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# Uncertainties of forest resources as enhanced by uncontrolled anthropogenic activities in rural Tanzania: A case of Kigosi Forest in Bukombe district

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**ABSTRACT**

The study assessed the influence of anthropogenic activities on forest resources in Bukombe District, Tanzania. The study used a cross-sectional design and opted for a mixed-methods approach combining quantitative and qualitative methods. Data were collected through household questionnaires and interviews, and quantitative data were analysed using SPSS, while qualitative data were analysed through content analysis. The study found that some human activities degrade forests, including logging, charcoal production, firewood collection, mining, and agricultural activities, resulting in forest ecosystem deterioration, reduced ecosystem services, land degradation, and species extinction. Furthermore, the study recommended potential forest restoration practices, including afforestation, reforestation, the use of alternative sources of energy, and alternative income-generating activities with less dependence on forest resources.
**Keywords:** Anthropogenic Activities, Forest, Forest Resources, Forest Degradation

## 1. Introduction

Forests occupy 4 billion hectares of the Earth's landscape, of which forests with native species are estimated to comprise 93%, with the remaining portion planted [1]. The countries that are largely covered by forests include Russia, Brazil, Canada, the USA, and China, where forest coverage is almost half of the total world coverage [2]. Forests provide multiple ecosystem services from local livelihoods and socio-economic development related goods and services, such as food, wood, and water, at the global ecological and economic services, including ecosystem functioning, biodiversity, carbon dynamics, and climate regulation [3].

Forest degradation includes the deterioration of forests through the depletion of their resources, encompassing both biotic and abiotic elements of forest ecosystems [4]. Deforestation and forest clearance in tropical areas have been a persistent impediment to socio-economic transformation in many parts of the world [1]. Additionally, deforestation is considered a significant problem in many parts of the planet, as it contributes to climate change and undermines biodiversity conservation. Some nations are cutting trees at alarming rates [5]. Globally, deforestation and forest degradation are among the major causes of greenhouse gas emissions, alongside the burning of fossil fuels [6]. Deforestation and forest degradation, particularly in the tropics, have continued unabated and pose serious threats to forests and the livelihoods of those who depend on forests and forest resources [3]. Understanding the drivers of forest degradation is fundamental for the progress of policies and initiatives that aim to combat the existing trend of forest degradation and achieve a more climate- and environmentally friendly outcome [6].

More than half of the global population, at 75%, depends unswervingly on activities related to the utilization of natural resources, particularly forest resources, for their livelihoods, while the remaining 25% meet household needs, fuel, industrial production, and recreational amenities from forest resources [4]. These anthropogenic activities on forest resources are causing topographic and forest cover changes with strong repercussions, including deforestation, embankments, soil erosion, and other impacts [7]. The study by Njora and Yilmaz [1] sought to identify potential human activities that have been enhancing forest degradation, including agricultural activities, rapid population growth, poor governance and corruption, unlawful logging, and wildfires. Most times, anthropogenic activities have been accelerating the excessive misuse of forest resources to meet human desires and anxieties in the face of readily unavailable alternatives, thereby leading to a serious reduction in global forest estates [8]. Estimates account for a considerable loss of 420 million hectares of forest from 2015 to 2015, while the degradation rate is 100 million hectares annually [8]-[10]. Furthermore, the study by Njora and Yilmaz [1] indicates that the global annual loss of forest accounts for 10 million hectares of the world's forests, with 80% due to agriculture as a primary human activity. Human-caused activities that lead to the loss and degradation of forests include agricultural activities, plantations, settlement establishment and expansion, industrial activities, mining activities, aquaculture-related practices, and others [11]. Furthermore, anthropogenic factors that lead to forest degradation include unlawful logging, unsustainable use, and reliance on forests as primary sources of energy [12].

Forests and their resources in Tanzania occupy about 48 million hectares of the total national land [13], accounting for 55% of Tanzania's total land and providing various goods and services demanded by humans, including but not limited to energy resources, building materials, and medicinal plants. In the periods 1980–1995 and 1995–2010, forests and their resources in the country reserves have been significantly degraded, as evidenced by uncontrolled charcoal burning, unlawful logging, shifting agriculture, firewood collection, pole harvesting, expansion of plantations, and climate change [14]. According to the United Republic of Tanzania, NAFORMA [15] outlines some critical anthropogenic activities that harm forest ecological services, including burning trees, charcoal making, harvesting wood for curing tobacco, overharvesting of firewood, and expanding cropland by clearing forests and expanding shifting cultivation. Most forest resources are hampered by forest damage, as enhanced by human activities, which are largely recorded in Eastern and Western Tanzania, including the Geita region [16]. This necessitated this study, and therefore, it was carried out to understand the role of human activities in enhancing forest degradation in Bukombe District, Tanzania.

