International Journal of Ecology and Environmental Sciences 49: 449-456, 2023
ISSN: 2320-5199 (Online); https://doi.org/10.55863/ijees.2023.3036

Review article

Role of Sustainable Forest Management in Poverty Reduction and Livelihood Improvement in Sudan: A Review

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ABSTRACT

In Sudan, the primary objectives of forest management are production, protection, and conservation, with minimal attention paid to social or other services. The forest resources in Sudan are great significance in term of ensuring sustainable livelihoods and preserving ecosystems. Forests are a valuable source of various goods such as gum, incense, fruit, medicine, and wild game. However, sustainable forest management is difficult due to the growing population and expansion of agriculture, which poses a significant challenge. reforestation and afforestation programmes is process of increasing forest cover and include enrichment planting, participation of local people engagement in the management of forest., The villagers in Sudan traditionally utilize native and regenerate naturally such as Tebeldi (*Adansonia digitata*), Dom (*Hyphaene thebaica*) and Hashab (*Acacia senegal*), trees due to their direct benefits. Additionally, Sudan containing three forest types according to administration system, viz., Federal forests, State forests and Community/private forests. *Balanites aegyptiaca, Ziziphus spina-christi*, *Adansonia digitate*, *Tamarindus indica*, and *Grewia tenax* represents the major tree species contribute to the rural and urban livelihood. It is recommended that, engagement of local communities in forest management is way to achieve sustainable forest management.

Key words: Forest Management, Sustainable Forest, Rural Livelihood, NWFP contribution.

INTRODUCTION

Forests play an important role in the sustainable development of a nation, by providing clean air and water, food, shelter, clothes, improving watershed, conserving biodiversity including the critical species of food chain (Lalhmingsangi and Sahoo 2016, 2019, Nayak and Sahoo 2020), and ecosystem, and carbon management (Gogoi et al. 2020, 2022, Deb et al. 2021). Over the years, there is an increasing pressure on the forest resources that have threatened the livelihood of millions people world over, especially the forest dwellers and people residing around the vicinity of the forest (Arnold and Perez 2001). For un-interrupted supply of good quality and quantity of forest resources, to meet the growing requirement, without deteriorating the quality and quantity of the forest produce, the forests need to be managed sustainably. Forests possess characteristics of both renewable and non-renewable resources. While plantation forests that are being harvested and regenerated frequently is an example of renewable resource, the natural and old growth forests when destroyed leads to in-replenishable resource losses resulting in disruption of sustainable supply of a plethora of goods and services (Gogoi et al. 2022). Nevertheless the forests (whether natural or planted) are critical economic importance to a nation. Sustainable management of forest resources can help increase biodiversity; abate climate change and arrest forest degradation and deforestation while increasing direct benefits to the people and the environment. However, many of the World's forests especially in tropics and sub-tropics are still not managed sustainably owing to either lack of appropriate forest policy legislation, infrastructure framework and incentive to promote sustainable forest management or inadequate funding or lack of technical capacity (Suratman et al. 2020, FAO 2022).

There are significant challenges in balancing immediate food and needs of livelihood with long-term

objective of environmental conservation, particularly when it comes to climate change adaptation and reducing emissions from deforestation and forest degradation (REDD). Mismanagement of natural forests, both inside and outside reserves, as well as land use change systems have led to a decline in the amount of growing stock in natural forests. Furthermore, natural regeneration has been impacted by factors such as rainfall deficiency and agricultural expansion, with the latter being the most significant factor. These issues are highlighted in research by El Tahir (2015), Kobbail (2011), and Taha et al. (2014). According to Kobbail (2011), the law regarding forest reserves states that access to these areas is restricted except for specific circumstances such as passage rights and limited benefits. However, despite efforts to guard and patrol these forests, local residents are still accessing them illegally for activities such as gathering wood and farming. This review is aim to provide existed information regarding forest management and its sustainability in Sudan, and to provide framework for natural resources and forest management and its sustainability.

