Available on: https://jnsrr.ep-journals.org/ E-ISSN: 3051-3766 P-ISSN: 3051-3758

Journal of Natural Science Research and Review

Volume: 02 Issue: 03 March-2026

# Socio-Economic Activities and Natural Resource Degradation in Lowangishu Hills, Burat Ward, Isiolo County

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**Published Date: March 19, 2026** **Article DOI: 10.65150/EP-jnsrr/V2E3/2026-02**

**ABSTRACT:** This study aimed at examining the impacts of socio-economic activities on the degradation of natural resources in the Lowangishu Hills, Burat Ward, Isiola County, with reference to sand harvesting, charcoal production, firewood collection and over grazing. The descriptive cross-sectional survey method was used in the research conducted in the Lotiki, Alamach, and Aremiet villages with 198 households' population, where 131 households were sampled to complete the questionnaires surveys. The quantitative data were analyzed with the help of SPSS software that led to percentage and frequency displays. In the findings, it is seen that social factors such as age, sex and education levels have no significant effect on degradation of natural resources. Rather, anthropogenic activities, such as overstocking, vegetation cover, soil erosion, and shrinking water resources are the major causes. The production of charcoal and collection of firewood became the main sources of income that led to the destruction of forests and loss of biodiversity and the harvesting of sands worsened soil erosion and riverbanks. The environmental changes were well exhibited by the members of the community despite the degradation. The study concludes that socio-economic activities have negative impact on natural resources in Lowangishu Hills and proposes the following solutions which include sustainable land use, managing resource use and involvement of community. It also recommends integrating community resources management with livelihood diversification in order to reduce environmental pressure.

**KEYWORDS:** Socio-Economic Activities, Natural Resource Degradation, Biodiversity, Rangelands Management, Lowangishu Hills, Isiolo County.

## 1. INTRODUCTION

### Background of the Study

Despite poverty and low income globally, natural resources are still a source of livelihood in almost all the ASALs regions. Grazing, watering, harvesting timber and non-timber forest products are all done on ecosystem services meant to sustain these livelihoods. The deterioration of the natural resources happens with population pressure, unsustainable use of resources and poor governance systems (FAO, 2023). In Africa, pressure has become unprecedented with urbanizations expansion, increased market demand, leading to soil erosion, loss of vegetation cover, biodiversity, and productivity. Such changes create a scenario where conservation of ecology is pitched against the sustenance of livelihoods that essentially depend on natural capital. In some of the most affected ASAL counties of Kenya like Isiolo, over 80% of the households are said to depend on natural resources for their income and livelihood (Wandera, Macharia & Ngare, 2024). Charcoal production, sand harvesting, uncontrolled grazing and increased settlement are all perceived as threats to the already fragile ecosystem of Isiolo County. The activities, although providing limited means of livelihood and subsistence income to the local community, are further exacerbated by urban market demands for fuelwood, livestock products and construction materials (Guild & Shackleton, 2018).

The hills provide pasture, water and fuelwood but are increasingly stressed by overgrazing, unsustainable sand harvesting and charcoal production that has led to deforestation. The social-demographic profile includes high unemployment rates, low education levels, population increase and a cultural perspective that sees cattle as both a social and economic resource; these factors influence human activities in this ecosystem. In terms of short-term subsistence or microbusiness opportunities that a household might prosper upon, these activities undermine the ecological resilience of these hills to support any livelihood.

This study examined socio-economic theories that provide a contextual explanation for the degradation of natural resources through three theoretical lenses. Tragedy of the Commons considers ways in which rational individuals acting in pursuit of their self-interest; toward short-term

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overgrazing, deforestation and heavy resource extraction to their long-term disadvantage and often also the disadvantage of the commons (Druzin, 2016). Political Ecology Theory further explains how the environmental degradation comes about through governance, power relations and property rights and thus offers insight into how inadequate policies and enforcement mechanisms tend to push the vulnerable and marginalized into unsustainable practices (Svarstad, Benjaminsen & Overå, 2018). According to Malthusian Population Theory, changes in population dynamics directly affect resource pressures, which directly increase soil erosion, deforestation and biodiversity loss in ecosystems (Maja, & Ayano, 2021). All the above assume the socio-economic context of environmental degradation and thus strengthen the case for the need for sustainable interventions.

**Statement of the Problem**

Around Lowangishu Hills, population growth continues increasing thus forcing communities to depend on unsustainable socio-economic activities like charcoal production, overgrazing and sand harvesting for survival. Thus, these fragile ecosystems have been put under increased pressure. The hills, therefore appear to have declining vegetation cover and soil fertility, as evidenced by the development of gullies and increasing bare ground as water sources diminished, thus threatening environmental sustainability and community livelihoods.

In this study area, conservation projects have continued being less effective, primarily on account of a lack of understanding of the relationship between direct-local socio-economic activities and the resource depletion phenomenon. Certainly, little empirical evidence exists on how specific economic and social practices exert pressure on the environment and hasten resource depletion while community members substantially depend on the hills for grazing, charcoal production, firewood, and other daily subsistence needs. Conflicts resulted from access to water and pastures in resource-sharing disputes, is captured in about all existing research literatures related to Isiolo County and other arid regions of Kenya. However, none of the studies has indicated the severe ecological impacts of such socio-economic activities in fragile ecosystems like Lowangishu.

**Objective**

This study aimed at examining the influence of socio-economic activities on natural resource degradation in Lowangishu Hills, Burat Ward, Isiolo County. The study achieved these by investigating the impacts of sand harvesting, charcoal production, firewood collection and overgrazing on the natural environment. It also assessed the perception of the community members concerning these changes on the natural environment and their influence on daily life.

