ГЛАСНИК Српског географског друштва 103(1) 433-446
BULLETIN OF THE SERBIAN GEOGRAPHICAL SOCIETY 2023

Original scientific paper
UDC 632.125 (6-15)
https://doi.org/10.2298/GSGD2301433F

Received: March 16, 2023
Corrected: March 28, 2023
Accepted: April 01, 2023

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MULTI-CROPPING: A LAND-USE PATTERN THAT SUPPORTS LIVELIHOOD ACTIVITIES AND PREVENTS LAND DEGRADATION IN SIERRA LEONE

Abstract: Land is a precious resource that requires adequate management attention to harness its potential of sustaining life and enhancing livelihood for all. The emergence of multi-cropping practices in Sierra Leone has negative and positive outcomes regarding environmental degradation. This article tries to synthesize multi-cropping land use challenges, benefits and role in tackling land degradation. The study was conducted in Mile 91 surrounding communities, Yoni Chiefdom, Tonkolili District, Northern provinces, Sierra Leone. A total of 100 respondents were randomly selected and interviewed. Additional data was collected through observation, group discussions and desktop review. The study reveals that multi-cropping practices, farming and deforestation were the main drivers of land-use change in the study. The key challenges facing the sustainable management of lands in Sierra Leone are obsolete land policies, complex land tenure system and conventional shifting cultivation practices. The land ownership system is strictly communal, with only a few families owning family bushes. The influx of recruited workers from overseas and other parts of Sierra Leone has positive and negative denotation. The study found that social problems like land confrontations, increase in food prices, school dropout rate, and dilution of traditional beliefs and norms are common in the study area. It is concluded that land-use change by multi-cropping is affecting the sustainable land management plan across the country. It is recommended that the government review past land policies and land tenure systems to tackle land confrontations soon.

Key words: West Africa, earth, land degradation, livelihood activities, multi-cropping

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Introduction

In Sierra Leone, land degradation due to poor sustainable land management practices and other land use is on the increase as a result of intensive anthropogenic activities, population increase, natural disasters and technological advancement (Etsay et al., 2019; Alemu, 2016; Belay et al., 2015; Pingali et al., 2014). The concept of sustainable land management in a developing country like Sierra Leone has gained momentum over the past decades due to the rate of environmental deterioration (Fayiah et al., 2018). According to (Alemu, 2016), sustainable land management is defined as the wise use of land resources for a win-win situation of meeting production targets for human survival and, at the same time upholding environmental sanity. Sustainable land management is the backbone of natural resource distribution, sustainable development, agriculture, biodiversity conservation and environmental protection (WOCAT, 2008). Across Sierra Leone, agricultural development and environmental sustainability are critical elements dependent on the sustainable land management approaches adopted.

The land tenure system in Sierra Leone is designed two-fold: The customary tenure system is ruled by customary law, and General Law governs the freehold tenure system. The customary law is practised in the provinces or rural areas, while the General Law is practised in the Western Area comprising Freetown and its surroundings (Hennings, 2020). The land across Sierra Leone is a fundamental factor of production that supports all livelihood activities that support human life in all spheres of society. Nonetheless, land resources are exposed to constant degradation associated with intensive exploitation of these resources due to wildfire, erosion, pollution, urbanization, agriculture, industrialization, and disease outbreak, among other challenges. Land degradation problem in Sierra Leone has existed for decades and poses a critical challenge to sustainable ecosystem function and services. Land in Sierra Leone provides valued ecosystem functions and services needed for the well-being of humanity. However, the degradation of these lands has reduced the potential ecosystem services and the socioeconomic output of these lands over the past years (Muñoz, 2018). Over the past decades, unsustainable land-use exploitation has resulted in the loss of soil fertility, biodiversity loss, a decline in food production, groundwater recharge etc. (Global Mechanism of the UNCCD, 2018; Nkonya et al., 2016; UNCCD, 2013).

The degradation of land for subsistence purpose is among the major challenges opposing global sustainable development and its effects has been felt through land pollution, biodiversity loss, decrease in soil fertility and vegetation (UNDP/WFP/GoSL, 2022). In Sierra Leone, mining, deforestation and shifting cultivation are the key culprit causing massive land degradation especially arable lands. The implication for land degradation and reduction in arable land fertility has huge production capability consequences of staple food that support sustainable livelihood of local indigenes in Sierra Leone (UNDP/WFP/GoSL, 2022).

