International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Analysis of Drivers of Forest Degradation in Cherangany Forest, Elgeyo Marakwet County, Kenya

Suter, C. C[1], Cheserek Grace[2], Kiptui Mark[3]

School of Environmental Studies, University of Eldoret p.o box 1125 Eldoret, Kenya

Abstract: ***There are a number of serious conservation problems associated with the Cherangany forest degradation due to human settlements. The communities are highly dependent on the natural resources available within their vicinity and thus cause the greatest sustained forest disturbance. The purpose of this study was to analyze the drivers of forestdegradation. This study adopted a descriptive survey research design and the sampling frame comprised of respondents drawn from household heads living adjacent to the forest, members of Community Based Organizations (CBOs), community forest associations (CFA), and Kenya Forest Service (KFS) personnel in the area. The study area was divided into three strata; Kapcherop, Embobut and Cheptongei. In order to ensure that representative samples were derived from each stratum, the 282 households were obtained by simple random sampling technique as per the population of each strata. The instruments used for collection of data were questionnaires interview schedules and focus group discussions. The study used frequencies and percentages to analyze quantitative data while qualitative data were data summarized and interpreted in line with the research objectives.Results were presented in form of figures and tables. The study found out that majority of the respondents were not employed and therefore depended on activities such as logging, charcoal burning, crop production and livestock rearing which have a negative effect on forest degradation. The study recommended that there is need for conservation of Cherangany forest through re-afforestation in places were agricultural activities such as crop production has taken place. This will increase the forest cover and thus reducethe socio-economic impacts associated with forest degradation. The research findings could influence policy makers and development agencies in the conservation of water catchment areas and will generate vital information on the socio-economic impact of the degradation of the forest on the household income.***

Keywords: Drivers, Forest, Degradation

1. Introduction

Thirty per cent of the earth's land area or about 3.9 billion hectares is covered by forests. It is estimated that the original forest cover was approximately six billion hectares (Bryant, Nielsen, & Tangley, 1997). The Russian Federation, Brazil, Canada, the United States of America and China were the most forest rich countries accounting to 53 per cent of the total forest area of the globe. Another 64 countries having a combined population of two billions was reported to have forest on less than ten per cent of their total land area and unfortunately ten of these countries have no forest at all. Among these countries 16 are such which had relatively substantial forest areas of more than one million hectares each and three of these countries namely Chad, the Islamic Republic of Iran and Mongolia each had more than ten million hectares of forest. The forest area remained fairly stable in North and Central America while it expanded in Europe during the past decade. Asian continent especially in India and China due to their large scale afforestation programme in the last decade registered a net gain in forest area. Conversely the South America, Africa and Oceania had registered the net annual loss of forest area (Anon., 2010).

Natural forests are threatened by several human related activities mostly excisions and degazettement for agriculture and other land uses that claim 5,000 ha of forest land every year (Wanjiku et al., 2005; Ogweno & Ototo, 2005). High demand for charcoal in urban areas is a key driver of deforestation that lead to clearing of 50,000 ha of forests annually (Hankins, 2002). Other management malpractices such as poor management, unsound practices and over-harvesting by licensees have left about 20,000 ha of plantations in establishment backlog (Ogweno et al., 2005; Kagombe *et al.*, 2005). Forest fires destroy on average 3,000 ha of forests every year (Kagombe et al., 2005). Though logging of indigenous forests was banned in 1986 (Ogweno & Ngutai, 1996), illegal harvesting of high value indigenous species such as camphor, Meru oak, Cedar and Sandal wood is still rampant in most forests. These factor contributed to the loss of 186,000 hectares between 1990 and 2005 (Kagombe *et al.*, 2005). Though the current annual deforestation rate, estimated at 0.34%, is lower than the average for Africa (0.78%), it is significantly higher than the world average of 0.24 % (Ogweno & Ototo, 2005).

The main sources of energy in Kenya are wood fuel, geothermal, and oil. Nationally woodfuel accounts for 70%; while oil and electricity constitute 20% and 9% of Kenya's energy consumption respectively. Energy resource development is important in natural resource management. Within the Cherangany hills watershed, energy requirements for domestic use are sourced mainly from woodfuel. The implication is that there is a buildup of pressure on demand for tree products for fuel wood from both gazetted and private forests. Further most households use wood fuel in devices that waste a lot of heat energy and this is not compatible with long term strategy of sustainable development. Despite Government restrictions, charcoal burning in the country continues in many forests and it accounts for business worth Ksh 17 billion annually. This study therefore analyzed the drivers of forest degradation in Cherangany forest in Elgeyo Marakwet County, Kenya.