## 2. Methods

The study was conducted in two villages, Kelezia and Imalamagigo, in Ushirombo ward, located in Bukombe District, Geita Region. The study villages were selected because they are located around the Kigosi forest reserve, and villagers depend on the forest resources of the identified forest. The study areas are located at coordinates 03° 28’ 015” S and 31° 54’ 00” E, with a total population of 407,102 people and a total coverage of 51 km2.

The study used a cross-sectional research design that minimized resource use by allowing data collection at one time and accommodating both quantitative and qualitative approaches [17]-[19]. Samples were used to obtain the desired information from the population. Simple random sampling was used to select respondents from villages around the study forest, while purposive sampling was used to select leaders and conservationists in the study area. The sample size for respondents of household questionnaires was 10% from both selected study villages. Based on that, the total number of households in the study areas was 854, and therefore the sample size of the study was (854 x 0.1) = 85. For the interview method, 3 respondents from each study village were included. The study collected primary and secondary data. Secondary data were collected from technical reports, articles, standard published books, and government-issued official documents. Primary data, the original unprocessed data directly from the field, were collected through questionnaires, interviews, and observation. Also, Google Earth was used to obtain satellite images of the Kigosi Forest from 2010 to 2025, assessing cover change over time at 5-year intervals.

## 3. Results and Discussion

### *3.1. Socio-economic characteristics of Respondents*

The study identified socio-economic characteristics of respondents, including age, sex, level of education, and household size (Table 1). Respondents' ages ranged from 18 years old and above, with both males and females involved. Most respondents (65.9%) had only primary education, and the most common family size was 7 members, reported by 19.8% of respondents.

Table 1. Socio-economic characteristics of respondents

| Characteristics (N = 85) | | Percentage (%) |
|---|---|---|
| Age | 18 – 35 | 28.2 |
| | 36 – 60 | 57.6 |
| | 60+ | 14 |
| Sex | Male | 43.6 |
| | Female | 56.4 |
| Education level | Informal | 27.5 |
| | Primary | 65.9 |
| | Secondary | 6.6 |
| | Post secondary | 00 |
| Household size | 1 – 3 | 20.8 |
| | 4 – 6 | 47.8 |
| | 7 – 9 | 30.2 |
| | 9+ | 01 |

*3.2. Anthropogenic Activities Related to Forestry in the Study Areas*

The study identified anthropogenic forestry activities in the study villages (Figure 1). The study assessed the primary economic activity respondents engage in to earn household income. Study findings show that 76% of respondents depend on crop farming as the foremost source of household income, 2.5% of respondents are employed in various sectors, and 11.5% of respondents are engaged in mining activities. The remaining 10% are engaged in multiple activities with no single primary activity. Agricultural expansion led to a high level of forest clearing.

Agriculturally related activities were widely reported to have exacerbated forest degradation. The study findings show that 58.2% of respondents expanded their cropland by clearing forest coverage around their study villages. Furthermore, the study's findings indicated that only 11.4% of respondents cultivated their agricultural farms of the same size without expanding their agricultural land. The study found that 50.5% of respondents practice shifting cultivation. The study respondents claimed that they normally leave their exhausted farms in search of new, fertile virgin lands. When they exhaust them, they then look for other areas as well.

Globally, and specifically in Africa, there have been cases of land fragmentation in which local and central government leaders are active players in fragmenting forest land into small farms and giving them to smallholder farmers. Such activities and practices sometimes lead to failure in regenerating and restoring the already degraded forests. Furthermore, farming in forests with indigenous and native species leads to irreversible damage to natural forests, turning the land cover into a new land use [9]. Africa, faced with rapid population growth, is inevitably driven to expand cropland, leading to increased demand for cropland and, in turn, greater forest clearance. The reduction in arable land per capita in the country has also been blamed for the increase in cultivation in forested areas [20].

