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Assessment of Ecological Distribution, Species Diversity, Utilization and Conservation of Indigenous Medicinal Plants in Kilifi North, Kilifi County –Kenya

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Abstract

In Jilore, Magarini, and Matsangoni of Kilifi County, assessments of ecological species variety, distribution, abundance, and utilization of therapeutic flora were made. Total of 90 field survey forms were distributed randomly to 90 households. Additionally, 60 10m × 10m quadrats were set up along 6 transects to gather data on the vegetation.

From the study, 97 floral species were identified. Menhinick, Dominance, Shannon-weinner, and Margalef indices were 1.8, 0.93, 3.3 and 9.8 respectively. Sorensen's similarity and Jaccard indices were 0.12 and 0.045 respectively. Abundance class 1 and 8-16 had the most species of 17 and 14 respectively, while class 128-256 and 256-512 had the least individual species. The findings showed that 51% of all respondents collected therapeutic flora as their prime health care to date.

There was a positive correlation with a p-value of 0.05 between utilization of medicinal plants and gender, level of education and income per capita with 0.349, 0.164 and 0.105 respectively. Conservation and domestication of medicinal plants was embraced by 40% of the respondents. There's need for determination of the efficacy and pharmacological profiles of these curative plants in future since not everyone in the community was familiar with the species.

Keywords: Kilifi county; Therapeutic flora; Utilization; Abundance; Conservation; Diversity; Distribution

Introduction

A population of more than 22.9% of the entire globe's populace depends on forest resources for their living [1]. FAO [2] projected that approximately 2 billion of the populace of the globe utilize trees on farms and on community forests to generate food, medicine, shelter, fuel, and cash. A population of 2.7 billion people lives in the rural areas and reports indicate that over 75% of them rely on therapeutic plants as their principal healthcare [3].

Since ancient times, plants have been used for their medicinal value by human beings and out of 258,650 species of upper plants reported globally, 10% are habituated to cure ailing communities [4]. World Health Organization [5] estimates that over 3.5 billion of the 85% Sphere's populace residing in the developing world depends upon plants as components of their core healthcare. Jamann et al. [6] estimates that 6.05 billion people occupying Asian and African countries and over 50% of the population in North America, Europe and other industrialized countries rely upon medicinal plants for healthcare a minimum of once in a very year.

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Prior to the arrival of Western linctus, Africans had created their own successful techniques of remedying ailments, whether they had spiritual or physical causes [7]. Even while the consumption of western linctus has accelerated in Africa [8,9] indigenous African medicines and cures have not been abandoned. It has been reported that the wide use of therapeutic flora in Africa can be attributed to the following factors: the accessibility of traditional healthcare providers in relation to modern western healthcare; generated cash; the price of modern-day medications; academic level; gender; age; and religious beliefs [10].

Kenya doesn't seem to be an exception when it comes to how people utilize forests [11]. Kenya accommodates assorted forest types, including montane, rainforest, savanna, shrub, and mangrove [12]. Over 7,000 florae have been recorded in Kenya, with several useful therapeutic plants among them [13]. Over 90% of the Kenyan populace consumes therapeutic florae at some time in their lives, and over 37.64 million Kenyans depend on therapeutic florae as their primary source of homoeopathic care [14]. Tsigemelak et al. [14], Kigen et al. [15] and Dharani [9] all point to a lack of suitable modern health facilities as a cause of the reliance on therapeutic plants.

There were severe environmental losses from the 1990s timber harvest of up to 93,000 hectares (ha) [16]. Approximately 186,000 hectares (ha) of Kenya's remaining forest cover was lost between 1990 and 2005, with 38,000 hectares (ha) of it being indigenous forests [17]. Medicinal plant populations have been shown to be declining in recent years [18]. Most medicinal plants are lost as a result of grazing, clear-felling for agricultural operations, indiscriminate harvesting, overexploitation, and clearing for settlements, as stated by Omwenga et al. [19]. Some medicinal plant species are becoming scarcer due to unsustainable harvesting practices [20,21].

Because of differences in geographical location and climate complexity, stopping the loss of biodiversity is challenging for medicinal plants [22]. In addition, the challenges faced by medicinal species vary with their demand, geographic location, and proximity to other hazards [20,21]. Several factors, such as the components removed, the species' obtainability, and the need, are considered in order to stipulate which species should be given protection urgency [23]. Numerous studies have been done to assess the conservation measures used to protect medicinal plants in Kenya; however, few records exist due to the widespread belief, held by many participants, that therapeutic plants grow naturally and are never in need of care [24].

In Kenya, ethnobotany has received a lot of attention, although studies in Kilifi County have been few. To ensure these species' survival, vital tree types, reports must detail the accessibility of therapeutic florae and provide a response to the query about the status of the variety of curative flora. There is also a need for abrupt documenting to prevent these floras from extinction. For future usage conservation of such trees, it is also necessary to conduct constant monitoring, identification, and documentation of medicinal plants before they are lost forever. Natural resource documentation particularly that of medicinal plants is also important since it aids in the preservation of ecologically significant areas.

Materials and Methods

Study area

Three locations (Magarini, Jilore, and Matsangoni) in Kilifi County served as the study areas. The county is located between longitude 39°05 and 40°14 East and latitude 2°20 and 4° South. There are 1,453,787 people living in Kilifi County overall [25] (Figure 1a). Regarding the study areas, Jilore has 12,311 residents, Matsangoni has 18,806 people, and Magarini (Dakatcha) has 6558 people [25]. The Giriama ethnic group is the most prevalent one among the three places (Figure 1b).

Sampling Procedure

Selection of respondents

Ninety households were randomly selected from the three study locations and given a detailed questionnaire designed to elicit qualitative responses. The names, methods of prescription, parts used, accessibility, techniques of exploitation, and protection mechanisms in place for commonly used therapeutic plants to manage human and animal pathological illnesses and other purposes were noted.

Vegetation sampling

The therapeutic plant species diversity, abundance, richness, evenness, and other quantitative data were recorded

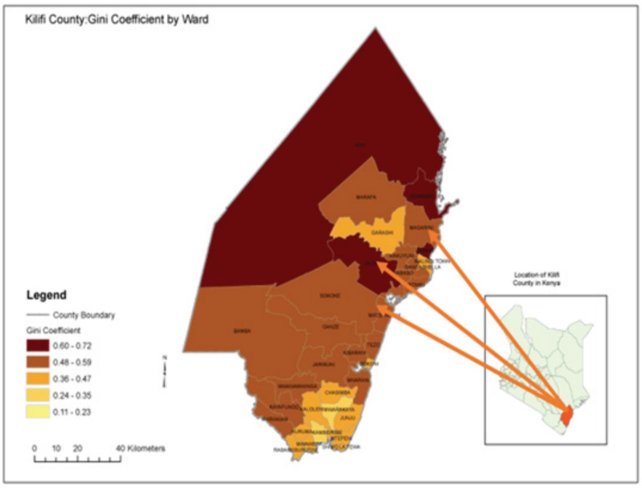

Figure 1a: Location of the three study sites (Matsangoni, Jilore and Magarini).