MATERIALS AND METHODS

Study area

Sudan has a land area of 1,882,000 km^2 and a population exceeding 36 million people. The country's population is growing at a rapid pace of 2.3% per year (Anonymous 2013). Sudan's forest products play a crucial role in supporting livelihoods sustainability and ecosystems (El Tahir 2015). While almost 30% of the people lives in urban, the majority of Sudan's people, comprising 70.5% of the population, reside in rural areas. Many of these rural residents are considered forest dependents, relying on wood as their primary energy source and using round wood and poles for building construction (Anonymous 2013). Since the separation of South Sudan in 2011, there has been a significant reduction in the vegetation cover of Sudan, decreasing to 10.3% of total area of Sudan from 40%. Out of this, only 4.9% is made up of reserved forests. 11.6% of forest cover out of total area estimated by the Forests National Corporation (FNC), while agricultural land (13.7%), range (26.4), and 0.17% water. However, sustainable management of forests can provide a range of valuable products, both wood and non-wood, which could improve the income and livelihoods of local communities and support economic development (Musa et al. 2021). Forests offer a range of resources, including non-timber products like gums, incense, resins, medicinal plants, and bush meat (El Tahir 2015). Among these, fruits are especially important for generating income in rural and urban areas and can serve as a vital source of sustenance during times of drought and famine, making them a crucial tool in fighting poverty and hunger (Ibrahim and Abdo 2017, Musa et al. 2021). There is increasing evidence to suggest that local communities are often better at managing natural resources than the government, as they have a vested interest in sustaining these resources for their livelihoods and have been doing so for many years despite state control (Taha et al. 2014).

Methods

The research concerning sustainable forest management (SFM) is highly context specific, and therefore many research papers have not really investigated various dimension of SFM. Since this review is the role of SFM in poverty reduction and livelihood improvement, all scientific publication that addresses these issues of Sudan, were downloaded from database (google scholar, scopus, web of science, pubmed, science direct etc.) using keywords like 'sustainable', 'forest', 'management', 'livelihood from forest', 'income generation from forest products', 'community forest interventions' etc. The findings of the papers are reviewed and reported in the results and discussion section.

RESULTS AND DISCUSSION

Forest management and its sustainability in Sudan

In Sudan forest management primarily focus on production of wood, protection, and conservation, with little consideration for social or multiple services. Management of reserved forests is either based on resources conservation and economics or a combination of both (El Tahir 2015). In the past, before the period of British colonial, the management of natural resources in Sudan was mostly carried out by local community leaders informally, including Nazirs, Sheiks, Omdas, and Sharti. However, later on, the state took over control of management from the villagers (Kobbail 2011, Kobbail et al. 2012). In Sudan, the local people in rural areas rely on using native trees that grow naturally and provide them with direct benefits. Examples of these trees include Hashab (*A. senegal*), Tebeldi (*A. digitata*), and Dom

(*H. thebaica*). This has been a traditional practice for the villagers in Sudan (Kobbail 2011).

Since 1958, Sudan has been collaborating with the FAO to improve its forestry sector. The cooperation has mainly focused on afforestation and reforestation in both irrigated and rain-fed areas, forest management, forestry extension, promotion of agroforestry, improved management of natural woodlands, and institutional support for the forestry sector (Ibrahim and Abdelmagid 2002). Notably, the participatory management of Elain reserved natural forest conservation and Elrawashda reserved forest rehabilitation has been successful, earning the trust of local communities and resulting in good forestry practices (Luukkanen et al. 2006). According to them the Elain forest in Sudan is an example of successful conservation efforts, which involved traditional leaders and forest-dependent villagers in protection of forest. The policy of actively involving local societies in management of forest has resulted in positive outcomes, including an increase in forest products and biodiversity. In contrast, an area where the policy was to prevent communities from entering the forest experienced forest degradation.