**Review of Literature**

This study was grounded in the following theoretical framework Malthusian Theory of Population Growth, the Tragedy of the Commons Theory and Political Ecology Theory in relating to the ability of local communities to maintain natural resources, the degradation of natural resources and livelihoods.

Unsustainable sand harvesting in riverine ecosystems causes negative on-site and off-site impacts, including the change in the river channels, river bank desiccation and disorganization of the terrestrial and aquatic food chains. The outcome of this activity is diminishing of water resources, degradation of aquifers and degradation of aquatic life which adversely affects the consumption water quality (Shinhu, 2024). Also, sand harvesting contributes to road erosion and infrastructure depletion by draining all groundwater and drying wells particularly in the rural regions. Sand harvesting is also a profitable enterprise although with these environmental impacts, it has not ceased at Isiola County and the entire region of Kenya (Wako, 2022). This is an unregulated and informal practice, which puts more emphasis on the short-term economic benefits of the middle men and communities, but at the end it becomes detrimental to the environment and weakens sustainable water supply. In this way it brings out the irony of having a potentially feasible natural resource project which results in degradation of the ecological environment which is the opposite of its initial ambition of providing survival.

The ecological effects of the production of charcoal are vast, such as deforestation, greenhouse gas emissions, land degradation, and ecosystem modifications (Kumar & Saikia, 2022). It is socially, economically, and culturally determined, making the management efforts difficult (Iiyama, Neufeldt, Njenga, Derero,Ndegwa, Mukuralinda, and Mowo, 2017). When forests are poorly governed, the practice becomes unsustainable, and biodiversity is at risk of extinction, as well as there is a chance of poaching (Barchok & Mwangi, 2024). The use of charcoal also leads to 15% of global greenhouse emissions, which increases the level of carbon dioxide emissions caused by humans (Pingault, Licona Manzur, Meybeck, Baral, Bernoux & Thomas, 2024). Deforestation affects the cycle of water, making the climate drier and more vulnerable to drought (Kirui, Jensen, Obare, Kariuki, Chelanga & Ikegami, 2022). Although charcoal has become a crucial cash product among rural and small-scale charcoal vendors, the informal trade does not favor the environmental protection as it has been shown to endanger the ecosystem health and the pastoralism in the area through short term profitability.

The use of firewood also causes gross impoverishment of natural resources especially in rural and desert regions where people mostly use it as a major source of energy. Persistent logging of forest, and poor forest regeneration, contributes to the destruction of forests, biodiversity, and deterioration of ecosystems (Kumar and Saikia, 2022). The practice contributes to other environmental problems that are reduced land productivity and soil erosion (FAO, 2010). Moreover, population increase, rural poverty, and urban energy needs are also some of the other factors that have turned to commodity the practice of woodcutting, which is contributing to unsustainable harvesting activities (Chidumayo and Gumbo, 2013).

Food production, income and employment are upheld by the livestock-rearing industry worldwide, especially in rural mountainous regions. Nonetheless, there are unsustainable actions, including intensive grazing, which cause depletion of the resources, which are harmful to the economy and environment. Overgrazing causes diminished biodiversity, soil compaction, and vegetation degradation, which are problematic to the environment with a strong impact on water interception, soil fertility, and stability of the ecosystem (Kaaria, 2024). Moreover, grazing animals exert pressure on the soil, which leads to water and wind erosion, particularly in hilly slopes with small vegetation cover. Research suggests that the overgrazing soils become more susceptible to erosion, resulting in reduced soil fertility and productivity, and the wetting and drying processes associated with overgrazing along with trampling increase the compaction of the soils, which causes droughts and desertification in the arid areas (Mganga, 2022).

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## 2. RESEARCH METHODS

### Research Design

This study employed a descriptive cross-sectional research approach. The use of a cross-sectional research design is predicated on its temporal limitations, obviating the necessity for time series analysis of identical phenomena (Hunziker, *et al*, 2024). Also descriptive approach was selected because the objective of the study was not to determine causal relationships or evaluate hypotheses, as would be typical in experimental or analytical designs, but to systematically outline the current condition of natural resource degradation and its effects on the ecosystem.

### Target Population and Sampling Techniques

According to the 2019 Population and Housing Census, the population of the Burat Ward is 15,609 people including 8,088 men and 7,521 women, and Study area contains approximately 198 households (KNBS, 2019). The research targeted villages close to the Lowangishu Hills like Lotiki, Alamach and Aremiet where people are involved in charcoal burning, sand harvesting, and rearing of livestock. The selection of respondents by quota sampling was ensured to evaluate how socio-economic activities affect the degradation of resources in the region to reduce the bias of the under-representation and guarantee that the population is represented (Sharma, 2017).

The researcher used Cochran formula of determining the sample size, and the adjusted sample size was about 131 households in a population of 198 in three villages, Aremiet, Lotiki, and Alamach. A quota sampling technique was used in the selection of the households whereby the number of households within a village was used as a division to the total households thus appropriate representation.

### Data Collection Instruments and Methods

Questionnaires were used in this research to determine socio-economic activities, which influence natural resources and subsistence. It was directed at the members of households aged 18 and above and included both open-ended and closed-ended questions. The questionnaire consisted of five parts that comprised basic household data, livestock grazing and overstocking, charcoal production and firewood collection, sand harvesting and local community attitudes towards environmental changes. The residents were supported by trained enumerators to fill the questionnaires especially those with non-formal education since they have the responsibility of farming and livestock.