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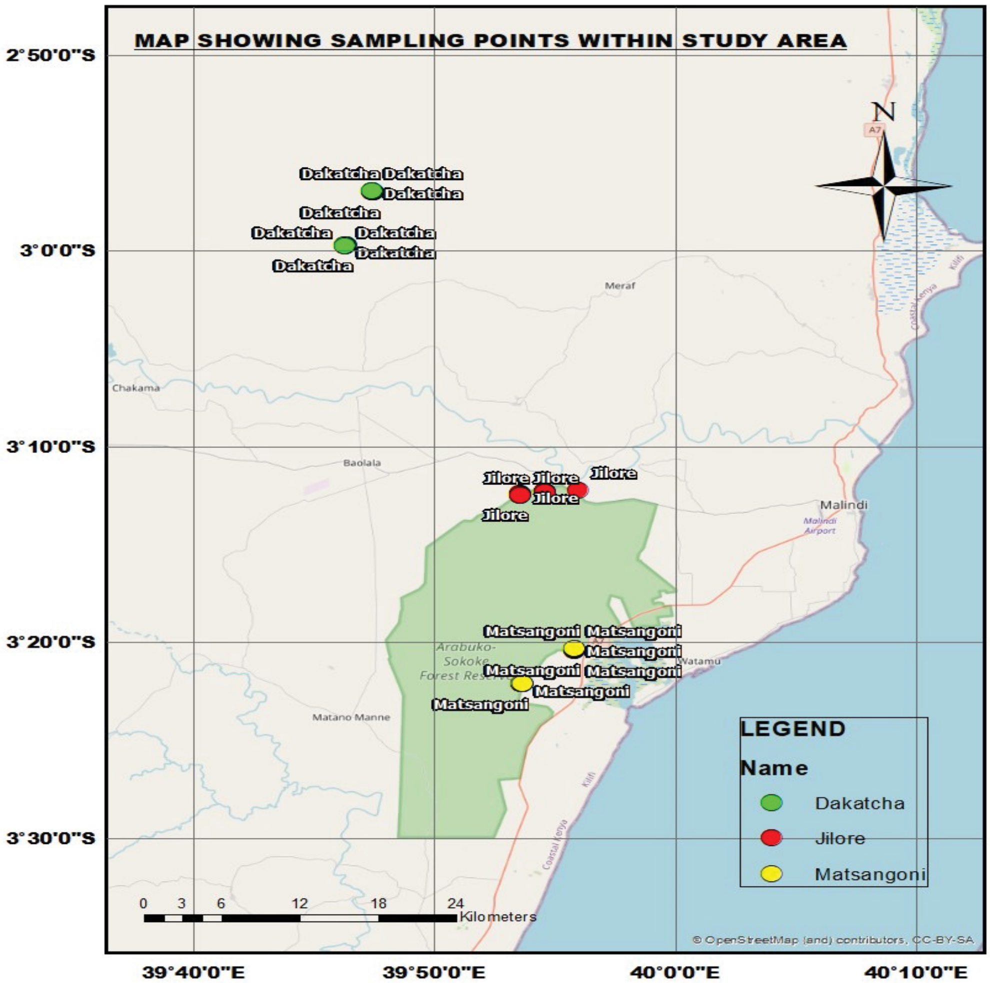

Figure 1b: Sampling points at the study sites.

using the Transect and Quadrat methods at the study site. Within each 600-meter transect set up at each study site, 10*10-meter quadrats were put out at 50-meter intervals using GPS technology [26]. Each sample plot was surveyed thoroughly, and all the flora was recorded. Trees were defined as individuals with a girth/dbh of ≥30cm, saplings as those 5 – 29cm in girth, while seedlings were those that were ≤ 1 meter in height.

Data analysis

Data was imported into JASP version 0.17.2.1, where summaries of data sets (Mean, median, variance and standard deviation), regression and Pearson Correlation were applied to draw connections among medicinal application while paying attention to demographic characteristics like education level, gender, income per capita, main financial activity, and age. The degree of correlation between independent variables, as well as the relationship between consumption, harvesting, threats, and conservation of the researched therapeutic flora, were determined via the use of multiple regression and Pearson correlation.

Pearson r correlation is the most widely used correlation statistic to measure the degree of the relationship between linearly related variables. The following formula is used to calculate the Pearson r correlation:

$$r_{xy} = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n\sum x_i^2 - (\sum x_i)^2}\ \sqrt{n\sum y_i^2 - (\sum y_i)^2}}$$

r_{xy} = Pearson r correlation coefficient between x and y

n = number of observations

x_i = value of x (for ith observation)

y_i = value of y (for ith observation)

NCSS and Biodiversity index Calculator were used to collect and evaluate species richness, abundance, species diversity and dominance index.

Species diversity

The number of different therapeutic species present in the three study sites was determined. Using the Shannon-wiener

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diversity index(H), the species diversity of the three research areas was calculated.

H=−∑[(pi)×ln(pi)]

Where:

∑=Sum

pi= proportion of individuals of i-th species in a whole community

ln=Natural logarithm

Species richness

The variety of existence at each of the three locations was measured with the use of the Margalef index. The Margalef index was established in 1958 as a way to quantify the prevalence of species [27]

Margalef's index = (S – 1) / In N

S = sum of the species present in the ecosystems

N = Sum of individuals in the sample

In = natural logarithm

Species evenness and similarity index

To report on species evenness, the first order Jackknife estimations and pileous Evenness (E) of the analyzed locations were computed. A species cumulative curve was also built for the three research locations. Sorensen's coefficient (SC) is a measure of similarity between flora groups. Sorensen's coefficient was computed to compare the therapeutic plants composition and their similarity among the three sites. Menhinick and dominance indices were determined using the following formulae.

Menhinick index (I) = S/√N

Where: I= Menhinick index

S= Specific species number

N= Total number of individuals

Dominance index (d)= N_{max}/N

Where: d= Dominance index

N_{max}= Sum of the most abundant species

N= Total number of individuals

Results

Abundance and frequency of therapeutic flora in Magarini, Matsangoni and Jilore

From the three locations, 97 plant species formed the basis of the research. Eighty-nine percent of the plants found were considered to have therapeutic properties. There were a total of 268 *Croton dichogamus*, 214 *Manilkara sulcata* and 104 *Flueggea virosa* among the three study locations. *Manilkara sulcata* had the highest relative frequency (66.67 percent), followed by *Croton dichogamus* (50 percent) and *Psydrax mombasae* (50%). The relative frequency was 33.33% for *Flueggea virosa*, *Cynometra webberi*, and *Thespasia danis* as shown in the Figure 2 below. In addition, abundance class 1 and 8-16 had the most species amounting to 17 and 14 respectively. Classes 128 – 256 and 256 – 512 had the least species individuals.

Species Richness, diversity, and dominance in Matsangoni, Magarini and Jilore sites

Menhinick index is used to measure how assorted species are in a population. Menhinick index was employed in this study to check abundance while Margalef index, dominance index and the Shannon-Wiener diversity index (H') were employed to quantify species richness, dominance, and diversity respectively. The Margalef index was at 9.8 meaning that there was a relatively high species richness as well as high dominance (0.93) of species in the three study sites. In addition, the diversity of the three study sites was very high with a measure of 3.3 and moderately high Menhinick index of 1.8. See Table 1 Dominance index Margalef richness index and Shannon index.

A comparison on diversity, richness, dominance and abundance on the three sites was made. Matsangoni had the highest diversity, dominance, menhinick and margalef indices (Table 2).

Sorensen's similarity and Jaccard indices

From the results, there were 4 common species in the 3 areas of focus. *Strychnos madagascarensis*, *Balanites wilsoniana*, *Cordia sinensis* and *Clausena anisata* were common in the study sites. Sorensen's index values range between 0 and 1. Value 0 means that the communities have exactly the same species composition while 1 means that they don't share any species. The areas of focus had a Sorensen's similarity index of 0.12 meaning that the 3 study sites are slightly shared species. Jaccard index which also measures the similarity of samples was found to be 0.045. The closer the index is to 1 the higher the similarity between or among the sample sets (Table 3).

