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Effect of Vegetation Cover Removal on the Environment and Forest products in Burbur district, North Kordofan, Sudan

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Vegetation Degradation; Environment; Forest ecosystem services; Sudan

Abstract

Forest products and environment are significantly impact by the removal of vegetation cover, which lead to deforestation and land degradation. The objective of the study was to investigate the effect of vegetation cover removal on environment and forest products production in Burbur district, North Kordofan, Sudan. Data were collected using questionnaires and direct observations, and 80 farmers were interviewed. The findings, based on respondents' perception, indicated that vegetation removal increased wind speed (92.4%), runoff (81.2%), and temperature (72.5%), while 78.8% reported a decline in rainfall. Respondents also noted a reduction in fruit production from key species, including Baobab (83.8%), desert date (82.5%), and *Grewia tenax* (85%). Moreover, forage availability and firewood collection decreased, whereas charcoal production showed a moderate rate due to intensified extraction. The study concludes that vegetation removal has negatively affected forest products, environmental stability, and local livelihoods. The findings emphasize the need for community-based management, reforestation, improved energy alternatives, and awareness programs to promote sustainable resources use. . .

1 Introduction

Forests is home for varieties of fauna and flora, which support biodiversity maintenance and conservation, regulating climate and pest activities (Musa & Sahoo, 2023). In dry land of Sudan, forest resources are particularly important for livelihoods, offering food, fodder, fuelwood, and income opportunities (Brockerhoff et al., 2017; Damptey et al., 2021; Jenkins & Schaap, 2018; Musa & Sahoo, 2023). However, vegetation cover has been declining due to agriculture expansion, overharvesting, population pressure, and other anthropogenic activities (Mohammed et al., 2022, 2025). Such disturbance reduces the availability of forest products, degrade land, and influence local climatic condition (Musa et al., 2023; Mustafa, 2007; Thom & Keeton, 2020). Conversely, population and economic growth are likely intensified uses and pressure on natural resource (Khalifa, 2016), and natural disturbances acting as a key role in shaping ecosystem services, biodiversity, and regeneration in forest ecosystems (Barnosky et al., 2012; Franklin et al., 2002; Rammer et al., 2021; Thom et al., 2017). Vegetation loss exposes soil to erosion, increases surface runoff, intensifies temperature fluctuations, and contributes to declining rainfall (Khalifa, 2016; Ziervogel et al., 2006). On the other hand, anthropogenic disturbances such as illegal cutting, farming, mining in forest areas significantly impact tree species diversity, density of stands and mature trees (Bentsi-Enchill et al., 2022; Himshikha et al., 2022). Moreover, in dryland ecosys-

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tems such as those in Sudan, frequent and severe disturbances particularly illegal cutting, overgrazing, and land clearing generally reduce forest canopy cover, hinder natural regeneration, and accelerate degradation processes (Mohammed et al., 2022; Musa et al., 2024) as well as increase weather extremes e.g. drought and heat (Thom et al., 2020).

Forest ecosystems contribute significantly to climate change mitigation (Keenan et al., 2016; Locatelli et al., 2015), therefore changes in vegetation composition negatively influence climate regulation (Thom et al., 2017), while extreme climatic event directly af-fect agricultural production (TNA, 2013). Several studies in Su-dan have focused on forest products (Adam et al., 2013; Musa et al., 2023), tree diversity and species distribution (Dafa-Alla et al., 2024; Mohammed et al., 2022; Musa et al., 2024), and forest degra-dation (Yasin et al., 2024), In the meantime, limited research ex-ists on how vegetation removal affects environmental conditions and forest ecosystem services in North Kordofan. This study addressed this gap by assessing community perceptions of vegetation removal impacts on climatic variables, fruit production, fuelwood and charcoal extraction, forage availability, and agriculture land. The study hypothesized that; a) vegetation removal significantly reduces fruits collection, b) forest product availability decreases with increasing disturbance, and c) vegetation removal negatively affects local climatic conditions. The findings of this study will help the policymakers in conserving forest resources and managing illegal cutting and other anthropogenic factors that lead to vegetation cover removal.

