers in the production of medicinal plants. These results correspond with

Astutik et al., (2019); Yeshiwas et al., (2019); Nwafor et al., (2020) who reported, that an increase in conservation practices safeguards numerous specie's diversity from extinction. The increased biodiversity protection practises of medicinal plants increase the rate of participation due to the guaranteed abundance of medicinal plant material. In simple terms, participation is increased because more natural resources that are available sustain smallholder medicinal plant farmers in business.

### **5.3.2 Effects of production of medicinal plants by smallholder farmers on household welfare**

The purpose of this study was to estimate the effect of the production of medicinal plants by smallholder farmers on household welfare. This study evaluates if there is a substantial effect on household welfare between participants in the production of medicinal plants and non-participants through the use of Propensity Score Matching (PSM). This sub-division shows that the production of medicinal plants influences the impact on the household welfare of smallholder farmers. The outcome of the input was estimated in fluctuations in capital, family labour, employed labour, quality of seeds used and the size of the worked area on the farm. To select the harmonizing things, a propensity score matching was done. The use of matching assets certifies that an evaluation set is formed with distinct features disseminated consistently diagonally quantiles in both the handling and the assessment clusters (Nkala et al., 2011; Taruvinga et al., 2023). The outcomes of the production of medicinal plants on household welfare were estimated using the adjacent Neighbour and Kernel corresponding methods. The propensity score matching assessment effect of the production of medicinal plants on household welfare is presented in Table 5.3 below.

**Table 5.3: Effects of production of medicinal plants by farmers on household welfare**

Output variable	Kernel Matching Method		
	ATT	Standard error	p- value
Household welfare	5624.641	4912.56	0.021**
	Nearest Neighbour Matching Methods		
	ATT	Standard error	p-value
Household welfare	6472.691	5472.691	0.003***

Model summary Number of observations= 150

Matches requested= 7 Treatment model= Logit

Notes: \*\*\* and\*\* mean significant at 1% and 5% levels, respectively

**Source:** Field Survey 2018

Based on the results on Table 5.3 reflected above, the estimates for the household welfare earned from smallholder farmers producing medicinal plants assortments from ZAR 5624.64 to ZAR 6472.69, depending on the matching methods used. All estimates were significantly different from zero at 1 % and 5% critical level, respectively. The results illustrated that, the more production of medicinal plants through the increase of land produced and more participants engaging, the more smallholder household welfare of farmers enhances. The production of medicinal plants was found to be statistically significant at 5% with a coefficient of ZAR 5624.641 in the Kernel Matching Method. This signified that growth in the production of medicinal plant enterprises result in an improvement in farm returns and welfare of farmers through the betterment of the standard of living of smallholder farmers through increased farm revenues. Furthermore, the production of medicinal plants had a significantly positive coefficient of ZAR 6472.691 if you select the Nearest Neighbour Matching Methods. The unwillingness to participate in the production of medicinal plants can be substantial for several reasons. The result was in line with Nyang’au et al., (2020) who revealed that the production of medicinal plants affects welfare of smallholder farmer’s rate of participation in medicinal plant production increases when they discover an incline in the farm revenues.

## 5.4 Conclusion

The study investigated the effects of producing medicinal plants on the household welfare of smallholder farmers of the Amatole District in the Eastern Cape South Africa. Medicinal plants are critical assets that are indigenous to the rural areas where smallholder farmers live. The production of medicinal plants by smallholder farmers plays a crucial role in the livelihoods of rural smallholder farmers by being the cheapest available resort to medicine moreover, contributing significantly to farm revenues. Using survey data collected in 2023 from sampled smallholder farmers around the Amatole District, descriptive statistics and applying the PSM method, this paper analysed the effects of producing medicinal plants on household welfare of smallholder farmers. Results depicted that the participation of smallholder farmers in the production of medicinal plants has a significant impact on household income and farm revenues.

Study results show that 67% of the smallholder medicinal plant operations are operated by women. Most of the farmers have not gone past matric in terms of education level, the highest achievable years they spent in school is ten years. The availability of extension and advisory is contributing significantly to the skills development of smallholder medicinal plant farmers and that increases participation of smallholder farmers in producing medicinal plants. On average there are five people living per household and is commissioning a lot of people to work in the fields, thus saving a lot of money that could hire casual labour. We identify factors affecting participation in the production of medicinal plants to be; Age, Gender, Educational level, Extension Visits, Household size, Farm size, Farming Experience and Protection of natural resources, these factors were found to play an important role in farmer's propensity to participate.

The study concludes that the production of medicinal plants has an impact on the welfare status of smallholder farmers. Outcomes reveal that smallholder farmers experience an increase in farm revenues when they participate in the production of medicinal plants. The study recommends that policymakers; and government (National Department of Agriculture, Land Reform, and Agrarian) must maximize investment in endorsing start-up medicinal plant projects as they give hope in bettering livelihood for smallholder farmers. The study suggests that civil extension agents must commit themselves to the task of mastering educational campaigns that will train smallholder farmers about inputs, marketing strategies, and technological advancements that will assist farmers in increasing output and farm revenue.

There is a huge gap that the private sector can fill to take an initiative that will improve the farming businesses of smallholder medicinal plant farmers such as providing seeds, skills and knowledge to smallholder farmers who can afford certain services that can be delayed if offered by public service.

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**CHAPTER SIX**  
**SUSTAINABLE CONSERVATION STRATEGIES FOR INDIGENOUS MEDICINAL PLANTS: BALANCING TRADITIONAL KNOWLEDGE AND ENVIRONMENTAL PRESERVATION: IMPLICATION FOR FOOD AND NUTRITION SECURITY**

**Abstract**

The conservation and sustainable use of indigenous medicinal plants constitutes an integral part of the preservation of indigenous medicinal plants. The biodiversity of medicinal plants is an important factor that needs to be protected to save plant species from endangerment. Medicinal plants have become a cornerstone for poverty alleviation for rural smallholder through the extraction of medicinal plants from the wild to sell, and heal their communities and livestock. However, the habit of extracting species without proportionate efforts of propagation is threatening the population of medicinal plants. Rural communities are usually rich in indigenous knowledge, though their information is passed down to generations through word of mouth and thus susceptible to permanent loss. There is minimal evidence in literature confirming studies on indigenous knowledge of medicinal plant conservation. Furthermore, little is known about the impact of mismanaged medicinal plant resources on the livelihood enhancement of rural smallholder farmers. Therefore, the study seeks to analyse the impact of the conservation and sustainable use of indigenous medicinal plants on food and nutrition security in the Amatole District Municipality of the Eastern Cape. Primary data for the study was collected through the use of well-structured questionnaires from smallholder medicinal plant farmers. A multi-stage stratified sampling technique was used to draw up an appropriate sample of 150 smallholder farmers for this study. Descriptive statistics were employed for analysis. The study results indicated that the women farmers who are 44 years of average age and 10 years of average schooling duration participate more in the production of indigenous medicinal plants. The average farm size per household is 1 ha and it is reliant on an average of 5 members per household. Additionally, findings indicated that smallholder farmers are only aware of keeping medicinal plants by producing them in protected areas and on-farm conservation, other measures appear to them challenging. The study advises that extension services should be utilized more so that they educate the farmers in rural areas. The government should prioritize funding skills training in the ADM.

