

# Population Status of *Hagenia abyssinica* and *Myrica salicifolia*: A Reflection from Rungwe District, Mbeya Region, Tanzania

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## Abstract

This study aimed at prioritizing medicinal plants used to manage HIV/AIDS opportunistic infections and assessing their wild population status. Data were collected using focus group discussions and inventories. Preference ranking and Microsoft Excel and QGIS software were used for data analysis. Up to seven species were prioritized as the most important in the disease management. It was also found that the species dominated the landscape with elevation between 1950 to 2050 masl. Moreover, the species displayed linear pattern distribution adjacent rivers. With regards to population structure, the species revealed J-shaped curves. The species density was 200/ha for *Hagenia abyssinica* and 28/ha for *Myrica salicifolia*. The dominance of species in higher altitudes as cited above indicates that they flourish well in highlands. The tendency of them to grow adjacent water sources reveals their water or moisture loving. Moreover, the J-shaped curves observed imply poor recruitment and hence unsustainable. The study recommends for urgent conservation plans especially on the sampled species. There is a need to ensure strict measures are put in place to safeguard the medicinal plant species to ensure their sustainability.

## Keywords

Spatial Distribution, Sustainability, Priority, Medicinal Plants, Rungwe

## 1. Introduction

Since time immemorial traditional medicines are acknowledged for their poten-

tial in the prevention and cure of various diseases worldwide [1] [2]. Globally, plants form the largest part of traditional medicine [3] [4] [5] [6]) of which 80% - 90% are wild [7] [8]. Medicinal plants are important for managing HIV/AIDS related infections, and have been widely used by HIV/AIDS patients [1] [9] [10]. By 2010's the HIV patients were reported to constitute one billion people who partly relied on medicinal plants [11], adding more pressure on the wild population of medicinal plants [7] [8].

In Tanzania, more than 60% of population depend on traditional medicine for primary health care [12]. For HIV patients, medicinal plants are mostly used as a solution to multiple related opportunistic infections. The trend of using plant medicine is associated with their availability all year long and affordability, both of which are not the case with modern drugs [13]. This has increased the extractive activities of most medicinal plants which contribute to alteration of their population status in the wild [8].

According to [14] report, 21% of the world plants are under threat of extinction. While Africa loses about 3.4 million hectares of forests [15] [16], Tanzania is estimated to lose 0.3% hectares of her forests annually due to conversion and over-exploitation of plant resources [17]. Though data on the loss are not specific to medicinal plants, it is likely that there is a large percentage of medicinal plants which are depleted [7], something which calls for urgent suitable conservation plans to guarantee their sustainable utilization [7] [11] [18] [19].

Numerous ethnobotanical studies have been conducted across the country including [9] [13] [20] [21]. However, these studies focused on the identification of species and their use in managing various diseases. In Rungwe particularly Poroto forest reserve, most of the studies conducted focused on gathering information mostly on general plant use and the presence of medicinal plant species in the area. A good example of these studies is a study by [22] who confirmed Poroto forest to be rich in diverse plant species and a study by [23] who related Poroto reserve's thick vegetation with the plenty of rainfall in the area and the adjacent communities that rely on the forest for livelihood including medicine. A study by [24] reported on the vegetation of Poroto forest reserve and the associated powerful ancestral spirits of Lake Ngozi with a special potency of most medicinal plants collected in the reserve.

Besides the confirmed use of medicinal plants among the HIV patients in Rungwe district [25], priority medicinal plant species are not documented. Also, limited studies have assessed the population status of the medicinal plants for managing HIV/AIDS opportunistic infections. This study was carried out to assess the population status of selected priority medicinal plant species used in the managing HIV/AIDS opportunistic infections in the Poroto forest reserve. Specifically, the study documented the priority medicinal plant species used to manage HIV/AIDS opportunistic infections and determined population structure, spatial distribution pattern, and population density to reveal its sustainability. These findings may benefit conservationists in their activities, the policy makers at all levels and the community at grassroots.