The study also assessed the level of firewood collection and charcoal burning in the study area. Study findings indicated that 61.4% of study respondents participate in firewood collection from the forest, while 100% of study respondents use firewood for cooking in their households. Furthermore, 38.6% of study respondents obtain firewood by buying from those who collect firewood from the forest for selling purposes. Most community members in rural areas have been depending on forest resources for fuelwood because they cannot afford or manage to use gas or electric stoves. Furthermore, the study found that 32% of respondents engaged in charcoal burning, while 95.9% used charcoal for household cooking. The level of charcoal use in the study villages is very high, thereby threatening the integrity of forest resources and exacerbating their degradation.

Charcoal production is still dominant in most areas around forests and thickets, as well as in woodlands, as a major economic activity and sometimes as a coping strategy for most households living in villages near dense and minor forests. Charcoal production has been leading to a considerable level of forest clearance due to its nature of cutting down trees and degrading forests, as it involves clear-cutting of forests unless it is a secondary activity after road construction or a related or similar preceding activity [21]. Charcoal is a major cooking fuel

for most rural and urban settlers, while firewood dominates in rural households. Apart from that, the regional demand for fuelwood sourced from forest resources has been increasing tremendously over time [22].

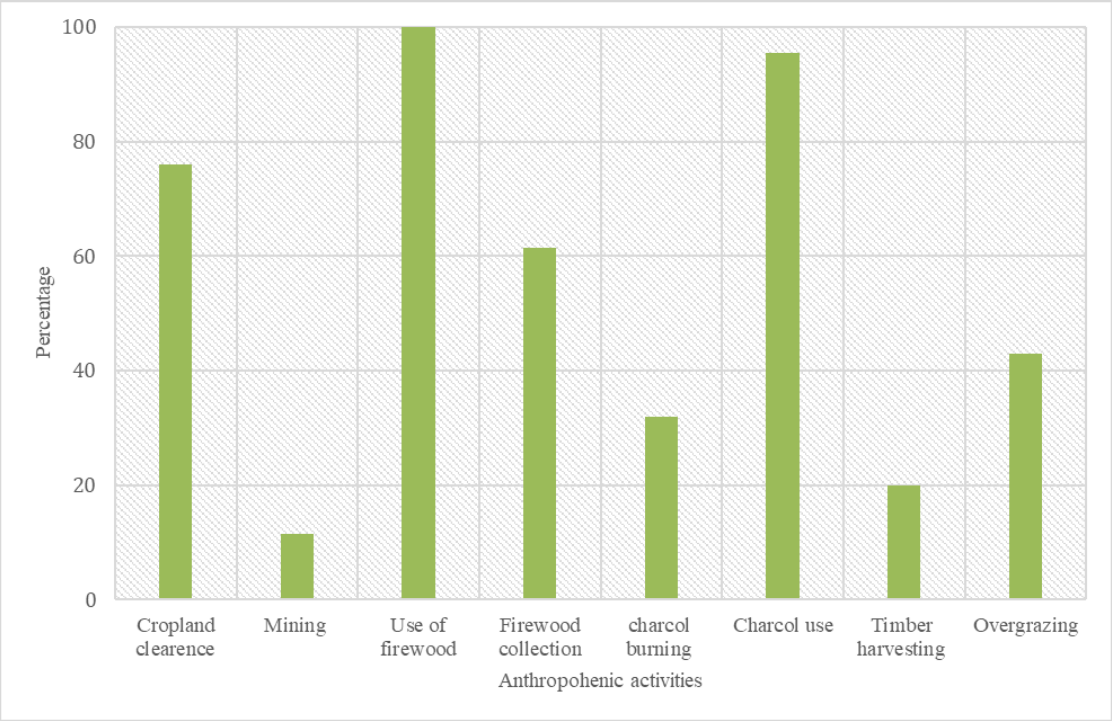


Figure 1. Anthropogenic activities leading to forest clearance

Tanzania Bureau of Statistics reveals its data indicating charcoal as the second most used fuel in the country, after firewood. The energy use in Tanzania confronts the energy hierarchy theory, where it is estimated that with the growth of the disposable income in the country, among the households in Tanzania, people should transition from the use of assumed low-cost sources of energy to more sustainable sources of energy, such as the use of Liquefied Petroleum gas (LPG) and electric stoves [23].