## 6.1 Introduction

Medicinal plants constitute among the most important plants in the world on account of their healing power. For mere reasons of using these plants for healing diseases in human and animal-related conditions, humans have kept close contact with these plants in their societies (Ssenku et al., 2022). They have multiple uses such as healing diseases, healthy eating, insects and pest repellent. The human community finds medicinal plants appealing because they are used in a wide range of applications however, the greatest attraction is that they are more cheap than manufactured medicine (Anwar et al., 2022). Astitik et al., (2019) noted that around 80 per cent of the populations across various parts of the globe have adopted the practice of using herbal medicine for therapeutic purposes. Significantly, the practice is particularly common in poor countries, where access to medicine is a struggle or very expensive.

The increase in human interest in medicinal plants has created opportunities for trade beyond Africa's borders to other countries, especially in Europe. In Africa, it is estimated that over 700,000 tons of plant products valued at USD 150 million are harvested from the wild annually to satisfy human demand (Seile et al., 2022). Similarly, Ndhlovu et al., (2021) argued that South Africa has an annual dry and manufactured harvest of about 20 000 tons worth R270 million (US\$60 million). These are values that they extracted for the market, medicinal plants in South Africa are traded through different avenues like small and big marketplaces. Local harvesters are raking in profits in the informal market of this country (Nwafor et al., 2021). The inflated attention of consumers on medicinal plants has attracted various interest groups including product developers, distributors, and extractors who are seeking profits. Thus, rural farmers had an opportunity to grow medicinal plants and take advantage of the gap present in producing herbal plants (Hilonga et al., 2019; Zahra, 2020). The demand for medicinal plants creates an extra burden on biodiversity management because some plant species are critically endangered in the wild. Therefore, all medicinal plant species are susceptible to extinction, more so, farmers stand a chance of losing even high-value medicinal plants.

Smallholder farmers rely on medicinal plants to sustain their livelihoods. The value of medicinal plants can be measured by consumer importance, demand, and availability. An example is *Agathosma betulina* (Buchu) with a huge profit margin, which is well known worldwide and forms part of exported products. According to Street and Prinsloo, (2013), it was in 1761, when the first export of Cape Aloe to Europe took place. Hence, it becomes clear that medical plants form an important part of a very lucrative business (Pei et al., 2020; Gonfa

et al., 2020). Smallholder rural households living near these natural resources are good potential key role players in this industry since these plants are situated at their convenience and close to access. It would result in sustainable profits and high benefits with minimal inputs if medicinal plants were permanently conserved. The availability of medicinal plants for smallholder farmers is threatened by degradation of biodiversity in the wild. Ndhlovu, et al., (2021), Seile, et al., (2022), and Astutik, et al., (2023) recognise several threats to medicinal plants and state only very few medicinal plants, if any, are well propagated after harvest in the settings.

However, for smallholder farmers to become vital role players in the business of medicinal plants, they are bound to overcome numerous challenges. Firstly, awareness of profitable opportunities is at risk of loss due to knowledge barriers that are challenging smallholder farmers. Village elders are knowledge holders and medicinal plant information is transmitted through word of mouth; hence, it is vulnerable to loss. (Nagothu, 2023). It is difficult to gauge the contribution made by smallholder medicinal plants towards livelihood enhancement, social welfare benefits, as well as employment which are key economic indicators for measuring impact (Chandra et al., 2020). Also, reduced productivity due to no mechanical inputs on smallholder farms denies these producers a fair chance to be competitive in the market (Tali et al., 2019). Therefore, with all the above-mentioned being missing, it becomes difficult to measure the food security and nutrition security benefitted by smallholder farmers from the commercialization of medicinal plants.

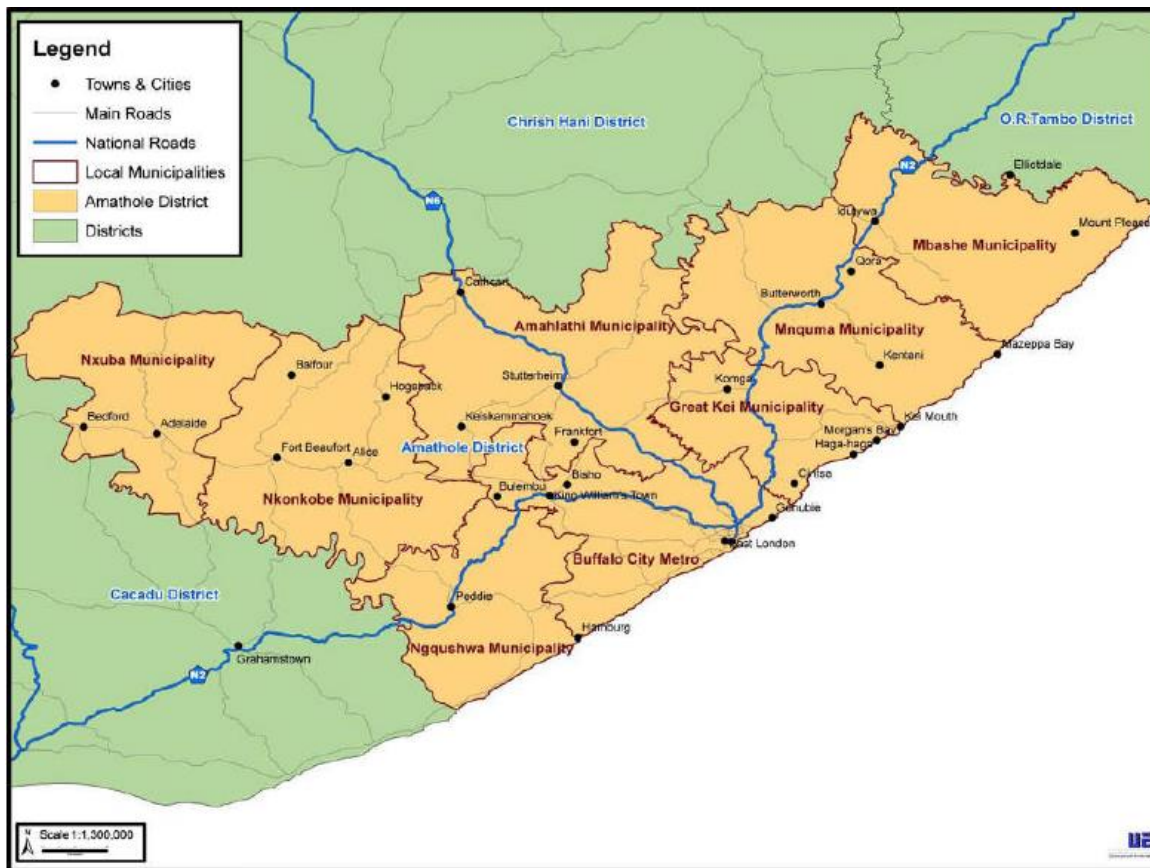
Therefore, the study pursues to contribute to the current literature, the sustainable conservation strategies for indigenous medicinal plants. The main intention of the study is to weigh the impact of conservation strategies on the food and nutritional security of smallholder medicinal plant farmers. Not much is acknowledged about how much the conservation strategies influence food and nutrition security. Due to the unregulated nature of the medicinal plant industry, there is a limited measure of the influence of conservation strategies on the long-term effects of the overharvesting of medicinal plants. Furthermore, there are close to no studies at all that have tested the effect of indigenous conservational knowledge in environmental preservation, and neither have these strategies been investigated against food and nutrition status. Information on the above mentioned are crucial, as they enlighten about the improvement of standards of living, sustainable income, food and nutrition security. Hence the need for this study.

