International Journal of
Environmental Science
(IJES)

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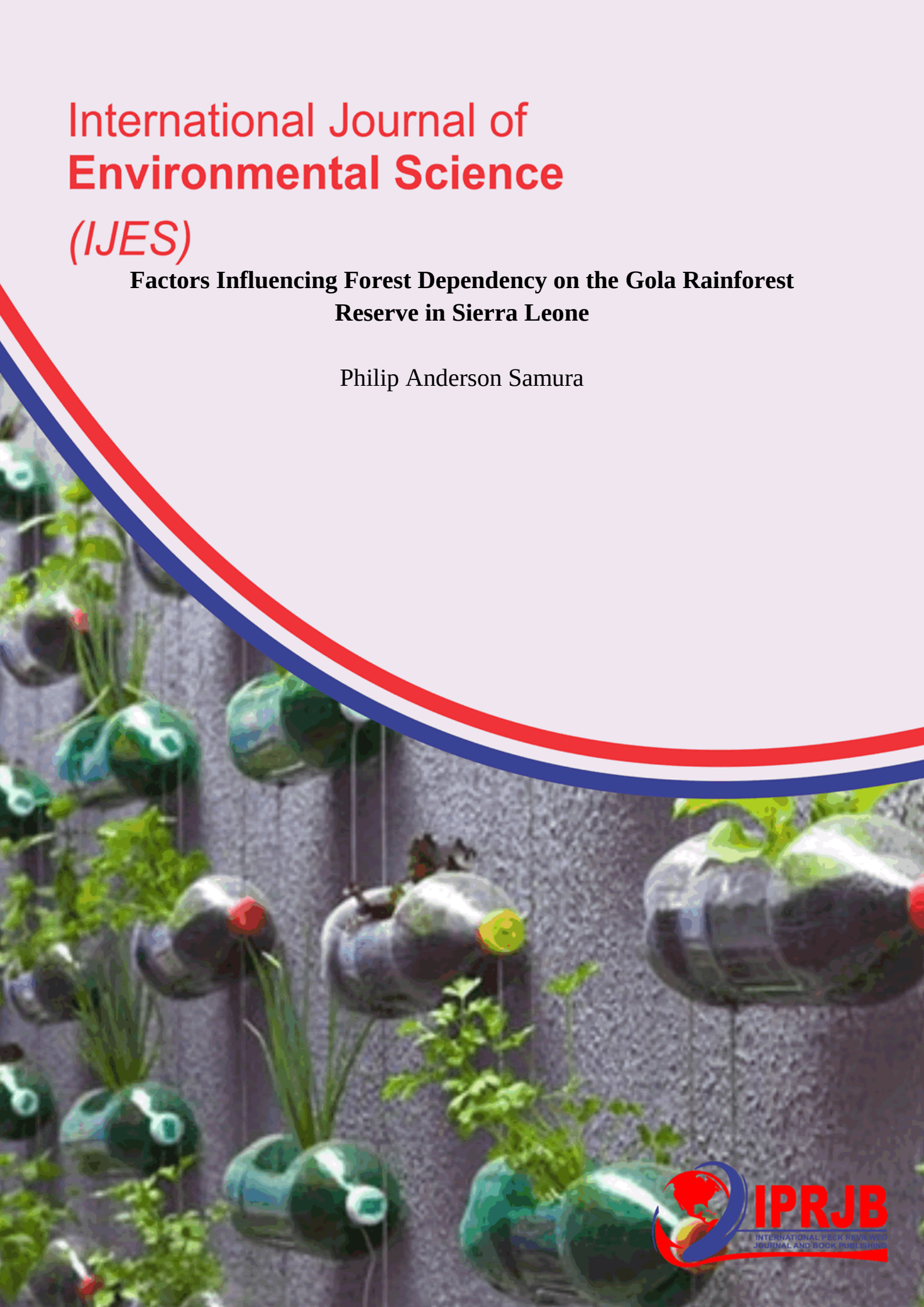

IPRJB
INTERNATIONAL PEER REVIEWED JOURNAL AND BOOK PUBLISHING

International Journal of Environmental Sciences
ISSN 2519-5549 (online)
Vol.7, Issue 1, No.2. pp 21 - 42, 2024

www.iprjb.org

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Article History

Received 18th March 2024

Received in Revised Form 27th March 2024

Accepted 30th March 2024

Abstract

Purpose: Forests are under intense human pressure due to a high level of dependency. Understanding socioeconomic and demographic incentives surrounding forest dependence is critical to mitigating the adverse impacts of forest degradation in Africa. Therefore, this study examines the factors promoting household forest dependence in Sierra Leone's Gola Rainforest Reserve through four research questions: (1) What is the contribution of forest income relative to total household income? (2) What are the key sources of relative forest income? (3) How do gender, age, and education influence forest dependency? (4) What factors drive dependence on forest resources?

Methodology: The study's target population was rural households living near the Gola Rainforest Reserve in Gaura and Tunkia Chiefdoms in the Kenema district. The study used convenience sampling. A questionnaire and an interview guide were used for data collection. It drew from 101 survey responses analyzed using descriptive and inferential statistics, binary logistic regression on S.P.S.S., and then —seven expert interviews and three focus group discussions explored with thematic analysis on Google Docs. The study used tables and figures for data presentation.

Findings: The study's results showed four key findings. First, forest income accounts for 46% of monthly household income in the sampled community. Second, the top five sources of forest income are cocoa (74%), moringa tea (9%), timber wood (4%), forest spices (4%), and forest fruit and vegetables (3%). Third, age, education, and gender influence forest dependence. Fourth, livelihood and direct consumption are the key factors driving dependence on forest resources. Therefore, the study recommended that decision-makers and conservationists consider socioeconomic factors like gender, age, education, and livelihood when designing forest management projects, strategies, or policies.

Unique Contribution to Theory, Practice, and Policy: The study's outcome contributes to the growing literature on forest dependency. It provides key insights into the significant contribution of forest resources to household income. Analyzing the influence of socio-demographic factors, like gender, age, and education, on forest resources enhances the understanding of resource-use patterns. This study allows forest conservationists, government decision-makers, and academics to develop projects, policies, and strategies from an informed perspective, considering socio-economic realities, to promote sustainable forest management practices in Sierra Leone and other developing countries to mitigate deforestation.

Keywords: *Dependency, Deforestation, Education, Mixed Methods, Sierra Leone*

INTRODUCTION

Forests are significant to human existence. They are defined as "land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land predominantly under agricultural or urban land use" (Food and Agriculture Organization [F.A.O.] 2020). According to F.A.O. (2020), there are four forest categories: (1) tropical, (2) subtropical, (3) boreal, and (4) temperate. Despite the categories, forests minimize disaster risk, sequestrate carbon, enhance human livelihoods, provide food and drinking water, and conserve and protect biodiversity (World Bank, 2021). Forest contributions to humans are so significant that they continue to be under intense human pressure due to a high level of dependency.

Humans depend highly on forest resources. About 1.8 billion people worldwide depend directly on the forest to meet some portions of their livelihoods, and more than 200 million rely entirely on forest resources to meet every portion of their livelihoods (Chao, 2012). According to F.A.O. (2022), the forest sector accounts for 1% of the global employment (33 million people). In 2015, the forest sector accounted for over $1.52 trillion of the world's gross domestic product (G.D.P.) (F.A.O., 2022). Around 3 to 6 billion people support their livelihoods with non-timber forest products (N.T.F.P.s), and around 3 billion rely on forest products like wood and charcoal for their cooking energy (F.A.O., 2022). This high dependence on forest resources has contributed to an increase in deforestation.

