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POPULATION DYNAMICS AND SUSTAINABLE FOREST RESOURCE MANAGEMENT IN MOSHI DISTRICT, KILIMANJARO REGION, TANZANIA

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Abstract

Forests constitute essential natural resources whose environmental functions are invaluable. They vary in size, distribution, and type, yet worldwide, forest ecosystems are undergoing significant alteration, leading to declines in both their ecological value and spatial extent. This study examined the relationship between population dynamics and sustainable forest management in Moshi District, Kilimanjaro, Tanzania. A descriptive research design integrating both quantitative and qualitative approaches was employed. Data were drawn from both primary and secondary sources using questionnaires, interviews, and document analysis guides. The sample comprised 39 Village Executive Officers, 14 Ward Executive Officers from 14 wards, and five key informants. Simple random sampling was used to select Village Executive Officers, while purposive sampling was applied for Ward Executive Officers and key informants. Data were analyzed using the Statistical Package for the Social Sciences (SPSS, Version 21) and presented through graphs, frequency tables, and figures. The study revealed that rising demand for forest resources, frequent fires, and heavy dependence on firewood and charcoal, along with land uses such as mining, quarrying, agriculture, settlement expansion, and construction activities, have accelerated deforestation in the district. This has resulted in challenges to sustainable forest management. Measures undertaken to promote forest sustainability include the enforcement of strict laws and policies, regular tree planting, and the active involvement of local communities, NGOs, and other stakeholders. However, some practices such as proper land use planning, soil conservation, and the adoption of green energy remain poorly implemented. The study recommends forest restoration and rehabilitation, alongside enhanced financial support for research and development, to strengthen sustainable forest management practices in Moshi District. Future studies should replicate this research in other settings to enhance the generalizability of findings and explore the role of green energy in promoting sustainable forest management.

Keywords: Population dynamics, Sustainable, Land use, Protected areas, Natural resources.

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Introduction

The global forest cover is about 4.06 billion hectares, equivalent to 31 percent of its total land area (FAO, 2020). This land area is comparable to 0.52 hectares per individual. However, forests are not disseminated correspondingly among the world's peoples or geographically. About 45% of global forest cover is found in tropical areas, superseding other forest areas such as subtropical, boreal, and temperate (FAO, 2020). It is estimated that each year about 17 million hectares of tropical forest disappear, an area the size of Tunisia or Uruguay. About 420 million hectares of forest cover have been lost due to the settlement and other land uses. Nevertheless, the deforestation rate from 2015 to 2020 was about 10 million hectares annually, whereas in the 1990s deforestation was about 16 million hectares per year (FAO, 2020). Thus, the global deforestation level is the most urgent concern for the sustainable of forest management. The total forest cover in Africa is about 674,419,000 hectares, which is 22.7% of the overall land area in the continent, representing 16% of the world's forest cover areas (FAO, 2020). However, from 1990 to 2010, Africa lost forest cover of approximately 3,740,950 hectares or 0.50% per year. Thus, in total, Africa lost about 74,819,000 hectares or 10.0% of its forest cover. Africa has experienced severe forest loss, about 3.9 million hectares of forest cover were lost in the period 10 years that is from 2010 to 2020 (FAO, 2020). The main drivers of deforestation in Africa are population growth, agricultural expansion, shifting cultivation practices, land tenure systems, urbanization, infrastructure construction, and overexploitation of natural forest resources.

According to the National Environmental Policy (2021), the total natural forest cover in Tanzania is about 47.4 million hectares (98.5 percent) whereas plantations cover only 600,000 hectares (1.5%). In 2000, 28% of Tanzania was covered with natural forest. Notwithstanding, the country had 24 million hectares of natural forest in 2010, equivalent to 26 percent of its total land area (World Resource Institute, 2024). However, forest ecosystems in Tanzania are endangered by deforestation. The annual deforestation rate in Tanzania is approximately 469,420 hectares. According to World Resource Institute, (2024) between the years 2001 and 2021, Tanzania has lost 2.86 million hectares of tree cover, and 32.3k hectares of humid primary forest, making up 1.2% of its total tree cover loss. In the period of 20 years that is from 2000 to 2020 Tanzania underwent a net alteration of -3.82m hectares (-11%) in tree cover (World Resource Institute, 2024). Whereas, about 165k hectares of natural forest cover was lost in 2021 (World Resource Institute, 2024). Kija et al. (2020) found that in greater Serengeti in Tanzania, woodland cover changed (-11.1 %) from most of the other land cover types from 1975 to 2015.

Moreover, most Tanzanians are generally those who depend on natural resources such as forests for survival. World Bank (2018) discovered that people who live in rural areas approximately 70% rely on the exploitation of natural resources for fodder, fuel, and food. Africa Development Bank (2018) asserted that more than 50% of Tanzanians rely on farming for their living. This weighs heavily on natural resources,

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specifically forest resources. Nation Bureau of Statistics (2017a) exhibited that, approximately 85% of Tanzania's energy is through the use of biomass in the way of firewood and charcoal firewood, principally for heating and cooking. Whereas, Tanzania's population has augmented more than five times from 12,313,469 million in 1967 to 61,741,120 million in 2022, with annual average intercensal growth of 2.7% between 2002 to 2012, and 3.2% between 2012 to 2022 (Tanzania Nation Bureau of Statistics, 2022). Therefore, Tanzania's forest ecosystems are being subjected to devastating pressure from anthropogenic activities such as industrial activity, settlement, infrastructural construction and farming. Consequently, the incompatible land uses create unsustainable forest management.

