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Research Paper

Ethnobotanical knowledge in communities living around Kaya Kauma and Kaya Tsolokero in Kilifi County, Kenya

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Abstract: The coastal plains of Kenya are dotted by pockets of indigenous rainforest locally referred to as Kayas. The diversified vegetation in these Kaya forests has fulfilled the needs of the local communities and immensely contributed to their livelihoods. The local communities living around these forests have used this flora for traditional medicine for generations. The population therefore, possess a great deal of knowledge on their ethnic plants which calls for documentation and preservation. An ethnobotanical demographic study was carried out around the sacred Kaya forests of Kauma and Tsolokero in Kilifi, Kenya between 2015 and 2016 to assess knowledge on useful plants to the population. A survey was carried out in 26 villages surrounding Kaya Kauma and Kaya Tsolokero forest of Kilifi, Kenya. The survey stratified the population into several categories to assess the level of knowledge the communities had on useful plants in their study forests. Data from the survey was analysed using Kruskal-Wallis H Test using SPSS Statistics. Kaya Kauma forest surrounded by eighteen (18) villages was inhabited by the Kauma, Duruma, Chonyi, Digo, Girima and Kambe Mijikenda sub-groups while Kaya Tsolokero forest had eight (8) adjacent villages inhabited by the Chonyi, Giriama, Jibana and Kauma sub-groups. A total of 444 useful plants were mentioned by the respondents using local names. However, 138 and 181 plant species were scientifically validated for Kaya Kauma and Kaya Tsolokero, respectively. The Kauma andthe Chonyi communities' fromKaya Kauma and Tsolokero respectively, were the most knowledgeable in useful plant species. The statistical analysis depicted significant ($p<0.05$) differences in knowledge among diverse categories of respondents. However, a big knowledge gap was noted between the adults and youth respondents. These findings shall not only provide recognition to this knowledge and the useful traditional plants but also help in the conservation of important skills and knowledge and endangered plant species. This

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study helped to bridge the knowledge gap between the older and the younger population.

Keywords: Kaya forest, Kilifi, Kenya

Introduction:

The evolutionary relationships between plants and people are complex. People have evolved with plants which is referred as co-evolution where species interact with and respond evolutionarily to each other (Raven, 2019). Medicinal plants have an unbelievable history in terms of serving humanity in almost all continents of the world. Traditional healers have transferred that incredible knowledge from generation to generation. Even modernity or cultural revolutions have not altered the in-depth wisdom of this natural medical paradigm. Pharmacological rationale in light of traditional uses followed by phytochemical studies could surely bring a new revolution in the treatment of diseases (Haroon, 2014).

As documented by Awas *et al*., 1997; Yirga, 2010; Asfaw & Tadesse, 2001 and Pei*et al*., 2009 there is a wealth of indigenous knowledge on the use and management of plant resources among the local indigenous communities. The data provided by the study on sacred forest of Rabai people (Kibet and Nyamweru, 2008) clearly shows that the folk knowledge on medicinal plants and their uses is still alive in that region. This indicates that ethno botanical studies constitute a valuable first step in the bio-prospecting, which may lead to the development of new plant-based medicines through phyto therapeutically research (El- Kamali and El-Khalifa, 2009).

There are many distinct ethnic groups in the African continent. Out of which, more than 40 groups reside in Kenya, ranging in size from about seven million Kikuyu to about 500 El Molo who live in the shore of Lake Turkana. Ethnic groups in Kenya can be divided into three broad linguistic groups;the Bantu, the Nilotic and the Cushite**.** The five largest tribes the, Kikuyu, Luo, Luhya, Kamba and the Kalenjinaccount for 70% of the population ("East Africa Living Encyclopedia," 2015). All these communities are dependent on the flora and fauna found in their respective areas. The use of herbal flora for treatment of diseases and for therapeutic purposes is common with the Mijikenda as well as amongst other Kenyan tribes. The Mijikenda are a cluster of nine (9) ethnic groups with similar culture and closely related dialects that live along the Kenyan Coast.The Mijikenda consist of the Giriama, Chonyi, Jibana, Kauma, Kambe, Digo, Duruma, Rabai, and Ribe (Park, 2015). The Mijikenda community has relied on plant resources for their basic needs, including medicine, for centuries (Pakia and Cooke, 2003) while a variety of food plants constitute their daily cuisine in a traditional flair. Specific flora from provide good quality timber for construction and for fuelwood while others for fodder. The construction industry world over hasused plants to increase productivity in the industry (Arditi *et al*., 1997). Traditional beekeeping is also important in agriculture, rural employment, human nutrition, and economic development. It has become an example of successful livelihood improvement in remote areas of developing countries. Traditional beekeeping carries low risks, requires little investments, generates active income, and saves labor (Altunel and Olmez, 2019; Muli *et al*., 2007). Specific plants have served communities through beautification and provision of livelihood. Kaplan, (1976) noted that the most important satisfaction people derive from gardening is the peace andtranquility they experience.

