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Plant species and their importance to housing in the Turkana community, Kenya

Everlyne Ejore[1], Roxventa Ongugo[2], Jackline Kemboi[1], Samson Ojunga[2] Patrick Mwenja[1] and Jesse Owino[2]*

[1]Kenya Forestry Research Institute, Turkana Forestry Research Station, P. O. Box 53-30500, Lodwar, Kenya.
[2]Kenya Forestry Research Institute, Rift Valley Ecoregion Research Program, Lndiani Centre, P. O. Box 382-20203 Londiani, Kenya.

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There are many native species that are important to local communities globally. There have been studies on the importance of these plant species for many uses by local communities. Though, there is scanty information on these species' recognition by researchers. Despite the harsh climatic conditions in Turkana (semi-arid to arid), the community has over the years developed strategies for conservation of some sections of important woodland and riparian zones that provide multiple goods and services for the people and livestock. This study seeks to appraise the plant species preferred for construction and related cultural uses by pastoral communities in Northern Kenya where Turkana county in situated. The key results are list of plant species and their uses in regard to housing as well as the relative importance of the plant species to the Turkana pastoral community for housing. This will inform on priority species for conservation and also emphasize on key areas that this knowledge can be used.

Key words: Turkana pastoralists community, housing, indigenous knowledge, plant species.

INTRODUCTION

Drylands occupied 41% of the total earth's land mass, this is about 6 billion ha and is home to over 2.0 billion dwellers majority of whom live in developing countries (FAO, 2016). Over 30% of the drylands are in Africa. People in these areas depend on products from forests and other woodlands, grasslands and trees for livelihood (Stringer et al., 2017). Wild plants play a critical role in the lives of local communities living the drylands all over the world and more so in developing countries. These plants have a significant role in farming systems as a source of food, fodder for animals, fuelwood, and play an important socio-economic role through their application in medicines, dyes, poisons, construction, fibers and religious and cultural ceremonies (Shelef et al., 2016). However, despite these uses, their importance has largely been ignored and received little recognition from the development community. Some of the reasons for neglecting such species include inadequate information regarding the extent of their applications and their importance in rural communities (Govindan, 2019). In addition, there is loss of traditional and ethnobotanical knowledge majorly influenced by urbanization, technology and globalization leading to continuous loss and desertification (Shisanya, 2017; Situma et al., 2019).

Turkana county is a semi-arid region of Northern Kenya with a population of 926,976 people (KNBS, 2019) and

*Corresponding author. E-mail: owinojesse@gmail.com. Tel: +254723772172.

variable rainfall pattern, which is bimodal in nature but drought is frequent with generally below average annual rainfall ranging from 200 mm in the drier central region to 400 mm in the west and south (CIDP, 2018). Altitude ranges from 370 m at the shores of Lake Turkana to 900 m at the foot of escarpment to west bordering Uganda. Mean annual temperatures for the county is 30° and ranges between 23 and 38°. The vegetation in the county is varied ranging from herbaceous plants, patchy annual grassland interspersed with shrubs and riverine woody tree species (Turkana County Government, 2015). Most regions in the county are covered with bushy species and dwarf shrubs. The county has many ephemeral streams with two major rivers: Turkwel and Kerio. The vegetation along the two rivers play a critical role in the lives of the communities as their livestock depend on the forage during the dry seasons (Opiyo et al., 2015). Arguably, the status and condition of Turkana county can be summarized by the words of Gulliver who stated that in Turkana "there is such a harsh and difficult climate that its effect on social life is all pervasive, inescapable both for the people themselves and for the observer of lives and activities" (Gulliver, 1955).

Turkana people are largely pastoralists about 55% depend solely on their livestock for livelihood. During the rainy seasons the animals are grazed in the lowlands and move gradually to the hills during the dry seasons (Opiyo et al., 2014). Land in Turkana is communally owned, this fits well with their lifestyle of nomadism of mobility to take advantage of seasonal availability of water and pasture (Kameri-Mbote, 2013). Turkana own a wide range of animal's species selected on the basis of tolerance and survivability to harsh climatic conditions. Livestock species kept are camels, cows, goats, sheep and donkeys, while crops farmed along the major rivers are watermelons, sorghum, beans, maize, green grams and cow peas. Over the recent past, the vegetation in Turkana county has come under intense pressure owing to climate change, increase in population, urbanization and sedentarization. These have threatened the backbone of these communities as animals browse on trees while people rely on wild fruits as food during the drought period (Notenbaert et al., 2008).