Utilization of therapeutic flora

Azadirachta indica, a non-native species, was the most frequently used pharmaceutical plant in Jilore, Magarini, and Matsangoni (64.44%). Besides it, *Oldifiedia somalensis*, *Aloe kilifiensis*, *Grewia plagiophylla*, *Croton dichogamus*, and *Moringa oloifera* were the most used indigenous species by the responders with frequencies of 54.44%, 26.67%, 24.44%, 23.33% and 23.33% respectively. In addition to being the least well-known, *Clausena anisata*, *Dichrostachys cineras*, *Manilkara mochisa*, *Bombax rhodognophalon*,

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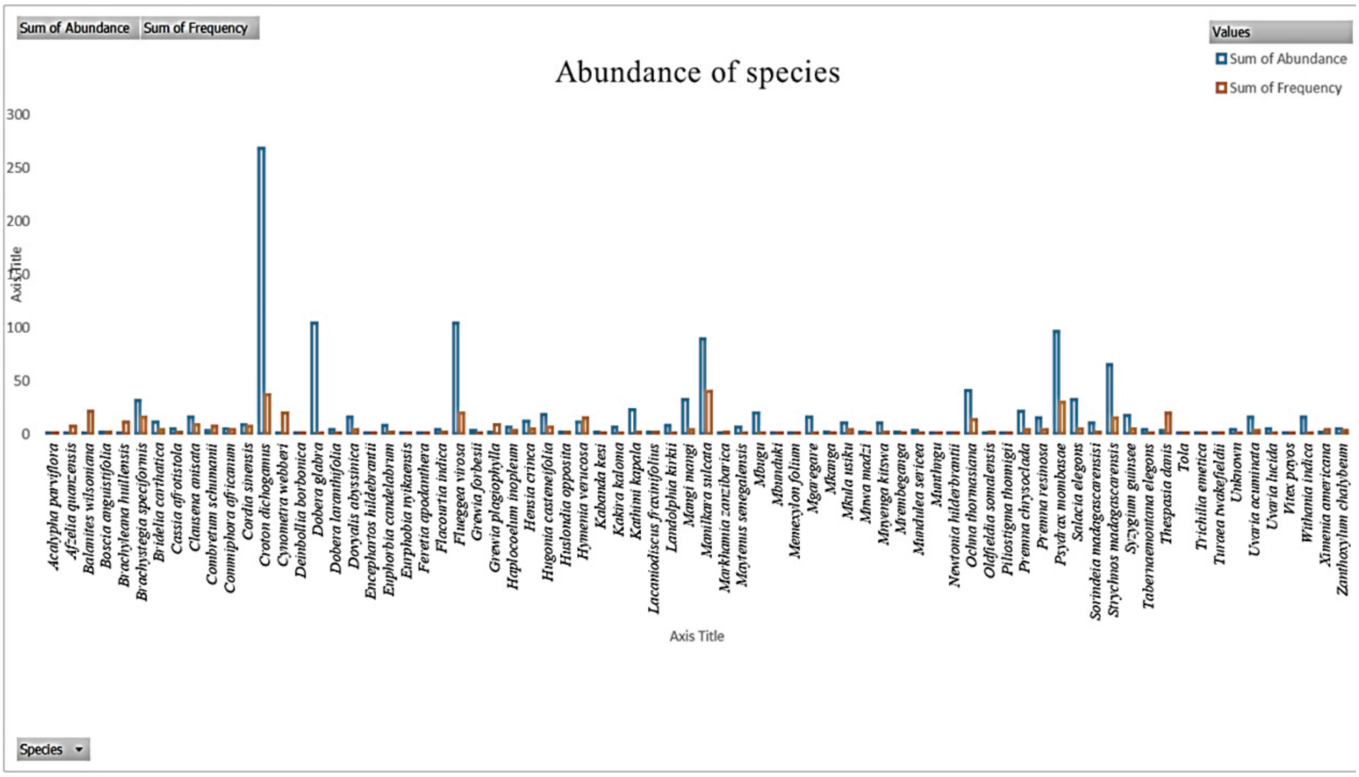

Figure 2: Floral abundance and frequency in the three study sites.

Mundulea sericea, Premna resinosa, Piliostigma thonningii, *Dobera glabra*, *Senna alata*, *Harrisonia abyssinica*, *Annona senegalensis* and *Senna siamea* (1.11%) were the least used species in focal areas (Figure 3).

Fever (18.5%), gastroenteritis (14%), anginas (7.3%), bruise (6.0%), hacks (4.8%), snake bites (4.8%), gastroenteritis (4.2%), grippe (3.8%), and oedema (3.8%) were the most commonly managed pathological conditions in the study areas. The least common homeopathic uses of therapeutic flora in the areas of focus were water treatment, control of jiggers, remedy of appendix, ears, STDs, constipation, and cardiac associated diseases (Figure 4). Utilization of curative flora was examined in relation to age, gender, education level, per capita income, household size, and primary economic activity.

Age of participant and extracting of therapeutic florae

The participant's age was hypothesized to be a factor in the use of medicinal herbs. According to Silva et al. [28] older persons may have more expertise using therapeutic vegetation because of their extensive knowledge and regular exposure to them. According to Begossi et al. [29], it was predicted that younger people would use medicinal herbs less frequently than older people (Table 4). According to the results of this survey, 11.1% of participants aged under 35 were reported to be utilizing therapeutic vegetation as their main source of healthcare. The utilization was highest among the people of age group 41- 45 years.

Table 1: Menhinick, margalef, dominance, Shannon-wiener indices of the study sites.

Total number of organisms	1587
Total number of species	97
Simpson index $\frac{\sum_i n_i(n_i-1)}{N(N-1)}$	0.067
Dominance index $1-\left(\frac{\sum_i n_i(n_i-1)}{N(N-1)}\right)$	0.93
Shannon index $-\sum_i\left(\frac{n_i}{N}\cdot\ln\left(\frac{n_i}{N}\right)\right)$	3.3
Menhinick index $\frac{S}{\sqrt{\sum_i n_i}}$	1.8
Equitability index $-\frac{\sum_i\left(\frac{n_i}{N}\cdot\ln\left(\frac{n_i}{N}\right)\right)}{\ln N}$	0.76
Margalef index $\frac{S-1}{\ln N}$	9.8

Utilization of therapeutic flora vs. gender

According to current assessments of Razafindraibe et al. [30] and Qureshi and Ghufran [31], women make up the majority of those who utilize therapeutic flora. See the table (Table 5 and Figure 5). Unfortunately, in this study, men participants used therapeutic vegetation more frequently than the equivalent females. It was clear that 42% of participants who used pharmaceutical flora were female and 58% of participants were men.

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Table 2: Dominance, shannon-weiner, menhinick and margaef indices of Matsangoni, Magarini and Jilore.

Site	Dominance Index $1-\left(\frac{\sum_i n_i(n_i-1)}{N(N-1)}\right)$	Shannon Index $-\sum_i\left(\frac{n_i}{N}\cdot\ln\left(\frac{n_i}{N}\right)\right)$	Menhinick Index $\frac{S}{\sqrt{\sum_i n_i}}$	Margalef Richness Index $\frac{S-1}{\ln N}$
Matsangoni	0.94	3.1	1.6	5.7
Magarini	0.85	2.4	1.6	5.1
Jilore	0.81	2.1	1.1	4.3

Table 3: Sorensen's and Jaccard indices.

