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An ethnobotanical study of medicinal plants commonly traded in Kajiado, Narok and Nairobi counties, Kenya

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Abstract

Over eighty percent of the world population depend on traditional medicine for their basic health care needs. A study was carried out in three counties in Kenya (Kajiado, Narok and Nairobi) to document the common plant species traded as medicinal or herbal remedies. Structured interviews and questionnaire were administered to herbalists with prior informed consent, who were willing to disclose information on the source, plant type and parts of the herbal medicine they were selling and ailments treated. The folk or common names were recorded and later translated to scientific names using para-taxonomists and previous published data. Majority of the herbalists interviewed were between the ages of 40-59 years and comprised of mostly women (54%). The investigations revealed that eighty-six (86) plant species were traded as medicinal plants out of which 51% were commonly traded across the three counties. The study further revealed that the most traded plant parts were stem, bark and roots which could pose a threat to conservation of the species due to complete or partial destruction of the trees during harvesting. Aloe species, *Prunus africana* and *Osyris lanceolata* were highly traded an indication of their preference by local inhabitants to treat particular ailments. The generated list of medicinal plants species will form baseline data that could be used to generate a comprehensive list of all plant species traded as herbal medicine in Kenya. The commonly traded plants can also be included in pharmacological studies which may lead to development of new and potential drugs.

Keywords: *Kenya; herbalist; Medicinal plants; use value; ailments*

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Introduction

The extensive use of traditional medicine in Africa, composed mainly of medicinal plants, has been argued to be linked to cultural and economic reasons. The World Health Organization (WHO) documented that between 65 % and 80 % of the population in developing countries use plants as medicinal remedies since modern medicine is not readily available (Karimi *et al*., 2015; Nisar *et al*., 2018). Globally, there is a rising trend to shift resources from allopathic to traditional healthcare systems due to the increasing cost of modern drugs coupled with the decline in the purchasing power of the people. This has been caused by the declining economic opportunities especially in rural areas that has made it mandatory for governments to intensify efforts towards documentation and research on medicinal plants. The global market for medicinal and aromatic plants was US$ 62 billion in 2002 and estimates suggest that it will reach US$ 5 trillion by 2050. Traditional complementary and alternative medicine like herbal medicines forms an integral part of primary health care in Kenya (Okumu *et al*., 2017). Over 80 % of the population use herbal remedies as a fundamental component of the healthcare system (Fowler, 2006; WHO, 2011; Randriamiharisoa *et al*., 2015). By the year 2011, Kenya had forty thousand traditional healers including herbalists, bone setters, faith healers

and birth attendants prescribing medicinal plants. This is due to their easy accessibility and affordability in providing health resource to the local community and at times they are only the therapy that subsists (Bii Barnabas, 2018). It is estimated that in Kenya, over 260 plant species are used as medicinal plants (Muthaura *et al*., 2007).

Use of plants parts as whole or in mixtures to treat ailments is prevalent in most counties and ranges from 4 to 20 percent. There are over 5000 plant species recorded over the years that are traded internationally as medicinal plants (Schippmann *et al*., 2002; Chen *et al*., 2016).

Major plant products used as herbal medicines include herbs, herbal materials, herbal preparations, and finished herbal products that contain parts of plants or other plant materials as active ingredients. These are derived from barks, leaves, flowers, roots, fruits, seeds. These medicines are effective for diseases like constipation, chronic hepatitis, allergies and Malaria, health promotion and therapy for chronic diseases (Mahomoodally, 2013). Furthermore, traditional medicines are widely assumed as natural and safe, thus non- toxic (Canter & Ernst, 2004; Cohen & Ernst, 2010).

The domestic and international markets for important medicinal plants of Kenya are not well documented. A number of institutes are involved in research on medicinal plants from survey of species diversity to various kinds of analytical studies. Majority of the documented studies have focused on specific diseases remediation, community's folk medicine or specific species of interest such as phytochemical analysis (Njoroge, 2012; Kigen *et al*., 2019).

As demand for plants for herbal remedies extraction increases in local and international markets, there is need to document the species traded and parts commonly harvested in order to establish their conservation status. Global efforts to conserve and protect economically important species is a pressing need because of the rapid loss of the natural habitats of some of these plants due to anthropogenic activities and also due to an erosion of valuable traditional knowledge. Nonetheless, there is still a paucity of updated comprehensive compilation of medicinal plants traded in Kenya, their source locations and parts traded.

This study was carried out to document the plant species and plant parts traded as medicinal remedies in selected counties in Kenya. The study focused on three counties: Kajiado and Narok that are regarded as rural counties; and Nairobi County which is the capital city of Kenya and regarded as urban county. The study was biased with a major focus of providing an overview of herbal medicine trade, plant species traded, plant parts used and overall opportunities of plant biodiversity conservation in the selected counties.

Materials and methods

Study areas

The study was conducted to document plant species sourced and traded as medicinal/herbal medicine from three counties i.e. Kajiado, Narok and Nairobi counties in Kenya (Figure 1). Kajiado County lies at the southern end of the Kenyan Rift Valley and borders Tanzania in the Southwest. The county lies at the rain shadow of Mount Kilimanjaro and has semi-arid climate (Campbell *et al*., 2000; MoALF, 2017). The vegetation is dominated by bushland, grassland and open woodlands along the seasonal river valleys. The total population in Kajiado is 1,117,840 inhabitants (KNBS, 2019) who mainly belong to the Maa community. The local inhabitants are believed to have strong cultural and traditional orientation and rely on herbal medicine from plants collected from both Kenya and neighbouring Tanzania.

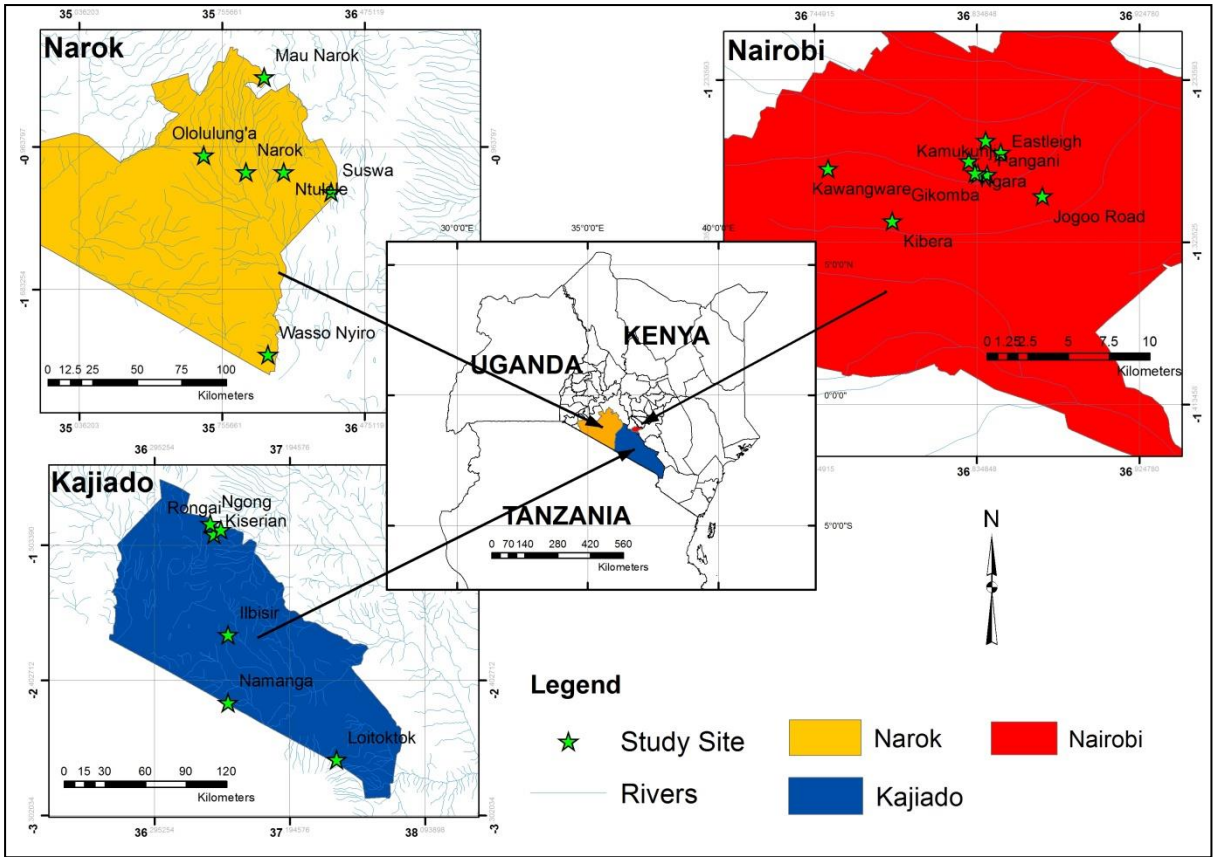

Figure 1: Main map showing Kenya and the locations of the counties - Narok, Nairobi and Kajiado. Inset maps outlines the counties and markets selected for data collection.