Despite the harsh climatic conditions in Turkana, the community has over the years developed strategies for conservation of some sections of important woodland and riparian zones that provide multiple goods and services for the people and livestock. They employ traditional ecological knowledge on natural resource management by constructing enclosures known as "Ekwar" reserve grazing areas to be used during extreme dry periods (Barrow and Mlenge, 2003). Traditional ecological knowledge (TEK) globally has played a key role in conservation of natural resources and has been studied and utilized for decades by the pastoral communities.

TEK is a cumulative knowledge, practice and belief which has been passed on from generation to generation by cultural transmission and has proven to be effective mainly because the local communities have interacted with the environment over a long period of time (Gadgil et al., 2003). TEK has shown to provide valuable information particularly in relation to restoration ecology, species selection for planning of restoration programs as well as traditional land management interventions in a short time frame. One of the key product of TEK is the use of enclosures for dry season grazing which has been adopted by the scientific community to allow recovery of degraded lands (Angassa et al., 2010).

Here, we appraise the plant species preferred for construction and related cultural uses by pastoral communities in Northern Kenya where Turkana county in situated, houses are made with materials that make the houses cool because of the hot climate. The materials range from cow dung, grass, stones, shrubs and trees. The houses are arranged in a clustered manner to signify and identify different clans and also for protection against enemies (Medianorth, 2016). Globally, the history of evolution of buildings demonstrates that constructors have always been adapting and upgrading housing structure by modifying locally available materials to meet their building's needs, while taking into consideration the prevailing economic, social and climatic conditions. Buildings have always adhered to local cultures resulting in contextual architecture, corresponding to unique construction methods and specific ways of life (Salman, 2019). Evolution of building structures has been influenced by intermingling among cultures bringing in novel technologies, materials and knowledge, in addition, the quest to sustainably balance between man and nature has resulted in the concept of sustainable development in construction of houses (Joffroy, 2016).

Houses in Turkana are constructed in places adjacent to trees to provide shade during the day and water source for both domestic and for animals. Acacia species which are thorny are used in fencing as they confer security. Their houses also reflect the cultural beliefs for instance we have the night hut, day hut, men's huts, kitchen hut and granary. Species such as *Cadaba rotundiflora,* and *Hyphaene compressa* are preferred as they provide optimum ventilation where these plant materials are available owing to the hot climate in Turkana (Barrow and Mlenge, 2003)

This paper explores the different tree species that are used in the construction of homesteads in Loima sub-county, Turkana county. This will inform future land restoration programs because one of the key drivers of land degradation in the drylands is deforestation mainly due to population pressure and also as the pastoralist's communities' transition from purely nomadic lifestyle to transhumance sedentary lifestyles. Land degradation arising from human activities poses a huge threat to the sustainable development of drylands because of the resulting soil erosion and loss of biodiversity (UNCCD, 1994).