The plantation of multiple plants has emerged as a sustainable land-use pattern capable of decreasing environmental atrocities in Sierra Leone while at the same time enhancing the productivity of these lands for economic development (Aruna et al., 2022). The most common multicropping plantation establishments in Sierra Leone are; forestry woodlot plantations, sugar cane for biofuels, palm oil, cashew nut, cocoa and coffee plantations (Aruna et al., 2022; Bald and Schroeder, 2011; Maconachie, 2018). The economy of Sierra Leone is hugely dependent on agricultural activities because 60% of the population is directly or indirectly engaged in agricultural activities on a subsistence or commercial basis

(FPRI, 2012). Mining operations in Sierra Leone orchestrate another major disruption to livelihood activities and land degradation. Rigorous mining activities in Sierra Leone have resulted in fertile arable lands being converted to unproductive lands unfit for agricultural purposes and other productive land-use activities.

The end of the 11 years of civil war in Sierra Leone saw a rise in the investment of plantations around the country (Grainger, Konteh, 2007). Although the initial plans for the establishment of plantations are profit-making, the venture is helping to prevent land degradation around the country in diverse ways. For instance, the Miro Forestry Company operates over 16.000 hectares of land with forestry trees and has employed approximately 2.000 workers. The company is expanding at a rate of 1.500 to 3.000 hectares per annum hence combating land degradation indirectly. Sunbird company produces ethanol through sugar plantations established in the north of the country. Besides the ethanol produced, the plantation help decreases the deforestation rate in the country (Dana et al., 2021). Another plantation established in the southern part of Sierra Leone is SOCFIN, a multinational oil palm agribusiness company that has been operating since 2011 and has acquired 18, 473 hectares of land and has transformed close to 13,000ha of lands into industrial oil palm plantations (Phoenix et al., 2019). Although the primary aim of SOCFIN investment was profit-making, however, the indirect benefits are enormous in preventing land degradation and vegetation clearance. A recent study by (Aruna et al., 2023) tried conceptualizing the influence of large-scale like that of Miro Forestry Plantation forests and SOCFIN oil palm plantation on variations in the socio-demographic physiognomies in local communities in Sierra Leone (Tagoe et al., 2020).

Despite the international efforts being put in place to tackle land degradation in developing countries, comprehensive studies on sustainable land management in Sierra Leone is unreachable and scanty if available. Therefore, this article is poised to explore the effects of plantation land use change on rural livelihood and sustainable land management challenges faced by land use practitioners. This publication tries to synthesize plantation land use change benefits and challenges faced in tackling land degradation. The article further pays keen attention to the multicropping plantation's role in protecting the environment from various degradation activities. The paper is poised to answer the following research questions 1) do plantation multicropping activities enhance livelihood activities in Sierra Leone? 2) which type of benefits does plantation multicropping provide for nearby communities? 3) how will land-use change help prevent land degradation? 4) what are the challenges posed by land-use change activities and how can these challenges be overcome to ensure the management of lands sustainably?

Material and Methods

Research area

Sierra Leone is situated in West Africa and is classified as a low-income country with approximately 7.8 million people (Statistics Sierra Leone, 2022; World Bank, 2020). Sierra Leone's central coordinates are – 6055'-10014'N and 10014'-13017'W, located on the West African Coast (Fayiah et al., 2022). The Republic of Liberia borders the country in the south and southeast, Guinea by the northeast, and North Atlantic Ocean by the West. Sierra Leone's land area is approximately 72.300 sq. Km with two pronounced seasons. The dry

season seasons start in November and ends in April, while the rainy season starts in May and ends in October, respectively (Wadworth et al., 2019).

