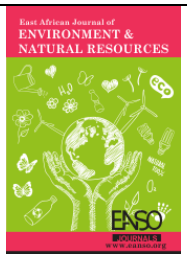

East African Journal of Environment and Natural Resources
eajenr.eanso.org
Volume 8, Issue 2, 2025
Print ISSN: 2707-4234 | Online ISSN: 2707-4242
Title DOI: https://doi.org/10.37284/2707-4242

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Perception of Local Communities Towards Conservation of Traditional Medicinal Plants in Karongi District, Rwanda

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Article DOI: https://doi.org/10.37284/eajenr.8.2.3190

Date Published:

23 June 2025

Keywords:

Perception, Local Communities, Conservation, Traditional Medicinal Plants.

ABSTRACT

Traditional medicinal plants played an important role in Rwanda's health, environmental, and cultural systems. This study assessed the perception of local communities towards the conservation of traditional medicinal plants in the Karongi District, specifically in the Bwishyura and Ruganda Sectors. Using a cross-sectional descriptive method, data were collected (analyzed with SPSS) from 398 participants through structured questionnaires, but field observations were also used. The study identified over 130 species of traditional medicinal plants, where Tetradenia riparia is the most commonly used by 86.68% of respondents. A significant majority (85.93%) were aware of Traditional medicinal plants, and 45.48% reported that they frequently use them. Additionally, 55.78% of participants strongly agreed that traditional medicinal plants are important in Rwanda's healthcare system. The most common uses of traditional medicinal plants were for treating digestive problems (66.83%) and skin diseases (61.56%). Most respondents (74.62%) reported that they obtain them from natural vegetation such as forests and wetlands, while 51.76% attain them from home gardens. However, 82.66% of participants think that access to traditional medicinal plants has decreased. The main reasons cited were urbanization (68.34%), agricultural expansion (58.04%), and deforestation (46.26%). Participants show that the most preferred conservation practices are allowing plants to regenerate (55.78%), and replanting after harvesting (49.25%). 21.61% reported the absence of specific conservation measures. Key challenges identified were a lack of knowledge of conservation methods (74.62%) and knowledge of traditional medicinal plants (69.10%), followed by government restrictions and limited access to land. The study concludes that enhancing community awareness through workshops and promoting intergenerational knowledge transfer can strengthen the conservation and sustainable use of traditional medicinal plants in Rwanda.

APA CITATION

Nkusi, C. (2025). Perception of Local Communities Towards Conservation of Traditional Medicinal Plants in Karongi District, Rwanda. *East African Journal of Environment and Natural Resources*, *8*(2), 178-192. https://doi.org/10.37284/eajenr.8.2.3190.

CHICAGO CITATION

Nkusi, Celestin. 2025. "Perception of Local Communities Towards Conservation of Traditional Medicinal Plants in Karongi District, Rwanda". *East African Journal of Environment and Natural Resources* 8 (2), 178-192. https://doi.org/10.37284/eajenr.8.2.3190

Article DOI: https://doi.org/10.37284/eajenr.8.2.3190

HARVARD CITATION

Nkusi, C. (2025) "Perception of Local Communities Towards Conservation of Traditional Medicinal Plants in Karongi District, Rwanda", *East African Journal of Environment and Natural Resources*, 8 (2), pp. 178-192. doi: 10.37284/eajenr.8.2.3190.

IEEE CITATION

C. Nkusi "Perception of Local Communities Towards Conservation of Traditional Medicinal Plants in Karongi District, Rwanda", *EAJENR*, vol. 8, no. 2, pp. 178-192, Jun. 2025.

MLA CITATION

Nkusi, Celestin. "Perception of Local Communities Towards Conservation of Traditional Medicinal Plants in Karongi District, Rwanda". *East African Journal of Environment and Natural Resources*, Vol. 8, no. 2, Jun 2025, pp. 178-192, doi:10.37284/eajenr.8.2.3190

INTRODUCTION

According to the WHO (2000), traditional medicine is referred to as "a health care system that is based on the sum of knowledge, skills and practices derived on theories, beliefs and specific experiences proper to a given cultural society and that are used to maintain human health and to prevent, diagnose, treat and cure physical and mental illness". Traditional medicine includes medicinal plants, animal parts, and minerals.

Folkloric methods of treatment used in the world include the use of medicinal plants and vary according to tradition (WHO, 2013). While traditional medicine is practised globally, its precise origins are complex and vary widely across cultures. It is rooted in the ancient practices and knowledge of various communities, with some forms tracing back thousands of years. Different cultures have developed their unique systems of medicine based on their environment, beliefs, and experiences. According to the World Health Organization (2002), over 80% of sub-Saharan Africans rely on traditional medicine, with plant-based therapies forming a major part of practices by traditional healers. Rwanda, a country with a tropical climate located in East Africa, is also known for its high biodiversity, harbouring numerous plant species that hold traditional, cultural, and medicinal significance. In this context, traditional medicinal plants play a vital role in the healthcare systems of many rural communities, serving as a natural and alternative source of treatment compared to modern pharmaceutical medicine (Ndamwizeye *et al*., 2020). Medicinal plants are used to treat various ailments, including malaria, respiratory infections, and gastrointestinal and dermatological conditions (Munyabwari *et al*., 2017). This biodiversity, along with the associated traditional knowledge, ensures community-level healthcare, especially in regions where modern health services are scarce. Despite their cultural and medicinal significance, Rwanda's medicinal plants face significant threats. Deforestation, urban expansion, agricultural encroachment, and climate change contribute to the degradation of natural habitats where many of these species grow wild (Dike, 2015). Additionally, the commercialization of medicinal plant products often involves unsustainable harvesting accelerates the depletion of these species (Nkubito *et al.*, 2019). While some efforts have been made to document and protect traditional knowledge, there remains a gap in comprehensive research on local communities' perceptions regarding the conservation of these botanical resources.

