Constraints to Cultivation of Medicinal Plants by Smallholder Farmers in South Africa

Ifeoma Nwafor 1,*, Christopher Nwafor 2 and Idah Manduna 1

1 Centre for Applied Food Sustainability and Biotechnology, Central University of Technology, Private Bag X20539, Bloemfontein 9300, South Africa; inwafor@cut.ac.za
2 Department of Agriculture, Central University of Technology, Private Bag X20539, Bloemfontein 9300, South Africa; manchrizzo@hotmail.com

* Correspondence: inwafor@cut.ac.za

Abstract: Growing demand for therapeutic products from indigenous medicinal plants has led to increased interest in its cultivation, which presents a viable option for improving smallholder farmers’ livelihoods, as well as sustaining the availability of these resources for future generations. Serious bottlenecks however exist for subsistent farmers in the cultivation of these valuable plants. It was pertinent to probe whether the cultivation of medicinal plants provides feasible solutions to rural poverty, while effectively conserving threatened indigenous biodiversity. The paper employed a comprehensive review of existing literature to explore issues constraining smallholder farmers from involvement in a potentially lucrative plant value chain. Findings indicate challenges such as inadequate domestication of valuable plants species, continued over-harvesting from wild populations, poor knowledge of required agronomic practices, low efficacy perception regarding derivatives from cultivated plants, among others. These constraints occur alongside the conservation-oriented strategy driven by international conservation agencies and wholly adopted by the South African government. Recommendations to improve smallholder involvement in the cultivation of medicinal plants include support to research and extension, targeted inducement to smallholders, contracting and off-take agreements, aimed at promoting an alternative poverty-alleviation-focused economic development strategy. The review adds to the conceptual discourse related to plant diversity, resource conservation, poverty alleviation, and economic development.

Keywords: conservation; cultivation; biodiversity; medicinal plants; smallholder farmer; strategy

1. Introduction

Medicinal plants remain relevant to human development and welfare, with traditional values among many indigenous communities [1–6]. In contemporary South Africa, medicinal plants have become the subject of extensive discourse among conservationists, policymakers, economists, and development actors due to their contribution to healthcare and potential as a vehicle for economic development and poverty alleviation. Medicinal plants contain substances useful for traditional healing purposes, or which are commercially blended for pharmaceutical purposes. Through secondary metabolism, medicinal plants produce a diverse array of biologically active compounds [7], credited with several pharmacological properties. As reported by Egamberdieva et al. [8], a vast number of medicinal plants have been studied regarding their phytochemical constituents including those commonly used in the treatment or prevention of specific ailments and diseases, and generally considered to play a beneficial role in healthcare. Their application in the treatment of humans and livestock for various ailments and diseases has been well documented, as local plants used for medicinal purposes possess biological and sociocultural legacies [9,10].

The cultivation, harvesting, processing, utilization, and marketing of medicinal plants make valuable contributions to the economic well-being of communities [11–13], while also
developing new value-chains and traditional healthcare knowledge systems. Medicinal and aromatic plants are also categorized as essential constituents of non-timber forest products, which are used in traditional healthcare interventions while supporting the livelihoods of many across the globe. Estimates indicate that approximately 80% of the global population depends on traditional medicines with a projected market value in excess of USD 72 billion [14,15].

Agri-Book Digital [16] averred that medicinal plant farms are considered as front-runners for the future provision of scarce and commercially valuable plant species with medicinal value in southern Africa. There is however insignificant cultivation of medicinal plants in South Africa [17,18], with only a few plants minimally cultivated such as *Moringa oleifera* and *Aloe ferox*. Considering the market potential and the shortfall from natural or wild sources, many international organizations including the World Health Organization, International Union for the Conservation of Nature, and World Wide Fund have argued that commercial cultivation provides a good alternative source and enduring livelihoods for local communities, including protection of the natural resource base [19]. Related closely to this, Ndou and others [20] explored the implications of a functional medicinal plant value-chain in South Africa, specifically linked to the viability and sustainability of smallholder farmers’ involvement. They outlined the entry constraints for smallholder farmers into the lucrative niche while advocating for the provision of necessary support to enable participation in the cultivation and processing of medicinal plants by rural producers. Cultivation of medicinal plants is considered a feasible diversification enterprise for many small-scale farmers as demand is high, trade opportunities are increasing and the income-generating potential is good [21].

However, very few studies have explored the challenges of medicinal plants cultivation and commercialization among smallholder producers. There are myriad risks and challenges inherent in the domestication of medicinal plants, which Volenzo and Odiyo [22] claimed to require additional comprehension. Astutik et al. [23] alluded to this as an amplification of the need for empirical investigation of medicinal plant production systems. This review, therefore, aimed to highlight the constraints related to the cultivation of valuable medicinal plants among rural smallholder producers in South Africa. The current paper differs from available studies on the cultivation of medicinal plants, by plugging existing gaps related to the involvement of small-scale farmers, which is deemed relevant for policymakers, agricultural development practitioners, and smallholder farmers interested in the cultivation of medicinal plants either as a rural livelihoods approach, a targeted strategy for poverty alleviation, and/or for increasing income generation opportunities.