Prior to data collection, a pilot was carried out in the study involving 13 households in the Asunyen village in Ngaremara ward which was closely related in demography, socio-economically and ecologically to the residents in the Lowangishu Hills in Burat ward. The evaluation was based on the capacity of the questionnaire to collect data concerning the demographic characteristic, livelihood practices and the attitudes towards resource degradation. The pilot outcomes were clear and understandable of all items, and a reliability analysis indicated that the Cronbachs Alpha values of major constructs were greater than 0.70. The results shown internal consistency in the measuring scales and only slight modifications were made to facilitate smooth flow in the items and minimize ambiguity.

### Data Analysis

Household interview data were organized and processed systematically with Microsoft Excel to perform the sorting and cleaning process followed with the export to SPSS in order to perform further analysis of the data statistically. The socio-economic factors and perceptions of anthropogenic processes, such as charcoal burning and sand harvesting, were summarized using descriptive statistics (means, frequencies, standard deviations, percentages), and showed the tendencies of natural resources degradation in Lowangishu Hills. The analysis of the predictors using inferential statistics involved Multiple Regression Model (MRM) where the predictors were grazing, sand harvesting, charcoal production, and firewood cutting against the degradation predictors such as soil erosion. The predictive strength and significance of these activities were evaluated using regression coefficients, R-squared values, p-values and confidence intervals and the results were presented in tables to make them clear.

### Ethical Considerations

The researcher sought the consent of the household prior to the beginning of the interview. The key information about the study purposes was clearly presented to the random participants of the research. The participants of the study did so as they were free to participate in the study and give informed consent. The true identities of the subjects were not displayed during the study as in the questionnaire there was no place where one could indicate who was being interviewed; no personal information was required. The study participants had a good understanding that the data, which was gathered, was confidential and would be stored intentionally to be used in academics and no other party would have been able to access the data. In addition, to support it, the researcher had to seek a research permit in NACOSTI prior to conducting the study.

## 3. RESULTS

### Response Rate

This was conducted by the administration of 131 questionnaires in different villages to be filled by trained enumerators with the face-to-face interviews. Each village had a predefined sample size with which the enumerators would interview, until the sampling size was achieved. Visits to households were done in follow-up visits since some households were not reachable during the initial visit. All the questionnaires were received as they were completed and a response rate of 100 percent was obtained. The response rate analysis for the study is as shown in the Table 4.1.

**Table 4.1: Response Rate**

| | | % |
|---|---|---|
| Response | 131 | 100% |
| Non-Response | 0 | 0% |
| **Total** | **131** | **100%** |

### Reliability Analysis

Reliability test was run using Cronbach's Alpha which measures the internal consistency by showing if certain items within a scale measure the same construct. The Alpha value threshold at is known to be 0.7. Reliability analysis for the study are as shown in Table 4.2.

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**Table 4.2: Reliability Analysis**

| | Alpha value | Comments |
|---|---|---|
| Livestock grazing Activities | 0.898 | Reliable |
| Charcoal production and Firewood Collection | 0.913 | Reliable |
| Sand Harvesting | 0.812 | Reliable |
| Community Perceptions and Recommendations | 0.924 | Reliable |

In this study, the Cronbach Alpha was established for every objective which formed a scale. The result as indicated in Table 4.2 shows that all the four variables were reliable as their reliability values were above the recommended alpha value of 0.7. This therefore tells that the research document was reliable and needed no changes or amendment.

**Demographic Information**

In this section respondents provided their background information including gender, age bracket, education background, Occupation, Household size and the years he or she has lived in that particular area. This general information was analyzed as presented in form of tables.

**Gender of the Respondent**

**Table 4.3: Respondents Gender**

| | Frequency | Percent |
|---|---|---|
| Male | 58 | 44.3 |
| Female | 73 | 55.7 |
| **Total** | **131** | **100** |

As shown in Table 4.3, findings revealed that majority of the respondents were females covering 55.7% of the total respondents while 44.3% were males. This shows that the researcher was not gender biased in data collection since all genders were considered during the household interviews. This implies that most of the socio-economic activities which are harmful to the natural resources in pastoral set ups are conducted by women. For example, in the study area charcoal burning and firewood collections activities were stated to be highly done by women.

**Age of the Respondent**

**Table 4.4: Age of the Respondent**

| | Frequency | Percent |
|---|---|---|
| 18-30 years | 60 | 45.8 |
| 31-45 years | 53 | 40.5 |
| 46-60 years | 11 | 8.4 |
| Above 60 years | 7 | 5.3 |
| **Total** | **131** | **100** |

Table 4.4 shows that 45.8% of the respondents are between the ages 18-30, 40.5% between the ages 31-45, 8.4% between the ages 46-60 and 5.3% above the ages 60. It means that it is a young and middle-aged population (so more than 86 percent of respondents), which are guided by socio-economic activities like livestock grazing and charcoal burning due to these socio-economically active populations. The large number of younger and middle-aged people points towards the prevalence of the extraction of natural resources and subsequent strain on the local resources, as the younger and middle-aged may be engaged in activities that could damage the environment. The reduced ageing factor points to a changing labour pattern whereby the younger people have more roles to play in their livelihood.

