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Drivers of Deforestation in the Miombo Woodlands and Their Impacts on the Environment

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Authors' contributions

This work was carried out in collaboration between all authors. Author NB designed the study and wrote the first draft of the manuscript. Authors NL and CN managed the field work, analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

One fundamental concern of decision-makers is focused on the need to foster sustainable economic development. In order to achieve this, there arises a need to engage in comprehensive development planning. The basic aim of development plans is to reduce the risk and uncertainty inherent in economic activity by making a range of projections about the future. This is especially important in the Miombo woodlands (Northern Zambia) where a causal combination of poverty and resource depletion translates into an urgent need of sustainable development planning. Unfortunately, very little has been done to analyze the likely future environmental and social impacts in this economy. Therefore, the overall purpose of this research is to unravel and contribute meaningful information to decision-making processes. This paper addressed the research question about the drivers of deforestation in the Miombo woodlands and their environmental and social impacts by a quantitative research approach. Based on percentage of

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forest cover and the rate of forest area change, a study area was picked and questionnaires were administered. Results show that 45,000 kilometer squared of forests have been lost to unsustainable agro practices. Further, data collected from 300 farmers shows that the major controls of deforestation in Northern Zambia are lack of farmer support services and population growth. These results can be taken into consideration by decision-makers to avert the losses associated with deforestation.

Keywords: Deforestation; sustainable development; environmental degradation; Miombo woodlands; Northern Zambia.

1. INTRODUCTION

In 2010 The United Nations Framework Convention on Climate Change [From here onwards described by the acronym UNFCCC] encouraged developing countries to study and integrate drivers of deforestation and forest degradation in the development of national strategies and action plans [1]. This is because clearing of forest lands and unsustainable management reduce carbon storage in tropical forests thus; there is mounting emphasis on reducing carbon stock losses. [2-4], document that Africa comes second to the Amazon in deforestation rates in the world. The Food Agriculture Organization [From here onwards described by the acronym FAO] estimates that Africa loses 4.0 million hectares of forest land annually [5]. These African forests are mainly in the tropical region of which Zambia (study area) is located.

While in many parts of the world infrastructure developments largely contribute to deforestation, the major cause of deforestation in Northern Zambia is unsustainable traditional farming especially because the rural majority depends on agriculture for their livelihoods [6]. This traditional farming system involves cutting trees on a large scale, pilling them and burning them in order to create a thick layer or ash. The ash is used to fertilize the crops. This traditional farming system is wasteful and unsustainable in the long run because while a large area is cleared, only a small portion is used and after 5 – 7 years farming seasons, the piece of land cannot be used again thus, remain dormant for 20 – 25 years. Therefore, farmers usually shift to another area [7].

[8-10]; show that this traditional farming system poses a threat to biological diversity in the forest ecosystem, it contributes to global warming, it encourages soil erosion thus, depleting the fertility of the soil and if not averted, it leads to desertification. In Northern Zambia alone, 45,000 kilometer squared of forests have been lost to this unsustainable agro practice [11]. Many studies (e.g. [12-14]) have shown that deforestation largely contributes to global climate and environmental change. These studies have also highlighted that drivers of deforestation are complex, and they differ from country to country. This paper focuses on a specific area of the Miombo woodlands; Northern Zambia, and investigates the factors that promote the unsustainable traditional farming system of the region. This study further hypothesizes and seeks to test that the practice of slash-and-burn agriculture in Northern Zambia is to a great extent influenced by socio-economic factors.

2. RESEARCH METHODOLOGY

2.1 Selection of Study Area

Based on percentage of forest cover and the rate of forest area change, Northern Province was selected as a study area. Of all the provinces (Table 1) that practice slash-and-burn agriculture in Zambia, Northern Province has experienced the highest rates of forest area change during the period 1996 – 2005 [15].