Absolute beta Value ($(S_0$-c)-(S_1-c)...):	88	Whittaker's Index (S/alpha):	3
Sørensen's similarity index:	0.12	Alternate Whittaker's Index (S/alpha-1):	2
Sørensen's similarity index (%):	12%	Jaccard Index:	0.045
Routledge beta-R Index:	90	Jaccard Index (%):	4.5%
Mountford Index:	0.00012	Number of Common Species:	4
Mountford Index (%):	0.012%	Bray Curtis dissimilarity	0.88

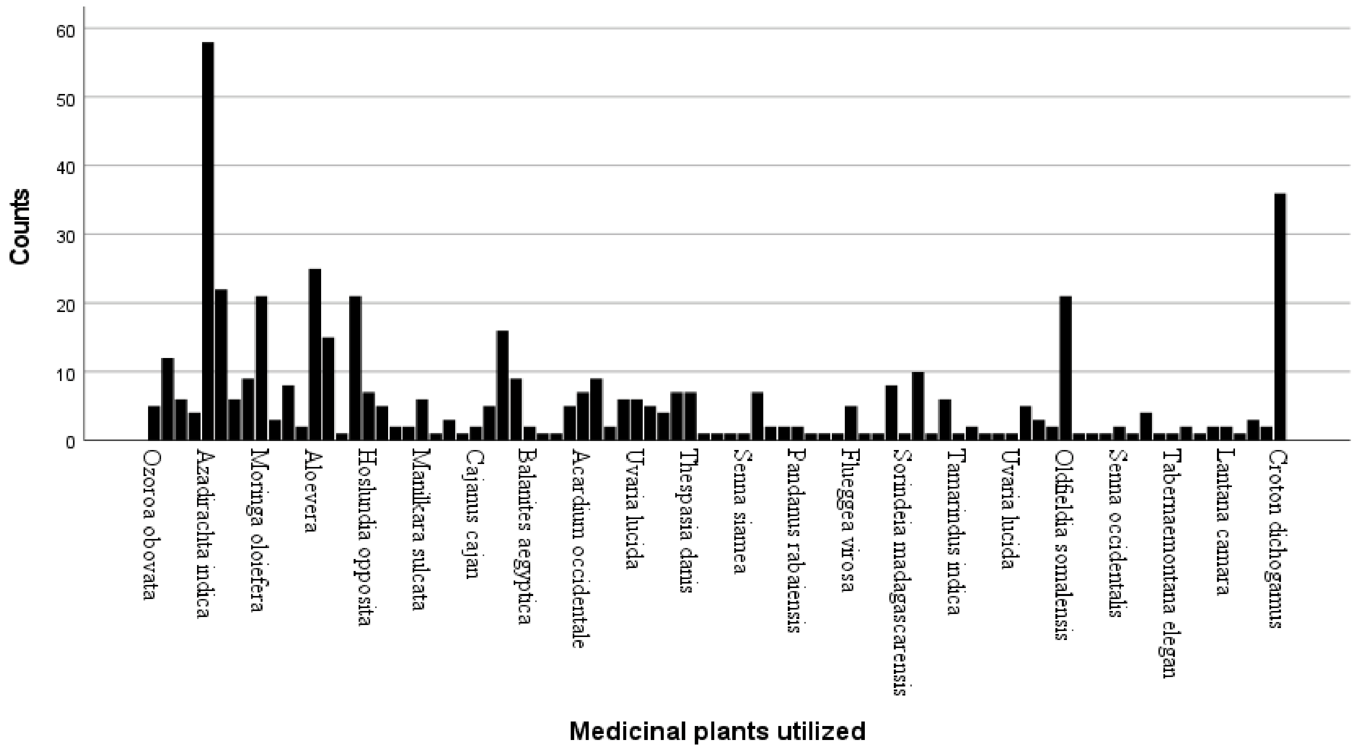

Figure 3: Frequency of utilization of medicinal plants.

Consumption of medicinal plants vs. level of education

Individuals with insignificant basic schooling were hypothesized to have more familiarity with therapeutic plants and higher rates of therapeutic plant consumption [32]. This is due to the local structure and the reality that those who have completed formal education have more options in life than those who have not [33]. Modern medical treatments are more affordable for the village's educated residents, while the less-informed choose for less-expensive remedies made from plants [34].

Of the participants who reported using therapeutic flora throughout the three research sites, 59% either had no proper schooling or had only completed elementary school, while 41% had finished secondary or higher schooling (Figure 6).

Income per capita and prime financial engendering activity

Income per capita is used to describe the quantity of cash engendered by an individual, family, nation or continent. The standard measure of a country's prosperity is its per capita income. Previous research has suggested that households

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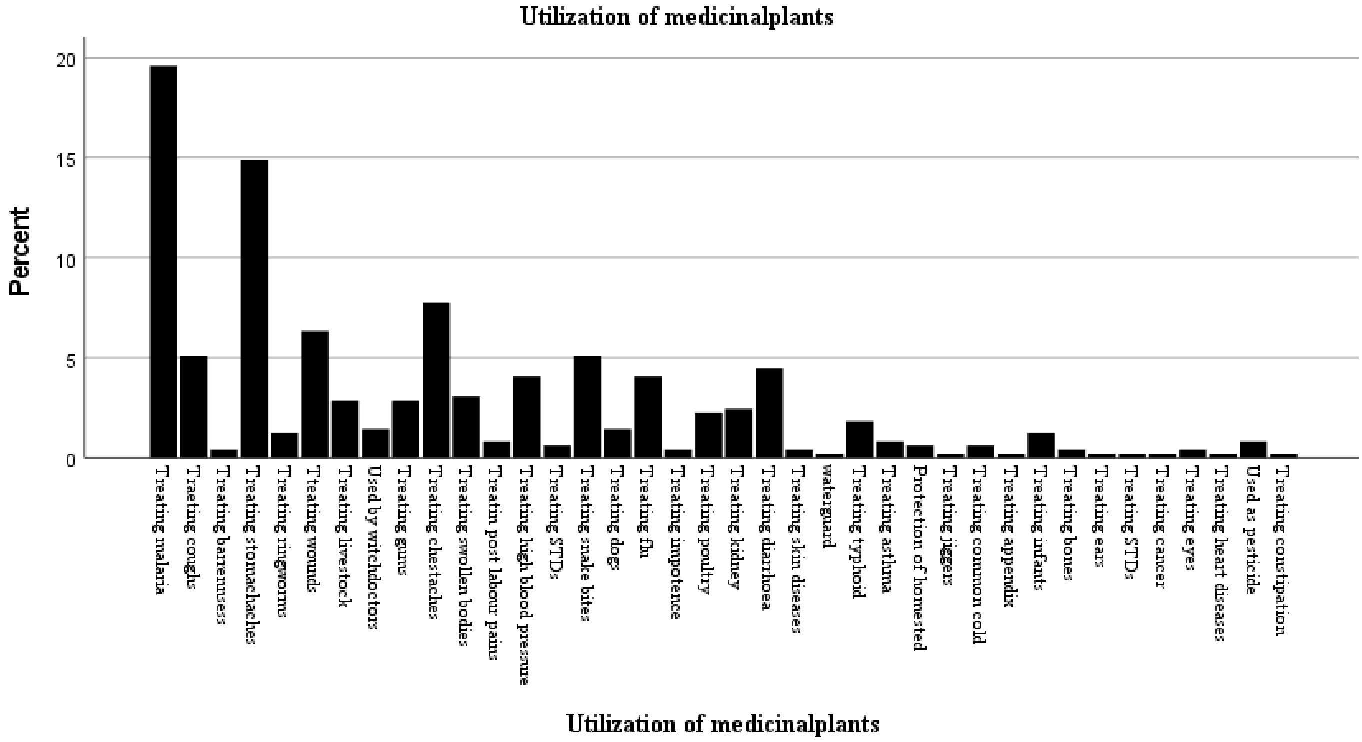

Figure 4: Pathological conditions managed by medicinal plants in the study areas.

