International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Conservation Measures Used to Check Human Encroachment on Aberdare Forest in Njabini Ward, Nyandarua County, Kenya

Mbugua Wandie[1], Dr. Amos Ngira[2], Wekesa Godfrey Wafula[3]

[1]PhD student at Karatina University, an associate lecturer at Mount Kenya University and Karatina University.
[2]Lecturer, School of social sciences, Pwani University and Mount Kenya University, Kenya.
[3]PhD student at Karatina University and an adjunct at Kibabii University.

ABSTRACT

Tropical mountain forests are under threat from human encroachment. Africa has a high population growth rate, leading to invasion of any unoccupied land. Aberdare Range ecosystem where Aberdare Forest is found is one of Kenya's five water towers. This research sought to establish the conservation measures applied to check human encroachment on the Range. The study findings may raise awareness on the available conservation measures used in the Aberdare Forest. The main limitations encountered in this research were limitation of time and finances. Data were presented through frequencies, percentages, tables and graphs. This study was carried out in Njabini Ward, Nyandarua County, Kenya: where a sample of 384 people was selected from a population of 20,665. Questionnaires, interviews, observations and documentary data analysis were used as data collection instruments. From the study it was established that banning exploitation of indigenous tree species and prohibiting unauthorized entry into the forest had significant ($p<0.05$) influence on human encroachment. This study recommends that management of Aberdare Forest Reserve should adopt modern approaches to conservation.

1. BACKGROUND OF THE STUDY

Man has used forests as a source of food, medicine, habitat, timber and non-timber resources, tourist attraction, fighting back global warming, as well as employment. The World Wildlife Fund (2016), released a report on forest cover loss which indicated that 31% of the Earth's surface is covered with forest, but which is reducing at 46 – 58 thousand square miles per annum. According to Yaro et al. (2016), tropical rain forest is one of the richest ecosystems containing more than half of all plants and animal species. A fifth of the tropical rain forest was destroyed between 1960 and 1990. At this rate tropical rain forests will be wiped out by thy middle of this century.

Kenya's share of forest loss has caused political rhetoric in the past decade on the foreseeable effects on local livelihoods. A number of conservation measures have been tried in forests like Mount Kenya so as to reduce human encroachment. Bans have been used to prohibit exploitation, trade, transportation and export of certain species. This was tried out in Kenya in 1986 and 2003 when a ban on indigenous trees was put on all forests and unauthorized entry by into Mount Kenya forest respectively (KWS/KFS 2007). Both showed a significant improvement of forest conservation.

In a country like China where environmental conservation is doing well, conservation measures are in two tiers: national and local governments. In the new constitutional dispensation in Kenya the same is true: environmental conservation is a shared responsibility between the National Government (NG) and the County Governments (CG). Their roles are stipulated in the Transitional Implementation Plan 2015, where each CG is expected to come up with its own strategies on achieving the National Goals at their level with the help of the Kenya Forest Service (KFS). The constitution of Kenya, chapter five section 69 (1) (d) requires that people living adjacent to forests be involved in preservation.

Kenya has five important forest ecosystems; Aberdare Range, Mount Kenya, Mau forest complex, Mount Elgon and Cherengani Hills. Aberdare Forest covers a total of 149,822.03 hectares. It serves four main river basins: Tana, Athi, Ewaso Nyiro North and Lake Naivasha. Aberdare Range hosts the Aberdare National Park which is branded as a world tourist destination and a conservation area. It is best known for the Treetops Hotel where Princess Elizabeth was on holiday in 1952, when her father, King George, died and she became Queen of England (Kenya Forest Service, 2009).

2. LITERATURE REVIEW

2.1 Bans

In forestry bans are imposed by governments so as to create a favorable environment for the local industry to compete in the global market (Hermosilla, 2000). Bans on exportation of logs or prohibitive log export taxes may also tame overexploitation of certain species, like was the case in 1986 when Kenya government banned the exploitation of all indigenous tree species from all public forests.

According to a KWS/KFS (2007), report the ban of unauthorized entry into Mt. Kenya forest has shown significant improvement, since there are 6,013.5 hectares of previously degraded forest that is currently regenerating after years of illegal exploitation. The impression here is that ban as a conservation strategy in Mount Kenya Reserve forest on the period 2003-2007 is likely to be an effective way to turn around the forest recession on forest ecosystems.

2.2 Legislations

According to the Global Forest Coalition report (Ahmed, 2008) legislation of forest in Bangladesh started in 1865. The then Indian Forest Act was meant to protect trees, prevent fires and prohibit cultivation and grazing in the forest. It helped conserve forest reserves until 1997 when the first modern Bangladesh forest management act was enacted.