2. Method

Extensive literature searches using web-based databases like Google Scholar, EBSCO-Host, and Web of Science were conducted between November 2020 and May 2021. Search words like ‘medicinal plants’, ‘cultivation of medicinal plants’, ‘medicinal plants in South Africa’ and ‘cultivation of medicinal plants in South Africa’ were used either singly or in combination with other words to obtain information about the subject matter. These searches yielded a total of 252 peer-reviewed articles, book chapters, academic reports, government gazettes, and web articles but after critical synthesis, only 103 relevant publications between 2000 and 2021 were used in the study.

The 103 publications consisted of the following categories; full research papers in journals (59), review articles in journals (17), book chapters and government gazettes or websites (19), position papers or presentations (7), and communications (1).

From the literature search, commonly recurring words which are related to constraints to the cultivation of medicinal plants among smallholder farmers were identified and selected. These words were compiled using a word count to indicate their frequency of occurrence, in order to identify which ones would be considered as significant among the sources consulted. We utilized the word count to create a “cloud” for providing visual identification of major constraints mentioned by authors from the literature.
Additional insights were also provided on practices in other countries that are related to the cultivation of medicinal plants.

3. Findings of the Review

We outline the findings made from the literature consulted below.

3.1. Key Constraints Identified

Many factors were identified in the literature as constraints experienced by smallholders in the cultivation of medicinal plants. The following words were found to be more frequently mentioned; propagation, planting materials, extension support, markets, information, diseases, pests, support, agronomic, costs, and returns. Other frequently mentioned words shown in Figure 1 include capital, funding, sustainability, environment and subsidies, economic, grants, and policies.

![Figure 1. Word cloud showing the various constraints identified by authors from the literature search.](image)

Based on the numerous words found which relate to constraints in the literature, it is obvious that smallholder farmers face considerable difficulties in the cultivation of medicinal plants in South Africa. These diverse issues range from agronomic considerations, economic concerns, government policies, extension support, environmental factors, to cultural acceptance and efficacy perception among the users of medicinal plants. The major issues, however, relate to propagation or availability of planting materials, costs involved, suitability and adaptability of the cultivars, as well as support from extension services.

3.2. Usefulness of Medicinal Plants in South Africa

In South Africa, medicinal plant-based formulations locally called ‘muthi’ in the isiZulu language and ‘amayeza’ in isiXhosa language is widely used in the healthcare system, particularly by the indigenous African population as shown in Table 1. In many rural communities where primary healthcare systems and livestock veterinary services are not easily accessible, indigenous medicinal plants are relied on for the treatment of diseases. Opara and Osayi [24] posited that in the face of systemic challenges, herbal
medicine presents a viable alternative in largely pluralizing health systems. Furthermore, medicinal plants are the backbone of an array of ethnoveterinary and traditional medical systems all over the world [25,26], as they are locally accessible, culturally appropriate, and economically affordable healthcare options [27].

Table 1. Some commonly used medicinal plants in South Africa.

| Species                          | Family         | Common Name | Uses                                                                 | Reference |
|----------------------------------|----------------|-------------|----------------------------------------------------------------------|-----------|
| *Agathosma betulina* (Berg.) Pillans | Rutaceae      | Buchu       | Antispasmodic, antipyretic, cough remedy, diuretic and to treat urinary tract infections. | [28]      |
| *Agathosma crenulate* (L.) Pillans | Rutaceae      | Buchu       | Anti-spasmodic, antipyretic, diuretic anti-microbial, anti-inflammatory anti-oxidant, and analgesic effects. | [29,30]   |
| *Aspalathus linearis* (Burm.f.) Dahlg. | Fabaceae     | Rooibos     | Anti-spasmodic, anti-oxidant, anti-aging, and anti-eczema activities (tea). | [31,32]   |
| *Sclerocarya birrea* (A.Rich.) Hochst. | Anacardiaceae | Morula or Marula | Infertility in females, dysentery, diarrhea, rheumatism, malaria and proctitis, ear nose, and throat conditions. | [33,34] |
| *Catharanthus roseus* (L.) G. Don. | Apocynaceae   | Periwinkle  | Urogenital infections, stomach ache, diabetes mellitus, unsuspected venereal diseases, and rheumatism. | [34]      |
| *Aloe ferox* (Mill.)             | Xanthorrhoeaceae | Bitter aloe or Cape aloe | Laxative, cuts and burns, emetics, arthritis, stomach pains, and hypertension. | [31,35]   |
| *Moringa oleifera* Lam.          | Moringaceae    | Moringa     | Anti-oxidant, anti-inflammatory, and anti-diabetic properties are used to treat mainly diabetes, high blood pressure, and rheumatism. | [17,32,36,37] |
| *Cyclopia genistoides* (L.) Vent. | Fabaceae      | Honeybush   | Anti-cancer, anti-diabetic use, alleviates menopausal symptoms, stomach tonic, expectorant, decongestant. | [31,38,39] |
| *Harpagophytum procumbens* (Burch.) DC. | Pedaliaceae | Devils claw | Treats rheumatism, arthritis, diabetes, gastrointestinal disturbances, menstrual difficulties, neuralgia, headache, heartburn, and gout. | [31,38–40] |
| *Pelargonium sidoides* DC.       | Geraniaceae    | Umckaloabo  | Disorders of the respiratory tract, gastrointestinal tract infections, diarrhea and dysentery, HIV complications. | [31,38–43] |
| *Pelargonium reniforme* Curt.    | Geraniaceae    | Kidney-leaved pelargonium, Rooirabas, | Stomach ailments, bronchitis, dysentery, bloody stool. | [17,41,42] |
| *Siphonoculus aethiopicus* (Schweinf) B.L. Burt | Zingiberaceae | African ginger | Immune-modulating properties, coughs, colds, asthma, headache, candida, malaria, pain, and influenza. | [17,43–45] |
| *Sutherlandia frutescens* (L.) R.Br. | Fabaceae      | Cancer bush | Stomach ailments, backache, diabetes, stress, fever, and wounds, HIV management. | [17,46]   |
| *Artemisia afra* Jacq. ex Willd. | Asteraceae     | African wormwood | Anthelmintic, anti-inflammatory. | [32,47,48] |
| *Hypoxis hemerocallidea* Fisch., C.A.Mey. & Ave-Lall. | Hypoxidaceae | African potato | Common cold, flu, hypertension, adult-onset diabetes, psoriasis, urinary infections, testicular tumors, prostate hypertrophy. | [17,32,49] |
| *Helichrysum odoratissimum* (L.) Sweet. | Asteraceae | Everlasting (impepho) | 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. | [50–53] |
| *Hoodia gordoni* (Masson) Sweet ex Decne. | Apocynaceae | Milkweed, Bushman’s hat, Kalahari cactus | Appetite-suppressant. | [54,55] |