The rate of deforestation has increased due to forest dependence. Deforestation is "the conversion of forest to other land use independently, whether human-induced or not" (F.A.O., 2020). From 1990 to 2022, the world lost more than 420 million hectares (ha) of forest (F.A.O., 2022), and Africa accounted for the highest annual deforestation in the last decade (F.A.O., 2020). The high rate of Africa's annual deforestation is due to the high demand for fuelwood, agriculture, and population and economic growth (Njora & Yilmaz, 2022; Josephat, 2018). In developing countries, including those in Africa, the main reason for deforestation is human reliance on forest products (Soe & Yao-Chang, 2019). Like many other countries, Sierra Leone continues to experience increased deforestation.

Deforestation is high in Sierra Leone. The country exemplifies West Africa's high-level deforestation (United Nations, 2021). Forest area accounted for 38% (2,726,000 ha) of Sierra Leone's land area (F.A.O., 2009), as cited in Butler (2011). Sierra Leone lost about 34% of its forest cover from 1975 to 2018 (Government of Sierra Leone, 2021). Some factors influencing deforestation in Sierra Leone include slash-and-burn agriculture, logging, cultivated land expansion, and mining (Government of Sierra Leone, 2021; U.N., 2021). These factors are driven by human reliance to either generate income to meet their livelihoods or consume forest products directly or indirectly.

Problem Statement

The Gola Rainforest possesses a high level of biodiversity. It is the largest remaining Upper Guinean Rainforest, a vast forest that once extended from Guinea to Togo (Abu-Kpawoh, 2017). Its total cover is around 700 km^2 (UNESCO, 2022). It is divided into three sections: the north, center, and south blocks, located in seven chiefdoms across the Kenema, Kailahun, and Pujehun Districts (Abu-Kpawoh, 2017). It has over 970 species of plants, with over 599 endemic to this region (UNESCO, 2022). The forest is inhabited by over 49 species of mammals, notably the renowned Pygmy Hippopotamus and Western Chimpanzee (UNESCO, 2022). The area is also a habitat for around 313 avian species, of which approximately 18 are of concern for global conservation (Abu-Kpawoh, 2017). Six of the 43 amphibian species in the Gola Rainforest are classified as threatened or vulnerable (Abu-Kpawoh, 2017).

Despite being a hotspot for biodiversity in Sierra Leone and West Africa, the Gola Rainforest faces significant human pressure due to dependency on its resources. As a result, the annual rate of forest cover loss is around 4.21%, 4.18% for community forests and 0.03% for the Park forest (Abu-Kpawoh, 2017). Unfortunately, as of the time this study was conducted, there was little or no study that analyzed the socio-economic factors influencing forest dependence in rural communities adjacent to the Gola Rainforest Reserve. This knowledge gap makes it challenging to develop sustainable forest management projects, strategies, or policies considering socio-economic realities. This underpins the significance of understanding factors influencing household reliance on forests for long-term sustainable forest management and conservation (Gunatilake, 1998; Hegde & Enters, 2000). This is a crucial step toward developing specific interventions to reduce forest reliance, and developing policy and sustainable management strategies (Babulo et al., 2008; Fikir et al., 2016).

Therefore, this study aims to understand the factors influencing household forest dependence and its implications for sustainable forest management practices in rural communities adjacent to the Gola Forest, Sierra Leone. Understanding these factors will assist forest conservationists, government decision-makers, and academics in developing interventions from an empirical point of view to promote sustainable forest management practices in Sierra Leone and developing countries, especially in Africa, to combat deforestation.

Research Questions

The undermentioned questions guided the study:

- What is the contribution of forest income relative to household income?
- What are the key sources of relative forest income?
- How do gender, age, and education influence forest dependency?
- What factors drive dependence on forest resources?

Research Objectives

The research was guided by the following objectives:

- To determine the contribution of relative forest income to household income;
- To classify the sources of relative forest income;
- To identify the socioeconomic factors that influence household forest dependency;
- To assess the reasons for forest dependence.

Literature Review

Forest dependence literature is growing. This is partially due to the degradation of forests in developing countries, primarily due to high dependability (Soe & Yao-Chang, 2019). The impacts of forest degradation include emissions of greenhouse gases, loss of biodiversity, soil erosion, and disruptions of livelihood (Kideghesho, 2015). These consequences are so severe that Ntiyakunze and Stage (2021) explain that the literature on forest dependence is receiving increasing attention to promote sustainable forest management practices. This literature review critically analyzes the existing literature on forest resources and identifies gaps the study aims to fill. It is divided into the following sections: forest dependency and forest income, socioeconomic factors influencing forest dependency, research gaps, and theoretical framework.

Forest Dependency and Forest Income

There is a small but growing literature on forest dependency. However, the definition of forest dependency, generally, is complicated because all human beings, in one way or another, rely on forest products/services. This reliance is through forests' provisioning of ecosystem services such as carbon sequestration, disaster risk mitigation, food and clean drinking water, and timber or non-timber products (Khan & Saimun, 2021). In its simplest form, forest dependency refers to the human-forest relationship characterized by humans' reliance on forest products for livelihood and non-livelihood activities (Khan & Saimun, 2021). These livelihood activities may generate income.

There are two categories of forest income. Adam and EL Tayeb (2014) categorized forest income into *relative* and *absolute* forest income. Pattanayak et al. (2003) define *absolute forest income* as the total income derived from forest products. On the other hand, relative forest income refers to the proportion of the total income that the forest contributes. Measuring the contribution of absolute forest income to household income is difficult (Adam & EL Tayeb, 2014). This could be because there are other sources of income like agriculture, off-farm activities, livestock, informal mining, etc., which may also contribute to household income (Fekadu, Soromessa, and Dullo, 2021). Therefore, this study uses the relative forest income approach by Fekadu, Soromessa, and Dullo (2021) to measure the forest's contribution to the total household income in the study location. This is because the study's goal is to assess the economic contribution of forests to rural communities living near and around the forest rather than comparing and contrasting countries, which mainly entail the forest dependency indexes (FDI) and relative forest income (RFI) (Mirza & Szirmai, 2010; Howe et al., 2014).

Socioeconomic Factors Influencing Forest Dependency

Using the forest dependency literature as a guide, the socioeconomic conditions of households affect their reliance on forest resources. This study reviews existing studies (see, for example, Adam and EL Tayeb, 2014; Baiyegunhi et al., 2016; Chhetri et al., 2013; Fonta & Ayuk, 2013; Lepetu, Alavalapati, and Nair, 2009; Ntiyakunze & Stage, 2021; Htun, Wen, & Ko Ko, 2017; Mujawamariya & Karimov, 2014; Garekae, Thakadu, and Lepetu, 2017; Ofoegbu, 2017; and Ntiyakunze and Stage, 2022) who contributed significantly to investigating socioeconomic factors influencing forest dependability. However, the variation in these findings underscores the need for additional research to critically examine the influence of socioeconomic factors on forest dependence.

For instance, age influences forest dependability. Garekae, Thakadu, and Lepetu's (2017) findings state that a unit increase in age reduces the likelihood of forest reliance. This is because the extraction of forest products is labor intensive, and young people may have more strength to undertake this activity than their older counterparts. Young people also have multiple uses for forest products (Lepetu, Alavalapati, and Nair 2009). This finding is consistent with studies from Adam and EL Tayeb (2014), Chhetri et al. (2013), Fonta and Ayuk (2013), Htun, Wen, & Ko Ko (2017), and Lepetu, Alavalapati, and Nair (2009). However, the finding contrasts with Ofoegbu (2017) and Baiyegunhi et al. (2016), whose result indicates that older people are more likely to depend on forest resources than their younger counterparts. The contrary views about the influence of age on forest dependence remain one of the most heated debates on social factors. Thus, there is a need for more research to investigate age and household forest dependence.

