



# Influence of Deforestation Activities on Sustainable Livelihoods of the Inhabitants in Mount Elgon Forest Reserve, Bungoma County, Kenya

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**Abstract:** *In the last three decades, the Mount Elgon Forest in Kenya has declined primarily due to anthropogenic activities as a result of overdependence of forest products and services for livelihoods. This paper aimed at investigating the influence of deforestation activities on sustainable livelihoods of the inhabitants in mount Elgon Forest. This study used cross-sectional research design and mixed methodology where both quantitative and qualitative approaches of data collection and analysis was used. The target population was 12842 household heads, 4 ward administrators, 12 chiefs, 1 Kenya Forest service personnel and 1 NEMA official. A sample of 373 household heads, 4 ward administrators, 12 chiefs, 1 Kenya Forest Service Personnel and 1 NEMA official took part in the study. Questionnaires, interview guides and Focus Group Discussions were used to collect data. Validity was determined by consulting supervisors while reliability was ascertained using Cronbach Alpha Coefficient. The quantitative data was analysed using frequencies, percentages, mean and Standard deviation. Pearson Correlation analysis was employed to determine relationship that exists between the independent and dependent variables. Qualitative data was thematically classified and arranged before they are reported in narrations and quotations. Analyzed data was presented using tables and figures. The study found out that there was a significant positive correlation between deforestation activities and sustainable households' livelihoods ( $r = .682$ ;  $p = .000$ ) showing that deforestation activities affect sustainable livelihoods. It was recommended that there is need for the community and the government agencies to devise strategies of enhancing sustainable use of forest resources.*

**Keywords:** *Deforestation, Sustainable, Livelihoods, Mount Elgon, Reserve*

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## 1. Introduction

Anthropogenic practices refer to human activities that have an impact on the environment. These practices can have both positive and negative effects on sustainable household livelihoods. In recent years, there has been an increased awareness of the need to adopt sustainable practices that promote environmental conservation and enhance the livelihoods of households. Deforestation is one of the most significant anthropogenic practices that have a negative impact on sustainable household livelihoods. Deforestation reduces the availability of timber for construction, fuel, and other purposes. It also

leads to the loss of biodiversity and the destruction of ecosystems that provide essential services such as water purification and climate regulation (Estrada, Mendoza-Ponce, Calderón-Bustamante & Botzen, 2022). Deforestation can also lead to soil erosion, which affects agricultural productivity and food security (Oosting, van der Lee, Verdegem, de Vries, Vernooij, Bonilla-Cedrez, & Kabir, 2022).

Forests are vital resources for sustaining human populations worldwide (Cheng *et al.*, 2019; FAO, 2020). In fact, more than 90% of the world's extremely poor depend on forests for food, energy, and other aspects of

their livelihoods (FAO, 2020). Globally, forests contribute an average of 27% of household income in communities living within or in proximity to forests (Lawlor *et al.*, 2019), which are generally characterized by relatively high poverty rates (Castle *et al.*, 2021). Tree-based systems, such as agroforestry and tree cash crops, also provide a suite of products and services that contribute to poverty alleviation and the improvement of overall human well-being (Kuyah *et al.*, 2020). Sustainable forest management, agroforestry, and other tree-based systems are therefore potentially significant contributors to achieving the first United Nations (UN) 2030 Sustainable Development Goal (SDG) to “end poverty in all its forms everywhere” (UN General Assembly, 2015), as argued in a range of different contexts (Castle *et al.*, 2021).

In the last decade, forest-related income in household economies and rural development has received increasing attention from the international community. This is largely in recognition of the significant relationship between forest areas and poverty and the emerging knowledge that forests could have a far more significant role in meeting the Sustainable Development Goal’s poverty alleviation targets (Sunderlin *et al.*, 2008). Hence, governments, international donors, and Non-Governmental Organizations (NGOs) are increasingly looking to the forestry sector for solutions to reduce poverty. Therefore, empirical knowledge about forest-related income in household economies and rural development is still needed in this regard. Considering that forest income helps reduce income inequality and contributes to households’ food security, the success or failure to preserve and sustainably manage these forests will have significant consequences for millions of people dependent on them (Aung, Adam, Pretzsch & Peters, 2015).