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Materials and Methods

A survey was carried out in 26 villages surrounding Kaya Kauma and Kaya Tsolokero forest of Kilifi, Kenya. The survey stratified the population into several categories to assess the level of knowledge the communities had on useful plants in their study forests. These population around the villages adjacent to Kaya Kauma and Kaya Tsolokero were interrogated through a questionnaire survey. The questionnaire targeted to get information on all ethnobotanical useful plants which were in use by the communities to suffice their livelihood. The communities mentioned plants used as food and fodder, medicine, construction, fuelwood, decoration, bee-forage, aesthetics, plants with cultural beliefs or any other as stated by the communities which was recorded. The readings were analyzed by using Kruskal-Wallis H Test using SPSS Statistics to obtain the significant (p value) knowledge in various categories of population was analyzed.

Description of Kaya Kauma and Kaya Tsolokero

Kaya is a Mijikenda word meaning village. Kaya Kauma is primarily a Kaya of the Kauma community. It is located in Jaribuni area in Kilifi County at 3°37.821S and 39°44.189E.The altitude of this forest is 120m above the sea level. The size of this forest is 100 ha which exhibits a deciduous pattern of vegetation. This forest slopes down in the North to River Ndzovuni. The forest has rich soil with iron-ore deposit. Kaya Kauma has a diverse pattern of vegetation. Interestingly, there is a village inside the Kaya forest which is used as a shrine for community rituals and is restricted to community members. The forest flourishes well on the hilltop with dense vegetation. The area is also rich in limestone. There are eighteen (18) villages within the radius of 4km around the forestwhich is endorsed by the community. Kaya Tsolokero is surrounded by eight (8) villages in the radius of 5km.There is a Kaya village inside the forest with dwelling population.

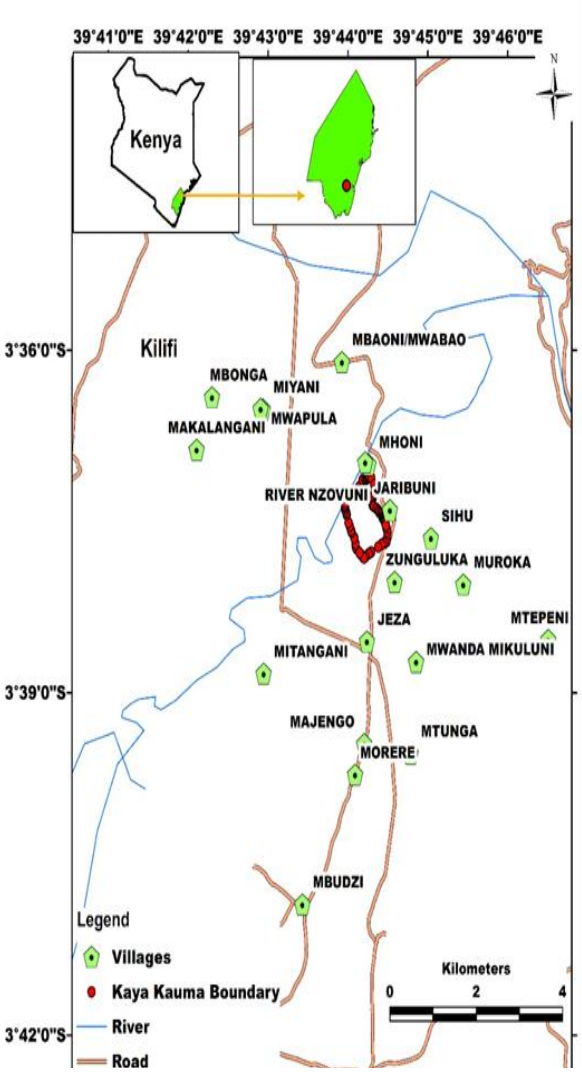

Fig 1: Map of Kaya Kauma and its adjoinig villages

Kaya Tsolokero is primarily a Kaya of the Jibana community. It is an extension of Kaya Jibana and a secondary Kaya forest. The forest exhibits a mixed population. It extends to an area of 35 hectares geographical positioned at 3°50.802E and 39°44.645S. The vegetation exhibits an evergreen pattern. This is a very thick forest with a diverse flora population with a rich culture