Meanwhile, population dynamics in Kilimanjaro region have immensely affected the natural environment such as soil, water bodies, and vegetation due to the high demand for food, fuel, settlement areas, grazing, and agriculture. The region is becoming an ecological island, isolated and surrounded by agriculture (Citizen New paper October 25, 2022). Price & Butt (2000) asserted that gigantic deforestation of conifer plantations, expansion of agriculture, land use changes, and rivers being diverted were enormously influenced by a mounting human population in the region. Moreover, the pressure on the natural environment has increased severely, (Zolongo et al., 2000) specified that the deforestation rate has increased abundantly around the streams and rivers due to farming and other anthropogenic activities such as fodder collection. Hemp (2005) highlighted that

Mount Kilimanjaro forests have been affected hugely due wildfires, however, most of these fires were caused by human activities particularly the clearing of forest by burning for farming expansion, poaching, and collection of honey. Additionally, there is a significant increase in the number and intensity of wildfires on Mount Kilimanjaro. Mbonile (2005) stated that about 41 km^2 of natural forest cover Kilimanjaro region diminished from 1952 to 1982 while forest cover loss increased from 1,606 hectares in 1973 to 5,170 hectares in 2000. Whereas from 1911 to 2022 Kilimanjaro region has lost 50% of its forest cover. Said et al. (2021) asserted that from 2018 and 2030 about 11.08 km2 of the forest area in Kikafu, Weruweru, and Karanga in the Moshi district Kilimanjaro region is likely to decline due to the settlement expansion and farming. Said et al. (2021) also suggested that in the same areas, about 57.24 percent of grasslands and 39.29 percent of wetlands are anticipated to deteriorate. Thus, these contending uses of land have adverse environmental impacts on the lasting sustainability of forest ecosystems.

The United Nations Economic Commission for Africa (1992) manifested that production and the global population growth rate, shared with unsustainable consumption patterns, lead to a serious imbalance in the life-sustenance abilities of our planet. Hereafter, the conference affirms that the requirements of this generation jeopardize the requirements of the coming generations through overexploitation of natural resources, pollution, and encroaching ecosystems, thus affecting the rate of regeneration of natural resources, mostly natural forest resources. The United Forum

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on Forest, aware of the damages caused by the human population, fashioned the instrument to control forest degradation, foster livelihood sustainability, minimize deforestation rate, and alleviate poverty for all communities that rely heavily on forests to foster sustainable forest management. However, implementation of the United Forum goals on forest management has been a challenge, particularly in developing countries, since the deforestation rate has increased significantly. Consequently, grounded on the aforementioned descriptions, it is an indisputable fact that population dynamics pose challenges to sustainable natural forest resource management.

Literature Review

Dimnwobi et al. (2021) studied population and environmental quality in five populated African countries, namely South Africa, Nigeria, Tanzania, Ethiopia, and the DRC. The study assessed the relationship among the data using Cross-sectionally augmented autoregressive distributed lag. The study found that environmental degradation increased substantially due to the high energy consumption, population growth rate, population density and population age structure. However, in the selected areas urban population growth rate had no substantial effect on degrading environment. The research also addressed the policies which steer population growth and the enhancement of environmental quality. From the findings, it was shown that the research focused on population and environmental quality; however, the study did not indicate how population dynamics affect the forest cover in particular. Again, the study used

Cross-sectionally augmented autoregressive distributed lag, whereas the current study used the descriptive design. Also, the study did not focus on a particular area, which could give more detail on the environmental quality; rather, the study was conducted in five countries, and the study was carried out in urban areas. Filling this gap of knowledge, the current study investigated the influence of population dynamics on sustainable forest resource management in Moshi district.

Uzobo & Jack (2016) studied population dynamics, environmental changes and sustainable development; implications for policymakers in Nigeria. The study found that population growth, fertility changes, mortality rate and morbidity rate increased speedily in Nigeria more than in other sub-Saharan countries. The study also found that there is an association between sustainable development and environmental changes, and population dynamics. Uzobo and Jack (2016) had significant importance in exploring the trends in population size in Moshi district between 2002 and 2022 since the study highlighted different trends in population size and distribution, such as morbidity rate, population growth rate, mortality rate and fertility rate. On the other hand, the study focused on population dynamics, environmental changes and sustainable development in Nigeria thus, is hard to get detailed information about each state of Nigeria, and the study could have focused on a few states rather than giving generalized information. To fill this gap, the current study focused on determining trends in population dynamics in Moshi district between 2002 and 2022.

AFIDEP & PAI (2012) investigated population dynamics and climate change, and

sustainable development in Kenya. The study found that the cause of the over-exploitation of land and natural resources is the rapid population growth rate. Additionally, the study specified that population growth, climate change, deforestation and expansion of agricultural areas, expansion of settlements, consumption of firewood and charcoal, and inadequate reforestation have drastically increased and contributed to deforestation. Finally, the study recommended that population dynamics and climate change issues should be addressed together since they are interrelated. The study findings showed that the researcher focused on population dynamics, sustainable development and change of climate thus, the study didn't show the influence of population dynamics on forest management. Again, AFIDEP & PAI (2012) study was carried out in Kenya in the year 2012, which depicts spatial-temporal differences. Filling the discrepancy, the current research was carried out in 2024 and focused on population dynamics and sustainable forest resource management in Moshi district, Tanzania.