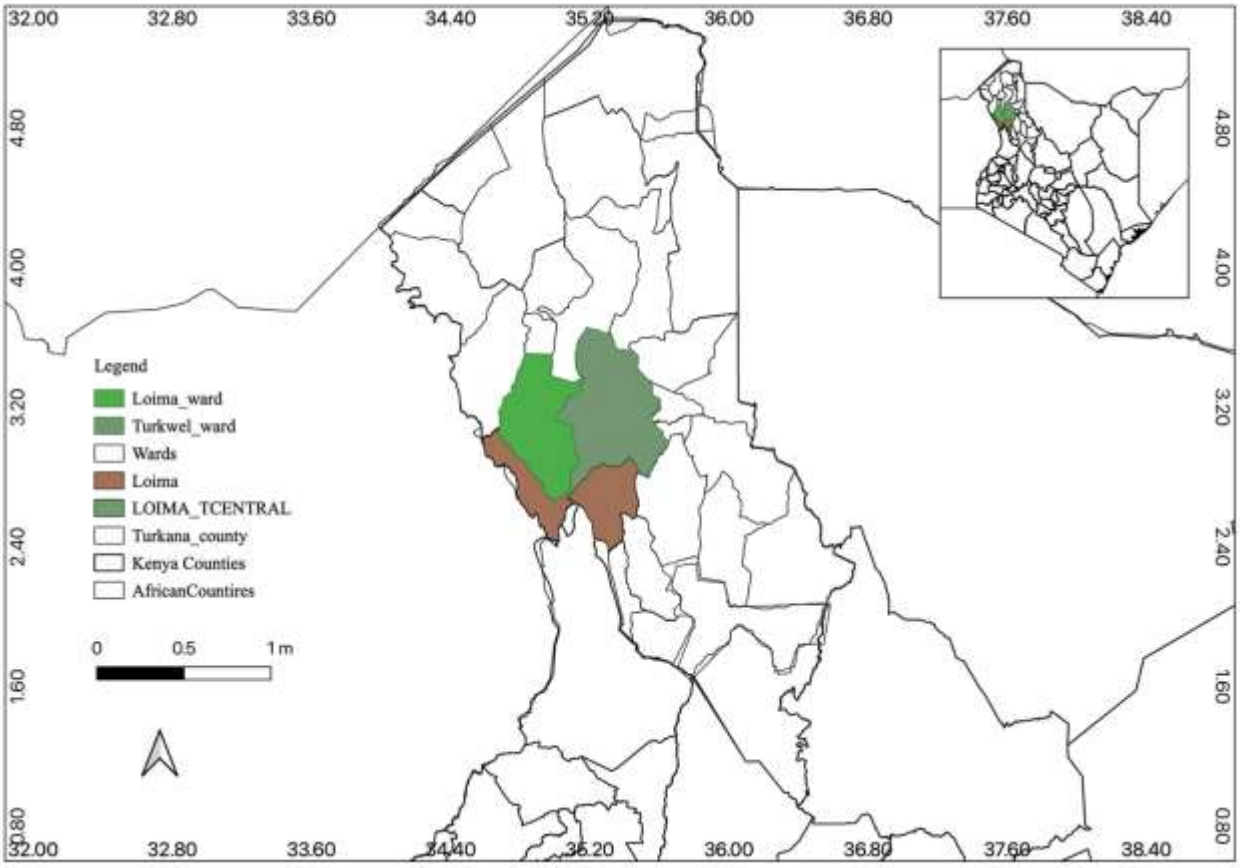

Figure 1. The two wards of Loima sub-county (Turkwel and Loima) from which villages and community was sampled.

Land degradation is estimated to affect the livelihoods of a whopping 1.5 billion people out of which 250 million reside in the drylands. Globally, 20% of all the drylands are degraded and 12 million ha get degraded each year driven mainly by unsustainable land use practices, unfavorable climate and increase in population resulting in decline in food security and vulnerability of the ecosystem to climate variability (Yirdaw et al., 2017). Restoration of damaged land is very costly and when severely damaged then the surrounding communities suffer terribly and economic and environmental benefit are lost as the productivity of land declines and in the pastoral community like the Turkana, animals die and hunger strikes. It is therefore important to assess and evaluate plant species used in construction, since this is one of the major drivers of deforestation which in turn causes land degradation and desertification (Zika and Erb, 2009).

The overall objective of this study was to identify the plant species used for building cultural houses in Turkana community. The specific objectives are (i) to assess the plant species used for fencing and filling in materials in Turkana community, (ii) to identify plant species used for fumigation of houses and thatching houses in Turkana community and (iii) to identify different housing materials from plants used by the Turkana community during different seasons.