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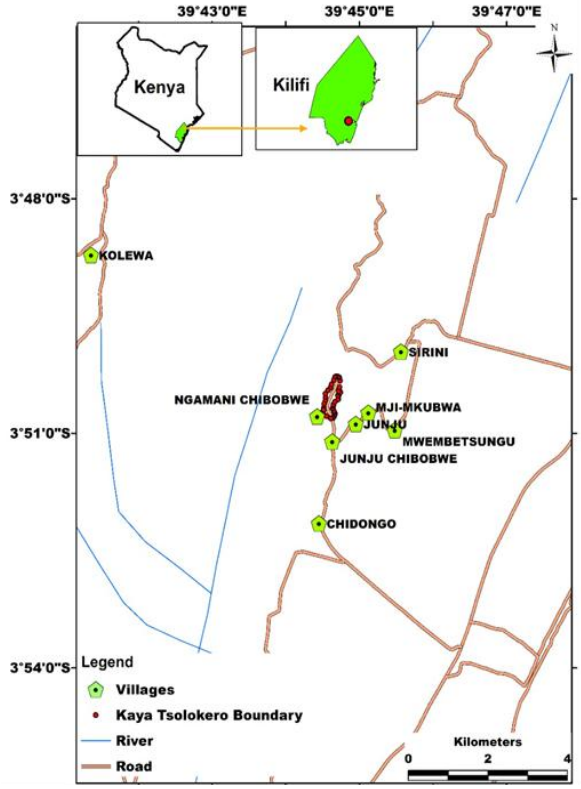

Fig. 2: Kaya Tsolokero with its adjoining villages

Study villages of Kaya Kauma and Kaya Tsolokero

Twenty-six (26) villages were identified around the study area with 18 from Kaya Kauma and 8 from Tsolokero as shown in the map of Kaya Kauma and Kaya Tsolokero with its adjoining villages (Fig. 1&2). These were selected from the four geographical directions at a radius of about 4km from the center of each forest

Table 1: Table of adjoining villages of kaya Kauma and Kaya Tsolokero

No	Name of Kaya	Latitude	Longitude
	Kaya Kauma Villages		
1	Jaribuni	S03°37.401'	E039°44.524'
2	Jeza	S03°38.551'	E039°44.237'
3	Majaengo	S03°39.449'	E 039°44.202'
4	Makalangani	S03°36.872'	E039°42.105'
5	Morere	S03°39.719'	E039°44.088'
6	Mbaoni/Mwabao	S03°36.104'	E039°43.924'
7	Mbonga	S03°36.412'	E039°42.297'
8	Mbudzi	S03°40.854'	E039°43.429'
9	Mhoni	S03°37.001'	E039°44.257'
10	Mitangani	S03°38.834'	E039°42.943'
11	Miyani	S03°36.518'	E039°42.934'
12	Mtepeni	S03°38.538'	E 039°46.507'
13	Mtunga	S03°39.532'	E039°44.783'
14	Muroka	S03°38.052'	E039°45.443'
15	Mwanda Mikuluni	S03°38.730'	E 039°44.852'
16	Mwapula	S03°36.514'	E039°42.907'
17	Sihu	S03°37.646'	E039°45.039'
18	Zunguluka	S03°38.028'	E039°44.584'
	Kaya Tsolokero Villages		

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1	Kolewa	S04°00.719'	E039°41.355'
2	Sirini	S03°49.955'	E 039°45.564'
3	Mwembetsungu	S03°50.959'	E039°45.481'
4	Mji-Mjubwa	S03°50.736'	E039°45.122'
5	Junju	S03°50.880'	E039°44.952'
6	Junju Chibobwe	S03°51.104'	E039°44.632'
7	Ngamani Chibobwe	S03°50.784'	E 039°44.427'
8	Chidongo	S03°52.151'	E039°44.450'

Data collection from the selected villages of Kaya Kauma and Tsolokero

An elaborate questionnaire was developed and used to get information from residents of eighteen (18) selected villages in Kaya Kauma and eight (8) villages in Kaya Tsolokero. The questionnaire which was ministered through face to face interviews focused on the general background information on key informants, description of uses, habits and distribution of plants mentioned as important and their uses. Details on the parts of the plant used, possibilities of commercialization and domestication were also recorded. Specific questions were posed to the herbalist to get details on the methods of collection, processing, preservation, application and medicinal prescription of medicinal plants. Information on commercialization, domestication and sustainable use of medicinal plants was also captured in the questionnaire. The population in all the villages surveyed around the kaya forests was obtained from secondary data in the administrative offices of Kilifi County and through direct interviews with area administrators.