## **6.2 Methodology**

### **6.2.1 Description of the study**

The study was conducted in the Amatole District Municipality (ADM) of the Eastern Cape. The district municipality is situated in the former Transkei region which is mostly rural settlements and some minority parts of it being peri-urban settlements (Mujuru and Obi, 2020). The Amatole District Municipality is classified as a category C2 Municipality that is comprised of 6 Local Municipalities that are distinguished as follows: Amahlathi; Great Kei; Mnquma; Ngqushwa; and Raymond Mhlaba. The district municipality is home to approximately 17 million people with 91% being African, 6% white, and 3% coloured (Wintola and Afolayan, 2015; Mudemba et al., 2018). Furthermore, females cover 52% of the population and the remaining 48% are males (Mudemba et al., 2018). The climate of ADM is characterised by average temperatures fluctuating between 7°C to 10°C in cool dry seasons when it can be snowy and from 18°C to 24°C in the hot humid season. Adequate rainfall ranges from 750 mm to 1050 mm per annum (Marume et al., 2013). Inside the boundaries of the ADM's territory, are richly endowed terrains bestowed with natural resources ranging from succulent grazing grasslands to forests, and marine life (Mdoda and Obi, 2019).

The Amatole District Municipality Integrated Development Plan (ADMIDP) estimates suggest that 54% of the population survives below the breadline (ADMIDP, 2016). Furthermore, 66% of the population survives through the assistance of social welfare grants because of the high levels of unemployment (ADMIDP, 2016). The majority of the dwellers of the district are involved in primary agriculture to alleviate poverty and sell surplus to obtain income. The predominant agricultural activities among smallholder farmers that are taking place in the Amatole District Municipality are seasonal maize production, poultry, horticulture, cattle (dairy and beef), small stock (sheep and goats) and forestry (ECDC, 2015). Amongst the natural vegetation of forests and grasslands is the abundant availability of medicinal plants that are indigenous to the study area, whom the dominant Xhosa tribe calls "Amayeza" or "Umthi" (Nwafor, 2021). The study was conducted in this district to investigate the participation of smallholder farmers in the production and sustainable use of indigenous medicinal plants to develop a sustainable livelihood. The plentiful availability of medicinal plant resources around them makes easy access to these medicinal plants without exhausting so many input resources.



**Figure 6.1:** Map showing the Amathole District Municipality

**Source:** Urban- Econ (2011)

### 6.2.2 Data collection methods and sampling techniques

The research design for the study was cross-sectional, where data was collected from smallholder medicinal plant farmers at a single time without repetition of the sample. The study made use of primary data. Primary data was collected through the use of self-administered structured questionnaires. The structured questionnaires were used to obtain data on socio-economic demographics, challenges affecting smallholder medicinal plant farmers, profitability, conservation strategies and contribution to household welfare. The reliability of the questionnaires was assured for appropriateness through a pre-test before the data collection. The pre-testing of the questionnaire was also important for training enumerators who were responsible for administering the questionnaires, the enumerators were fluent in the local language which is Xhosa. The study selected the participants voluntarily and without coercion. The researcher worked in close liaison with the extension officers for assistance in identifying smallholder medicinal plant farmers of the Amathole District Municipality. A multi-stage stratified sampling technique was used in selecting the study participants. A sample of 150

smallholder medicinal plant farmers was selected with the hope that they would produce unbiased responses. The data was collected between July and August 2023

### 6.2.3 Data analysis

The study employed descriptive statistics to analyse this chapter. The significance of using descriptive statistics in the study is to assess the conservation strategies that can be used to sustain the use of indigenous medicinal plants, the scale allowed the respondents to rate the conservation strategies according to their own experience and how they relate to them. The mean score was produced by the total summation of the product of rating points and observation divided by the total sample size (Obayelu and Fadele, 2019).

The socio-economic characteristics of the study were analyzed and defined using descriptive statistics. The study used graphs, sums, tables, averages, and frequencies. This analytical tool was employed to examine the social profile of smallholder farmers and their farming practices that are aimed at conserving nature’s biodiversity.

## 6.3 Findings and Discussion

This section is divided into two. The first profiles the socio-demographic factors. The second section analyses the conservation strategies used by medicinal plant farmers.

### 6.3.1 Socio-economic characteristics of smallholder farmers in the Amatole District

The sustainable conservation strategies for indigenous medicinal plants were estimated by smallholder farmers who utilised conservation strategies for environmental preservation. The sampled 150 medicinal plant farmers exposed that 125 farmers were medicinal plant farming participants and 25 of the farmers acknowledged having information about the existence of medicinal plants but did not participate in the production of medicinal plants, including the conservation of species diversity and environmental preservation.