In China protection and conservation of natural ecosystem has enjoyed the enactment of Forest Ecosystem Conservation that encourage afforestation, conservation and limiting logging. The others are Soil and Water Conservation which fosters afforestation, vegetation and slope conservation as well as timber and timber products management. As a result China has formed over two thousand nature reserves, which protect about 15 per cent of her total land area (Czarnezki & Yu, 2013).

In Kenya the most important legislation is the Constitution. According to chapter five section 69 (1) (b) of the Kenya Constitution (2010), the state is expected to work towards achieving and maintenance of a 10% tree cover of Kenya's total land area. Part (e) of the above requires that the state protects genetic resources and biological diversity. Section 62 (1) (g) identifies water catchment areas, national reserves and game reserves as being under public land unless legally acquired, managed, or in use by a particular community as their forest, for grazing or as shrines, while part 4 say that public land should be used under terms specified by an Act of Parliament (GoK, 2010).The State is therefore required to oversee sustainable exploitation, use, manage and conserve the environment and its natural resources.

The National Government has over the years, been implementing three core programs namely: (i) Forest Conservation and Management, (ii) Forest Plantations and Enterprise, and (iii) Farm and Dry-land Forestry Development (Kenya Forest Service, 2015).

Kenya's Vision 2030 is yet another important development policy with impact targets on Kenya's forests. It's forth pillar is on environment and is stated as "*A nation living in a clean, secure and sustainable environment*". It identifies unsustainable management of natural resources like forests as one of the major challenges facing Kenya. Continued encroachment, environmental degradation, deforestation, poaching, human wildlife conflicts, ineffective policies, regulatory/institutional framework as well as poaching are identified as the main threats to Kenya's environment. This is to be implemented through four broad measures namely: conservation, pollution and waste management, ASAL and disaster zones, and environmental planning and governance.(Thugge, Ndung'u, and Otieno, 2008)

2.3 Devolution

China has devolved forest management so that there are roles for the state and those of local authorities. The two levels share in collection of permits, restricting purchases and sales, setting limits of import and export, surveying and filing of resources as well as management of the natural environment in which these wild floras is found. The Chinese government has empowered the two tiers to ensure activities that may impact on the environment negatively are stopped fast (Czarnezki & Yu, 2013).

According to the Kenya Constitution forests are managed at two levels: National and County. The Transition Implementation Plan (2015) explains the implementation of devolved forestry functions. Every County Government is required to ensure that housing estate developers establish at least five per cent of their total land as green zones. The County Governments are also expected to establish and maintain a recreational centre in every market place. In the Forest (Charcoal) Act (2012) the County Government is supposed to licence and manage charcoal trade from production, transportation to sale. KFS is supposed to support the county in the process of developing county by-laws, policies and legislation to support implementation of the forestry development activities (Kenya Forest Service, 2015).

2.4 Public Participation

Participation of local community is becoming widely acceptable than the centralized way of forest management (Ligani, Savado, Tigabu, and Oden, 2011). They identify two necessary conditions for it to be effective: (i) empower women by encouraging women groups' participation in NTFP collection and sale (ii) increase environmental education to the local people.

According to chapter five section 69 (1) (d) of the Kenya Constitution (2010), public participation is a requirement when it comes to managing, protecting and conserving the environment (GoK, 2010). In Kenya today the problem is not legislation but putting the laws into practice. The concept of Community Forest Association has been put in place in the Aberdare forests. Even though, from the MENR (2003) survey of there was rampant logging of indigenous tree species and especially Cedar in the Forest Reserve than across the boundary on private lands.

2.5 Barriers

According to a research done by Gotmark, Soderlundh, & Thorell (2000) in Southern Sweden four items stands out from their work: Buffer zones are an important forest conservation measure, buffer zones can be established using State financial support in areas where the value of forest is high, buffer zoning is

more efficient than just declaring a forests as a reserve, and that forestry is still possible within the buffer zones.

In the Aberdare Conservation Area forest cover increased by 20.6 per cent between 2005 and 2010 (GoK, 2013). This is attributed to establishment of the fence around the protected area. A sharp difference in charcoal burning and illegal logging of indigenous trees was noted in 2007 where the latter was 12.1% in fenced areas and 87.9% in the unfenced forest areas (Rhino Ark Org., 2011). Declaring of all public and community forests as protected areas may help in conserving them since protected areas are proposed in Vision 2030 to have their boundaries protected from encroachment (GoK, 2007).