Also, education predicts forest dependence. Adam and EL Tayeb (2014) found that educated people are more likely to depend on forest resources. This finding is counterintuitive, and it is contrary to Fonta and Ayuk (2013), Garekae, Thakadu, and Lepetu (2017), Lepetu,

Alavalapati, and Nair (2009), Baiyegunhi et al. (2016), Chhetri et al. (2013), Mujawamariya and Karimov (2014), Htun, Wen, & Ko Ko (2017), Fonta and Ayuk (2013), and Ofoegbu (2017) whose findings indicate that formal education reduces the likelihood of forest dependability. This is because education presents an opportunity for better job opportunities, which may decrease the probability of the educated participating in direct forest-dependent activities like fuelwood collection, charcoal production, harvesting of non-timber forest products, etc. (Lepetu, Alavalapati, and Nair, 2009). The variation in education's role in forest dependability calls for more investigation.

Moreover, gender remains one of the most controversial topics in forest dependency. Ntiyakunze and Stage (2021) found that male-headed households are less likely to depend on forest products than female-headed households. This finding is consistent with Garekae, Thakadu, and Lepetu (2017), whose result shows that women depend more on forest resources due to their limited education and livelihood opportunities. This contradicts the findings of Adam and EL Tayeb (2014) and Lepetu, Alavalapati, and Nair (2009), who suggest that men rely more on forest resources. This is because the harvesting of some forest products is highly prohibited, and there may be some risks or dangers of wild animals; men, in contrast to women, are more likely to risk going into the forest despite the prevailing inhibitors (Lepetu, Alavalapati, and Nair, 2009). These contradictory findings present a need for thorough research on gender and household forest dependency.

Research Gaps

From the above literature review, the study identified two research gaps that support future research. These gaps are the generalization of forest income to three forest-dependent categories and the conflicting or contradictory nature of the socio-economic factors influencing forest dependence.

First, the level of forest dependence varies. This variability is partly due to the proximity to the forest and the type of forest-dependent people (traditional and indigenous communities living within the forest, farmers and other rural communities living near and around the forest, and people living outside the forest) (United Nations Department of Economic and Social Affairs & United Nations Forum on Forests Secretariat, 2021). The existing body of knowledge on forest income has generalized forest income to the three forest-dependent categories using rural households or communities. Studies (see, for example, Angelsen et al., 2014; Mukul et al., 2016) argue that forest incomes in developing countries are significant pillars of rural livelihoods and contribute to meeting the subsistence need and the generation of income from forest resources for rural households. It is not clear whether the income is for traditional and indigenous communities living within the forest, rural communities living near and around the forest, or people living outside the forest. These categories are not homogenous; thus, specificity is needed. Therefore, this study categorizes relative forest income to rural communities near and around the forest. This knowledge is significant to the debate about forest dependence variability.

Second, the influence of socioeconomic factors on the forest dependency literature is contradictory. The existing literature (see, for example, Adam and EL Tayeb, 2014; Baiyegunhi et al., 2016; Chhetri et al., 2013; Fonta & Ayuk, 2013; Lepetu, Alavalapati and Nair, 2009; Ntiyakunze & Stage, 2021; Htun, Wen, & Ko Ko, 2017; Mujawamariya & Karimov, 2014; Garekae, Thakadu, and Lepetu, 2017; Ofoegbu, 2017; and Ntiyakunze and Stage, 2021) provides substantial evidence which supports socioeconomic influence on forest dependability. However, as stated in the literature review section, this evidence is conflicting. For instance, findings from Garekae, Thakadu, and Lepetu (2017) indicate that women depend more on

forest resources than their male counterparts. In contrast, Adam and EL Tayeb (2014) and Lepetu, Alavalapati, and Nair (2009) find that men depend more. Considering the contradictory nature of the findings from these studies, there is a need for further research on how age, education, and gender influence forest dependability to contribute to the global discourse on socio-economic factors and forest dependency. This research gap supports the need for context-based and geographic-location studies. Because there is no study regarding the socio-economic factors influencing forest dependency in the study location, it is crucial to undertake this study.

Theoretical Framework

This study is grounded on the Resource Use Theory. Firey (1960) propounded the Resource Use Theory. It identifies three conditions—cultural, economic, and ecological—that interact with each other and influence local people's perception of the resource system (Adam & EL Tayeb, 2014). Balancing these three resource conditions (cultural, economic, and ecological) against one another to achieve conservation goals and economic development remains a crucial challenge (Firey, 1960), and these two targets (conservation goals and economic development) should not be mutually exclusive. Firey (1960) elaborates that local people's attitudes towards conservation can be positive and negative, depending on the benefits they would derive from the resource system and the cost. Adam and EL Tayeb (2014) state that there are differences among social groups in their perception and need concerning resources; therefore, their attitudes towards resource systems also differ. Adam and EL Tayeb (2014) used this theory to guide their study of Forest Dependency and its Effects on Conservation. The Resource Use Theory provides a theoretical guide for this study because forest dependency can be attributed to cultural, economic, and ecological factors, influencing households' attitudes toward the resource system based on benefits and costs.

Drawing on the resource use theory and the literature review, the undermentioned framework (see Figure 1) is developed to analyze the impact of forest dependency on sustainable forest management practice in the Gola Forest.

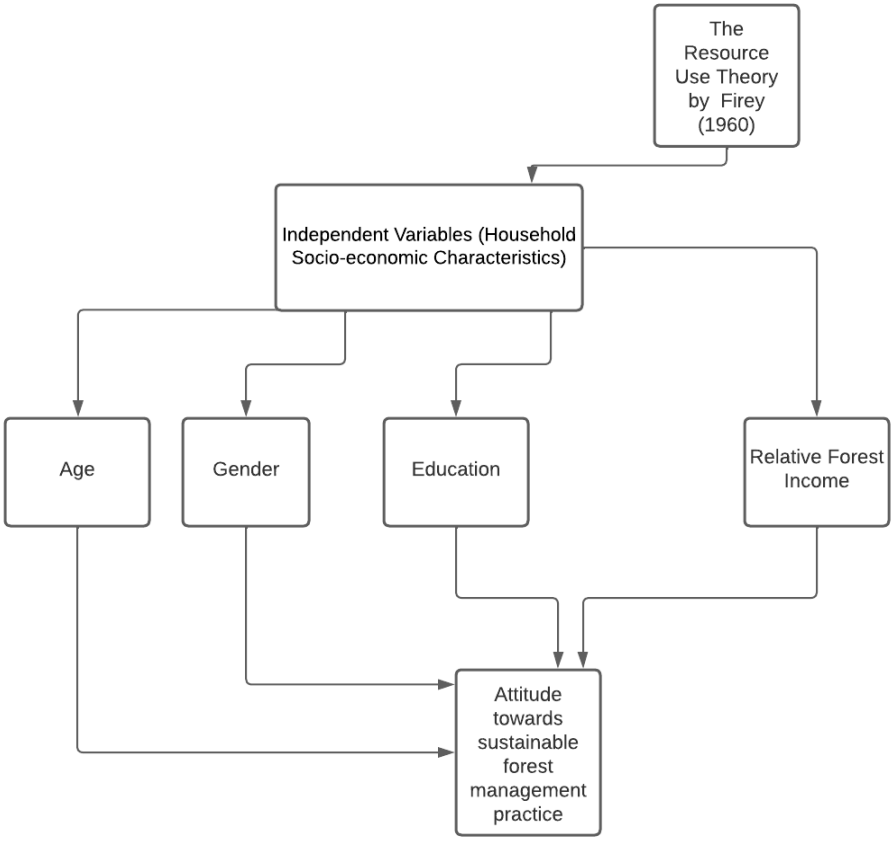

Figure 1: Theoretical framework

This framework is built upon two interconnected models. First, the influence of socio-economic factors such as age, gender, education, and household size on forest dependability (relative forest income), and second, the influence of forest dependability on household attitudes towards sustainable forest management practices.

