Influence of Distance in Forest Utilization and Its Interaction with Neighbouring Communities of South West Mau, Kenya, Konoin Sub-County

* Bett K. Nelson, Mwasi Benjamin and Lawrence Esho
School of Environmental Studies, University of Eldoret, P.O. BOX 1125, Eldoret

*Corresponding Author's Email Address: bettnel@gmail.com

Abstract

Intensity of use of forest and interaction of neighbouring communities with the forest is not uniform. This study looked at how individual's distance from forest edge influences their access to forest resources and their participation in conservation. The purpose of the study was to determine: how forest utilization varies with distance from forest edge; how distance of an individual's location from South West Mau forest border influences his/her interaction with the forest. A total of 360 households were interviewed along six transects of six kilometers across the study area. First ten households within every strata along each transect were sampled. Equal number of males and females as well as youth and old were sampled. For each respondent, the numbers of forest uses were determined. The results indicated that forest utilization and interaction decrease as one is located further away from forest. All forest uses studied showed a decreasing trend on increasing distance. Among the forest uses tested firewood, pasture, initiation, praying, and marriage materials indicated that they significantly vary with distance, P values of 0.0000, 0.0000, 0.0267, 0.0063 and 0.0011 respectively. However, honey, seeds/seedlings and herbal medicine were not significantly different along distance0.0578, 0.064 and 0.0612 respectively. Conservation planning and management of forests should involve community members who are close to the forest as possible especially within three kilometers distance from the forest.

Keywords: Forest interaction, neighbouring communities, forest edge and individual's location

INTRODUCTION

Background information

Though extensive, the world's forests have shrunk by about 40 percent since agriculture began 15,000 years ago (FAO, 2006). Total forest area declined by 3% between 1990 and 2015, from 4,128 million hectares to 3,999 million ha (FAO, 2015). Natural forest loss between 1990 and 2015 was higher, declining by 6%, from 3,961 million hectares to 3,721 million hectares, while planted forest (including rubber plantations) increased from 168 million ha to 278 million hectares. The composition and quality of many forests have changed over the years. African continent lost 64 million hectares of forest between 1990 and 2005, the greatest decline of any other continent (FAO, 2006). In forestry as in many other aspects, Africa is a continent of diversity. It includes countries with some of the world's richest forests. Others are poor in valuable species while others severely lack forest cover.

In Kenya, gazetted forests cover a total area of 1.4 million hectares, representing about 1.7% of total land area (MENR, 2007). This does not meet the internationally recommended minimum of 10% of country forest cover. Though most of Kenya's forests have been decimated by degradation among other factors, the Mau Complex forests cover has been the most affected and has receded drastically over time (KIFCON, 1991). The forest is under threat from irregular and ill planned settlements, encroachments and illegal exploitation. Over the last decades, approximately 25% of Mau forest has been lost to excisions and encroachment. As a montane forest, the Mau Complex is one of the five main "water

towers" of Kenya, with Mt. Kenya, the Aberdare Range, Mt. Elgon, and the Cherengani Hills. It feeds major lakes which are cross boundary. Mau forest is the largest water catchment area in Kenya (KIFCON, 1991). The water from Mau forests serves more than eight million people inhabiting several locations in Kenya and Northern Tanzania (FAO, 2006). In addition the Mau Complex provides continuous river flow and favorable micro-climate conditions which are essential to crop production, as well as many products including medicinal plants, firewood and grazing.

Conservation and management of natural resources have to actively involve all relevant stakeholders and particularly the local communities for success (Wandago and E. Nahama, 2007). The inclusion of communities in the management of state-owned forest resources has become increasingly common over the past 25 years. Schreckenberg et al, 2006, indicated that majority of the countries in Africa and Asia are promoting participation of rural communities in the management and utilization of natural forests and woodlands through some form of Participatory Forest Management (PFM).Participatory Forest Management is the local involvement of stakeholders in management of a forest, which may be dry woodlands, tropical forests, mangrove, or plantations, for the mutual benefit of both the species of flora and fauna and the community.

Studies for instance Barrow et al, 2001, Matiku, 2012 and Muller, 2003 have been undertaken to identify determinants of access to forest products. Numerous benefits were expected to accrue to individuals from participating in community forest associations through increased access to forest products such as fuel wood, herbal medicine, honey, tree seedlings, thatch grass and fodder.