The objectives of this study were to identify the traditional medicinal plants found in Karongi District, evaluate the attitudes of local communities in the Karongi District towards the conservation of traditional medicinal plants and assess the role of traditional practices in the sustainable management and conservation of medicinal plants in Karongi District.

Karongi District in Rwanda's Western Province presents a unique case study for examining the relationship between traditional knowledge, community perceptions, and conservation efforts (NISR, 2022). The region hosts diverse ecological habitats, including forests and wetlands, which support a variety of medicinal plants (REMA, 2015). However, like many rural areas in Rwanda, Karongi faces the dual challenge of preserving traditional practices while adapting to

Article DOI: https://doi.org/10.37284/eajenr.8.2.3190

modernization. Local livelihoods heavily depend on agriculture and natural resources, creating tension between economic development and conservation goals (REMA, 2015). Agricultural expansion, particularly tea and coffee plantations, though economically vital, further threatens indigenous medicinal flora by destroying natural habitats (Kabanda *et al.*, 2020). Hence, this study explores the perceptions and values of local communities in Karongi District concerning the conservation of traditional medicinal plants. Key considerations include cultural beliefs and risk awareness, which may hinder or support conservation initiatives. By examining these factors, the research aims to identify strategies that enhance conservation effectiveness, promote sustainable harvesting, and safeguard cultural heritage tied to medicinal plant use (McPhee, 2016). The conservation of Rwanda's traditional medicinal plants demands an integrated approach that balances ecological, cultural, and socioeconomic dimensions. Understanding community perspectives is crucial not only for protecting biodiversity but also for ensuring that traditional healing practices remain viable amidst rapid societal and environmental changes.

METHODS AND MATERIALS

Description of the Study Areas

Karongi District is located in Western Rwanda, bordered by Rutsiro District to the north, Ngororero District to the east, Nyamasheke District to the south, and Lake Kivu to the west, which forms a natural boundary with the Democratic Republic of the Congo (MINALOC, 2020). The district lies at approximately 2.1652° S latitude and 29.3452° E longitude and features a landscape of rolling hills and valleys that sustain diverse ecosystems, including forests, wetlands, and agricultural lands (REMA, 2019). Karongi has a moderate tropical climate, with average annual temperatures ranging between 15°C and 25°C and two distinct rainy seasons: March to May and September to December. The district receives an average annual rainfall of 1,200–1,500 mm (Meteorology Rwanda, 2021). Due to its relatively undisturbed natural environment and rich biodiversity, Karongi serves as a strategic location for studying the conservation of native medicinal plants (REMA, 2019).

The district's limited industrial activity, coupled with its status as a key tourist destination, has helped preserve its ecosystems, making it an important habitat for traditional medicinal flora. Additionally, the coexistence of tourism and local traditions presents a unique opportunity to explore the interplay between cultural knowledge and nature conservation. These factors make Karongi an ideal study area for examining local community perceptions regarding the conservation of medicinal plants.

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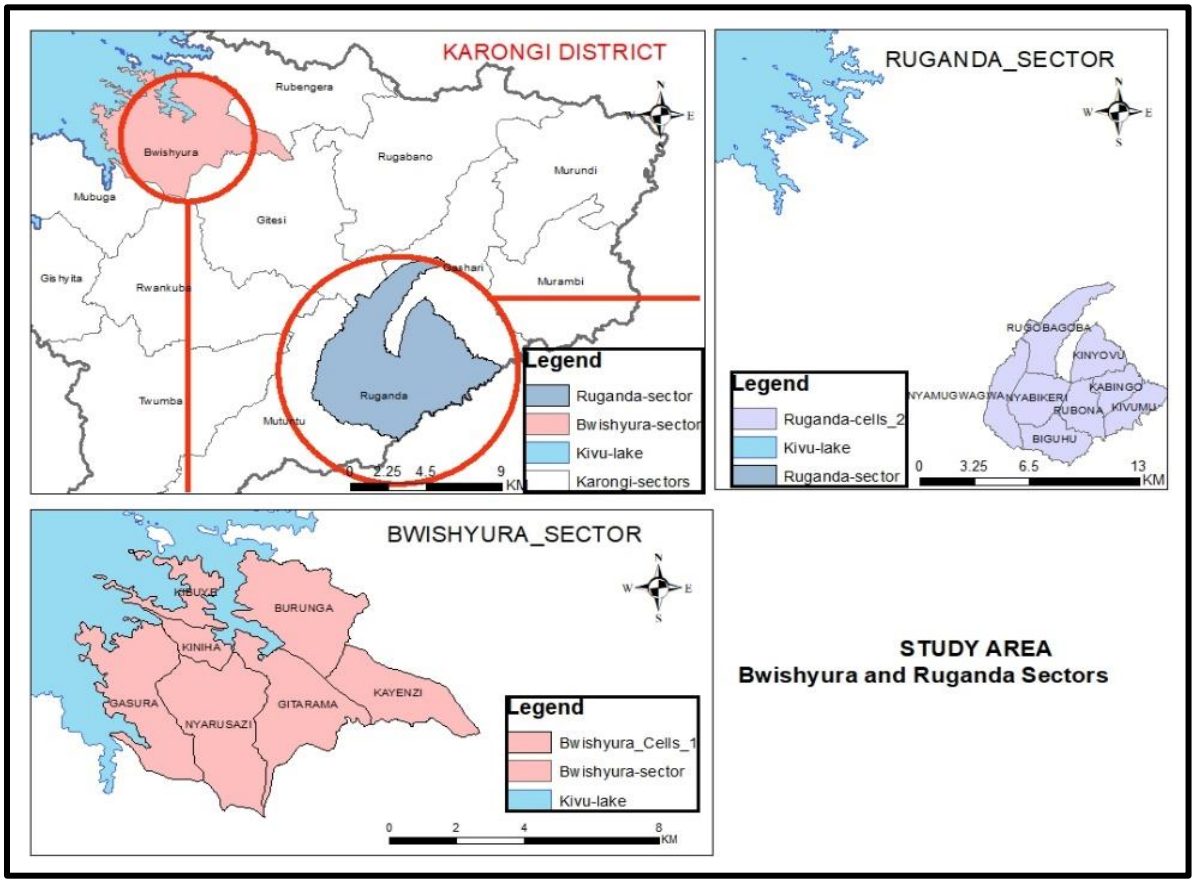
Figure 1: Map of Karongi District