Narok County is situated along the Great Rift Valley and borders Tanzania to the South. The county has a population of 901,777 (KNBS, 2019) and hosts the Mau forest complex and Loita forest. The Mau Forest Complex forms the largest closed-canopy forest ecosystem in Kenya and is the most important water catchment in the Rift Valley and Western regions of Kenya. Loita forest is predominantly semi-arid with dry upland forest and extensive grasslands of approximately 330 km^2 which lies between the Nguruman - Magadi escarpment and the Maasai Mara National Game Reserve. The forest is rich in plant biodiversity and has great cultural and spiritual value to the local communities. The forest has been reasonably well maintained but due to increasing demand for forest products, land for cultivation and grazing biodiversity has been on the decline (Kariuki *et al*., 2016). The two forest harbour high biodiversity of medicinal plant species believed to be primary health care source for the Maa and other neighbouring communities.
Nairobi is a metropolitan county that hosts Nairobi town, the capital city of Kenya with a population of 4,397,073 (KNBS, 2019) and thus hosts big clientele for herbal products (Bussmann *et al*., 2006; National Coordinating Agency for Population & Development, 2008; Mwangi & Gitonga, 2014).

Selection of sampling sites

The study areas were purposively selected to include diverse locations (counties) and markets where medicinal plants are sourced or traded. In Nairobi County, nine markets centres were selected (Eastleigh, Gikomba, Jogoo road, Machakos Country Bus, Kibera, Ngara, Kamukunji, Kawangware, Pangani); while six markets centres were selected in Narok (Wasso nyiro, Suswa, Narok Town, Ntulele, Mau Narok, Ololulunga). Kajiado had six markets including Kiserian, Rongai, Ngong, Namanga, Ilbisir and Loitoktok. The market centres considered in this study incorporated major urban areas within the three Counties believed to form part of the market catchments of the medicinal plant trade in Kenya. The target population of respondents consisted of herbalists domiciled in Kenya and trading in herbal medicine.

Identification and sampling of respondents

Initial field visits were conducted in order to identify the known/authentic herbalists in the counties. The initial selection was based on the willingness of herbalists to voluntary give information and interaction with the researchers during the field visits and group discussions. Simple random sampling method was then used to choose the respondents for the study. The sampling method was ideal because it ensured a high level of representation by providing the respondents with equal opportunity of being selected to participate in the study. The herbalists were interviewed within their practice, which in most cases were their selling points in the markets centres. A total of 90 herbalists were finally identified and included the study (Table 1).

Table 1: Selected study counties, market centers and number of herbalists sampled

County	Market centre	No of herbalist sampled
Narok	Wasso nyiro	6
	Suswa	6
	Narok Town	5
	Ntulele	5
	Mau Narok	5
	Ololulunga)	3
Nairobi	Eastleigh	2
	Gikomba	2
	Jogoo road	5
	Machakos Country Bus	3
	Kibera	5
	Ngara	4
	Kamukunji	3
	Kawangware	3
	Pangani	3
Kajiado	Kiserian	4
	Rongai	1
	Ngong	4
	Namanga	7
	Ilbisir.	9
	Loitoktok	5
	Total	90

Data collection and identification of plant species

Data collection involved application of both qualitative and quantitative techniques. Structured questionnaire were administered to individual herbalists in order to maintain data independence while complementary ethnobotanical methods including species observation and interviews with key village elders were used to enrich the data collected.

Ethnobotanical surveys

To document the plant species traded as herbal medicine, ethnobotanical data was collected using semi-structured interviews and group conversation with herbalists trading at selected open air markets after obtaining prior informed consent. Data on herbal products (common name and/or scientific names), purity of the products (single or mixture of species), uses and plant part traded (leaves, bark, roots, fruits, flowers, tubers), registration status of herbalists (either registered or has permits to collect plants from protected areas), age of herbalist, gender and locality was recorded.

Secondary data sources included analysis of taxonomic information to examine plant uses and verification of scientific names which was used to enrich the primary data. The folk or common names were recorded and later translated to scientific names by para-taxonomist and taxonomists at the East African Herbarium-National Museums of Kenya and in reference to published data (Maundu *et al*., 2001; Kokwaro, 2009). Samples of plant products traded as herbal medicine were collected from willing herbalists in surveyed markets for future molecular identification, phytochemical and pharmacological analysis.

Quantitative analysis

The ethnobotanical data was analysed using different quantitative indices including Use Value (UV) and percentage Use Index (% UI). For every medicinal species recorded, a Use Index (UI %) was calculated to give relative importance of use of each plant species and trade frequency of the species across the three counties under study.

The percentage Use Index (% UI) is derived from the formula:

$$\% \text{ UI} = \frac{na}{NA} * 100 \quad \ldots\ldots 1$$

Where *na* is the number of herbalists who were selling that particular species; *NA* is the total number of herbalists interviewed.

In order to assess the respondent's valuation of the medicinal plant species, Use value (UV) was calculated for each plant species (Phillips & Gentry, 1993; Krupa *et al*., 2019) as follows:

$$UV_i = \frac{\sum Ui}{N} \quad \ldots\ldots 2$$

Where UV indicates use value of individual species, U is total number of uses recorded for that plant species and 'N' is total number of herbalists interviewed in each county.

A species that recorded high UV score indicated many recorded uses in ailments treatment as cited by interviewed herbalists (Faruque *et al*., 2018). The medicinal plant use combinations mentioned by the interviewees were counted and recorded. Since the informants were interviewed only once, it was decided to interpret each plant-disease-use combination mentioned by each informant as an event. Theoretically use value varies from 0 to 1 where 0 implies that none of the informants mention any use of the plant while 1 the plant is most frequently mentioned as useful in treatment of the highest number of ailments

Data analysis

Ethnobotanical data was entered in to SPSS version 21 and summarized using descriptive statistics Höft *et al*., (1999). The data was filtered to determine frequencies of citations and responses so as to identify the most common families and species in the study areas, popularly used as medicinal plant, their uses and plant parts used and traded.

Results and discussion

Demographic characterization of the herbalists

The study revealed that out of the 90 herbalists interviewed, 54% were females while 46% were male. The age distribution of herbalists ranged between 20-80 years old with an average age of 50 years. Most of the informants were in the age group of 40-49 (28.89%) followed by 50-59, 60-69 and 30-39 years at 26.67%, 20% and 11.11% respectively. Majority of the interviewed herbalist had little or no education (78.78%) while 10% had basic education.

Diversity of medicinal plant species traded

Our findings revealed that a total of 86 medicinal plant species belonging to 42 floristic families were traded in the three study counties (Table 2). Kajiado had the highest number of plant species (71) derived from 42 families which were traded and used as medicinal remedies. In Narok County, the study revealed that there were 63 species belonging to 41 families while in Nairobi County, 55 plant species belonging to 37 families were traded.