The policies do not put into consideration interaction of the local communities with the forest resources and the location of an individual who participate in forest conservation planning thus; it is critical and urgent to understand influence of distance in forest utilization and the interaction of local community with the adjacent forests for better environmental outcomes in Kenya.

The problems associated with natural resource management are essentially specific to localities; hence solutions must be sought through co -operation with local participants (Sharma, 1992). Informed consultation with and participation of indigenous peoples is essential for success of forest based activities. Participation increases the likelihood of active engagement by affected communities and community ownership of project activities (WCED, 1987). It also enables people to make informed decision on plans that will affect them as well as being informed on who should be involved in conservation planning of the forest. Distance decay in forest utilization and interaction between community members with forests is important to match with participation in conservation through CFA membership so as to avoid conflict over forest resources.
Statement of the problem

Policies and conservation plans have been developed to save the forests in Kenya. However, encroachment and degradation still continue. Public interest is diverse, changing and contradictory (Catanese, 1984). There is rarely, if ever, unity of public interest in issues with which planners deals with. This means that changes and revisions should be eagerly sought rather than avoiding them. It is clear that people tend to become involved in planning mainly when there are some specific and tangible interests for them and their groups. Balancing competing interests and objectives is a constant challenge in forest management

Forest adjacent communities are highly dependent on forest resources for their livelihoods (FAO, 1998). Forests and other natural resources are foundation for most indigenous peoples' livelihoods, social organization, identities and cultural survival, which are based on a strong and deeply rooted historic relationship with their ancestral land and natural resources. The identity of stakeholders and the nature of their interest vary in time and space (Barrow et al., 2001). In any one place, the relative rights of access to resources by various stakeholder groups and their relative roles and responsibilities are not static. Different stakeholders within a community may have different interests from one forest.

The distance between the location of an individual and the forest affects access to the forest resources (Hegde & Enters, 2000 and Guthiga, 2008). Distance to the forest edge as a significant contributor to the use of forest products indicate that households that extract forest products come from far and wide. This study therefore looks into forest utilization and the interaction of primary stakeholders in South West Mau forest in regard to their relative distance to the forest. If care is not taken, individuals with lower interaction may get engaged in conservation strategies more than those who are closer to the forest with higher interaction hence stirring conflict. If such crucial groups and their interests are ignored, they'll seek extra-legal ways of acquiring forest resources hence perpetuating degradation of the forest.

The objectives of the study were; to determine how forest utilization varies with distance from South West Mau forest edge, to determine how distance from forest edge influence interaction of local community members with South West Mau forest.