Karongi District spans 993 km² with a population of 373,869 and a population density of 376.6 inhabitants/km², reflecting an annual population growth rate of 1.2% between 2012 and 2022 (NISR, 2022). The district's economy is primarily driven by agriculture, fishing, and tourism. Key agricultural products include coffee, tea, maize, beans, and bananas, which serve both subsistence and commercial purposes across rural villages (NISR, 2022). Local economic development is sustained by smallholder farming, artisanal fishing, and small-scale trade, with minimal industrial or large-scale commercial activity (VISION 2050).

Tourism plays a significant role, boosted by historical sites, scenic landscapes, and eco-tourism offerings such as boat excursions, camping, and hiking (MINICOM, 2013).

Karongi is also a home to the Museum of Environment, one of its roles is preserving the traditional medicinal plants in Rwanda, and Bwishyura sector serves as a major economic hub, hosting critical infrastructure and commercial enterprises within the district (RDB, 2020).

Research Design

To obtain an in-depth understanding regarding traditional knowledge, cultural significance, and challenges related to the conservation of traditional medicinal plants—and to gather formalized data concerning the perception of the local community towards their conservation—a cross-sectional descriptive study design was employed. This type of study involves the collection of data at a single point in time, allowing researchers to describe the characteristics, attitudes, and perceptions of a specific population without manipulating variables (Levin, 2006). It is particularly suitable for assessing community perspectives and identifying prevailing trends or issues within a defined time frame.

A structured questionnaire comprising closed-ended questions, open-ended questions, and Likert scale items was used to measure levels of

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agreement or disagreement on various topics related to traditional medicinal plant conservation. Data analysis was conducted using SPSS software to generate descriptive statistics such as frequencies and percentages. Tables and figures were created using Microsoft Excel, while the full text was typed in Microsoft Word. Additionally, ArcGIS software was used to create a spatial map of the study area. A column chart was employed to present the percentages and their associated variables graphically, enhancing the visual interpretation of the data.

Sampling Methods

This research used a stratified sampling technique to choose sectors in Karongi District through a simple random sampling to achieve the research objectives and address the research problem. Moreover, a purposive sampling technique was applied to select those who met the criteria of the targeted population. For the first objective, field observation was used to identify the medicinal plants found in Karongi District, for the second and third objectives, semi semi-structured questionnaire that included both open and closed questions was used for each respondent.

Sample Size

The research was carried out in Karongi District which has 13 sectors and the researcher used a stratified sampling method to select 2 sectors randomly, a purposive sampling technique was used to select those who met all criteria being local community members, elders, local leaders, and policymakers in selected sectors, the selected sectors which are Bwishyura and Ruganda, that have populations of 40,720; 19,132 respectively. The minimum sample size was calculated by using the Yamane formula (1967) as follows in equation (1): $\boldsymbol{n} = \frac{\boldsymbol{N}}{1+\boldsymbol{N}*(\boldsymbol{e})^2}$ (1)

Variables:

$\boldsymbol{n}$: The sample size

N: The population size

e: the margin of error (level of significance)

1: unite (a constant value)

The population size is 59,852 and the margin of error is 5% then the sample size will be:

$\boldsymbol{n} = \frac{59852}{1+59852*(0.05)^2}$ =397.3 ≈398

RESULTS AND DISCUSSION

Demographic Information

From the study, population demography was assessed and comparison between age range and gender where 37.19% of the total respondents were above 50 years of age and 26.38% were in the range 29-39 age range which indicates that elder members of the community know about traditional medicinal plants conservation as different studies shows that this knowledge pass from generation to another orally (Munyabwari *et al.*, 2017). The study indicated that 56.03% of the respondents were Christian and 23.62% were Muslim but there were others who had no religious affiliation (13.82%) while others were in traditional/indigenous religion (6.53%), whereas among the total respondents, 54.2% were males and 44.2% females which implies gender equality consideration while collecting data. The below figure indicates the age range, sex ratio and religious affiliation:

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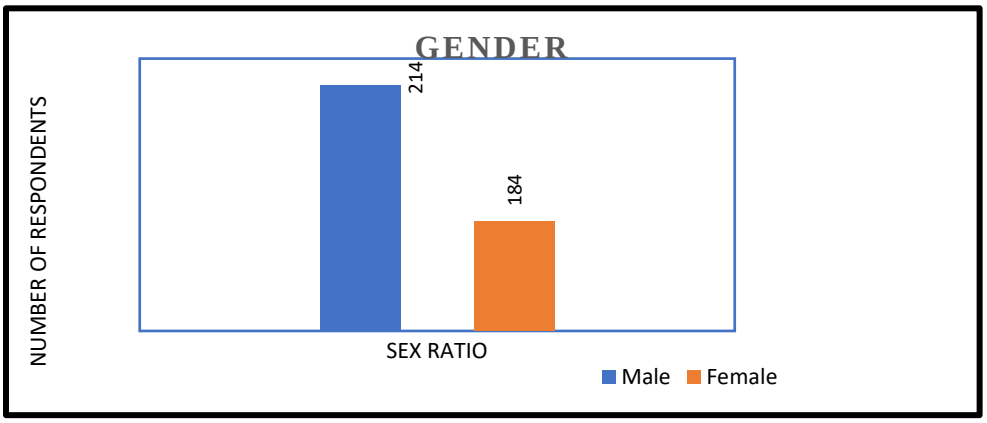
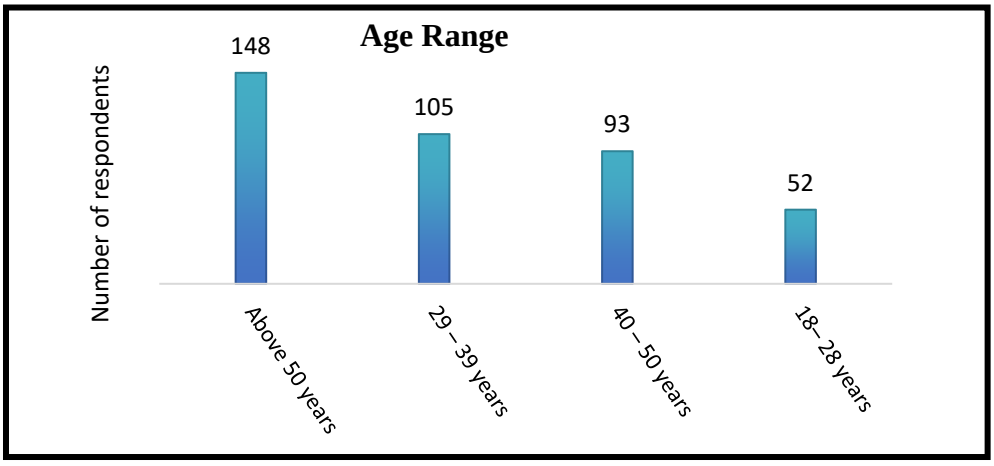
Figure 2: Gender of Respondents



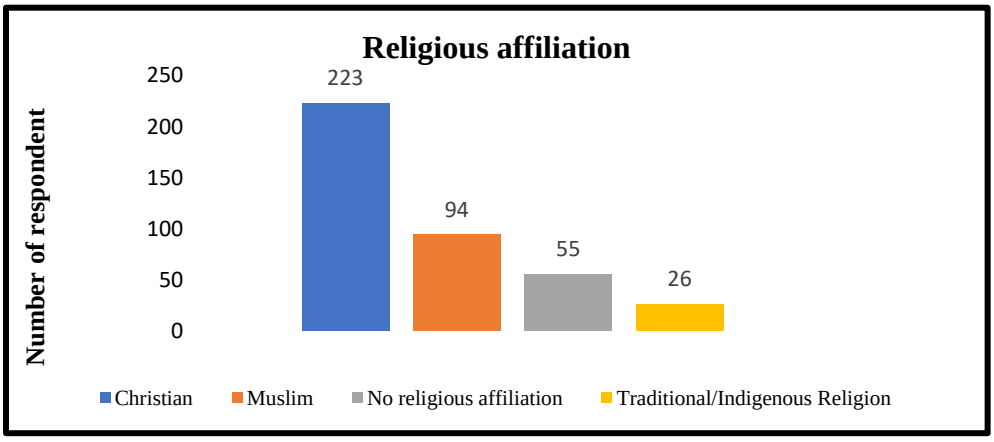
Source: *Primary source, 2025*

Figure 3: Age Range of Respondents



Source: *Primary source, 2025*

Figure 4: Religious Affiliation



Source: *Primary source, 2025*

The following education status was identified 20.9% and 58.04% did secondary school, and primary school, 13.1% had no formal education, and 8.04% did university studies. While 32.7%, 27.9%, and 17.6% are farmers, government employees, and others, respectively, the below figure indicates the education level and occupation status:

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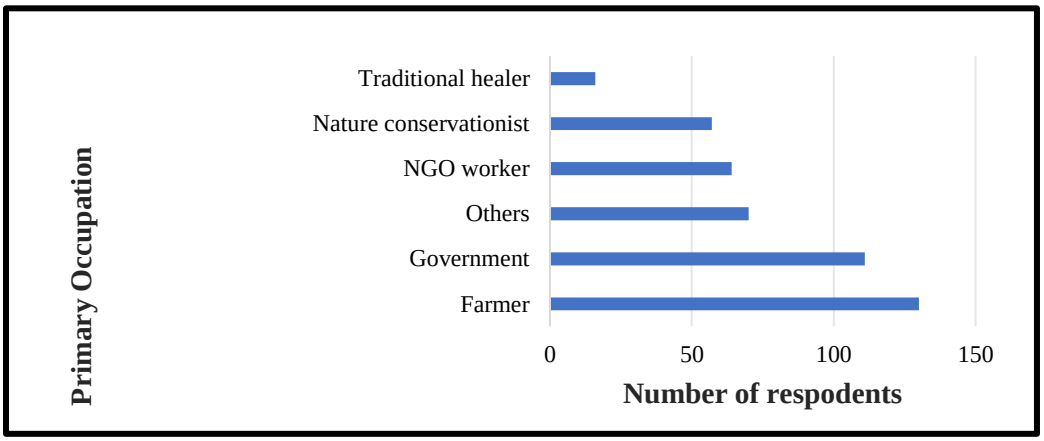
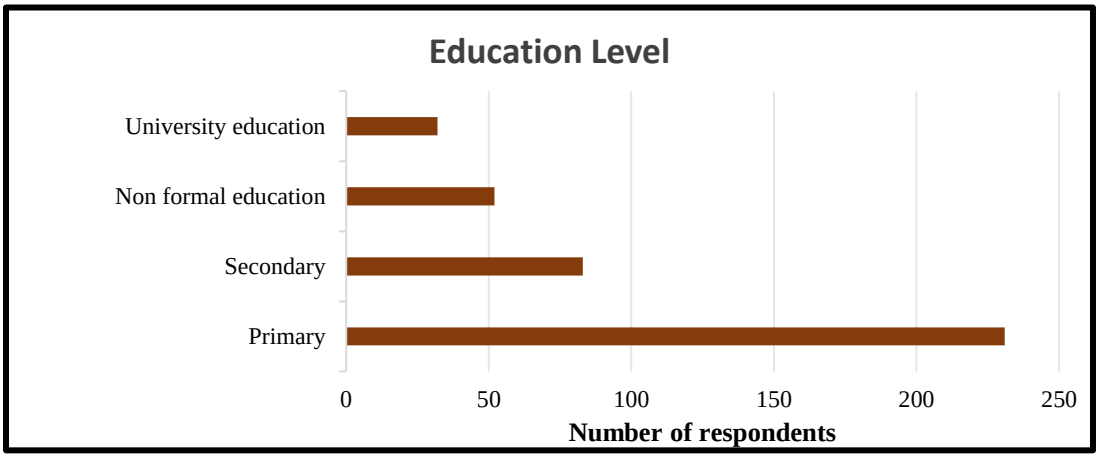
Figure 5: Primary Occupation of Respondents