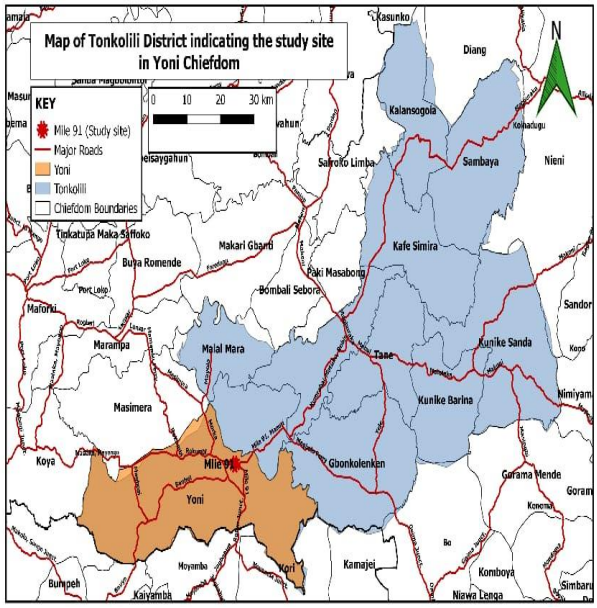

Fig. 1. Map of Sierra Leone

The country is among the ten least developed nations, and its Human Development Index is ranked 182 out of 189 (UNDP 2020). Most of the population lives on barely US$ 2.0 a day due to abject poverty (UNDP, 2020), and the country's economy is 70% dependent on subsistence and commercial agricultural activities. Crop lands are the most widespread in Sierra Leone, covering 61.22% of the country's national territory (NBSAP, 2017; GoSL, 2018). A map of Sierra Leone and a map of the study area are shown in the figure (Figure 1, Figure 2).

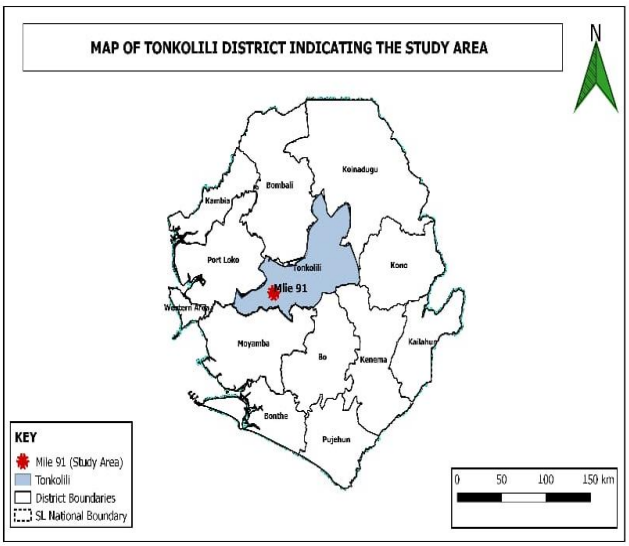

Fig. 2. Map of Study area

The study was conducted in Mile 91, Yoni Chiefdom, in Tonkolili District, Northern provinces, Sierra Leone. Tonkolili is located at an elevation of 112m above sea level on latitude 8°40″ North and longitude 11°40 West (Kainyande et al., 2022; GoSL, 2017; Crokimba, 2013). Tonkolili District cover an area of 5.391 km2. Over the past years, the company has developed initial pilot scale veneer, sawmilling and edge glue board production operations, among other wood related productions.

Methodological approaches

The study relied on both primary and secondary sources of data. Secondary sources of information included literature from published articles, manuals, reports, and other publications from the internet. The primary sources of data required information from respondents through interview and filling of questionnaires on the topic of study. The questionnaire for respondents included questions that made it possible to assess: age, education, gender; demographic characteristics of respondents; drivers of land-use change; sustainable land management challenges; major livelihood activities provided; major livelihood activities of the residents; land ownership structure in the study area; recommended sustainable land – use measures by respondents; social problems associated with plantation establishment. The random sampling technique was adopted for the study. A total of 100 respondents were interviewed across the study area. A well-structured questionnaire was used as the data collection strategy to source relevant information needed for the study. Other data collection approach adopted during the study was oral interview, observation and group personal discussion with relevant stakeholders. Collected data was systematically sorted to extract key and useful i-Target Population. The target population for this study was the community stakeholders, farmers, land holding families, company workers, other local authorities within Mile 91 situated in Tonkolili District. The explanation for sampling these set of respondents is that they are involved in various land use activities as well as land allocation. The data analysis approach adopted for this study is descriptive in nature and relies on data collected from respondents through the use of closed-ended questionnaires. Collected data was analyzed using the Statistical Package for Social Sciences (SPSS), SPSS Version 28 and Microsoft EXCEL.