Research hypothesized that distance travelled by local community members to reach South West Mau forest has no significant influence on its utilization; the local community members interact uniformly with the forest from distance of 1km through 6km from edge of South West Mau forest.
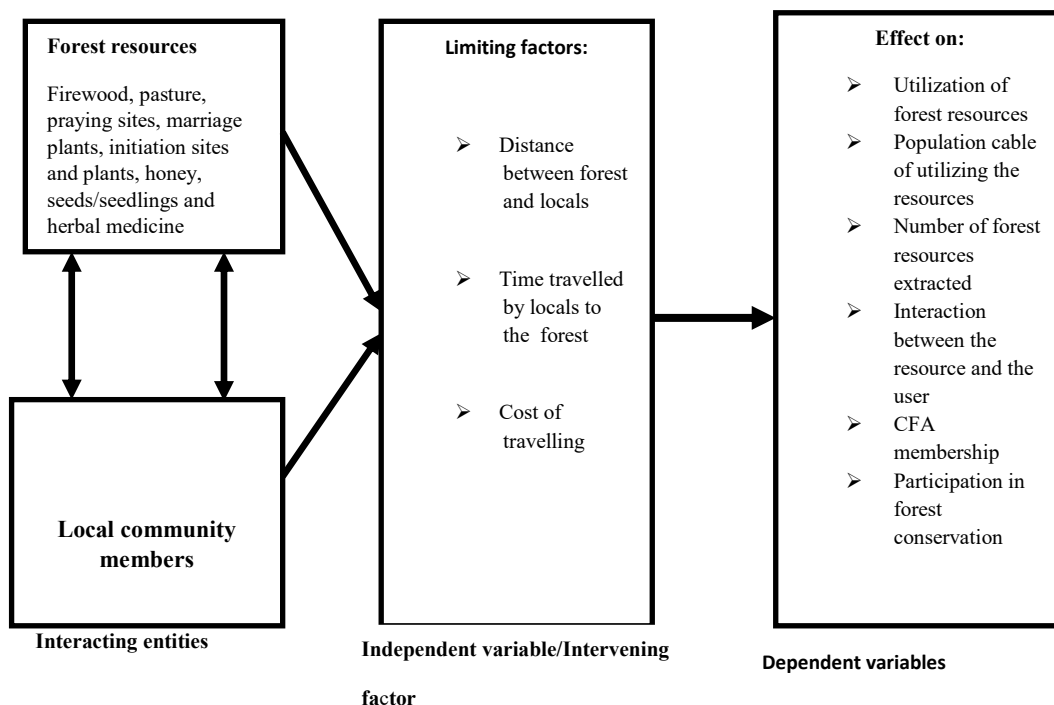
Theoretical framework
The study was based on distance decay model. Distance decay is a geographical term which describes the effect of distance on cultural or spatial interactions. The distance decay effect states that the interaction between two locales declines as the distance between them increases (Rodrigue et al., 2009). Once the distance is outside of the two locales' activity space, their interactions begin to decrease. Tobler's (1970), first law of geography, an informal statement that "*All things are related, but near things are more related than far things*". It has long been posited that the interaction between two locations declines with increasing (distance, time, and cost) between them, but is positively associated with the amount of activity at each location (Isard et al., 1975).

Newton's law states that: "*Any two bodies attract one another with a force that is proportional to the product of their masses and inversely proportional to the square of the distance between them*" (Rodrigue et al., 2009). When used geographically, the words 'bodies' and 'masses' are replaced by 'locations' and 'importance' respectively, where importance can be measured in terms of population numbers, gross domestic product, or other appropriate variables.

Distance decay is graphically represented by a curving line that swoops concavely downward as distance along the x-axis increases. Distance decay can be mathematically represented by the expression $I = 1/d^2$, where I is interaction and d is distance, among other forms. The model was derived from gravity model.

Conceptual framework

The study was based on distance decay model where the distance between the user (local community member) and the resource (forest) affects the interaction of the two. This distance between them has effect on time travelled to reach forest resource and cost of travelling.

Forest resources

Firewood, pasture, praying sites, marriage plants, initiation sites and plants, honey, seeds/seedlings and herbal medicine

Local community members

Interacting entities

Limiting factors:

➢ Distance between forest and locals

➢ Time travelled by locals to the forest

➢ Cost of travelling

Independent variable/Intervening factor

Effect on:

➢ Utilization of forest resources
➢ Population cable of utilizing the resources
➢ Number of forest resources extracted
➢ Interaction between the resource and the user
➢ CFA membership
➢ Participation in forest conservation

Dependent variables

Figure 1: Conceptual frawormework

Distance of individual's location from forest influence forest utilization in terms of population who access forest resources and the number of resources used, interaction CFA membership and their participation in conservation planning of the forest. Transferability of forest products depends on geographic distance, economic distance and time distance. The cost to overcome must not be higher than the benefits of related interaction, even if there is complementarily and no alternative opportunity. Transferability is related to volume, value and variety of goods, to be transported. Population utilizing the forest, the number of forest products extracted, interaction and participation decline with increase in distance from the forest.

METHODOLOGY

Data collected

Land cover maps of Konoin sub-county and Mau forest were used as a guide in the study. Primary data was obtained by the use of structured questionnaire. The questionnaire was designed to capture data on distance of the respondents' location from the forest, age, gender and forest uses acquired. Forest uses subjected into study were firewood, herbal medicine, seeds/seedlings, honey, and pasture/fodder, praying sites, plants for marriage and initiation ceremonies.

Meffe & Carroll, 1990, asserted that forest-adjacent communities within a distance of 5Km from forest border exert an impact on the forest and this impact decreases with distance. They further stated that the impact is less significant beyond a distance of 10Km from the forest border. This study focused on the local community members within 6Km distance from the border of South West Mau forest in Konoin sub-county. Up to 10th household within every kilometer at each transect of six kilometers from the forest edge were sampled. These made a total of 60 households in each transect and thus a total of 360 households for all the six transects.