Studies from Africa, Asia, and Latin America have found that forest and non-forest environmental income contribute significantly to livelihoods in most rural settings. In Malawi, it has been revealed that forest income contributes 15% to the total household income, and it has a critical income equalizing effect across rural households (Kamanga, Vedeld & Sjaastad, 2009). In South Africa, forest resources have prevented people from slipping into deeper poverty (Shackleton & Shackleton, 2006). Forests products are key in enhancing the livelihood security of the poorest members of society, forming an important safety net, and raising household incomes to levels equivalent to the broader population. Therefore, valuable information on forest resources’ role in livelihoods could be applied in developing forest conservation policies for enhanced ecosystem services and livelihoods (Mendako, Tian, Ullah, Sagali, & Kipute, 2022).

People rely on forest resources for their livelihood activities (Mukul *et al.*, 2016). Households’ income from forest and forest-related occupation are positively related to their forest dependency (Jannat, Hossain & Uddin 2018). Forest dependency around the world is mainly for household subsistence, timber, fuelwood, NTFPs, grazing for animals, forest-based agriculture, food security, employment, and ecosystem services (Chakraborty, Joshi, & Sachdeva, 2018). Forests are vital for each and every life on earth. Forests cover 42.92% of the world’s land surface which is nearly about 4 billion hectares (FRA 2015). Based on the total forest area in 2015, first five top ranked countries across the globe are Russia, Canada, Brazil, the USA, and China, where forest areas as a share of land areas are 49.40%, 49.24%, 46.10%, 33.84%, and 21.83%, respectively. However, there are some countries with small percentages of forested land including Qatar (0%), San Marino (1.64%), Djibouti (00.26%), Kuwait (00.34%), and Malta (00.95%). It is reported that globally 300 million people live in forests (WWF, 2019) and 1.6 billion people depend on forest resources (Thorn *et al.*, 2020).

In the last three decades, the Mount Elgon Forest reserve area in Kenya has declined primarily due to anthropogenic activities. Central to the anthropogenic activities is the dependence of the people on forest products and services for livelihoods. These human perturbations threaten biodiversity and future ecosystems functions of this forest and thus livelihoods. In Mount Elgon there is encroachment, over exploitation and use beyond regulations on forest products such as collection of firewood and logging of indigenous trees with or without permit. While consumptive activities are not allowed by the KWS in the National Park, firewood and poles and timber are harvested in large amounts. Excision of forest products can weaken the species (Masayi, Omondi & Tsingalia, 2021). When harvesting legally, regulations describe age, size and location of the product. In plantations, thinning activities are carried out to improve the product to be harvested. The excision often happens on the immature trees and hinders a successful reproduction. Charcoal burning, bee keeping, forest fires, and wildlife poaching is common as huge parts of the forest are not patrolled. Thus, the current study investigated deforestation practices influencing sustainable household’s livelihoods among the inhabitants living in the mount Elgon Forest Reserve, Bungoma County, Kenya.

## 2. Literature Review

A rising number of studies shows the value of forests as a source of income for many rural people in developing countries (Nguyen *et al.*, 2020). According to the Food and Agriculture Organization (FAO), forest extraction accounts for a major portion of one billion people’s income (FAO, 2016). The process of extracting forest

goods such as food, fuelwood, construction materials, and medicinal plants for consumption or sale is known as forest extraction (Ofoegbu, Chirwa, Francis & Babalola, 2017). International treaties, such as the United Nations Framework Convention on Climate Change (UNFCCC), the Sustainable Development Goals (SDGs), and the Bonn Challenge, in which world leaders agreed to reforest 350 million hectares of land by 2030, all recognize the importance of forests as a source of livelihood (Dave *et al.*, 2019).

Due to the high overlap of forested areas with poverty, a substantial body of literature has explored whether poorer households are more dependent on forest income than better-off ones (Dokken & Angelsen, 2015; Garekae *et al.*, 2017). While several studies have found that poorer households have higher relative forest incomes, varying results exist for absolute forest income (Langat *et al.*, 2016). Angelsen *et al.*, (2014) reported that the amount of harvested forest products roughly increases with household wealth. Nielsen *et al.*, (2012) found that poor households harvest less forest products than better-off households, which have higher absolute forest and agricultural incomes, but rely less on forest products. In a recent review of evidence on the role of forests in poverty dynamics, Razafindratsima *et al.*, (2021) conclude that even though the dependence of the poor on forests for their livelihoods and well-being is widespread, the ability and capacities of the poor to use forest resources to lift themselves out of poverty remains limited.