Results

About 42% of the respondents fell within the age bracket of 18- 30 yrs. Another 40% fell within the ages bracket of 31 - 45yrs. Only 18% of the respondents fell within the age range of 46yrs and above (Table 1).

Tab. 1. Demographic Characteristics of Respondents (N=100)

Demographic Characteristics		Descriptive Statistics Test			
		Male		Female	
		N	%	N	%
Age	18-30	32	32	10	10
	31-48	30	30	10	10
	46 above	10	10	8	8
Education	Non-formal	25	25	5	5
	Primary	30	30	8	8
	Secondary	15	15	10	10
	Tertiary	5	5	2	2
Marital status	Single	25	25	15	15
	Married	30	30	15	15
	Widow	10	10	5	5
Occupation	Farmer	30	30	1	1
	Trader	20	20	12	12
	Company staff	15	15	2	2
	Civil servant	10	10	2	2
	Driver/Motorist	8	8	0	0
Family size	0-3	30	30	5	5
	3-6	40	40	5	5
	6-9	15	15	10	10
	9 & above	9	9	1	1

This age range was useful in giving vital information based on experience. Most respondents had non-formal (30%) and primary education (38%). Most of the respondents were married (45%) and engaged in trading (32%). According to (Figure 3), multicropping, farming and deforestation were the main drivers of land-use change in the study. The establishment of Miro Forestry Plantation within the study area adds to farming and other anthropogenic activities driving land use change within the Mile 91 environment. These land-use change activities are the key source of livelihood activities for residents of the area.

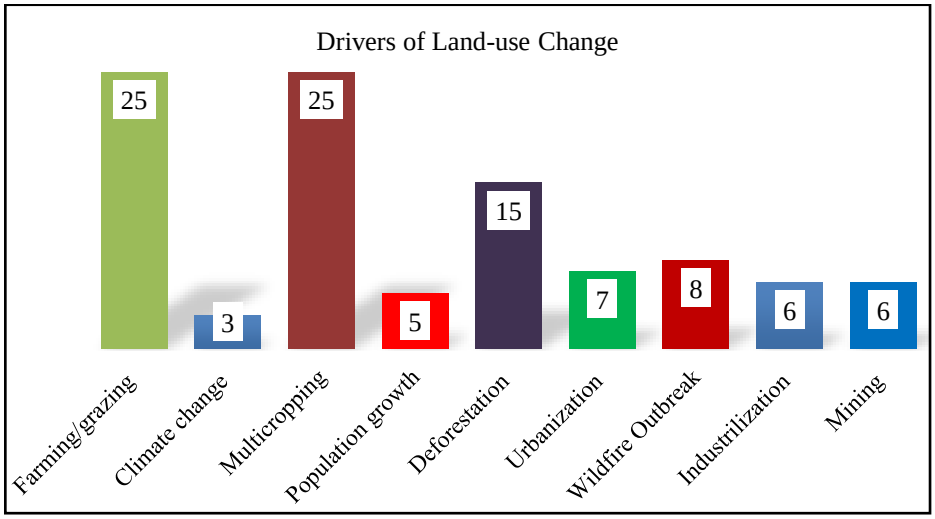

Fig. 3. Drivers of land-use change

The judicious use of land resources within the study area is being hampered by anthropogenic activities, the complex land tenure system, natural disasters, and infrastructural

expansion, among other sustainable land management challenges (Figure 4). Since the study area is a rural settlement, subsistence farming, charcoal burning, pole harvesting, animal grazing, and fuel wood collection are critical to providing income, energy, food and shelter (Armstrong et al., 2021).