Kauma and Chonyi languages were used as media of communication with the villagers. Enumerators who were local residents conversant with these two languages and English were trained to conduct the survey and report findings as guided in the questionnaire that was prepared in English. The Kaya elders, herbalist, local leaders and a sample of adults were randomly selected for interviews. A consent to carry out the study in the two kaya forests was sought from the kaya elders. The data collected was then evaluated and the results were manipulated to obtain a general information on the prevalent knowledge on the useful plants in the population. The useful plants were classified on the basis of services they provide which include food, medicine, construction, fuel and firewood, decoration, bee-keeping and other plants category.

The total of 492 households was interviewed with a total population of 4555 which translates to a mean of about nine (9) individuals per household living around Kaya Kauma. Kaya Tsolokero had a total of 1000 households with a total population of 9088, thus translating to a similar mean of about nine (9) individuals per household.

Results and discussion:

Demography

Muhoni, meaning river in the Northern part of Kaya Kauma had the lowest population density whilst Mitangani the South had the highest. In Kaya Tsolokero, the highest population was in Kolewa village in the North of the forest, while the lowest was Chidongo village on the Western (Table 2). The spread of the villages as shown in Figure 2 is concentrated on the side with road infrastructure.The population around Kaya Tsolokero was getting dominated by the Chonyi community gradually replacing the indigenous Jibana community. There is

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some continuous assimilation of several Mijikenda communities around Kaya Tsolokero and Kauma.

Table 2: Population of selectedvillages along the four geographical directions of the study forests

Name of Kaya	Direction of the village around	Name of the village	Total population	No. of households
Kaya Kauma	Eastern side	Jaribuni	800	68
		Zunguluka	565	70
	Western side	Miyani	560	40
		Mpula	680	60
	Northern side	Muhoni	277	40
	Southern side	Jeza	657	91
		Mitangani	1016	123
Kaya Tsolokero	Eastern side	Sirini	3840	310
	Western side	Chidongo	1985	210
	Northern side	Kolewa	4893	530
	Southern side	Junju	2210	260
Total			17483	1802

Demography and ethnobotanical knowledge in Kaya Kauma

Out of the population interviewed the respondents around Kaya Kauma belonged to nine(9) different ethnic groups. They were Digo, Duruma, Girima, Kambe, Kauma, Chonyi, Digo and Kamba. Based on gender diversity, not much difference in knowledge were seen. 54% of the male respondents in Kaya Kauma had knowledge on useful plants compared to 46% of the females. This knowledge was further analyzed on the basis of plants which were used as food, medicinal, constructional, fuel and firewood, decorative, recreational, beekeeping and others. Generally, 59% of the total population around Kaya Kauma exhibited knowledge on the food plants, 97% on medicinal plants, 44% on constructional plants,79% on fuel and firewood plants, 74% on decorative plants while recreational and bee-keeping scored 7%, respectively. Knowledge on other plants not included in this criterion was 2%.Knowledge on medicinal, fuelwood and decorative plants was high within the population.

Adults in the category of 35 years and above had 72% knowledge on the useful plants. The youth in the category of 18-34 years had 24% knowledge on useful plants compared to children under 18 years of age with 4%. There was an alarming threat on the knowledge of useful plants displayed by a steep knowledge gap between adults and the youth. Comparatively, less youth were available for interviews compared to the adults in the society which altered the knowledge level.This pointedan incorporation of modernized life style which has created a loss of interest for ethnic values and beliefs among the youth.

Married population had 56% knowledge on useful indigenous plants compared to 20% knowledge within the unmarried population. This indicates an enhancement

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in knowledge to people with family for their livelihood. The widowed population had 21% knowledge while divorced population had 3%. On the basis of educational level, the population with no formal education exhibited 44% knowledge on indigenous useful plant species compared to population with formal education where primary education scored 32%, secondary education 16%, college goers at 3% and others at 4%. There is a general decline in knowledge on indigenous plants as the population is introduced to formal education (Table 3).