UNECA (2020) studied population dividends, sustainable development demographic and population change in West Africa. The study found that global population growth poses grave challenges to food security, water supply, and other vital natural resources. The problem of population growth is particularly acute in West Africa. The recognition of the sustainable development goals is endangered by the population growth rate in West Africa. UNECA's (2020) study was carried out four years ago again the study was conducted in West Africa, which signifies the spatial-temporal difference between the current study and the UNECA (2020) study. In addition, the study focused on population dynamics, demographic dividends and sustainable development, and thus didn't indicate the linkage between population dynamics and forest management sustainability. To fill this gap, the current study aimed to determine trends in population dynamics in Moshi district between 2002 and 2022.

Muttarak (2021) carried out a study on demographic perspectives in research on global environmental change. The study discovered that the main driver of universal environmental change is the human population. It further articulated that climate and environment are highly affected by population dynamics. However, climate change, on the other hand, affects human health and the well-being of the human population. Muttarak (2021) was very pertinent since the study deliberated linkages between population and environment and how they influence each other. Such an approach gave a big picture about the current study in investigating the influence of population changes on sustainable forest resource management in Moshi district. However, based on the findings, the study by Muttarak (2021) did not indicate the influence of the human population on land cover change. Moreover, the researcher assessed the influence of demographic perspectives on environmental change globally. With this aspect, this research covered the gap by examining the effect of population dynamics on sustainable forest management in Moshi district.

Price (2020) examined the linkages between population change and climate change in

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Africa. The study found that the ability of communities to adapt to climate change and the resilience of communities are negatively influenced by rapid population growth. Moreover, the study asserted that poverty alleviation, human development, food security, and the provision of basic services are highly affected by rapid population growth and climate change. They pointed out that population change and other non-climatic drivers are likely to have drastic impact in Africa than climate change. There were several gaps identified between Price's study and the current study. Firstly, regarding spatial-temporal differences, Price's (2020) study was conducted on the whole of Africa in 2020, whereas this study was specifically carried out in Moshi district, Tanzania, in 2024. Secondly, the difference in content, Price's study aimed at analyzing the connections between population dynamics and climate change in Africa, whereas the current study aimed at investigating population dynamics and sustainable forest resource management in Moshi district, Tanzania.

Ali et al. (2021) carried out in Pakistan about Forest Resource Management. The study examined the public views toward sustainable forest management in the area of Gilgit–Baltistan, Pakistan. Data were collected from 250 participants using a quantitative approach. Data were collected from 250 participants using a quantitative approach. The study explored three significant levels of management of natural forests, namely local, strategic, and communication. The study found that to promote sustainable natural forest management policies, it is important to start focusing on the strategic level of management of natural forests, then on the local level and subsequently communication level. All these three factors are very paramount in measuring and counting sustainable natural forest management in Gilgit-Baltistan. Ali et al. (2021) study focused on examining public opinions on forest sustainability. The study could be more reliable if the data were collected from environmental experts and government officials who are directly involved in forest sustainability rather than common citizens who may not know about forest sustainability. In addition, the study by Ali et al. (2021) used one type of data collection instrument, from which it can be difficult to get reliable data. To fill this gap, the current study focused on analyzing sustainable forest resource management measures used in Moshi district and questionnaires, interview guides, and document analysis were used in data collection.

Olukwa-Kula et al. (2022) conducted a study on the evaluation of challenges to sustainable forest management in Abia State, Nigeria. The study scrutinized the challenges facing sustainable forest management in Abia state from 2008 to 2017. The data were collected through questionnaires and focus group discussions and the data analysis was done through referential and descriptive statistics. The study identified the main challenges facing forests in Abia state are; shortage of logistics, insufficient staff recruitment, inadequate of funding, and poor government policies in the state government. The study recommended that it is important to ensure the provision of adequate funding, formulation of proper policies, recruitment of enough staff, and involvement of the federal government for sustainable forest

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management in the state of Abia. Olukwa-kula et al. (2022) collected data via focus group discussion and structured questionnaires, thus data are more reliable when the researcher uses more than two research instruments for data collection. Moreover, the study was carried out in Nigeria in the year 2022 which portrayed a spatial-temporal gap. To fill this gap, the current study analyzed sustainable forest resource management measures used in Moshi district the data were collected through questionnaires, interview guides, and document analysis schedules.

Kilimanjaro National Park (KINAPA) (2020) examined the Conservation outlook of Mount Kilimanjaro Forest Reserve in Kilimanjaro region, Tanzania. The report focused on a full assessment of the threats facing Kilimanjaro Forest reserve namely; fire, deforestation and changing land use on the lower slopes, poaching, climate change, the impact of tourism, and ecological modifications. Furthermore, the report substantiated the essential elements for the management and protection of the natural forest such as integration into regional and national planning systems, and relationship with the local, and legal framework. The study also deliberated on law enforcement, research, boundaries, effective management system, staff capacity, training and development, tourism as well as visitation management. The KINAPA (2020) study focused on the conservation outlook of reserve forests found around Mount Kilimanjaro and the study was carried out in 2020 whereas the current study targeted on the influence of population dynamics on sustainable forest management in Moshi district and study was carried out in 2024.