MATERIALS AND METHODS

Study area

The study was conducted in Turkwel and Loima wards, Loima sub-county, Turkana county (3.1155°N, 35.6041°E) (Figure 1). Turkana county is an arid and semi-arid county in north-western part of Kenya, characterized by dry and hot climate conditions most of the time. The night time minimum temperature ranges between 24.2 and 26.0°C and the day time maximum temperature oscillates between 35 and 36.0°C. The rainfall pattern and distribution are erratic and unreliable both in temporal and spatial. Turkana county has three main rainfall seasons (long rains occur on March-April-May, June-July-August which occurs in Turkana west, Turkana south, Loima and some parts of Turkana east sub-counties. This is influenced by inter-tropical convergence zone (ITCZ) rainfall bearing systems as well as Cong Airmass (CAM). The short rains occur in October-November-December. The soils in Turkana county are mainly sand with alluvial deposits in areas close to the rivers (CIDP, 2018).

The vegetation comprises densely populated *Prosopis juliflora* and scattered *Acacia tortilis* along the riverine. Other tree species in

the area include *Salvadora persica, Acacia melifera, Acacia senegal, Acacia reficiens, Acacia nubica, Terminalia brownii* and *Zyziphus Mauritania*. Annual grass species include *Aristida mustabilis* while perennial grasses are mainly *Cenchrus ciliaris*. The forbs in area include *Indigofera spinosa*. The population of Turkana county is 926,976 and the main economic activity of communities living in Turkana county is pastoralism (KNBS, 2019). Agro-pastoralism is also practiced in areas that receive moderately high rainfall and irrigated farming along the river Turkwel.

Sampling

Three villages namely Naurenpuu and Lomil in Turkwel ward and Namoruputh in Loima ward were purposively selected as sample sites for this study. The selection of these villages was informed by the semi-sedentary lifestyle adopted by resident pastoralists in a bid to improve their livelihoods. A total of 30 households out of the total 303 households representing 10% of the total household within the three villages sampled. The three villages were sampled randomly and proportionately allocated according to the local information on total households per village. The Naurenpuu village (89 households) was proportionately allocated 9 respondents, Lomil (103 households) 10 respondents and Namoruputh (113 households) 11 households (Kothari, 2004). The desired numbers of household heads per villages were systematically randomly selected from a list of households per village to avoid biasness and for administration of structured questionnaire. A semi-structured questionnaire was administered at household level targeting household heads to provide critical information on the tree species used for cultural housing, fencing, thatching and fumigation by the residents of Turkana community.

Data collection

Data were collected between November and December 2019 using semi-structured questionnaires on plant species' preferred by the community and their important values within the community. Thirty households were interviewed in each of the communities by a team of enumerators, in the local language dialects of Turkana community. The survey covered the following topics: the number of trees planted, their traditional purposes, the uses during dry and wet seasons of the plant species.

Data analysis

The data collected was analyzed using SPSS version 20 after data was entered into Microsoft Excel. Both qualitative and quantitative data were presented through tables. The data were processed through SPSS program to compute the frequencies tables and ANOVA to gain insights into the different tree species and their importance to the community.

RESULTS

The general gender distribution of household showed that 43.33% were males while 56.67% were females. Majority of the respondents did not have any formal education with illiterate household heads accounting for 75% and those with secondary and higher education accounting for an average of only 3.7% of the respondents. Majority of the household heads were in formal marriage (77%) with only 10.00% either divorced or separated (Table 1).

Relative importance values (RIV) of all species from the habitat types are given with the highest (RIV) in different habitats summarized in order of importance (Table 2). A total of 22 wild species were identified as shown in Table 2. All the species are indigenous except *P. juliflora* which is exotic and also known to be invasive (Ngigi, 2017). Thirteen of the species are trees, 4 shrubs, 1 grass species and 4 herbs species.

A total of seven uses had been identified, namely: thatching of houses, production of poles, fumigation, coloring, joining of house structures, filling of the house structure and fencing. Each household was interviewed based on the seven uses and percentage use of each species for different used tabulated (Table 3). Each of the species is used for different purposes with most of the species having more than one use at different degrees per household. The majority of the respondents preferred *H. compressa* (34.8%) in joining house structure, *Boswelia neglecta* for furmigation (33.3%), *Cordia sinensis* for coloring (26.1%) and *S. persica* (20.3%) for filling of house structure (Table 3).