Table 4: Age and utilization of medicinal plants in the study areas.

Age	Cumulative %
41-45 years	0.1889
51-55 years	0.1778
Above 61 years	0.1667
36-40 years	0.1556
56-60 years	0.1
31-35 years	0.1
46-50 years	0.1
26-30 years	0.0111
Grand Total	1

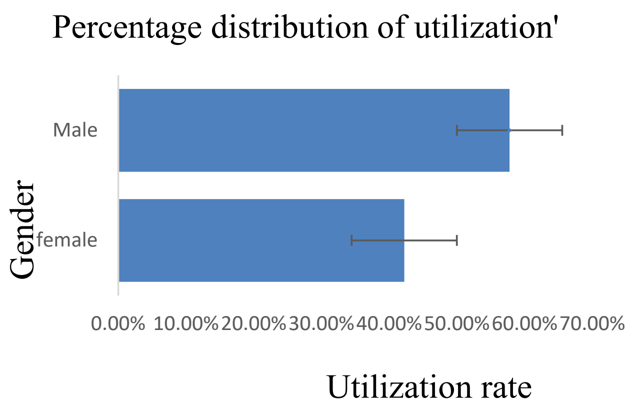

Figure 5: Percentage distribution of utilization in Matsangoni, Magarini and Jilore

Table 5: Utilization of medicinal plants vs. gender in Matsangoni, Magarini and Jilore.

% of utilization	
Gender	Count of Gender
Male	0.5778
female	0.4222
Grand Total	1

with limited means will rely largely on therapeutic vegetation due to their convenience and low cost. As a result, it was considered that people living in areas with a lower per capita income were more likely to make use of therapeutic vegetation. Daily average income was converted to Kenyan shillings (Kshs). Eighty-two percent and seventy-six percent of those who answered the survey and reported using therapeutic herbs, respectively, had a per capita income of Kshs. 0 to 100 and Kshs. 101 to 500. Figure 7 shows participants with a per capita daily income of between Kshs. 501 and Kshs. 1000 were least likely to rely on traditional medicines.

Person correlation between consumption of therapeutic flora to independent size of the family, age, main financial engendering activity, gender, daily generated cash and education level.

The degree of relationship between linearly related variables was determined. The statistical significance relationship of utilization and dependent variables such as

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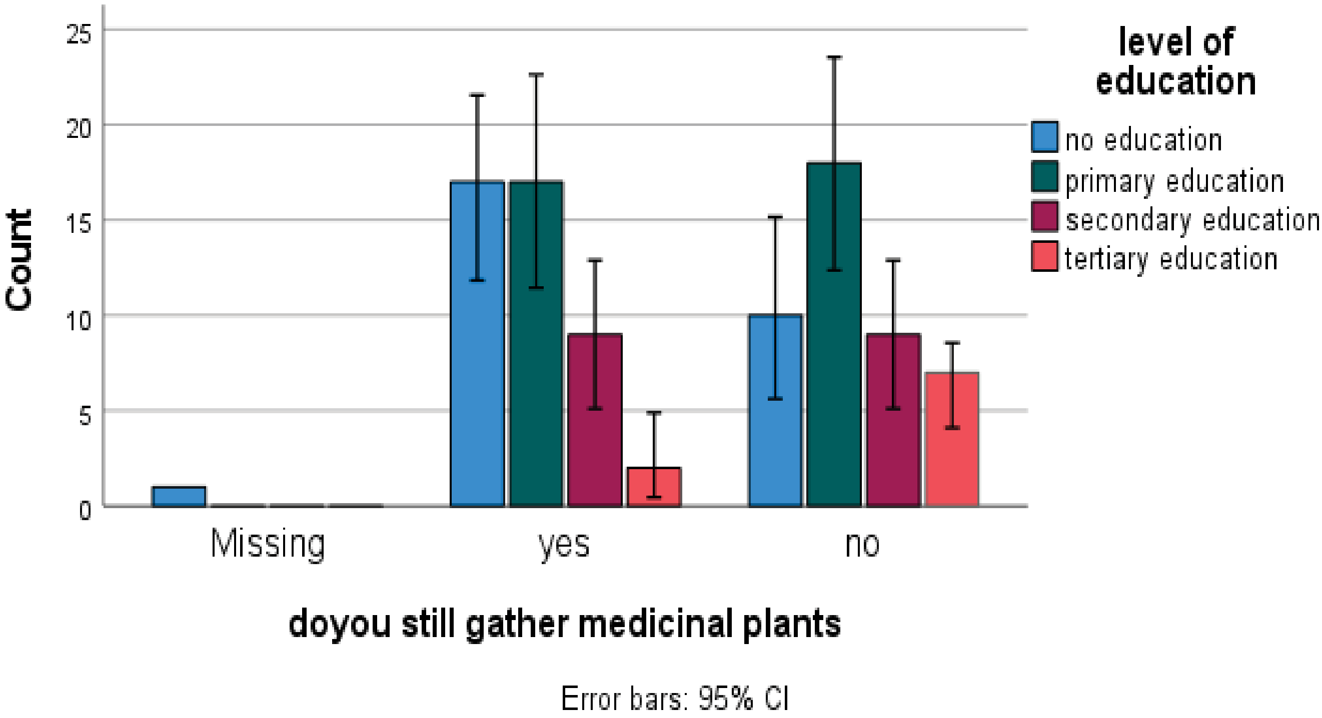

Figure 6: Level of education vs. utilization of medicinal plants in Matanagoni, Magarini and Jilore.