Source: *Primary source, 2025*

Figure 5: Education Level of Respondents



Source: *Primary source, 2025*

Identify the Medicinal Plants Found in Karongi District

By assessing the perception of local communities towards the conservation of traditional medicinal plants (TMPs) in Karongi District. The first objective of this study was to identify the medicinal plants found in Karongi District, their scientific names, and their families. The research identified 130 traditional medicinal plants, including shrubs and trees, which are from 52 different families, and the study shows that *Tithonia diversifolia* is the most abundant TMPs found in the study area, followed by *Tetradenia riparia* and *Vernonia amygdalina.* Karongi is known for its relatively undisturbed natural environment and its landscape's biodiversity richness (REMA, 2019). It is endowed with a dense ecological and cultural heritage (Nsengimana *et al.*, 2020). Karongi district has a forest cover of 30.2% of its total land, including forest plantation and natural forests (REMA, 2020), and this study shows that many of these TMPs found in natural vegetation.

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Table 1: List of TMPs Found in Karongi District, Their Families and Scientific Names

Acanthaceae	**Convolvulaceae**	**Nyctaginaceae**
Acanthus polystachyus	*Astripomoea grantii*	*Mirabilis jalapa*
Brillantaisia cicatricose	*Ipomoea cairica*	**Ochnaceae**
Crossandra tridentata	**Crassulaceae**	*Ochna hackarsii*
Hygrophila auriculata	*Kalanchoe crenata*	**Olacaceae**
Hypoestes trifloral	*Kalanchoe marmorata*	*Ximenia caffra*
Monechma subsessile	**Cucurbitaceae**	**Oleaceae**
Thunbergia alata	*Lagenaria abyssinica*	*Jasminum Fluminense*
Amaranthaceae	*Momordica foetida*	*Olea europaea*
Achyranthes aspera	*Zehneria scabra*	**Onagraceae**
Amaranthus spinosus	**Ebenaceae**	*Ludwigia abyssinica*
Chenopodium album	*Euclea racemosa*	**Oxalidaceae**
Cyathula cylindrica	**Euphorbiaceae**	*Oxalis corniculate*
Dysphania ambrosioides	*Euphorbia gratii*	**Pedaliaceae**
Amaryllidaceae	*Euphorbia heterophylla*	*Sesamum angolense*
Scadoxus multiflorus	*Euphorbia tirucalli*	**Peraceae**
Anacardiaceae	*Ricinus communis*	*Clutia abyssinica*
Searsia natalensis	*Synadenium grantii*	**Phytolaccaceae**
Apiaceae	*Tragia brevipes*	*Phytolacca dodecandra*
Centella asiatica	**Fabaceae**	**Plantaginaceae**
Choritaenia capensis	*Cajanus cajan*	*Plantago palmate*
Apocynaceae	*Desmodium adscendens*	**Poaceae**
Catharanthus roseus	*Entada abyssinica*	*Bambusa vulgaris*
Gomphocarpus physocarpus	*Erythrina abyssinica*	**Polygalaceae**
Asparagaceae	*Indigofera arrecta*	*Securidaca longepedunculata*
Dracaena fragrans	*Senna didymobotrya*	**Polygonaceae**
Dracaena steudneri	*Senna occidentalis*	*Persicaria setosula*
Asphodelaceae	*Sesbania sesban*	*Rumex bequaertii*
Aloe dawei	*Tephrosia vogelii*	*Rumex usambarensis*
Aloe lateritia	*Vachellia hockii*	**Primulaceae**
Aloe secundiflora	*Vigna unguiculata*	*Lysimachia ruhmeriana*
Asteraceae	**Iridaceae**	**Ranunculaceae**
Dicoma anomala	*Crocosmia masoniorum*	*Clematis simensis*
Berkheya spekeana	*Gladiolus natalensis*	*Ranunculus multifidus*
Carduus nyassanus	**Lamiaceae**	**Rosaceae**
Conyza aegyptiaca	*Coleus barbatus*	*Rubus pinnatus*
Crassocephalum vitellinum	*Hoslundia opposite*	**Rubiaceae**
Echinops sphaerocephalus	*Leucas martinicensis*	*Rubia cordifolia*
Guizotia scabra	*Ocimum canum*	*Spermacoce princeae*
Lactuca inermis	*Ocimum gratissimum*	*Vangueria apiculate*
Meranthera scandens	*Orthosiphon thymiflorus*	**Sapindaceae**
Senecio cydoniifolius	*Rotheca myricoides*	*Dodonaea viscosa*
Tithonia diversifolia	*Tetradenia riparia*	*Haplocoelum foliolosum*
Vernonia amygdalina	**Leguminosae**	**Solanaceae**
Vernonia hochstetteri	*Canavalia ensiformis*	*Capsicum frutescens*