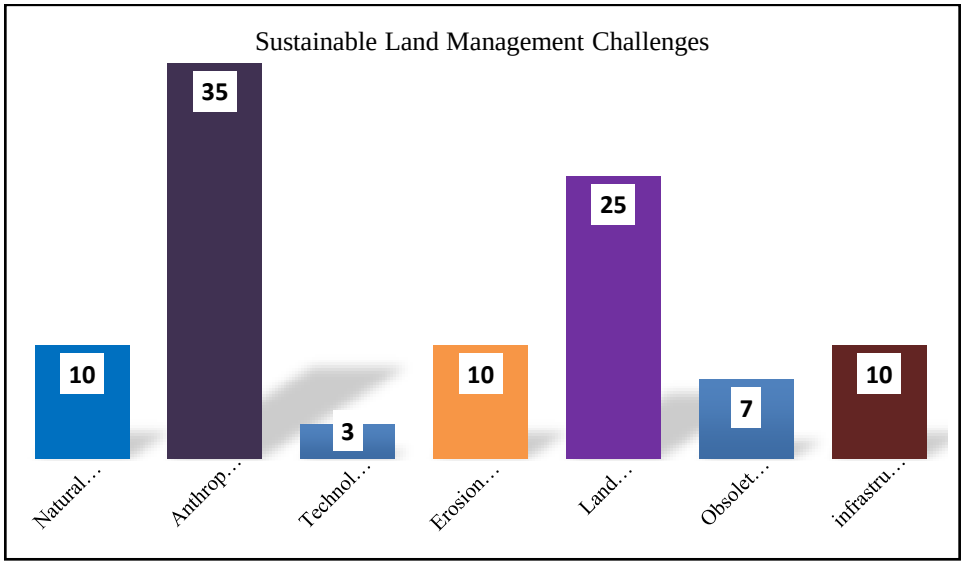

Fig. 4. Sustainable Land Management Challenges

The Miro Forestry Company Ltd has been providing livelihood support as part of the company's corporate social responsibility (CSR) for the establishment of forestry plantations on the lands of the local people. Employment, health facilities, educational support, income and food supplement are some corporate social responsibility activities to offset land owner's welfare (Table 2).

Tab. 2. Major livelihood activities provided by Miro Forestry Company

Major livelihood support activities provided by Miro Plantation Company	Descriptive Statistics Test		
	Sex	n	%
Employment	Male	70	70
	Female	30	30
Education (materials and scholarship	Male	65	65
	Female	35	35
Health facilities	Male	60	60
	Female	40	40
Water	Male	60	60
	Female	40	40
Income through royalties & lease agreement	Male	75	75
	Female	25	25
Food	Male	55	55
	Female	45	45
Social amenities like Community center & Barry	Male	50	50
	Female	50	50

The study finds that the major sources of livelihood are derived from activities such as farming (30%), employment from companies (25%), livestock grazing (10%), trading (10) etc. Most residents who couldn't get employment from the company due to age and

other fitness criteria are engaged in activities like hunting, blacksmithing, charcoal burning and trading (Fig. 5).

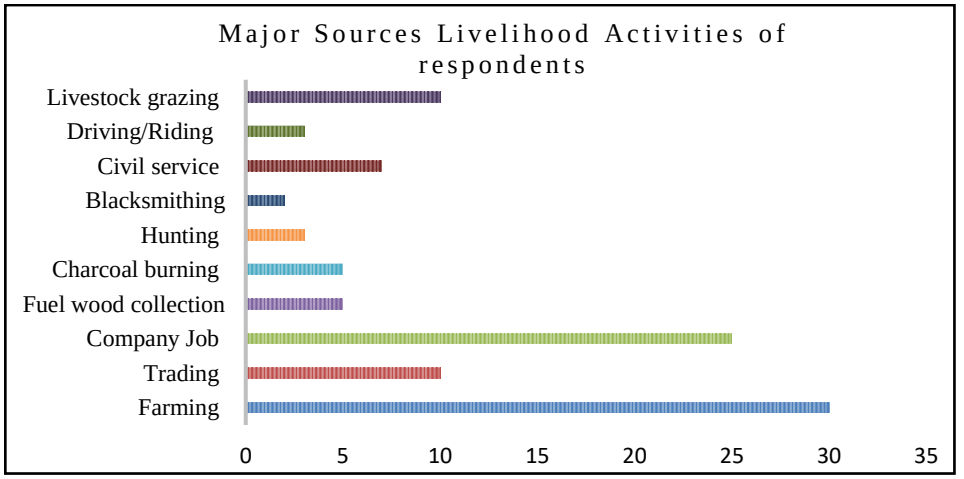

Fig. 5. Major livelihood activities of the residents

The land tenure or ownership structure of the study area is presented in (Figure 6) below. The study finds that most of the land ownership pattern in the study area is communal (60%) in nature. Communal lands are lands that belong to the community instead of an individual. Another land ownership pattern discovered is inheritance (20%), purchase (10%), among other land acquisition pattern in the study area.