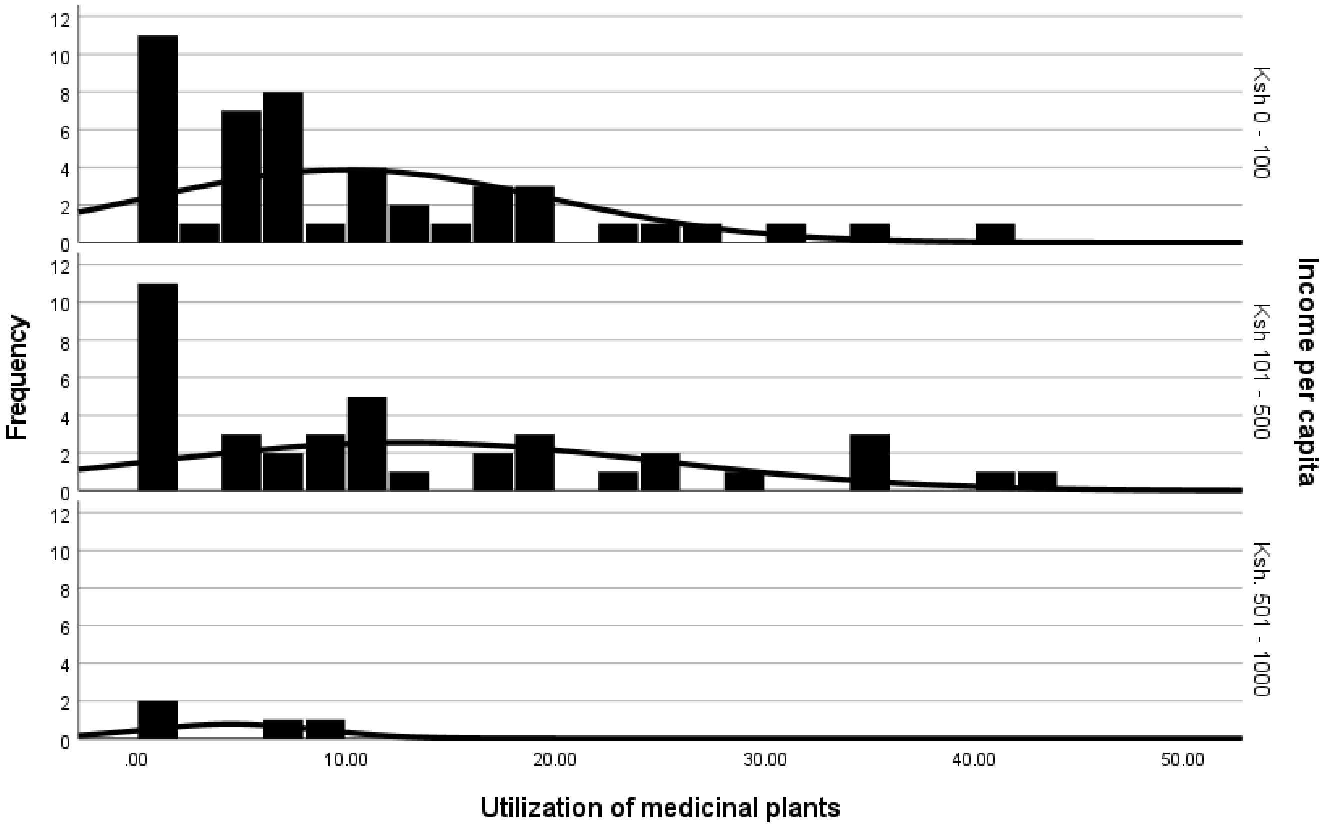

Figure 7: Utilization of medicinal plants vs Income per capita of the respondents in Matsangoni, Magarini and Jilore.

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age, gender, income per capita, education level, household size and primary economic activity was calculated. The R^2 of the model was 0.041for the H1 meaning that variability was explained (Table 6).

Person correlation between utilization and demographic factors

The z-score which is used to determine dispersion of data was between -1.273 and 1.039 meaning that the datum lied closer to the mean. The data was then tested at p-value > 0.05 significance level. Use of remedial flora was positively related to all independent variables as follows; gender (0.349), participant level of education (0.164), and primary economic activity (0.105) with p> 0.05. As can be shown in (Table 7) below, there was a negative connection between therapeutic florae use and several demographic variables, including participant age (-0.144), income per capita (-0.266), and household size (-0.061).

Conservation of medicinal plants in Matsangoni, Magarini and Jilore

In the same way that regular garden plants, field crops, and intercropped plantation crops are all possible, so too can gardens full of therapeutic flora [35].

Methods of harvesting therapeutic flora in Matsangoni, Magarini and Jilore

Human activity is not the primary reason in the proliferation of therapeutic plant species; rather, natural processes like climatic change (fire and herbivory) and the availability of resources (water and nutrients) have a larger role. However, there are local extinction risks for these therapeutic species because of overexploitation, environmental changes, and changes in land use. Leave removal (44%), root extraction (38%), stem ringing (9%), and plucking of twigs (3%) were the most common techniques for extraction. Of the three locations, pruning had the lowest extraction rate (0.2%) (Figure 8). Roots and leaves were clearly the most popular plant components among those who were interested in using plants for pharmaceutical purposes. The practice of uprooting and removing leaves is ecologically threatening and may even endanger certain species' survival.

Table 6: Model summary of utilization of therapeutic plants.

Utilization of Medicinal Plants				
Model	R	R^2	Adjusted R^2	RMSE
H_0	0	0	0	0.503
H_1	0.203	0.041	-0.028	0.51

Threats facing therapeutic flora in Matsangoni, Magarini and Jilore

Several factors were noted throughout the three research locations that contributed to the decreased availability of therapeutic flora (Figure 9). Most of the world's therapeutic species are under danger from human activities including uncontrolled charcoal making (44.58%) and overutilisation of therapeutic plant components such as roots (27.21%), followed by modern agricultural development (10.54%), the complete taking out of the plant from the ground caused excessive harvesting (9.64%), climate change (3.61%), and clearing for housing development (2.41%). Interestingly, about half of the participants (60%) reported growing their own therapeutic flora at home, whereas the other half (40%) did not. According to the research, 13.79% were domesticated to make them more easily accessible, 10.34% were tamed so they could be used for maintaining mild pathological conditions, and 9.20% were domesticated to save from extinction. The results showed that 3.45% was set aside to deter trespassing, 1.45% was set aside to safeguard cultural practices, and 3.45% was set aside for basic medical treatment.

Possible protection actions for therapeutic flora in Kilifi County (Jilore, Magarini and Matsangoni)

A substantial 93.26 percent of participants expressed approval of a conservation area, while only 1.12 percent expressed opposition. Among those who said they'd be okay with conservation zones or botanical gardens existing, 54% said it was to conserve endangered tree species, 8% said they weren't sure, 4% said it was to safeguard local culture and discourage trespassing, and 2% said it was to promote research. Forty percent of the participants from all the locations had domesticated therapeutic plants for managing mild pathological conditions.

Table 7: Person correlation between utilization of medicinal plants and demographic factors.

Variable	Sample size	Person's r	z-score	p	Lower 95% CI	Upper 95% CI
Age	90	-0.144	-1.273	0.203	0.003	0.223
Gender	90	0.389	0.763	0.445	0.009	0.314
Primary economic activity	90	0.105	1.039	0.299	0.04	0.406
Income per capita	90	-0.266	-0.644	0.52	0.006	0.283
Level of education	90	0.164	0.651	0.515	0.01	0.317
Household size	90	-0.061	-0.061	0.097	0.002	0.184