**Table 6. 1: Socio-economic characteristics of smallholder farmers in Amatole District Municipality medicinal plant participants and non-participants**

Characteristics	Medicinal plant participants (n= 125)	Non- Medicinal plant participants (n= 25)	Overall (n= 150)
	Mean	Mean	Mean
Age	0.56	0.32	0.44

Gender (female)	0.59	0.74	0.67
Educational level	7.4	12.8	10.6
Extension Visits	0.57	0.58	0.56
Household size	6.00	5.00	5.62
Farm size (Ha)	0.92	0.98	0.95
Farming experiences (year)	16.44	4.36	10.42

**Source:** Field Survey (2023)

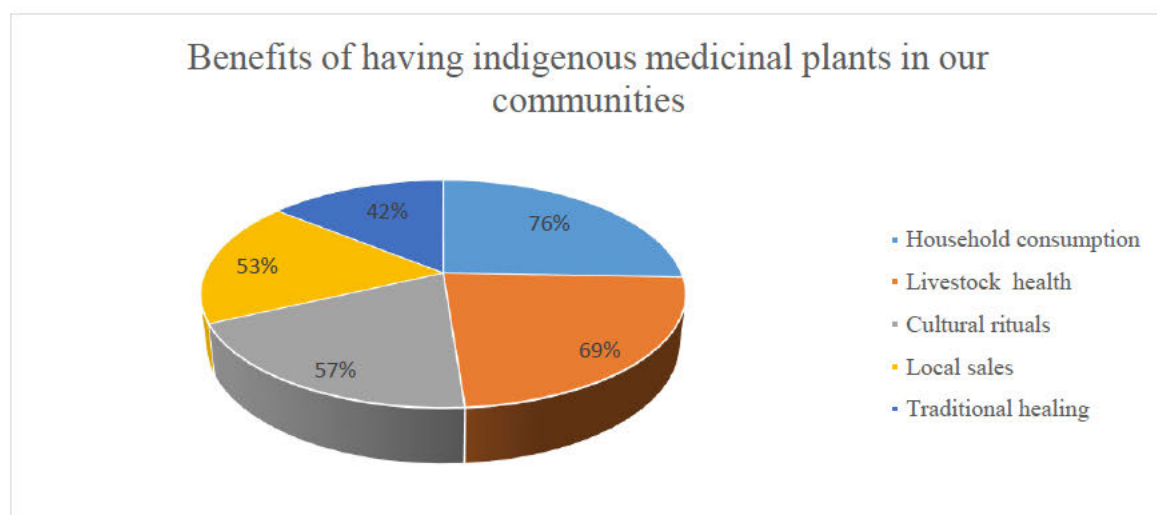
As reflected in Table 6.1 above, the results of the study portrayed that medicinal plant farmers of the Amatole District Municipality (ADM) are mostly females. Female farmers of medicinal plants are approximately 67% and this implies that women assume a leading role in the primary production of indigenous medicinal plants than their male counterparts. These results relate to findings presumed by Sumardjo (2021) who found that females engage to more roles in medicinal plant farming, in particular backyard gardening of medicinal plants. The age of the smallholder farmers that are in medicinal plant production is averaging at 44 years of age. These findings suggest that most of the smallholder medicinal plant farmers are middle aged women. The findings of the study were in line with Silva et al., (2011) who found that middle aged women participate more in practices of medicinal plants because they are more knowledgeable than the younger generation, with more strength than the older generation and that is what drives their urge to the production of medicinal plants.

The results depict that the average educational level of the medicinal plant farmers of the ADM is 10 years in school. Ten years in school indicates a decent level of literacy, understanding and intellect that makes one to be in capacity to make informed decisions. Gichangi et al., (2019) presented similar findings that farmers with formal education are likely to make more rational decisions and are capable of contributing valuable inputs into their farming operations. The result show that the extension visits in the Amatole District Municipality per year were 5. Extension and Advisory Services (EAS) constitute an integral part of knowledge and skills of smallholder medicinal plants farmers through dissemination of lucrative agricultural information. The study results are consistent to those of Emeana et al., (2019) who found that extension system is effective when they give valuable, consistent and relevant information to local smallholder farmers to make a pivotal impact in the use of significant medicinal plant resources and sustainable farming.

The findings of the study illustrated that on average, households had 5 members and are occupying a land sizes that are less than 1 ha. The results suggest that there is an availability of labour force since smallholder medicinal plant farmers often source workforce from family members thus giving them an advantage of cost minimization. These study results are consistent with the study conducted by Demissie and Legesse (2013) who distinguished that members of the family participate as extra force in farm work and non- farm activities with the intention of generating more income while saving significantly on labour costs. The results of the study reveal that medicinal plant farmers have 11 years of experience in farming. These findings influence the farmer’s ability to make decisions because experience has created hindsight of past events and an understanding of how solutions were made. The study results correspond with Xhoxhi et al., (2020) who exposed that smallholder farmers with longer experience in the production of medicinal plants are considered to have better strategies to counter arising challenges and risks.

### 6.3.2 The benefits of having indigenous medicinal plants in our communities.

The information about the benefits of having indigenous medicinal plants in our communities was gathered from a field survey of a sample of 150 respondents that were chosen by the study. Figure 6.2 below depicts the benefits of having indigenous plants in our communities as in the case of Amatole District municipality.



**Figure 6.2:** Benefits of having indigenous medicinal plants in our communities

**Source:** Field Survey (2023)

Figure 6.2 above indicates that household consumption in the event of illness was the most benefit that the smallholder medicinal plant farmers exploited from the use of medicinal plants.

Approximately 76% of rural smallholder farmers use medicinal plants to maintain the health of family members in their households. This could be attributed by the fact that medicinal plants are cheaper resort to medicine than to purchase manufactured medicine. Additionally, rural areas are mostly situated distantly to towns, therefore, herbal medicine is the more fastest option reachable in the event of a sickness of a family member. The study results were consistent to those of Chen et., al (2016) and Astutik et al., (2019) who found that herbal medicine is cheaper than manufactured medicine, hence the majority of rural people consider them.