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Vernonia lasiopus	*Senna septentrionalis*	*Datura stramonium*
Bignoniaceae	**Malvaceae**	*Nicotiana tabacum*
Kigelia africana	*Abutilon angulatum*	*Physalis peruviana*
Markhamia lutea	*Alcea rosea*	*Solanum aculeastrum*
Cannabaceae	*Dombeya rotundifolia*	*Solanum incanum*
Trema orientale	*Grewia similis*	*Solanum indicum*
Celastraceae	*Hibiscus fuscus*	*Solanum nigrum*
Gymnosporia senegalensis	*Pterygota mildbraedii*	*Solanum villosum*
Chrysobalanaceae	*Sida cordifolia*	**Urticaceae**
Parinari curatellifolia	**Meliaceae**	*Urtica massaica*
Cleomaceae	*Carapa grandiflora*	**Verbenaceae**
Cleome gynandra	**Moringaceae**	*Lantana trifolia*
Clusiaceae	*Moringa oleifera*	*Verbena officinalis*
Garcinia buchananii	**Myrsinaceae**	**Vitaceae**
Harungana madagascariensis	*Maesa lanceolata*	*Cyphostemma ukerewense*

Source: *Primary source, 2025*

The Attitudes of Local Communities in the Karongi District Towards the Conservation of Traditional Medicinal Plants

The second objective was to evaluate the attitudes of local communities towards the conservation of traditional medicinal plants (TMPs).

Here, the researcher assessed the uses and role of TMPs in the health care system and the contribution of TMPs in the conservation of biodiversity.

The majority of respondents, 85.93%, know traditional medicinal plants, 45.48% use them frequently, and 55.78% strongly agreed that traditional medicinal plants play an important part in Rwanda's health care system.

Table 2: Use and Importance of Traditional Medicinal Plants

1. Do you know traditional medicinal plants?	**Respondent**	**Percentages**
Yes	342	85.93%
No	56	14.07%
2. How often do you or your family members use traditional medicinal plants?		
Frequently	181	45.48%
Rarely	152	38.19%
Always	46	11.56%
Never	19	4.77%
3. Do you think traditional medicinal plants play an important part in Rwanda's health care system?		
Strongly agree	222	55.78%
Agree	117	29.40%
Neutral	32	8.04%
Strongly disagree	23	5.78%
Disagree	4	1.01%

Source: *Primary source, 2025*

The research indicated that *Tetradenia riparia (Umuravumba)* was the most used traditional medicinal plant, with 86.68% of respondents and local people in Karongi District using the traditional medicinal plants mainly for digestive problems and skin disease, with 66.83% and 61.56% respectively

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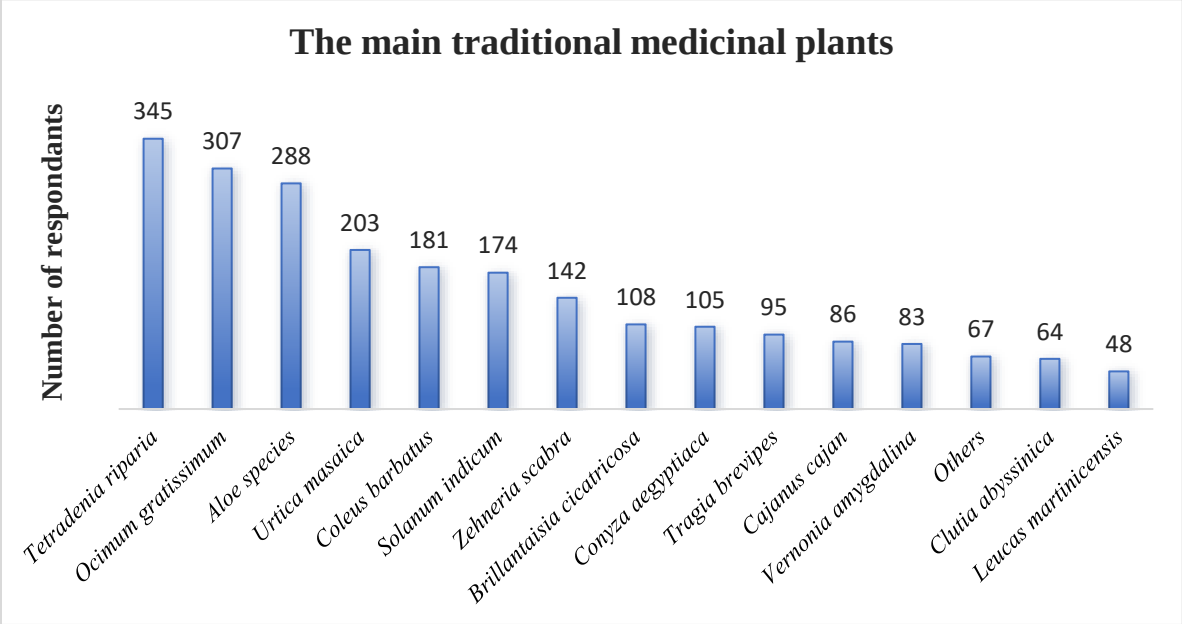
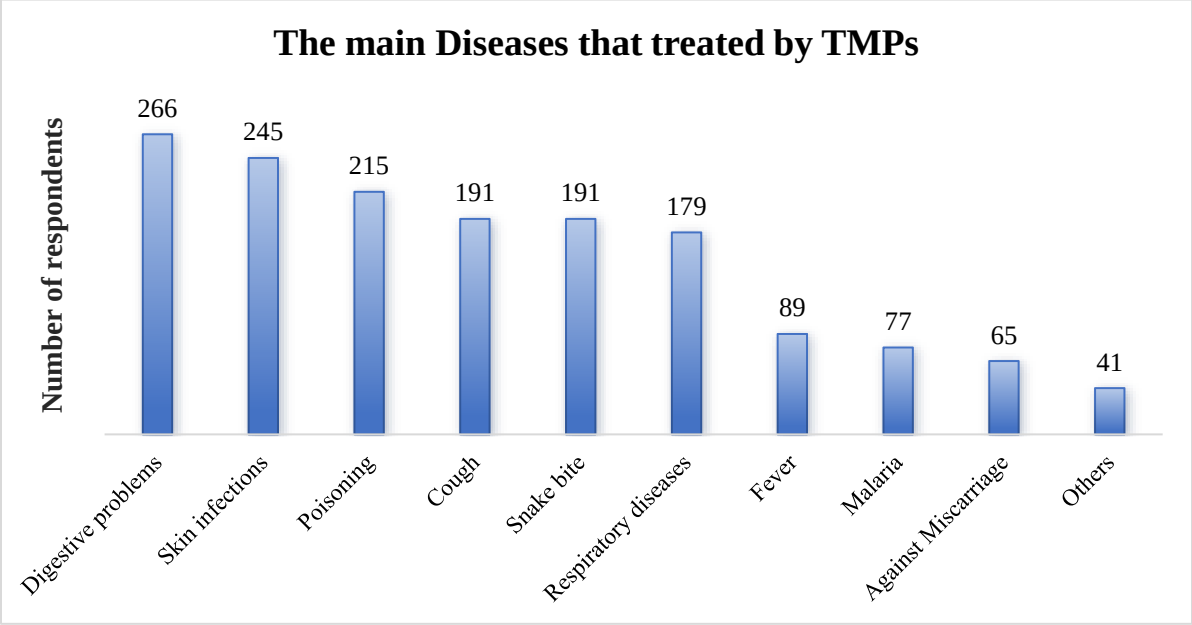
Figure 6: The Main Traditional Medicinal Plant Used