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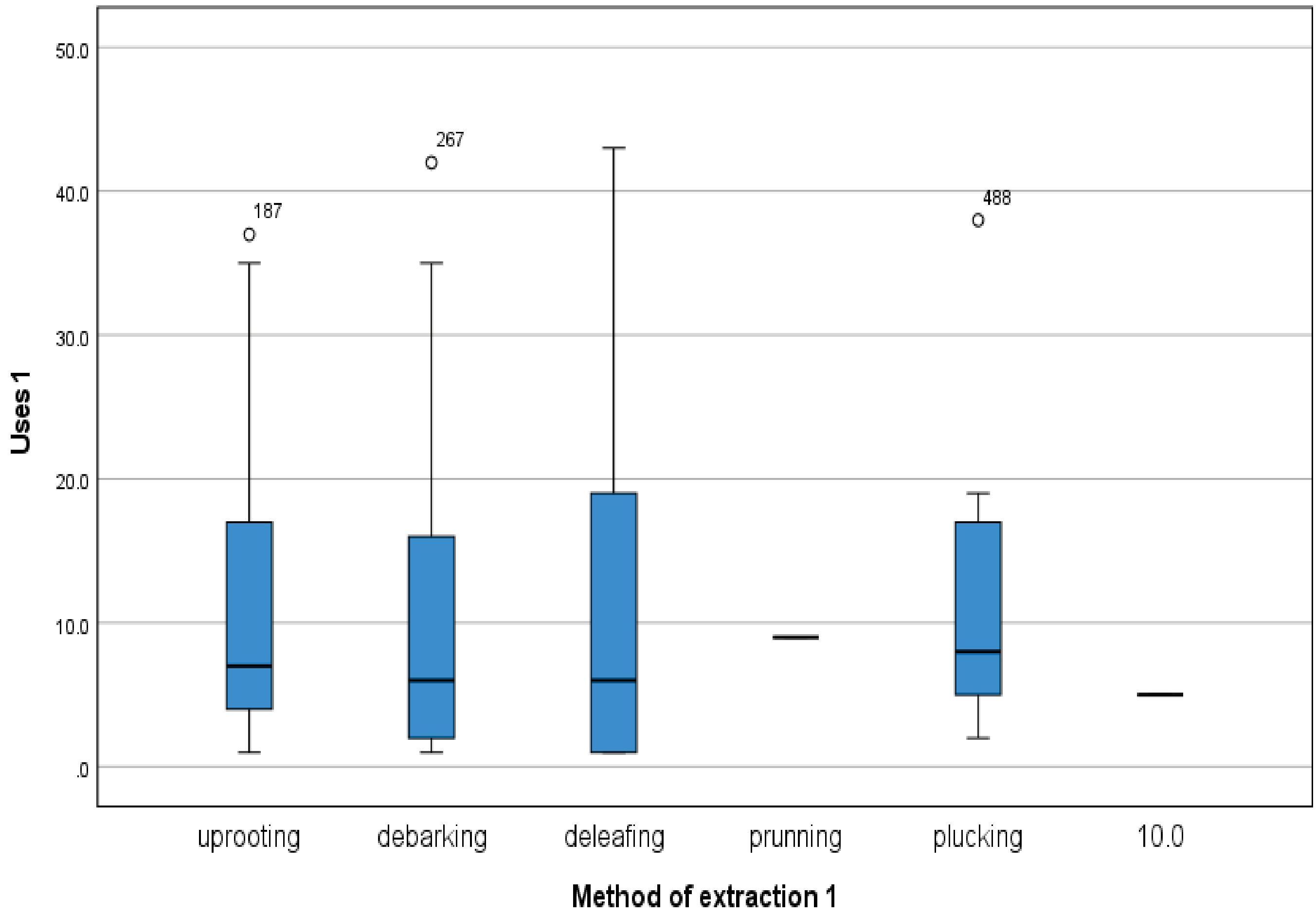

Figure 8: Methods of extraction of medicinal plants.

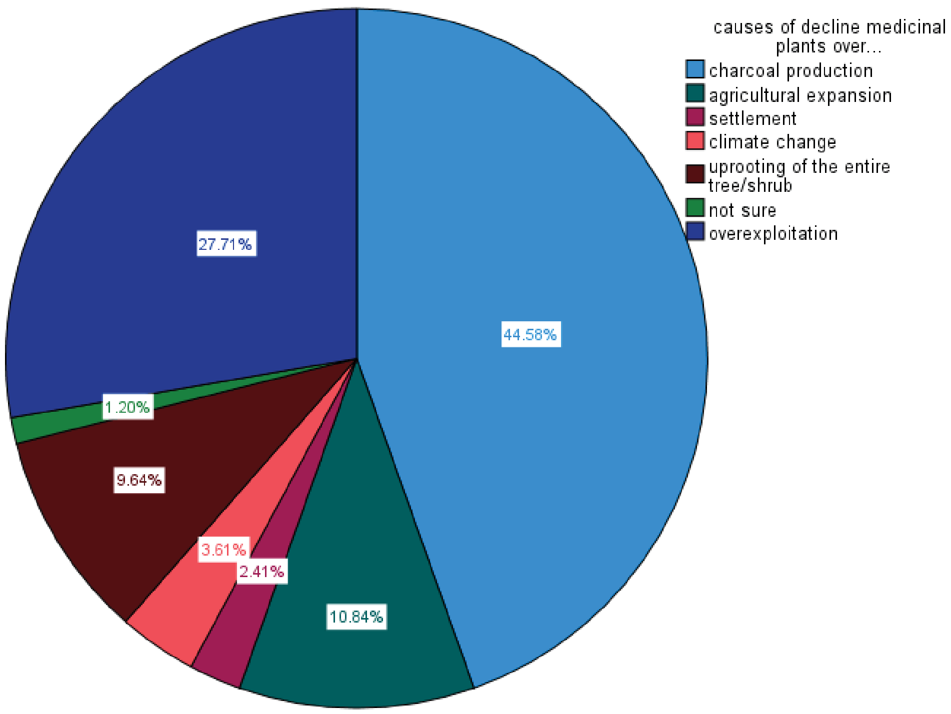

Figure 9: Threats facing medicinal plants in Matsangoni, Magarini and Jilore.

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Discussion

The Shannon-Wiener diversity index (H') was applied to the data from Magarini, Matsangoni, and Jilore to calculate the species diversity at each location. Matsangoni exhibited the highest species diversity (H' 3.1) out of the three study locations, followed by Magarini (H' 2.4) and Jilore (H' 2.1). In addition, Matsangoni surpassed both Magarini and Jilore in terms of number of available species and evenness. In addition, Matsangoni had the highest species richness and abundance at an index of 5.7 and 1.6 respectively. Species dominance was determined in the three focal areas and Matsangoni had the highest dominance index of 0.94 followed by Magarini and Jilore with 0.85 and 0.81 respectively. The Matsangoni part is located close to Arabuko Sokoke woodland, one of East Africa's last surviving coastal forests. Due to its designation as a UNESCO Man and Biosphere Reserve, Matsangoni is well protected and is thus likely responsible for its high biodiversity.

Many "tropical woodlands possess high species richness", as described by Gentry et al. When comparing the "comparative status of different species in an bionetwork, species dominance is the most relevant aspect" [36]. The "level of dominance in an ecosystem is a good predictor of the connection between species variety and bionetwork performance" [37].

The Dakacha woodland (Community owned forest) in Magarini is where the vast majority of the data was obtained, however it is isolated from the microclimate unrepented by the nearby Arabuko Sokoke forest. The Dakatcha forest has also been harmed by charcoal manufacture and the unrestrained growth of pineapple plantations. Inefficient farming practices cause soil erosion, and local laws pay little attention to the massive pressure on the forest. The economy of the region in which Jilore is located relies primarily on charcoal production and small-scale animal rearing for livelihood. While grazing affects tree biomass overall, charcoal manufacture often singles out and eradicates entire species.

