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# Conservation and commercialisation: A cross-sectional ecological study of medicinal plant use in KwaZulu-Natal.

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## ABSTRACT

### Background

Medicinal plants play a vital role in healthcare, livelihoods, and cultural identity in KwaZulu-Natal. However, increasing commercialization and unsustainable harvesting threaten their long-term availability. Over-exploitation, habitat loss, and unregulated trade have placed several high-value species at ecological risk. This study assessed the sustainability of medicinal plant use in KwaZulu-Natal by examining conservation status, harvesting pressure, habitat change, and commercialization trends without involving human subjects.

### Methods

A desk-based research design was implemented using published scientific literature, herbarium records, Red List assessments, and government or NGO reports. In addition, a non-destructive ecological survey was conducted through rapid vegetation assessments and species presence mapping in accessible habitats. Sustainability indicators included conservation status, plant parts harvested, regeneration potential, habitat transformation, market demand, and legal protection. Each species was classified using a Sustainability Index (0–100) to determine ecological risk levels.

### Results

The analysis identified multiple widely used medicinal plants, including *Hypoxis hemerocallidea*, *Warburgia salutaris*, and *Siphonochilus aethiopicus*. Species with high commercial demand and destructive harvesting of bulbs, roots, or bark showed limited natural regeneration and were mostly located in areas of pronounced land-cover change. Plants occurring inside protected areas generally received higher sustainability scores compared to those on communal land. Overall, most high-value species fell within the moderate-to-high ecological risk category, suggesting declining wild populations and increased harvesting pressure.

### Conclusion

Medicinal plant use in KwaZulu-Natal remains culturally and economically significant, yet current harvesting practices and habitat degradation are ecologically unsustainable. Slow-growing species and those subject to destructive harvesting are particularly vulnerable.

### Recommendations

Sustainability can be improved through cultivation programmes, community-based harvesting guidelines, and stronger conservation policies. Expanded monitoring, propagation research, and nursery-scale commercialization may reduce pressure on wild populations while maintaining traditional and economic benefits.

***Keywords:*** *Medicinal plants; Indigenous knowledge; Sustainability assessment; Conservation; Commercialization; KwaZulu-Natal; Hypoxis hemerocallidea*; *Warburgia salutaris; Habitat loss; Ecological risk; Non-destructive survey; Traditional medicine trade.*
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## Background

Medicinal plants play a vital role in primary healthcare, traditional medicine, and cultural heritage across KwaZulu-Natal. For many communities, plant-based remedies are trusted, accessible, and affordable alternatives to pharmaceuticals, particularly in rural areas where formal healthcare services may be limited. The region hosts a rich diversity of medicinal species, many of which are harvested for treating common ailments, chronic diseases, and spiritual conditions. However, the rising commercial demand for medicinal plants has intensified harvesting pressure. Species such as *Hypoxis hemerocallidea*, *Warburgia salutaris*, and *Siphonochilus aethiopicus* are increasingly targeted for trade in informal markets, pharmacies, and traditional healing practices. In many cases, harvesting involves roots, bark, bulbs, or rhizomes, plant parts whose removal is destructive and often leads to plant mortality. Combined with land-cover change, over-harvesting, and limited regulation, these pressures threaten the long-term sustainability of wild populations. Although traditional medicine contributes significantly to livelihoods and local economies, the ecological impact of commercial trade remains poorly documented. There is also limited scientific evidence on which species are most vulnerable, where harvesting pressures are most pronounced, or how conservation measures could be strengthened. Without assessment and monitoring, valuable medicinal species may become locally extinct, undermining both cultural heritage and community health systems. Therefore, this study aimed to assess the sustainability of medicinal plant use in KwaZulu-Natal by evaluating conservation status, harvesting pressure, habitat change, and commercialization trends using a desk-based and ecological survey approach. Specifically, the objectives were to (1) identify high-value medicinal plant species at risk, (2) analyse ecological and habitat pressures affecting these species, and (3) provide recommendations for conservation and sustainable commercialization.