The survival of certain communities has relied on their ability to understand and adapt to their environment (Kobbail 2011). Elrawashda serves as an example of successful forest restoration, where both the communities and the Forests national corporation have benefited from the project. This successful approach has been applied to other forests reserves, such as Wad Kabo and Shasheina, both Gedaref State and Blue Nile region (Luukkanen et al. 2006). The process of increasing forest cover involves implementing reforestation and afforestation programs such as enrichment planting, involving local communities in managing tree resources, utilizing human resources to manage marginal and degraded lands, and increasing wood or other tree product production to address deficits (Glover et al. 2010). The British Government established the Sudan's Department of Forest in 1901 with the primary goal of ensuring a steady supply of wood for steamers on the River Nile (Elmahi and Abdel Magid 2002). *Acacia senegal*, commonly known as the gum Arabic tree species, is the predominant tree planted in Sudan by farmers. Forests national corporation ranging from the manager of the state forest to the forest overseer, interacts with farmers in various ways (Luukkanen et al. 2006). After rotation of forest or "bush period," the land is clean for crop cultivation (Elmqvist et al. 2005, Hammad 2010, Adam et al. 2017). Besides gum Arabic production, other Acacia-based systems of agroforestry exist in the region.

Sudan forests types according to administration system (El Tahir 2015).

(i) Federal forests refer to the forests located along the White Nile, Blue Nile region, and their tributaries, including riverine forests, as well as forests reserves found in various mountainous regions such as Jebel Marra, Nuba Mountains, Ingessana, and Fau, among others. These forests are situated 13 degrees' north latitude.

(ii) States forests that are located at a distance from rivers, as well as forests that have been registered as per the National Comprehensive Strategy (NCS), are included in this category.

(iii) Community and private forests refer to all the forests that are created or intended to be created by communities, organizations, and the private sector. Examples of such forests include those owned by Gezira Board, Company of Kennana Sugar, and Rahad Scheme. Additionally, community and private forests can also be found in places like Jebel Mara, Singa, and Mazmum, as well as other areas throughout the country.

Participation of local communities in forest management

NGOs and community-based organization (CBOs) have found Participatory Forest Management (PFM) to be a promising area for their engagement (Wily 2002). The forest policy has been advocating for the local communities' involvement in sustainable management of the forest reserves. Forestry experts are now seeking partners to share the responsibility of forest management, as economic, social, and historical factors have limited the ability of local people to fully participate in sustainable development practices on their land (Kobbail 2011). The population growth and expansion of agriculture for exporting products have led to increasing pressure on forests in recent years, causing deforestation and other issues (Kobbail 2011). To address this problem, farmers in areas have started planting trees. They have planted trees for short-term needs such as fruits, fodder, and fuelwood, as well as for long-term benefits such as gum production, timber, and to prepare for future emergencies

like urgent cash needs (Glover et al. 2010). Sudan experiences higher levels of rainfall in the southern region compared to the northern region, although the majority of the country is classified as arid or semi-arid. The forests in Sudan are crucial to the people's way of life, as they provide vital services to support their livelihoods. Around 66% of the population living in rural areas and rely on forests resources for fuelwood as primary source of energy, as well as round wood for construction purposes (Hamed and Abdel Magid (2009). According to Abdoun (2020), the participation of local communities in afforestation activities has led to a significant increase in the number of planted trees, in addition to improved protection and production of seedling. Therefore, continuing to invest in involvement of community would make a significant contribution towards achieving the strategic target. There some collaboration between FNC and community in reforestation and afforestation programme and most programme is successful implemented e.g. in Gadarif state, Blue Nile region, South Kordofan State, North Kordofan State, Gezira state and Sinnar State; but this programme exclude Darfur region due to conflicts. Sulieman (1996) stated that, when the Sudanese forestry authorities recognized the importance of involving local communities in tree planting, they assumed that the reason why villagers were not planting trees was due to a lack of knowledge and awareness of the benefits of forests. However, Taha et al. (2014) state that, natural regeneration is crucial for sustainable forest management in semi-arid woodlands that have a sufficient number of healthy mature trees.

Contribution of Forest product in poverty reduction and income generation

Sudanese forests have a significant impact on the well-being of the local population and provide a range of products such as honey, fruit, fiber, and medicines, which are particularly important for rural areas (Taha et al. 2014, Elzaki and Gang 2019). Historically, people in Sudan have relied on the resources from the forests in their vicinity (Kobbail 2011). The decision to plant trees in Sudanese farmland depends on the species chosen and how it can contribute to the income and livelihoods of rural farmers (Elzaki and Gang 2019). Sudanese people they rely on forests resources to meet the energy needs, with more than 80% of their energy coming from fuelwood and charcoal, mainly from the Hashab class of forests that contain *Acacia senegal* trees in forested areas and agroforestry systems (Adam et al. 2017). According to Elzaki and Gang (2019), trees play a significant role in providing around 30% of domestic animals' fodder needs. Given the evidence of the Sudan climate change, ecological zones and the insufficient local and foreign forests investment, suggests that adopting agroforestry technologies could make a considerable contribution to promoting sustainable forest management (El Tahir 2015).