Table 1. Forest area change in Zambia

Province	Forest area change Km^2
Northern	-35,092
Luapula	-24,742
Eastern	-12,919
Central & Lusaka	-12,045
Copperbelt	-3,331
Southern	-2,441
Western	-1,355
All Provinces	-74,384

Source: Chidumayo et al., 2012

2.2 Formulation of Questionnaire

The questionnaire (Appendix 1) was formulated in consultation with Zambia Agricultural Research Institute (ZARI) Officers. With the hypothesis that the practice of slash-and-burn agriculture in Northern Zambia is to a great extent influenced by socio-economic factors, the questionnaire was developed so as to seek to understand a farmer's educational background, main source of income, size of family, main reasons for practicing slash-and-burn agriculture, and other agro alternatives available to the farmer.

2.3 Data Collection

This paper addressed the research question about the drivers of deforestation in the Miombo woodlands and their environmental and social impacts by a quantitative research approach. Scientists who have used this approach in their studies include: [16,17]. The data gathering approach integrated comprehensive literature review, stakeholder interviews and field visits. The developed questionnaire (Appendix 1) was distributed to 300 respondents in Northern Province.

2.4 Data Analysis

A descriptive method was employed in data analysis, which involved cross-checking duly-filled questionnaires for errors and running frequencies. Pie charts were also created using Frequency distributions. A comprehensive questionnaire review was done in order to understand the drivers of slash-and-burn agriculture in Northern Zambia.

3. RESULTS AND DISCUSSION

3.1 Geographical Location of the Study Area

Northern Province (Fig. 1) of Zambia is bounded by Muchinga Province to the east, Luapula Province to the west, Tanzania to the Northeast, and Democratic Republic of Congo to the Northwest. It has land coverage (generally Miombo woodlands) of 77,650 km^2; the province is mainly a plateau with a unimodal type of rainfall and average annual accumulation of 1200 mm [18].

3.2 Data Collected

Analysis of the data (Fig. 2) collected indicated that the major drivers of slash-and-burn include lack of improved farming inputs and credit facilities, increase in the number of family members, which brought pressure on the need to earn a living, lack of knowledge of the environmental degradation that deforestation causes, and shear availability of land.

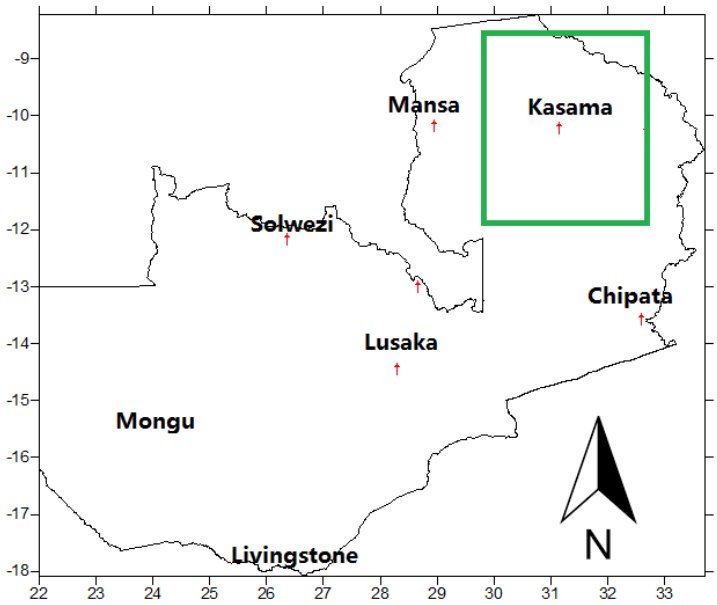

Fig. 1. Northern province (green rectangle) in map of Zambia bounded by latitudes 8°and 18°s, and longitudes 22°and 34°e