3.3. Economic Importance of Medicinal Plants in South Africa

There is significant trade in the South African traditional medicine sector exceeding R2.9 billion annually [56]. The linkages between biocultural diversity and the abundance of plant species in South Africa provide an impetus for extant interventions to develop traditional medicines. Medicinal plants are vital in the modern complementary and alternative medicines sector and facilitate the discovery of novel drug contenders in the pharmaceutical sector [14]. Medicinal plants also play a central role not only as traditional medicines but as trade commodities, and the contribution to livelihoods these goods make
to a large number of rural communities has been noted [57]. With increasing population growth, urbanization, and strong cultural values regarding traditional medicines, the trade-in medicinal plants have surged considerably [17,58]. This has resulted in the over-harvesting of certain important species found in the wild, to the point of certain extinction. For instance, medicinal plants such as *Siphonochilus aethiopicus* (Zingiberaceae) commonly called ‘wild ginger’ is widely considered as an endangered species on the Red Data List, with a variety of uses for which the Botanical Society of South Africa has actively encouraged farmers to cultivate [59]. Significantly, the tubers of *Pelargonium sidoides* and *Pelargonium reniforme* are considered important medicinal species, a rich source of vital ingredients with useful properties, which have been harvested from wild populations for the export market [41,43]. With virtually negligible field cultivation, the pressure on existing naturally occurring populations and resulting depletion presents a looming threat to biodiversity [43].

Both empirical and anecdotal evidence indicates the entrance of medicinal plant products into the informal and formal entrepreneurial sectors of the South African economy which is referred to as a large and growing industry [59,60]. This has led to an increase in the numbers of wild plant harvesters, backyard medicinal plant gardens, and smallholdings of selected medicinal plants, cottage processors, and traders. An entire value chain for medicinal plants has developed to meet the needs of millions of traditional-remedy consumers in southern Africa [61]. Evidently, the demand for medicinal and aromatic plants has grown rapidly because of accelerated local, national, and international interests. The Department of Agriculture, Forestry, and Fisheries [17] estimated that this interest resulted in the export of approximately 6497 tons of medicinal plants in 2015. This acceleration in demand according to Noorhosseini et al. [62] is attributed to a global trend in the increased acceptance of herbal products especially in developed countries, and the involvement of western pharmaceutical industries. The demand is expected to grow significantly in the future fueled by the growth in sales of herbal supplements and remedies.

3.4. Related Studies on Cultivation of Medicinal Plants in South Africa

Scholars and researchers have earlier highlighted the importance of cultivating medicinal plants in South Africa [58,63,64]. This was considered both a conservation strategy and poverty reduction plan, inherited from rural development thinking. The conservation-through-cultivation approach espoused by McGaw et al. [65] is a predominant framework, guiding current policies and strategies related to medicinal plants. Recent studies on the cultivation of medicinal plants have also primarily adopted the conservation approach, either to highlight value chain interactions, sustainability, and quality assurance issues [20,60], identified abiotic conditions or reviewed strategies for cultivation [58,66], compared benefits from wild and cultivated medicinal plants [67], or documented local knowledge and practices among segments of the population [68,69]. Specific studies related to constraints facing smallholder farmers in cultivating medicinal plants in South Africa are scant. Keirungi and Fabricius [64] earlier averred that the main barriers to commercial cultivation are the availability of suitable land, irrigation facilities, lack of start-up capital, inadequate access to markets, and unavailability of seeds or propagation materials. They also opined that the cultivation of medicinal plants could contribute to the economic empowerment of women in rural areas. However, Volenzo and Odiyo [22] reported the low benefits for growers of medicinal plants even in the face of increasing international trade and attributed this to existing non-tariff barriers such as health and safety requirements, and high transactional costs.