2.6 Research Design

Descriptive survey used allowed the researcher to gather information by questioning or interviewing respondents then summarize, present and interpret it. It was used to assess the conservation measures used in Njabini Ward and how it is checking human encroachment on the Aberdare Range Forest.

3. METHODOLOGY

3.1 Location of the Study

The study was carried out in Njabini Ward, Kinangop constituency of Nyandarua County, Kenya, which borders the Aberdare Range on its western slope. This county has land area totalling to 3,107.7 km^2. The gazetted forest area is 499.2 km2, under four forest stations: South Kinangop, North Kinangop, Geta and Ndaragwa (Aberdare Forest Reserve Management plan 2010-2019, 2016).

3.2 Target Population

Njabini Ward has a total population of 20,665 while Nyandarua County's level of urbanization is 18.5% compared to Kenya in general which has 32.3%. (Aberdare Forest Reserve Management plan 2010-2019, 2016).

3.3 Sampling Procedures and Techniques

The following formula was used to determine sample size.

Where: n = the desired sample size

z = standard normal deviation at the required confidence level (1.96)

p = proportion in the target population (0.5)

q = 1-p

d = level of statistical significance set (0.05)

Hence: n = (1.96)2 (0.5) (1-0.5) / (0.05)2

= 3.8416 x 0.25 /0.0025

= 0.9604 / 0.0025

= 384.16

Mugenda and Mugenda (2003)

The target population of 20,665 therefore had a sample of 384 people. Stratified sampling was used to select the groups of respondents; KWS/KFS officials and the local population. To avoid gender or age bias purposive sampling was used in choosing key informants in each stratum.

3.4 Sample Population

South Kinangop Forest Station, the only one in Njabini Ward, has twenty five forest officers (KFS seventeen and KWS eight). From the sample population of 384 we remain with 376 for the local population. The KFS and KWS officers were subjected to interviews while the rest of the population filled questionnaires.

3.5 Construction of Research Instruments

The study used questionnaires, interviews, observations and documentary data review to collect data.

3.5.1 Questionnaires

Mugenda and Mugenda (2003) view questionnaires as meant to allow a researcher to measure for or against a particular view point. Questionnaires were formulated to collect data from respondents according to the purpose of this study.

3.5.2 Interviews

Oso and Onen, (2005) define interview as person to person communication in which one asks the other or group questions intended to give information or options. Interviews were subjected to Kenya Forest Service and Kenya Wildlife Service officers at the South Kinangop Station. This collected their views on conservation measures used on Aberdare.

3.5.3 Observation

The researcher observed for signs of livestock grazing, cultivation, settlement, charcoal production, and logging.

3.5.4 Documentary Data Analysis

The researcher referred to secondary data sources and used the Kenya Forest Service and Kenya Wildlife Service journals and books from their libraries.

3.6 Testing for Validity and Reliability of Research Instruments

3.6.1 Validity

Validity is the extent to which an instrument accurately measures what it is supposed to measure. It seeks to establish the opinion of the experts in the field of study (Orodho, 2005). In this case the researcher conducted a pilot study in South Kinangop Forest Station. After scrutiny, the researcher amended the instruments to ensure content and criterion validity.

3.6.2 Reliability

Reliability according to Gay, (1992) is the extent to which a test instrument consistently measures whatever it is meant to. It is where a test gives similar results over a number of repeated trials. In order to establish reliability piloting of questionnaire was done.

3.6,2.1 Piloting of Questionnaire Instrument

Piloting helps detect vagueness in the questions, familiarize with the expected responses during the main study, insufficient space to write responses and whether the anticipated analytical techniques will be appropriate, Kothari (2004). Piloting for this study was conducted in part of Njabini ward. Care was taken to ensure that the questionnaires and interview schedules were precise

3.7 Data Collection Methods and Procedures

The researcher distributed the questionnaires to the prospective respondents, collected them back at the respondents' convenient time within two weeks and examined documentary data from the offices, as well as booked and conducted interviews on the day and time agreed.

3.8 Data Analysis Techniques and Procedures

Collected data were verified for completeness, accuracy and uniformity on the questionnaire. Then edited, coded, classified and tabulated into meaningful categories and later subjected to descriptive and inferential statistics based on themes using the principle of inductive reasoning. Analyzed frequency distributions, measures of central tendency i.e. mean and percentages of the data were presented in

tables. Linear regression was employed with the help of the Statistical Package of Social Sciences (SPSS). Frequency distribution tables, pie charts and bar graphs were used to present data.