**Education Background**

**Table 4.5: Education Background**

| | Frequency | Percent |
|---|---|---|
| No formal Education | 76 | 58.0 |
| Primary | 46 | 35.1 |
| Secondary | 8 | 6.1 |
| Tertiary | 1 | 0.8 |
| **Total** | **131** | **100** |

The results show that the percentage of those who have no form of education is 58 and the proportion of those who have primary, secondary, and tertiary education is 35.1, 6.1 and 0.8 respectively. This implies that there is a low literacy population that restricts job prospects and enhances the

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dependence of such people on the natural resources, which can result in ecological degradation. The low education level is structural factor of vulnerability in livelihood and natural resource management because communication and literacy barriers prevent people to be involved in conservation programs and understand sustainable practices.

**Household size**

**Table 4.6: Household Size**

| | Frequency | Percent |
|---|---|---|
| 1 to 2 members | 3 | 2.3% |
| 3 to 4 members | 31 | 23.7% |
| 5 to 6 members | 47 | 35.9% |
| 7 to 8 members | 37 | 28.2% |
| More than 8 members | 13 | 9.9% |
| **Total** | **131** | **100** |

The majority of households in the study region are of medium to large sizes with 5-6 (35.9%) and 7-8 (28.2) being the main ones. Only 2.3% is comprised of smaller households with 1-2 members. It is based on pastoral and agro-pastoral systems of the past, in which bigger households are important in agriculture and gathering of resources. But, the high population growth, as proposed by the Malthusian theory, implies that bigger families can contribute to accelerate environmental degradation in the Lowangishu hills as a result of an increased resource extraction meaning that household dynamics is very important in degrading the ecosystem.

**Occupation**

**Table 4.7: Occupation**

| | Frequency | Percent |
|---|---|---|
| Boda boda operator | 8 | 6.1% |
| Business/Trader | 23 | 17.6% |
| Farmer | 1 | 0.8% |
| Herder | 7 | 5.3% |
| Charcoal Burning | 92 | 70.2% |
| **Total** | **131** | **100** |

The survey data indicated that Charcoal burning was the main pre-occupation of 70.2 percent of the respondents with the second highest being business/trading (17.6%), boda boda operators (6.1) and herding (5.3) with the remaining 0.8 percent or respondents being farmers. This means that there is a high reliance on the burning of charcoal to sustain livelihoods which negatively impacts on the local woodlands and leads to deforestation and erosion of the ecosystem in the Lowangishu Hills. The low agricultural activity is an indication that there was less dependence on agricultural practices with the socio-economic stability in the community being greatly dependent on degrading actions. This is in line with other pastoral and agro-pastoral areas in northern Kenya where livelihoods based on forests have been related to destruction of the environment.

**Living Duration**

**Table 4.8: Living Duration**

| | Frequency | Percent |
|---|---|---|
| 1 to 5 years | 4 | 3.1% |
| 6 to 10 years | 12 | 9.2% |
| 11 to 20 years | 30 | 22.9% |
| More than 20 years | 85 | 64.9% |
| **Total** | **131** | **100** |

The study revealed that respondents staying in the area of study more than 20 years were 64.9, 11-20 years was 22.9 and 1-5 years was 3.1 and 6-10 years respectively. The long-term residents have an in-depth understanding of natural resources in the area and have practiced some socio-economic activities including grazing and charcoal production, which affect the ecosystem. Conversely, short-term settlers though not numerous also have an impact on the degradation of the resources. This highlights the need of utilizing local information of long-term residents in the management of natural resources to make the environment to be sustainable in the Lowangishu Hills.

**Descriptive Analysis of Study Variables**

This section summarized findings on Livestock grazing, Charcoal production/Firewood Collection and Sand Harvesting and how these activities

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influence the degradation of the natural environment within the study area.

**Livestock grazing**

The respondents were asked to indicate on how much they agreed with below statement on the influence of grazing activities on degradation of natural resources. Their responses are presented in Table 4.9.

**Table 4.9: Livestock grazing and its influence on degradation of the natural resources**

| Statements | Mean | Std. Dev. |
|---|---|---|
| Livestock in this area often exceed the available pasture carrying capacity | 4.11 | 0.905 |
| Vegetation cover in Lowangishu Hills has reduced due to overgrazing | 4.11 | 0.905 |
| Overgrazing has led to visible soil erosion in Lowangishu Hills | 4.09 | 0.924 |
| Livestock grazing activities have contributed to the degradation of water sources (springs, wells) | 4.15 | 0.872 |

It has been found that livestock grazing in Lowangishu hills is the main cause of natural resource degradation. There is a high degree of agreement with the responders to the effect of overstocking that the vegetation cover is reduced (mean = 4.11), soils are eroded (mean = 4.09) and the water sources are diminished (mean = 4.15). The trend indicates the pressure of communal grazing systems, which are similar to Tragedy of the Commons Theory in which individual self-interest leads to overuse and depletion of resources. The extensive livestock population in pastoral households because of economic and subsistence purposes increases the desertification of pastures, loss of vegetation, soil erosion and reduced quality and quantity of water. The view of the majority of the respondents attests that due to overgrazing, community livelihoods are in danger, as it is a systemic problem affecting the environment.