To keep livestock in a healthy state rank second on the benefits of having indigenous medicinal plants in our communities. About 69 % of the rural smallholder farmers reap a large benefit from medicinal plants as they can use them to maintain the health of their herds. This could be as a result of, livestock being one of the of the primary commodities that rural smallholder farmers pride themselves for having as a tool to alleviate poverty. Therefore, the availability of affordable medicine protects assets such as livestock and cash for medicine, that smallholder famers draw livelihood from through nutrition and saving money for alternative uses. The study was in line with that of Jayakumar et al., (2018) who found that herbal medicine is playing a significant role in the health of livestock in rural areas and its affordability saves smallholder farmers money to invest elsewhere.

Uses of medicinal plants for cultural rituals and beliefs was one of the benefits of having access to medicinal plants in close proximities to where people live, about 57% of smallholder farmers attest to this benefit. The reason for embracing the benefits of medicinal plants for rituals and beliefs could be that certain medicinal plants are sometimes demanded by culture and therefore, one could feel the need to acquire the plant from faraway places just fulfil his or her cultural desires. Additionally, when there is a shortage of these plants in the market, the price of getting them rises. The rise of these prices solicits funds that were initially going to be for household food and nutrition. However, smallholder farmers appeared to be very adamant about fulfilling cultural desires. The study results are consistent to those of Mattalia et al., (2020) who has found that faith in religion plays a pivotal role in influencing a smallholder farmer to adopt the use of medicinal plants and it drives them to lengths and depths to assure that they get the plants they need just to fulfil beliefs.

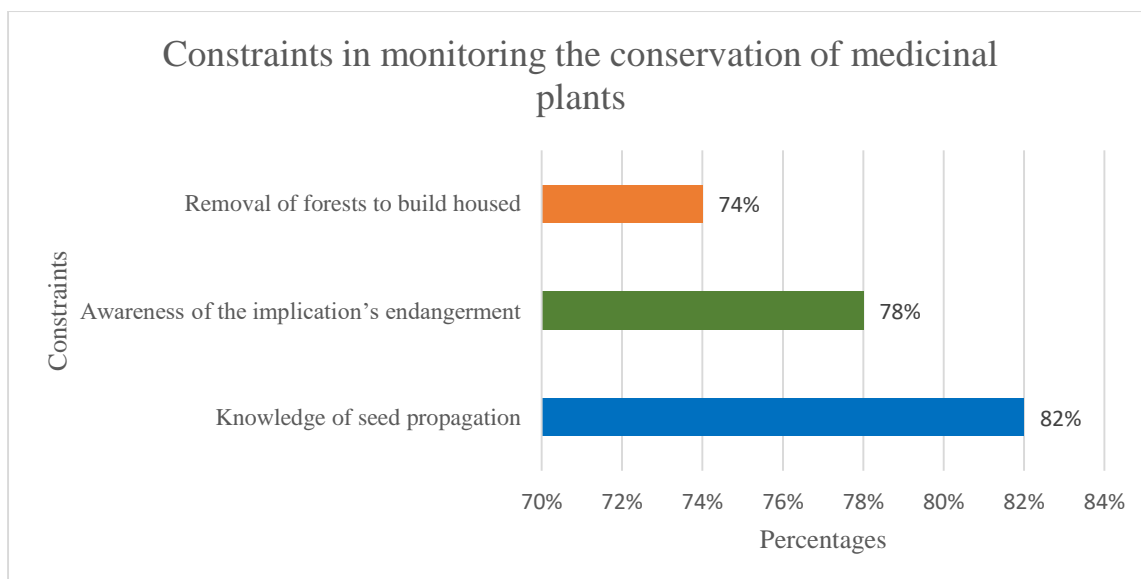
The sales of “Muthi” to local markets is one of the benefits of local access to indigenous medicinal plants. About 53 % of the smallholder farmers of the Amatole District Municipality

of the Eastern Cape confirmed that they were involved in the trading of medicinal plants. This could be attributed from reasons such as, medicinal plants are having a booming market are sellable from the street corners and do not need a large capital to start. Therefore, smallholder farmers use medicinal plants as an avenue to draw financial benefit in order to feed their households sustainably. The results are in line to those of Shah et al., (2019) who found that, the trade of medicinal plants is an additional livelihood option for the poor and smallholder farmers and it contributes greatly to their food and nutritional security.

To use medicinal plants as a traditional healer when consulted by patients was found to be one of the benefits of having medicinal plants in our communities. About 42% of the traditional healers that were interviewed confirmed that there are additional financial benefits exploited from the consultations of people. This could be attributed to the claims that traditional healers can navigate to one's life spiritually and diagnose a person's illness before fiddling trial and error. Therefore, these claims draw more people to consult for these diagnoses that are drawn from sacred medicinal plant sources that they were not comfortable to share. The study is in line with those of Ambu et al., (2020) who found that the incentives made by traditional doctors in healing people is highly profitable and is capable of sustaining people's a household for as long as the traditional healer lives.

### **6.3.3 Constraints faced by smallholder farmers in the use of medicinal plants**

The availability of medicinal plants at the convenience of rural smallholder farmers has proven to be beneficial to rural smallholder farmers in multiple ways. However, the smallholder farmers appear not be doing a good job in conserving these medicinal plants so that they can sustain it for future generations to come. This section was considered to understand the constraints preventing the adoption of a sustainable conservation framework by smallholder farmers of indigenous medicinal plants. Figure: 6.3 below illustrates the constraints that smallholder farmers face in conserving medicinal plants as per the study was informed.



**Figure 6.3:** Constraints in monitoring conservation of medicinal plants

**Source:** Field Survey (2023)

According to the study results, knowledge in seed propagation is a primary constraint that limits the smallholder farmers in the conservation of medicinal plants. This could be attributed by the findings that most farmers of the ADM have spent 10 years in school. Seed propagation can be a complex subject for people who had limited education of the skill to propagate seeds. Moreover, medicinal plants are wild species that are not often around people's households in order to consistently make plans to conserve them. The unawareness of the implication of endangerment is also a knowledge factor that limits smallholder farmers from facilitating biodiversity conservation measures. About 78% of people attested to not being aware of what would happen if they were to lose medicinal plants or have never given thought to it. This can be attributed by lack of education or negligence, and it may leave a lot of smallholder medicinal plant farmers in dire poverty, food and nutritional insecurity. The study is in line with that of Ssenku et al., (2022) who found that knowledge and education are primary contributing factors limiting smallholder farmer to pulling through sustainable conservational approaches.