Ndou and others [20] investigated the medicinal plants’ value chain in South Africa and identified the various actors involved in the sector. Their study highlighted existing relationships among the different role players in the medicinal plants’ trade, characterized by processing and trade, with entry difficulties for smallholder producers. Tanga et al. [60] explored the cultivation of medicinal plants in South Africa with an emphasis on the quality assurance and sustainability of supply. They pointed out the scarcity of information on
this topic, which they blamed on attention being paid to food crops and food security issues. Their study mostly dwelt on issues of propagation, bio-diversity conservation, sustainability of supply, product quality, and commercialization. The study, however, identified pertinent issues including the accessibility of plant materials, disease susceptibility, labor cost, environmental and agronomic adaptation issues facing potential entrants in the cultivation of medicinal plants. Xego and others [58] examined methods suitable for growing medicinal plants, though they specifically concentrated on hydroponics as a cultivation strategy. While concluding on the positive income-generating potential, their review did little to highlight possible constraints to smallholder involvement in medicinal plant cultivation.

Semenya and Potgeiter [34] documented some of the medicinal plants and indigenous knowledge among the Bapedi tribe and observed that traditional healers cultivated scarce medicinal plants in backyard home gardens. Their study, however, focused on the identification of medicinal plants found in home gardens within their study area. Van Wijk and Prinsloo [67] explored the harvesting, sustainability, and cultivation of medicinal plants, outlining inherent advantages in cultivating these plants rather than wild harvesting of medicinal plants. They identified challenges to the cultivation of medicinal plants, requiring a shift from traditional harvesting to planned cultivation for formal markets. Maroyi [68] identified some of the wild and cultivated plant species useful for medicinal purposes in the Eastern Cape province, while primarily focusing on the diversity of use and local knowledge among study respondents. Tshabalala et al. [66] used analytical modeling to predict the spatial suitability distribution of Moringa oleifera cultivation and concentrated on soil and other conditions favorable for maximum growth of the plant. Considered generally, these studies are favorably aligned to the school of thought promoting cultivation as a pure conservation strategy.

4. Discussion

The exploration of available literature on the cultivation of medicinal plants in South Africa revealed pertinent issues and challenges relevant for decision-makers or smallholder farmers. Firstly, medicinal plants cultivation in South Africa has been promoted by policymakers mainly as a conservation strategy. Secondly, there is a multitude of agronomic and agro-ecological issues that present a considerable hindrance to cultivating medicinal plants, especially for smallholder farmers. Finally, a host of complex socio-economic and socio-cultural considerations need to be resolved before any progress can be attained involving South African smallholder farmers in the medicinal plants’ value chain. These issues are discussed below.

4.1. Cultivation of Medicinal Plants as a Conservation Strategy

The position taken by differing schools of thought regarding what might be considered a better conservation strategy represent significant hurdles. While a number of agencies are recommending that wild species be brought into cultivation systems, others have argued that sustainable harvesting presents a better approach for most wild-harvested species [69]. This discourse considers the contributions made to local economies by medicinal plants and their greater value to harvesters over the long term. The crux of this argument is whether the conservation of medicinal plants should ideally happen in nature or in the nursery, or even both [58,70]. Cultivation can have conservation impacts, positive or negative, either reducing the extent to which wild populations are harvested, or leading to environmental degradation and loss of genetic diversity as well as loss of incentives to conserve wild populations. The relationship between in situ and ex situ (in-domo) conservation of medicinal plant species is an interesting topic with significant implications, though it is beyond the scope of this review. Identifying the conservation benefits and costs of the different production systems will continue to guide policies.

Tanga and others [60], highlighted that the cultivation of medicinal plants falls primarily within the domain of biodiversity conservation while enhancing quality assurance
and increasing the availability of medicinal plants for commercialization. It, therefore, has both primary and secondary objectives. Among proponents of cultivation as a conservation strategy, propagation of medicinal plants also come with risks especially for traditional healthcare and cultural practices [69]. These risks include issues of acceptability and efficacy of the commercially propagated plant materials. For threatened medicinal plant species, commercial cultivation is seen as a conservation option, while for all other harvested species the priority conservation option is sustainable harvesting from wild populations. This represents the strongly held viewpoint among many conservationists.