3.9 Ethical Considerations

The researcher explained to the respondents the purpose of the study and assured them of confidentiality so as to create rapport and improve on correctness of information to be gathered. Anonymity, respect of their cultural values and interests were adhered to, in order to ensure that valid data were collected.

4.0 DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Response rate

The respondents involved were KFS/FWS officers and Njabini/Kiburu Ward residents. They returned the questionnaires as tabulated in Table 4.1.

Table 4. 1 : Instrument return rate

Respondents	Sampled size	No. collected	Return rate (%)
KFS/KWS Officers	25	25	100.0
Njabini Residents	359	300	83.57

Table 4.1 shows that the average questionnaire return rate was well above 80% which according to Mugenda and Mugenda (2003) is an acceptable proportion and can be termed adequate for analysis.

4.2 Demographic information

4.2.1 Demographic data of residents and KFS/KWS officers.

The demographic data of KFS/KWS officers was based on their gender, age, period of living along the forest/working at Aberdare, training level related to environmental conservation/related to forestry and period of working in the ministry.

Respondents were asked to indicate their gender. Responses are summarized and presented in figure 4.1.

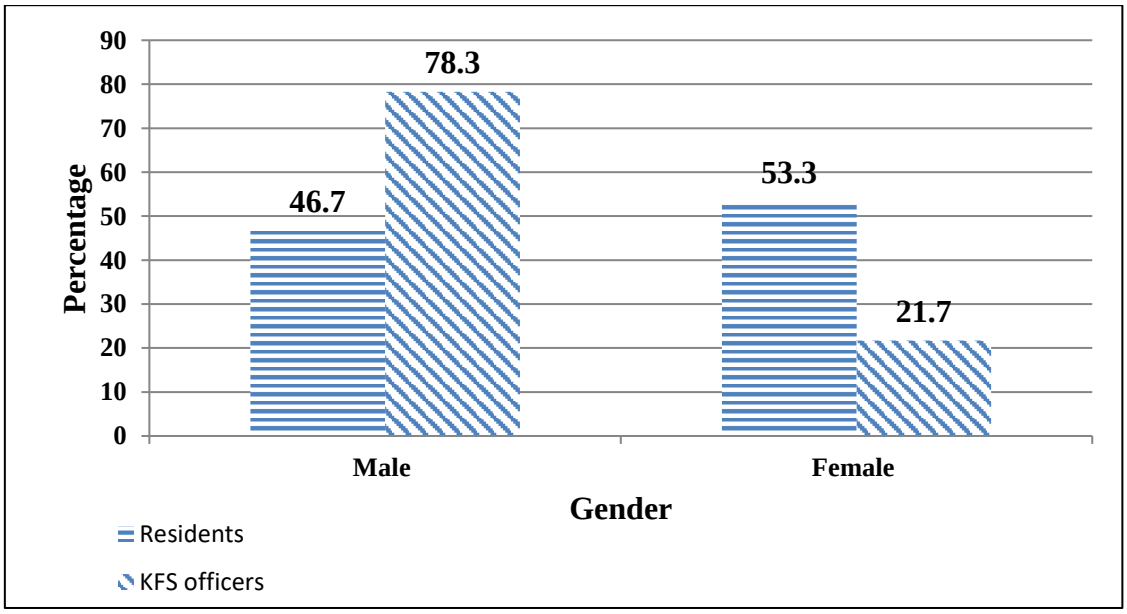

Figure 4. 1 : Gender of residents and KFS/KWS officers

Findings in figure 4.1 show that 53.3% of the residents were female and 78.3% of the KFS/KWS officers were male. This shows both gender was well represented in the study.

Respondents were also asked to indicate their age. Responses are summarized and presented in figure 4.2.