2 Methodology

2.1 Study area

The study was conducted in Barbur district of the North Kordofan state which lies between latitude 12°15 and 13°35 North and longitude 29°30 and 30°35 East longitude. It occupies a total area of about 185,302 km² (Fig. 1). The climate is hot and semi-arid with mean annual rainfall varying from 300 mm in the north to over 900 mm in the south. Rainfall is concentrated in a single short season which increases in reliability and length from north (July–September) to south (May–October).

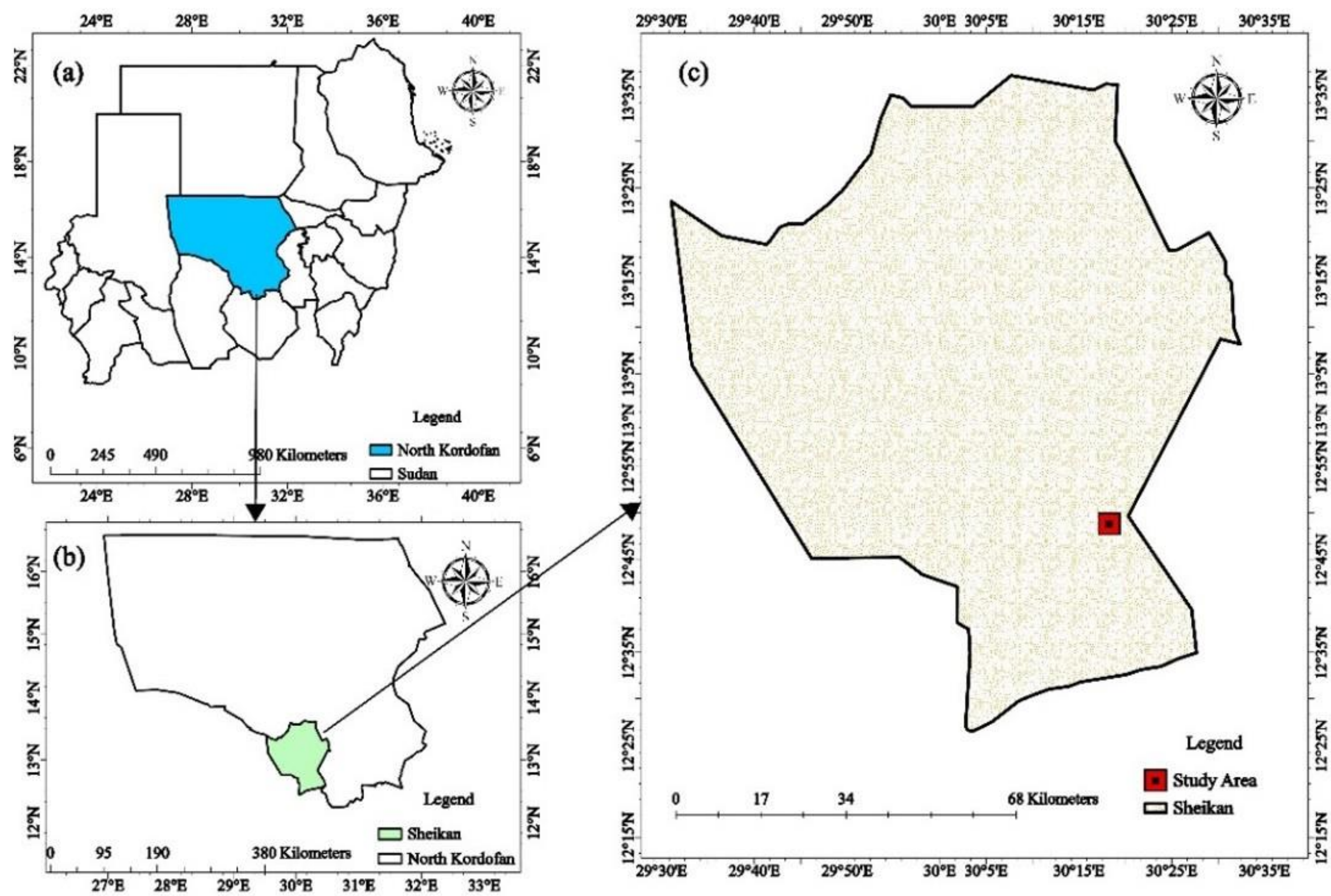

Figure 1: Study area, a) Sudan and North Kordofan state, b) Sheikan locality, and c) location of study site. The map is create using ArcGIS pro and can be accessed via (https://pro.arcgis.com/en/pro-app/latest/get-started/download-arcgis-pro.htm)

Generally, the rainy season normally extends from June/July to September/October. However, the period between the first and last useful rains is limited from 70 to 90 days only. Average maximum monthly temperatures range from 29.9 °C in January to 39.6 °C in May with annual average of 34.5 °C, while the minimum vary from 13.3 °C in January to 24.7 °C in June with annual average of 20.3 °C.

Burbur district it is one of the most important forested areas and

well known by gum Arabic from *Senegalia senegal*, baobab (*Adansonia digitata*), Tamarind (*Tamarindus indica*), Ziziphus (*Ziziphus spina-christi*) and Guddim (*Grewia tenax*) fruits production and dominant tree species in the area. On the other hand, the farmers in the study are cultivate varieties of agricultural crops including sorghum, sesame and ground nut.

2.2 Data collection

A semi-structure questionnaire was designed, and pre-tested to cover local residence in the study area deals with non-wood forest product collection and depend on forest for their fuelwood and forage. Multi-stage sampling techniques was applied where 80 farmers were selected. The questionnaire was developed based on a review of relevant literature to ensure content validity. A pilot test was conducted with a sample of 20 respondents to assess its reliability and clarity. However, the internal consistency of the questionnaire was evaluated using Cronbach's alpha which yielded a value of 0.88, indicating excellent reliability.

2.3 Data analysis

The data analysis was made using descriptive statistics, whereas frequencies, averages and percentages were calculated. Data were analyzed using Statistical Packages for social Sciences (SPSS) (version 2022) and Excel. Results were interpreted in tables and figures.

3 Results and discussion

3.1 Sociodemographic characteristics of Respondents