**Charcoal Production and Firewood Collection**

Respondents were requested to indicate the impact of charcoal production and firewood collection activities to the vegetation, forest cover and biodiversity. Their responses are as presented in Table 4.10

**Table 4.10: Charcoal Production and Firewood collection activities' influence on natural resources degradation.**

| Statements | Mean | Std. Dev. |
|---|---|---|
| Charcoal production has reduced vegetation and forest cover in this area. | 4.47 | 0.501 |
| Firewood collection negatively affects local biodiversity. | 4.29 | 0.696 |
| Firewood scarcity has contributed to destruction of remaining forest cover. | 4.45 | 0.529 |
| Poor regulation of charcoal production has accelerated forest degradation in this area | 4.47 | 0.501 |

The study shows that charcoal production and firewood collection are important practices that cause encroachment on the resources in the Lowangishu Hills. According to the respondents, the practices have significantly led to a decrease in vegetation cover (mean = 4.47), damage of the biodiversity (mean = 4.29) and lack of forests (mean = 4.45). Vivid agreement is reached regarding the harshness of these adverse effects due to lack of proper control over the charcoal production by the local governments (mean = 4.47). The results are consistent with Political Ecology Theory and indicate that environmental degradation is the result of the power relations, access to resources, and failures in the institutions. The outcomes highlight the socio-economic dependence of the local communities on the forest resources and the structural inequalities in the access and use of the same.

**Sand Harvesting**

Respondents were requested to indicate their perception regarding sand harvesting and its environmental effects. Their responses are as shown in Table 4.11.

**Table 4.11: Influence of Sand Harvesting Activity on Natural Resource Degradation.**

| Statement | Mean | Std. Dev. |
|---|---|---|
| Sand harvesting is a common activity in this area. | 4.56 | 0.499 |
| Formation of deep gullies is linked to sand harvesting. | 3.96 | 0.783 |
| Water levels and water retention in rivers have declined due to sand harvesting | 4.31 | 0.465 |
| Unregulated sand harvesting has resulted in loss of vegetation cover and degradation of river ecosystems in this area. | 4.56 | 0.499 |
| Current sand harvesting practices are unsustainable. | 4.56 | 0.499 |

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Results show that sand harvesting is a major degradation of natural resources in Lowangishu Hills and respondents pointed that it is very common (mean=4.56) and not well controlled which leads to loss of vegetation and degradation of river ecosystems. The majority of them linked it to soil erosion and deep gulches (mean=3.96), minimized water level and storage (mean=4.31). The outcomes highlight the environmental impacts of uncontrolled mining, which is indicative of dependence on sand because of poor governance. According to the political ecology theory, it is because of power imbalance and institutional inefficiency that compel the communities to exhaust sand resources in an unsustainable way during the time of poor policies. In general, it can be agreed that the existing practices cannot be considered sustainable and there is an observation of the interaction between the human livelihoods and access to resources as well as the risks of environmental degradation, which seems to be caused both by human activities and the socio-political conditions of the resource exploitation.

**Community perception and recommendations**

The respondents shared their opinions about the environmental changes and possible solutions as shown in Table 4.12.

**Table 4.12: Community Perception on Environmental Changes and Possible Solutions**

| | Strongly Disagree f (%) | Disagree f (%) | Neutral f (%) | Agree f (%) | Strongly Agree f (%) | Total |
|---|---|---|---|---|---|---|
| The environmental condition of Lowangishu Hills is worse compared to 10 years ago. | 0 (0%) | 0 (0%) | 0 (0%) | 64 (48.9%) | 67(51.1%) | 131 (100%) |
| Access to good pasture has significantly decreased over the last 10 years. | 0 (0%) | 0 (0%) | 0 (0%) | 66 (50.4%) | 65(49.6%) | 131 (100%) |
| Livestock health and productivity have declined due to environmental deterioration. | 0(0%) | 0(0%) | 0 (0%) | 70 (53.4%) | 61(46.6%) | 131 (100%) |
| Socio-economic activities are the main drivers of natural resource degradation. | 0(0%) | 0(0%) | 0(0%) | 54 (41.2%) | 77(58.8%) | 131 (100%) |
| Community involvement is essential for environmental conservation. | 0(0%) | 0(0%) | 0(0%) | 68 (51.9%) | 63(48.1%) | 131 (100%) |
| Alternative livelihood options can reduce pressure on natural resources. | 0(0%) | 0(0%) | 0(0%) | 64 (48.9%) | 67(51.1%) | 131 (100%) |

The results indicate that Lowangishu Hills community is highly environmentally aware and clearly understands that the environmental conditions deteriorated along with the last decade. The majority of members, associate this degradation with the negative impact on the livestock health and productivity, and the following activities are recognized as the primary contributors: grazing, charcoal burning, firewood collection, and sand harvesting. The community encourages conservation efforts and alternative livelihoods to ease pressure on the resources meaning they are aware of the problems surrounding the environment and are committed to sustainable lifestyles, which may lead to proper management of community resources.

**Regression Analysis**

This research has used multiple regression analysis to test the effect of the independent variables based on the statistical package of social science (SPSS). Measurement inputting, coding and calculation were carried out, and the model summary was provided in Table 4.13.

**Table 4.13: Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.890 | 0.792 | 0.784 | 0.12355 |

As it is shown in the model summary table, natural resource degradation in Lowangishu Hills is strongly predicted by sand harvesting, charcoal production and livestock grazing with R = 0.890 as the correlation value. According to R Square, this relationship accounts 79.2 percent of the variance in degradation. Adjusted R square 0.784 indicates a steady contribution to the negative changes in the environment, whereas a low standard error of the estimate (0.123555) indicates a high predictive value.

In this study, the researcher evaluated the relevance of the model in terms of ANOVA method, the results of which are described in Table 4.14.

