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POPULARITY, DISTRIBUTION AND CONSERVATION STATUS OF SACRED AND MEDICINAL INDIGENOUS TREES IN CHEMOSOT, KERICHO COUNTY, KENYA

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ABSTRACT

Comprehensive data on sacred and medicinal plants of communities in Kenya are scarce. Such plants are increasingly being threatened by loss of cultural knowledge, indigenous belief systems and collapse of traditional botanical management. The current study aimed at assessing the popularity, distribution, and conservation status of traditionally important sacred and medicinal plants at Chemosot Ward in Kericho county. Ethnobotanical data was collected from interviewing 83 land-owners using the Kipsigis language and 10 local experts, while the diversity, number and distribution of sacred and medicinal trees was collected from 10 transects using systematic random sampling. Results document a total of 35 species of sacred and medicinal indigenous tree species, of which 27 were medicinal, two were sacred, and six were both sacred and medicinal. There was a higher number of species in farmlands than along roadsides while riparian areas had the lowest number of species. Three species were identified as critically endangered (*Ekebergia capensis*, *Carissa spinarum*, and *Trimeria grandifolia*), 11 as endangered, two as rare while nine more were identified as vulnerable. In conclusion, the study confirms the bi-purpose (sacred and medicinal) role of trees in the Kipsigis community and that several of these culturally important trees may be highly threatened locally. It is therefore recommended that additional research be conducted to further determine the influence of Traditional Ecological Knowledge (TEK) on the conservation status of sacred and medicinal indigenous tree species.

Keywords

Sacred trees, Taboos, Popularity index, Conservation status, Chemosot, Kericho, Kenya.

Introduction

The loss of cultural knowledge and the collapse traditional resource management strategies has been closely tied to urbanization, overexploitation, and land use changes among different communities across the world (Arjona-García et al, 2021). This cultural loss is perceived to influence biodiversity loss because studies indicate that the cultural value and religious importance of a plant species highly influence plant conservation and sustainable utilization (Wilder et al., 2016). Traditional ecological knowledge (TEK) is a collective body of knowledge, beliefs, and practices, evolving from the interaction and adaptation to the environment by communities that influence access and utilization of natural resources. Taboos, alongside the cultural and medicinal values of plant species has promoted their domestication in farms and their protection in the wild (Kibonde, 2020; Clemence and Chimininge, 2015). Hence, loss of TEK is a major threat to plants and animal species across the world (Mehra et al., 2014).

The Kipsigis community are known to have a rich cultural heritage that includes a vast repository of ethnobotanical knowledge evidenced by their use of sacred plants in every ritual and ceremony. For example, Cattle for bride price are usually driven to the bride's home after bride price negotiations (koito) using a special plant, senewet*, Senna didymobotrya* while, *s*moke from *Zanthoxylum spp,* (sagawaita), was traditionally used to cleanse belongings and households of the deceased (Enneth, 2015). Such significance of plants in religious worship, rituals, and traditional ceremonies (Douglas, 2016) leads to creation of specific beliefs, taboos, and cultural practices about several culturally important plants that in turn enhance their conservation.

Unfortunately, culturally important tree species are increasingly being threatened through land use changes. Moreover, sacred and medicinal plants are disappearing due to unsustainable harvesting methods. As access to modern healthcare improves and cultural practices and taboos continue to be lost, the incentive to preserve certain culturally important medicinal and sacred plants diminishes and people are more inclined to violate taboos regulating harvesting and utilization of sacred species (Arjona-Garcia et al, 2021).

Furthermore, although loss of TEK has been cited as a threat to conservation of sacred and medicinal trees among the Kipsigis, little data exists on the diversity and the conservation

status of sacred and medicinal trees. Hence, there is little cultural incentive to preserve these species. More so, the ones that manage to survive are increasingly being overexploited as taboos governing their utilization fade (Doffana, 2017; Negi et al, 2018). This study therefore sought to determine the current popularity, distribution, and conservation status of key Kipsigis sacred and medicinal trees in Chemosot Ward. This knowledge can be used to promote the conservation of these plants, promote sustainable use and preserve the rich Kipsigis culture.

METHODOLOGY

Study area

Chemosot Ward is situated between Litein and Kericho towns along highway C23 in Kericho County (Figure 1). The area receives high rainfall with annual average exceeding 1900 mm and an average temperature of 17˚C. The area is well drained by several small rivers and streams which drain into River Itare/Chemosit at the upstream sections of River Sondu. The ward covers an area of approximately 50 Km^2 with a population of 35,940 people as per the 2019 national census estimates (Kenya National Bureau of Statistics (KNBS), 2019) and about 4700 households (KNBS, 2013).