FAO (2020) investigated the state of the forests in the world. The report deliberated on numerous issues including people, forest and biodiversity. The report suggested several ways of promoting sustainable forests use and management of forest such as reverse of forest degradation and deforestation. Moreover, the study recommended the integration of community needs in managing and conserving of forest reserved areas, ways of militate overexploitation of natural forest resources, and the significance of involving local people in substantiating the main drivers of natural forest loss as well as spearhead factors that can control forest degradation and deforestation. The study by FAO gave the overview of the global assessment of forests, biodiversity, and people, thus, didn't focus on a particular area which could give more detailed information about the forest situation. The study didn't stipulate which type of research instruments were used in collecting and analyzing data so that the reader may be able to judge the validity and reliability of the data. To fill this gap, the current study analyzed sustainable forest resource management measures used in Moshi district and instruments for data collection and analysis were stipulated.

European Union (2018) carried out a study on Sustainable Forest Management in the European Regions. The study used an online Questionnaire for the consultation in the collection of data. The study found that LRAs do support developing the purposes of the EU forest policy/strategy in different ways such promotion of both public and private forestry investment and balancing various forest functions. Nevertheless, the study found that when needs are met through various services pertained forest-based

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promote sustainable forest management principles. The research targeted on sustainable forest management in Europe and data were collected through online consultation questionnaires thus the data were collected by a single research instrument which makes it very difficult to get reliable data. To fill this knowledge, the current study established sustainable forest resource management measures used in Moshi district and data were collected through interview guides, document analysis schedules, and questionnaires.

Methodology

The study employed a descriptive research design. Kombo & Tromp (2006) state that descriptive research involves collecting data systematically and in a standardized form from either distinguishable respondents or representatives. This study used a descriptive study targeting the local government officials such as village executive officers and ward executive officers, key informants from different environmental agencies namely Forest Industries Training Institute (FITI), Moshi district forest executive officers, Tanzania Forestry Research Institute Authority (TAFORI), Tanzania Forest Services Agency (TFS), and Kilimanjaro National Park (KINAPA)who broadly looked at the problems of forest degradation and its management. Consequently, the study used 50% of village executive officers as recommended by (Mugenda &Mugenda, 2019). He asserted that in descriptive research, 10-50% sample size is accepted. Therefore, 39 (50%) of village executive officers were selected as respondents and Creswell and Clark (2018) support those 39 respondents in the quantitative study are

adequate. Thus, the total respondents involved in this study were 57. The village executive officers who live around the buffer zone to Mount Kilimanjaro Forest which is half Mile Strip were randomly selected. According to Creswell & Clark (2018), the simple random sampling is the technique that is applied in quantitative studies for selecting participants. In this type of sampling method, each participant has an opportunity of being chosen from the target population to participate in the study by guaranteeing that the sample selected is part of the population from which it was drawn. To get the required feedback from the respondents, purposive sampling was used to get information especially those living around the Mount Kilimanjaro Forest. Whereas ward executive officers and key informants from selected agencies were sampled purposively.

The study collected data from the two data sources that including secondary and primary data. Subsequently, interview guides were used to gather information from the key resourceful persons from KINAPA, Moshi district forest executive officers, FITI, and TFS who are very directly concerned with the forest management in Moshi district. The researcher used a document analysis schedule with areas such as population size, the average annual inter-censal population growth rates and population density which used to determine trends in population dynamics in Moshi district between 2002 and 2022. Whereas, questionnaires were given to the local authorities.

The procedures for data analysis comprised of various steps such as; the qualitative data were coded and then themes were formulated. Consequently, the SPSS program was applied to analyse quantitative data and

data were presented through percentage, frequencies, standard deviation and mean scores. Lastly, the researcher merged quantitative data using a side-by-side comparison (Creswell & Creswell 2018).

Results

The examined the demographic characteristics of the participants based on the following categories namely gender distribution, age distribution, working experience and the academic level of the participants. About respondents' gender female were 63% and 37% were males. Regarding academic level of the participants, 64.9% of the respondents were diploma holders, 26.3% were having bachelor degree, and 7.0% were having certificate while 1.7% were postgraduate holders. Age group of the respondent as follows; 29.8% of the respondents had the age between 20-29 years, 50.8% the age ranges from 30-39, 7.0% had the age between 40-49 years, whereas 12.2% had the age ranges from 50-60 years. Working experience of the respondents, 49.1% had working experience of 0-5 years, 31.5% had working experience of 6-10 years, 7.0% had working experience of 11-15 years, and 12.3% had working experience of 16 years and above.

Population Dynamics and Sustainable Forest Management in Moshi District

The research assessed the trends in population dynamics obtained through document analysis. The study also examined the most common influences of population growth on sustainable forest resource management in Moshi district, and the influence of population growth on sustainable forest resource management in Moshi district. The information was obtained through questionnaires from village executive officers and ward executive officers, but also an interview guide was carried out on the key informants from Moshi district forest executive officers, Tanzania Forest Services Agency (TFS), and Kilimanjaro National Park (KINAPA) and Moshi district forest executive officers.