**Table 4.14: Analysis of Variance (ANOVA)**

| Model | | Sum of Squares | Df | Mean Square | F | Sign. |
|---|---|---|---|---|---|---|
| 1 | Regression | 7.261 | 5 | 1.452 | 95.140 | <0.001 |
| | Residual | 1.908 | 125 | 0.015 | | |
| | **Total** | **9.169** | **130** | | | |

The analysis of the ANOVA shows that the regression model applied in the given research is statistically significant in predicting the resource

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degradation in the Lowangishu Hills with F-value of 95.140 and p = 0.001. Predictable activities that lead to environmental degradation are socio-economic activities such as sand harvesting, production of charcoal, and grazing of livestock. The regression sum of squares (7.261) is significantly higher than the sum of squares in the residues (1.908) which proves that these activities contributed to most of the variation in the degradation of natural resources, which supports the aim of the study to determine the impact of their activities on the environmental conditions.
A coefficient table was used to obtain the model of the study and the results were found in Table 4.15.

**Table 4.15: Regression Coefficients**

| | Un standardized Coefficients | | Standardized Coefficients | t | Sig |
|---|---|---|---|---|---|
| | **B** | **Std. Error** | **Beta** | | |
| (Constant) | 0.828 | 0.185 | | 4.464 | < 0.001 |
| Demographic Information | 0.003 | 0.030 | 0.005 | 0.114 | 0.910 |
| Livestock Grazing | 0.156 | 0.012 | 0.532 | 12.965 | < 0.001 |
| Charcoal Production and Firewood collection | 0.175 | 0.022 | 0.331 | 7.844 | < 0.001 |
| Sand Harvesting | 0.147 | 0.022 | 0.276 | 6.680 | < 0.001 |
| Community Perception regarding the environmental degradation | 0.312 | 026 | 0.503 | 12.063 | < 0.001 |

The regression equation of the degradation of natural resources in Lowangishu Hills has been expressed as **Y = 0.828+0.003X1 + 0.156X2 +0.175X3 + 0.147X4+ 0.312X5**. In this case, Y is the degradation outcome with the intercept (0.828) and the coefficients of the predictors, which include X 1 (Demographics), X 2 (Livestock Grazing), X 3 (Charcoal Production and Firewood Collection), X 4 (Sand Harvesting), and X 5 (Community Perception). The findings reveal that the demographic factors (X 1) do not significantly affect (B = 0.003) but socio-economic activities (X 2 to X 5 ) are very important in the degradation. The impact of livestock grazing (B = 0.156), charcoal production and firewood harvest (B = 0.175), sand harvesting (B = 0.147), and the perception of the community (B = 0.312) on the vegetation and the deterioration of the environment is significant and needs to be mentioned as the main causes of natural resource deterioration in the region.

## 4. DISCUSSION

This study aimed at establishing the influence of socio-economic activities on the degradation of natural resources in Lowangishu Hills, Burat Ward, Isiolo County. The study showed a 100% response rate indicating a very good participation and reliability of the collected data. Reliability analysis confirmed that all research instruments had a Cronbach's Alpha value of more than 0.8, which indicates a very high internal consistency and the validity of the instrument in the study.
The demographic characteristics show that most respondents were women (55.7%), implying that activities such as charcoal burning and firewood collection which directly touch on the environmental issues are functions largely undertaken by women. Most respondents fall within the age range of 18 and 45 years (86.3%), which revealed the influence of the socio-economic activities causing environment impact as coming from the youthful group who are economically active portion of the population. However, a big proportion (58%) had no formal education indicating that awareness of sustainable natural resource management practices is limited. Most households were generally large, having between 5 to 8 members, which can heighten the cumulative pressure on local natural resources through domestic consumption needs; this finding support the Malthusian Theory of population growth which argues that as the population grows at sharp slopes, humans exhaust natural resources thus causing soil erosion and decreasing biodiversity. Besides, many respondents (64.9%) have lived in the area for over 20 years, thus showing adequate information on environmental changes and long-term effects of human activities.
The research has indicated that the socio-economic practices such as livestock grazing, overstocking, charcoal production, and firewood collection are significant sources of natural resources degradation in Lowangishu Hills. Respondents observed that the livestock surpass the carrying capacity causing diminished vegetation, soil erosion and degradation of water sources. Excessive inventory strains the rangeland ecosystem, which impacts on the quality of the environment. Charcoal making and fire wood gathering are also regarded as the important causes of loss in forest cover and rising shortage of fuel wood with charcoal being less controlled. These results are consistent with those of Guild and Shackleton (2018), which point to the dual effect of local demands of livelihood and external market demand on the overuse of resources. Also, the research demonstrates the Tragedy of the Commons theory explaining how the common resources in the Lowangishu Hills fall victim to overuse owing to selfish tendencies without any form of control.
According to the study area, sand harvesting is a destructive and uncontrolled activity with the high mean agreement score of 4.56 of the respondents. It leads to the decreasing level of river water, degradation of land, and gullies, disorganizing the soil structure and promoting the process of watershed degradation. Along with Shinhu (2024), the research concludes that unsustainable sand mining has great environmental consequences, such as the change in river structure, depletion of groundwater, and biodiversity destruction. The negative impact is seen in the quality of the water and its availability to the communities and it is further worsened by the bad governance and a lack of proper controls and regulations, which just shows the difficulty in the riverine ecosystem control.
The results show that there is a common worry among the respondents on the declining environmental conditions in Lowangishu Hills in the last 10 years, mostly due to the escalation of socio-economic activities such as livestock grazing and charcoal production. These activities have increased stress to the natural resources and have resulted in natural environmental degradation and low rangeland productivity that threatens

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pastoral livelihoods. Although these were the concerns, the respondents were optimistic about the community involvement in the conservation programs and use of alternative livelihood strategies as a possible solution to these problems. Other studies by Jani, Webb & de Wit, (2024), of the same nature have been done to drive the positive effects of community-based conservation programs on the local attitude toward sustainable resource management. The effectiveness of such programs, as observed in the CAMPFIRE programs of Zimbabwe, indicates the effectiveness of empowering communities to take part in conservation, meaning that increasing such programs would help in reducing the rate of environmental degradation in the area.