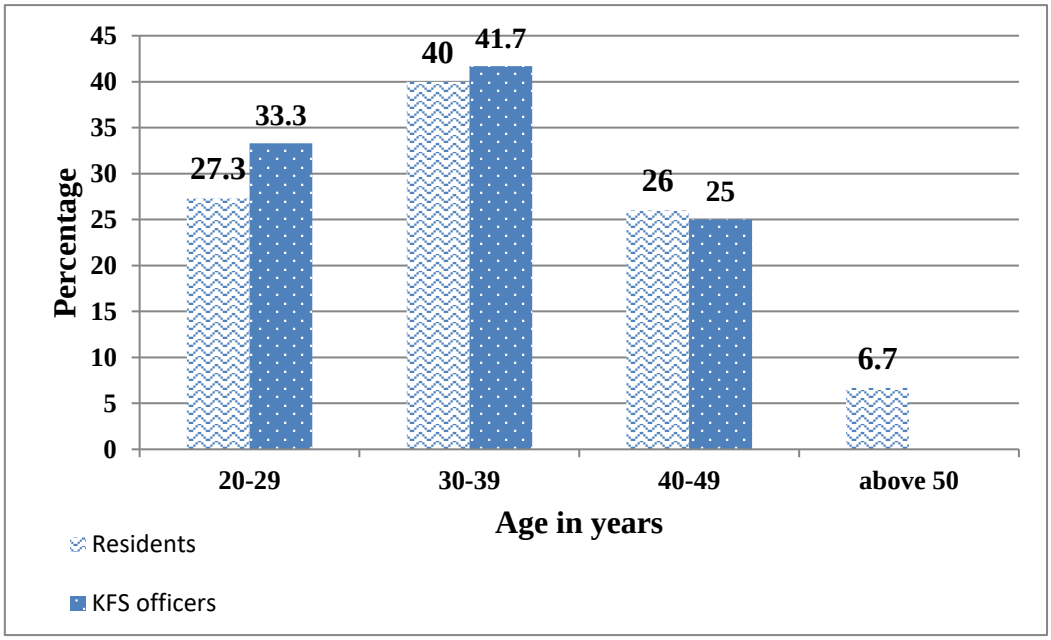

Figure 4. 2 : Age of residents and KFS/KWS officers

Findings in figure 4.2 shows that 40% of the residents were aged between 30-39 years and 41.7% of the KFS/KWS officers were aged between 30-39 years. This shows that the respondents were relatively old to understand the concept of the study.

The researchers also sought to establish the respondents' level of training on environmental conservation/forestry. Findings are summarized and presented in figure 4.3.

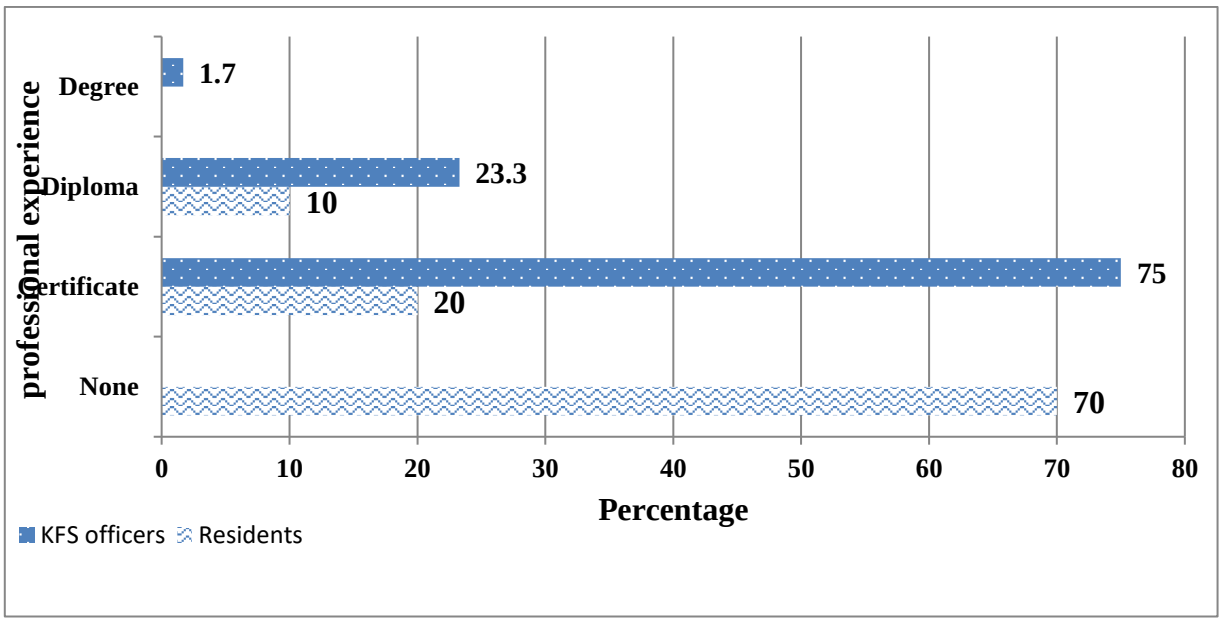

Figure 4. 3 : Respondents' level of training

Findings in figure 4.3 show that 70% of the residents did not have any training on environmental conservation and 75% of the KFS/KWS officers had a certificate trssaining in related to forestry. This implies that lack of training on environmental studies influenced limited conservation activities by the

residents while all the KFS officers were in a good position to protect the forest since they were trained on various courses related to forestry.