Sampling frame

The study area was divided into belts of one kilometer distance each i.e. X_1, X_2, X_3, X_4, X_5, and X_6. The zones were $0<X_1\leq1$ km, $1<X_2\leq2$ km, $2<X_3\leq3$ km, $3<X_4\leq4$ km, $4<X_5\leq5$ km and $5<X_6\leq6$ km distances from the forest edge. Six transects across these zones were established at interval of 4.5 kilometers (figure 2). The first ten households in every strata along transects were sampled. Structured questionnaires were administered using personal interview approach. The questions were read and interpreted to the interviewees as data was being recorded. However, the literate respondents were given questionnaire to answer. Male and female respondents were alternated. The questionnaires were also equally administered to both old and youth. At every household where youth were available a chance was granted until five of them were interviewed and the other five household old respondents were picked. Footpaths and /or roads transect was used to identify sampling units.
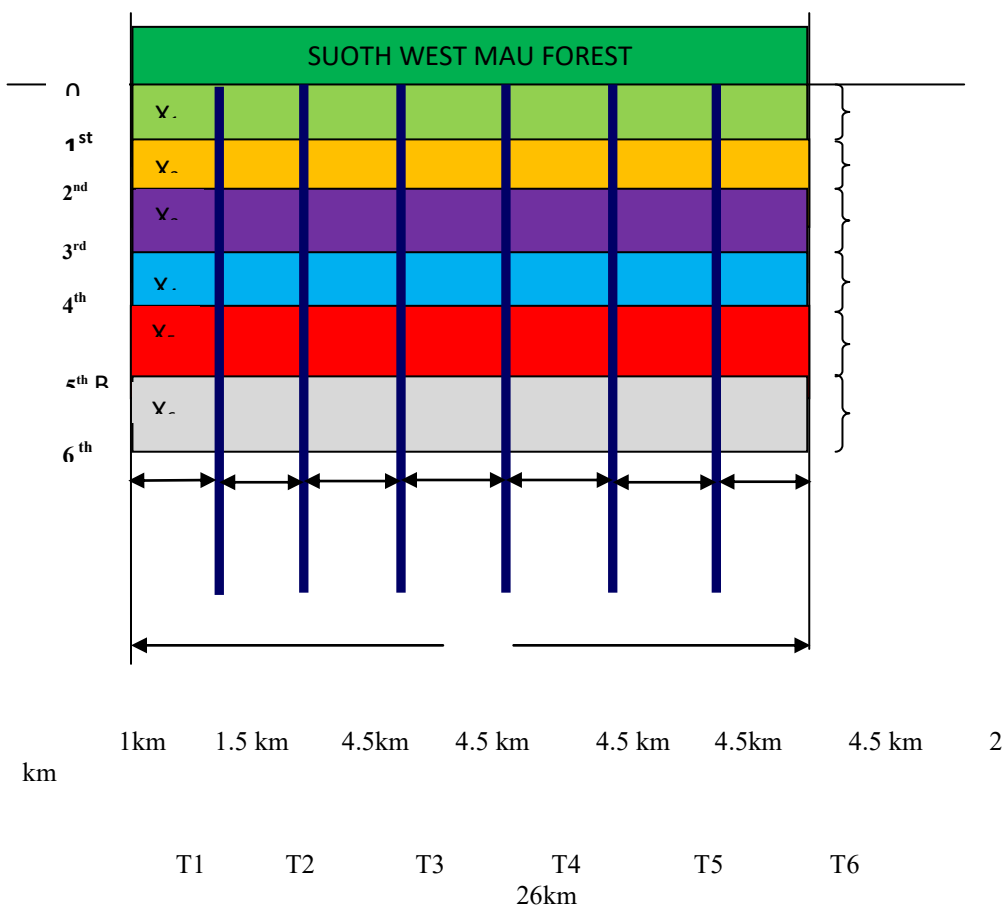
Figure 2: A representation of arrangement of transects and strata across study site

Data was analyzed using mean population; frequency and graphical representation of the respondents were done to show the trends on utilization of different forest uses and interaction as distance increase. ANOVA was also used to determine whether the forest uses show any significant differences in forest uses.