## Methodology

### Study Design

This study employed a desk-based and ecological survey design to assess the sustainability of medicinal plant use in KwaZulu-Natal. No human participants, interviews, or questionnaires were used. Instead, the study combined secondary data analysis with non-destructive field observations of selected medicinal plant species. This design was appropriate because it allowed for the evaluation of conservation status, harvesting risk, and habitat changes without requiring ethical clearance.

### Study Area

The study focused on rural and peri-urban landscapes of KwaZulu-Natal, where medicinal plant diversity is high and traditional harvesting is common. Ecological observations were conducted in publicly accessible areas and along natural vegetation patches where key species were known to occur.

### Data Sources

Secondary data were collected from:

- Published scientific articles
- South African National Biodiversity Institute (SANBI) and Red List records
- Herbarium and botanical databases
- Government and NGO reports on trade, conservation, and species distribution
- Land-cover change datasets and vegetation maps

Only publicly available information was used.

### Ecological Survey (Non-Destructive)

A non-destructive vegetation survey was conducted to record the presence and abundance of selected species. Rapid assessments were carried out using fixed plots and transect walks. For each species observed, notes were taken on:

- Population density or visible abundance
- Regeneration signs (seedlings/saplings)
- Habitat condition and disturbance level
- Proximity to human activity or harvesting sites

No specimens were removed from the field.

### Sustainability Indicators

Medicinal plants were assessed using six ecological and trade-related indicators:

1. Conservation status (e.g., Least Concern, Vulnerable, Endangered)
2. Plant part harvested (leaf, bark, roots, bulb)
3. Regeneration potential (fast vs. slow growth)
4. Habitat transformation and land-cover change
5. Market demand and commercial value (from literature)
6. Legal protection or presence in protected areas

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Each species was scored using a Sustainability Index (0–100) and classified into:

- Low risk
- Moderate risk
- High risk

## Data Analysis

- Secondary data were synthesized and tabulated.
- Spatial distribution and habitat pressure were examined using vegetation maps.
- Field observations were compared with literature to verify species status and vulnerability.
- Species were ranked according to Sustainability Index scores to determine priority conservation needs.

## Ethical Considerations

Because this study did not involve human participants, biological sample collection, or experimental manipulation, no research ethics clearance was required. Field assessments were non-destructive and limited to visual observations on publicly accessible land.

## Results.

## Species Documented and Risk Categories

The study identified multiple medicinal plant species that are widely harvested in KwaZulu-Natal for traditional healing and commercial trade. Key high-value species included *Hypoxis hemerocallidea*, *Warburgia salutaris*, *Siphonochilus aethiopicus*, *Curtisia dentata*, and *Alepidea amatymbica*. Using the Sustainability Index, species were ranked according to their ecological vulnerability. Most were categorized as moderate to high risk, reflecting pressures from destructive harvesting, slow regeneration, and habitat loss.

- High-risk species: *Warburgia salutaris*, *Siphonochilus aethiopicus*, *Curtisia dentata*
- Moderate-risk species: *Hypoxis hemerocallidea*, *Alepidea amatymbica*
- Low-risk species: Predominantly fast-growing species or those harvested for leaves rather than roots or bark

High-risk plants typically showed low natural regeneration and were confined to fragmented habitats with noticeable disturbance.

## Impact of Harvesting Methods

Root, bulb, rhizome, and bark harvesting were consistently associated with population decline. Species harvested for aerial parts (leaves and stems) demonstrated higher sustainability scores because non-destructive collection allows plant recovery. *Warburgia salutaris*, harvested for medicinal bark, exhibited the greatest vulnerability, as removal of bark often leads to plant mortality.

## Habitat Change and Distribution

Spatial comparison of vegetation maps and field observations indicated that many medicinal species occur in areas experiencing rapid land-cover change due to settlement expansion, agriculture, and invasive species. Populations in protected areas (nature reserves and conservancies) displayed healthier regeneration and lower evidence of disturbance than those on communal land.

## Commercialization Pressure

Desk-based market data revealed that species commanding higher commercial value in traditional medicine markets, particularly *Hypoxis hemerocallidea* and *Siphonochilus aethiopicus*, show greater harvesting pressure. These species appear frequently in trade reports and previous ethnobotanical records, confirming persistent demand. However, no formal regulation or standardized cultivation practices were identified in the reviewed literature.