In conclusion, the growing literature on forest dependence has contributed significantly to the knowledge of sustainable forest management. However, because communities are heterogeneous, the literature on forest dependence contains numerous variations and contradictions. To avoid generalizing existing knowledge to the Sierra Leone context, this study will present a case study of the Gola Forest in Sierra Leone. Decision-makers, forest conservationists, academics, and civil societies will use the findings of this study to promote sustainable forest management practices in Sierra Leone and the rest of the world.

Research Methods

This section presents the study's research methods. It has six subsections, including the research design and target population, sample size and sampling, method of data collection, participants, and method of data analysis.

Research Design and Target Population

Descriptive and correlational designs are used in this study. The descriptive design describes respondents' demographics and socioeconomic factors influencing forest dependability. The correlational design helped predict the influence of the independent variables on the dependent variables. Thus, descriptive and correlational designs are used in this study to describe the variables and predict the relationships between the independent and dependent variables. The

study's target population was rural households near or adjacent to the Gola Rainforest across Tunkia and Gaura chiefdoms. Around 54,271 (Tunkia 36,054 and Gaura 18,217) individuals live across these chiefdoms (Statistics Sierra Leone, 2015).

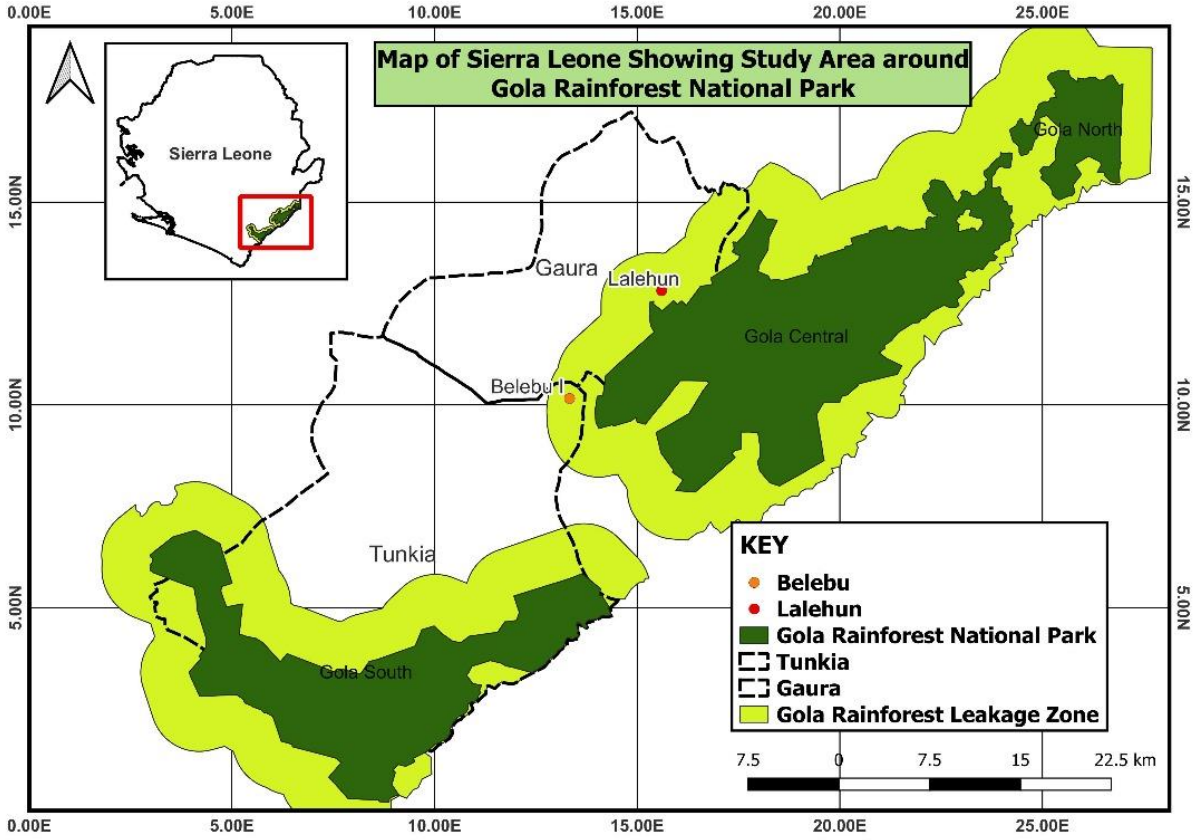

Figure 2: Map of the Study Area

Sample Size and Sampling

The study calculated the sample size using Slovin's formula. It calculates sample sizes of unknown population variabilities (Tejada, Raymond, & Punzalan, 2012). The population size used is 54,271. The study used a non-probability sampling method through convenience sampling to gather data from easy-to-reach and available individuals (Taherdoost, 2016). It is less time-consuming and saves costs but could be more objective (Horton, 2021).

Table 1: Sample Size Calculation

Meaning	**Formula**	**Calculations**
n= Sample size N= Population e= margin of error	n= N/1+ N (e)2	n= 54271/ (1+ 22000*0.1)2 n= (0.1)2 *54271+ 1= 543.71 n= 54271/544=99.7 **n=100**

Method of Data Collection

The study employed a mixed-method data collection technique through triangulation. First, quantitative data was collected through a survey. Three trained data collectors administered the structured questionnaire through a Google Form. A total of 101 responses were collected from

participants in the study location. Second, qualitative data was collected through 7 interviews and three focus group discussions. The triangulation method, which utilizes multiple data collection sources, provides a multidimensional perspective of forest dependability (Thurmond, 2001). This multidimensional perspective contributes to the study's depth and breadth and helps reduce bias.

Participants

Two groups of participants participated in the study for quantitative and qualitative data collection. One hundred and one participants from Tunkia and Gaura chiefdoms participated in the study for quantitative data. Four vital demographic characteristics (age, gender, education, and income) were used to categorize these participants. For instance, participants' minimum age is 20, whereas the maximum is 62. The average age for this study is 38 years. Also, the minimum income is 0, and the maximum is SLE 5.000. The average monthly income based on the median is SLE 400. Moreover, the majority of the participants have no formal education (52.5%), followed by participants with primary education 24.8%, participants with secondary education (14.9%), and finally, participants with tertiary education (7.8%)

Twenty-seven participants participated in the qualitative data collection. These participants are divided into seven experts (expert interview) and 20 local community members (focus group discussions). The experts have a high level of education relative to local community members. The minimum expert education level is undergraduate, and the maximum is graduate (Master's). On the other hand, a significant portion of the participants who participated in the focus group discussions were without formal education, and those with formal education attained their highest level of education in secondary school. This mixture of educated and uneducated (formal education) participants provided unique perspectives to the study's results.