Forest law and policy

Prior to the introduction of the Forest Act in 1989, the Forests National Corporation (FNC) in Sudan utilized the taungya system, a type of agro-forestry, as a means of managing degraded forests. This was achieved through the participatory forest management (PFM) approach (El Tahir 2015). Historically, forestry professionals were primarily trained to manage large, reserved state forests and establish plantations, while also preventing local communities from accessing these areas. However, there is now a growing recognition of the need for new strategies that emphasize community participation in forest management (Sulieman 1996).

Forest Act 1989 allows for a range of different arrangements of forest management. These include:

(i) Joint Forest Management is a significant initiative for managing forest resources. This is enabled by the Act of Forest, which allows people to enter into cooperative agreements with the government and other owners of forest. In protected and forest reserves, specific areas are allocated as community forests for the benefit of villages located inside or nearby these forests. Although no legal rights to the communities' land in reserved forests, the Joint Forest Management aims to promote the sustainable use of forests resources to meet local needs fairly, while also preserving the environment and promoting conservation. The JFM encourages the active participation of village communities in developing sustainable forest management practices, which can help to address the long-lasting challenges of land degradation and deforestation in Sudan.

(ii) Institution Forests (IF) refer to afforestation/ reforestation initiatives carried out by specific organizations on unused farmland, large irrigated areas that have been cut out, or other forms of barren land under their ownership or control.

(iii) Community Forest Management (CFM): These are

usually partnerships between FNC, NGOs, and local villagers. Local governments are permitted by law to designate and subsequently gazette village, group, or private forest reserves

The Forests National Corporation 1989 Act includes the following functions (Anonymous 1992, Sulieman 1996).

(i) To raise knowledge and understanding of forests and trees among authorities, residents, and financiers.
(ii) To increase the number of trees planted for both protection and production reasons, and to encourage people to volunteer their efforts.
(iii) Encouraging the creation of forests and providing support in the form of seedlings and guidance techniques.
(iv) To encourage the gums production, particularly gum Arabic, and to prioritize the development of other less prominent forest products.

Constrain of forest resources in Sudan

Sudan, similar to other developing nations, lacks effective policies, strategies, and legal frameworks to ensure the sustainability of natural resources (Deafalla et al. 2015). The country has a low vegetation cover and 1.6% approximately experiences an annual removal (Abdoun 2020). Additionally, the absence of secure land tenure prevents farmers from planting trees on their land. In Kordofan, land use/land cover has been impacted by several issues due to inadequate policy frameworks, the absence of integrated legislation, and insufficient