Regression analysis further proved that socio-economic activities such as livestock grazing, charcoal production and firewood collection and sand harvesting were significant predictors toward natural resource degradation. This model accounted for approximately 79.2% of variation in the levels of degradation due to a strong influence of human activity upon the environment. However, demographic characteristics had no significant effect statistically. Coefficient results showed that the drivers of degradation in the area are charcoal production, firewood collection and grazing livestock.

## 5. CONCLUSION

The study concluded that socio-economic activities such as livestock grazing, charcoal burning, firewood collection and sand harvesting are primarily linked with degradation of natural resources in Lowangishu Hills. It had been found that overgrazing was one of the most important causes of the decline in vegetation, soil erosion and degradation of water resources which argue for the Tragedy of the Commons Theory that says common resources are always subject to high vulnerability in the absence of coercive regulation (Mganga, 2022). The regression model shows that livestock grazing alone accounts for a considerable portion of environmental degradation, hence justifying this class as a primary driving force within the pastoral ecosystem of the regions.

Charcoal burning and firewood collecting were proven to have a detrimental effect on the forest cover, biodiversity, and density of vegetation due to ineffective local governance and laws. The same resonates with results from other pastoral and agro-pastoral areas in northern Kenya, where forest-based livelihoods in the area have been linked to land degradation and deforestation (Mwangi & Kariuki, 2015; Siko, 2021)). Unregulated sand harvesting was mentioned among the top activities that aggravate soil erosion and gulley formation and reduce water retention in the rivers, hence proving the institutional impotence in resource management as discussed in Political Ecology Theory (Siko, 2021).

The demographic characteristics indicate about 85% of the people being economically active, having low levels of formal education, having large household sizes and having spent long periods of residence within the area. Such sociological structures could worsen the reliance of the area on natural resources, thus restricting the possibility of adoption of alternatives for sufficient livelihoods and sustainable land-use practices within the region. Such patterns hold true within semi-arid studies, supporting that household vulnerability to environmental degradation is determined by low levels of education and dependence on external sources to manage their livelihoods (Wamalwa, 2020).

The survey on perceptions of the community revealed that there is a very high environmental perception among the community members which linked livestock productivity decline with loss of pasture and ecosystem degradation. The community also demonstrated much agreement toward conservation and alternative livelihoods, showing willingness toward participatory management approach. This builds further in justifying the use of local ecological knowledge to enhance the development of sustainable interventions, as demonstrated by community-based natural resource management studies in northern Kenya (Robinson, Nganga, Ontiri & Moiko, 2021).

Such activities therefore yield to the conclusion that socio-economic activities within the Lowangishu Hills statistically highly significantly influence resource degradation; nearly 79% holds well as environmentally observed degradation, which requires intervention through regulating the extractive activities themselves and educational programs about sustainable land-use practices and alternative livelihoods, and a little form of community-based conservation, thus bringing in additional evidence to reinforce the case that indeed, this view that degradation of common-property resources is seen as an issue related to human livelihoods and structural governance cuts across all ASALs, Kenya included, making a call for integrated socio-ecological interventions.

## 6. RECOMMENDATIONS

The study identifies grazing and overgrazing as the key factors degrading the natural resources in lowagishu hills. Communal grazing methods have caused indiscriminate degradation of the vegetation cover, soil erosion and degradation of water sources. The study therefore recommends that, local authorities and the community leaders should provide input in establishing and implementing rotational grazing as a forward step to mitigate these challenges. Dry season fodder enhancement programs on the other hand should be enhanced as a way to reduce dependence on rangelands and thereby reduce the environmental pressure. The study also recommends that Community awareness efforts should enhanced and focus on sustainable grazing practice, which merges traditional knowledge with modern rangeland management for equilibrium with ecology and pastoral livelihood.

Charcoal burning and firewood collection were thus seen to be the major cause of the loss of vegetation cover, biodiversity loss and massive deforestation. The Local Authorities have further been sighted as being weak in the regulation of such practices. So, the study recommends an urgent call for strengthening the monitoring regulations of charcoal burning and firewood collection. Such strengthening should promote solar cookers, improved/end-user cook stoves and biogas digesters as fuelwood alternatives. Women, the key stakeholders/actors in these activities, should be trained in sustainable methods for charcoal-making integrated with agroforestry practices. A Community Forest Management Committee can also be established to monitor tree planting, protection and sustainable harvesting while addressing the livelihoods' concerns.

Environmental threat due to sand harvesting is under poor regulation thus leading to effects like soil erosion, gully formation and decline of water retention in rivers as a result of uncontrolled sand harvesting. To redress some of these threats, the study recommends that the local/county government and leaders from this community should initiate a system of permits for the practice of sand harvesting designating limits on quantity to be harvested and targeted zones. Rehabilitation programs for reforestation and river bank stabilization could be initiated to restore the wind

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damaged areas. Training on sustainable sand mining practices and raising environmental impact awareness could empower the communities in ecosystem conservation while sustaining their livelihoods.