## 2. Materials and Methods

### Study area

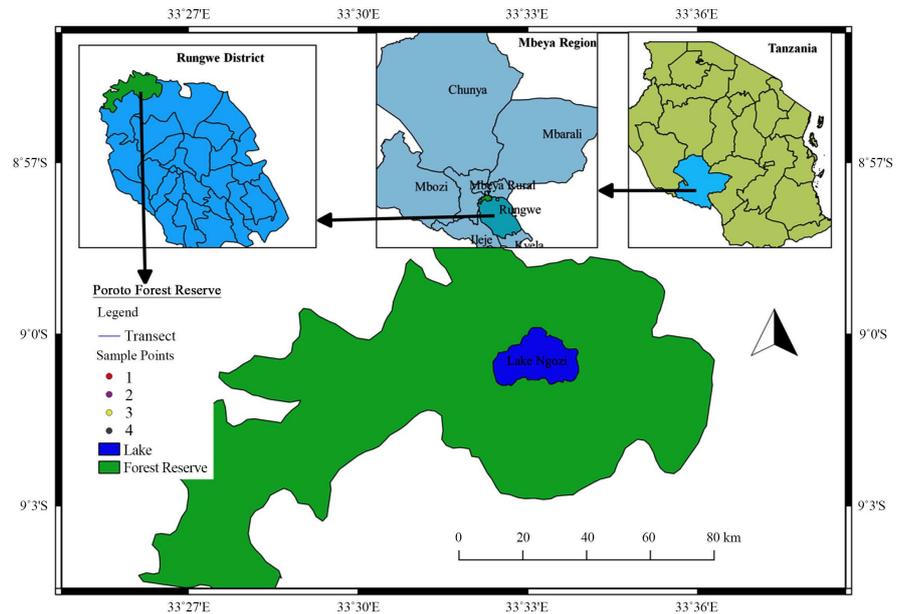
A mixed study was conducted between September 2016 to January 2017 in the Poroto forest reserve, Rungwe district, Mbeya region, Tanzania. Poroto forest reserve is located between Latitude 8°58' and 9°05' South and Longitude 33°26' and 33°36' East (**Figure 1**). The forest trans-bordering Rungwe and Mbeya Rural district has an area of about 9332 ha with the altitude ranging from 1750 - 2620 masl [22].

### Data collection

Data on prioritization were collected through focus group discussions with traditional healers and people with sound ethnobotanical knowledge. Participants of the focus group discussions were purposively selected with the help of local government leaders as recommended by [26] [27]. Sixteen (16) participants were obtained from two villages whereby each village was represented by eight participants and one focus group discussion was conducted in each of the selected villages. The participants were the Traditional Healers (THs) and other knowledgeable people on particular ailments and traditional medicine. In the first place, members in the (FGDs) were asked to prioritize medicinal plant species based on their uses/importance [28] [29]. Guidelines for group discussions were developed to facilitate the collection of information. An interview guide was used to collect information on priority species, diseases treated, parts used and preparation methods. Systematic sampling technique was used to obtain samples. Transects were laid on the sites where local people (traditional healers) guided the area with availability of these two species in abundance. Each transect was located by global positioning systems (GPS) and transects were separated by 500 metres each measured 1 kilometre long. A total of 44 circular sample plots were established along transects with 15 cm diameter radius and 100 metres apart. Diameter at Breast Height (DbH) was measured at 1.3 m above the ground. Information collected from plots included transect number, plot number, geographical coordinates, elevation, species names, number of species in the plot and DB using a high sensitivity GPS device (Extrex-Garmin) and recorded on data collection sheet. The species were then identified at the University of Dar es Salaam.

### Data analysis

Preference ranking following [30] and Microsoft Excel were used to obtain priority medicinal plant species as well as to determine population structure. Then, data were organized in an Excel table, bearing the following information; name of the collector, collection date, geographical coordinates, elevation, species family, scientific names, local names and DBH. QGIS software version 2.18 was used to analyse and describe the spatial data on the priority medicinal plants. Data on species' diameter breast height (DBH) were summarized in DBH size classes to determine population structure of the two species. This study adopted and modified [31]'s classification of trees which are in three classes to



**Figure 1.** Study area.

two. Trees were counted as seedlings if they had (<10 cm) and mature if they fell in (>10 cm) class. Density in terms of the number of individual plants in a given area and one factor in determining sustainability was used to calculate density of the medicinal plant species used to manage HIV/AIDS opportunistic infections as follows:

$$N = \frac{n_i}{a_i} \quad (1)$$

where  $N$  is the number of trees per ha;  $n$  is the number of trees in plot  $i$  and  $a$  is the plot area  $I$ .

### 3. Results

#### Priority medicinal plants

Results from preference ranking showed seven medicinal plant species to be of priority in managing HIV/AIDS opportunistic infections in the study area (**Table 1**). However, the assessment of population status of priority medicinal plants was performed on two medicinal plant species only, *Hagenia abyssinica* and *Myrica salicifolia*. The assessment was performed on two species based on their reported multiple uses that would lead to their depletion.