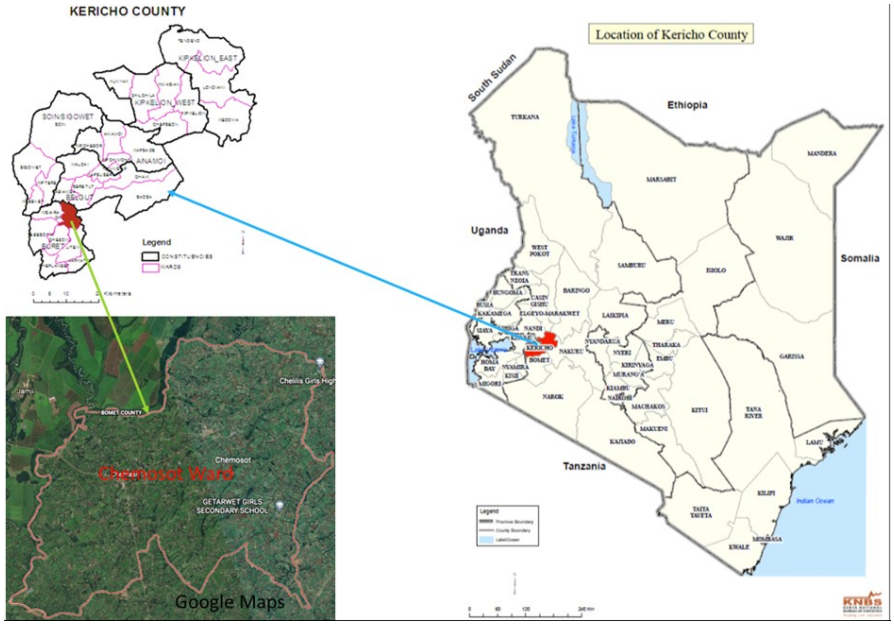

Figure 1: A map showing location of Chemosot Ward in Kericho County, Kenya. (Source: Author)

The major economic activity is mixed farming with tea being the dominant cash crop (County Government of Kericho (COK), 2019). Major income sources are tea, vegetables, maize, and milk (COK, 2019). More than 80% of residents use firewood and only about 10% use electricity for cooking and lighting. According to 2013 estimates, only 22.4% of ward

residents were formally employed while 47% were informally employed in agricultural related activities, artisanal, family related businesses and other small-scale enterprises (COK, 2019).

Study Design

Ethnobotanical data collection was implemented in two stages.

First, simple random sampling was used to select 100 residents for an ethnobotanical survey. The sample size was calculated using Yamane's Formula, n = N/1 + N€2; where N= number of households and e is the precision level which was 0.1 for this study (Adam, 2020). Selection of sample households was done using a procedure by Pearson, Rzotkiewicz & Zwickle, (2015). Whereby, first 2000 households were identified, marked and numbered sequentially using Google Maps place markers. Secondly, an online random number generator was used to generate a random sample of 100 households. Then all selected households were visited with the aid of Google Maps navigation (Pearson, Rzotkiewicz, & Zwickle, 2015) and semi-structured interviews administered in the local Kipsigis language or Kiswahili (Figure 2).

Second, multistage sampling was used to collect actual field data from 10 transects on sacred a medicinal indigenous tree species. Whereby, purposive sampling was used to select a road route for data collection whereby a 3km route passing through riparian and farmland habitats was identified and added to Google Maps (Figure 3). The selected route was then used as a road transect and data was collected systematically by walking along the route and recording tree data from both sides of the road at 300m intervals.

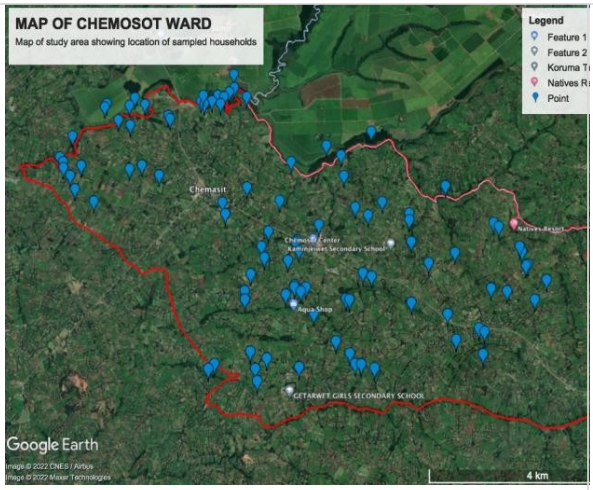

Figure 2: Location of the selected sample households at Chemosot Ward.