Method of Data Analysis

The study used quantitative and qualitative data analysis techniques. Descriptive and inferential statistics using S.P.S.S. and Google Sheets were used for the quantitative analysis. Inferential statistical analysis predicted the impact of the explanatory variables on the outcome variables through a logit model. Three factors informed the use of the logit model: large sample, binary dependent variable, and multiple independent variables. Several studies (see, for example, Adam and EL Tayeb, 2014, and Garekae, Thakadu, & Lepetu, 2017) have used the logit model to predict the impact of the explanatory variables on the outcome variables based on the factors above. Descriptive statistical analysis helped describe participants' demographics (gender, education level, and age). Thematic analysis was used for the qualitative analysis.

Results

This section presents the study's results. The study's four crucial results are (1) the level of relative forest income's contribution to total household income, (2) the critical sources of relative forest income, (3) the influence of gender, age, and education on forest dependency, and (4) the factors driving dependence on forest resources.

Result 1: The Level of Relative Forest Income's Contribution to Total Household Income

The study used the relative forest income framework. Fekadu, Soromessa, and Dullo (2021) measured relative forest income by dividing the total forest income (T.F.I.) by the total household income (T.I.) with the formula RFI = TFI/TI. Tables (2, 3, 4) explain the relative forest income for communities adjacent to the Gola Forest; visit Appendix 2 for more details.

Table 2: Total Household Incom (Monthly)

Income Activity	Monthly contributions (Nle)	Monthly contributions (USD)	Percentage (100%)
Agricultural income	196, 650	9,957	47.0%
Forest income	193, 244	9,785	46.2%
Livestock income	16, 790	850	4..0%
Other income	11, 590	587	2.8%
Total Household Income (Nle)	418, 274	21,179	100%

The table above presents the total household income. It includes four categories of income activities (agriculture, forest, livestock, and other). Table 2 indicates that the total household income is Nle 418, 274 (USD21,179), and agricultural income of 47% and forest income of 46% are the main contributors to the total household income.

Table 3: Total Household Forest Income (Monthly)

Forest activity	Monthly contributios (Nle)	Monthly contributions (USD, as of July 31st 2023)	Percentage (100%)
Forest coffee income (F.C.I.)	143, 570	7,269	74.2%
Moring tea income (M.T.I.)	17, 320	877	8.9%
Timber wood income (T.W.I.)	8, 509	431	4.4%
Forest spices income (F.S.I.)	7, 110	360	3.7%
Forest fruit and vegetable income (F.F.V.I.)	5, 870	297	3.0%
Construction material income (C.M.I.)	3, 000	152	1.6%
Miscellaneous good income (M.G.I.)	2, 935	149	1.5%
Bush meat income (B.M.I.)	2, 540	129	1.3%

Medicinal plant income (M.P.I.)	2, 050	103	1.0%
Honey and beeswax income (H.B.I.)	340	17	0.2%
FGI forest grazing income (F.G.I.)	0	0	0%
FWI fuel wood income(F.W.I.)	0	0	0%
CI Charcoal income (C.I.)	0	0	0%
TGI thatch grass income (T.G.I.)	0	0	0%
MBI mats and baskets income (M.B.I.)	0	0	0%
Total Forest Income (T.F.I.)	193, 244	9,785	100%

Table 3 presents 15 categories of forest income. These 15 categories contribute Nle 193,244 (USD9,785) to the total forest income. F.C.I., M.T.I., T.W.I., F.S.I., and F.F.V.I. comprise the top five and account for about 94.2% or Nle 182,379 (USD9,594) of the total forest income. OANDA Currency converter was used to get the USD Value as of July 31st, 2023.

Table 4: Relative Forest Income

Meaning	**Formula**	**Calculations**
RFI= Relative Forest Income TFI= Total Forest Income TI=Total Income	RFI= TFI/TI	RFI= 193244/ 418274 RFI= 0.46200338*100 RFI= 46.2%

Relative Forest Income (RFI) = Total Forest Income (TFI)/Total Income (TI)

RFI= **46%**

This indicates that relative forest income accounts for 46%, around Nle193,244 (USD9,785) of the monthly household income. It is the second highest contribution to household income, behind agriculture, with 47% around Nle196,650 (USD9,957). The qualitative data through focus group discussions and interviews supported this finding.

Result 2: The Key Sources of Relative Forest Income

The study examined fifteen different sources of forest income. From the fifteen sources of forest income, the top five sources of relative forest income are below in Table 5.

Table 5: Sources of Relative Forest Income

Sources	Income (Nle)	Income (USD)	Percentage %
Cocoa	143,570	7, 269	74.2%
Moring tea	17,320	877	8.9%
Timber wood income	8,509	431	4.4%
Forest spices income	7,110	360	3.7%
Forest fruit and vegetable income	5,870	297	3.0%
Total	182,379	9,594	94.2%

The table shows the top five contributors to relative forest income. These sources account for 94.2% about Nle182,379 (USD9,594) out of Nle193,244 (USD9,785). The remaining ten products only account for 5.8%, around Nle10,865 (USD550). When triangulated by the interview and focus group discussion, the validity of this finding was confirmed. Most residents rely on these products to generate income to enhance their livelihood. This is why cash crops contribute more than products for domestic consumption. The subsequent section, after the table, explains the influence of gender, age, and education on forest dependency.

Result 3: The Influence of Gender, Age, and Education on Forest Dependency

The study used a binary logistic regression analysis model to predict the influence of gender, age, and education on forest dependency. Male was coded zero, and female was coded one as dummy variables. No formal education, primary, secondary, or tertiary, was coded as dummy variables. The outcome variable is dichotomous, meaning one if forest dependency exists and zero if it does not.

The model is a good fit for running the analysis. First, the classification tests show that the predicted variable's percentage of accuracy (P.A.C) is 70.3%. This means the model's predictive capability is 70.3% correct. Second, the Omnibus Tests of Model Coefficients show that the Chi-square is 24.993 with 5 degrees of freedom and a p-value of <.001, which is statistically significant. Thus, the model is a better fit for the prediction. Third, the model summary indicates that Cox & Snell R Square is 0.219 and Nagelkerke R Square is 0.300. This means that the predicted variables explain between 21.9% and 30% of the variance in the dependent variable. The tables below show the influence of gender, age, and education on forest dependency (see Appendix 3 for more details), and the subsequent paragraphs present the findings.

Table 6: Socio-Economic Factors Influencing Forest Dependency on The Gola Rainforest Reserve

Variables	β	S.E.	Wald	d.f.	Sig.	Exp(β)
Gender	**-1.883**	.572	10.853	1	**<.001**	**.152**
Age	**.033**	.031	1.116	1	**.291**	**1.033**

No Formal Education (1)	**-2.040**	.949	4.617	1	**.032**	**.130**
Primary (1)	**-1.978**	1.009	3.845	1	**.050**	**.138**
Secondary (1)	**-.832**	1.066	.609	1	**.435**	**.435**
Constant	**.428**	1.501	.081	1	**.775**	**1.535**

β=regression coefficients which stand for the odds ratio of the probability of success to the probability of failure; SE=standard error of the estimate; Wald= the probability of significance of the independent variable with a unit increase; d.f.=degrees of freedom; Sig=statistically significant at 0.05 level of significance; Exp (β)=odds ratio (probability of success/probability of failure).

The table presents three main findings. Males depend more on forests than females. The regression coefficient of -1.883 depicts that being a female decreases the likelihood of relying on the forest by 1.883 units. The odd ratio of 0.153 indicates that females have 15.2% of being dependent on the forest relative to men. With a p-value of <.001, the data is statistically significant. Thus, gender is an essential predictor of forest dependency, and females rely less on the forest than males. Findings from the interview and focus group discussion confirmed that males depend more on forest resources than females.