#### Distribution of *Hagenia abyssinica* and *Myrica salicifolia* by elevation

Both *Hagenia abyssinica* and *Myrica salicifolia* preferred growing within the range of 1950 and 2050 m above the sea level (**Figure 2**). This implies that the two species are of high altitudes therefore, any conservation approach that involve replanting or planting of these species outside their habitat should consider elevation aspects.

#### Species distribution in relation to water sources

The two priority medicinal plant species, *Hagenia abyssinica* and *Myrica salicifolia* established their growth within the range of 450 m from water sources in particular rivers (Figure 3). The Poroto forest reserve was evidenced to be surrounded with a number of permanent and seasonal rivers which provide favourable environment for the priority medicinal plant species and the forest ecosystem at large.

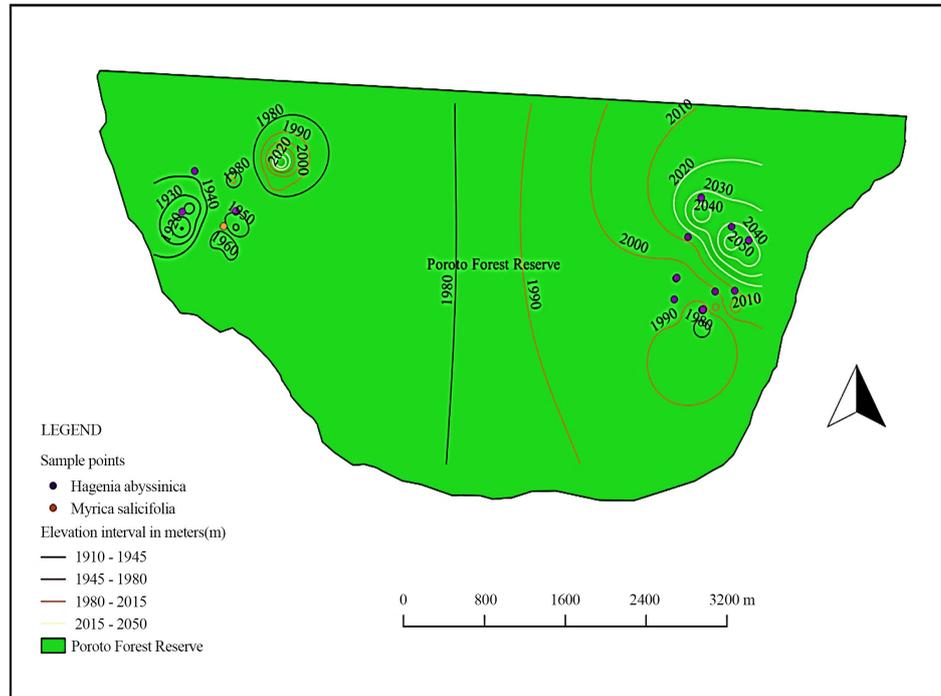


Figure 2. Species distribution by elevation.

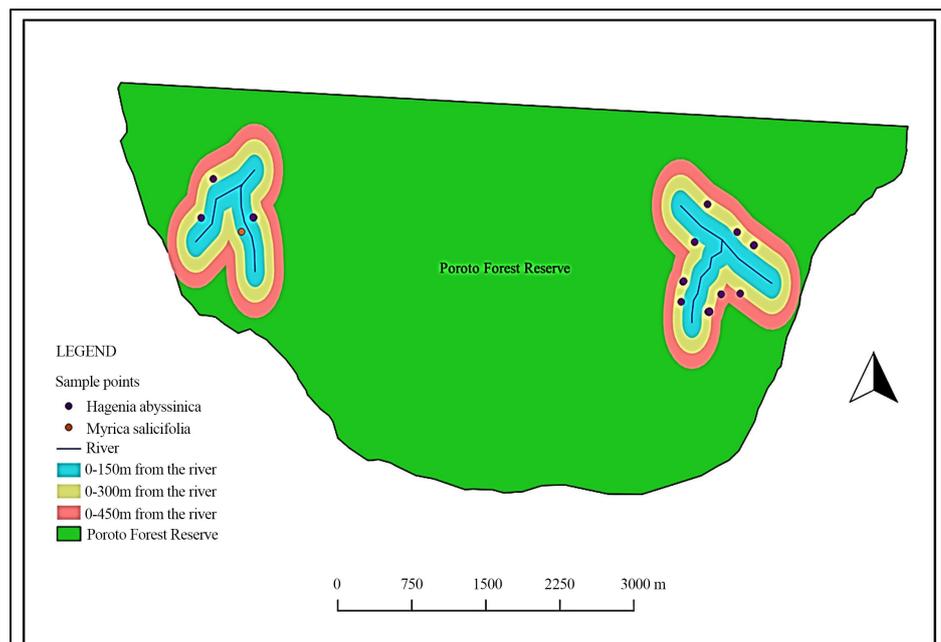


Figure 3. Species distribution in relation to water sources.