Tests of relationships between the mean number of tree species planted per household and their various uses reveal a number of significant relationships as reported in Table 4. Those households number of trees for thatching ($p<0.05$), fumigation of houses ($p<0.05$), coloring of house materials ($p<0.05$) and filling of house structures ($p<0.05$) are significant at 95% CI.

DISCUSSION

H. compressa is the overall best ranked based on relative importance value analysis with 21.43 average points. This species is also the most preferred for thatching houses ($p<0.05$) and joining of the house structures ($p<0.05$) with 22.95 and 34.78% of households, respectively. *H. compressa* commonly known as doum palm has many other uses in Turkana county and only grows along the riverine areas. Some of the other recorded uses are making of baskets, tablemats, brooms, carpets, ropes, floor mats, lampshades, hammocks and hats. Additionally, livestock such as cattle feed on fresh young palms and dry leaves of doum palm during the dry seasons (Amwatta, 2004). The nuts of the tree are also consumed by Turkana people as alternative source of energy and also provide essential nutrients, overtime however, the species is now threatened due to over utilization and land degradation (Lokuruka, 2007).

Secondly, *C. sinensis* is following in relative importance value with aggregate average of 15.9. It is the most preferred for production of poles together with *P. juliflora* and *A. tortilis* all having 16.39% each, this means that 49.2% of all the construction poles in Loima sub-county come from the three species. *C. sinensis* is also one of the most versatile. It has been used in all the category uses except fumigation and in five of the uses it has over

Table 1. Socio economic of the respondents.

Variable	Area/Villages			Mean of variables
	Lomil	Namoruputh	Naurienpuu	
Gender (Household Heads %)				
Female	60	54.55	55.56	56.70
Male	40	45.45	44.44	43.30
Average age of household heads (Years)	**47.9**	**43.09**	**39.11**	**43.37**
Female	35.67	44	37.8	39.16
Male	66.25	42	40.75	49.67
Education (%)				
Illiterate (none)	90	45.45	88.89	74.78
Basic/pre-primary	0	9.09	0	3.03
Primary school	10	36.36	0	15.45
Secondary	0	9.09	0	3.03
Higher Education	0	0	11.11	3.70
Marital status (%)				
Divorced/separated	0	9.09	22.22	10.44
Married	80	72.73	77.78	76.84
Widow/widower	20	18.18	0	12.73
Main occupation (%)				
Agroforestry	10	0	33.33	14.44
Casual labourer	0	9.09	11.11	6.73
Charcoal burner	0	9.09	0	3.03
Livestock	30	18.18	0	16.06
Self-employed/business	60	63.64	55.56	59.73

15% overall preference, a clear indication that it is highly valued and utilized in this community. Moreover, the leaves of *C. sinensis* are highly palatable and nutritious with 11% crude protein (Khaskheli et al., 2019) and livestock especially goats and camels depend on its leaves in times of scarcity. The tree also produces fruits that the communities depend on during dry seasons providing them with essential phytonutrients.

Thirdly, *S. persica* closes the best three species based on RIV with 14.95 points. This species is the most used in filling of the house structure with 20.34%. Besides, it used in five of the sampled uses except coloring and joining the house structure and has over 10% share in all of the five uses, a significant share, indicative of its importance in the target community. *S. persica* locally known as Esekon is also widely used for oral hygiene as toothbrush. Research done on the efficacy of the species on oral hygiene have shown the presence of significant quantities of antibacterial substances (Araya and Yoseph, 2007). It is also often lopped to provide fodder for goats and camels for the pastoral community (Kumar et al., 2012).

B. neglecta is the most preferred for fumigation with a third of the total percentage share. This is not surprising given that research has shown that *Boswellia* species have wide application in fumigation powders ($p<0.05$) with very high amount of biocidal chemicals such as alcohol (Fanta et al., 2013). On the other hand, *P. juliflora* was one of the most used for production of poles together with *C. sinensis* and *A. tortilis*. Since proposis is a very invasive species. The community need to be encouraged to continue using the species and minimize the cutting of the other two which provide fodder for animals especially during the dry seasons (Achankunju, 2015). *Acacia tortilis* together with *A. reficiens* were the most preferred for fencing both of them taking 43% of the total share among all the species identified showing the degree of utilization of these species given that the pastoral communities have to fence their homesteads to protect their animals.