The disagreement regarding the potential benefits between in situ preservation and in domo conservation strategies, do not take into account the absence of established cultivation practices for many indigenous medicinal plants, especially those facing threats of over-harvesting and extinction. This will therefore entail the introduction of these medicinal plant species into existing farming systems, such as home or backyard gardens, commercial nurseries, greenhouses, and smallholder specialty organic farms. A transformational agenda involving a rethink and reframe of strategy related to the cultivation of medicinal plants will introduce required fundamental changes. These changes need to pay greater attention to integrating social, economic, and environmental sustainability issues in the medicinal plants’ sector. This position reflects a growing synergy between effective biodiversity conservation and poverty reduction efforts [71].

4.2. Agronomic and Agro-Ecological Issues

For medicinal plants to be successfully cultivated by smallholder farmers, these plants need to be domesticated. This involves the modification of the plant’s morphological characteristics and genetic make-up, and possible adjustments to the physical environment in which the plant is grown, especially for greenhouse cultivation. The domestication of plants previously found in the wild involves their adaptation to a socially managed environment [59]. Proper crop cultivation techniques need to be developed by crop scientists, and the transfer of scientifically developed domestication technology and procedures to potential growers by agricultural extensionists. Over the years, traditional healers have propagated commonly used medicinal plants in their home plots, and these plants such as *Catharanthus roseus* have successfully become adapted to a domesticated environment [34].

Issues that are related to the yield and potency of domesticated medicinal plants have been raised by Chen et al. [2], which requires the application of biotechnical approaches such as tissue culture, micro-propagation, synthetic seed technologies, and molecular markers. These approaches aim to improve desirable characteristics of cultivated medicinal plants while reducing the possibilities of misidentification and adulteration of critically endangered species. Strategic funding and partnerships are hence required with regards to this and involves greater commitment from government agencies, international organizations, and regulators as well as the scientific community.

Cultivation provides a number of advantages over wild stocks for the production of plant-based medicines, outlined in van Wyk and Prinsloo [67]. These include reliable botanical identification, sustainable sourcing, pre-contract agreements on volume and price, quality control, standards according to regulations and preferences, product certification, and homogeneity. Xego et al. [58] also reported the potential of using an alternative cultivation strategy such as hydroponics in the cultivation of medicinal plants. They observed the many reports of hydroponics cultivation producing more shoots than conventional soil cultivation and relatively higher yields of bioactive fraction and total activity than from wild-harvested plants. Giurgui et al. [72] earlier posited that cultivation using hydroponics improved the concentration of bioactive properties in medicinal plants. Successful cultivation of medicinal plants depends on diverse biotic and abiotic factors which can modulate the composition of secondary metabolites and essential oils. Also, there seems to be a preference for organic or nature-based farming which is devoid of chemical fertilizers and pesticides [73].
However, some common issues facing producers of medicinal plants include abundance and accessibility of wild populations in certain areas, agro-environmental conditions that are different from those in areas with naturally occurring plant populations, labor availability and costs, investments in machinery, post-harvest processing, and profitability of production [74,75].

4.3. Socio-Economic Considerations

Some researchers have posited that for the cultivation of medicinal plants to be feasible economically and achieve scale, there is a need for the intensification of production within selected clusters of micro enterprise-based groups [76]. These plants have to be cultivated cheaply and in large quantities to generate profits for growers in the value chain. Contrarily, though the main rationale for cultivation is economic feasibility, the limitations posed by uncontrolled harvesting from the wild will continue to drive prices lower. Cultivation for profit will hence be restricted to those plant species already on the brink of extinction, and useful for high-value medicinal preparations. Several challenges to the large-scale cultivation of medicinal plants in South Africa are identified and they include a lack of institutional support for production and dissemination of the propagation materials for important species, the low prices paid to harvesters, and the long maturity periods for important medicinal plants [67]. Other limitations include the poor adaptation of plants in cultivated environments, their susceptibility to various pests and diseases, including high labor costs and low net returns [60].

A number of studies have advocated for initiatives in South Africa to develop propagation and sustainable production methodologies. These proposed initiatives will ensure continuous availability and sustainable use of medicinal plant materials. In the absence of these propagation initiatives, Crouch and Smith [77] envisaged limited progress and ineffective implementation of sustainable conservation strategies for various over-exploited medicinal species. Any effort to stimulate the commercial cultivation of medicinal plants, especially by smallholder farmers in rural communities cannot gain traction without the financial, resource, and human capital support from the national government, provincial administration, municipalities, and the private sector [67]. These key players and sectors have been slow in promoting the value chain, and this deferment makes it impractical and uneconomical for increased smallholder involvement. Many smallholder farmers have faced difficulties accessing market information, wastage of valuable plant materials, and subsequent abandonment of their projects.

The South African Department of Environment [78] and a report by the Small Enterprise Development Agency [79] confirmed the limitation of smallholder farmers in the medicinal plants’ value chain, with some subsistence cultivation of indigenous species by disadvantaged individuals. Most large-scale cultivation, especially of rooibos (Aspalathus linearis) and buchu (Agathosma betulina) have been undertaken by commercial farmers.

Van Wijk and Prinsloo [67] articulated the potential for large-scale monocultural plantations established for export markets by external investors, altering market forces to their advantage and restricting the social and economic development of small-scale farmers. The commercial cultivation of medicinal plants in South Africa, therefore, has the potential to widen the existing dichotomy between smallholders and commercial farmers identified by scholars [80]. This portends the exclusion of smallholder farmers from participation, a looming irrelevance of the strategy for livelihoods improvement and rural poverty alleviation.