Interaction model equation was used to determine the interaction level of community members with the forest at different distance from forest edge to 6km away from the forest. This was done using the formula:

$I_{ij} = (Pi*Fj)/D^2ij$

Where: (I) is interaction between locales i (individual's location) and j (forest) which is a function of population (P) at i acquiring forest resources and attractive forces/forest uses (F) obtained at j, and an inverse function of the distance (D) between i and j.

RESULTS

Forest utilization

The research found that the location of an individual from the forest edge has great effect on utilization of forest resources. As a member of the local community gets further away from the forest the lesser is its ability to get access to forest resources and services (figure 3). Those who are closer to the forest easily access to forest products and services than those who are far away from the forest.

The results shows that mean population of respondents utilizing the forest resources in almost all forest uses investigated did decrease as their location become further away from the forest (figure 3 and table 3). Collection of seeds/seedlings from the forest scores highest with highest mean population while lowest means population use praying sites in the forest (table 3). Extraction of firewood and pasture show a drastic decrease with an increase in distance away from the forest and both are zero at 6km. However, it is somehow different in extraction of honey, herbal medicine and seeds/seedlings i.e. vary from 8.0 to 5.0 for both honey and seedlings while herbal medicine ranges from average of 8.0 to 3.0. They tend to show a slight decrease with an increase in distance (figure 3). There are highest means in use of firewood and pasture from residence closer to the forest i.e. within one kilometer distance whereas honey, herbal medicine and seeds/seedlings score higher means as compared to others after five kilometer distance (figure 3). Cultural values i.e. use of forest and its resources for initiation, praying and marriage are generally lower as compared to other uses (figure 3 & table 3).

Use of forest on firewood and pasture indicate higher F values of 60.805 and 50.80 respectively (table 3). This suggests that there is higher variation in their uses with changes in distance.

Table 1: Analysis of variance on forest uses from South west Mau forest edge at Konoin sub-county, Bomet County

| Forest use	Mean	STD	DF	F	P-values
Honey * distance	6.0833	1.29560	35	8.790	0.0578NS
Seeds * distance	6.3333	1.21890	35	7.765	0.0640NS
Firewood * distance	3.6111	3.04516	35	60.805	0.0000*
Pasture * distance	3.8056	2.76529	35	50.800	0.0000*
Initiation * distance	1.8611	1.62398	35	21.016	0.0267*
Praying * distance	1.5833	1.05221	35	10.034	0.0063*
Marriage * distance	1.8889	1.42984	35	12.667	0.0011*
Herbal * distance	5.9444	1.80388	35	7.946	0.0612NS

*significant difference at $p < 0.05$
NS- Not Significant

There are significant differences in firewood, pasture, initiation, praying, and marriage with changes in distance (table 1). Pasture and firewood extraction indicate high significance (P=0.000 & F=50.800 and 60.805 respectively). However, herbal (F=7.949), seeds (F=7.765), and honey (F=8.790) did show no significant variation in their extraction from the forest from 1 kilometer distance to 6 kilometers away from the forest.