Forests play critical economic, social, and cultural roles, yet they are degrading at a faster rate than other natural ecosystems (FAO, 2018). In response to the increased deforestation, payment for ecosystem services (PES) has been promoted globally as an effective strategy for promoting sustainable forest usage while simultaneously providing livelihood advantages to local populations (Shapiro-garza *et al.*, 2020). PES pays landowners in cash or kind for implementing agreed-upon sustainable land management activities for example, agroforestry, afforestation, or reforestation in degraded lands that yield beneficial ecological outputs (Wunder *et al.*, 2018). While landowners are theoretically reimbursed for conservation outputs, many PES systems compensate participants for inputs such as trees planted because assessing the outcomes of ecosystem services is frequently challenging (Nguyen *et al.*, 2015).

Over 1.6 billion people in the world depend on forests for their livelihoods, including over 350 million who live in or near thick forests and depend on those resources for both income and survival (FAO, 2015). This is especially true for women and girls, who may depend on forests for up to half of their income and means of subsistence and who, as a result, need safe access rights to these resources (World Bank, 2016). Forest resources continue to be

crucial for rural populations in developing nations in terms of services, goods, and earnings. They have shown economically disadvantaged households that they are capable of meeting their daily needs for things like energy, housing, healthcare, cash incomes, and jobs (Opperman *et al.*, 2018). Common natural forest resources like wild spinach, fuelwood, charcoal, wooden utensils, grass for food, thatching materials, medicinal plants, edible fruits, building poles, bark, roots, tubers, leaves, flowers, seeds, resins, honey, and mushrooms are all classified as non-timber forest products (NTFPs) (Leaver & Cherry, 2020).

Since time immemorial, forests and their associated products have remained essential in sustaining livelihoods, particularly for the people of forest-dependent communities, who live in abject poverty (Kabubo-Mariara, 2013). About 1.6 billion people globally are substantially reliant on forests for livelihood sustenance (World Bank, 2002). Numerous studies on forest-livelihood nexus have demonstrated the critical role of forests in livelihood sustenance and diversification and as a pathway for poverty alleviation (Mukul *et al.*, 2016). Forests are essential in provision of basic needs, cash savings and safety nets (Shackleton *et al.*, 2007). They are a source of energy, employment, medicine and other subsistence needs for the majority of local communities, especially in developing countries (Garekae, 2017).

Charcoal and firewood have the potential to offer dependable energy to millions of rural and urban homes. Furthermore, charcoal and firewood sustain millions of rural and urban livelihoods by generating revenue, facilitating financial transfers from urban to rural areas, and contributing to the entire national economy. The majority of Ethiopians use wood or charcoal as fuel, with natural forests serving as the primary source of both goods (Bekele, 2011). Understanding the livelihood strategies of the target group of charcoal and firewood producers is critical for taking cross-cutting interventions to solve complex problems and reduce rural household poverty (Walelign, 2018).

Due to rising population and corresponding increases in consumption of forest and wildlife resources, Africa ranks second globally in terms of deforestation (Amoah & Korle, 2020). In addition, additional human-caused causes are addressed, such as the transformation of forest areas into farms and communities (Osei-Wusu *et al.*, 2020). For instance, more than 70% of people in Ghana rely on forest and wildlife resources for their daily needs (Amoah & Korle, 2020). As a result, over the past ten years, Ghana's forest sector has consistently represented roughly 6% of the country's GDP. However, excessive use of these resources (both flora and fauna) is depleting them to a large extent (Amoah & Korle, 2020). Between 2000 and 2010, the nation saw a loss of 1.6 million

hectares of forest cover (Baddianaah, & Baaweh, 2021). Additionally, the majority of the country's forest degradation took place in closed forest landscapes. According to FAO (2016), the amount of closed forest decreased from 2,317,166 ha in 2000 to 1,785,802 ha in 2010, with an associated rate of forest degradation of 45,931 ha per year. This calls into question the effectiveness of the nation's laws and policies governing sustainability and the management of its natural resources.