The study presented the important sociodemographic characteristic of respondents such as sex, education level, occupation and family size (Table 1). The majority of respondents (55%) are male which consider have more frequent appearance in the forest for collection of timber and non-timber forest products. The findings align with Eltahir et al. (2024) who stated that the participation of men and women are mostly similar in agriculture and non-agriculture activities. The findings also reflect the active participation of both gender in supporting livelihood income generation. However, 42% of the respondents have studied up to primary school, 33% of them are farmers, 31% free labors, and 27% employees (Table 1). The findings revealed that in rural area of Sudan most of residences are farmer and during agriculture off season they collect forest products to support their livelihoods. In the meantime, education level is believed to be one of the decision factor determinants the engagement of respondent to particular field (Musa et al., 2025). In general education levels remain low, which may influence awareness about sustainable resources management practices. Conversely, larger families may also exert greater demand for fuelwood and forage, potentially intensifying vegetation removal.

Table 1: Sociodemographic of respondents in the study area

Category	Variables	Respondent (%)
Sex	Male	55
	Female	45
Education level	Primary	42
	Secondary	22
	University	36
Occupations	Employees	27
	Free labors	31
	Farmers	33
	Others	9
Family size	1-2 persons	20
	3-5 persons	41
	> 5 persons	39

Source: Field work, 2023

3.2 Effect of vegetation removal on climatic factors

The respondents' perception on effect of vegetation removal on climatic variabilities are shown in (Table 2). Most respondents perceived increased in wind speed (92.4%), higher runoff (81.2%), and rising temperature (72.5%), while 78.8% reported a decline in rainfall. These perceptions align with established literature showing that vegetation loss intensifies erosion, reduces moisture retention, and alters microclimates (Khalifa, 2016; Thom et al., 2017; Ziervo-gel et al., 2006). In contrast, vegetation cover act as a buffer that regulates microclimatic conditions by reducing wind velocity, fa-cilitating water infiltration, stabilizing soil, and moderating tem-perature fluctuations. A study by Chen et al. (2013) and Mohamed et al. (2024) described that, based on climatic projection, tempera-ture is expected to increase while rainfall will decrease, and this will significantly impact vegetation cover and agriculture production.