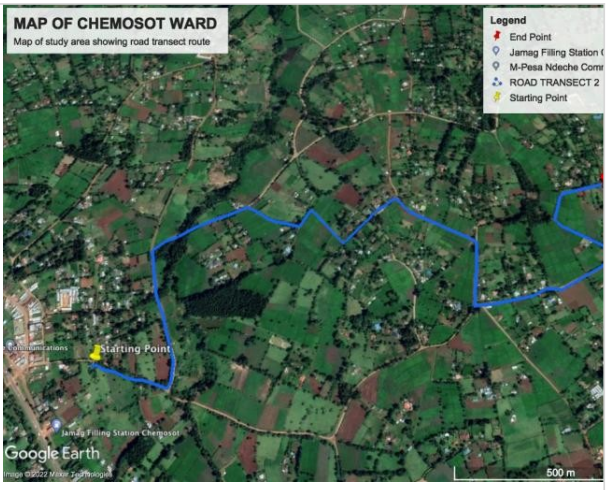

Figure 3: Map of the road transect through Chemosot Ward

Diversity of sacred and medicinal trees

All interviewed respondents were requested to provide names of the sacred and medicinal indigenous tree species which they knew. As most responses were given in Kipsigis, the names were recorded alongside their scientific equivalents whenever it was possible. The informants were also asked to provide description, location, or guide field observation of less familiar species whenever it was possible for proper identification. The data was calculated using the Shannon's Diversity index.

Popularity of sacred and medicinal trees

All respondents were asked to provide information on their current or recent uses of cited sacred and medicinal tree species. All sacred and medicinal uses were recorded, and this information was later used to determine the popularity of the listed species. The popularity of sacred and medicinal trees was determined using the Species Popularity Index (Umair, Altaf & Abbasi, 2017).

Distribution of sacred and medicinal trees in various habitats

During the road transect sampling, all known sacred and medicinal tree species encountered were recorded alongside details such as number of individuals and the type of habitat in which they occur e.g., roadside, farmland, or riparian. The distribution of sacred and medicinal trees in the ward was determined by calculating the frequency of each species from the tree sampling data. In addition, the Kruskal-Wallis test was used to test whether there was a significant difference in the mean number of sacred and medicinal trees across different habitats and all significant differences were accepted at $p<0.05$.

Conservation status of sacred and medicinal trees

Shah et al., (2019) recommended that for every cited tree species, each respondent should be asked to provide information on their occurrence, availability, and regeneration potential. The informants are then asked to rank their responses in a scale of 1 to 3 whereby occurrence (1 for rare, 2 for moderate, 3 for abundant), availability (3 for increasing, 2 for stable, 1 for decreasing), and regeneration potential (3 for high, 2 for moderate, 1 for low) are recorded. In addition, each informant was asked to state the major threatening factors to cited tree species including conservation efforts. The three most cited threats and conservation efforts were recorded. Each threatening factor was assigned a value of 1 to 3 with a value of 3 for extensive, 2 for moderate, and 1 for least extensive. Each conservation effort was assigned a value of 1. The respective plant conservation statuses were calculated using the equation

CS = K (OC + AV + CE)/TF X RP; Where CS is the conservation status, **K** is a constant assigned a value of **1**, **OC** is the occurrence, **AV** is the availability, **CE** is the conservation efforts, **TF** represents threatening factors, **RP** stands for the regeneration potential. The species threat evaluation was based on both calculated CSI indices and IUCN listings of each cited tree species in Chemosot Ward.

3.3. Plant Identification

All species encountered during the study were easily identified in-situ with the help of local informants, published field guides, publications (Beentje, Adamson & Bhanderi, 1994; Maundu, & Tengnäs, 2005) mobile-based software applications and online plant databases.

RESULTS AND DISCUSSION

Diversity of sacred and medicinal indigenous trees

A total of 35 species were recorded during the study of which 27 were only medicinal, six were both sacred and medicinal, while two were exclusively sacred (Table 1 in the appendix). The diversity of sacred and medicinal indigenous trees in the ward which was assessed using Shannon's diversity index was found to be 1.58. .