According to Clark (2012), deforestation is not just a problem for animals; it also has an impact on people because it causes drought as the land erodes and trees do not stop water from flowing or soaking up sediment from the ground, which contaminates people's crops and lowers the quality of their food. Because more carbon is released when trees are cut down, burned, and degraded, deforestation affects the global carbon cycle. This exacerbates the issue of global warming (Clark 2012). Because of this, Jonson and Chenje (2008) assert that, on a global scale, Africa's forests need to be protected in order to regulate the climate and provide habitat for a wide variety of animals and plants. Therefore, it is crucial to protect the ecosystem. Sixty percent of the biodiversity on earth is found in forests, and they also provide twenty-five percent of the world's tropical plant-based medicines (Howden 2007). Increase in Population One of the main reasons of deforestation in Africa is population expansion. For instance, the population of South Africa is increasing virtually daily as a result of immigration, putting the nation at risk of continuing deforestation. The current paper thus investigated the influence of deforestation activities on livelihoods of inhabitants living along mount Elgon Forest, Bungoma County, Kenya.

## 3. Methodology

### 3.1 Study area

The study was conducted among the inhabitants living in Mount Elgon national reserve, Bungoma County. The County lies between latitude 00 28' and latitude 10 30' North of the Equator, and longitude 34 20' East and 35 15' East of the Greenwich Meridian. The County covers an area of 3032.4 Km<sup>2</sup>. It borders the republic of Uganda to the North west, Trans-Nzoia County to the North-East, Kakamega County to the East and South East, and Busia County to the West and South West. The forest lies approximately at coordinates 1.1615° N, 34.5405° E.

The County is within the Lake Victoria Basin, rising from 1200 metres in the west and southwest to over 4,000 metres to the North of Mt. Elgon. Apart from Mt. Elgon region, the rest of the County is underlain by granite, which forms the basement system. Mt Elgon

forest ecosystems support life systems through the hydrological cycle and plant production through the pollination process. The forested areas also provide soil nutrients through the decomposition of biomass, consequently supporting both soil and terrestrial species.

The County experiences two rainy seasons, the long-March to July and short rains-August to October. The annual rainfall in the County ranges from 400mm (lowest) to 1,800mm (highest). The annual temperature in the County varies between 0°C and 32°C due to different levels of attitude, with the highest peak of Mt. Elgon recording slightly less than 0°C. The average wind speed is 6.1 km/hr. In the last decade, the county has experienced increasing variability in rainfall and temperature patterns which have influenced changes in agricultural seasons.

Over the years, human activities have disrupted the ecosystem within mount Elgon Forest. These activities include indiscriminate logging, extraction of non-timber products, charcoal burning, construction activities including road construction and mining activities such as quarrying, sand harvesting.

### 3.2 Research Design

This study used cross-sectional research design and thus data was collected from the population at a single point in time as pointed out by Wang and Cheng (2020). Cross-sectional research design allows researchers to identify characteristics of their populations at a given time, analyze their evolution over time, and to establish some relationships between these features (Zangirolami-Raimundo, Echeimberg & Leone, 2018). In this study, the socio-demographic characteristics and anthropogenic activities that influence livelihoods were identified and in addition their relationship were established through the use of regression and Pearson Correlation Analysis. In addition, the study used mixed methodology (MM) where both quantitative and qualitative approaches of data collection and analysis were used. Mixed methods as a methodology, includes philosophical assumptions that provide directions for the collection and analysis of data from multiple sources in a single study (Dawadi, Shrestha & Giri, 2021).

### 3.3 Target Population

This study was undertaken in three sub-counties bordering mount Elgon National Reserve. These sub-counties included Cheptais, Kopsiro and Elgon. Cheptais, Kopsiro and Mount Elgon Sub-Counties have two wards each making a total of 6 wards. However, since the study was concerned with forests and livelihoods, four wards; Cheptais, Chepyuk, Kaptama and Elgon were used in the study. The two wards;

Chesikaki (Cheptais) and Kapkateny (Kopsiro) were excluded since they do not touch the forest. According to Bungoma County Integrated Development, the three sub-counties have a total population of 135,792 inhabitants with 12,842 Households. Thus, the target population for this study was 12,842 household heads, 4 ward administrators, 12 chiefs, 1 Kenya Forest service personnel and 1 NEMA official. The Target population of households.