At Kaya Kauma, apart from knowledge on food and medicinal plants that were significant ($p<0.05$) for most users, the remaining categories were not. At Kauma site, there was no significant difference in knowledge between male and female ($p=0.841$), main occupation ($p=0.904$) and relationship to the village ($p=0.124$) at $p<0.05$ significant level. However, a significant difference in knowledge was noted in age of the respondents ($p=0.012$) whereby the youth were more knowledgeable than children and adults (mean=1.488). A significant difference in knowledge was also noted in the marital status ($p=0.027$) whereby the divorced were most knowledgeable (mean=1.75) compared to single, married and widowed in that order.

Demography and ethnobotanical knowledge in Kaya Tsolokero

Out of the population interviewed, the respondents around Kaya Tsolokero belonged to four major tribes; the Chonyi, Jibana, Kauma and Giriama. On the basis of the gender,generally the male population had 53% knowledge on indigenous useful plants compared to 47% of females. On the basis of age 98% of the adults were informed compared toyouth at 6%. There was a steep decline of knowledge on indigenous plantsbetween the adult and youth populations which is a major concern. On the basis of marital status 62% of married population had knowledge on indigenous useful plants compared to 12% of the unmarried population, 10% for the widowed and divorced, respectively. Population with no occupation had 25% knowledge on indigenous plants while 70% of farmers and 14% of the population with other occupation were informed useful indigenous plants. Highest knowledge on plants was exhibited by farmers.Generally, population in Kaya Tsolokero had the highest knowledge on medicinal (86%) and food plants at 75%. The Chonyi were the most informed with 72% knowledge on constructional plants 22% on firewood, 21% on decorative, 5% on bee-keeping 3% on recreational plants, and 7% on other plants. Knowledge on specific categories of plants with population sect are shown in Table 3.

At Kaya Tsolokero, In relationship to age, there was a significant difference in knowledge in the medicinal plant ($p=0.032$) and constructional plants ($p=0.01$). The adults were more informed on the medicinal plants (mean=2.581) while the youth were more informed about on constructional plants (mean=3.6). There was no significant difference in knowledge across the respondents on food, medicinal, constructional, fuelwood, decorative, re-creational and bee-keeping plants.

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Table 3: Categories of useful plant and knwoledge of various sect of population

	Category of population and knowledge level(%)															
Types of plants	**Food**		**Med**		**Cons**		**Fuel**		**Deco**		**Recre**		**Bee**		**Others**	
Forest	Ka	Tso	Ka	Tso	Ka	Tso	Ka	Tso	Ka	Tso	Ka	Tso	Ka	Tso	Ka	Tso
Male	54	85	98	96	45	73	77	33	73	25	8	5	5	53	3	7
Female	55	79	96	94	45	77	84	21	76	17	7	2	8	47	11	4
Adult	48	84	97	95	45	73	76	24	79	21	7	7	9	95	6	7
Youth	21	3	23	4	14	4	18	2	6	1	9	1	2	5	7	0
No formal education	40	80	96	94	39	70	77	26	80	21	7	4	7	55	6	7
Formal education	28	88	41	91	20	83	34	27	29	19	3	4	3	42	3	7
Kauma community	55	13	98	31	49	74	80	22	76	21	8	3	8	72	5	10
Chonyi community	2	60	3	71	2	51	2	15	2	16	1	2	0	7	0	13
Giriama	65	8	96	7	48	6	82	3	60	1	4	0	9	10	9	0
Other tribes*	27	16	90	18	9	16	81	7	81	5	0	3	9	18	0	3

*Digo & Duruma (Kauma) *Giriama and Kauma (Tsolokero)

Ka-Kauma Tso-Tsolokero Med=Medicinal Cons=Constructional Fuel=Fuelwood

Deco=Decoration Bee=Bee-keeping Others=Other plants mentioned from the given category

Kauma community- dominant in Kaya Kauma Chonyi community-dominant in Kaya Tsolokero

Plant species and their uses in Kaya Kauma and Tsolokero

A total of four hundred and forty four (444) useful plants were mentioned by the respondents using local names. However, one hundred and thirty eight (138) and one hundred and eighty one (181) plant species were validated scientifically for Kaya Kauma and Kaya Tsolokero, respectively. Different categories of useful plants with the number as stated by the respondents was recorded (Table 4). Forty five (45) species were common for both forests and in addition nineteen (19) and forty three (43) species possessed multiple local names across the communities in Kaya Kauma and Kaya Tsolokero respectively. For example species *Azadirachta indica* also known as Neem tree was referred with multiple names as Mzirikita, Mzerecta, Mkilifi, Mwarobaini and Mwarobaini kamili. Similarly *Landophia kirkii* was referred with Mtongazi, Mtulwa, Mtondo, Mtorya, Vitorya, Mpo and Mvipo.