Table 2: List of Ethnomedicinal plant species traded in selected markets in Nairobi, Kajiado and Narok counties

S.No	Family	Species & Voucher ID	Plant part used	County where the medicinal plant was traded
1.	Aloeceae	*Aloe sp*	Leaves	Narok, Nairobi and Kajiado
2.	Anacardiaceae	*Ozoroa insignis,* Delile (NMK: 10894)	Stem	Narok, Nairobi and Kajiado
3.	Anacardiaceae	*Schinus molle,* L. *(NMK:133980)*	Stem, roots	Narok, Nairobi and Kajiado
4.	Anacardiaceae	*Searsia natalensis, (*Bernh. ex C.Krauss) F.A.Barkley (NMK: 10747)	Stem, seeds	Narok, Nairobi and Kajiado
5.	Apocynaceae	*Acokanthera schimperi, (*A.DC.) Benth. & Hook.f. ex Schweinf. (NMK:10779)	Stem	Narok, Nairobi and Kajiado
6.	Apocynaceae	*Carissa edulis,* Forssk. (NMK:10794)	Stem, bark, leaves, roots, seeds	Narok, Nairobi and Kajiado
7.	Apocynaceae	*Mondia whytei,* (Hook.f.) Skeels (NMK:10330)	Stem, roots	Narok, Nairobi and Kajiado
8.	Apocynaceae	*Periploca linearifolia,* Quart.-Dill. & A.Rich.(NMK:10900)	Stem	Narok, Nairobi and Kajiado
9.	Asteraceae	*Psiadia punctulata,* Vatke (NMK:10728)	Stem, bark, roots	Narok, Nairobi and Kajiado
10	Asteraceae	*Gutenbergia cordifolia Benth. ex Oliv. (NMK:13575)*	Leaves	Narok and Kajiado
11.	Barberidaceae	*Berberis holstii, Engl.* (NMK:10789)	Stem, roots, leaves	Narok and Kajiado
12.	Boraginaceae	*Commiphora africana, (Rich.) Engl (NMK: 13576).*	Bark	Kajiado
13.	Burseraceae	*Commiphora swynnertonii, Burtt (NMK: 13577)*	Leaves	Nairobi
14.	Canellaceae	*Warburgia ugandensis, Engl .* (NMK:13005)	Stem, bark, leaves	Narok, Nairobi and Kajiado
15.	Caricaceae	*Carica papaya, L. (NMK:13392)*	Stem, bark	Narok
16.	Celastraceae	*Maytenus senegalensis, (Lam.) Exell (NMK:13367)*	Stem, bark, leaves, roots, seeds	Narok, Nairobi and Kajiado
17.	Celastraceae	*Mystroxylon aethiopicum, (Thunb.) Loes (NMK: 13410)*	Bark, leaves, roots, seeds	Narok, Nairobi and Kajiado
18.	Compositae	*Solanecio angulatus, (Vahl) C.Jeffrey*	Bark	Narok, Nairobi and Kajiado

		(NMK:13578)		
19.	Compositae	*Tarchonanthus camphoratus, L. (NMK:13579)*	Stem,bark	Narok, Nairobi and Kajiado
20.	Compositae	*Vernonia brachycalyx, O.Hoffm.* (NMK:13008)	Stem, bark, leaves, roots	Narok, Nairobi and Kajiado
21.	Compretacaeae	*Combretum molle, R.Br. ex G. Don* (NMK:10802)	Stem, roots	Narok and Kajiado
22.	Cucurbitaceae	*Momordica friesiorum, (Harms) C.Jeffrey (NMK:13580)*	Stem, bark, leaves, roots, seeds	Narok and Kajiado
23.	Cucurbitaceae	*Zehneria scabra, (L.f.) Sond. (NMK:13581)*	Stem	Narok and Kajiado
24.	Ebeneceae	*Euclea divinorum, Hiern* (NMK:10809)	Stem, bark, leaves, roots, seeds	Nairobi
25.	Ebeneceae	*Euphorbia candelabrum, Trémaux ex Kotschy*	Stem	Nairobi
26.	Ebeneceae	*Euphorbia sp*	Stem	Nairobi
27.	Euphorbiaceae	*Croton dichogamus, Pax (NMK:13341)*	Stem, bark, leaves, roots, seeds	Narok, Nairobi and Kajiado
28.	Euphorbiaceae	*Croton megalocarpus, Hutch. (NMK:13382)*	Stem, leaves	Narok, Nairobi and Kajiado
29.	Euphorbiaceae	*Croton somalensis, Vatke & Pax ex Pax (NMK:13558)*	Stem, bark, leaves	Narok, Nairobi and Kajiado
30.	Fabaceae	*Acacia abyssinica, Hochst. ex Benth. (NMK:13335)*	Stem, bark	Narok, Nairobi and Kajiado
31.	Fabaceae	*Acacia drepanolobium, Harms ex Y.Sjöstedt* (NMK:10971)	Stem, roots	Narok, Nairobi and Kajiado
32.	Fabaceae	*Acacia gerrardii, Benth.* (NMK:10774)	Stem, bark, roots, seeds	Narok, Nairobi and Kajiado
33.	Fabaceae	*Acacia mellifera, Vahl. (NMK: 13514)*	Stem, bark	Narok, Nairobi and Kajiado
34.	Fabaceae	*Acacia nilotica, Schumach. & Thonn* (NMK:10775)	Stem, bark, roots, leaves, seeds	Narok, Nairobi and Kajiado
35.	Fabaceae	*Acacia nubica, Benth. (NMK: 13390)*	Stem, bark, roots, leaves, seeds	Narok, Nairobi and Kajiado
36.	Fabaceae	*Acacia Senegal, (L.) Willd. (NMK:13377)*	Stem, bark	Narok, Nairobi and Kajiado
37.	Fabaceae	*Acacia thomasii, Harms (NMK:1313583)*	Stem, bark	Narok, Nairobi and Kajiado
37.	Fabaceae	*Acacia tortilis, Forssk. (NMK:13364)*	Stem, bark	Narok, Nairobi and Kajiado
39.	Fabaceae	*Acacia xanthophloea, Benth.* (NMK:10776)	Stem	Narok, Nairobi and Kajiado
40.	Fabaceae	*Albizia amara, Boiv.* (NMK:13010)	Stem, bark	Narok, Nairobi and Kajiado
41.	Fabaceae	*Albizia anthelmintica, Brongn. (NMK:13394)*	Stem, bark	Narok, Nairobi and Kajiado
42.	Fabaceae	*Albizia schimperiana, Oliv. (NMK:13584)*	Stem	Narok, Nairobi and Kajiado