Notably, *Croton macrostachyus and Vernonia auriculifera* are tied together using *Adenia bequaertii* (nyelwot) to traditionally construct mabwaita (shrine/altar) for many purposes such as prayers, sacrifices and circumcision rituals. *V.auriculifera* was also traditionally used in certain cleansing rituals. *Rhamnus staddo* (sirtitiet) is used in central in Kipsigis traditional circumcision ceremonies and is also used to produce the sticks for the tilet ap kirokto (the cutting of the stick ceremony), a special ritual performed just before the passing out of the initiates. *Podocarpus falcatus* (saptet), also is used to perform clan rituals. *Erythrina abyssinica* was used to administer oaths during trials. It was a taboo (yetanet) to use *E. abyssinica* as firewood except in the case of very old women. *Cordia monoica* (logirwet) is traditionally used to make special sacred canes carried by motirenik – the persons who accompany the initiates throughout the circumcision rites of passage.

Popularity of sacred and medicinal indigenous trees of Chemosot Ward

The mean popularity of sacred and medicinal indigenous tree species was found to be 0.17. The popularity varied with species and use. The mean popularity of sacred trees was 0.19 while the mean popularity of medicinal trees was 0.18. However, many trees encountered during the study were more popular for medicinal than sacred uses.

Prunus africana (tenduet) was found to be the most popular medicinal tree followed closely by *Ekebergia capensis*. Other popular medicinal trees include *Zanthoxylum gilettii*, *Croton macrostachyus*, and *Erythrina abyssinica.* *Croton megalocarpus, Warbugia ugandensis*, and *Acokanthera schimperi* were moderately popular. *Trema orientalis* and *Croton sylvaticus* were the least popular medicinal trees.

Croton macrostachyus was the most popular sacred tree followed by *Rhamnus staddo* while *Eryhrina abyssinica* was the least popular sacred tree. Overall, *Croton macrostachyus* was the most popular tree both for sacred and medicinal purposes.

Distribution of sacred and medicinal indigenous trees of Chemosot Ward

In general, there was a higher number of species and individuals in farmlands namely *Croton macrostachyus, Croton megalocarpus*, *Prunus africana*, *Zanthoxylum gilettii*, and *Podocarpus falcatus* than along roadsides. Riparian areas had the lowest number of species and individuals that is *Polyscias fulva* and *Albizia gummifera*. The Shannon diversity index between habitats was 0.925 with an Eveness score of 0.842 confirming high diversity in the area. However, the distribution of trees among the three habitats varied with species. Thus, out of the total number of species recorded during the ethnobotanical survey, only 22 were encountered during the actual vegetation survey. Of the remaining species, most were easily located growing in farmlands and forested areas but 2 could not be located during the study.