The assessment conveyed a higher consumption among the males than the females. While earlier research depicted females as making most use health care services as compared to men. da Costa et al. [38], Stjernberg et al. [39], Díaz-Reviriego et al. [40] studies found the opposite to be true. The bulk of local hospitals and dispensaries employ young female nurses, thus the men interviewed for this study said they would rather use medicinal herbs than modern treatment. They also found that certain medicinal plants were less expensive, more easily available, and more effective than dispensaries. Most participants, independent of gender, age, main financial engendered activity and income per capita, indicated using *Oldfieldia somalensis*, *Aloe kilifiensis*, *Grweia plagiophylla*, *Diospyros consolata* or *Azadirachta indica* for prime well-being. They could have been used because they were common in the area and effective in halting the spread of disease. It's also possible that they became popular because of the passing down of traditional wisdom from one generation to the next. The participants may not have been familiar with, or interested in consuming, *Premna resinosa*, *Senna siamea*, *Dobera glabra*, *Clausena anisata*, *Piliostigma thonningii*, *Mundulea sericea*, *Dichrostachys cineras*, *Manilkara mochisa* and *Bombax rhodognophalon* because these species were not native to the areas where the surveys were conducted. In addition, their usefulness and participants' ethnobotanical knowledge may have contributed to their low usage. All sites have the most common and well-known species, according to the research [41]. All participants reported seeing, hearing, or consuming *Azadirachta indica*, indicating that it was present at all research sites. Furthermore, it was observed by Omwenga et al. [19] that all participants were familiar with Urtica dioica because of its prevalence in all study locations and was a common weed in the area.

The significant dangers to therapeutic species included charcoal making, overutilization, expansion of farms, and overextraction at 45%, 27%, 11% and 10% respectively. Protracted famine (4%) and housing development (3%) were also identified as major problems. In Mwingi and Mwala Sub-counties, overgrazing, charcoal burning, and environmental degradation were all threats to medicinal plants in those areas [42,43]. Furthermore, Groner et al. [44] found that the availability of therapeutic florae was threatened in most developing countries by charcoal manufactures, an unregulated market for medicinal plants, uncontrolled harmful gathering practices, overharvesting, and climate change). As a result, it is urgent that measures be taken to encourage more effective conservation practices and the responsible management of essential plant materials. Kilifi County, particularly Jilore, Matsangoni, and Magarini, "requires early preventive actions that will promote proper and continuous use of plants resources to forestall strain on medicinal plants that can eventually affect entire forest environment" [45].

Unsustainable methods of extraction and harvesting threaten the survival of many medicinal plants [46]. Although plants with a low reproduction rate may be negatively impacted by unsustainable harvesting practices, this is not the case for all species [47]. Tolerance, lifetime, amount harvested, and growth rate are just some of the variables that determine a plant's vulnerability to unsustainable harvesting. Extraction of leaves accounted for 51% of all edible plant components across all three sites while roots, bark and the entire plant were extracted at 31%, 11% and 2% (2%) respectively. Twigs, sap, seeds and fruits were the least extracted plant components.

Numerous useful pharmaceutical flora can be grown in backyard gardens, tamed as agricultural crops, or

fortune Journals
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incorporated into existing crop rotations [48]. Communities "have applied Waterborne "ailments have continued to cause many illnesses and deaths, hence there in need for concerted effort to stem this trend in the entire world" [49]. Validation of "old-style use of antidiarrheal therapeutic florae by examining the biological action of extracts of such florae, which have antispasmodic properties, delay intestinal transit, suppress gut motility, stimulate water absorption or reduce electrolyte secretion is called for" [50]. From the many "phytochemicals (such as alkaloids, tannins, flavonoids and terpenes) available in active extracts, tannins and flavonoids play a key role in antidiarrheal action by enhancing colonic water and electrolyte reabsorption" [51]. There is a need to "evaluate the safety of plants preparations to eliminate their toxic properties" [52]. A few "clinical trials have evaluated the safety and tolerability of traditional and herbal medicine preparations used to treat diarrhea and generally indicate that minimal side effects are observed". However, "with the increased popularity of plant-derived and herbal medicines in Western society, the benefits and potential dangers of these medicines must be considered" [53]. In a surprising finding, just 60% of participants had grown their own therapeutic herbs at home. In addition, 13.79% domesticated them so they would always be available, 10.34% so they would always have medicine on hand in case of an emergency, and 9.20% so they wouldn't go extinct, 3.49% so they wouldn't have to trespass in government forests, and 1.15% so they could be used only for cattle and fowl. Interestingly, 60% of participants said they would create conservation areas on their farms if given the resources to do so. Very little effort has been made by African countries to grow medicinal plants for use in drug development and research [54]. Jeruto et al. and Wekesa et al. [55] urged local communities, government agencies, and non-profits to domesticate forest resources as a means of protecting forest biodiversity. In a similar vein, Jeruto et al. stressed the significance of community capacity building in regard to the preservation of plant species for ethnobotany. All responders in the current survey called for more environmental education about the use, cultivation, and protection of medicinal plants.

Conclusion

Based on the results of this evaluation, 87 different types of medicinal plants were found among the three locations analysed. The greatest number of useful plants were found in Matsangoni (31), next in Magarini (29), and finally in Jilore (27). Human-induced activities like charcoal manufacture, firewood gathering, or removal for agricultural expansion were shown to increase in frequency as the number of curative species in a site decreased. Some respondents felt that human interference reduced biodiversity and altered forest structure.

One measure of biodiversity's value is its species richness or the variety of species present overall in a studied region. The Margalef index (K = log S/log N - where S being the quantity of species and N represented the total number of subjects in the sample) was used to quantify species richness in this research. The overall species richness was 9.8. Matsangoni site scored a higher Margalef index (5.7) than either Jilore (4.3) or Magarini (5.1). An unstable environment, as indicated by low species richness, has consequences for food webs and chains. This study found that low species richness in Jilore and Magarini indicated an unhealthy environment that might hasten the extinction of some species.

How species are dispersed throughout a region is referred to as the distribution pattern of those species. Therefore, the species distribution in Matsangoni was more easily seen than in the other two locations. Repetitive human activities including timber harvesting, charcoal making, agricultural growth, and population growth all contribute to low species diversity. Matsangoni site (3.1) had the greatest variety of species, whereas Magarini (2.4) and Jilore (2.1) had the fewest. Sorensens' similarity (a model intended to illustrate the degree of flora similarity) was calculated between the three locations. Sorensen's quotient of similarity was estimated at 0.12 in all sites with 4 species being common in all sites. These species were *Clausena anisata*, *Balanites wilsonina*, *Cordia sinensis* and *Strychnos madagascerensis*. Since a forest with high conservation values tends to contain more species than one with low conservation values, this may explain why Matsangoni is so rich in biodiversity. Species richness may also have been affected by factors such as climatic change, altered land use practices, the tolerance range of individual species, interspecific competition, and interspecific interactions [4,56].

Among those who utilized medicinal florae, 59% were males and 41% were women. Previous research has shown that women are more likely than males to utilize medicinal herbs. The study's results corroborated the widespread usage of medicinal plants by males who lacked the confidence to seek treatment at conventional medical institutions. Fever was the most commonly treated disease (19%), followed by gastroenteritis's (14%), angina pains (7%), bruise (6%), snakebites (5%), hacks (5%), gastroenteritis (4%), grippe (4%), and oedema (4%). The insignificant common uses of therapeutic plants in the survey sites were for the treatment of cancer, jiggers, cardiac problems, epidemic conditions, STDs, and ears. Research with the Nandi, Maasai, Luo, and Suba peoples of Kenya yielded the same findings.

The hazards of overexploitation and depletion due to overharvesting, charcoal manufacturing, and grazing are reflected in the continued use of medicinal herbs. Farmer-managed natural regeneration and the domestication of forest resources are two methods for easing human strain on forests and preserving their biodiversity. Due to a lack of understanding on medicinal plant conservation techniques,

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unfortunately, 13.79% of participants had domesticated therapeutic plants. Dispersion patterns in ecosystems and across species are poorly understood, which contributes to conservation challenges [57,58].

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Data Availability Statement

The data that support the findings of this study are available upon request from the author (valerina.mulatya@gmail.com)

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