KFS/KWS officers were also asked the number of years working in the current station. Findings are summarized and presented in figure 4.4.

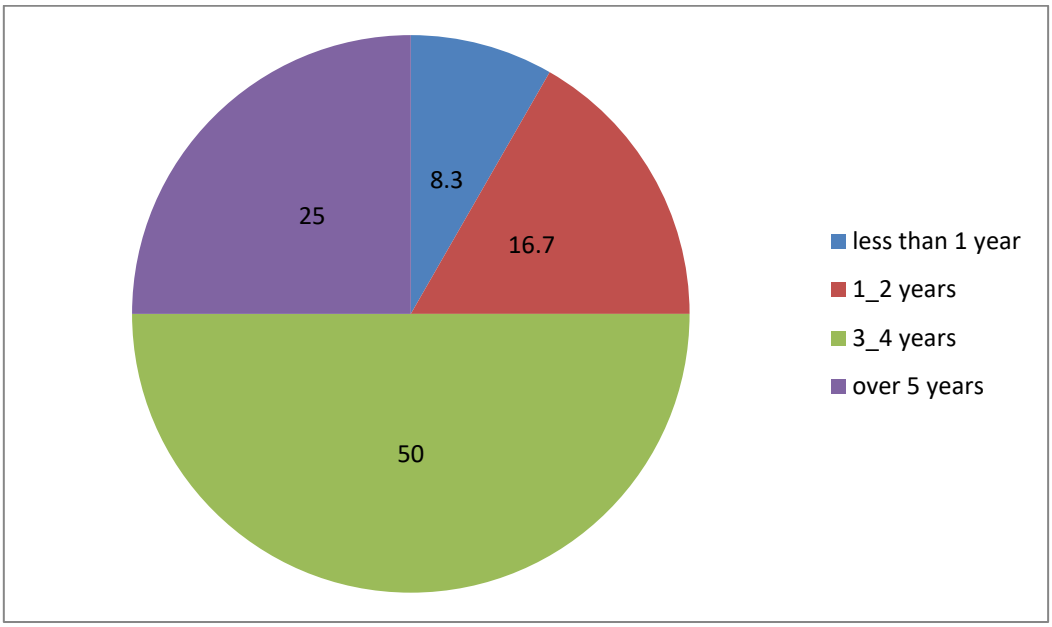

Figure 4. 4 : Period of working the current station

Findings in figure 4.4 show that 50% of the KFS/KWS officers had worked at Aberdare forest for between 3-4 years. This shows that they understood the causes of encroachment and measures to control encroachment of the forest.

The researcher also sought to establish the period residents have been living along Aberdare forest. Responses are summarized and presented in figure 4.5.

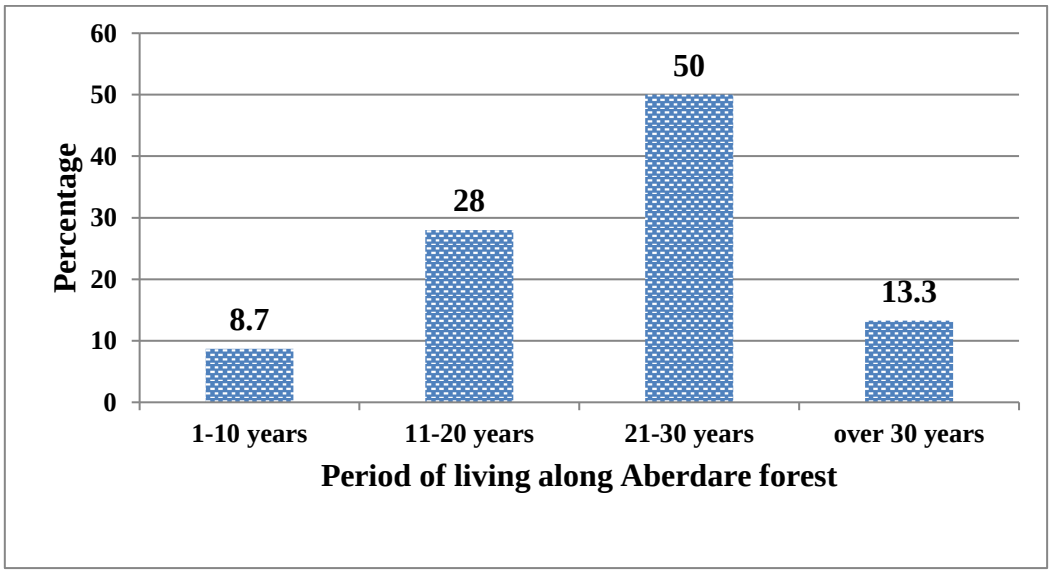

Figure 4. 5 : Period of living along Aberdare forest

Findings in figure 4.5 show that 50% of the residents had lived along Aberdare for between 21-30 years. This shows that they were in a good position to understand the concept under study since they were exp-

sserienced in living near the forest.