Trends in Population Dynamics in Moshi District Between 2002 and 2022

Trends in population dynamics in Moshi district between 2002 and 2022 are categorised in three dimensions, namely trends in population size, trends in population density and trends in the average annual intercensal population growth rates in Moshi district.
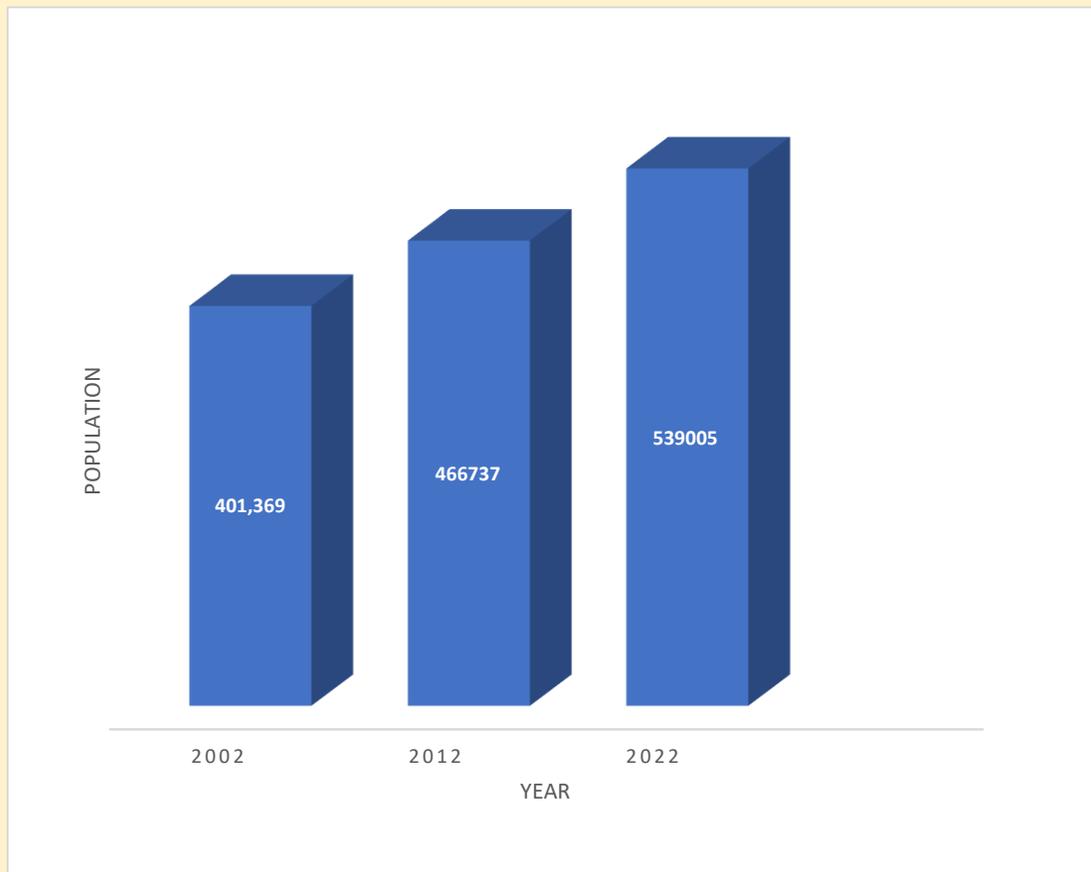
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Figure 1: Shows the Trends in Population Size, Moshi district, 2002-2022

Source: NBS (2002, 2012 & 2022)

Figure 2: Shows the Trends in the Average Annual Intercensal Population Growth Rates, Moshi District, 2002 – 2022
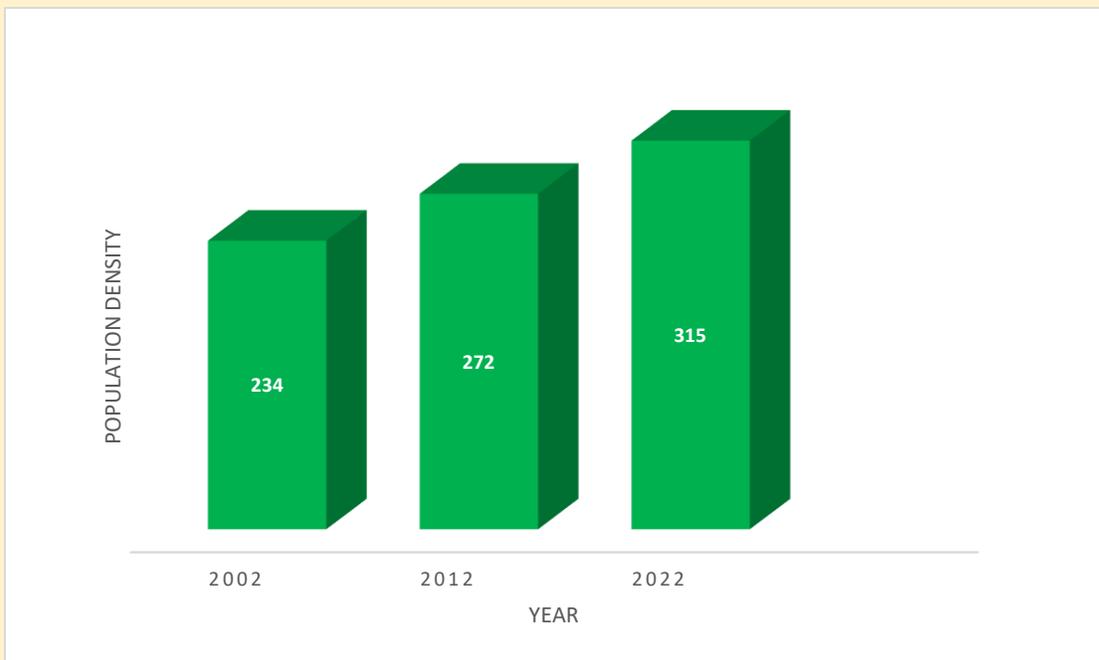
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Source: NBS (2002, 2012 & 2022)