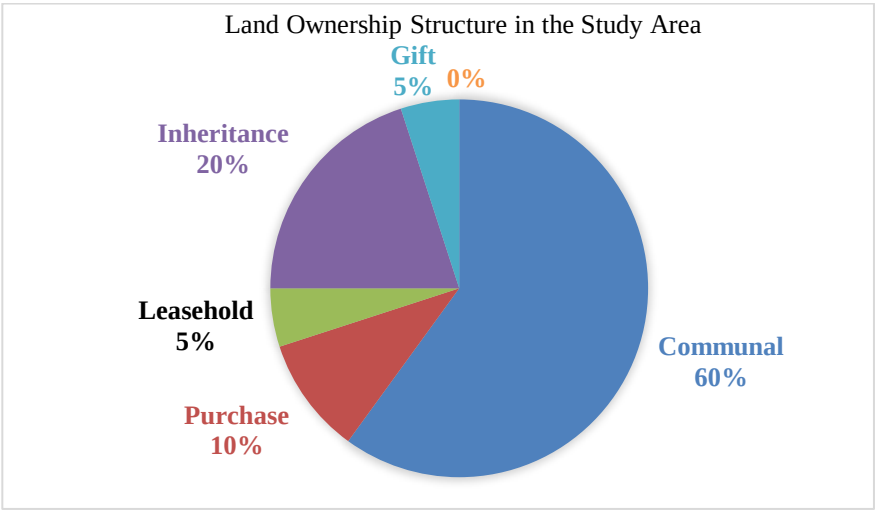

Fig. 6. Land ownership structure in the study area

The influx of recruited company workers into these communities have both positive and negative impact on the way of life of residents. Findings from the research revealed that the establishment of the forest plantations triggered some social problems in surrounding communities (Mekonnen, 2016). These problems include frequent land confrontations, high school dropout rate, sicknesses outbreak, and increased crime (Figure 7).

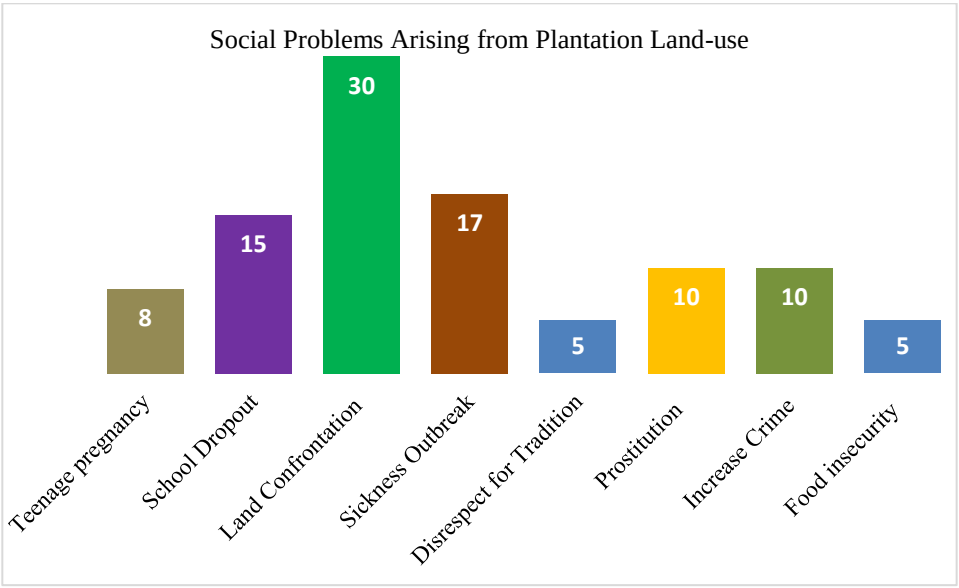

Fig. 7. Social problems associated with Plantation Establishment

Group discussions and oral consultations with respondents proposed the following options to help tackle the land-use degradation problem in the study. The key recommendation was to design sustainable land-use bye-laws (30%), review the land tenure system in the country (22%) and conduct thorough consultations of stakeholders (20%) on all land matters (Table 3).