**Table 1.** Direct matrix ranking of priority medicinal plants.

Scientific Name	Family	Local Name	Form	CD	Hz	Infections managed				Total	R
						Hs	TB	OC	CC		
<i>Dissotis phaeotricha</i> (Hochst.) Hook. f.	Melastomataceae	Kyumika	Shrub	14	10	12	0	10	11	57	2 <sup>nd</sup>
<i>Berberis holstii</i> Engl.	Berberidaceae	Rungwe	Shrub/Tree	16	9	10	14	11	13	73	1 <sup>st</sup>
<i>Myrica salicifolia</i> Hochst. ex A. Rich.	Myricaceae	Nsibhisibhi	Tree	16	0	0	14	13	15	66	3 <sup>rd</sup>
<i>Hagenia abyssinica</i> (Bruce ex Steud.) J.F.Gmel.	Rosaceae	Ntululunga	Tree	14	14	13	14	0	16	73	1 <sup>st</sup>
<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Rosaceae	Nsongwa	Tree	16	3	0	14	0	0	33	5 <sup>th</sup>
<i>Aloe</i> sp.	Xanthorrhoeaceae	Mwalovela	Herb	10	12	6	8	0	0	36	4 <sup>th</sup>
<i>Rubia cordifolia</i> L.	Rubiaceae	Idadauzi	Climber	14	0	13	0	0	0	27	6 <sup>th</sup>

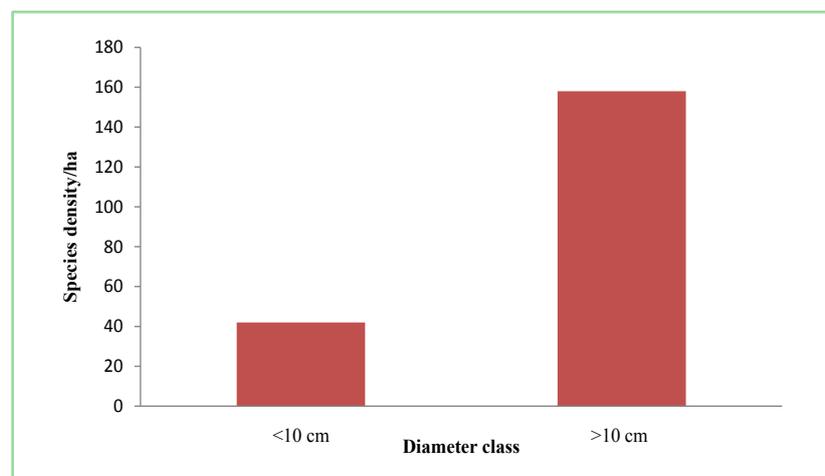
**Key:** Cd = Chronic diarrhoea; Hz = Herpes zoster; Hs = Herpes simplex; Oc = Oral candidiasis; Cc = Chronic cough; TB = Tuberculosis, R = Rank.

### Population structure of the species by diameter size classes

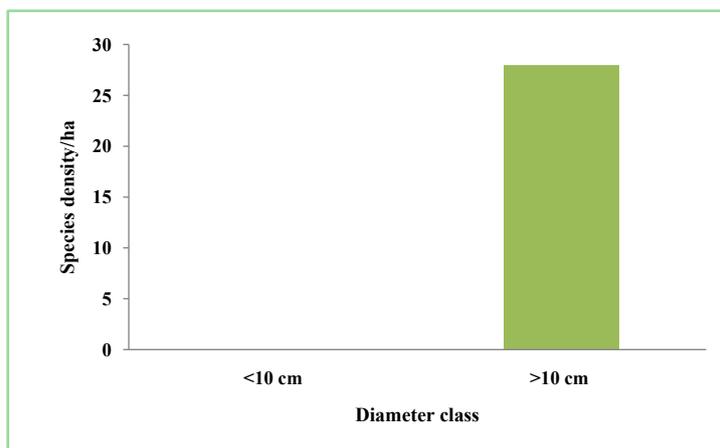
The population structures of *Hagenia abyssinica* and *Myrica salicifolia* in Poroto forest reserve were represented as mature trees with DBH classes (>10 cm). The lowest class that included plants with (<10 cm) known as seedlings, were poorly represented to indicate poor recruitment of the species. The worst scenario was observed on *Myrica salicifolia* as the species was not represented by trees in the lowest diameters (<10 cm) (Figure 4 and Figure 5).