The study assessed respondents' engagement in timber harvesting in the study areas. The study found that only 19.9% of respondents engage in timber harvesting. Study findings indicate that timber harvesting in the forest involves cutting natural trees without reforestation practices. Logging operations in the African continent, particularly in the Central African Republic, have been identified as the largest contributor to deforestation. Trees are indiscriminately cut so that they provide raw materials for furniture and other uses. The companies that carry out logging activities in the continent and the country do so using efficient machines and labour-intensive operations that not only remove trees but also eradicate any vegetation on the ground surface.

The study assessed the nature of livestock keeping and the practice of grazing in the study area and in protected areas. The study findings indicated that 43% of respondents practice traditional livestock keeping and graze on natural vegetation, including in the forest. Most respondents' households have more than 30 cattle and more than 20 goats, in which the rearing of these animals is traditionally practiced. Such practices have been degrading forest resources, exacerbating the destruction of water resources, and accelerating soil erosion. Uncontrolled livestock grazing contributes significantly to soil erosion and forest degradation. In Tanzania, in Shinyanga, in the Maasai land, in Geita, Kigoma, and other parts, the number of pastoralist activities is widely recognized as a critical factor in forest degradation [24]. Livestock keepers in these regions have large numbers of grazing animals, including cattle, goats, sheep, and donkeys, and sometimes face higher consumption demands than the environmental carrying capacity [25].

Mining activities, particularly gold mining, also dominate the study areas. The study observed that most mining areas were previously covered by vegetation and forests. The study findings further show that 11.5% of study respondents are engaged in mining activities, which form the basis of their household income. Mining activities affect forest resources by clearing forests.

Also, mining activities involve the use of logs or timber, which are highly susceptible to mining and therefore contribute to forest degradation. The presence of coal, gold, and diamond mining, as well as tanzanite and other mining activities, which are becoming more widespread, also causes disturbances in forests [26]. On the other hand, Geita, Mara, and Shinyanga are the areas with the largest gold mining sites in Tanzania, with mining activities occurring on land formerly covered by forests [27]. Mining activities, especially in the Central African region and the Congo Basin, have contributed to deforestation [28].

*3.3. Impact of anthropogenic practices on forest resources in the study areas*

The study assessed the impacts of anthropogenic activities on forest resources, leading to forest degradation. Through observation, household questionnaires, and key informant interviews, the study identified a number of impacts on forest resources that affect the forests, leading to degradation. Through the household questionnaire, the study found that 89.6% of respondents identified that soil erosion in the study areas has been accelerated by human activities, including cutting trees for lumbering and logging.

Also, study respondents reported that agricultural activities, including farm expansion and intensive farming, have caused soil erosion in the study villages. Additionally, mining activities were identified as causing land degradation, including soil erosion and forest degradation. A significant number of forest areas in the study areas are being adversely affected by forest resources. Also, livestock overgrazing has been causing adverse impacts on forest resources in the study areas.

Through observation and satellite imagery, the study areas were found to have declining forest cover, with parts of the forest cleared due to human activities, including charcoal burning, firewood collection, and mining (Figure 1). Satellite images indicate that the forest has been declining in size and canopy cover from time to time, from 2010 to 2025.