About 74% of the rural smallholder medicinal plant farmers confirmed that the removal of forest with the motive of building houses limit their contribution in the biodiversity conservation of indigenous medicinal plants. The conversion of forests, production field and rangeland camps into residential areas is common in rural areas and challenging every discipline of agriculture. The consequences can be greater on food and nutritional security in the case where the land is so small that it is insufficient to produce enough food and medicinal plants to fulfil a sustainable livelihood. The results of this study are consistent to those of Umar

et al., (2020) who stated that deforestation has a negative impact on the species diversity of medicinal plants even if the intention was to provide people with shelter. Therefore, it has a negative effect in the livelihood enhancement of rural people via agriculture.

### 6.3.4 Examination of used conservation strategies on rural medicinal plants

The examination of conservation strategies by smallholder farmers in the production of medicinal plants was measured to investigate the knowledge of smallholder farmers of the strategies to conserve natural resources. A sample of 150 farmers was investigated. Table 6.2 illustrates the percentage scores of their responses.

**Table 6.2: Examination of medicinal plants on smallholder medicinal farmer**

Conservation strategies		Frequency	Mean
			$\left( \frac{n}{150} \right)$
<i>In- Situ</i> Conservation	Protect areas	62	0.41
	On farm conservation	39	0.26
<i>Ex- Situ</i> Conservation	Botanical Gardens	0	0
	Gene Banks	0	0
Production process	Good Agricultural Practises (GAP)	6	0.04

**Source:** Field Survey (2023)

According to table 6.2, most practiced conservation strategies are *In- Situ* conservation. Under *In- Situ* conservation we have protected areas, which are protected areas and on farm conservation. According to the field survey, 41% of the smallholder farmers practiced the protected area conservation strategy, while 26% practice on farm conservation strategy and the remaining 23% did not practice any form of conservation measure. This implies that protected area conservation strategy was the most conducive for smallholder medicinal plant farmers. Protected areas in the case of the Amatole District Municipality are achieved through the use of land marks, dongas, rivers, and boundaries to demarcate certain camps and restrict entry for conservational purposes. This is how rural people protected their forests from external intruders who wanted to benefit from medicinal plants that are not from their territories. This study

results are in line with those of Gülzau and Mau, (2021) who found that barriers, checkpoints and landmarks are effective tools of segregation. Moreover, very effective to rural setting in order to protect a certain village from harvesters of another village.

Approximately 26 % confirmed that they conserve medicinal plants on their farming land through micro- nurseries and transplanting to their farmland. Domestication is an attribute of indigenous knowledge that their forefathers were using in order to bring medicinal plants closer to service, when needed. These study results were in line with those of Ramawat and Arora, (2021) who found that, the domestication of medicinal plant impacts positively to the ecological security of biodiversity.

### **6.3.5 Implication for food security and Nutrition**

According to Figure 6.2, medicinal plants played a crucial role in the lives of smallholder medicinal plant farmers. They contributed imperatively to food security and nutrition, particularly through the household consumption of medicinal plants, livestock health, local sales and cash exchanges received from traditional healing services. The household consumption of medicinal plants included the advantage that smallholder medicinal plant farmers embrace of having access to medicinal plants in close proximities, saving them all the costs of acquiring them from a distance. The value of the money that is saved can be used by the farmers to ensure food availability for their households. These findings are in line with Chowdhury et al., (2020) who found that own production of medicinal plants boosts food security by saving significantly on the costs imposed when having to purchase from other producers. Livestock health has a dual benefit for medicinal plant producers. Livestock was the pride of these smallholder medicinal plant producers as they were their form of banking and food. The maintenance of livestock health increased market value, which enabled them to fetch a higher income upon sale and therefore have plenty to bring back home. The study results were consistent with Mapiye et al., (2020) who found that livestock contributes significantly to food availability and access through incorporation into daily diets and its sales can provide income to households of smallholder medicinal plant farmers to enhance livelihood.

However, Table 6.2 displayed alarming results that smallholder medicinal plant farmers did not have sustainable conservation strategies in place as there were only 41% of farmers growing medicinal plants on protected areas, 26% on farms and 0.04% who were compliant with Good Agricultural Practises (GAP). These results could be attributed to a lack of

knowledge of seed propagation, lack of awareness of implications and removal of forests to build houses as per the results in Figure 6.3. The prior mentioned is highly detrimental to food security and nutrition of smallholder medicinal farmers as they have adverse effects on income flow and destabilize future access to medicinal plants. Conservation ensures the access and availability of medicinal plants for generations, if not maintained may lead to the extinction of lucrative medicinal plant species that smallholder farmers maintain livelihoods from. Therefore, without proper mitigation measures, many households would be exposed to starvation. This was echoed by Chen et al., (2016); Astutik et al., (2019); and Nwafor et al., (2021) who found that conservation is the cornerstone of safeguarding species diversity to maintain sustainable income streams for smallholder medicinal plant farmers.

#### **6.4 Conclusion**

The incorporation of indigenous knowledge in the conservation of indigenous medicinal plants is an integral part of biodiversity protection in rural areas. This can be achieved through the employment of various conservation strategies. These strategies are difficult to apply in rural settings in a scientific way but community elder are in possession of ancient methods that they applied in order to safeguard their species from extinction. These conservation strategies are very important because they ensure that the livelihood of medicinal plant farmers is improved and food and nutritional security is maintained through the maintenance of the plants that they sell to get cash incentives. However, the study found that rural farmers are not very good conservers of natural resources. There are some strategies that they used to conserve such as protected areas and on farm conservation, but it is fairly a small amount of smallholder farmers that have adopted. Therefore, the study recommends the interventions of government and extension advisory to raise awareness campaigns and offer technical advice on the conservation strategies. The lack of information calls for intensification in rural development of smallholder farmers through information transfers. However, if these were to be managed thoroughly they could ensure food and nutrition security for a lifetime.

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## CHAPTER SEVEN

### SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

#### 7.1 Introduction

This section of the study summarised all the chapters of the document, along with the conclusions. This chapter also suggested the appropriate policy solutions that may enhance the conservation and sustainable use of indigenous medicinal plants in the Amatole District Municipality. The summary, results and policy recommendation are all provided in this chapter.

#### 7.2 Summary

Chapter 1 focused on providing the background and problem statement of the study. The medicinal plants industry offers substantial commercial opportunities for smallholder farmers, particularly in impoverished rural areas like the Eastern Cape. These plants provide accessible healthcare when factory-made medicine is unaffordable. They have been a primary source of medicine for rural farmers for generations, benefiting both humans and livestock. Cultivating these plants can save farmers money and improve their livelihoods. However, farmers face challenges in utilizing these plants effectively. To address this, a study examined challenges faced by farmers, the profitability of medicinal plants, their effects on household welfare, and conservation strategies. This study is crucial as there is limited research on conserving and sustainably using medicinal plants by smallholder farmers.