Figure 3: Shows the Trends in Population Density, Moshi District, 2002-2022

Source: NBS (2002, 2012, & 2022)

Figure 1, shows trends in population size in Moshi district. The district had a population of 401,369 in 2002, in 2012 the population increased to 466737, while in 2022, Moshi district had a population of 539005. On the other hand, Figure 2 indicates trends in the

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average annual intercensal population growth rates in the Moshi district between 2002 and 2022. The data revealed that between 1988 and 2002, Moshi district had an average annual intercensal population growth rate of 1.1%, while between 2002 and 2012 had an average growth rate of 1.5%, and between 2012 and 2022, Moshi district had an average growth rate of 1.4%. Moreover, Figure 3 portrays trends in population density in the

Moshi district between 2002 and 2022. In 2002, the district's population density was 234 people/km², while in 2012 the district's population density was 272 people/km², and in 2022, Moshi had a population density of 315 people/km².

The Most Common Influences of Population Growth on Sustainable Forest Resource Management in Moshi District

Figure 4: VEO's (n=39) and WEO's (n=14) Responses on the Common Influences of Population Growth on Sustainable Forest Resource Management in Moshi District
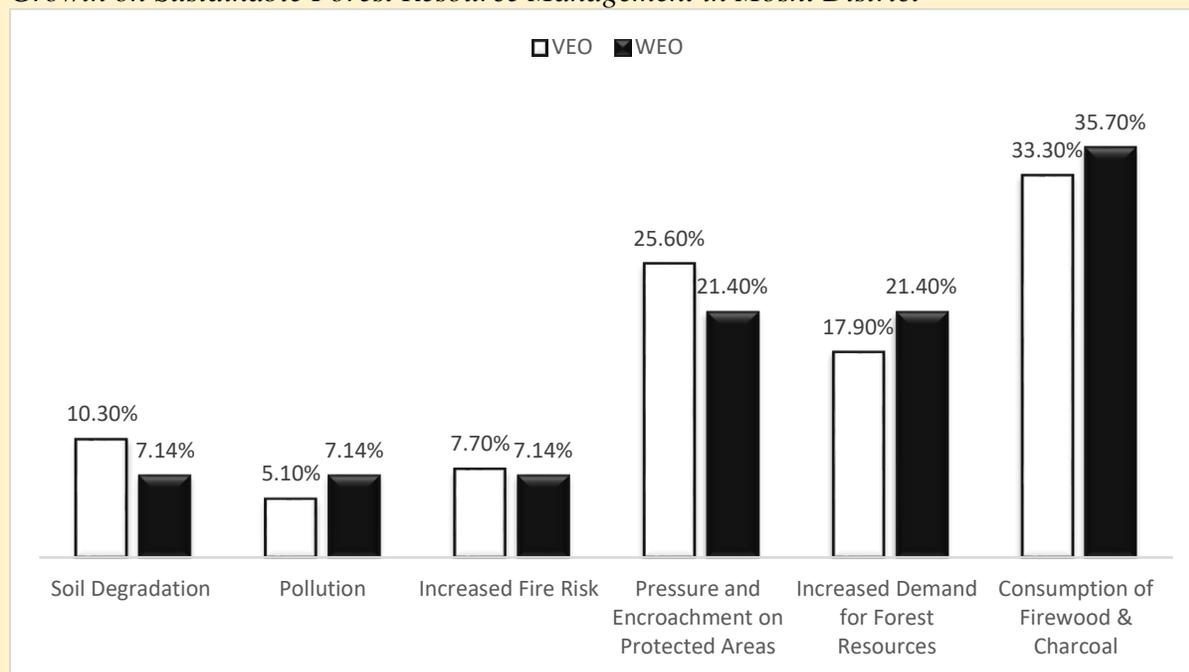
Source: Field Data (2024)

Figure 4, indicated that 33.3% village executive asserted the most common influences of population growth on sustainable forest resource management in Moshi district is consumption of firewood and burning of the charcoal, while 17.9% increased demand for forest resources, 25.6% putting pressure and encroaching on the forest protected area, 7.7% increased fire

risk, 10.3% soil degradation and 5.1% pollution. On the other hand, 35.7% ward executive officers stated that the most common influences of population growth on sustainable forest resource management in Moshi district is fetching of firewood and burning of the charcoal, 21.4% putting pressure and encroaching on forest protected areas, 21.4% increased demand for forest

resources and 21.3% respondents asserted the most common influences of population growth on sustainable forest resource management in Moshi district is pollution, soil degradation and increasing fire risk. The finding revealed that the majority of the respondents suggested that the most common influences of population growth on sustainable forest management in Moshi district are; consumption of firewood and burning of charcoal, increased demand for forest resources and increased pressure and encroachment on the protected areas. The Moshi Forest executive officer reported that demand for firewood and charcoal has exacerbated deforestation in Moshi district. Out of 372 schools, only 6 do not use charcoal and firewood, whereas the rest of the schools consume tonnes of charcoal and firewood.