Table 2: Mean populations of various forest users at different distance

Distance (Km)	Honey Herbal	Seeds/seedlings	Firewood	pasture	initiation	praying	Marriage	Herbal
1	8.0	7.5	7.8	7.3	4.0	3.0	4.0	8.0
2	6.5	7.3	6.3	6.5	3.5	1.8	2.7	7.0
3	5.8	6.5	4.2	4.3	1.7	1.8	1.8	6.1
4	5.7	6.2	2.8	3.0	1.2	1.5	1.3	5.7
5	4.8	5.5	0.5	1.7	0.3	1.0	1.0	5.0
6	5.5	5.0	0.0	0.0	0.5	0.3	0.5	3.8
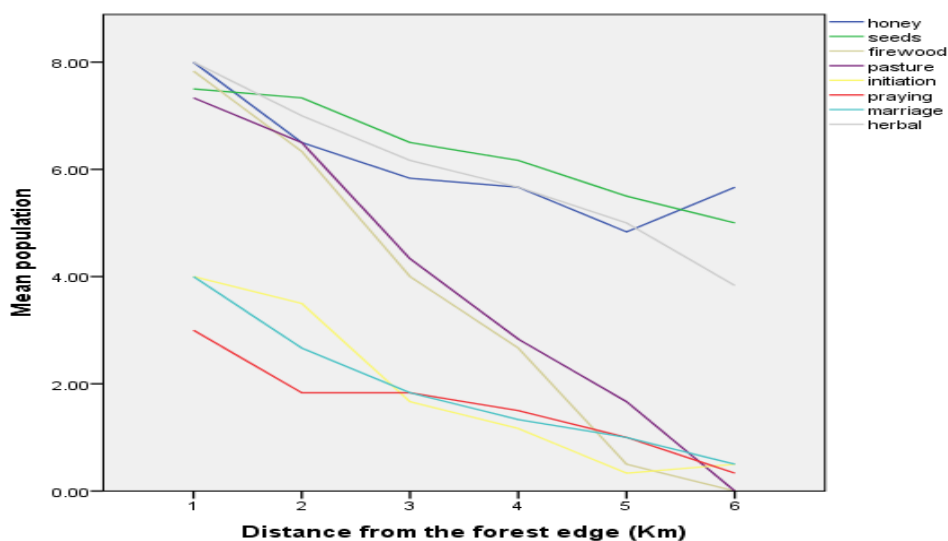
Figure 3: Mean populations accessing different forest products and services at different distances from forest edge

The frequency of visit to the forest is highest for the community members within 1km distance and this decrease as one is located away from the forest (figure 3). Increase with distance result in decrease in the number of times a member gets into the forest per week. People within 1 and 2 kilometer distances from the forest edge indicate highest and almost similar percentage of frequency visit per week while those at 5 and 6 kilometers indicate equal and minimal frequency of visit per week.
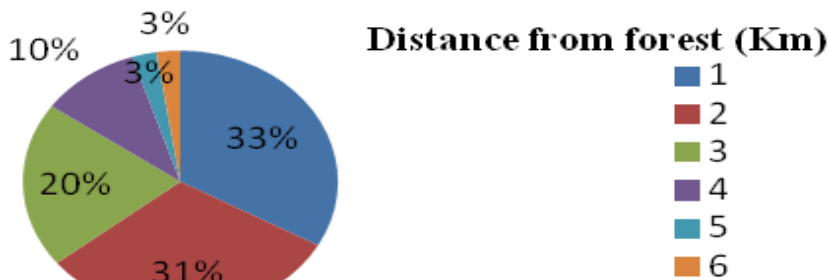
Figure 4: Frequency of visit to the forest per week

Interaction of local community with the forest
Interaction between community members and the forest varies with the distance from forest edge. The results show that interaction is inversely proportional to distance (figure 4). There is closer association with members of the community within a close proximity to the forest but this decline as distance from the forest increases. The interaction of forest adjacent people within a kilometer distance is highest while those who are within five to six kilometers away from the forest show minimal interaction. The shorter the distance travelled by the members to the forest the higher the interaction and the converse is true.
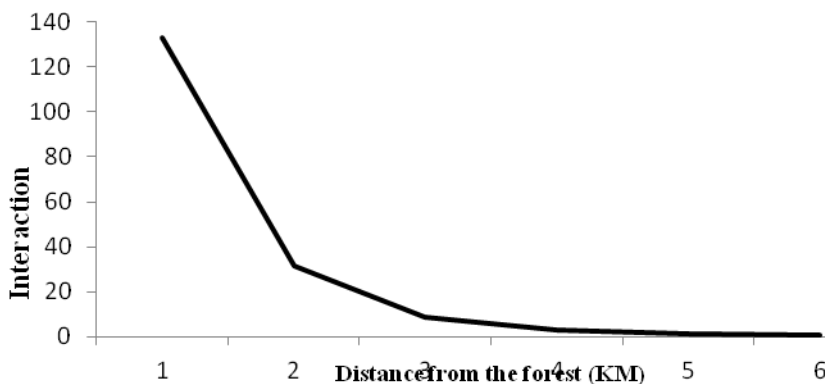
Figure 5: Interaction between the locals and the forest at different distances away from the forest edge