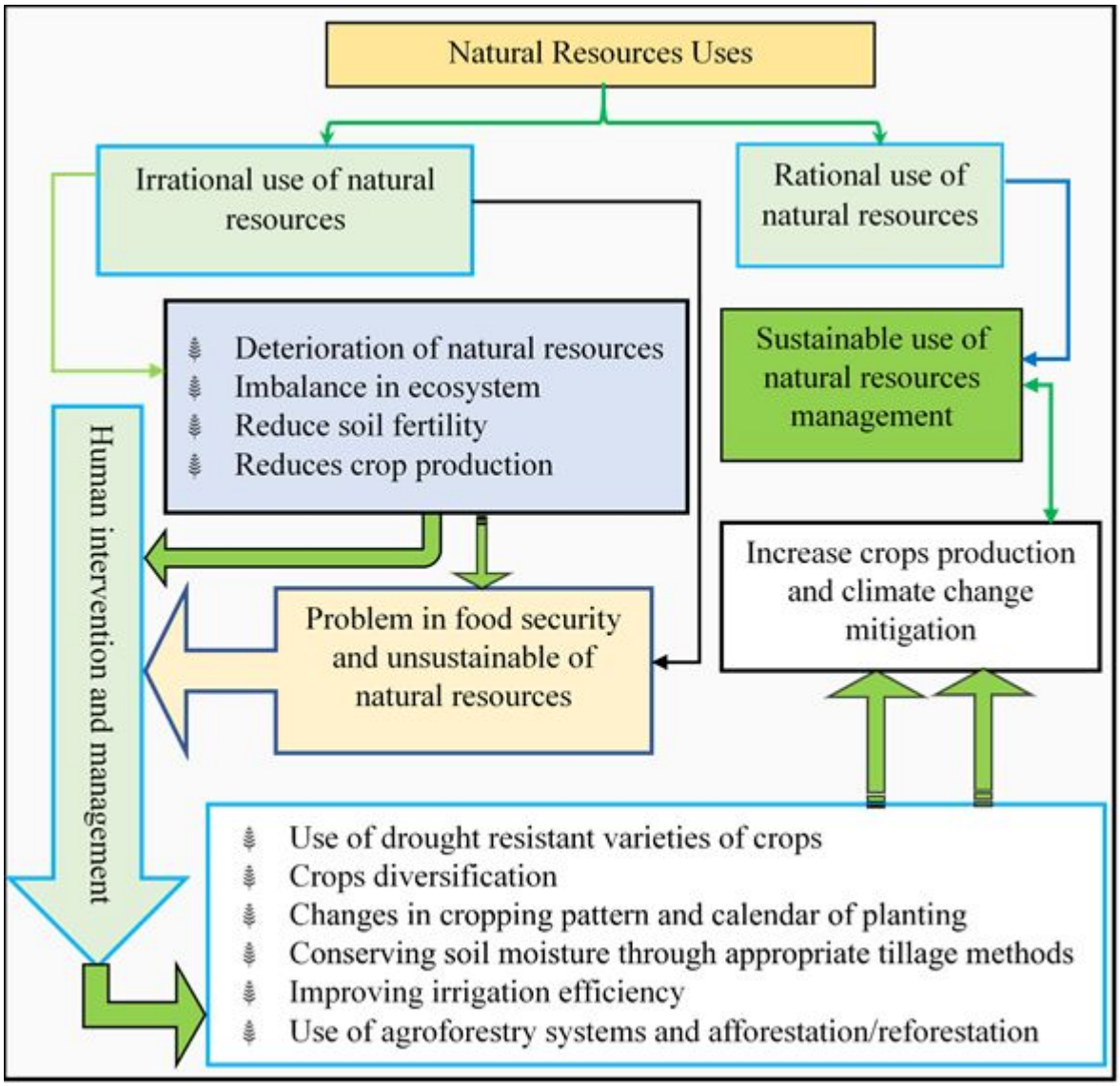

Figure 1. Efficiency use of natural resources and management framework

socioeconomic factors consideration that influence land management and conversion (Adam et al. 2017). The lack of timely and adequately mobilized funds, coupled with the absence of a national land use framework or strategic plan to manage land use effectively, is another constraint hindering the satisfaction of various sectors' needs and priorities (Abdoun 2020). All mentioned constrains by other authors could lead to unsustainable of natural resources and forest cover particularly, natural resources sustainable use of and forest resources (Fig. 1 and 2).

CONCLUSION AND RECOMMENDATIONS

Forest is home for many living organisms including human as well as provide sources of food, medicine, fodder, and other products. Additionally, represented sources of income for rural and urban communities and create employment opportunities. Forest products play significant roles in poverty reduction. Afforestation and reforestation is main way to achieve sustainable forest management. Furthermore, involvement of local people in management of forest and conservation could lead to