Figure 5: Shows a Heap of Firewood in Moshi District

Source: Researcher (2024)

The Influence of Population Growth on Sustainable Forest Management in Moshi District

This section sought to uncover the influence of population growth on sustainable forest management in Moshi district. The results are summarised in Table 1, showing the responses from village executive officers and ward executive officers.

Table 1: *Responses of VEO (n=39) and WEO(n=14) on the Influence Population Growth on Sustainable Forest Management in Moshi District*

Statements	Respondents	SD %	D %	U %	A %	SA %

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1. The size of the forest has been altered by population growth	VEO	-		2(5.1)	24(61.5)	9(23.1)
	WEO	-	4(10.3) 1(7.1)	1(7.1)	8(57.1)	4 (28.6)
2. Forest biodiversity in Moshi rural has been lost due to population growth	VEO	2(5.1)	-	5(12.8)	23(59.1)	9(23.1)
	WEO	-	-	1(7.1)	8(57.1)	5(35.7)
3. The forest cover has been lost due to frequent bush fires caused by population growth	VEO	4(10.3)	6(15.4)	11(28.2)	15(38.5)	3(7.7)
	WEO	1(7.1)	3(21.4)	2(14.3)	4(28.6)	4(28.6)
4. The forest cover in Moshi rural has reduced over the years resulting from population growth	VEO	-	-	4(10.3)	21(53.8)	14(35.9)
	WEO	-	-	-	9(64.3)	5(35.7)
5. Soil degradation has increased because of population growth	VEO	-	-	3(7.7)	24(61.5)	12(30.8)
	WEO	-	-	1(7.1)	8(57.1)	5(35.7)
6. The deforestation level has increased due to population growth	VEO	-	-	3(7.7)	20(51.3)	16(41.0)
	WEO	-	-	1(7.1)	8(57.1)	5(35.7)
7. Pressure on forest	VEO	-	-	5(12.8)	24(61.5)	10(25.6)
	WEO	-	-	3(21.4)	5(35.7)	6(42.9)

Statement	Group	SD	D	U	A	SA
protected areas has increased due to population growth						
8. Forest resources have declined due to population growth	VEO	-	3(7.7)	3(7.7)		12(30.8)
	WEO	-	2(14.3)	-	21(53.8) 8(57.1)	4(28.6)
9. Population growth have increased demand on firewood and charcoal	VEO	1(2.6)	4(10.3)	-	24(61.5)	
	WEO	-	1(7.1)	1(7.1)	7(50.0)	10(25.6) 5(35.7)
10. Population growth have increased pollution level on the forest reserved areas	VEO	2(5.1)	1(2.6)	3(7.7)	21(53.8)	
	WEO	-	1(7.1)	1(7.1)	7(50.0)	12(30.8) 5(35.7)

Source: Field Data (2024)

Key: SD=Strongly Disagree, D=Disagree, U=Undecided, A=Agree, and SA=Strongly Agree

It is evident that 23.1% of the village executive officers strongly agreed that the size of the forest has been affected by population growth, while 61.5% agreed on the same. However, 5.1% of village executive officers were uncertain, and similarly, 10.3% disagreed that the size of the forest has been affected by population growth. On the other hand, 28.6% of ward executive officers strongly agreed that the size of the forest has been affected by land uses, and this was further supported by 57.1% of the ward executive officers who agreed on the same. The result indicated that 7.1% of ward executive officers were uncertain while 7.1% disagreed that the size of the forest has been affected by population growth. A larger percentage of the respondents affirmed that the size of the forest has been altered by population growth.

Further, 23.1% of the village executive officers strongly agreed that forest biodiversity in Moshi district has been lost due to population growth, and this was further supported by 59.1% of the village executive officers who agreed on the same. However, 12.8% of village executive officers were uncertain, while 5.1% strongly disagreed that forest biodiversity in Moshi district has been lost due to population growth. Moreover, 35.7% of the ward executive officers strongly agreed that forest biodiversity in Moshi district has been lost due to population growth, while 57.1% agreed on the same. However, the study showed that 7.1% of the ward executive officers were uncertain. Some of the forest diversity in Moshi is likely to become extinct due to population growth.

Figure 6: Shows the Cutting Down of the Rear Tree Species in Moshi District

Source: Researcher (2024)

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In addition, 7.7% of the village executive officers agreed that the forest cover has been lost due to frequent bush fires caused by population growth, which was also supported by 38.5% of the respondents who agreed on the same, while 28.2% were uncertain. On the contrary, 15.4% of the village executive officers disagreed, and 10.3% strongly disagreed that the forest cover has been lost due to frequent bush fires caused by population growth. Nonetheless, 28.6% of ward executive officers strongly agreed that the forest cover has been lost due to frequent bush fires caused by population dynamics, and this was further supported by 28.6% of the ward executive officers who agreed on the same. However, the study showed that 14.3% of ward executive officers were uncertain that the forest cover has been lost due to frequent bush fires caused by population growth, whereas 7.1% disagreed and 21.4% strongly disagreed. Its undisputable majority of the respondents agreed that the forest cover has been lost due to frequent bush fires caused by population growth. KINAPA officer asserted that fires happen during the poaching and burning of charcoal, which affects the forest in the district to a large extent.