Age is not a significant predictor of forest dependency. 0.033 regression coefficients mean that an increase in age increases the likelihood of forest dependency by 0.033 units. The 1.033 odd ratio signifies that a year increase in age increases the chance of forest dependency by 3.3%. As much as a relationship exists between age and forest dependency, a p-value of 0.291, greater than 0.005, depicts a weak age prediction. Thus, age does not significantly predict forest dependency.

In addition, education, especially no formal and primary education, significantly predicts forest dependency. People with higher education tend to rely less on forests than those with lower education. The odd ratio of 0.130 and 0.038 respondents with no formal education and primary education have a 13.3% and 13.38% probability of not relying on forest resources relative to those with tertiary education with 30.32%. The next section presents the factors driving forest dependence.

Result 4: The Factors Driving Dependence on Forest Resources

Understanding factors influencing forest dependence is critical to promoting sustainable forest management. This study deployed the interview data collection method and obtained data from seven participants through a semi-structured interview. The interviews were recorded and later transcribed for analysis. During the transcription, 20 codes were generated, and six codes formed the foundation for analysis. The six codes (income generation, inadequate job facilities, food, medicine, shelter, and clothing) are used to generate the themes (livelihood activities and direct consumption) for the analysis. Thematic analysis, a qualitative method, was performed to examine the data closely and identify common themes and patterns. This type of analysis is vital to assess people's views, experiences, or knowledge from qualitative data. The subsequent table and section present the results from the thematic analysis and findings.

Table 7: Reasons for Dependence on Forest Resources

Codes	Themes
1.1 Income generation 1.2 Inadequate job facilities	1. Livelihood activities
2.1.Food 2.2 Medicine 2.3 Shelter 2.4 Clothing	2. Direct Consumption

Livelihood Activities and Direct Consumption

From the thematic analysis, it is clear that there are two main reasons for forest dependency. People rely on forest resources to enhance their livelihood through income-generation activities like harvesting and selling cocoa products to the public. This is due to the need for more job facilities within communities. Also, they depend on the forest resources to directly consume food, medicine, shelter, and clothing. Sustainable forest management interventions should focus on striking a balance between conservation and human needs. The following section discusses the study's results.

Discussions

The study showed that forest contributes 46.2% of total household monthly income, around Nle 193.244. This reveals the high household dependence on forest resources. Specific drivers for this high reliance on forest resources are the high rate of unemployment and poverty found within communities adjacent to the Gola Rainforest Reserve. As a result of poverty and unemployment, communities turn their attention to natural resources, especially forests, to meet their livelihood demands through income-generating activities. The following section analyzes the sources of forest income.

The findings revealed five primary sources of relative forest income. These sources are cocoa (74.2% or Nle 143,570), moringa tea (8.9% or Nle17,320), timber wood (4.4% or Nle8,509), forest spices (3.7% or Nle7,110), and forest fruit and vegetables (3.0% or Nle5,870). The top five sources account for 94.2% of Nle 182,379 out of Nle 193,244. The remaining products only account for 5.8%, around Nle 10,865. When triangulated by the interview and focus group discussion, the validity of this finding was confirmed. Most residents rely on these products to generate income to enhance their livelihood. This is why cash crops contribute more than products for domestic consumption. This indicates a need for alternatives to reduce overreliance on these resources and prevent the extinction of these products. It is crucial to note that socio-economic factors like gender, age, and education influence the reliance on forest resources. The following paragraph discusses these factors.

The study's result demonstrated that gender, age, and education influence forest dependency. Males rely more on forests than females. This finding aligns with Adam and EL Tayeb (2014)

and Lepetu, Alavalapati, and Nair (2009), whose results show that men depend more on forest resources than women due to selective harvesting. However, this contradicts Garekae, Thakadu, and Lepetu (2017), whose findings state that women rely more. Males' heavy reliance on forest products is due to the patriarchal nature of utilizing forest products in the study location. For instance, women have limited access to participate in timber harvesting due to access to finance and other factors. They participate actively in small-scale harvesting for domestic consumption. Specific drivers for this are the social construction of gendered domestic activities that keep women at home for more hours per day, the dangers for women walking far in remote areas, and childcare responsibilities that limit women's mobility into forests.

For age, a unit increase in age increases the likelihood of forest dependency. Therefore, older people have become more dependent on the forest. However, age is not a statistically significant predictor of forest dependency. The result is consistent with Ofoegbu (2017) and Baiyegunhi et al. (2016), whose result indicates that older people are more likely to depend on forest resources than their younger counterparts. However, this is in contrast to Adam and EL Tayeb (2014), Chhetri et al. (2013), Fonta and Ayuk (2013), Garekae, Thakadu, and Lepetu (2017), Htun, Wen, & Ko Ko (2017). A possible explanation is that young people are likelier to embark on rural-urban migration and attain quality education. This diversifies their livelihood options and makes them less reliant on forest products.

On the other hand, both non-formal and primary education are significant predictors of forest dependence. People who fall within these categories depend more on forest resources than those with tertiary education. However, secondary education is not a significant predictor of forest dependency, even though obtaining a secondary education decreases the likelihood of not depending on the forest. Therefore, an increase in education decreases the likelihood of forest dependence. This finding aligns with findings from Lepetu et al. (2009), Fonta and Ayuk (2013), Garekae, Thakadu, and Lepetu (2017), and Baiyegunhi et al. (2016), who argued that higher education provides sustainable employment opportunities, which prevent people from extracting resources from the forest. The following subsection discusses the reason for forest dependency using thematic analysis.

The study's thematic analysis revealed that Livelihood activities and direct consumption are the main reasons for forest dependence. First, forest-adjacent communities are poor. They rely on the forest to meet most of their financial and non-financial needs. As a result, they harvest forest products and sell them to generate income to enhance their livelihoods and take care of themselves and their families. Therefore, livelihood activities, such as forest plantation and timber logging, are fundamental reasons they rely on forest resources. Chao (2012) notes that around 1.1 to 1.8 billion of the global population directly depend on forest resources for some sections of their livelihoods, and over 200 million depend entirely on forest resources for their livelihoods. F.A.O. (2022) expanded this by stating that the forest sector employs around 33 million people, and about 3.5 billion to 5.7 billion people utilize non-timber forest products (N.T.F.P.s) to support their livelihoods.

Second, people rely on forest resources for direct consumption. Considering proximity and cheap labor, people harvest forest resources for their direct use. These resources include but are not limited to fruits and vegetables, pepper, spices, wood, charcoal and firewood, and medicinal herbs. These resources provide forest communities with food, shelter, clothing, and medicine. F.A.O. (2022) states that about 2.6 billion people depend on traditional fuels and wood for household cooking energy. Forests' role in promoting direct consumption in communities is significant. The following section presents the study's conclusion.

Conclusion

The study's results reveal that socioeconomic factors contribute to forest dependency. These factors include gender, age, education, and livelihood activities. For gender, males rely more on forests than females. For age, older people, like young people, rely on forest resources. For education, an increase in it decreases the probability of depending on forest resources. Livelihood activities like forest and agricultural plantations reinforce forest dependency.

Recommendations

Based on this study's findings, decision-makers and conservationists should consider socioeconomic factors when designing forest management projects or policies. Community members should be encouraged to attain higher levels of education by making it accessible and affordable since higher education reduces the likelihood of forest dependency. Also, there should be job training programs and alternative livelihood support for both genders, especially males, to reduce their high level of dependency. In addition, stakeholders, including governmental bodies, should prioritize forest conservation and develop eco-friendly income-generating activities. Moreover, efforts should be concentrated on creating awareness about sustainable harvesting methods and introducing techniques that minimize waste during direct consumption. These findings would help promote sustainable forest management practices in the Gola Rainforest Forest Reserve and contribute to the growing literature on forest dependency.