DISCUSSION

Forest utilization and interaction
Forest utilization decreases with an increase in distance from the forest edge. As one is located further away from the forest then his/her ability to acquire forest resource and services is almost impossible. Distance between the forest and the location of an individual

do affect the interaction of the two. People located at close proximity have higher interaction than those who are far away from the forest. Holmes 2007, also noted that the further the communities from the forest resource, the less they interact with the resources. Those with a closer distance easily get access to the forest resources. The finding is in line with previous studies for example, Suda (1992), Allhasan (2010) and Emerton (1993), who found out that forest-adjacent community within 5 km buffer zone, depend on the forest for their livelihoods. This could be attributed by the short distance covered to travel to the forest hence short time taken to reach the forest. Those who are located far away have a long distance to travel for them to get into the forest thereby increasing time taken. Those at a distance of 4, 5, and 6 kilometers could have to incur extra cost of transportation of forest resources like pasture ad fire wood. These people could opt for other means of acquiring the same within their farms or at a close range.

Considering also myriad of farm activities they are engaged in, most of those who are further away from the forest rather spent their time undertaking them. This concur with Allhasan (2010) study. Conversely their counterparts within a close proximity to the forest easily get to the forest especially in the afternoon hours to fetch firewood and pasture among other resources. Holmes 2007, also noted the same. The bulky nature of pasture and firewood makes it difficult for community members who are far to acquire the two from the forest. Some of the members take their animals upon payment of chargeable fee. This is easily done by those within close proximity to the forest since animals will have to travel short distance to reach the grazing field. Movement of livestock for a longer distance lowers their production and increase incidence of contracting diseases. Traversing such distances in search of pasture deter the farmers who are far thus seeks alternative forage source.

The extraction of honey, herbal medicine and seeds/seedlings indicated higher means as compared to other uses at 5 and 6 kilometers away from the forest. This is because they are not as bulky as firewood and pasture. Also their extraction and utilization is long term. Their frequency of extraction and use is low. Cultural practices i.e. marriage plants, initiation practices and praying share similar features with the above three uses. Utilization and extraction of these uses could be or are seasonal hence their frequency of use being low. This may be an explanation as to why people at far distances still could obtain them from the forest. These forest activities, i.e. honey production, herbal `medicine and cultural uses, are occasionally obtained from the forest. The community members could also have alternative sources for instance planting of tree species of such purposes within their farms hence reducing their interest in getting into the forest.

With the emergence of the new technologies like hospitals, electricity and use of gasoline for cooking, people still use the forest as a cheap option in fulfilling the need of treatment medicine and power/energy. Herbal medicine for instance is still used especially on young children. This has made the locals utilize forests to acquire such resources. However, the cultural practices i.e. marriage, initiation and religious practices have been reduced by modern ways of doing them. Religious practices in the forests have been impacted negatively with the emergence of new religious way of worshipping where churches are being used and for this therefore the religious practices done in the forest is very low except for the few old members of the community who grew up witnessing them being done in the forest. The same is applicable for marriage and initiation practices which are low since churches and hospitals have replaced them. Marriage practices have also been lowered still because some have opted for the government institutions that carry out the practice. The health policies and facilities have been adopted by most of the local community members except for extraction of some few materials needed in carrying out initiation practices. This therefore lowered the population that still use of forest on it. Furthermore, new Christian

way of initiation does not require traditional practices thus the forest sites and materials used during initiation are not required. Therefore few individuals, mostly the old still value the forest materials in traditional marriage and initiation.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Distance of an individual from a forest is a key factor in forest utilisation and interaction. Those who are located closer to the forest have more attachment to the forest in terms of their utilisation, interaction hence join CFA for their involvement in conservation planning of it. However, those who are far away from the forest especially after three kilometre distance from forest edge show little attachment to it. Because of higher dependence on forest by those at close proximity, they are so keen in various activities and management decisions done about the forest.

Interaction of forest adjacent community members with the forest declines with an increase in distance of their location from forest edge. Those who are closer to the forest have higher interaction than those who are further away from the forest.

Recommendation

Since most of the people within three kilometres utilise forest and have higher interaction with the forest, they should be involved as much as possible in forest management activities. When planning on use of forest on firewood and pasture utilisation, community members within three kilometres should be involved adequately. Those at 5 and 6 kilometres need not be involved on the same. On matters relating honey, herbal medicine, and cultural practices there is need to involve all the members up to six kilometre distance.