Table 4: Number of useful plants mentioned under each category by population of Kaya Kauma and Kaya Tsolokero

SN	**USE**	**Number of species dentified**	
		Kaya Kauma	**Tsolokero**
1	Food	37	52
2	Medicinal	58	90
3	Construction	12	52
4	Fuel	24	13
5	Decoration	2	16
6	Recreation	6	3
7	Bee-forage	2	10
8	Others	1	2

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The sacred Kaya forests are legally protected areas of biodiversity, ecological services and cultural heritage. Ethnobotanical knowledge provided understanding and prospects for sustainable diverse uses of plant resources for the purposes of conserving both cultural and ecological diversity of protected areas (Carvalho & Frazão-Moreira, 2011). This implies that foundational knowledge of scientific systems emanates from traditional knowledge. Data information, knowledge and perceptions of the local community are the characteristic driving forces of forest ecosystems (Kujawa *et al*., 2016). Inhabitants of an area hold vast ecological knowledge, emerging from prolonged day-to-day contact with the environment. The local ecological knowledge involves all branches of ecology that is increasingly acknowledged by the scientific world (Bélisle *et al*., 2018). Modernization and the media are a serious challenge to indigenization paradigm in Africa. Western media and technology has re-shaped social outputs of youth and other users in Africa in favour of foreign content (Endong, 2014). Additionally, in other studies, the decreases in ethnobotanical knowledge with the increase of education (Benz *et al*., 2000; Martínez-Ballesté, *et al*., 2006) and wealth (Holmes, 2003) was attributed to the process of assimilating other cultures and the loss of indigenous languages among indigenous communities (Benz *et al*., 2000; Nicolás*et al*., 2017). Probably, this has affected the outlook of youth towards indigenous medicinal knowledge. The segments of the community directly engaged in herbal treatments had significant high knowledge in medicinal plants. Medicinal plants play an important role in health care around the world. Knowledge on medicinal plant is necessary to treat diseases that the "doctorsmay not cure," in culture-bound communities (Nicolás *et al*., 2017).Generally, the population in Kaya Kauma and Kaya Tsolokero had vast indigenous knowledge on their respective plant resources. The Kauma from Kaya Kauma, were the most informed on the application of useful indigenous plants among the seven Mijikenda communities.

Conclusion and recommendations:

The population around Kaya Kauma and Tsolokero had a vast knowledge on their flora. A variety of useful flora is used by the communities to fulfil their livelihoods. Most knowledge on indigenous flora was exhibited by the adult population. The youth were poorly informed about their rich flora probably because of change in life styles, apathy for traditions and customs andpoor interaction with the elderly members of the community.Incidentally the elderly sect that included men & women and population with low formal education were well informed on their indigenousplants and related applications. This knowledge gap should be addressed so that the rich culture and knowledge of these communities isretained. Introduction of ethnobotanical studies and activities in elementary and secondary schoolsmay addressed by governments to culture interest towards flora among the youthful generation.

Community standing herbaria of indigenous trees, establishment of nurseries and environmental clubs should be established. Theyouthshould be involved in field trips, forest walk to inculcate interest in the environment. Such exposure shall enable interaction with nature and experience the benefits indigenous ecosystems offer. The importance and efficacy of herbal medicine may be introduced to the youth in schools through professional talks by practitioners and professional herbalists to showcase herbal medicine as a source of livelihoods.

Intricate extraction techniques and simple medicinal formulations can be shared through practical classes in schools to generate interest in medicinal flora. Indigenous plants in the forest are named from their morphological structures or uses they offer to the society. These are usually the first hints the community has interacted with particular species in their midst. Some names are also very telling to their applications and any imminent benefit or danger they may pose to the community. There is a need therefore to document this floraand their applications as mentioned by the community for preservation of skills and indigenous knowledge in the community.

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