Furthermore, the cultivation of medicinal plants has the potential to deny current wild harvesters and traders any further participation in this income-generating activity [20], hence there is a reported disinclination among wild harvesters and traders to encourage any sustainable cultivation of commonly used medicinal plants [67]. This situation reduces the availability of highly sought-after medicinal plants, with the scarcity of these plants having positive economic outcomes for traders and gatherers who benefit from resultant higher prices.
4.4. Socio-Cultural Considerations

Among some conservationists and social researchers, there is a reported concern about the acceptance of cultivated medicinal plants [58,81], as cultivated material is believed by some to lack spiritual power [82,83]. Although cultivated medicinal plant material is accepted as an alternative, certain South African conservative traditional health practitioners have expressed views suggesting that cultivated plants lack efficacy in healing. It is noteworthy to state that no specific African or South African ethnic group was reported to hold the above notion except for the submissions of Sanhokwe et al. [83] whose study was based amongst the majorly Xhosa-speaking ethnic group of the Eastern Cape province of South Africa. According to Fennel et al. [84], cultivated medicinal plants may not have the same healing properties as those harvested from wild populations. Furthermore, Prinsloo and Nogemane [85] adduced factors such as season, irrigation, and fertilization of material to possibly result in the altered medicinal activity of cultivated materials. Furthermore, Schippmann et al. [86] averred that bioactive compounds in fast-growing cultivated stock may be lower than in wild populations because wild populations may be older due to slow growth.

However, this contention has been shown to be unfounded by Giurgiu et al. [72] as the tissue-cultured method adopted in the propagation of *Pelargonium sidoides* produced materials of similar ‘coumarin’ profiles to those existing in wild populations [43]. Contrarily, specific research regarding this issue reported that cultivated medicinal plants possess superior concentrations of active molecules compared with those harvested from the wild [87,88]. Arguments regarding the preference of wild medicinal plants over cultivated ones, in terms of efficacy or possession of superior metabolites, were hence consigned to the realm of speculation and personal opinion devoid of scientific backing [89].

4.5. Other Hindrance to Smallholder Involvement

Lubbe and Verpoote [90] as well as Schippmann et al. [86] have reported that many plant species are not easy to cultivate or are slow-growing, while cultivation of medicinal plants at a commercial scale comes with other challenges such as pests and diseases [91]. Large investments are therefore required before production can start and during the cultivation process. However, Moeng and Potgieter [92] admitted that the most critical species in the *muthi* trade can be successfully cultivated if best-practice cultivation methods can be successfully pioneered on a large scale, which is a further obstacle to smallholder farmers. Misra [93] also expressed concerns regarding the tendency of cultivated medicinal plants to thrive in monocultures, and smallholders’ capacity to meet the required production volumes. Furthermore, there is a paucity of relevant knowledge among extension officers regarding commercially required types of medicinal plants, local sources of seeds or propagation materials, ideal soil requirements, and other agronomic information that are mostly unavailable to smallholder farmers in South Africa.

Legislative and policy bottlenecks exist as South Africa is reported as one of the African countries with an existing national policy on the conservation of medicinal plants. However, the implementation of environmental legislation is hindered by the shared responsibility between national and provincial governments. Strydom et al. [94] posited that this has resulted in a fragmented implementation of environmental laws, and failure to act against transgressors of the law. This loophole has been exploited by those harvesting critically endangered species as well as other medicinal plant species. Various international treaties such as the Convention for Biological Diversity and the Global Strategy for Plants Conservation, and the International Conservation of Nature, all emphasize sustainable harvesting from wild populations. The Food and Agriculture Organization and World Health Organization also recommend continued strengthening of legislation related to medicinal plants, while supporting the commercial cultivation of medicinal plants to benefit from the expanding global market of herbal medicines [18]. These policy frameworks actively promote the conservation strategy for medicinal plants.
4.6. Status of Medicinal Plants Cultivation in Other Countries

There is very little reported information regarding the commercial cultivation of medicinal plants by smallholder farmers in many African countries, similar to what is obtainable in South Africa. In Ghana, Appiah et al. [95] stated that most of the medicinal plants used were collected from the wild and are not under commercial cultivation. Ofori et al. [96] also admitted a lack of cultivation, while suggesting commercial-scale cultivation as a panacea to the reported scarcity or unavailability of more than 100 species. Though large-scale cultivation of the medicinal plant *Artemisia annua* was reported in Kenya, Uganda, and Tanzania; in Benin, medicinal plant gardens have also been established in different ecological zones [97]. These practices were associated with research activities or government extension initiatives, as there is limited progress in the uptake of cultivation of medicinal plants among small-scale farmers. Recommendations for additional efforts in establishing home and botanical gardens for medicinal plants have been made.