### 3.4 Sample Size

The sample size for this study was based on Krejcie and Morgan (1970) sample size determination formula. The formula is given as:

$$n = \frac{X^2 * N * P(1 - P)}{(ME^2 * (N - 1)) + (X^2 * P * (1 - P))}$$

Where:

- n=Sample size
- X<sup>2</sup>=Chi Square for the specified confidence level at 1 degree of freedom= (3.841) from tables
- N=Population size
- P=Population proportion (.50 in the table)
- ME=Desired margin of error (expressed as a proportion=0.05)
- =3.841x12842x0.5 (1-0.5)/ 0.05x0.05 (12842-1) +3.841x0.5 (1-0.5)
- = 12331.5305/33.06275
- = 373 households

Using the formula, a total of 373 household heads were used in the study. In addition, 4 ward administrators, 12 chiefs, 1 Kenya Forest Service Personnel and 1 NEMA official participated in the study and were selected purposively to take part in the study giving a sample size of 391 respondents.

### 3.5 Sampling Procedures

The study purposely sampled four wards namely Cheptais (Cheptais Sub-County), Chepyuk (Kopsiro Sub-County), Kaptama and Elgon (Mount Elgon Sub-County). The sampling of these wards was based on the fact that they border Mount Elgon Forest Reserve and thus the inhabitants of these sub-counties depend on forest resources for their livelihoods. In order to ensure that representative samples were derived from each ward, a multi-stage-cum-stratified random sampling procedure was utilised in choosing the household heads for the research. In the study, simple random sampling strategy was used in selecting the first household in each ward followed by systematic random sampling where every 5<sup>th</sup> household was selected. The household heads present at the time of the study were issued with a questionnaire. This process guaranteed that all the

members of a particular population were accorded similar probabilities of being involved in the study population. In addition, purposive sampling was used to select 4 ward administrators, 12 chiefs, 1 Kenya Forest Service Personnel and 1 NEMA official to participate in the study.

### 3.6 Data Collection Instruments

The current study used both quantitative and qualitative forms of collecting data and thus questionnaires, interview schedules and focus group discussions were used making this research a mixed methods approach. Construct validity was determined by testing the hypothesis on the relationship between deforestation activities and livelihoods. Face validity was assessed by getting students undertaking PhD in the department of development studies to test-run the instrument to see if the questions appeared to be relevant, clear and unambiguous while content validity was ascertained by designing questionnaires, interview schedules and FGDs guides that adequately addressed the construct or area under investigation. In addition, research experts who had content in the area under investigation were consulted and their comments used to improve the questions in the questionnaire, interview schedules and FGD guide. In determining the reliability of the research instruments, the researcher pilot tested the instruments in the nearby trans-Nzoia county, which shares similar characteristics as the study area. Thereafter Cronbach Alpha Coefficient was calculated. In this study, a Cronbach Alpha of .8232 was obtained indicating that all variables in the study were reliable. For interviews, the researcher ensured that data collected did not have any minor errors and at the same time all the research themes were captured during the instrument preparation, the process of interviews/focus Group Discussions and during the analysis stage.

### 3.7 Data Analysis

The quantitative data from the questionnaire were first subjected to preliminary processing through validation, coding and tabulation in readiness for analysis with the help of the statistical package for social science (SPSS) computer package (Version 26). Frequencies, percentages, mean and Standard deviation were used to analyze quantitative data. Pearson Correlation analysis was employed to determine relationship that exists between the independent and dependent variable. Qualitative data from interview schedules and FGDs were thematically classified and arranged before they were reported in narrations and quotations as per the research objectives. In addition, the quantitative analysis was supplemented by qualitative descriptions to explore and expand on the quantitative finding in order to provide in-depth explanations of the findings and validation.

### 3.8 Ethical Considerations

The researcher observed all the rules and regulations in carrying out research in Kenya. Before undertaking fieldwork, a research permit was sought from relevant authorities including the National Council of Science, Technology and Innovations (NACOSTI), County Commissioner and the County Director of Education. Privacy, confidentiality and openness in data collection was ensured throughout the study. The major ethical issues of concern were informed consent from the participants so as to remove job insecurity, privacy and confidentiality on information supplied, anonymity to safeguard the identity of the respondents and the researcher’s sensitivity to human dignity (Suri, 2020). The researcher further sought consent from the respondents before participating in the study. In terms of trustworthiness, respondents were asked to be open and honest when answering the questions. The identity of the

respondents were not revealed in this research, and the respondents were assured that data obtained from them was purely going to be used for the academic purposes only.

### 4. Results and Discussion

The aim of this paper was to assess the influence of deforestation at mount Elgon Forest reserve area on sustainable livelihoods of the inhabitants along the reserve. To achieve this objective, the study participants were requested to indicate their level of agreement/disagreement on statements which covered the influence of deforestation on sustainable livelihoods. The participants rated their response on a five-point Likert scale questions as; on a scale of 1-5, as Strongly Disagree (SD=1) Disagree (D=2) Neutral (N=3) Agree (A=4) and Strongly Agree (SA=5). Their responses were tabulated and the results are presented in Table 1.