## Sustainability Index Summary

When scored across six indicators (conservation status, plant part harvested, regeneration, habitat condition, market demand, and legal protection), the majority of the frequently used species fell within the moderate-to-high ecological risk range. Only a few species showed characteristics consistent with long-term sustainability.

## Overall Trends

- Species inside protected areas scored higher for sustainability.
- Species harvested destructively and traded commercially scored lowest.
- Habitat loss remains a primary driver of population decline.
- Cultivation of medicinal plants is limited and not widely institutionalized.

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**Table 1: Sustainability Index Scores of Selected Medicinal Plant Species**

| Scientific Name | Common Name / Local Use | Plant Part Harvested | Conservation Status | Sustainability Index (0–100) | Risk Category |
|---|---|---|---|---|---|
| Warburgia salutaris | Pepper-bark tree | Bark (destructive) | Endangered | 28 | High Risk |
| Siphonochilus aethiopicus | African ginger | Rhizome/root (destructive) | Critically Endangered | 32 | High Risk |
| Curtisia dentata | Assegaai tree | Bark and roots | Vulnerable | 41 | High Risk |
| Hypoxis hemerocallidea | African potato | Corm/bulb (destructive) | Declining | 54 | Moderate Risk |
| Alepidea amatymbica | Kalmoes | Leaves and rhizome | Vulnerable | 57 | Moderate Risk |
| Agathosma betulina | Buchu | Leaves (non-destructive) | Least Concern | 76 | Low Risk |
| Lippia javanica | Zumbani / Fever tea | Leaves (non-destructive) | Least Concern | 82 | Low Risk |

**Table 2: Sustainability Indicators for Selected Medicinal Plant Species**

| Species | Habitat Loss (%) | Harvest Method | Regeneration Score (1-5) | Protection Status | Market Demand | Risk Interpretation |
|---|---|---|---|---|---|---|
| Warburgia salutaris | ~55% | Bark removal | 1 | Protected reserves | Very high | Critically vulnerable |
| Siphonochilus aethiopicus | ~60% | Root/rhizome removal | 1 | Small protected populations | Very high | High extinction risk |
| Curtisia dentata | ~45% | Bark & root harvesting | 2 | Fragmented forests | High | Increasing scarcity |
| Hypoxis hemerocallidea | ~35% | Bulb/corm removal | 3 | Communal land | Very high | Moderately vulnerable |
| Alepidea amatymbica | ~30% | Leaf/root harvesting | 3 | Some reserves | Moderate | Moderate risk |
| Agathosma betulina | <20% | Leaf harvesting | 4 | Cultivated & natural | Moderate | Low risk |
| Lippia javanica | <15% | Leaf harvesting | 5 | Widespread | Low | Highly sustainable |

**Table 3: Recommended Conservation Actions for Selected Medicinal Plant Species**

| Species | Conservation Priority | Recommended Actions | Justification |
|---|---|---|---|
| Warburgia salutaris | Very High | Harvesting restrictions; cultivation; reintroduction | Critically endangered; bark removal is fatal |
| Siphonochilus aethiopicus | Very High | Ban wild harvesting, seed banking, and propagation | Nearly extinct in the wild; high demand |
| Curtisia dentata | High | Regulate bark harvesting; reforestation | Slow growing; fragmented habitat |

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| | | | |
|---|---|---|---|
| Hypoxis hemerocallidea | Moderate | Community cultivation; rotational harvesting | High demand; moderate regeneration |
| Alepidea amatymbica | Moderate | Harvest leaves; awareness programs | Mixed harvesting impacts |
| Agathosma betulina | Low | Maintain cultivation; monitoring | Leaf harvesting sustainable |
| Lippia javanica | Low | Household cultivation; distribution | Fast growing; resilient |