43.	Fabaceae	*Caesalpinia volkensii, Harms. (NMK:13585)*	Bark	Narok, Nairobi and Kajiado
44.	Fabaceae	*Ormocarpum trachycarpum, (Taub.) Harms (NMK:13586)*	Stem	Narok, Nairobi and Kajiado
45.	Fabaceae	*Piliostigma thonningii, (Schum.) Milne-Redh. (NMK:13554)*	Stem, bark	Narok, Nairobi and Kajiado
46.	Fabaceae	*Pterolobium stellatum, (Forssk.) Brenan (NMK:13587)*	Leaves	Narok, Nairobi and Kajiado
47.	Lamiaceae	*Ajuga remota, Benth.* (NMK:10770)	Bark	Nairobi and Narok
48.	Loganiaceae	*Strychnos henningsii, Gilg (NMK:10849)*	Stem, bark,leaves	Narok, Nairobi and Kajiado
49.	Malvaceae	*Grewia bicolor, Juss.* (NMK:10741)	Stem, bark, leaves, roots, seeds	Narok, Nairobi and Kajiado
50.	Malvaceae	*Grewia similis, K.Schum. (NMK:10985)*	Stem, bark	Narok, Nairobi and Kajiado
51.	Malvaceae	*Hibiscus flaviflorus, (F.Müll.) Kuntze (NMK:13345)*	Stem, bark	Narok, Nairobi and Kajiado
52.	Meliaceae	*Azadirachta indica, A. Juss. (NMK:13418)*	Stem, bark, leaves	Narok, Nairobi and Kajiado
53.	Meliaceae	*Turraea abyssinica, Hochst.* (NMK:10867)	Stem, bark leaves	Narok, Nairobi and Kajiado
54.	Meliaceae	*Turraea mombassana, C. DC.* (NMK:10871)	Stem, bark	Narok, Nairobi and Kajiado
55.	Mimosaceae	*Rapanea melanophloeos, (L.) Mez (NMK:13548)*	Seeds,	Narok, Nairobi and Kajiado
56.	Moringaceae	*Moringa oleifera, Lam. (NMK:13437)*	Stem, leaves	Nairobi
57.	Myricaceae	*Myrica salicifolia, Hochst. Ex A.Rich (NMK: 13560).*	Stem, bark	Narok, Nairobi and Kajiado
58.	Ochnaceae	*Ochna ovata, F.Hoffm. (NMK:13588)*	Stem, bark, leaves, roots, seeds	Narok and Kajiado
59.	Olacaceae	*Ximenia Americana, L.* (NMK:10865)	Stem, bark, leaves, roots	Narok, Nairobi and Kajiado
60.	Oleaceae	*Olea europaea, L. (NMK:*10984)	Stem, Bark	Narok, Nairobi and Kajiado
61.	Penaeaceae	*Olinia rochetiana, A. Juss.* (NMK:10872)	Stem	Narok and Kajiado
62.	Plumbaginaceae	*Plumbago zeylanica, L. (NMK:13564)*	Stem, bark, leaves, roots	Narok, Nairobi and Kajiado
63.	Primulaceae	*Embelia schimperi, Vatke* (NMK:10805)	Stem, bark, leaves, roots, seeds	Narok and Kajiado
64.	Primulaceae	*Myrsine Africana, L.* (NMK:10980)	Stem, bark	Narok and Kajiado
65.	Rhamnaceae	*Rhamnus prinoides, L'Hér* (NMK:13019)	Stem, bark	Narok, Nairobi and Kajiado
66.	Rhamnaceae	*Rhamnus staddo, A.Rich* (NMK:13015)	Stem, bark, leaves, roots	Narok, Nairobi and Kajiado
67.	Rhamnaceae	*Scutia myrtina, (Burm.f.)* Kurz (NMK:1010831)	Stem, roots	Narok, Nairobi and Kajiado
68.	Rhamnaceae	*Ziziphus mucronata, Willd. (NMK:12385)*	Bark, root	Narok, Nairobi and Kajiado

69.	Rosaceae	*Prunus Africana, (Hook.fil.) Kalkm.(*NMK:10329*)*	Stem, bark	Narok, Nairobi and Kajiado
70.	Rubiaceae	*Tarenna graveolens, (S.Moore) Bremek. (NMK:13589)*	Stem,bark	Narok and Kajiado
71.	Rutaceae	*Toddalia asiatica, (L.) Lam.* (NMK:13014)	Stem, bark, leaves, roots	Narok, Nairobi and Kajiado
72.	Rutaceae	*Vepris nobilis, (Delile) Mziray* (NMK:10852)	Stem,	Narok, Nairobi and Kajiado
73.	Rutaceae	*Vepris simplicifolia, (Engl.) Mziray* (NMK:10860)	Stem, bark, leaves, roots	Narok, Nairobi and Kajiado
74.	Rutaceae	*Zanthoxylum usambarense, (Engl.) Kokwaro* (NMK:10968)	Stem, Bark	Narok, Nairobi and Kajiado
75.	Salicaceae	*Dovyalis abyssinica, Warb.* (NMK:11019)	Stem	Narok and Kajiado
76.	Salicaceae	*Trimmeria grandifolia, (Hochst.) Warb.*(NMK:10851)	Stem,bark,roots	Narok and Kajiado
77.	Salvadoraceae	*Salvadora persica, L (NMK:13590)*	Stem, bark, roots	Narok, Nairobi and Kajiado
78.	Santalaceae	*Osyris lanceolate, Hochst. & Steud.* (NMK:13001)	Stem, bark, leaves, roots, seeds	Narok, Nairobi and Kajiado
79.	Sapindaceae	*Pappea capensis, Eckl. & Zeyh.* (NMK:10872)	Stem, bark, leaves, roots, seeds	Narok, Nairobi and Kajiado
80.	Solanaceae	*Withania somnifera, (L.) Dunal (NMK:13591)*	Leaves, roots	Narok and Kajiado
81.	Stilbaceae	*Nuxia congesta, R. Br. (NMK:13592)*	Stem, bark	Narok and Kajiado
82.	Urticaceae	*Urtica massaica, Mildbr. (NMK:13593)*	Leaves, roots, stem	Narok, Nairobi and Kajiado
83.	Verbenaceae	*Clerodendrum myricoides, (Hochst.) R.Br. ex Vatke* (NMK:10801)	Stem, bark, leaves, roots, seeds	Narok, Nairobi and Kajiado
84.	Vitaceae	*Cissus quadrangularis, L. (NMK:13594)*	Stem, bark,	Narok, Nairobi and Kajiado
85.	Vitaceae	*Rhoicissus tridentate, (L.f.) Wild & R.B.Drumm.* (NMK:10913)	Stem, bark	Narok, Nairobi and Kajiado
86.	Zygophyllaceae	*Balanites aegyptiaca, Delile (*NMK:10743)	Bark, roots	Nairobi

Plant families with the highest number of species reported to be of medicinal value were: Fabaceae (17 species), *Apocynaceae, Rhamnaceae* and Rutaceae (each with four species) (Figure 2). Sixteen out of 42 families recorded had at least two species traded across the three counties and were considered as the dominant families in this study.

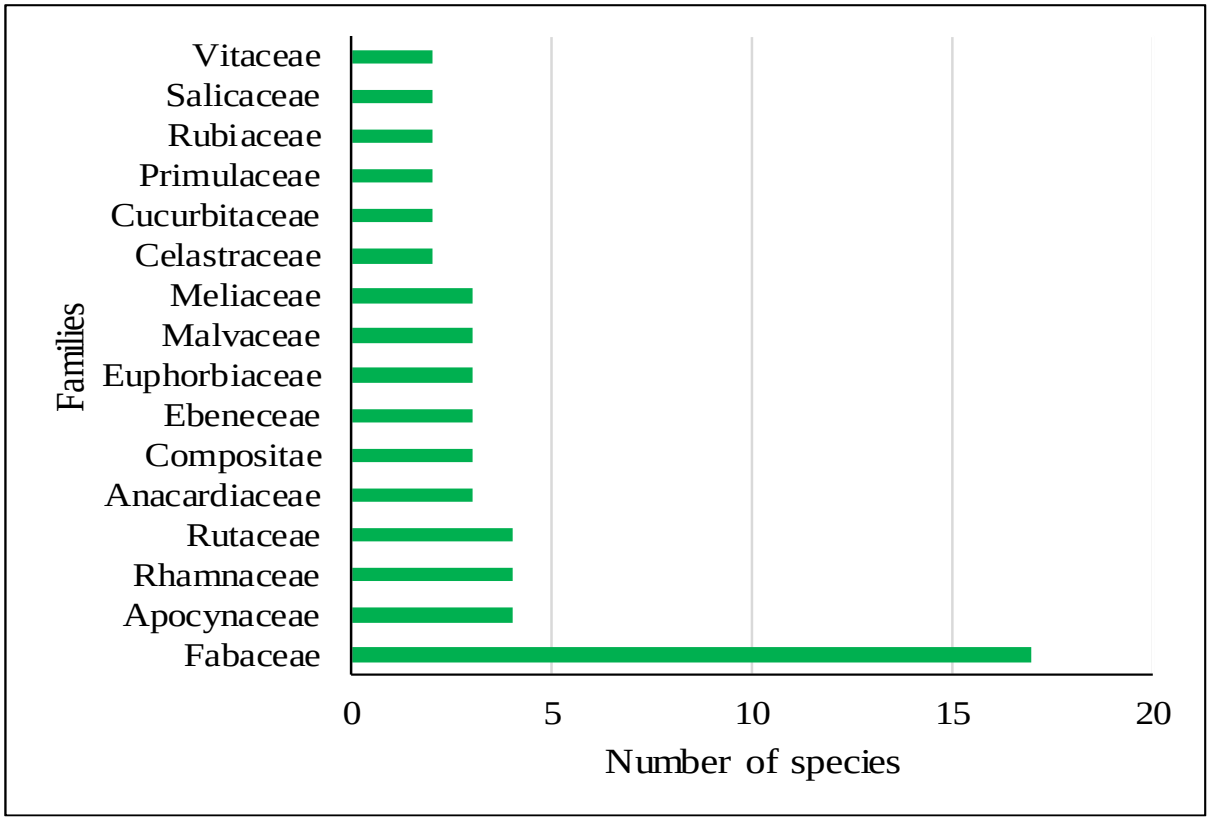

Figure 2: Dominant families of medicinal plants species in the three study counties (Narok, Kajiado and Nairobi)

Most of the medicinal species recorded in this study were shrubs (66.28%) followed by trees (16.28%), herbs (11.63%) and climbers (5.81%). The study revealed that medicinal plants were mostly traded as single species across the three counties.