The literature review reveals that medicinal plants have long been integral to smallholder farming practices worldwide, with documented use in countries like China, Iran, Greece, and across Africa. These plants are crucial for providing affordable healthcare to humans and livestock. In Africa, they are known by various names, such as muthi and amayeza, and play a significant role in rural communities' healthcare and livestock management. Integrating medicinal plants into trade can benefit smallholder farmers by combining indigenous knowledge with economic development and sustainable cultivation techniques. Smallholder farmers often rely on growing and selling these plants for financial stability. Conservation strategies are essential to ensure the sustainability of medicinal plants, as traditional methods alone may not be sufficient. Efforts like discouraging deforestation and promoting tree planting

are important, but biotechnological approaches may also be necessary to mitigate ecological losses.

Chapter 3 addresses the challenges faced by smallholder farmers in the Amatole District Municipality (ADM) regarding medicinal plant cultivation. The study surveyed 150 farmers using structured questionnaires to gather primary data. Results indicated that the average active farmer is a 44-year-old female with 10 years of education, highlighting gender imbalance and low educational levels. The survey identified various medicinal plants in the ADM that cater to both humans and livestock. One major challenge is the frequency of extension visits, which is deemed insufficient for effective knowledge transfer. Recommendations include empowering youth and males to address gender imbalances, enhancing educational opportunities, and enforcing biodiversity regulations to protect plant populations. These measures are crucial for raising incomes, mitigating challenges, and building sustainable livelihoods for smallholder farmers.

Chapter 4 examines the profitability and determinants of high-value medicinal plants. The analysis found that cultivating these plants is profitable, with an average net farm income of ZAR 19,091.72 per growing period. Factors such as age, household size, extension visits, farming size, and farming experience were identified as influencing profitability through multiple regression analysis. The study recommends that the Department of Agriculture strengthen the role of extension officers to improve knowledge transfer about medicinal plants. It also suggests providing financial support from government and NGOs to help smallholder farmers acquire more inputs, believing that increased investment in production inputs could lead to higher profits for farmers.

Chapter 5 examines the effects of cultivating medicinal plants on the household welfare of farmers. The study found that cultivating these plants positively impacts the welfare status of smallholder farmers, leading to increased farm revenues. It recommends that policymakers and government bodies, such as the National Department of Agriculture, Land Reform, and Agrarian, invest in supporting start-up medicinal plant projects to improve the livelihoods of smallholder farmers. The study also suggests that civil extension agents should focus on educational campaigns to train farmers in inputs, marketing strategies, and technological advancements to increase output and farm revenue. Additionally, there is a significant role for the private sector to fill in improving the farming businesses of smallholder medicinal plant farmers.

Chapter 6 explores conservation strategies to sustain the use of indigenous medicinal plants. Incorporating indigenous knowledge is crucial for biodiversity protection in rural areas. Conservation strategies, though challenging to apply scientifically in rural settings, can be learned from community elders who have preserved species using ancient methods. These strategies are vital for improving the livelihoods of medicinal plant farmers and maintaining food and nutritional security. However, the study found that rural farmers are not effective conservers of natural resources, with only a small percentage adopting conservation methods such as protected areas and on-farm conservation. The study recommends government and extension advisory interventions to promote conservation. Improving rural development and information transfer can enhance conservation efforts, ensuring food and nutritional security in the long term.

### **7.3 Conclusion**

The study concludes that medicinal plants are a viable income option for smallholder rural medicinal plant farmers. Though smallholder farmers of the ADM face numerous challenges such as lack of capital, knowledge barriers and lack of agricultural inputs, the medicinal plant enterprise seems to be thriving regardless due to the fact that most of the plant material is accessible from the wild without any tariffs nor cost of production required. The extraction of medicinal plants is highly profitable to rural smallholder farmers and contributes greatly to the livelihood enhancement through food and nutritional security. Smallholder farmers were however challenged in the conservation of indigenous medicinal plants which in turn threatens future sustainability of the resource.

### **7.4 Policy Recommendation**

- Regulatory policies around market information of medicinal plants need to be reworked. There is limited measurement of economic indicators. No one knows the actual contribution of smallholder rural medicinal plant farmers to GDP, to employment and the degree to which it has changed their lives.
- The bio-diversity conservation framework needs to be reworked and enforced to maintain law. The over-harvesting of medicinal plants needs to be monitored and regulated such that the natural resources can be sustained for generations.
- The government needs to readjust their Small Medium and Micro Enterprise funding criteria to accommodate emerging medicinal plant farmers as well. This can assist imperatively in the initiation of new entry businesses.

## **7.5 Future research**

The study focused on the Amatole District Municipality. Future studies can investigate the perceptions of smallholder farmers, market participation, profitability, conservation strategies in the whole of the Eastern Cape. Comparative studies of different regions and districts can also be conducted to assess the conservation and sustainable use of indigenous medicinal plants.

## APPENDICE A: QUESTIONNAIRE



**University of Kwa-Zulu Natal**

**School of Agricultural, Earth and Environmental Sciences**

**Discipline of Agriculture Economics**

**TOPIC: Economic analysis of conservation and sustainable use of indigenous medicinal plants by smallholder farmers in the Amathole District Municipality of Eastern Cape Province**

Dear participant

I am Zusiphe Mbelebele a master's student in Agricultural Economics student at the University of Kwa-Zulu Natal. I am conducting a study on **Conservation and sustainable use of indigenous medicinal plants by smallholder farmers**, to identify and profile different challenges faced by different indigenous medicinal plant farmers, establish the profitability and determinants of high-value medicinal plants in farmers, assess farmers' effects of producing medicinal plants on the household welfare of farmers and examine the conservation strategies that can be used to sustain the use of indigenous medicinal plants. By participating in the questionnaire, you will help me better understand the conservation and sustainable use of indigenous medicinal plants. This study will be conducted within the ranks of Amathole District Municipality and the information provided here will be treated as **STRICTLY CONFIDENTIAL**. Data gathered by this tool will be used solely for the purpose of this intended investigation and no other agenda. Personal details and socio- economic details of respondents will be kept confidential and no mention of people's identities will be made in the final report.

**Draft Questionnaire**

Questionnaire No.

Village.

Local municipality.