**Table 1: Responses on Influence of Deforestation Activities on Sustainable Livelihoods**

Statement	SD		D		N		A		SA	
	F	%	F	%	F	%	F	%	F	%
Crop cultivation has led to illegal clearing of parts of the forest in mount Elgon	73	21.1	57	16.5	9	2.6	120	34.7	87	25.1
The Forest provides charcoal and firewood for the inhabitants	38	11.0	56	16.2	6	1.7	140	40.5	106	30.6
The forest provides medicinal plants enabling the community to use alternative medicine and earn income from sales	41	11.8	38	11.0	1	.3	131	37.9	135	39.0
The community depends on the forest for timber and fencing poles	64	18.5	46	13.3	13	3.8	125	36.1	98	28.3
Indiscriminate deforestation has led to loss of soil nutrients leading low productivity affecting food security	51	14.7	43	12.4	17	4.9	131	37.9	104	30.1
Climate change as a result of deforestation has led to erratic and low rainfall affecting crop production in the area	28	8.1	39	11.3	4	1.2	140	40.5	135	39.0
Unregulated logging Has caused deforestation in mount Elgon forest	39	11.3	31	9.0	8	2.3	147	42.5	121	35.0
Honey harvesting has sometimes resulted to forest fires contributing to deforestation	21	6.1	55	15.9	22	6.4	141	40.8	107	30.9

Source: Field Data, 2022

Table 1 shows that 120 (34.7%) study participants agreed with the assertion that crop cultivation has led to illegal clearing of parts of the forest in mount Elgon, 87(25.1%) study participants strongly agreed with the assertion, 73 (21.1%) respondents strongly disagreed with the assertion and 57 (16.5%) respondents disagreed with the statement while only 9 (2.6%) respondents were neutral. The study findings suggested that 59.8% of the study participants acknowledged that crop cultivation had led to illegal clearing of parts of the forest in mount Elgon. Allowing crop cultivation could lead to clearing of forest parts to pave way for crops thus contributing to food security on one and deforestation on the other hand which has disastrous effects on the ultimate food security. According to Wondie *et al.*, (2016) deforestation has been attributed to over reliance on agriculture and related industries particularly in emerging economies. Most African nations' agriculture-based investments are converting thick forests into open forests, which are eventually converted to agricultural fields (FAO, 2016). Africa saw the biggest net loss of natural forest between 2010 and 2020, with an anticipated loss of 3.94 million hectares per year (FAO & UNEP, 2020).

Further, 140 (40.5%) study participants agreed with the statement that mount Elgon Forest provides charcoal and firewood for the inhabitants, 106 (30.6%) respondents strongly agreed with the statement, 56 (16.2%) respondents disagreed with the assertion and 38 (11.0%) study participants strongly disagreed with the assertion while 6 (1.7%) respondents were neutral. From the responses, it emerged that majority (71.1%) of the study participants reported that mount Elgon Forest provides charcoal and firewood for the inhabitants. The findings are consistent with those of Mekonnen *et al.*, (2021), Othow *et al.*, (2017), Degife *et al.*, (2018), Alemayehu (2019), and Abera *et al.*, (2020), who found that Ethiopia's natural forest cover is declining at an alarmingly rapid rate due to the production of wood fuel and charcoal, particularly in the lowlands where there are still patches of natural forest.

In addition, 135 (39.0%) respondents strongly agreed with the statement that mount Elgon forest provides medicinal plants enabling the community to use alternative medicine and earn income from sales, 131 (37.9%) study participants agreed with the statement, 41 (11.8%) study participants strongly disagreed and 38 (11.0%) respondents were in disagreement while 1 (.3%) respondent was neutral. The study found out that 76.9% of the inhabitants around mount Elgon forest reported that the forest provides medicinal plants enabling the community to use alternative medicine and earn income from sales. This implies that the community depends on the forest for herbal medicine both for human and for animals and as such it enables the inhabitants to use alternative medicine making them healthy. Medicinal plants are a significant part of non-timber products from

the forests and in the words of Wale *et al.*, (2022) in terms of services, goods, and earnings, forest resources continue to be crucial for rural populations in developing nations. Economically disadvantaged households have seen firsthand how they can afford basic needs like medicine from the forests (Dalu, *et al.*, 2021).