Ranking of most traded and used plant parts

Even though all plant parts are used in preparation of medicinal remedies, the present study revealed that stem, bark, leaves, roots, seeds and tubers were used as herbal remedies either alone or in combinations. Stems were the most commonly utilized and traded plant part with 34% followed by barks (33%) and roots (13%). The stems were the most common traded plant parts in Kajiado and Narok counties at 33.8%, while in Nairobi; barks were the most traded plant parts (34.8%) (Figure 3).

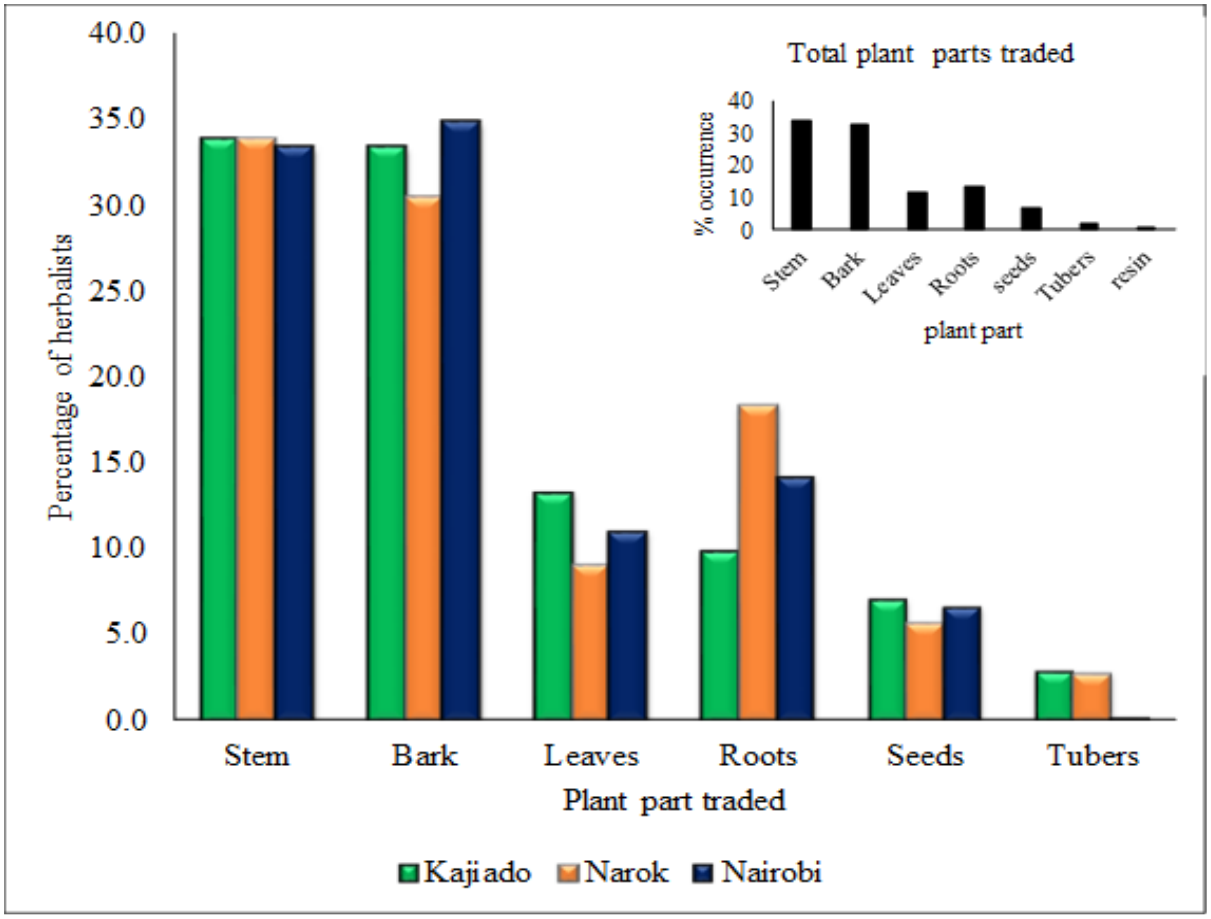

Figure 3: Percentage of plant parts citations used by herbalists. Inset: Total of the plant parts traded for medicinal use in Narok, Kajiado and Nairobi counties

Plant species and treatment associations

The study revealed that plant species were associated with ailments that could be treated or managed by the plant extract. The reported diseases categories or ailments were first classified into 14 different categories on the basis of their use reports (Table 3). The three prevalent ailments in the study regions were abdominal, respiratory and malaria and were treated by the highest recorded species at 18.8, 14.3 and 13.5 % use reports respectively. Urinary disorders had the least use reports in this study. The study further revealed that the most popular medicinal plants in the markets are connected to the local problems including malaria, respiratory and abdominal pains.

Table 3: Common disease categories or ailments treated by medicinal plants as recorded in this study

Diseases categories or Ailment	Number of plant species of use reports	Percentage of use reports
Abdominal	25	18.8
Respiratory diseases	19	14.3
Malaria	18	13.5
Sexual diseases	15	11.3
Nutrition	15	11.3
Body aches	14	10.5
Body energizer	6	4.5
Fertility	6	4.5

Snake bites	4	3.0
Skin disorders	3	2.3
Eye infections	3	2.3
Nervous disorders	2	1.5
Dental	2	1.5
Urinary disorders	1	0.8
Total	133	100

Use Index and Use Value

An analysis of cross cutting species traded within the three counties revealed that 44 species were commonly traded across the three counties. Out of these, *Osyris lanceolata* had the highest percentage use index (68.9%), followed by Rhamnus *staddo (54.4%), Rapanea melanophloes* (53.3%) and *Acacia nilotica (52.2%*. To determine the relative importance of each plant species, Use Value (UV) was determined for each species. *Clerodendrum myricoides and Combretum molle* had the highest use value of 0.12 followed by *Euclea divinorum* and *Warburgia ugandensis* at 0.11 and 0.10 respectively. *Mystroxylon aethiopicum, Aloe sp, Vernonia Brachycalyx, Periploca linearifolia, Turraea abyssinica* had the lowest use value at 0.01. (Table 4)

Table 4: Common species traded in the three counties, their percentage use index, use value and their treatment associations