2. Statement of the Problem

Forest degradation in Kenya especially the Mau Complex has led to drastic and considerable land fragmentation, deforestation of the headwater catchments and destruction of wetlands previously existing within the fertile upstream parts. Today, the effects of the anthropogenic activities are slowly taking toll as is evident from the diminishing river discharges during periods of low flows, and deterioration of river water qualities through pollution from point and non-point sources (Kenya Forests Working Group [KFWG], 2001; Baldyga et al., 2007).Forest degradation and depletion in Kenya has in the recent past assumed alarming rates. It is estimated that Kenya's forests are lost at the rate of 5,000 to 6,000 hectares per year (IUCN, 1996). As per Kenya Forest service (2015), there are a number of serious conservation problems associated with the Cherangany forest degradation. Further KFS (2015) noted that assessment of the human settlements in the areas surrounding the Cherangany forest blocks reveals an increased densification of settlements and intensification of land use activities driven by rapid population growth and increasing incidences of poverty. The communities are highly dependent on the natural resources available within their vicinity and thus cause the greatest sustained forest disturbance. This study therefore analyzed the drivers of forest degradation in Cherangany forest, Elgeyo Marakwet County.

3. Significance of the Study

In Kenya biological diversity plays a centre role in the socio-economic activities of the majority of the people. The country's economic development relies on the ability of its natural resource base to support agricultural production. Decline in biological diversity is attributed to many reasons, where habitat destruction is the major contributing factor. The rising populations put a lot of pressure on existing natural resources such as forests, wildlife, water, and soils

Human-environment relations are confronted with major problems due to degradation of forests. Local communities in Cherangany water catchment are usually the most immediate and the adversely affected by such degradation. People living in the periphery of forestland depend on its resources for their subsistence. With the degradation of forests, life of these local communities has deteriorated as the socio-economic and cultural systems of these people are interlinked with the ecology of the forest. The rationale of this study therefore was to investigate the socio-economic impacts of the degradation of the water tower.

This study will generate vital information on the socio-economic impact of the degradation of the water tower on the household income. This study seeks to enrich available literature. The research findings could influence policy makers and development agencies in the conservation of water catchment areas.

4. Methodology

This study was conducted in Kapcherop, Embobut and Cheptongei forests in the larger cherangany forest in Elgeyo Marakwet County This study adopted a descriptive survey research design. According to Kothari (2004), descriptive survey methods provide a suitable means through which community views, opinions, perceptions, aspirations, and suggestions regarding the phenomenon under investigation are obtained.

The sampling frame for this study comprised of respondents drawn from household heads adjacent to the forest. Key informants comprised of members from Community Based Organizations (CBOs) and community forest associations (CFA), and Kenya Forest Service (KFS) personnel in the area. Currently there are five CBOs and three (3) CFAs in the study area and this formed the sampling frame. In order to ensure that representative samples are derived from each category of respondents a formula by Yamane; (1967) was used to determine the sample size. The forest was sub-divided into three strata as per the level of degradation; highly degraded, medium degraded and low degradation. The sample size per cluster was then proportionally determined. Key informants comprised of KFS officials, and members who are registered with the 5 CBOs and 3 CFAs in the Cherangany catchment. According to 2009 national population census, there were 209 households in Kapcherop area, 311 in Embobut forest area and 233 in Cheptongei forest area (Gok, 2010). This is projected to have risen to 257 households in Kapcherop forest area, 381 households in Embobut forest area and 315 households in Cheptongei forest area as shown in Table 1.

Table 1: Households in Cherangany Forest Area

Forest Area	Households as per 2009	Households as per 2015
Kapcherop (Medium Degradation)	209	257
Embobut (Highly degraded)	311	381
Cheptongei (low degradation)	233	315
Total	**753**	**953**

The sample size was determined from the formula proposed by Yamane cited by Isreal (2009) given as:
$n=N/1+N\ (e)^{2}$
Where n=sample size
N=target population size
e = level of precision (sampling error)
Therefore, N=26796 households and e=5%.
$n =953/1+ 953(0.05)^{2}$
= 282 households

In order to ensure that representative samples were derived from each strata, the 282 households were obtained by simple random sampling technique as per the population of each strata. The study area was divided into three strata; Kapcherop, Embobut and Cheptongei. The sample size of each stratum was first determined in proportion to the population size in each of the three forest zones as shown in Table 2.