Table 2: Respondent's perception on effect of vegetation removal on climatic factors

Item	Increased (%)	Decreased (%)	Fixed (%)
Wind Speed rate	92.4	7.6	-
Rainfall status	18.8	78.8	2.5
Run-off status	81.2	15.0	3.8
Temperature status	72.5	20.0	7.5

Source: Field work, 2023

3.3 Effect of vegetation removal on fruit collection

Respondents reported significant declines in fruit production from baobab (83.8%), desert date (82.5%) and Guddim fruits (85%) (Table 3). Reducing tree density, poor regeneration, erratic rainfall, and soil degradation likely contribute to this decline. Although vegetation removal is a major driver, ecological interactions such as drought and nutrient depletion also play roles. The substantial decline in fruit production from baobab, desert date, Guddim and other species reflects both reduced in the tree density and impaired regeneration caused by vegetation removal. Similarly, Mohammed et al. (2025) observed that decreases in tree density significantly impacts households' income. In contrast, many forest species rely on mature trees with large canopies, which are increasingly lost due to land clearing, fuelwood extraction, and agricultural expansion. Additionally, vegetation degradation modifies soil fertility, reduces moisture ability, and increases exposure to drought, all of which negatively impact fruit yield. The respondents' perceptions align with ecological evidence that, disturbances in dryland directly reduce fruit productivity (Dafa-Alla et al., 2024; Mohammed et al., 2022; Musa et al., 2024). This decline threatens rural food security and household income, given the high reliance on these species for nutrition and livelihoods. On the other hand, Eltahir et al. (2025) reported that gum Arabic producer associations started promoting agroforestry in most part of Sudan to increase vegetation cover and production of gum Arabic.

Table 3: Respondent's perception on effect of vegetation removal on fruit collection

Item	Increased (%)	Decreased (%)	Un-changed (%)
Baobab	2.5	83.8	13.8
Tamarind	83.8	16.2	-
Desert date (Lalob)	11.2	82.5	6.2
Grewia (Guddim)	1.2	85.0	13.8

Source: Field work, 2023

3.4 Effect of vegetation removal on charcoal, firewood, forage, and agricultural land

Perceptions indicated that forage availability (87.5%) and firewood collection (50%) have decreased. Charcoal production increased moderately (53.8%) (Table 4), likely due to rising demand despite decreasing tree stocks. Agricultural land decreased (78.8%) (Fig. 2) due to sand encroachment, soil degradation, and reduced productivity linked to vegetation loss. On the other hand, most of respondents (56%) stated that tree cutting has benefit (Fig. 3). However, as vegetation becomes scarce, households intensify extraction to meet economic needs, especially for charcoal, which has a high market value. Conversely, forage and firewood availability showed marked declines, reflecting the sensitivity of grasslands and shrubs to overharvesting and land degradation. Reduced forage limits livestock productivity, while reduced firewood availability increases the burden on women and children who collect fuelwood. The reported decline in agricultural land indicates soil degradation, sand encroachment, and loss of soil structure following vegetation removal.

Moreover, the quantitative estimates provided by respondents demonstrate significant reductions in key natural resources. The sharp decline in firewood and forage production reflects the loss of biomass and ground cover following vegetation removal. Similarly, the reduction in agricultural land suggests compromised soil productivity driven by erosion, nutrient depletion, and shifting sand accumulation. The moderate increase in charcoal production despite vegetation decline indicates short-term extraction pressure driven by market needs a process that is unsustainable and further accelerates forest degradation. These quantified changes reinforce the perception-based findings and highlight the need for urgent action to restore vegetation, regulate resource extraction, and rehabilitate degraded land and also observed by Hammad et al. (2025).