S. No.	Scientific Name	Folk name	Use index (%)	Use value (UV)	Treatment associations
1	*Osyris lanceolate, Hochst. & Steud.*	Olosesiai	68.9	0.03	Abdominal pains in children, Diarrhoea, Gonorrhoea
2	*Rhamnus staddo, A.Rich*	Olkokola	54.4	0.06	Strength/nutrient, supplement, sexually transmitted diseases, flu/cold
3	*Rapanea melanophloeos, (L.) Mez*	Seketet/ Lodwaa/ Oldwai	53.3	0.04	Fever, diarrhoea, anthelmintic and purgative
4	*Acacia nilotica, Schumach. & Thonn*	Olkiloriti/ Enkiloriti	52.2	0.09	Strengthened/ tonic, appetizer, body aches, stomachic, stamina, stimulant/excitant, antioxidant
5	*Zanthoxylum usambarense, (Engl.) Kokwaro*	Oloisuki/ Muguchwa	48.9	0.06	Malaria, backache, painful joints and rheumatism and also as an emetic and purgative.
6	*Rhamnus prinoides, L'Hér.*	Olkonyil/ Mukarakinga	45.6	0.04	Sexually transmitted infections, back and joint aches, arthritis, aids in digestion, tonic
7	*Warburgia ugandensis, Engl.*	Osokonoi/ Muthiga	41.1	0.10	Chest problems, pneumonia, diarrhoea, respiratory problems, stomach ache, malaria, STDs, malaria, abdominal disorders, arthritis
8	*Pappea capensis, Eckl. & Zeyh.*	Entimigomi/ Oltimigomi	36.7	0.07	Strengthens, food, fertility, stomach ache, stamina, aphrodisiac
9	*Croton somalensis, Vatke & Pax ex Pax*	Enchani emburkel /	34.4	0.02	Food, stomach ache

		Olchani olpurkel			
10	*Carissa edulis, Forssk.*	Olamuniaki/ Mukawa	32.2	0.06	Joint and muscle pain, gonorrhoea, chest pains, polio symptoms
11	*Toddalia asiatica, (L.) Lam.*	Ole parmunyo/ Mururue	31.1	0.03	Cold, fever and malaria,
12	*Embelia schimperi, Vatke*	Olchani onyokie/ enchani enkashe/ Onchani empuken	27.8	0.02	Anthelmintic, diarrhoea
13	*Azadirachta indica, A. Juss.*	Neem/ mwarobaini/ murubaini	24.4	0.04	Malaria, fever, aches, pains, Skin infections
14	*Turraea abyssinica, Hochst.*	Enchani enkashe	22.2	0.01	Anthelmintic
15	*Euclea divinorum, Hiern*	Olkinyei/ Osojo/ Mukinyai	21.1	0.11	Ulcers, diarrhoea, wounds, arthritis, snakebites, headache, toothache, gonorrhoea, purgative (in soup) and as a tonic for anaemia,
16	*Plumbago zeylanica, L.*	Enekuseron/E nchani enkusero	21.1	0.03	Skin diseases, infections and intestinal worms
17	*Albizia anthelmintica, Brongn.*	Emugutan	20.0	0.06	Purgative, tonic, de-wormer, fever and malaria
18	*Clerodendrum myricoides, (Hochst.) R.Br. ex Vatke*	Olmakutukut	20.0	0.12	Gonorrhoea, rabies, measles, TB, colic, eye disease, malaria, swellings, in the body, wound dressings, asthma and as aphrodisiac
19	*Olea europaea, L.*	Oloirien / Mutamaiyu	20.0	0.02	Malaria, pneumonia
20	*Strychnos henningsii, Gilg*	Entipilikwa/ Oltipilikwa/ Mteta	18.9	0.03	Rheumatism, gastrointestinal complaints and snake bites
21	*Rhoicissus tridentate, (L.f.) Wild & R.B.Drumm.*	Orarait/ Olkilenyai/ Ole rubat	17.8	0.06	infertility, stomach, kidney and bladder complaints, dysmenorrhea
22	*Albizia amara Albizia amara, Boiv.*	Olpere longo	16.7	0.06	Piles, diarrhoea and gonorrhoea, cough, ulcers, dandruff and malaria, Cancer
23	*Ximenia Americana, L.*	Enkamai/ Olamai	16.7	0.06	Stomach-ache in kids, food, tonic, constipation, HIV
24	*Croton dichogamus, Pax*	Olokirdingai/ Enkitarru	15.6	0.03	Polio-like symptoms, gonorrhoea, chest pain
25	*Periploca linearifolia, Quart.-Dill. & A.Rich.*	Osinandei	14.4	0.01	Dental hygiene
26	*Salvadora persica, L*	Oremit/ Eremit	14.4	0.08	Eye infections, worms, malaria, stomach ache, constipation, cold, teeth hygiene, respiratory infections

27	*Combretum molle, R.Br. ex G.Don*	Olmaroroi	13.3	0.12	Abdominal pain, colic, constipation, intestinal worms and dysentery, fever, malaria, headache, backache, HIV infections, cough
28	*Trimmeria grandifolia, (Hochst.) Warb.*	Oledat/ muhinduhindu	13.3	0.02	Soup, Malaria
29	*Vernonia brachycalyx, O.Hoffm.*	Ologumati	13.3	0.01	Malaria
30	*Urtica massaica, Mildbr.*	Entamejoi /Ndamesoi/ Thabai	11.1	0.04	Malaria, fractures and venereal diseases, stomach-ache
31	*Piliostigma thonningii, (Schum.) Milne-Redh.*	Orbukoi/ Olbukoi	10.0	0.08	Wounds and ulcers as a haemostatic and to promote healing, diuretic, diarrhoea, dysentery, worms and other intestinal problems
32	*Acokanthera schimperi, (A.DC.) Benth. & Hook.f. ex Schweinf.*	Olmorijoi	8.9	0.01	Malaria
33	*Prunus Africana, (Hook.fil.) Kalkm*	Olkoijuk / Muiri	8.9	0.02	Cancer, stomach-ache
34	*Searsia natalensis, (Bernh. ex C.Krauss) F.A.Barkley*	Olmisigiyioi/ Muthigiu	8.9	0.10	Worm infections, chest problems, pneumonia, respiratory disorders, stomachic, malaria, digestive disorders, gonorrhoea
35	*Turraea mombassana, C. DC.*	Enchani enkashe	8.9	0.03	Excess bile, malaria and other fevers.
36	*Aloe sp*	Osuguroi/ Esuguroi	6.7	0.01	Malaria
37	*Mystroxylon aethiopicum, (Thunb.) Loes*	Olodo nganayioi	6.7	0.01	Colic pain, especially in children
38	*Psiadia punctulata, Vatke*	Olabaai/ Olabaai la partolu	6.7	0.03	colds, headache and abdominal pains
39	*Myrica salicifolia, Hochst. ex A.Rich.*	Olkitoloswa	5.6	0.02	Tonsillitis, throat infections
40	*Acacia mellifera, Vahl.*	Oiti	4.4	0.04	Postpartum tonic, appetizer, sore throat, stomach ache
41	*Acacia nubica, Benth.*	Oldepe	4.4	0.04	Sexually transmitted infections, postpartum tonic, facilitate lactation, rejuvenation
42	*Grewia bicolor, Juss*	Emporokwai / Esiteti	4.4	0.03	Eye infections, respiratory disorders, snake bite
43	*Maytenus senegalensis, (Lam.) Exell*	Olaimurunyai	4.4	0.10	Infectious diseases, arthritis, diarrhoea, dysentery, gastrointestinal diseases, menstrual pain, eye infections, nausea, , severe headache, aphrodisiac
44	*Ajuga remota, Benth*	Osarara	3.3	0.02	Malaria, fever, infections

Ranking of threatened medicinal plant species
While most species were common in the three study regions, a few plant species were specific to the sites as shown in Table 5. Based on the degree of rarity, 12 plant species in Kajiado, 8 species in Nairobi and 7 species in Narok were identified as specific to the study regions and thus classified as rare and under threat of over exploitation. Therefore, conservation priorities need to be identified for the threatened medicinal plants in the regions.