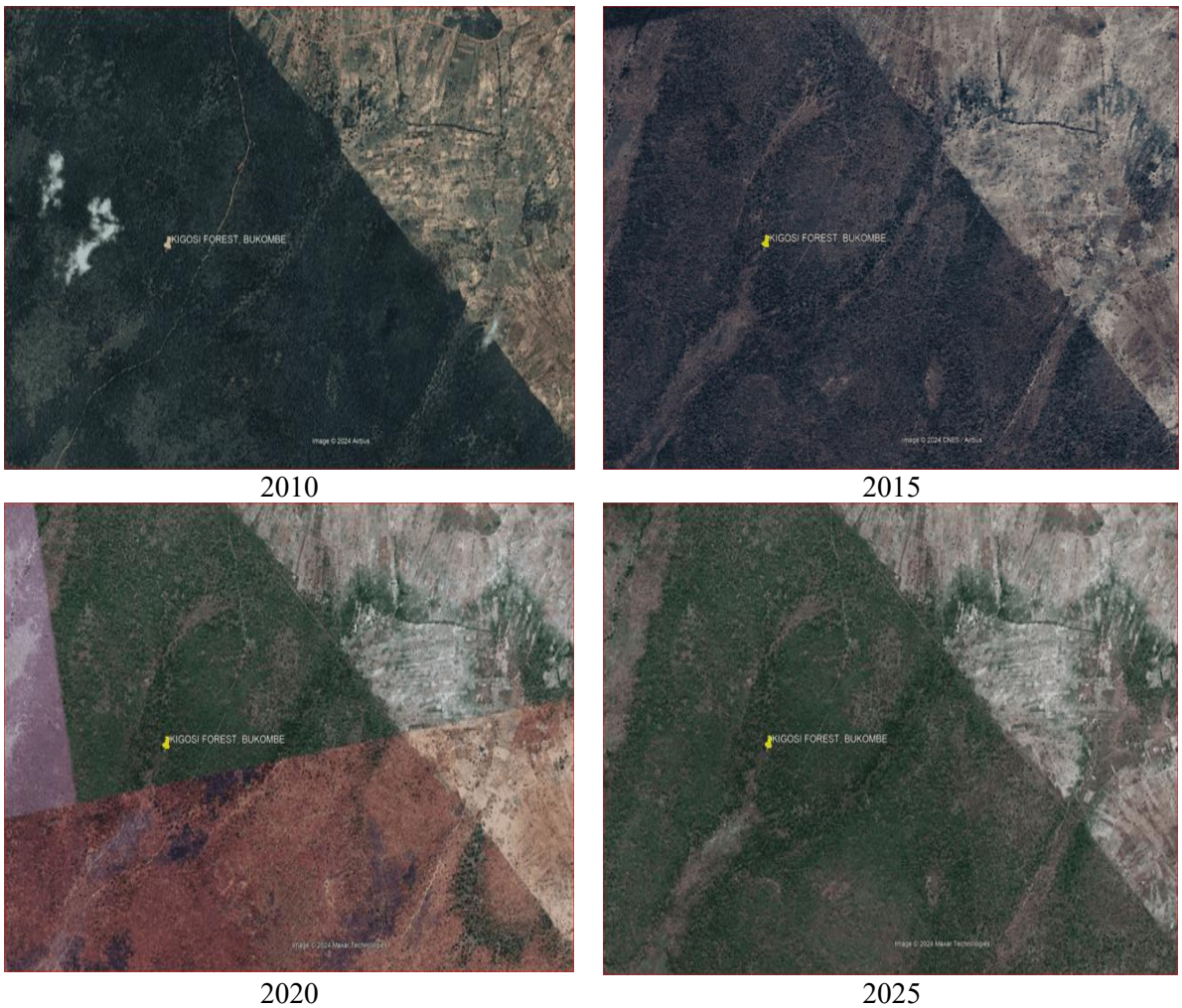


Figure 1. Satellite images showing the over time forest cover change in the Kigosi Forest Reserve in the study area from 2010 to 2025. Source: Google Earth Pro Map, 2025.

Furthermore, the study areas are affected by drought, which also impacts forest resources, leading to forest degradation. The study's findings indicate that 73.6% of respondents identified that drought has occurred due to human activities and forest clearing. Most forest resources are diminishing and being worn away due to human drought. Also, forest degradation has been leading to adverse impacts on water resources, thereby causing severe drought in these areas.

Deforestation results in several problems encircling environmental degradation through an augmented rate of soil erosion, increasing river sedimentations, siltation of reservoirs and river beds, increase in the regularity and dimension of floods and droughts, disruption of rainfall pattern, increasing greenhouse effects, increase in the devastating vigor of the atmospheric storms, etc [29,30]. According to the Food and Agriculture Organization of the United Nations [9], 10% of the forest areas in Africa were damaged as a result from deforestation. In the continent that borders the sub-Saharan desert, deforestation has persistently worsened drought conditions, leading to increased water scarcity and uncertain access to clean water. Soil erosion was reported to have occurred by 98% of respondents, who claimed it was due to human activities on forest resources. Leaving the soil leads to easy runoff and perpetual soil erosion [30].