Table 2: Sample Size

Forest Area	Target Population	Sample Size
Kapcherop (Medium Degradation)	257	76
Embobut (Hihgly degraded)	381	113
Cheptongei (low degradation)	315	93
Total	**953**	**282**

To obtain the sample size in each of the strata, the first households were selected by simple random sampling followed by a sequence where the 5th household was selected until the sample size for each area is obtained.

The instruments used for collection of data relevant to this study were questionnaires interview schedules and focus group discussions. Questionnaires were administered to 282 household heads from the three strata. The questionnaire consisted of both structured and non-structured questions. The unstructured items captured opinion, feeling and suggestions of the respondents in the space provided. All the questions in the questionnaire were related to the objectives and the research questions of the study. Interview schedules were used to gather information from the KFS officials in the study area to obtain information on drivers of degradation of Cherangany Forest. Focus Group Discussions (FGDs) was held among the members of the 5 CBOS and 3 CFAs present in the study area on socio-economic impacts of forest degradation in Cheragany forest. One focus group was held in each forest area; Kapcherop, Embobut and Cheptongei and comprised of eight respondents (8) randomly drawn from the CBOs and CFAs. Therefore a total of 3 focus Group Discussions were held in the study area. The study utilized descriptive analysis techniques. Data was processed and analyzed using the Statistical Package for Social Sciences (SPSS) version 21.The data collected were assembled, grouped into categories, coded then entered into SPSS and analyzed to get results. Quantitative data was analyzed by use of frequencies, and percentages while qualitative data was summarized and interpreted in line with the research objectives. Results were presented in form of figures and tables.

5. Results

The purpose of this study was to identify the drivers of degradation of Cherangany forest. To achieve this objective, the respondents were asked to indicate the factors which they considered were responsible for forest degradation. They were allowed to indicate multiple factors and therefore their responses were more than 263. Data was tabulated and the results are presented in Table 3.

Table 3: Factors Responsible for Cherangany Forest Degradation

Factor	Frequency	Percentages
Logging	261	28.5
Crop Production	35	3.8
Overgrazing	47	5.1
Fuelwood(firewood)	59	6.4
Forest fires	71	7.7
High population growth	78	8.5
Charcoal burning	97	10.6
Timber harvesting	109	11.9
Infrastructure development	26	2.8
Poor governance	31	3.4
Inadequate natural resource planning and monitoring	17	1.9
Corruption	66	7.2
Exploitation of mineral resources and Mining	20	2.2
Total	**917**	**100.0**

Source: Field Data, 2016

Table 3 shows that 28.5% respondents cited logging (Plate 4) as the major factor responsible for cherangany forest degradation, 109(11.9%) respondents cited timber harvesting while 97(10.6%) respondents cited charcoal burning. However, exploitation of mineral resources (2.2%), crop production (3.8%), infrastructure development (2.8%) and inadequate natural resource planning and monitoring (1.9%) were cited as the factors that had the least effects on Cherangany forest degradation. From the responses, it can also be shown that Fuelwood (firewood) (6.4%), forest fires (7.7%), high population growth in the area (8.5%) and corruption were responsible for medium level degradation of cherangany forest. The study findings showed that among the major factors that were associated with Cherangany forest degradation were logging, timber harvesting and charcoal burning. However, among other factors which caused forest degradation were; crop production, overgrazing, fuelwood (firewood), forest fires, high population growth, infrastructure development, poor governance in forest department and exploitation of mineral resources and Mining.

On conducting interviews and Focus Group Discussions (FGDs) it emerged that among the major factors that were associated with the degradation in the three forest areas of Cheptongei, Kapcherop and Embobut were logging, charcoal burning and agricultural activities especially farming due to high population growth in the area (plate 5). However, forest fires, firewood collection and livestock grazing seemed to degrade minimally the forests. Agricultural activities involving maize, beans and potato farming, were more evident in all the three forest areas under the study. This implies that farming contributes largely to forest degradation in the study area.