On the international front, it has been estimated that between 1.3% and 3.3% only of the identified 2500 medicinal plants species traded are under cultivation [98]. Though India is a major exporter of medicinal plants, McGaw et al. [65] informed that only a few species are actually cultivated, as the emphasis is on collection from the wild. Cultivation in India is also considered a conservation effort aimed at maintaining natural stocks. However, Chapman and Chomchalow [99] reported that only a few countries in the Asian countries are now farming better cultivars, with the rest relying on wild material for cultivation.

Shengi et al. [100] and Kunwar et al. [101] reported that cultivated species from private farmlands in China and Nepal contributed significantly to cash incomes for local farmers, and constituted an estimated 32% of total exports. This has been attributed to the approach taken, wherein the cultivation of medicinal plants is primarily aimed at improving local livelihoods [102,103]. A livelihoods approach supported by a poverty-alleviation strategy towards the cultivation of medicinal plants, therefore, provides a much-needed impetus for smallholder farmers to participate in the commercial cultivation of medicinal plants.

5. Conclusions

The review showed that improving the livelihoods of rural smallholders, reducing the pressure on wild populations, protecting choice species from extinction, and enhancing biological diversity are the main reasons for promoting the cultivation of medicinal plants. Various constraints were identified which have the potential to limit the participation of smallholder farmers in the cultivation of valuable medicinal plants. Invariably, these challenges require concerted efforts towards resolution, from government, research, and other interested stakeholders. As reported, a conservation-through-cultivation strategy currently drives efforts at cultivating medicinal plants in South Africa. The implication is that any planned large-scale cultivation of important indigenous medicinal plants by smallholder farmers will be a conservation-based decision. This decision helps to achieve biodiversity targets using an economic development approach. The active involvement of smallholder farmers faced with a myriad of possible constraints will therefore require inducements in the form of subsidies from local, provincial, and national governments.

However, as shown in the case of some Asian countries, economic drivers need to be at the forefront before conservation and biodiversity concerns. When considered from livelihoods and poverty-reduction perspective, participation in cultivating medicinal plants will become attractive to smallholder farmers as there are clear economic benefits with potential for improved cash incomes for households. This will require the elimination or reduction of various bottlenecks such as unfavorable policies, low prices, insufficient research, and poor extension delivery which are currently faced by small-scale farmers in cultivating medicinal plants.

In our view, two options are open for consideration towards the involvement of smallholder farmers in the medicinal plants’ value chain. First, a conservation-driven strategy aimed at sustainability of the plant species rather than an economic-based decision to improve the household incomes of smallholder farmers. This requires various forms
of inducement from the government, such as allocation of planting quotas, either by providing grants or subsidies per hectare planted by smallholder farmers. Secondly, a poverty elimination strategy driven by economic consideration places the smallholder farmer in the focus of all medicinal plant cultivation efforts. Various bottlenecks identified need to be reduced or eliminated. Contracting and off-take assurances contained within buy-back agreements between farmers and pharmaceutical companies or wholesale buyers should hence be put in place.

Through the use of these non-mutually exclusive strategies, smallholder farmers can be sustainably involved in the commercial cultivation of medicinal plants, while supporting the government to achieve both biodiversity conservation and economic development. There is considerable ambit for a win-win situation.

**Author Contributions:** Conceptualization, I.N., C.N. and I.M.; methodology, I.N., C.N. and I.M.; software, C.N. validation, C.N. and I.N.; formal analysis, I.N.; investigation, I.N. and C.N.; resources, C.N. and I.M.; data curation, C.N. and I.N., writing—original draft preparation, C.N.; writing—review and editing, C.N., I.N. and I.M.; visualization, I.N. and I.M.; supervision, I.M.; project administration, I.N. and I.M.; funding acquisition, I.N. and I.M. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by the Post-Doctoral Research Grant of the Central University of Technology, Free State, grant number RGS/PDF/ICNwafor/02.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Acknowledgments:** The authors would like to acknowledge the administrative and technical support from the Centre of Applied Food Sustainability and Biotechnology (CAFSaB) of the Central University of Technology, Free State.

**Conflicts of Interest:** The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

**References**

1. Anthonio, G.D.; Tesser, C.D.; Moretti-Pires, R.O. Contributions of Medicinal Plants to Care and Health Promotion in Primary Healthcare. *Interface* 2013, 17, 615–633.

2. Chen, S.L.; Yu, H.; Luo, H.M.; Wu, Q.; Li, C.F.; Steinmetz, A. Conservation and Sustainable Use of Medicinal Plants: Problems, Progress and Prospects. *Chin. Med.* 2016, 11, 37. [CrossRef]

3. Mahmoudi, R. Application of medicinal plants: From past to present. *MOJ Biol. Med.* 2017, 1, 80. [CrossRef]

4. Kumar, S.; Bhatnagar, T. Studies to Enhance the Shelf Life of Fruits using Aloe Vera Based Herbal Coatings: A Review. *Int. J. Agric. Food Sci. Technol.* 2014, 5, 211–218.

5. Panday, A.; Singh, S. Aloe Vera: A Systematic Review of its Industrial and Ethno-Medicinal Efficacy. *Int. J. Pharm. Res. Allied Sci.* 2016, 5, 21–33.