Conclusion

The effects of climate change and globalization is

Table 2: Traditional plant species and importance in the Turkana community housing

Traditional Plant Species	Proportion in percentage (%) of respondent using the species for various reasons within Turkana county, Kenya							Relative Importance Value	Rank
	Thatching houses	Poles	For fumigation of houses	Coloring of house materials	Joining the house structures	Filling in the house structure	Fencing		
Hyphaena compressa	22.95	6.56			34.78			21.43	1
Cordia sinensis	3.28	16.39		26.09	17.39	15.25	17.02	15.9	2
Salvadora persica	13.11	11.48	12.82			20.34	17.02	14.95	3
Boswelia neglecta		1.64	33.33	8.7				14.56	4
Prosopis juliflora	4.92	16.39		13.04		18.64	12.77	13.15	5
Acacia mellifera			12.82					12.82	6
Sanseveria ehrerbergii	16.39				19.57		2.13	12.7	7
Acacia tortilis	3.28	16.39	2.56		21.74	10.17	21.28	12.57	8
Acacia reficiens		13.11	5.13		6.52	15.25	21.28	12.26	9
Cadaba rotundifolia	14.75		10.26			11.86	4.26	10.28	10
Cissus quadrangle			10.26					10.26	11
Faidherbia albida		1.64		17.39				9.52	12
Diospyros scabra	6.56	3.28		17.39				9.08	13
Cenchrus ciliaris	6.56							6.56	14
Zyziphus Mauritania		4.92	2.56	17.39		3.39	2.13	6.08	15
Boscia coriacea	3.28		7.69					5.49	16
Acacia eliator	1.64	6.56				1.69	2.13	3.01	17
Aloe turkanensis			2.56					2.56	18
Acacia nubica						1.69		1.69	19
Combretum hereroense		1.64				1.69		1.67	20
Balanites aegyptiaca	1.64							1.64	21
Indigofera spinosa	1.64							1.64	22

Table 3. Summary of the most preferred species per category and respective percentage household share.

Species	Use category	Percentage share
Hyphaena compressa	Joining of house structure	34.78
Boswelia neglecta	Fumigation	33.33
Cordia sinensis	Coloring	26.09
Hyphaena compressa	Thatching	22.95
Acacia reficiens, Acacia tortilis	Fencing	21.28
Salvadora persica	Filling of house structure	20.34
Acacia tortilis, Cordia sinensis, Prosopis juliflora	Poles	16.39

Table 4. The *F*-statistic in ANOVAs of mean number per tree species uses.

Use of tree species	Mean number of trees/household	S.E.	F value	P-value
Thatching houses	8.09	0.526	2.059	0.037
Poles for construction	5.60	0.485	1.139	0.361
For Fumigation of houses	3.95	0.390	2.507	0.023
Coloring of house materials	2.71	0.436	1.740	0.031
Joining the house structures	5.00	0.521	1.587	0.137
Filling in the house structure	3.78	0.332	1.927	0.050
Fencing	4.05	0.403	0.452	0.934

threatening the livelihood of the community who are now transitioning from purely nomadic lifestyle to transhumance sedentary living owing to the changing climatic conditions and urbanization. The Turkana community in the sample area has somewhat permanent shelters which they construct using locally available plant species. This change in lifestyle is exerting pressure on the arid environment as this same species provide fodder for their animals and fruits for the community due to limited sources of income. This study puts emphasis on all the stakeholders and especially the development community to recognize the crucial role that wild plants species play in the drylands and develop robust restoration programs especially for the identified multi-purpose tree species like *H. compressa, C. sinensis, B. neglecta, A. tortilis, S. persica* and many others that are key to both environmental health and pastoral development in the arid and semi-arid regions of Kenya. This paper recommends for future studies a further review of fodder species and also medicinal species use in the pastoral communities during the climate change adaptation process.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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