Focused group discussion further revealed that some forest officers colluded with timber and charcoal dealers and this was thought of by most residents as having the most negative impacts on forest degradation since this group especially those involved in timber and pole harvesting targeted huge trees which have been in forest for quite long.

On conducting interviews with KFS officials in the study area it emerged that the most important drivers of forest degradation in the study area were logging, fuelwood collection and charcoal burning. They indicated that most of the youths in the study area are not employed and therefore in order for them to earn a living, they have ventured into logging and charcoal burning which degrades the forests.

6. Discussions

The study findings showed that among the major factors that were associated with Cherangany forest degradation were logging, timber harvesting and charcoal burning. It emerged that there are a lot of logging and charcoal burning in the three forest areas of Kapcherop, Embobut and Cheptongei. However, most of the logging activities have occurred in Embobut forest area in comparison to Cheptongei and Kapcherop. Loggers mostly target trees for fencing poles, timber, construction materials (wood) and mostly these activities occur at night or when it is raining when forest rangers are not around. This study finding is consistent with

FAO report (2006), which indicated that overexploitation of forest resources for fuelwood or timber can result in degradation of forest cover. This is further consistent with the findings of De Fries et al., 2010 which indicated that timber and logging activities account for more than 70% of total degradation in Latin America and (sub) tropical Asia. Furthermore Rademaekers et al., (2010) pointed out that increasing demand for timber and agricultural products in a globalizing economy are identified as main indirect drivers of deforestation and degradation.

In some parts of the study area, parts of the forest areas have been converted to agricultural lands where parts of forest land have been cleared for food production especially maize, beans and potatoes. This supports the findings of other researchers such as van Kooten and Bulte, (2000), Anon, (2010) and Hosunuma *et al.,* (2012) who showed in their findings that most forests especially in third world countries have been cleared to pave way for agricultural activities especially farming. Agriculture is estimated to be the proximate driver for around 80% of deforestation worldwide which is in line with estimates provided by Geist and Lambin (2002), and Gibbs et al. (2010). However, Geist and Lambin (2001) noted that forest conversion to pastureland for cattle ranching was a much more frequent cause for deforestation in South America. In this study however, there was grazing within the forest areas but was not considered by both the residents and forest officers as the major factor for forest degradation since it did not disturb significantly the forest structure and function.

Further, Focus group discussions and interview schedules held showed that there have been some incidences of forest fires but were not of higher magnitude to destroy the whole forest. This shows that among the factors responsible for Cherangany forest degradation was forest fires which according to FAO (2006) has been associated with forest depletion worldwide. Furthermore, the Ministry of Environment, Water and natural resources report (2014) acknowledges that among the factors that have caused accelerated forest degradation in Kenya were forest Fires.

In addition, most of the residents in the study area use firewood for cooking and since there are inadequate farm trees in the area to gather for this, the inhabitants especially women fetch firewood for cooking from the forests. This was witnessed in all the three forest areas under the study and this could have a negative effect on the structure and functions of the forest especially where living (green) trees are cut for firewood. From other research done, fuelwood gathering is not usually considered the major cause of forest degradation (Rowe *et al.*, 1992; Anon., 1994). However, in some parts especially in drier areas fuelwood gathering could cause forest degradation (Repetto, 1990). In this study fuelwood was not considered by most residents, community forest associations and Kenya Forest Service (KFS) personnel as a major factor influencing forest degradation.

7. Conclusions

The study concluded that the major factors that were associated with Cherangany forest degradation were logging, timber harvesting, conversion of forests to agricultural lands for food production and charcoal burning. Most of the logging activities have occurred in Embobut forest area in comparison to Cheptongei and Kapcherop. Further, fuelwood collection was not considered by most residents, community forest associations and Kenya Forest Service (KFS) personnel as a major factor influencing forest degradation.

8. Recommendations of the Study

In order to reverse the degradation of Cherangany forest, logging, timber harvesting, conversion of forests to agricultural lands for food production and charcoal burning need to banned.

There is need for conservation of Cherangany forest through re-afforestation in places were agricultural activities such as crop production has taken place. This will increase the forest cover and thus reducethe socio-economic impacts associated with forest degradation.

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