Failing to provide ecosystem services is also accounted for, including minimal carbon storage, limited food production, and the extinction of certain species, as acknowledged by 69% of respondents, who also reported that this is a common and rapid phenomenon due to encroachment by human activities in forest resource areas. In recent decades, deforestation has been largely reducing the functionality of forest ecosystems and, therefore, failing to meet the potential social and economic demands of the human societies surrounding such forests [31]. Biodiversity degradation and species extinction are becoming common due to uncontrolled human activities over forest resources, which entail excessive exploitation [32].

### *3.4. Measures on Combating Forest Degradation in the Study Areas*

The study engaged respondents to suggest measures that are believed to contribute to the protection of forest resources and to the elimination of forest degradation. Several strategies were suggested (Figure 2). The study findings indicated that the Kigosi forest conservationists were not involving the communities surrounding the forest in conservation, but they normally imposed coercion with limited engagement, including limited awareness-raising seminars. 93% of study respondents suggested community engagement in conservation activities, while 87.3% suggested awareness creation on forest conservation among villagers in surrounding villages.

Raising public awareness is unquestionably important for communities with forests around them, as it can help counter forest loss and its consequences for forest degradation. It is important to raise public awareness of the extent and consequences of forest loss and degradation, as well as the potential for forest landscape restoration [33]. Deforestation and reduction in forest quality are problems in virtually all regions of the world. The conservation agenda of the past few decades has largely focused on stopping these degrading processes and saving forests, particularly tropical forests [34]. Creating public awareness of the importance of embarking on large-scale, concerted restoration initiatives is probably the first step in any attempt to redirect public funds.

Through the household questionnaires, 77.8% of study respondents suggested imposing strict penalties on those illegally harvesting forest resources, such as charcoal burning. Furthermore, the study's findings indicate that 47.1% of respondents support increasing the tax on charcoal-burning permits. In comparison, 99.1% of respondents mentioned reducing the gap between the price of electricity and the price they can use, and stopping the use of forest-resourced fuelwood.

During the interview, conservationists suggested that the areas need restoration programmes, including afforestation and reforestation, to regrow trees and restore the areas' green cover to what it was before.

Introducing programs that necessitate planting trees and forests in areas that were deforested and in areas that had no forests previously. These two practices, reforestation and afforestation, lay the groundwork for restoring deteriorated forests while maintaining the integrity and sustainable functionality of forest ecosystem services. Forest Landscape Restoration needs to be addressed in national policies and reflected in global agendas while developing specific strategies at the local level [35]. Also, Forest Landscape Restoration programmes and specific strategies, when incorporated and intentionally reflected at various levels from national to local, ensure easy attainment of desired restoration goals [36]. Such practices, including

afforestation and reforestation programmes, can be easily implemented when set up as a pilot study initiated in various ecological regions at various levels, from local to regional.

In Tanzania, there is a famous practice among the Sukuma pastoralists in Shinyanga, traditionally known as Ngitili. Many farmers or communities in these Sukuma communities have traditional local enclosure systems (known as ngitili), which are reserved for use as grazing land in the dry season [37]. This encourages grazing grasses to regenerate and restore, while providing browsing and fodder assurance later in the dry season, when feeding grasses become scarce [38]. Traditionally, ngitili were set near home compounds, and silage or fodder from them was used to support calves, old animals, and oxen that could not graze with the main herd. The proprietorship, management, and tenure rights of Ngitili were governed by customary law [39].

## 4. Conclusion

The study identified human activities that degrade forest resources. Based on the study findings, the study concludes that charcoal burning and the collection of fuel wood significantly contribute to the decline in forests and, therefore, lead to the deterioration of forest resources. Furthermore, the study concludes that uncontrolled timber harvesting leads to the clearing of a significant portion of forests, thereby causing forest degradation. Additionally, agricultural land expansion and shifting cultivation lead to the clearing of large areas, thereby depleting forests and reducing the provision of limited forest ecosystem services. Furthermore, mining activities and livestock grazing cause significant loss of forest resources, leading to forest degradation. The study identified the effects of human activities on forest resources. The study concludes that, if human activities are not adequately controlled, they result in deforestation, soil erosion, desertification, and drought, thereby leading to forest degradation. The study also concludes that afforestation, reforestation, community engagement, strict laws and regulations, increasing the taxation of logging permits, and reducing the prices of gas and electricity are potential methods for eliminating forest degradation and thereby ensuring forest integrity. Also, awareness-raising among villagers is very important for the sustainable management of forest resources.

## Conflict of Interest

The author declares no conflict of interest.

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