REFERENCES

Alhassan A. M. (2010) Analysis of primary stakeholders participation in forest resources management: the case of the krokosua hills forest reserve,Ghana, *Master of Science Thesis,*Kwamenkuruma university: Ghana.

Barrow, E.,et al (2002) *An analysis of stakeholders in community involvement in forest management in eastern and southern Africa*. Nairobi: International Union for Conservation of Nature-East Africa Regional Office.

Catanese J. A., (1984) *The Politics of Planning and Development.* Sage Publication Ltd: New Delhi.

Emerton, L. (1993) *The value of Kenya's indigenous forests to adjacent households.* Nairobi: Forest Department.

FAO (1998) Integrating conflict management into National Policy Frameworks- *Proceedings of a Satellite Meeting to the IX World Forestry Congress*, 10-13 October 1997, Atalya, Turkey, Rome .

FAO (2006) Global Forest Resources Assessment 2005 Rome: accessed at: www.fao.org/forestry/site/32038/en

FAO (2015) Global Forest Resources Assessment 2015 Durban, South Africa: accessed at:http://theconversation.com/forest-loss-has-halved-in-the-past-30-years-latest-global-update-shows-46932,September 7, 2015.

Guthiga, P.M. 2008 "Economic Assessment of Different Management Approaches of Kakamega Forest in Kenya: Cost-benefit and Local Community Satisfaction Analysis" (PhD Thesis).

Hegde, R. and T. Enters. 2000 Forest products and household economy: A case study from Mudumalai Wildlife Sanctuary, Southern India. *Environmental Conservation* 27(3): 250–259.

Holmes, T. N. (2007) Contribution of Participatory Forest Management (PFM) Intervention to the Socio-economic Development in the Southern Cape Forests: A Retrospective Approach. *Masters of Philosophy Thesis* (Social Science Methods). University of Stellenbosch, South Africa.

Isard, W. et al., (1975) Methods of Interregional and Regional Analysis, ("Gravity and Spatial Interaction Models"), Ashgate, pp. 243.

KIFCON.(1991) *Terrain and Soils of South West Mau Forest, Nakuru District.* Nairobi: Kenya.

Matiku, P. (2012) The impact of participatory natural resources management on forest integrity and livelihood systems in Arabuko-Sokoke forest, Kenya. *Ph.D. Thesis*. Kenyatta University, Nairobi, Kenya.

Meffe G. and R.C. Carroll (1990) *Principles of Conservation Biology*, Sinauer Asssociates Inc. Publishers, Massachusetts: USA.

MENR, Ministry of Environment and Natural Resources (2007) *Participation in Sustainable Forest Management.*2007 Draft Rules and Guidelines.

Mlenge W. C. (1991) '*Participation: Genuine or Perverse* 'PP 5-8.

Muller, S. (2003) Toward Decolonisation of Australia's protected area management: the Nantawarrina Indigenous Protected Area experience. *Australian Geographical Studies* 41(1).

Rodrigue, J. P., Comtois, C., Slack, B. (2009) *The Geography of Transport Systems*. London, New York: Routledge.

Sharma P. (1992) Managing the World's Forests: Looking for Balance Between Conservation and Development. Kendall: USA.

Schreckenberg K., C. Luttrell, and C. Moss(2006) *Participatory Forest Management: An Overview, Forest Policy and Environment Programme*, Grey Literature, UK.

Suda, C. (1992) *Literature review on the use of indigenous forests in Kenya*. Nairobi: Kenya Indigenous Forest Conservation Project/Institute of African Studies, University of Nairobi.

Tobler W. (1970) "A computer movie simulating urban growth in the Detroit region".Economic Geography, 46(Supplement): 234-240.

Wandago B. and E. T. Nahama (2007) "Participatory forest management experience in Kenya (1996–2006)," in *Proceedings of the 1st National Participatory Forest Management Conference*, KEFRI Headquarters, Nairobi, Kenya.

WCED(1987) *Our Common Future*. Clays Ltd.: Britai.

World Bank (2008) Forests Source Book: *Practical Guidance for Sustainable Forests in Development Cooperation.*