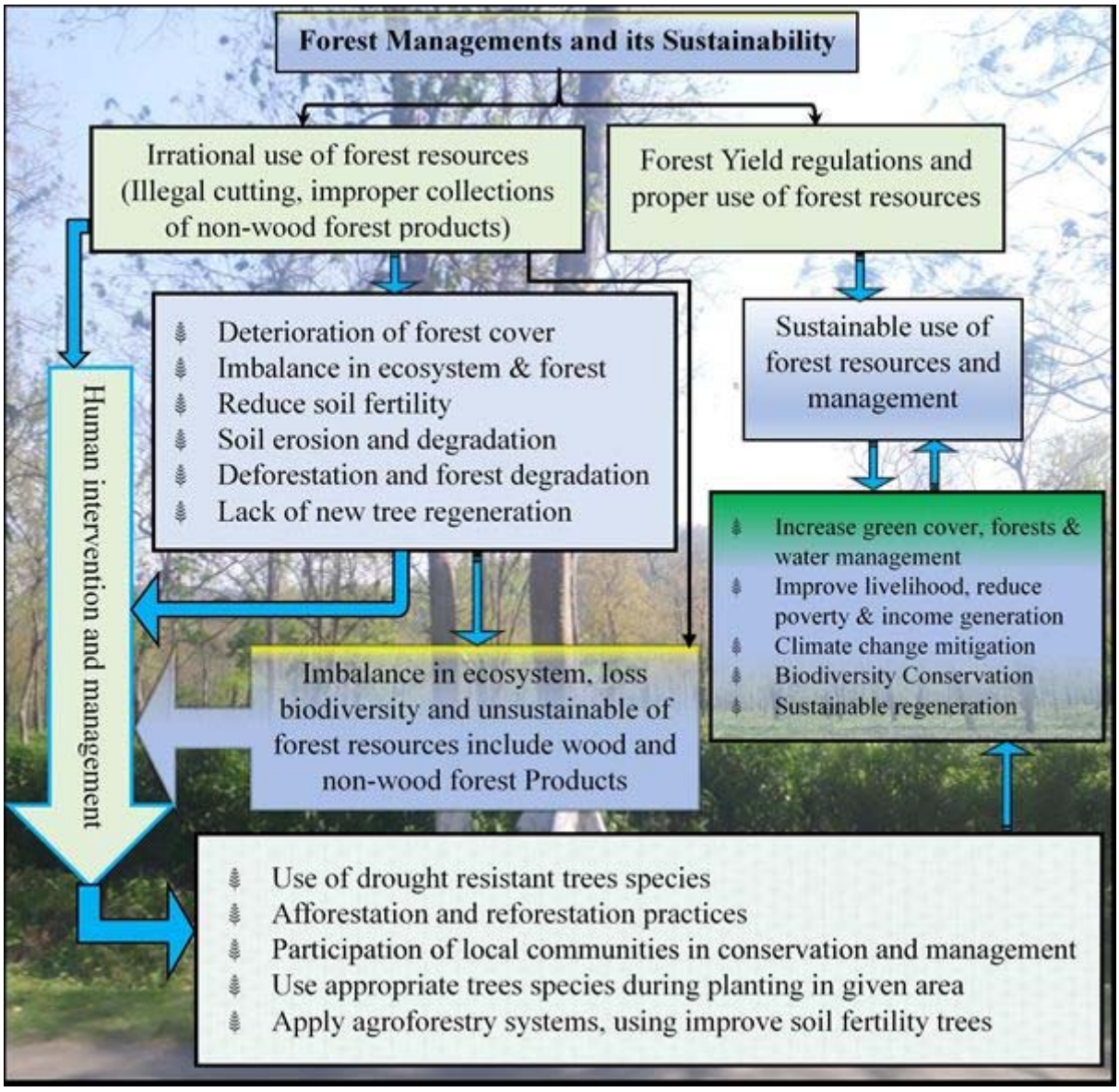

Figure 2. Forest managements and its sustainability framework

forest products protection and biodiversity, is point of view to achieving sustainable forest management.

It is recommended that the local communities should participate in forest management and conservation. Forest law should be implemented for conserving reserved forest and conservation of biodiversity. Local communities should be trained on how to conserve forest and forest product as well as restoration of degraded land and agroforestry system. It is thus suggested that the combination of knowledge sharing between Forests National Corporation and related universities to local communities must be done on priority.

Authors' contribution: Both the authors contributed equally

Conflict of interest: Authors declare no conflict of interest

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Received: 18th May 2023
Accepted: 1st August 2023