Due the fact that community have knowledge on environmental degradation and other socio-economic activities; the members are in fact ready to commit themselves to any conservation effort. The study is therefore recommending joint collaborations between the local community and conservation agency, along with the county government to ensure accountable inclusiveness in decision-making, enforcement and benefits sharing. Additionally, the study recommends awareness-raising programs to teach the public about alternative livelihoods, such as bee-keeping, eco-tourism and sustainable agriculture to reduce pressure exerted on the natural resources. It also recommends regular monitoring of environmental issues by responsible authority like NEMA to help in informing adaptive management and providing the basis for incentives that enforce regulations and maintain community involvement in conservation activities.

## 7. ETHICAL DECLARATION

**Research Ethics**: The researcher obtained research permit from NACOSTI before commencing the research and the participants gave their informed consents and they voluntarily participated in the study.

**Funding Information**: No funding was used for the manuscript writing.

**Conflict of Interest**: The authors declared that there is no conflict of interest.

**Data Availability Statement**: Data remained available upon request from the author.

## 8. RECOGNITION OF AUTHORS

**Mr. Julius Lopeyok**- Played key role in inception of the research idea, Conceptualization, methodology, data collection, data analysis, compiling and writing.

**Dr. Rehema Swaleh**- Helped in Supervision, reviewing, refining methodology, editing and validation.

**Dr. Monica Kinyanjui**- Co-helped in Supervision, Reviewing and editing.

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**Study Title:** Socio-Economic Activities and Natural Resource Degradation in Lowangishu Hills, Burat Ward, Isiolo County.

**Respondent Code:** _____ **Village:** _____ **Date:** _____

**Enumerator Name:** _____

**SECTION A: Household Background Information.**

*Please provide the following background information about your household.*

| No. | Question | Response Options |
|---|---|---|
| **1.** | Gender | ☐ Male ☐ Female |
| **2.** | Age | ☐ 18–30 ☐ 31–45 ☐ 46–60 ☐ Above 60 |
| **3.** | Education Level | ☐ No formal education ☐ Primary ☐ Secondary ☐ Tertiary |
| **4.** | Occupation | _____ |

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| | | |
|---|---|---|
| **5.** | Household Size | ☐ 1–2 members ☐ 3–4 members ☐ 5–6 members ☐ 7–8 members ☐ More than 8 members |
| **6.** | Years Living in This Area | ☐ Less than 1 year ☐ 1–5 years ☐ 6–10 years ☐ 11–20 years ☐ More than 20 years |

**SECTION B: Livestock Grazing and Overstocking**

*Please indicate how frequently or severely the following occur in your area.*

| No. | Statement | Strongly Disagree (1) | Disagree (2) | Neutral (3) | Agree (4) | Strongly Agree (5) |
|---|---|---|---|---|---|---|
| **LG.1** | Livestock in this area often exceed the available pasture carrying capacity | ☐ | ☐ | ☐ | ☐ | ☐ |
| **LG.2** | Vegetation cover in Lowangishu Hills has reduced due to overgrazing | ☐ | ☐ | ☐ | ☐ | ☐ |
| **LG.3** | Overgrazing has led to visible soil erosion in Lowangishu Hills | ☐ | ☐ | ☐ | ☐ | ☐ |
| **LG.4** | Livestock grazing activities have contributed to the degradation of water sources (springs, wells) | ☐ | ☐ | ☐ | ☐ | ☐ |

**SECTION C: Charcoal Production and Firewood Collection**

*Please rate the level of impact and availability related to the following activities.*

| No. | Statement | Strongly Disagree (1) | Disagree (2) | Neutral (3) | Agree (4) | Strongly Agree (5) |
|---|---|---|---|---|---|---|
| **CP.1** | Charcoal production has reduced vegetation and forest cover in this area. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **CP.2** | Firewood collection negatively affects local biodiversity. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **CP.3** | Firewood scarcity has contributed to destruction of remaining forest cover. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **CP.4** | Poor regulation of charcoal production has accelerated forest degradation in this area. | ☐ | ☐ | ☐ | ☐ | ☐ |

**SECTION D: Sand Harvesting**

*Please indicate your perception of sand harvesting and its environmental effects.*

| No. | Statement | Strongly Disagree (1) | Disagree (2) | Neutral (3) | Agree (4) | Strongly Agree (5) |
|---|---|---|---|---|---|---|
| **SH.1** | Sand harvesting is a common activity in this area. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SH.2** | Formation of deep gullies is linked to sand harvesting. | ☐ | ☐ | ☐ | ☐ | ☐ |

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| | | | | | | |
|---|---|---|---|---|---|---|
| **SH.3** | Water levels and water retention in rivers have declined due to sand harvesting | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SH.4** | Unregulated sand harvesting has resulted in loss of vegetation cover and degradation of river ecosystems in this area. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **SH.5** | Current sand harvesting practices are unsustainable. | ☐ | ☐ | ☐ | ☐ | ☐ |

**SECTION E: Perceptions and Recommendations**

*Please share your opinions about environmental changes and possible solutions.*

| No. | Statement | Strongly Disagree (1) | Disagree (2) | Neutral (3) | Agree (4) | Strongly Agree (5) |
|---|---|---|---|---|---|---|
| **PR.1** | The environmental condition of Lowangishu Hills is worse compared to 10 years ago. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PR.2** | Access to good pasture has significantly decreased over the last 10 years. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PR.3** | Livestock health and productivity have declined due to environmental deterioration. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PR.4** | Socio-economic activities are the main drivers of natural resource degradation. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PR.5** | Community involvement is essential for environmental conservation. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **PR.6** | Alternative livelihood options can reduce pressure on natural resources. | ☐ | ☐ | ☐ | ☐ | ☐ |

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