Source: *Primary source, 2025*

Figure 7: The Main Diseases that Treated by TMPs



Source: *Primary source, 2025*

The Role of Traditional Practices in the Sustainable Management and Conservation of Medicinal Plants in Karongi District

The third objective was to assess the role of traditional practices in the sustainable management and conservation of medicinal plants.

Sources and Accessibility of Traditional Medicinal Plants

Results show that 74.62% of the respondents said that they obtain TMPs from Natural vegetation like forests and wetlands, followed by home gardens with 51.76%. The respondents, with 82.66%, think that the accessibility of TMPs has decreased. The research indicated that urbanization, Agricultural expansion, and Deforestation are the main causes of the decrease in TMPs accessibility, as confirmed respectively with 68.34%, 58.04%, and 46.26%. There are

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others including climate change, Over-harvesting, and Industrialization.

Table 4: Sources and Accessibility

Where do you obtain TMPs?	Respondents	Percentages
Natural vegetation (forest, wetland)	297	74.62%
Grown in home gardens	206	51.76%
Farmlands	199	50.00%
Roadsides	165	41.46%
Purchased from local markets or herbalists	111	27.89%
1. Do you think the accessibility of TMPs is decreasing?		
Yes	329	82.66%
No	48	12.06%
Not sure	21	5.28%
2. What do you think are the main causes of this decrease		
Urbanization	272	68.34%
Agricultural expansion	231	58.04%
Deforestation	184	46.23%
Climate change	143	35.93%
Overharvesting	102	25.63%
Industrialization	73	18.34%
Other	10	2.51%

Source: *Primary source, 2025*

Conservation Practices and Challenges of TMPs

The respondents indicated that the conservation practices they apply to TMPs are Leaving some plants to regenerate, replanting after harvesting and harvesting only mature plants with 55.78%, 49.25% and 42.21% respectively, while some of the respondents said that there are no specific conservation practices 21.61%, but others confirmed that they do Rotational harvesting 20.85%. Despite that, communities face different challenges while conserving TMPs, and the main challenges found are a lack of knowledge on conservation methods at 74.62%, Lack of knowledge on TMPs at 69.10%, Government restrictions at 33.42% and Limited access to land at 31.16%.

Table 5: Conservation Practices and Challenges

1. Which Conservation practices do you apply to protect TMPs	Respondents	Percentages
Leaving some plants to regenerate	222	55.78%
Replanting after harvesting	196	49.25%
Harvesting only mature plants	168	42.21%
No specific conservation practices	86	21.61%
Rotational harvesting	83	20.85%
2. What challenges do you face in conserving TMPs		
Lack of knowledge on conservation methods	297	74.62%
Lack of knowledge on TMPs	275	69.10%
Government restrictions	133	33.42%
Limited access to land	124	31.16%
Other	4	1.01%

Source*: Primary source, 2025*

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RESULTS AND DISCUSSION

Community Reliance on Traditional Medicinal Plants (TMPs)