Acknowledgment

The author is grateful to his capstone supervisor, Dr. Laine Munir, for her invaluable support through insightful feedback from proposal to defense. This research could not have been conducted without the contribution of Dr. Sue Snyman, who helped in developing the research topic and narrowing the scope; Mr. Kwame Norvixoxo, who contributed to the author's theoretical knowledge and practical skills through his Research Symposium courses; the African Leadership University School of Wildlife Conservation and the M.A.V.A. Foundation which provided financial support for the author's studies through the M.A.V.A. Scholarship for Young Conservation Leaders; and Mr. Edward Kamara, Mr. Vandy Lansana, and Mr. Mohamed Feika who helped with data collection.

REFERENCES

Abu-Kpawoh, J.C. (2017). Deforestation in Gola Forest Region, Sierra Leone: Geospatial Evidence and a Rice Farmer's Expected Utility Analysis - https://www.proquest.com/openview/01d240f082f5f485abfdb66f54d44eff/1?pq-origsite=gscholar&cbl=18750.

Adam, Y.O. & El Tayeb, A.M. (2014). Forest Dependency And Its Effect On Conservation In Sudan: A Case Of Sarf-Saaid Reserved Forest In Gadarif State. Agriculture & Forestry, Vol. 60 Issue 3: 107-121, 2014, Podgorica 107 https://media.proquest.com/media/hms/ORIG/1/LQJgC?_s=E8eTYdQP3MbmwSZiYCassGyb7H0%3D

Ajzen, I. (1991). The theory of planned behavior. 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-t

Andrade, C., Menon, V., Ameen, S., & Praharaj, S. K. (2020). Designing and Conducting Knowledge, Attitude, and Practice Surveys in Psychiatry: Practical Guidance - Chittaranjan Andrade, Vikas Menon, Shahul Ameen, Samir Kumar Praharaj, 2020. Indian Journal of Psychological Medicine. https://journals.sagepub.com/doi/10.1177/0253717620946111

Angelsen, A., Jagger, P., Babigumira, R., Belcher, B., Hogarth, N.J., Bauch, S., Borner, J., Smith-Hall, C., Wunder, S. (2014). Environmental income and rural livelihoods: a global-comparative analysis. World Development 64:S12–S28. https://doi.org/10.1016/j.worlddev.2014.03.006

Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J., & Mathijs, E. (2021). Household livelihood strategies and forest dependence in the highlands of Tigray, Northern Ethiopia. Agricultural Systems, 98(2), 147–155. https://www.academia.edu/22183586/Household_livelihood_strategies_and_forest_dependence_in_the_highlands_of_Tigray_Northern_Ethiopia

Baiyegunhi, L.J.S., Oppong, B.B., & Senyolo, M.G. (2016). Socio-economic factors influencing mopane worm (Imbrasia belina) harvesting in Limpopo Province, South Africa. J For Res 27(2):443–452 https://www.researchgate.net/publication/292138727_Socio-economic_factors_influencing_mopane_worm_Imbrasia_belina_harvesting_in_Limpopo_Province_South_Africa

Bulte, E., Kontoleon, A., List, J., Mokuwa, E., Richards, P., Turley, T., et al. (2013). REDD + SOCIO-ECONOMIC DESCRIPTIVE ANALYSIS. Final Report. Gola Rainforest National Park, Sierra Leone

Butler, R. A. (2011). Tropical Rainforest Conservation. https://rainforests.mongabay.com/deforestation/2000/Sierra_Leone.htm

Chao, S. (2012). Forest peoples numbers across world. http://www.forestpeoples.org/sites/fpp/files/publication/2012/05/forest-peoples-numbers-across-world-final_0.pdf

Chhetri, B.B.K., Johnsen, F. H., Konoshima, M. & Yoshimoto, A. (2013). Community Forestry in The Hills of Nepal: Determinants of User Participation in Forest Management. Forest Policy and Economics, 30, 6–13. https://doi.org/10.1016/j.forpol.2013.01.010

FAO. (2020). Terms and Definitions FRA 2020. https://www.fao.org/3/I8661EN/i8661en.pdf

FAO. (2022). The State of the World's Forests 2022. Forest Pathways for Green Recovery and Building Inclusive, Resilient and Sustainable Economies. https://doi.org/10.4060/cb9360en

FAO. (2020). Global Forest Resources Assessment 2020. FAO. https://doi.org/10.4060/ca8753en

Fekadu, A., Soromessa, T., and Dullo, B.W. (2021). Role of forest provisioning services to local livelihoods: based on relative forest income (RFI) approach in southwest Ethiopia coffee forest. https://doi.org/10.1186/s40068-021-00223-7

Fikir, D., Tadesse, W., & Gure, A. (2016). Economic Contribution to Local Livelihoods and Households Dependency on Dry Land Forest Products in Hammer District, Southeastern Ethiopia. International Journal of Forestry Research, 2016, 1–11. https://doi.org/10.1155/2016/5474680

Firey, W. (1961). Man, Mind and Land: A Theory of Resource Use. The American Catholic Sociological Review, 22(2), 182. doi:10.2307/3708953.

Fonta, W.M. & Ayuk, E.T. (2013). Measuring the role of forest income in mitigating poverty and inequality: evidence from south-eastern Nigeria. Forests, Trees and Livelihoods 22(2):86–105. https://doi.org/10.1080/14728028.2013.785783

Garekae, H., Thakadu, O. T., & Lepetu, J. (2017). Socio-economic factors influencing household forest dependency in Chobe enclave, Botswana. Ecological Processes, 6(1). https://doi.org/10.1186/s13717-017-0107-3

Government of Sierra Leone. (2021). Updated Nationally Determined Contribution. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Sierra%20Leone%20First/210804%202125%20SL%20NDC%20(1).pdf

Gunatilake, H. (1998). The role of rural development in protecting tropical rainforests: evidence from Sri Lanka. Journal of Environmental Management 53(3):273–292. https://www.sciencebase.gov/catalog/item/5053d007e4b097cd4fcf20d4

Hegde, R. I., & Enters, T. (2000). Forest products and household economy: a case study from Mudumalai Wildlife Sanctuary, Southern India. Environmental Conservation, 27(3), 250–259. https://doi.org/10.1017/s037689290000028x

Heinen, J.T. (1993). Park-People Relations in Kosi Tappu Wildlife Reserve, Nepal: A Socio-economic Analysis. Environmental Conservation Vol. 20, No. 1 , pp. 25-34. https://www.jstor.org/stable/44521726

Horton, M. (2021, May 17) Simple Random Sample: Advantages and Disadvantages. https://www.investopedia.com/ask/answers/042815/what-are-disadvantages-using-simple-random-sample-approximate-larger-population.asp

Howe, C., Suich, H., Vira, B., & Mace, G.M. (2014). Creating win-wins from trade-offs? Ecosystem services for human well-being: a meta-analysis of ecosystem service trade-offs and synergies in the real world. Glob Environ Chang 28:263–275. https://doi.org/10.1016/j.gloenvcha.2014.07.005

Hungerford, H. R. and Volk, T.L. (1990) . (n.d.). Changing learner behavior through Environmental Education. http://www.elkhornsloughctp.org/uploads/files/1374624954Changing%20learner%20behavior%20-%20H%20and%20V.pdf

Htun, T., Wen, Y., & Ko Ko, A. C. (2017). Assessment of Forest Resources Dependency for local livelihood around Protected Area: A Case Study in Popa Mountain Park, Central Myanmar. International Journal of Sciences, 3(01), 34–43. https://doi.org/10.18483/ijsci.1176