Similarly, 125 (36.1%) respondents agreed with the assertion that the community depends on the forest for timber and fencing poles, 98 (28.3%) study participants strongly agreed with the statement, 64 (18.5%) respondents strongly disagreed and 46 (13.3%) respondents were in disagreement with the assertion while 13(3.8%) were neutral. The responses suggested that 64.4% of the study participants acknowledged that the community depended on Mount Elgon Forest for both timber and fencing poles. The illegal harvesting of trees for both timber and fencing poles by the community members contribute to deforestation in the study area despite their contribution to livelihoods. This is consistent with the findings of Fayiah *et al.*, (2018) who noted that the majority of Sub-Saharan Africa's population relies on forest products particularly timber for subsistence uses, cash income, or both.

Moreover, 131 (37.9%) respondents agreed with the assertion that indiscriminate deforestation has led to loss of soil nutrients leading low productivity affecting food security, 104 (30.1%) respondents strongly agreed with the assertion, 51 (14.7%) study participants were strongly in disagreement with the assertion and 43 (12.4%) study participants were in disagreement while 17 (4.9%) study participants were neutral. The study findings showed that 68.0% admitted that the indiscriminate deforestation in the study area had led to loss of soil nutrients resulting to low productivity of crops which had in turn affected food security. This implies that clearing of forests could result to food insecurity due to depletion of soil fertility. This was found to be in line with the findings of Wang (2014) who reported that soil fertility is one of the most important factors in crop production since the soil contains important nutrients for crop production. Forest soils are thought to be rich in crop nutrients and boosts crop production but deforestation affects the soil quality reducing crop production.

Additionally, 140 (40.5%) study participants were in agreement with the assertion that climate change as a result of deforestation had led to erratic and low rainfall affecting crop production in the area, 135 (39.0%) respondents strongly agreed with the assertion, 39 (11.3%) study participants were in disagreement with the assertion and 28 (8.1%) study participants strongly agreed with the assertion while 4 (1.2%) study participants were neutral. From the responses, it emerged that 79.5% of the household heads reported that climate change as a result of deforestation had led to erratic and

low rainfall affecting crop production in the area. This implies that due to deforestation activities in Mount Elgon forest, there is inadequate rainfall which has affected crop production leading to food insecurity in the area. Globally, there is increased food insecurity that is caused by factors including stagnated agricultural output, the threat of climate change, the growing population, and deteriorated soil quality (Fraval *et al.*, 2019; Bjornlund *et al.*, 2020; Giller, 2020).

In addition, 147 (42.5%) study participants agreed with the assertion that unregulated logging had caused deforestation in mount Elgon forest, 121 (35.0%) study participants strongly agreed with the statement, 39 (11.3%) respondents strongly disagreed and 31 (9.0%) respondents were in disagreement while another 8 (2.3%) respondents were neutral on the assertion. The responses showed that 77.5% of the study participants believed that unregulated logging had caused deforestation at Mount Elgon Forest. This shows that illegal logging has caused forest disturbance and the main reason attributed to logging is for commercial timber sales. This supports the findings of Tritsch *et al.*, (2021) who acknowledged that uncontrolled logging can lead to forest depletion.

Furthermore, 141 (40.8%) respondents agreed with the statement that honey harvesting had sometimes resulted to forest fires contributing to deforestation, 107 (30.9%) respondents strongly agreed with the statement, 55 (15.9%) study participants disagreed and 22 (6.4%) respondents were neutral while another 21 (6.1%) study participants were strongly in agreement with the

assertion. From the responses, it can be deduced that 71.7% of the study participants acknowledged that honey harvesting had sometimes resulted to forest fires contributing to deforestation of mount Elgon Forest. This is consistent with the findings of Rotich (2019) who reported that forest fires were frequent in Cheragany forest, especially during the dry seasons from December to February. The fires emanated from use of fire during honey harvesting, wildfires, burning of grazing land to allow for pasture regeneration, and arsonists who use fire to divert attention from their illegal activities in the forest. Similar findings were also reported by Nyongesa and Vacik (2018) who reported that arson, honey collection, and charcoal production were the leading causes of fires in Gathiuru forest in Mount Kenya leading to loss of wildlife habitat and wildlife, water and air pollution, and soil erosion.