Table 4: Respondent's perception on effect of vegetation removal on charcoal production, firewood collection and forage production at the study area

Item	Increased	Decreased	Unchanged
Charcoal production	53.8	46.2	-
Firewood collection	47.5	50.0	2.5
Forage production	10.0	87.5	2.5

Source: Field work, 2023

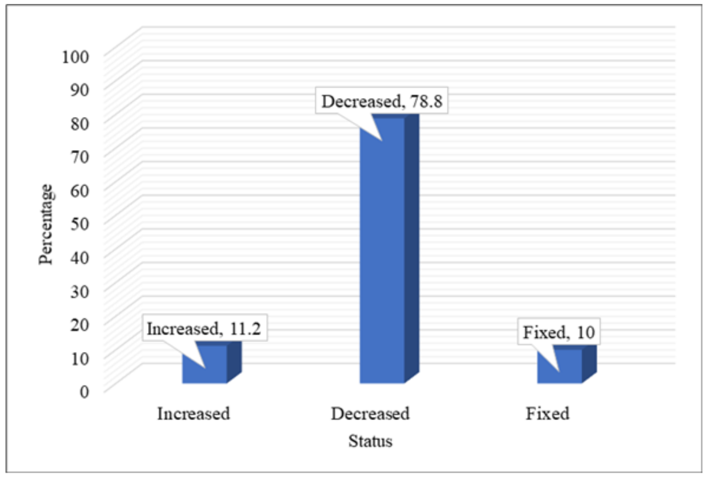

Figure 2: Respondent's perception on effect of vegetation removal on agricultural area
Source: Field work, 2023

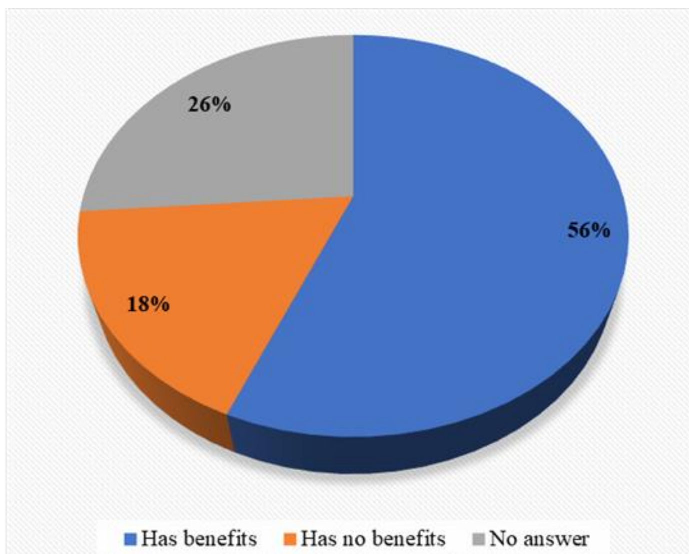

Figure 3: Respondents' perception on tree cutting status
Source: field work, 2023

4 Conclusion and recommendations

Vegetation cover removal has significantly affected environmental stability, forest products availability, and local livelihoods. Increase in wind speed, runoff, and temperature, coupled with declines in rainfall and fruit production, indicate severe socio-economic and ecological degradation. Charcoal and firewood pressures remain high, while agriculture land and forage resources are shrinking. The study recommends implement afforestation and reforestation using drought-tolerant species, establish commu-nity forests to meet local fuel and fodder needs, promote agro-forestry and tree planting within farms, introduce alternative en-ergy sources (e.g., improved stoves, LPG), strengthen community awareness on sustainable forest management, and support natural regeneration through grazing control and seed broadcasting.

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Conflict of interest
The authors declare that they have no conflict of interest.

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Data availability Statement
Data can be made available on the behave of the request

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