Table 5: Plant Species traded as herbal remedies which were specific to regions

Kajiado	**Nairobi**	**Narok**
Acacia thomasii	*Carica papaya*	*Grewia similis*
Cissus quadrangularis	*Euphorbia candelabrum*	*Ozoroa insignis*
Zehneria scabra	*Balanites aegyptiaca*	*Momordica friesiorum*
Acacia abyssinica	*Commiphora swynnertonii*	*Tarenna graveolens*
Acacia xanthophloea	*Ziziphus mucronata*	*Hibiscus flaviflorus*
Albizia schimperiana	*Moringa oleifera*	*Nuxia congesta*
Caesalpinia volkensii	*Acacia tortilis*	*Ochna ovata*
Commiphora africana	*Mondia whytei*	
Croton megalocarpus		
Guttenbergia carviflorus		
Ormocarpum trachycarpum		
Vepris nobilis		

Discussion

Demographic features of the informants
Patterns in traditional medicine use and practices have always been biased towards women. In this study more women were involved in medicinal plants trade in all the studied counties. These results are similar to previous studies carried out in Kenya and India which revealed that the active ages of herbalists is usually between 40 - 60years (Islam *et al*., 2014; Okumu *et al*., 2017; Rehman *et al*., 2017; Silambarasan *et al*., 2017). Majority of the young herbalists were trading in Nairobi while the elderly herbalists were mainly from Narok region. Similar results were recorded in previous studies by Kamau *et al*., (2016) in Central Kenya. The study also established that most of the herbalists were uneducated (77.78%) and only 1.11% had college education as recorded in other studies such as Islam *et al*., (2014) and Hilonga *et al*., (2019). This figure is slightly higher compared with the average national adult literacy rate of 71% in Kenya (Muthee *et al*., 2011).

Taxonomic classification and growth forms of medicinal plants in the study area
The 86 plant species recorded belonging to 42 families is an indication of species diversity of plants being traded as herbal medicine in selected regions in Kenya. In this study diverse growth forms were recorded: shrubs at 66.28% (57species), trees 14 (16.28 %) herbs 10 (11.63%) and climbers 5 (5.81%). The dominance of shrubs and trees in this study is in agreement with studies conducted in Mana Angetu district and Hawassa city in Southern Ethiopia (Lulekal *et al*., 2008; Regassa, 2013; Tefera & Kim, 2019). A study in Pakistan reported trees as the most traded form followed by herbs (Rehman *et al*., 2017). The study further revealed 16 dominant families that were recorded across the three counties with a minimum of two species each, with Fabaceae leading with 17 species. Similar studies carried out in Tanzania, Baglandesh, Ethiopia, India, recorded Fabaceae as the most traded plant family (Islam *et al*., 2014; Kidane *et al*., 2018; Silambarasan *et al*., 2017; Hilonga *et al*., 2019; Krupa *et al*., 2019). Utilization of Apocynaceae, Rutaceae and Rhamnus as ethinomedicinal plants have been reported in parts of Italy, Pakistan and other parts of the world. This can be attributed to its wide

distribution in many environments. In addition, the study revealed that each county had specialised species listed and used as medicinal species.

Plant parts used and ailment treatment associations

This study revealed that stem, bark, leaves, roots, seeds and tubers were used in combination or alone to treat diverse ailments. The most utilized plant parts were stems and barks. Most studies in the world have recorded leaves as the most traded plant part in herbal medicine preparations (Islam *et al*., 2014; Kichu *et al*., 2015; Mukungu *et al*., 2016; Rehman *et al*., 2017; Demie *et al*., 2018a, 2018b; Faruque *et al*., 2018; Venkatachalapathi *et al*.,2018; Krupa *et al*., 2019; Ndhlovu *et al*., 2019). Other studies carried out in Ethiopia such as Lulekal *et al*., (2008) and in Kenya (Kiringe, 2006) showed that roots were the most utilized plant parts in preparation of herbal remedies followed by leaves. Single species were used to treat several ailments while single ailments could be treated by a variety of medicinal species. *Osyris lanceolata* had the highest percentage use value (68.9%) and mostly used to treat abdominal and sexual ailments. *Rhamnus staddo*, *Rapanea melanophloes* and *Acacia nilotica* had percentage use value above 50% and used for treatment of the three leading ailment groups (abdominal, respiratory and malaria). The study recorded three species that are nationally and internationally protected that were being traded illegally. All Aloe species, *Prunus africana* and *Osyris lanceolata* are protected in CITES appendix II where Kenya is a signatory. None of the herbalists selling the plant products of these species had permits for neither harvesting nor trading.

Conclusion

The study was successful in generating a list of plant species that are traded and used as medicinal plants in the three study areas. It was revealed that there is diversity of medicinal plant species that are used by herbalists to treat various ailments. Among the main categories of ailments reported were abdominal, respiratory and malaria.

The generated list of plant species could be used as baseline data to document diversity of plant species traded as medicinal in Kenya. Ethnobotanical data recorded showed that *Osyris lanceolata* was the most commonly traded plant species with the highest use index. This species is however listed under CITES Appendix II as a threatened species which require conservation; and such guidelines have been developed in Kenya towards its domestication. The high use value and use index of medicinal plant species is an indication of their preference by local inhabitants to treat particular ailments. Therefore, such popular plant species could be further analyzed for pharmacologic components which may lead to development of new and potential drugs. Additional studies are recommended to establish the population status of *Prunus africana, Osyris lanceolata* and Aloe species that can be used to prepare guidelines on domestication and sustainable harvesting of these protected species.

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References

Bii Barnabas. (2018). "Take a sip of Capparis tomentosa: My patients are proof that it works!" - *Daily Nation.* Retrieved from https://www.nation.co.ke/health/Using-herbal-medicine/3476990-4644238-mrxdp9/index.html

Bussmann, R. W., Gilbreath, G. G., Solio, J., Lutura, M., Lutuluo, R., Kunguru, K.,

Mathenge, S. G. (2006). Plant use of the Maasai of Sekenani Valley, Maasai Mara, Kenya. *Journal of Ethnobiology and Ethnomedicine*, 2(1), 22.

Campbell, D. J., Gichohi, H., Mwangi, A., & Chege, L. (2000). Land use conflict in Kajiado District, Kenya. *Land Use Policy*, 17(4), 337–348.

Canter, P. H., & Ernst, E. (2004). Anthocyanosides of Vaccinium myrtillus (Bilberry) for Night Vision - A Systematic Review of Placebo-Controlled Trials. *Survey of Ophthalmology*, 49(1), 38–50.

Chen, S. L., Yu, H., Luo, H. M., Wu, Q., Li, C. F., & Steinmetz, A. (2016). Conservation and sustainable use of medicinal plants: problems, progress, and prospects. *Chinese medicine*, *11*(1), 37.

Cohen, P. A., & Ernst, E. (2010). Safety of Herbal Supplements: *A Guide for Cardiologists. Cardiovascular Therapeutics*, 28(4), 246–253.

Demie, G., Negash, M., & Awas, T. (2018a). Ethnobotanical study of medicinal plants used by indigenous people in and around Dirre Sheikh Hussein heritage site of South-eastern Ethiopia. *Journal of Ethnopharmacology*, 220, 87–93.

Demie, G., Negash, M., & Awas, T. (2018b). Ethnobotanical study of medicinal plants used by indigenous people in and around Dirre Sheikh Hussein heritage site of South-eastern Ethiopia. *Journal of Ethnopharmacology*, 220, 87–93.

Faruque, M. O., Uddin, S. B., Barlow, J. W., Hu, S., Dong, S., Cai, Q., & Hu, X. (2018). Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban District of Bangladesh. *Frontiers in pharmacology*, *9*, 40.

Fowler, M. W. (2006). Plants, medicines and man. *Journal of the Science of Food and Agriculture*, Vol. 86, pp. 1797–1804.

Hilonga, S., Otieno, J. N., Ghorbani, A., Pereus, D., Kocyan, A., & de Boer, H. (2019). Trade of wild-harvested medicinal plant species in local markets of Tanzania and its implications for conservation. *South African Journal of Botany*, 122, 214–224.

Höft M, Barik SK, Lykke AM: Quantitative Ethnobotany. Applications of multivariate and statistical analyses in ethnobotany. *People and Plant Working Paper*; 1999

Islam, M. K., Saha, S., Mahmud, I., Mohamad, K., Awang, K., Jamal Uddin, S., Shilpi, J. A. (2014). An ethnobotanical study of medicinal plants used by tribal and native people of Madhupur forest area, Bangladesh. *Journal of Ethnopharmacology*, 151(2), 921–930.