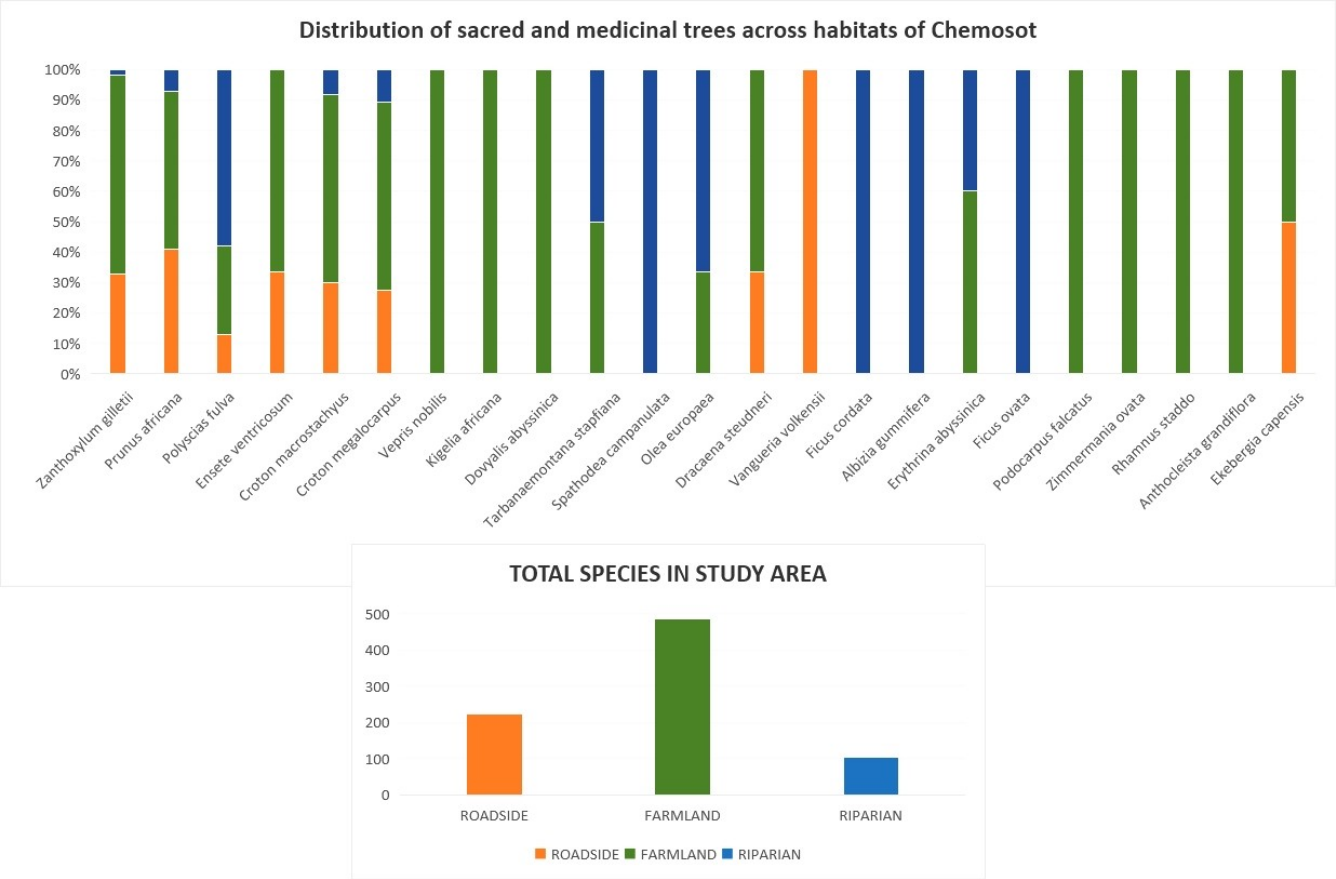

Figure 4:Distribution of sacred and medicinal trees between farmlands, roadsides, and riparian areas

Croton macrostachyus, Zanthoxylim gilettii, Prunus africana, and Croton megalocarpus were the most widely distributed species. In fact, *Croton macrostachyus* occurred nearly everywhere in the study area. From the road transect survey data, *C. macrostachyus* had a percentage frequency of 100 while *Z. gilettii and Prunus africana* both had a frequency of 80% while *C. megalocarpus* had a frequency of 70%. The least distributed plants were found among species such as *Rhamnus staddo, Ficus cordata, Ensete ventricosum, Dracaena steudneri, Kigelia africana, Dovyalis abyssinica,* and *Zimmermania ovata*; all of which had a frequency of 10%.

Analysis with Kruskal-Wallis test revealed no significant difference in the number of sacred and medicinal indigenous trees between farmlands, roadsides, and riparian areas; $p>0.05$ ($H=0.321$, $p=0.85$). In addition, one-way ANOVA test, using F distribution df (2,36), p-value (0.595875) revealed F equals 0.525241 which is in the 95% region of acceptance. However, the observed effect size f is small (0.17) indicating that the magnitude of the difference between the averages is small.

Conservation status of sacred and medicinal indigenous trees of Chemosot Ward

Based on the CSI indices calculated from the data collected during the study, 3 species (*Ekebergia capensis*, *Carissa spinarum*, and *Trimeria grandifolia*) were evaluated as critically endangered in the study area. Furthermore, 11 species were evaluated as endangered, 9 as vulnerable, 2 as rare, while 10 were evaluated as of least concern. In contrast, only 2 of the species were listed as threatened by IUCN. These were *Warburgia ugandensis* (Critically Endangered) and *Prunus africana* (Vulnerable). The rest of the species were listed as of least concern contrary to what the study results seemed to suggest. This implies that although most species of sacred and medicinal indigenous trees appear to be threatened locally within the study area, they were far from being threatened regionally or globally. The study found no correlation between the popularity and the conservation status of sacred trees; $p>0.05$ ($t=1.015$, $p=0.17$) and medicinal trees; $p>0.05$ ($t=0.386$, $p=0.35$).