### Population density of *Hagenia abyssinica* and *Myrica salicifolia*

The density of the two priority medicinal plant species encountered in the Poroto forest reserve was 228 stems per ha. *Hagenia Abyssinica* contributed the largest share as compared to *Myrica salicifolia*. From the overall density, the individual species densities the stem per ha, of the two medicinal plants, *Hagenia abyssinica* and *Myrica salicifolia* are presented in Table 2.



**Figure 4.** Population structure of *Hagenia abyssinica*.



**Figure 5.** Population structure of *Myrica salicifolia*.

**Table 2.** Density distribution of selected priority medicinal plants.

Diameter Classes (cm)	Species Density (stems/ha)	
	<i>Hagenia abyssinica</i>	<i>Myrica salicifolia</i>
<10	42	0
10 - 20	104	14
>20	54	14
<b>Total</b>	<b>200</b>	<b>28</b>

#### 4. Discussions

The communities interviewed in the study area seemed to be knowledgeable on the priority medicinal plant species as they mentioned up to seven of them in dealing with HIV/AIDS opportunistic infections. The prioritized species implies that they may contain bioactive ingredients as stated in literature by [32] [33]. The literature reveals that if plants are repeatedly used for the same purpose they are likely containing active ingredients. The medicinal plant species that were prioritized in this study have also been reported as priority species in other areas, for example, *Berberis holstii* by [34] in Malawi. *Hagenia abyssinica* and *Myrica salicifolia* by [35] [36] in Ethiopia.

The two priority medicinal plant species revealing their distribution in higher altitudes indicate they are afro-montane habitat. The findings from this study are supported by studies conducted by [35] [37] which showed similar species growing in higher altitudes. However, the species tended to decrease as the altitudes were getting to the peak, which is probably due to poor edaphic factors and prevailing high soil erosions. Therefore, in order to implement conservation strategies of *Hagenia abyssinica* and *Myrica salicifolia* in the study area or other places, efforts should focus on among others physiological factors and identifying favourable altitude thresholds. The altitudinal range reported in this study was considered favourable due to its thicker soils and low soil erosion as compared to steeper slopes.

Moreover, the tendency of species displaying linear pattern adjacent rivers may indicate that these plants require high soil moisture content and that in drier areas these species survival could be uncertain. These findings relate to those reported by [38] who associated the growth of *Hagenia abyssinica* with fertile and moist soils. Also, similar findings are reported in studies conducted in Ethiopia which confirm that *Myrica salicifolia* was found to be highly threatened by prolonged drought although other factors including anthropogenic activities contributed as well [6] [36].

The implication of *J*-shaped curves revealed by both species is that, the future of medicinal plants is uncertain. This is because both plants missed or had few younger plants (seedlings) to succeed the mature plants which signal for unsustainability medicinal plant species. According to [39], the proportion of plant population in the seedling (young) stage determines a predictable plant population at mature stage. A study conducted by [40] indicated that similar species (*Hagenia abyssinica* and *Myrica salicifolia*) missing representation in the lowest DBH class sizes (seedlings). Other studies have reported on *Hagenia abyssinica* and *Myrica salicifolia* being utilized for various purposes other than medicine such as house construction, furniture making and fuel wood, hence, threatening the species [6]. This implies the species have multiple uses and thus highly demanded to probably require conservation measures to ensure sustainability in future.

Generally, the density of the two species especially for the lowest DBH size class indicated that these species could be threatened. The threats might have been caused by factors such as fuel wood extraction, farming activities and animal grazing as they were observed during the survey in the forest reserve. The findings relate to what [41] stated that activities such as farm size expansion, extraction of wood for furniture and construction materials posed threats to the survival of *Myrica salicifolia* in Ethiopia.

## 5. Conclusions and Recommendations

The respondents in the study area were revealed to attach values to some species than others. These species are the most species people living with HIV/AIDS use or once used to manage the HIV/AIDS related infections. The population assessment performed on the two priority species (*Hagenia abyssinica* and *Myrica salicifolia*) growing in the Poroto forest reserve revealed that the species were unsustainable as the young plants were poorly represented. The study findings inform the policy makers and other stakeholders interested in medicinal plants of what is taking place in the forest reserve. Likewise, the study urges for joint efforts among policy makers, conservationists, local authorities, people at grass-roots and other stakeholders interested in medicinal plants to safeguard the medicinal plant species.

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### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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