Kamau, L. N., Mbaabu, P. M., Mbaria, J. M., Gathumbi, P. K., & Kiama, S. G. (2016). Ethnobotanical survey and threats to medicinal plants traditionally used for the management of human diseases in Nyeri County, Kenya. *TANG [HUMANITAS MEDICINE]*, 6(3), 21.1-21.15.

Karimi, A., Majlesi, M., & Rafieian-Kopaei, M. (2015). Herbal versus synthetic drugs; beliefs and facts. *Journal of Nephropharmacology*, 4(1), 27–30.

Kariuki, P. M., Njoka, J. T., Saitabau, C. L., & Saitabau, H. S. (2016). Forest Governance, Livelihoods and Resilience: The Case of Loita Forest (Entime e Naimina enkiyio), Narok County, Kenya. In *Dryland Forests* (117-138). Springer, Cham.

Kenya National Bureau of Statistics (KNBS) (2019). Detailed Census Results - Kenya National Bureau of Statistics. Nairobi Kenya

Kichu, M., Malewska, T., Akter, K., Imchen, I., Harrington, D., Kohen, J., … Jamie, J. F. (2015). An ethnobotanical study of medicinal plants of Chungtia village, Nagaland, India. *Journal of Ethnopharmacology*, 166, 5–17.

Kidane, L., Gebremedhin, G., & Beyene, T. (2018). Ethnobotanical study of medicinal plants in Ganta Afeshum District, Eastern Zone of Tigray, Northern Ethiopia. *Journal of Ethnobiology and Ethnomedicine*, 14(1), 1–19.

Kigen, G., Kamuren, Z., Njiru, E., Wanjohi, B., & Kipkore, W. (2019). Ethnomedical Survey of the Plants Used by Traditional Healers in Narok County, Kenya. *Evidence-Based Complementary and Alternative Medicine*, 2019, 1–8.

Kiringe, J. W. (2006). A Survey of Traditional Health Remedies Used by the Maasai of Southern Kaijiado District, Kenya. *Ethnobotany Research and Applications*, 4, 061.

Kokwaro, J. O. (2009). *Medicinal plants of East Africa*. University of Nairobi press.

Krupa, J., Sureshkumar, J., Silambarasan, R., Priyadarshini, K., & Ayyanar, M. (2019). Integration of traditional herbal

medicines among the indigenous communities in Thiruvarur District of Tamil Nadu, India. *Journal of Ayurveda and integrative medicine*, *10*(1), 32-37.

Lulekal, E., Kelbessa, E., Bekele, T., & Yineger, H. (2008). An ethnobotanical study of medicinal plants in Mana Angetu District, southeastern Ethiopia. *Journal of Ethnobiology and Ethnomedicine*.

Mahomoodally, M. F. (2013). Traditional Medicines in Africa: An Appraisal of Ten Potent African Medicinal Plants. *Evidence-Based Complementary and Alternative Medicine*, 2013, 1–14.

Maundu, P., Berger, D., Nasieku, J., Kipelian, M., Mathenge, S. G., & Morimoto, Y. (2001). Ethnobotany of the Loita Maasai. *People and Plants Working Paper*, 8: 1–35.

Mukungu, N., Abuga, K., Okalebo, F., Ingwela, R., & Mwangi, J. (2016). Medicinal plants used for management of malaria among the Luhya community of Kakamega East sub-County, Kenya. *Journal of Ethnopharmacology*, 194, 98–107.

Muthaura, C. N., Rukunga, G. M., Chhabra, S. C., Mungai, G. M., & Njagi, E. N. M. (2007). Traditional antimalarial phytotherapy remedies used by the Kwale community of the Kenyan Coast. *Journal of Ethnopharmacology*, 114(3), 377–386.

Muthee, J. K., Gakuya, D. W., Mbaria, J. M., Kareru, P. G., Mulei, C. M., & Njonge, F. K. (2011). Ethnobotanical study of anthelmintic and other medicinal plants traditionally used in Loitoktok district of Kenya. *Journal of Ethnopharmacology*, 135(1), 15–21.

Mwangi, J., & Gitonga, L. (2014). Perceptions and Use of Herbal Remedies among Patients with Diabetes Mellitus in Murang'a North District, Kenya. *Open Journal of Clinical Diagnostics*, 04(03), 152–172.

National Coordinating Agency for Population & Development. (2008). Seeking Solutions for Traditional Herbal Medicine: Kenya Develops a National Policy. Policy Brief No.1, 1–4.

Ndhlovu, P. T., Mooki, O., Otang Mbeng, W., & Aremu, A. O. (2019). Plant species used for cosmetic and cosmeceutical purposes by the Vhavenda women in Vhembe District Municipality, Limpopo, South Africa. *South African Journal of Botany*, 122, 422–431.

Nisar, B., Sultan, A., & Rubab, S. L. (2018). Comparison of Medicinally Important Natural Products versus Synthetic Drugs-A Short Commentary. *Nat Prod Chem Res*, *6*(2), 308.

Njoroge, G. N. (2012). Traditional medicinal plants in two urban areas in Kenya (Thika and Nairobi): Diversity of traded species and conservation concerns. *Ethnobotany Research and Applications*, 10(0), 329–338.

Okumu, M. O., Ochola, F. O., Onyango, A. O., Mbaria, J. M., Gakuya, D. W., Kanja, L. W., … Onyango, M. A. (2017). The legislative and regulatory framework governing herbal medicine use and practice in Kenya: A review. *Pan African Medical Journal*, Vol. 28.

Phillips, O., & Gentry, A. H. (1993). The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. *Economic Botany,* 47(1), 15–32.

Randriamiharisoa, M. N., Kuhlman, A. R., Jeannoda, V., Rabarison, H., Rakotoarivelo, N., Randrianarivony, T., Bussmann, R. W. (2015). Medicinal plants sold in the markets of Antananarivo, Madagascar. *Journal of Ethnobiology and Ethnomedicine*, 11(1), 60.

Regassa, R. (2013). Assessment of indigenous knowledge of medicinal plant practice and mode of service delivery in Hawassa city, southern Ethiopia. *Journal of Medicinal Plants Research*, 7(9), 517–535.

Rehman, M. N., Ahmad, M., Sultana, S., Zafar, M., & Edwards, S. (2017). Relative popularity level of medicinal plants in Talagang, Punjab Province, Pakistan. Brazilian Journal of Pharmacognosy, 27(6), 751–775.

Schippmann, U., Leaman, D. J., & Cunningham, A. B. (2002). Impact of cultivation and gathering of medicinal plants on biodiversity: Global trends and issues. *Biodiversity and the ecosystem approach in agriculture, forestry and fisheries*.

Silambarasan, R., Sureshkumar, J., Krupa, J., Amalraj, S., & Ayyanar, M. (2017). Traditional herbal medicines practiced by the ethnic people in Sathyamangalam forests of Western Ghats, India. *European Journal of Integrative Medicine*, 16, 61–72.

Tefera, B. N., & Kim, Y. D. (2019). Ethnobotanical study of medicinal plants in the Hawassa Zuria District, Sidama zone, Southern

Ethiopia. *Journal of Ethnobiology and Ethnomedicine*, 15(1), 1–21.

The Ministry of Agriculture, Livestock and Fisheries (MoALF), Nairobi, K. (2017). Climate Risk Profile for Kajiado County. Kenya County Climate Risk Profile Series | CCAFS: CGIAR research program on Climate Change, Agriculture and Food Security.

Venkatachalapathi, A., Sangeeth, T., Ali, M. A., Tamilselvi, S. S., Paulsamy, S., & Al-Hemaidc, F. M. A. (2018). Ethnomedicinal assessment of Irula tribes of Walayar valley of Southern Western Ghats, *India. Saudi Journal of Biological Sciences*, 25(4), 760–775.

World Health organization (WHO) (2011). The World Medicines Situation 2011 Traditional Medicines: Global Situation, Issues and Challenges. World Health Organization, (3rd Edition), 1–14.