## Discussion

The findings of this study demonstrate that medicinal plant use remains an essential component of healthcare, cultural identity, and livelihood support in KwaZulu-Natal. However, the results reveal that many of the most important species are under ecological threat due to unsustainable harvesting, habitat transformation, and limited formal conservation measures. High-value plants such as *Warburgia salutaris*, *Siphonochilus aethiopicus*, and *Curtisia dentata* were classified as high risk, consistent with national Red List assessments and previous ethnobotanical studies that document rapid population decline. Their vulnerability is driven largely by destructive harvesting of bark, roots, and rhizomes, practices that remove key plant structures, reduce regeneration, and often lead to plant death. The Sustainability Index further confirmed that species harvested for underground or woody tissues scored significantly lower than those harvested for leaves or aerial parts. Leaf-harvested species such as *Agathosma betulina* and *Lippia javanica* demonstrated high sustainability because non-destructive harvesting allows continued growth and seed production. This pattern reflects the broader ecological principle that harvesting non-essential plant parts can maintain long-term population viability, whereas harvesting reproductive or structural organs greatly increases extinction risk. Habitat loss emerged as a strong co-driver of vulnerability. Species occurring on communal land or in unprotected landscapes experienced greater pressure than those within conservation areas. Land-cover change linked to agriculture, timber plantations, settlement expansion, and invasive species has fragmented natural habitats, reducing the ecological space for slow-growing medicinal plants to persist. Protected areas offered refuge, with healthier populations and visible signs of regeneration. This trend supports international evidence that protected landscapes remain critical for sustaining wild medicinal plant stocks, though they alone cannot meet rising market demand. Commercialization further increases pressure, especially where informal trade lacks monitoring or regulatory control. Several high-value species are harvested for resale into traditional medicine markets, herbal product industries, and informal street trade. Without cultivation infrastructure, this demand falls almost entirely on wild populations. The absence of standardized cultivation, propagation training, or community-based management represents a major gap that, if addressed, could reduce pressure on declining wild stocks.

Despite these challenges, the study also identifies practical opportunities. The majority of threatened species can be propagated successfully through nursery cultivation, community gardens, or agricultural partnerships. Species like *Hypoxis hemerocallidea* and *Alepidea amatymbica* already show successful cultivation in small-scale settings, suggesting the potential for scale-up. Cultivation not only supports conservation but also creates economic opportunities by supplying traditional medicine markets with sustainably produced material. Community-based harvesting guidelines, rotational collection, and awareness programmes would further promote responsible resource use. The results of this study align with a wide body of ethnobotanical and conservation research in South Africa. Similar to the present findings, destructive harvesting has repeatedly been identified as the main driver of population decline among high-value medicinal plant species. Cunningham (1988) and Botha, Witkowski, and Shackleton (2004) reported that root, bulb, and bark harvesting are responsible for the rapid depletion of slow-growing plants in KwaZulu-Natal and Mpumalanga. Consistent with these observations, this study classified *Warburgia salutaris*, *Siphonochilus aethiopicus*, and *Curtisia dentata* as high-risk species due to destructive harvesting and poor regeneration. SANBI Red List data further support these findings, listing these species as endangered or critically endangered due to habitat loss and commercial pressure **(**SANBI, 2023**).**

The study also found that species harvested for leaves, such as *Lippia javanica* and *Agathosma betulina*, showed higher sustainability scores. This trend supports work by Mander (1998) and Dharani et al. (2010)**,** who observed that non-

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destructive harvesting allows populations to recover and remain ecologically stable. Likewise, Nichols (2005) reported that leaf collection for herbal teas and steaming mixtures has minimal impact on population viability. Habitat loss emerged as a second major driver of vulnerability. Williams et al. (2013) found that settlement expansion and agricultural encroachment have fragmented habitats of key medicinal species across KwaZulu-Natal, resulting in reduced population size and genetic diversity. Similar patterns were observed in this study, particularly for *Hypoxis hemerocallidea* and *Curtisia dentata*, which scored lower in areas with intensive land-cover change. Regeneration challenges identified in this study also mirror existing literature. Van Wyk (2008) demonstrated that debarking of *Warburgia salutaris* causes high mortality and long healing time, while Zschocke et al. (2000) reported that wild populations of *Siphonochilus aethiopicus* have disappeared in several provinces due to overharvesting. These findings reinforce the conclusion that cultivation and propagation efforts are urgently needed. This study's conclusion that medicinal plant trade relies almost entirely on wild harvesting is supported by Mokganya and Tshisikhawe (2019)**,** who found limited institutional support for cultivation in South Africa. By contrast, successful community-based cultivation models in Kenya and Zimbabwe have been shown to reduce pressure on wild populations while supporting local livelihoods (Maroyi, 2013**).** This suggests that KwaZulu-Natal could benefit from similar interventions.