6. Leratholi, L.; Chaudhary, S.K.; Combrink, S.; Viljoen, A. Bush tea (*Athrixia phylicoides*): A review of the traditional uses, bioactivity and phytochemistry. *S. Afr. J. Bot.* 2017, 110, 4–17. [CrossRef]

7. Cushnie, T.P.; Cushnie, B.; Lamb, A.J. Alkaloids: An overview of their antibacterial, antibiotic-enhancing and anti-virulence activities. *Int. J. Antimicrob. Agents* 2014, 44, 377–386. [CrossRef]

8. Egamberdieva, D.; Wirth, S.; Behrendt, U.; Ahmad, P.; Berg, G. Antimicrobial Activity of Medicinal Plants Correlates with the Proportion of Antagonistic Endophytes. *Front. Microbiol.* 2017, 8, 199. [CrossRef] [PubMed]

9. Mbuni, Y.M.; Wang, S.; Mwangi, B.N.; Mbari, N.J.; Musili, P.M.; Walter, N.O.; Hu, G.; Zhou, Y.; Wang, Q. Medicinal Plants and Their Traditional Uses in Local Communities around Cherangani Hills, Western Kenya. *Plants* 2020, 9, 331. [CrossRef] [PubMed]

10. Sher, H.; Busmann, R.; de Boer, H.D. Traditional use of medicinal plants among Kalasha, Ismaeli and Sunni groups in Chitral District, Khyber Pakhtunkhwa province, Pakistan. *J. Ethnopharmac.* 2016, 188, 57–69. [CrossRef]

11. Bareetseng, S. Community Involvement in the Commercialisation of Medicinal Plant Species. The Case Studies: *Lippia javanica* and *Elephantorrhiza elephantine*. A CSIR Presentation, Pretoria, Gauteng, South Africa. 2015. Available online: https://www.dffe.gov.za/sites/default/files/docs/publications/communityinvolvement_commercialisation_medicinalplantspecies.pdf (accessed on 28 September 2020).
93. Misra, A. Studies on biochemical and physiological aspects in relation to phyto-medicinal qualities and efficacy of the active ingredients during the handling, cultivation and harvesting of the medicinal plants. *J. Med. Plant Res.* 2009, 3, 1140–1146.

94. Strydom, H.A.; King, N.D. *Fuggle and Rabie’s Environmental Management*, 2nd ed.; Juta: Clairmont, South Africa, 2013; p. 1142. Available online: https://juta.co.za/catalogue/fuggle-rabie’s-environmental-management-in-south-africa-3e-print_24846 (accessed on 20 February 2020).

95. Appiah, K.S.; Oppong, C.P.; Mardani, H.K.; Omari, R.A.; Kpabitey, S. Medicinal Plants Used in the Ejsu-Juaben Municipality, Southern Ghana: An Ethnobotanical Study. *Medicines* 2019, 6, 1. [CrossRef]

96. Ofori, D.A.; Obiri, B.D.; Gyimah, A.; Adam, K.A.; Jimoh, S.O.; Jamnadass, R.H. Ethnobotany, propagation and conservation of medicinal plants in Ghana. *GIF* 2012, 28, 29–38.

97. Gurib-Fakim, A. *Novel Plant Bio-Resources: Application in Food, Medicine and Cosmetics*, 1st ed.; Wiley & Blackwell: Oxford, UK, 2014.

98. Rajeswara, R.B.; Syamasundar, K.V.; Rajput, D.K.; Nagaraju, G.; Adinarayana, G. Biodiversity, conservation and cultivation of medicinal plants. *J. Pharmacogn.* 2012, 3, 59–62.

99. Chapman, K.; Chomchalow, N. Production of medicinal plants in Asia. *Acta Hortic.* 2005, 679, 45–59. [CrossRef]

100. Shengji, P.; Hamilton, A.C.; Lixin, Y.; Huyin, H.; Zhiwei, Y.; Fu, G.; Quangxin, Z. Conservation and development through medicinal plants: A case study from Ludian (Northwest Yunnan, China) and presentation of a general model. *Biodivers. Conserv.* 2010, 19, 2619–2636. [CrossRef]

101. Kunwar, R.M.; Mahat, L.; Acharya, R.P.; Bussmann, R.W. Medicinal plants, traditional medicine, markets and management in far-west Nepal. *J. Ethnobiol. Ethnomed.* 2013, 9, 24. [CrossRef] [PubMed]

102. Williams, S.J.; Jones, J.P.; Annewandter, R.A.; Gibbons, J.M. Cultivation can increase harvesting pressure on overexploited plant populations. *Ecol. Appl.* 2014, 24, 2050–2062. [CrossRef]

103. Negi, V.S.; Kewlani, P.; Pathak, R.; Bhatt, D.; Bhatt, I.D.; Rawal, R.S.; Sundriyal, R.C.; Nandi, S.K. Criteria and indicators for promoting cultivation and conservation of medicinal and aromatic plants in Western Himalaya, India. *Ecol. Indic.* 2018, 93, 434–446. [CrossRef]