Conclusion

The study aimed to determine the popularity, distribution, and conservation status of indigenous sacred and medicinal trees in Chemosot Ward through interviews with selected household residents and local experts in the area in order to document the identity and uses of various sacred and medicinal trees alongside their occurrence, availability, regeneration potentials, threats, and local conservation efforts; and subsequent vegetation surveys to assess their distribution. Based on the quantitative analysis of the collected data the diversity, popularity, distribution, and conservation status of identified sacred and medicinal tree species were evaluated. The Shannon's diversity index of index of sacred and medicinal trees in the area was found to be 1.58. The mean popularity of identified tree species was evaluated as being low but the popularity varied with the species and the use type. In general, medicinal trees were more popular than sacred trees.

The study also revealed that although most of the species were not listed as threatened globally or regionally, they were highly threatened locally in the study area. However, no statistically significant relationship was found between their popularity and conservation status. And while some species had a sparse distribution, others were thinly distributed but there was no statistically significant difference in the number of sacred and medicinal indigenous trees among sampled habitats in the study area.

This study recommends that additional research be conducted to determine the influence of TEK on the conservation status of sacred and medicinal indigenous tree species. In addition, it recommends that similar research should also be undertaken to ascertain the diversity,

popularity, distribution, and conservation status of other groups of sacred plants in the area, e.g. herbs, as well as other trees which are neither sacred nor medicinal.

Acknowledgment

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Appendix

Table 1: Data on sacred and medicinal indigenous trees of Chemosot Ward

LOCAL NAME	SCIENTIFIC NAME	Popularity index		Conservation Status Index
Sacred plants only				
Kosisisiet/Sirtitiet	*Rhamnus staddo*	0.333333333		1
Logirwet/Nogirwet	*Cordia monoica*	0.075268817		2
Sacred and medicinal plants		**Sacred**	**Medicinal**	
Tebeswet	*Croton macrostachyus*	0.623655	0.344086022	8
Tebeng'wet	*Vernonia auriculifera*	0.139784946	0.23655914	1.67
Senetwet	*Senna didymobotrya*	0.11827957	0.290322581	3
Kuriot	*Vepris nobilis*	0.096774194	0.096774194	2
Bisarwet	*Erythrina abyssinica*	0.47311828	0.064516129	1.2
Simotwet	*Ficus cordata*	0.107526882		1.25
Emitiot	*Olea europaea subsp.africana*	0.021505376	0.172043011	1
Medicinal plants only				
Kelelwet/ Masineitet	*Croton megalocarpus*	0.247311828		9
Araruet	*Ekebergia capensis*	0.698924		0.8
Aonet	*Polyscias fulva*	0.086021		7
Mosombobet	*Anthocleista grandiflora*	0.032258065		1.33
Saptet	*Podocarpus falcatus*	0.139784946		4
Rotinwet	*Kigelia africana*	0.064516		1
Museset	*Olinia rochetiana*	0.107526882		2
Sagawaita	*Zanthoxylum gilettii*	0.548387097		2.67
Soget	*Warburgia ugandensis*	0.23655914		1
Sasuriet	*Ensete ventricosum*	0.096774194		2.5
Legetetiet	*Carissa spinarum*	0.075268		0.75
Keliot	*Acokanthera schimperi*	0.172043011		2
Chemulmogoiywet /Museng'iot	*Ficus ovata*	0.043010		2
Kimolwet ne leel	*Vangueria volkensii*	0.086021505		1
Nukiat	*Dovyalis abyssinica*	0.053763441		1
Seet	*Albizia gummifera*	0.032258065		1
Lebekwet	*Dracaena steudneri*	0.11827957		1.67
Sebetet	*Spathodea campanulata*	0.11827957		7
Tenduet	*Prunus africana*	0.838		2.33
Chepkowet	*Trimeria grandifolia*	0.129032258		0.8
Kwom-tebeng'wet	*Vernonia amygdalina*	0.043010753		1.67
Mobet	*Markhamia lutea*	0.096774194		18
Cheptoror-belion	*Trema orientalis*	0.010752688		8
Silibwet	*Croton sylvaticus*	0.021505376		1
Kaldit	*Bridelia micrantha*	0.064516129		2.67
Ng'atumiat	*Maesa lanceolata*	0.032258065		2
Rerendet	*Tabernaemontana stapfiana*	0.161290323		1.33