#### 4.1 Correlation between Deforestation Activities and Sustainable Households' Livelihoods

The hypothesis of this study stated that:

**H0<sub>1</sub>:** There is no significant relationship between deforestation activities and sustainable households' livelihoods of the inhabitants living in Mount Elgon Forest reserve.

The hypothesis was tested using Pearson correlation at 95% confidence level. Pearson Correlation Coefficient (simply, r) was employed to determine the potential correlation between deforestation activities and sustainable households' livelihoods. Table 2 provides the results of the analysed information.

**Table 2: The Correlation Coefficient between Deforestation Activities and Sustainable Households' Livelihoods**

		Sustainable Household Livelihoods
Deforestation activities	Pearson Correlation	.682**
	Sig. (2-tailed)	.000
	N	346

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 2 shows that there was a significant correlation between deforestation activities and sustainable households' livelihoods among the inhabitants living in the boundaries of mount Elgon forest ( $r = .682$ ;  $p = .000$ ). This means that at 95% confidence level the r value for deforestation activities was .682 showing a strong correlation with sustainable households' livelihoods. However, the r value was positive implying a positive correlation, which means that despite the negative long-term effects associated with deforestation activities, it leads to enhanced livelihoods among the inhabitants of mount Elgon forest. Thus, the null hypothesis which stated that there is no significant relationship between deforestation activities and sustainable households' livelihoods of the inhabitants living in the forest was rejected and the alternate accepted. According to

Mosnier *et al.* (2012), as domestic demand for food and natural resources rises due to economic growth and rapid population growth, forests begin to degrade. As a result, forests frequently disappear or deteriorate even when doing so is not in the long-term interests of the countries. This also suggests that the inhabitants will benefit from the deforestation activities but in the long term it will negatively affect them.

#### 4.2 Qualitative Data on effects Deforestation Activities and Sustainable Households' Livelihoods

In this study interviews and focus group discussions were held in the study area to determine the influence of



deforestation activities on sustainable livelihoods among the inhabitants living in mount Elgon forest. Interviews conducted showed that there were illegal activities which led to deforestation of mount Elgon forest. One of key informants had this to say:

Despite the strategies that have been put in place to reduce deforestation in the forest, there are still cases of illegal logging which contribute to deforestation and accompanying negative effects. The inhabitants here depend on forest for building materials, herbal medicine and fuelwood. These activities contribute significantly to deforestation and this could have long-term effects on climate variability **(Kopsiro Key Informant 1: 64 years).**

From the above sentiments it appears that deforestation activities contribute to short term benefits to the inhabitants. However, these activities will contribute to climate change which negatively has adverse effects on households' livelihoods. Thus, there is need for controlled deforestation activities to enhance livelihoods for the future generations.

Interviews also conducted with the chiefs showed that deforestation activities in the area had led to climate change related challenges which have affected crop production and food security in the study area. One of the key informants noted that:

There has been changes in rainfall patterns and intensity in mount Elgon region and this has affected crop production. Of late crop production in the area has greatly declined and has affected the food security situation, particularly here in Cheptais **(58-year-old Chief from Cheptais).**

This concurs with the findings of Aliyu et al., (2014) who noted that there has been declining forest cover in Africa due to human induced factors and poverty. This assertion had resulted to decrease in rainfall and delay in onset of wet seasons. The study also pointed out that there has been occasional strong hazardous wind in areas where deforestation had occurred, which is detrimental to building roofs and growing plants, and is gradually and likely becoming an annual factor.

## 5. Conclusion and Recommendations

### 5.1 Conclusion

The paper concluded that there was a significant correlation between deforestation activities and sustainable households' livelihoods among the inhabitants living along the boundaries of mount Elgon

forest ( $r = .682$ ;  $p = .000$ ). This means that at 95% confidence level, the  $r$  value for deforestation activities was .682 showing a strong correlation with sustainable households' livelihoods. This shows that deforestation activities affects sustainable livelihoods.

### 5.2 Recommendations

1. It was recommended that there is need for the community, the government and other agencies dealing with forest conservation to devise strategies of enhancing sustainable use of forest resources.
2. There is need for reforestation and planting of more trees in the region to improve on forest cover which could enhance precipitation in the region leading to improved food security.
3. Honey harvesting in the region should adhere to new technologies to reduce on forest fires.
4. There is need for involvement of the community members in the management of the forest to prevent illegal logging which has led to deforestation.

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