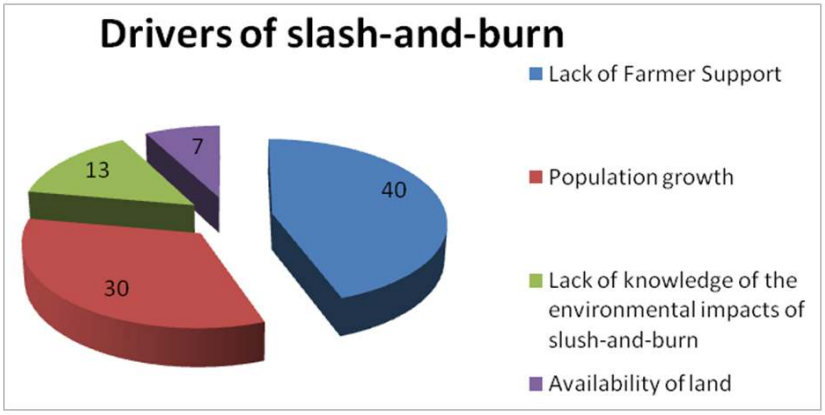

Fig. 2. Drivers of slash-and-burn agriculture in the Northern Province

3.3 Discussion of Results

The Central statistics office of Zambia (CSO) indicates that the slash-and-burn prone region of Northern Province, at 4.3% increase per year, has the highest annual population growth in Zambia [19]. This increase in population causes the demand for more land to increase which leads to increased slash-and-burn agro practices, increased biomass extraction, large scale soil erosion and surface run-off and diminishing of the woodlands which host extremely biologically diverse ecosystems.

These results are consistent with similar studies done elsewhere around the globe for instance [20] found that population growth mounts pressure on the forests over the Brazilian Amazon. Research also shows that human population density is heavier in forested regions, usually these regions host the highest number of myriad species ranging from amphibians, birds, mammals, all the way to snakes; many of these are threatened with extinction due to deforestation [21]

In agreement with the results obtained in the present study, the lack of existing of credit facilities, technical support, key sustainable agricultural knowledge and skills were cited as contributing factors to slash-and-burn agriculture in a study done in Madagascar [22].

4. CONCLUSION AND RECOMMENDATION

While in many parts of the world infrastructure developments largely contribute to deforestation, the major cause of deforestation in Northern Zambia is unsustainable traditional farming especially because the rural majority depends on agriculture for their livelihoods. The practice of slash-and-burn agriculture in Northern Province of Zambia has persisted for many years despite many interventions to stop it. About 45,000 kilometer squared of forests have been lost to this unsustainable agro practice. Further, data collected from 300 farmers shows that the major controls of deforestation in Northern Zambia are lack of farmer support services and population growth. These results are consistent with similar studies done elsewhere around the globe [23-25].

The factors that contribute to the continuation of slash-and-burn agriculture in Northern Province of Zambia as discussed in this paper can be looked at by policy makers in order to formulate policies that discourage this unsustainable practice. This work also provides a bench-mark for future research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Appendix 1. Questionnaire

Date of field visit	District	Name of enumerator	Name of farmer	Age of famer	Sex of farmer	Marital status of farmer	Total number of farmer's family members
Farmer's Family Members' Contribution towards Home Income	Famer's Education Level	Number of Years the Farmer has practiced Slash-and-burn Agriculture	Farmer's source of Slash-and-burn Agriculture knowledge	Farmer's 5 Most important Reasons for practicing Slash-and-Burn	Farmer's other sources of income apart from Slash-and-Burn	Farmer's Annual Land Area for Slash-and-Burn	Advantages and Disadvantages of Slash-and-Burn; The Farmer's Perspective
Farmer's Knowledge of Alternative Farming Methods	Farmer's Relationship with Government Agro Officers (if any)	Farmer's Relationship with NGOs (if any)	Farmer's Relationship with Financial Institutions (if any)	Farmer's Relationship with Government Forestry Officers (if any)	Farmer's Relationship with Government Environmental Officers (if any)	Any other Farmer Comments	Enumerator's Comments

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