Tab. 3: Recommended Sustainable Land –use Measures by respondents

Proposed Sustainable Land-use Measures	Frequency	Percentage (%)
Review land tenure system	22	22
Design sustainable land-use bye laws	30	30
Consult all stakeholders on land matters	20	20
Institute a land use plan for the country	15	15
Enforce present land management policies	13	13
Total	100	100

Discussion

In a developing country like Sierra Leone, the land remains an important livelihood source for most of the population, especially those in rural areas. Sierra Leone's Gross Domestic Product (GDP) relies heavily on agriculture in the form of farming, fishery and animal husbandry that is only practised on lands (Hennings, 2020; FAO, 2019; Statistics Sierra Leone, 2016). Land use change is fundamental across societies worldwide due to food production, minerals, industrialization, and urbanization. Land-use activities have led to massive land degradation, especially in developing countries like Sierra Leone. Land use change has both positive and negative implications in societies. For instance, plantation multi-cropping land-use change pattern indirectly protects the environment from further degradation, as in the case of Miro Forestry Company plantation. Nonetheless, these land-use practices are challenging the sustainable management of land resources across the country. On the other

hand, land-use change results in environmental degradation, pollution, biodiversity loss and a decline in ecosystem services.

Respondents' main drivers of land use change are agriculture, multi-cropping, deforestation and wildfire. These land-use changes are the principal culprit behind the degradation of the environment in the study area. The findings of (Phoenix et al., 2019; Hennings, 2020) lend credence to this discovery. This could be attributed to the dominance of the grassland ecosystem in the study area. As such, wildfire ignition during the dry season is eminent because residents use wildfire as cheap labour, energy and a tool for hunting. This assertion is in line with (Hansen et al., 2016), who reported that land grabbing in Sierra Leone is facilitated by wildfire outbreak. The land ownership structure practised in the study area is that of customary law (Njoh et al., 2012). In this land tenure system, the land belongs to the community, not the state, and the paramount chief is given jurisdiction on behalf of the community (Shakya et al., 2016). However, individuals in the community can acquire a piece of land through inheritance, gift, lease, among other options. These findings align closely with the Local Government Act, and Chiefdom Council Act (2004) of Sierra Leone. This land tenure system gives the local community, through their paramount chief the right to negotiate the lease of lands to investing companies for industrial purposes for 25 or more years. However, the land holding family's benefits more than other stakeholders in the community. Investors also exploit the poor economic situation of local areas by making alluring promises of development opportunities. The vulnerability of local people to land investors is further undermined by poor governance at the national level and external politico-financial interest in favour of such investments. Local populations are vulnerable to organized campaigns of land acquisitions by multi-national companies. Proper legal and institutional frameworks are required to protect local interests in these land deals (Yengoh et al., 2016).

According to the research, natural disasters, complex land tenure system and intensive anthropogenic activities are among the principal challenges facing the sustainable land management plan in Sierra Leone. The recent spark in natural events like landslides and flooding across Sierra Leone is escalating the impossibility of managing land resources sustainably. In addition, the country's socioeconomic status is forcing citizens to engage in activities that contradict the sustainable management of land resources (Dana et al., 2021). These activities range from charcoal burning, infrastructure construction, and unsustainable farming approach among other challenges (Aruna et al., 2022). In addition to these activities, obsolete land policies over the years has expose land resources to degradation. The findings align with the review findings of (Alemu, 2016) on the sustainable land management challenges. The use of land resources to acquire food, build infrastructure, obtain income and enhance industrialization serve as the sources of land degradation and stumbling blocks in managing lands sustainably in Sierra Leone.