In many communities, traditional medicinal plants (TMPs) remain the primary healthcare resource (Tesfaye & Awas, 2018). Their widespread use stems not only from proven therapeutic efficacy but also from lower costs, cultural acceptability, trust in traditional healers, and dissatisfaction with modern healthcare systems (Eshete & Molla, 2021; Welz *et al*., 2018). This study examined local attitudes toward TMPs conservation, assessing their role in healthcare and biodiversity preservation. Findings revealed strong community awareness; 85.93% of respondents recognized various TMPs. Usage remains prevalent, especially in rural areas. Karongi District, where 93.1% of the population resides in rural zones exemplifies this trend, with TMPs serving as primary or complementary treatments. Practices are rooted in intergenerational knowledge, family traditions, and plant availability (Oladele & Alade, 2011). In Karongi, 45.48% of respondents reported frequent TMP use, while 11.56% relied on them exclusively. Rwanda's historical reliance on traditional medicine underscores its perceived safety and efficacy (Ministry of Health, 2019). TMPs are viewed as affordable, accessible, and culturally integral, particularly in remote areas with limited healthcare infrastructure (Tan *et al.*, 2021). Notably, 55.78% of respondents strongly agreed that TMPs play an important role in Rwanda's healthcare system. Usage frequency varies based on accessibility, cultural beliefs, and health conditions (Nsengimana *et al*., 2020), with many prioritizing TMPs despite modern healthcare availability (Elias & Fabien, 2024).

Traditional Practices and Conservation Challenges in Karongi District

Local communities recognize TMPs' dual significance for health and biodiversity. Most obtain plants from forests and wetlands, though home gardens are increasingly supplementing the supply due to environmental pressures (Bizuru, 2020; Nsengimana *et al.*, 2021). However, accessibility has declined, driven by agricultural expansion, deforestation (Mupenzi *et al.,* 2019), and climate change (Habimana & Ntirenganya, 2020). This threatens indigenous knowledge tied to disappearing species. However, the key concerns include overharvesting without replacement planting, risking species extinction (Eshete & Molla, 2021; Chekole, 2017), loss of learning opportunities as critical plants vanish, and the lack of a centralized TMPs database to preserve healers' knowledge for future research.

While conservation efforts exist, gaps persist. Some respondents admitted to no conservation practices, highlighting awareness deficits. Challenges like land scarcity and restrictive policies further hinder progress. Sustainable solutions require community education on conservation techniques, policy reforms integrating traditional knowledge, and collaborative land-use planning balancing agriculture and biodiversity.

CONCLUSION AND RECOMMENDATIONS

Traditional medicinal plants (TMPs) represent a significant component of healthcare and biodiversity in Karongi District, Rwanda. This study confirms that community members possess strong awareness and frequent use of TMPs to treat common diseases such as digestive issues, skin infections, poisoning, and coughs. However, these valuable resources face significant threats from urbanization, agricultural expansion, and deforestation. The loss of natural habitats and inadequate conservation awareness contribute to the gradual disappearance of valuable species and practices. Despite some local efforts such as controlled harvesting and replanting, critical gaps remain in conservation education, resource management, and policy support. To address these challenges while preserving both medicinal plants and associated traditional knowledge, this study proposes a comprehensive five-pillar strategy encompassing education, sustainable practices, policy support, research integration, and land management. The foundation of conservation efforts must begin with community education and capacity building. Targeted educational programs

Article DOI: https://doi.org/10.37284/eajenr.8.2.3190

should be developed to teach sustainable harvesting and conservation methods, ensuring local communities understand the ecological importance of TMPs. Equally crucial is establishing formal systems for intergenerational knowledge transfer, creating structured opportunities for elders to pass traditional ecological knowledge to younger generations. Complementing these efforts, community-based monitoring programs would empower local people to track medicinal plant populations and identify species at risk. Sustainable utilization practices form the second critical pillar of this conservation framework. Practical initiatives should include promoting medicinal plant nurseries and home gardens, which reduce pressure on wild populations while ensuring reliable access to medicinal plants. Hands-on training programs in sustainable harvesting techniques would teach community members how to collect plants without damaging populations or ecosystems. For wild populations, implementing scientifically designed rotational harvesting schedules would allow plant communities adequate time to regenerate between harvests. Policy and institutional support constitute the third essential component. Local and national governments should formulate policies that formally recognize and protect traditional medicinal knowledge as part of Rwanda's cultural heritage. Medicinal plant conservation must be integrated into regional land-use planning frameworks to prevent habitat destruction. Additionally, developing clear legal guidelines for sustainable wild harvesting would help regulate collection practices while respecting traditional rights. The fourth pillar focuses on research and healthcare integration. Rigorous scientific studies should validate the efficacy and safety of commonly used medicinal plants, providing evidence to support their continued use. Research should also explore systematic pathways for integrating validated TMPs into national healthcare systems, potentially creating official recognition of their therapeutic value. Establishing collaborative platforms that connect traditional healers with biomedical professionals would foster knowledge exchange and mutual understanding.

Finally, sustainable land management practices are needed to protect medicinal plant habitats. Promoting agroforestry systems that incorporate medicinal plants alongside food crops can maximize land use efficiency while preserving biodiversity. Designating specific conservation areas for threatened medicinal species would provide protected spaces for vulnerable plants to thrive. Implementing participatory community-based forest management programs would engage residents as stewards of medicinal plant habitats.

This multifaceted approach recognizes that conserving traditional medicinal plants requires addressing educational, practical, political, scientific, and ecological dimensions simultaneously. By implementing these interconnected strategies, Karongi District can protect its medicinal plant heritage while ensuring these valuable resources remain available for future generations. The success of this initiative will depend on collaboration between communities, researchers, policymakers, and healthcare providers, all working together to preserve Rwanda's rich tradition of plant-based medicine.

Acknowledgement

The author would like to express his gratitude to all individuals and institutions who contributed to this study. Special thanks are extended to the local communities, elders, local leaders, policymakers, and traditional healers for generously sharing their indigenous knowledge and experiences. Additionally, we appreciate the guidance and constructive feedback from peer reviewers, which helped improve the quality of this manuscript.

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