The results also revealed that 35.9% and 53.8% of the village executive officers strongly agreed and agreed, respectively, that the forest cover in Moshi district has reduced over the years, resulting from population growth. However, 10.3% of the village executive officers were uncertain regarding whether the forest cover in Moshi district has reduced over the years, resulting from population growth. Moreover, 35.7% of ward executive officers strongly agreed that the forest cover in Moshi district has reduced over the years, resulting from land uses, and this was further supported by 64.3% of the ward executive officers who agreed on the same. The largest number of respondents affirmed that the forest cover in Moshi district has reduced over the years, resulting from population growth.

Moreover, 30.8% of the village executive officers strongly agreed that the soil degradation has increased because of population growth, while 61.5% agreed on the same observation. However, 7.7% of village executive officers were uncertain. Moreover, 35.7% of ward executive officers strongly agreed that soil degradation has increased because of population growth, while 57.1% agreed on the same. The study found that 7.1% of ward executive officers were uncertain that soil degradation has increased because of population growth. Sand harvesting and quarrying that are carried out by local miners have led to soil degradation in Moshi district. Also, he stated that the increased demand for materials for building and construction, such as stones and sands, has led to an increase in soil degradation in the district.

Lastly, 25.6% of the village executive officers strongly agreed that a lot of pressure on forest protected areas has increased due to population growth, and this was supported by 61.5% of them who agreed on the same. However, 12.8% of the village executive officers were uncertain that a lot of pressure on forest-protected areas has increased due to population growth. The results also revealed that 42.9% and 35.7% of the ward executive officers strongly agreed and agreed, respectively, that the pressure on forest protected areas has increased due to population growth. However, 21.4% of the village executive officers were undecided whether population growth put pressure on forest-protected areas. Population growth put pressure on forest protected areas since the majority of respondents agreed on the same. TFS officer reported that poaching, collection of fodders and firewood have greatly influenced forest protected areas.

Discussion

The researcher observed that population dynamics in Moshi district highly depend on forest resources subsequently cause threat on the sustainable forest management in the district. Population dynamics in the district has increased consumption of firewood and burning of the charcoal, increased demand for forest resources, putting pressure and encroaching on the forest protected area, increased fire risk, soil

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degradation and pollution. World Bank (2018) revealed that people who are living in rural areas, approximately 70%, rely on the exploitation of natural resources for fodder, fuel and food. AFIDEP & PAI, 2012 stated that the cause of over-exploitation of land and natural resources is the rapid population growth rate. These unsustainable exploitation of forest resources caused by population dynamics is likely to bring about adverse impacts on the environment, namely depletion of soils, deforestation, forest fires, over-hunting of game, pollution, and climate change.

The studies show that the growth of population dynamics leads to the alteration of natural resources. Boserup (1996) asserted that population dynamics determined changes in land use, land tenure systems, human settlement, and agricultural technology. Henceforth, when population change necessitates or pushes technological change in agriculture, land use change. Thus, population dynamics in Moshi district have led to the expansion of agricultural activities in the district since more than 70% of Tanzania rely on agriculture (World Bank, 2018). Dimnwobi et al. (2021) found that environmental degradation increased substantially due to the high energy consumption and population dynamics. The study by Uzobo and Jack (2016) also found that there is association between sustainable development and environmental changes, and population dynamics. Thus, there is symbiosis between population dynamics and adverse environmental alterations. The Network for the UN 75th Anniversary report (2020) states that nature in all its forms is being significantly transformed by human activity everywhere on the planet.

Mongo (2007) stated that three districts in Kilimanjaro region, that is, Hai, Moshi district and Rombo, which form the largest part of the forest land in the region, about 92% of households in these districts rely on charcoal and firewood as their main source of energy. According to the National Bureau of Statistics (2017a), about 85% of the energy supply in Tanzania depends on forests. Therefore, the size of forest in diminished drastically. Kilimanjaro region has lost nearly 30% of its forest cover during the past

century due to population growth (Tanzania Pole Pole Club, 2011). Mbonile (2005) also highlighted that about 41 km^2 of natural forest cover Kilimanjaro region diminished from 1952 to 1982, while forest cover loss augmented from 1,606 hectares in 1973 to 5,170 hectares in 2000.

Moreover, there are extinction of some tree species due to the increase of firewood consumption, burning of charcoal and frequently fires and increased demand of material for building. Kija et., (2020) stressed that the loss of woodland in Serengeti ecosystems was caused by the growing human population size. Deforestation has severely reduced the size of the forest over the years. According to World Resource Institute, (2024) Tanzania has lost 8.19k hectares of tree cover from fires and 2.85 million hectares from all other drivers, most of these fires caused by human beings in 2017 tree cover loss was approximately 832 hectares, 0.43% caused by fires, that marked the year with the highest tree loss due to fire.

Conclusion

The forest in Moshi district is important in the sustainability of the local economy, a source of energy and material for constructions. The unsustainable exploitation of forest resources due to population dynamics brings about adverse impacts on the environment, namely depletion of soils, deforestation, forest fires, over-hunting of game, pollution, and climate change. Moreover, there are often ineffective management strategies and enforcement mechanisms to foster the long-term sustainability of these resources. Subsequently, understanding the dynamics of population growth and its influence on forest resources is vital for developing integrated management methods that can support both the livelihoods and forest conservation. Since, forest conservation and sustainable development is crucial for long-term poverty alleviation and sustainable development. Therefore, the study recommends restoring and rehabilitating forests and calls for appropriate financial support for research and development to strengthen sustainable forest management practices. In addition, all

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stakeholders namely government, non-governmental organization and local community should be involved in order to provides a comprehensive and integrated approach for forest conservation and management.

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