Infield, M. (1988). Attitudes of a rural community towards conservation and a local conservation area in Natal, South Africa. Biological Conservation, 45(1), 21–46. https://doi.org/10.1016/0006-3207(88)90050-x

Kar, S. P., & Jacobson, M. J. (2012). NTFP income contribution to household economy and related socio-economic factors: Lessons from Bangladesh. Forest Policy and Economics, 14(1), 136–142. https://doi.org/10.1016/j.forpol.2011.08.003

Khan, M.A.S. and Saimun, S.R. (2021). Forest Dependency: Status, Assessment Tools, and Influencing Factors. (2020). ResearchGate. https://doi.org/10.1007//978-3-319-71065-5_24-1

Kideghesho, J. R. (2015). Realities on Deforestation in Tanzania — Trends, Drivers, Implications and the Way Forward. InTech EBooks. https://doi.org/10.5772/61002

Lepetu, J., Alavalapati, J., & Nair, P. (2009). Forest Dependency and Its Implication for Protected Areas Management: A case Study From Kasane Forest Reserve, Botswana. Int. J. Environ. Res, 3(4), 525–536. https://tspace.library.utoronto.ca/bitstream/1807/49471/1/er09058.pdf

Liao, X., Thi, & Lowe, A. J. (2022). Use of the knowledge, attitude, and practice (KAP) model to examine sustainable agriculture in Thailand. 3(1), 41–52. https://doi.org/10.1016/j.regsus.2022.03.005

Mirza, B. & Szirmai, A. (2010). Towards a new measurement of energy poverty: A cross-community analysis of rural Pakistan. MERIT Working Papers 2010-024, United Nations University – Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT). https://www.researchgate.net/publication/46433662_Towards_a_new_measurement_of_energy_poverty_A_cross-community_analysis_of_rural_Pakistan

Mukul, S.A., Rashid, A.Z.M.M., Uddin, M.B., and Khan, N.A. (2016). Role of non-timber forest products in sustaining forest-based livelihoods and rural households' resilience capacity in and around the protected area: a Bangladesh study. Journal of Environmental Planning and Management 59:628–642. https://doi.org/10.1080/09640568.2015.1035774

Mujawamariya, G. & Karimov, A. A. (2014). Importance of socio-economic factors in the collection of NTFPs: The case of gum Arabic in Kenya. Forest Policy and Economics, 42, 24–29. https://doi.org/10.1016/j.forpol.2014.02.005

Nagendra, H. (2011, November). Heterogeneity and Collective Action for Forest Management. Human Development Research Papers (2009 to Present); Human Development Report Office (HDRO), United Nations Development Programme (UNDP). https://ideas.repec.org/p/hdr/papers/hdrp-2011-02.html

Nepal, S.K. & Weber, K.E. (1995). Prospects for Coexistence: Wildlife and Local People. Ambio Vol. 24, No. 4, pp. 238-245. https://www.jstor.org/stable/4314336

Njora, B., & Yilmaz, H. (2022). Analysis of the Effects of Deforestation on the Environment and Agriculture in Kenya. Int. Journal of Water Management and Diplomacy.

https://dergipark.org.tr/en/download/article-file/2112021

Ntiyakunze, M.S. & Stage, J.(2021). Forest dependence in developing countries: The role household heterogeneities. https://www.diva-portal.org/smash/get/diva2:1584789/FULLTEXT01.pdf

Ntiyakunze, M., & Stage, J. (2022). Forest dependence in Tanzania: Analysis of the determinants of perceived forest dependence. Trees, Forests and People, 8, 100277–100277. https://doi.org/10.1016/j.tfp.2022.100277

Ofoegbu, C., Chirwa,P. W., Francis, J., & Babalola, F. D. (2017). Socio-Economic Factors Influencing Household Dependence On Forests And Its Implication For Forest-Based Climate Change Interventions. Southern Forests: A Journal of Forest Science. https://www.tandfonline.com/doi/abs/10.2989/20702620.2016.1255420

Pattanayak, S. K., Sills, E. O., Mehta, A. D., & Kramer, R. A. (2003). Local Uses of Parks: Uncovering Patterns of Household Production from Forests of Siberut, Indonesia. Conservation and Society, 1(2), 209. https://www.conservationandsociety.org.in/article.asp?issn=0972-4923;year=2003;volume=1;issue=2;spage=209;epage=222;aulast=Pattanayak

Soe, K.T. and Yeo-Chang, Y. (2019). Livelihood dependency on non-timber forest products: Implications for REDD+. Forests, 10(5), 427. https://doi.org/10.3390/f10050427.

Statistics Sierra Leone. (2015). Re-analysis of the 2015 Population and Housing Census. https://www.statistics.sl/images/StatisticsSL/Documents/Census/2015/sierraleone_-2015_population_census_data_for_16_districts_5_regions.pdf.

Sunderland, T., Powell, B., Ickowitz, A., Foli, S., Pinedo-Vasquez, M., Nasi, R., Padoch, C. (2013). Food security and nutrition: The role of forests. CIFOR Discussion Paper No. 1. Center for International Forestry Research, Bogor. https://www.cifor.org/publications/pdf_files/WPapers/DPSunderland1301.pdf

Taherdoost, H. (2016). Sampling Methods in Research Methodology; How to Choose a Sampling Technique for Research. SSRN Electronic Journal, 5(2), 18–27. https://doi.org/10.2139/ssrn.3205035

Tejada, J., Raymond, J., & Punzalan, B. (2012). On the Misuse of Slovin's Formula. https://www.psai.ph/docs/publications/tps/tps_2012_61_1_9.pdf

Thurmond, V. A. (2001). The Point of Triangulation. Journal of Nursing Scholarship, 33(3), 253–258. https://doi.org/10.1111/j.1547-5069.2001.00253.x

UNESCO. (2022). Gola-Tiwai Complex. https://whc.unesco.org/en/tentativelists/6589/.

United Nations. (2021). Involving Communities to Strengthen Forest Management. | Department of Economic and Social Affairs. https://sdgs.un.org/partnerships/involving-communities-strengthen-forest-management

United Nations Department of Economic and Social Affairs & United Nations Forum on Forests Secretariat (2021). The Global Forest Goals Report 2021. https://www.un.org/esa/forests/wp-content/uploads/2021/08/Global-Forest-Goals-Report-2021.pdf

Vandamme, E. (2009). Concepts and Challenges in the Use of Knowledge-Attitude-Practice Surveys Literature Review. Department of Animal Health Institute, Institute of Tropical Medicine, Antwerp. - References - Scientific Research Publishing. (2016). Scirp.org.

https://www.scirp.org/(S(351jmbntvnsjt1aadkposzje))/reference/ReferencesPapers.aspx?ReferenceID=1885577

Vedeld, P., Angelsen, A., Bojö, J., Sjaastad, E., & Berg, K.G. (2007). Forest environmental incomes and the rural poor. Forest Policy and Economics 9(7):869–879 https://doi.org/10.1016/j.forpol.2006.05.008

World Bank. (2021). Forests and Terrestrial Ecosystems (Landscapes). https://www.worldbank.org/en/topic/forests

World Health Organization. (2008). Advocacy, communication and social mobilization for TB control: a guide to developing knowledge, attitude and practice surveys. https://apps.who.int/iris/bitstream/handle/10665/43790/9789241596176_eng.pdf

Appendix

1. Respondents' descriptive statistics
2. Income calculation
3. Model summary
4. Interview transcripts
5. Focus group discussion transcript
6. Questionnaire
7. Raw Data Records
8. Interview Guide