Land-use change practices within the company operation areas have also affected land ownership pattern in the study area. Large private agricultural projects are described by their promoters as "win-win" partnerships: investments supposedly make it possible to increase agricultural productivity in developing countries, and to create thousands of jobs in the industry (Palliere et al., 2018). This finding corresponds with the investigation done by (Phoenix et al., 2015) using the SOCFIN plantation in the south of Sierra Leone as a case study. Limited land availability to farm has affected food sufficiency, education, traditional beliefs, health and other social orders (Baird, 2020; Phoenix et al., 2015). Although there

are few social problems reported officially to authorities, the company's growth will, in the long term, create social cohesion among company workers and the community. As the company expands, more land confrontation, crime increase, disease outbreaks, and school dropout problems will emerge (Baird, 2020). However, the company's presence has reduced land grabbing and other illegal land acquisition activities within the study area (Personal communication with the town chief).

Nonetheless, Miro Forestry Company has been honouring its Corporate Social Responsibilities (CSR) by providing assistance in the form of scholarship for school going pupils, employ indigenes to work on the plantation site, provide income in the form of royalties and lease payment, provide water and health facilities among other benefits (Aruna et al., 2023). This finding corresponds with the result obtained from the study conducted by (Aruna et al., 2022) on Miro Plantation Company. The authors classify the benefits derived from the plantation to be direct and indirect in nature. Another study conducted by Aruna et al., (2023) argue that plantation or multi-cropping influence the socio-demographic changes in the form of education, migration, population, employment and household income (SLDHS, 2014). However, the land holding families are said to benefit more than any other stakeholders in the study area. The company has been digging water wells, providing ambulance for emergency health services, building community infrastructure like community centres, public toilets and many more. Respondents recommended the following measures; review land tenure system, institute sustainable land-use bye laws, consult all stakeholders on land matters and develop a land use plan for the country.

Conclusion

Land degradation due mainly to multi-cropping and other land-use change activities is evident in Sierra Leone. Its severity and scale has been on the increase over the past decades across the country. The land is an irreplaceable resource that has been supporting life since time immemorial. The sustainable management of land resources in Sierra Leone is faced with diverse challenges, such as land-use practices, intensive anthropogenic activities, and natural disasters. The establishment of the plantation has direct and indirect benefits for surrounding communities and stakeholders. Direct benefits comprise income, employment, education assistance, infrastructure development, water and health facilities etc. The indirect benefits include climate amelioration, carbon market, road construction and an increase in vegetation cover. The study finds that plantation multi-cropping activities can potentially support the livelihood of surrounding communities through the income derived from salaries, royalties, lease payment, and other cooperate social responsibilities. The productivity of the farming systems will be greatly increased by adopting suitable crop combinations and respective plant populations. Tree crops such as cocoa and coffee, which demand a longer rainy season, are cultivated in the forest zone. Still, mango, citrus, avocado, papaya, and guava, which can withstand drier circumstances, are grown in regions with little rainfall and shorter growing seasons. Higher production and greater financial gain for farmers are ensured by using enhanced crop types. The major livelihood activities in the study area are farming, trading, fuelwood, employment from the company and charcoal burning.

Most of the respondents contacted fell within the age range of 18-30, had primary education, were mostly married and were traders and farmers by occupation. In the rural part of

Serra Leone, youth are encouraged to marry early to build a sustainable workforce for the family. The high illiteracy rate in rural areas forces local residents to engage in farming or trading, requiring little or no formal education. Moreover, the high literacy rate of respondents could be attributed to the belief that school is for urban settlers or the rich class in society. In Sierra Leone, two-thirds of women within the age range of 15-49 and men 14-49 barely have formal education. Over the past decades, land-use practices have affected the sustainable land management plan due to population growth, farming, mining, urbanization, livelihood and technological advancement. It is recommended that the land tenure system or ownership structure of the study area be revised. Stakeholders should ensure that revenues from the plantation are shared equally among community members in the study area. The country's agro-climatic areas need to be redefined in light of important factors like rainfall, the growing season, and related socioeconomic situations. Such an all-encompassing approach might help identify farming systems related to these zones, or even only a portion of them, providing a foundation for mapping out farming systems across the nation.

Conflicts of Interest: The authors declare no conflict of interest.

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