Please answer in the appropriate box

**Section A: Demographics**

<b>Gender</b>	<b>Age</b>	<b>Education</b>	<b>Marital status</b>	<b>Household size</b>	<b>Employment</b>	<b>Occupation</b>	<b>Level of income</b>	<b>Race</b>
0- Female 1- Male	(Actual years)	(Actual years spent in school)	0- Single 1- Married 2- Other	(Actual number)	0- Yes 1- No	0- Student 1- Formal employment 2- Self-employment 3- Unemployed	(Actual money)	0- African 1- Colored 2- Indian 3- White 4- Other

<b>Are there any medicinal plants existing in your community?</b>  1- Yes  2- No	<b>How do they grow?</b>  1- In the wild  2- Domestically  3- Both?	<b>How do you know about medicinal plants?</b>  1- Informal education  2- Formal education  3- Traditional practitioners	<b>Does your farm have any of the medicinal plants you know?</b>  1- Yes  2- No	<b>Farm size?</b>  <b>(Actual size in hectares)</b>	<b>Tenure security</b>  1- Own land  2- Leased land  3- Communal land	<b>What assets do you on?</b>  1. Land  2. Tractors and implements  3. Human resource  4. Financial resource  5. None

**Section B: To identify and profile different challenges faced by different indigenous medicinal plant farmers.**

Are you a medicinal plant farmer?  (Participation)  Yes  No	What do you farm?  (List )	List common medicinal plants used on daily bases		Experience  (actual years)	Extension visits per year  (Actual number)	Do you receive government funding?  0- Yes  1- No	Do you receive skills development trainings?  0- Yes  1- No	Where do you sell it?  0- Formal markets  1- Informal markets  2- Other	As a medicinal plant farmer, do you see change in your livelihood?  0- Yes  1- No
		List	Uses						
	1.	1.							
	2.	2.							
	3.	3.							
	4.	4.							
	5.	5							

Please range the challenges faced by smallholder farmers according to your experience	None	Slight	Neutral	Mild	Severe
Lack of capital					
Lack of machinery (Tractors & Implements)					
Knowledge barriers					
Absenteeism of the key farmer					
Limited Institutional support					
Cultural differences					
Other: 1. 2. 3.					

**Section C: To establish the profitability and determinants of high-value medicinal plants in farmers.**

<p><b>Are you a High- Value medicinal plant extractor?</b>  (Participation)</p> <p>Yes</p> <p>No</p>	<p><b>Experience</b>  (Actual Years)</p>	<p><b>Would you prefer them than ordinary plant species?</b></p> <p>Yes</p> <p>No</p>	<p><b>What is the peak market season for you?</b></p> <p>0 -summer</p> <p>Autumn</p> <p>Winter</p> <p>Spring</p>	<p><b>How often do you receive funding from government structure?</b>  (Actual Number)</p>

Please provide details for the table below:

<b>High-Value medicinal plants</b>	<b>What are they used for?</b>	<b>Gross Value of Production (R/Year)</b>	<b>Total Variable cost (R/Year)</b>	<b>Total Fixed Cost (R/Year)</b>	<b>Net Farm Income (R/Year)</b>
1.					
2.					
3.					
4.					
5.					

**Section D: To assess farmers' effects of producing medicinal plants on the household welfare of farmers.**

<p><b>Does the production of medicinal plants contribute to your health?</b></p> <p>Yes</p> <p>No</p>	<p><b>Do you think they have the power to cure certain disease?</b></p> <p>Yes</p> <p>No</p>	<p><b>Do you participate in producing medicinal plants?</b></p> <p>Yes</p> <p>No</p>	<p><b>In the event of profit, how would you state the outcome of your livelihood?</b></p> <p>Positive</p> <p>Negative</p>	<p><b>In the event of Loss, how would you state the outcome of your livelihood?</b></p> <p>Positive</p> <p>Negative</p>	<p><b>Are there any nutritional Benefits that you, see?</b></p> <p>0= Yes</p> <p>1= No</p>	<p><b>Do you think the production of medicinal plants extensively can safeguard species population?</b></p> <p>0= Yes</p> <p>1= No</p>	<p><b>Do earnings recovered from the production and commercialization of medicinal plant contribute provide reasonably incentives towards a daily living?</b></p> <p>0= Yes</p> <p>1= No</p>

Please range the possible effects of producing medicinal plants according to your experience

	<b>None</b>	<b>Slight</b>	<b>Neutral</b>	<b>Mild</b>	<b>Severe</b>
Protection of Natural resource					
Medicine invention					
Livelihood enhancement/ Poverty alleviation					
Income generation opportunities					
International market potential					

Are you aware of quality standards of producing medicinal plants?

No                      Yes                      If yes state here:

Do they not provide barriers to trade in the market?

No                      Yes

Is there a willingness to take skills development in the production of medicinal plants (Formal education)?

No                      Yes

**SECTION E: To examine the conservation strategies that can be used to sustain the use of indigenous medicinal plants.**

Are you a traditional healer or a farmer?	What do you use medicinal plants for?	How many times do you harvest a week?	Are there any signs of decreased population in the species?	Do you ever extract material for planting?	Do conservation officials? Yes No
Traditional healer	Healing		Yes	Yes	Yes
Farmer	Selling Planting		No	No	No
		ANS:			

Please range the possible conservation strategies that you have used according to your experience as a smallholder farmer

<b>Conservation strategies</b>		<b>None</b>	<b>Slight</b>	<b>Neutral</b>	<b>Mild</b>	<b>Severe</b>
<b>In-Situ Conservation</b>	1. Protected areas					
	2. On farm conservation					
<b>Ex-Situ Conservation</b>	3. Botanical Gardens					
	4. Gene Banks					
<b>Production Process</b>	5. Good Agricultural Practices (GAP)					

**Thank you**

## APPENDICE B: ETHICAL CLEARANCE



02 May 2023

Zusiphe Mbelebele (222129074)  
School Of Agri Earth & Env Sc  
Pietermaritzburg Campus

Dear Z Mbelebele,

**Protocol reference number:** HSSREC/00005086/2022

**Project title:** Economic analysis of conservation and sustainable use of indigenous medicinal plants by smallholder farmers

**Degree:** Masters

### Approval Notification – Expedited Application

This letter serves to notify you that your application received on 24 November 2022 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

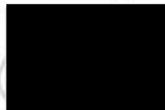
**Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.**

This approval is valid until 02 May 2024.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040).

Yours sincerely,



Professor Dipane Hlalele (Chair)

/dd

### Humanities and Social Sciences Research Ethics Committee

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Founding Campuses:  Edgewood  Howard College  Medical School  Pietermaritzburg  Westville

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