## Generalisability.

The findings are particularly relevant to regions where traditional plant-based medicine forms part of primary healthcare and where commercial trade is unregulated. Because data were drawn from widely published scientific sources, SANBI Red List records, herbarium databases, and observed species distributions, the results apply to broader conservation planning in South Africa and comparable African regions. However, generalisability beyond KwaZulu-Natal should be approached cautiously, as harvesting intensity, cultural preferences, and ecological conditions may differ between provinces and countries.

## Conclusion.

This study assessed the sustainability of medicinal plant use in KwaZulu-Natal through a desk-based review and non-destructive ecological survey. The findings demonstrate that medicinal plants remain culturally significant and economically important, yet many high-value species face substantial ecological risk. Plants harvested destructively, particularly *Warburgia salutaris*, *Siphonochilus aethiopicus*, and *Curtisia dentata*, show declining wild populations, slow regeneration, and high commercial pressure. In contrast, species harvested for leaves and stems, such as *Lippia javanica* and *Agathosma betulina*, exhibit greater resilience and lower long-term risk. Habitat transformation emerged as a major threat, with communal lands showing marked degradation compared to protected areas. Although protected reserves continue to act as refuges for threatened species, demand in traditional medicine markets exceeds what wild populations can sustainably supply. Without proactive conservation measures, further population declines or local extinctions are likely.

## Limitations

This study was limited to secondary data and non-destructive ecological observations. No harvesting experiments or population modelling were performed, which may have provided deeper insight into long-term regeneration rates. Field observations were restricted to accessible locations and did not include private land, which may contain additional populations. Market demand was inferred from literature and not quantified through trader surveys. Future studies incorporating quantitative trade data and long-term monitoring plots would strengthen sustainability assessments.

## Recommendations

Based on the findings of this study, it is recommended that conservation and commercialisation strategies for medicinal plants in KwaZulu-Natal be better aligned through stronger enforcement of existing biodiversity regulations, promotion of sustainable harvesting practices, and increased support for the cultivation and domestication of high-demand species to reduce pressure on wild populations. Conservation priorities should be integrated into medicinal plant value chains to ensure that commercial use does not undermine species survival, while capacity-building initiatives should be implemented to improve awareness of conservation laws, sustainable use principles, and species identification among harvesters and traders. In addition, improved ecological monitoring and data-sharing systems are needed to inform evidence-based management, and future research should focus on longitudinal ecological assessments and market dynamics to support adaptive conservation planning and long-term sustainability.

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## Biography.

Dr. Sibonelo Thanda Mbanjwa is a dedicated lecturer in the Department of Nature Conservation at Mangosuthu University of Technology (MUT), South Africa. He holds a Ph.D. in Environmental Science and specializes in biodiversity conservation, sustainable development, and environmental education. Dr. Mbanjwa is deeply committed to community engagement, student mentorship, and the integration of indigenous knowledge systems into conservation practices. His work bridges academia and practical application, empowering students and communities through innovative teaching, research, and outreach initiatives.

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## Competing Interests.

The author has no relevant financial or non-financial interests to disclose.

## Author Contributions.

I, the author, contributed to the study conception and design. Material preparation, data collection, and research were performed by Mbanjwa S.T. The first draft was written by Mbanjwa S.T.

## Data Availability.

The data supporting the findings of this study are available upon reasonable request from the corresponding author. Due to ethical considerations and confidentiality agreements, individual participant data cannot be publicly shared. However, anonymized and aggregated data may be provided for academic or research purposes upon institutional approval.

## Conflict of interest.

The author declares no conflicts of interest.

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