4.3 Conservation measures

The objective of this study was to examine conservation measures used to check human encroachment on Aberdare forest cover. Respondents were to indicate the extent to which erecting barriers like fences or roads between forests and private land will discourage people from exploiting forest products illegally. Responses are summarized and presented in table 1.4 below.

Table 4. 2 : Extent to which barriers discourage encroachment

Extent	Frequency	Percentage
Very high	170	56.7
High	80	26.7
Moderate	45	15.0
Low	5	1.6
Total	**300**	**100**

Findings in table 4.4 show that 56.7% of the residents indicated that barriers discourage encroachment to a very high extent, 26.7% indicated to a high extent, 15% indicated to a moderate extent and 1.6% of the respondents indicated that barriers discourage encroachment to a low extent. This implies that barriers like fences or roads between forests will discourage people from exploiting forest products illegally and this finding concurs with Rhino Ark Organization (2011) that erecting fences reduces charcoal burning and illegal logging of indigenous trees.

The researcher also sought the residents' opinions on conservation measures. Findings are presented in table 4.5.

Table 4. 3 : Residents opinion on conservation measures

Statements	Yes		No	
	F	**%**	**F**	**%**
Exploitation of indigenous tree species is banned.	300	100	-	-
Unauthorized entry into the forest is prohibited.	280	93.3	20	6.7
The KFS is involved in promoting forest conservation education to the local population.	175	58.3	125	41.7
There is/are a group(s) in Njabini Ward which is/are involved in forest conservation.	163	54.3	137	45.7
The public is involved in managing, protecting and conserving of public forest.	155	51.7	145	48.3
All forest boundaries are clearly marked.	76	25.3	224	74.7
The general public is aware of the forest legislations in Kenya.	53	17.7	247	82.3

N=300

Findings in table 4.5 indicate that; all residents indicated that exploitation of indigenous tree species in banned, 93.3% indicated that unauthorized entry into the forest is prohibited, 58.3% indicated that the Kenya Forest Service is involved in promoting forest conservation education to the local population, 54.3% indicated that there is/are a group(s) in Njabini Ward that is/are involved in forest conservation, 51.7% indicated that the public is involved in managing, protecting and conserving of public forest,

74.7% indicated that not all forest boundaries are clearly marked and 82.3% of the residents indicated that the general public is not aware of the forest legislations in Kenya. The KFS officers also indicated that imposing bans on exportation of logs, establishing rules to protect natural resources like forests, devolving forest management, participation of local community and fencing around the protected areas as some of the measures to curb forest encroachment. This implies that banning exploitation of indigenous tree species and prohibiting unauthorized entry into the forest helps to protect encroachment of the forest. This finding concurs with KWS/KFS (2007) report that the ban of unauthorized entry into forests has shown significant improvement with regards to human encroachment on Aberdare forest cover.

Table 4. 4 : Relationship between conservation measures and Encroachment

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.550	.071		-7.727	.000
	Exploitation of indigenous tree species in banned	.818	.070	.484	11.624	.000
	Unauthorized entry into the forest is prohibited	.732	.066	.458	11.005	.000
a. Dependent Variable: Extent to which erecting barriers will discourage people from exploiting forest products illegally						

The results in table 4.6 indicate that banning exploitation of indigenous tree species and prohibiting unauthorized entry into the forest had significant ($p<0.05$) influence on Aberdare forest encroachment. This means that imposing laws to ban exploitation of indigenous tree species and allowing only authorized persons to enter the forest could highly contribute to reduction on forest encroachment.

5. SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

The findings revealed that erecting barriers like fences, or roads between forest and population will discourage people from exploiting forest products illegally to a very high extent as indicated by 56.7% of the residents. The study explored various conservation measures which can be employed to curb human encroachment into forests. They include: banning the exploitation of indigenous tree species as indicated by all residents, prohibiting unauthorized entry into the forest as indicated by 93.3%, promoting forest conservation education to the local population as indicated by 58.3%, forming groups to educate community on forest conservation as indicated by 54.3%, involving the public in managing, protecting and conserving of public forests, as indicated by 51.7%, marking all forest boundaries clearly as indicated by 74.7% and sensitizing the general public on forest legislations as indicated by 82.3% of the residents. This finding concurs with Rhino Ark Organization (2011) and KWS/KFS reports that fencing reduces charcoal burning and illegal logging of indigenous trees.

5.2 Conclusion

The study established that the government together with relevant stakeholders like the Rhino Ark can employ measures to conserve the forest which include banning exploitation of indigenous tree species,

prohibiting unauthorized entry into the forest, involving the public in managing, protecting and conserving of public forests, marking all forest boundaries clearly and sensitizing the general public on forest legislations.

5.3 Recommendations

The management of Aberdare Forest Reserve should engage modern methods of conserving the forest resources, including fencing and surveillance. This would help keep off intruders into the forest.

5.4 Suggestions for further study

After carrying out this study it emerged there is need to recommend the following as areas for further studies:

1. Challenges of traditional methods of forest conservation on forest in Kenyan.
2. Impact of modern methods of forest conservation on forests in Kenya.

REFERENCE

1. Ahmed, A. I. (2008). Underlying Causes of Deforestation and Degradation in Bangladesh. Dhaka: GFC.
2. Czarnezki, J. J., & Yu, W. (2013). Challenges of China's Natural Resources Conservation and Biodiversity Legislation. Pace University: Pace Law Faculty Publications.
3. GoK. (2007). Kenya Vision 2030: Popular Version. Nairobi: G.P.
4. GoK. (2010). Consttution of Kenya. Nairobi: GP.
5. GoK. (2013). National Climate Change Action Plan: Rehabilitation and Protection of Indigenous Forests in Five Water Towers. Nairobi: GoK.
6. Gotmark, F., Soderlundh, H., & Thorell, M. (2000). Buffer Zones for Forest Reserves: Opinions of Land Owners and Conservation Value of their Forest Around Nature Reserves in Southern Sweden. Biodiversity and Conservation, 1377-1390.
7. Hermosilla, A. (2000). Underlying Causes of Forest Decline.
8. Kenya Forest Service. (2009). Aberdare Forest Reserve Management Plan 2010-2019. Nairobi: KFS.
9. Kenya Forest Service. (2015). Implementation of Devolved Forestry Functions:Transition Implimentation Plan 2015-2016. Nairobi: K.F.S.
10. Kothari, C. R. (2009). Research Methodology: Methods & Techniques. Delhi: New Wiley Eastern Ltd.
11. KWS/KFS. (2007). Aerial Monitering of Forest Boundaries . Nairobi: KWS/KFS.
12. Ligani, P. C., Savado, P., Tigabu, M., & Oden, P. C. (2011). Factoers Influencing People's Participation in the Forest Management Program in Burkina Faso, West Africa. Forest Polcy and Economics, 292-302.
13. McBurney, D., & White, T. L. (2010). Research Methods 8th Ed. California: Wardsworth Cengage Learning.
14. MENR. (2003). Aerial Survey of the Destruction of the Aberdare Range Forests. Nairobi: MENR.
15. Ministry of Water, Environment and Natural Resources. (2015). The Forest (Charcoal) Regulations, 2015: The Forest Act 2015. Nairobi: GoK.
16. Mugenda, O. M., & Mugenda, A. G. (2003). Research Methods: Quantitative & Qualitative Approaches. Nairobi: Acts Press.

17. National Assembly Bills 2015 #49. (2015). The Forest Conservation and Management Bill. Nairobi: Kenya Gazatte Supplement #133.
18. Orodho, J. A. (2005). Elements of Education and Social Science Research Methods. Nairobi: Masola.
19. Oso, W., & Onen, D. (2005). A handbook for beginning researchers. Kisumu: Options press and publishers.
20. Rhino Ark Org. (2011). Environmental, Social and Economic Assessment of Fencing of Aberdare Conservation Area. Nairobi: KWS, KFS, KFWG, UNEP, Rhino Ark .
21. Thugge, K., Ndung'u, N., & Otieno, R. O. (2008). Unlocking the Future Potential for Kenya – The Vision 2030. Nairobi.
22. Yaro, M. A., Okon, A. E., & Bisong, F. &. (2016). Impact of Forest Encroachment on Rural Livelihoods in Akamkpa Division of Cross River National Park, Nigeria. Journal of Environmet And Earth Science, 41-84.