

Determinants of Lake Zone Forest Resources' Status: Analyzing the Impact of Implemented Policies in Tanzania

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Abstract

The Lake (Victoria) zone of Tanzania, which has the least forest resources in the country, is a potential economic growth zone in the country. Therefore, this study analyses the impact of implemented forest policies on the status of forest resources in the area, given the unique features. The study identifies the status of forested lands in the area, and then fits binary logistic regression to identify the impact of policies related elements (i.e. type of forest, type of management) on the status; forest area and location (region) are used as control variables. Results show that 63% of the forested land in the area is destructed; main activities being agriculture, residential, firewood, and charcoal burning activities. Logistic results showed natural forests, forests located in Geita region, forests managed by municipal councils are more likely to be destructed; while plantation forests, forests located in Kagera region, privately managed forests are less likely to be destructed. Thus, the study concludes that policies and measures are not enough for the preservation of forest resources in the area; some of the economic activities in the area are occurring at the expenses of the forests; hence recommend more sustainable development plans and incorporating different crossing cutting sectors in the policies.

Key Words: forest resources, determinants, policies

Introduction

It can be seen all around the globe that forests are utilized, protected, and conserved in several ways. As resources, forests provide us with a broad range of relevant renewable raw materials such as food, fuelwood, and other bio products (Langat et al. 2016; Lee 2019), without forgetting the essential ecological and environmental services such as soil and water protection, recreation, conservation of biodiversity, carbon storage and climate change mitigation (Dhyani and Dhyani 2016; Duguma et al. 2019). The integrity of forest ecosystems has been wholly/partially

altered and damaged by various human activities such as excessive timber exploitation, settlement, infrastructure, agriculture, and other disturbances (Butler and Laurance 2008; Addai and Baidoo 2013; Barnes et al. 2017). Such activities, if are left (unchecked) to continue, will jeopardize the ability of the future generation to enjoy the benefits of the resources. All over the globe, the rapid disappearance of natural forests has been witnessed, and the situation is even worse in the tropics (Chukwu and Osho 2018; Maryudi et al. 2018). The worse situation in the tropics might be because of the weather conditions that support the biodiversity of trees species, which in turn boost the cutting

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down of the trees because of their uses.

Tanzania is a tropical country with significant forest resources. About 50% of Tanzania’s total land area, is covered by forests and woodlands that provide unique natural ecosystems, biological diversity, and water catchments (Food and Agriculture Organization of the United Nations 2015). Forest services in the country are so crucial to humankind and other species, and cannot be compromised. They have supported the livelihoods of many poor households by providing over 90% of the country’s energy supply (Hoffmann et al. 2015), construction materials, and many indigenous medicines (Milledge et al. 2007). The forest sector is a significant contributor to the national economy through its contribution to national GDP and total export earnings (MRNT 2008). It also provides formal and informal employment to a significant number of people (Kideghesho 2015). Regardless of all benefits this sector provides, the forestry sector in Tanzania continue to face many challenges with regard to sustainable forest management. From 1990, Tanzania has continued to lose significant areas of forest cover (Table 1). Between 1990 and 2015, the country has lost about 394,400 ha which is equal to the rate of 0.8 % per year (Food and Agriculture Organization of the United Nations 2015), the loss was estimated to be 19.4% of the total forest cover (Kideghesho 2015), which is a significantly high. This loss of forest cover is a result of heavy pressure from agricultural expansion, livestock grazing, wildfires, over-exploitation and unsustainable utilization of wood resources and other human activities mainly in the general lands (Geist and Lambin 2002; Burgess et al. 2010). In addition to that, there have been conflicts between governments (authorities) and forest-dependent

communities in the forested areas, thus, adding more pressure to the resources (Meijaard et al. 2013).

All the mentioned challenges together with recommendations/agreements from different organizations as the Rio-Conference in 1992, International Monetary Fund (IMF) and the World Bank (WB) (Mgaya 2016), made Tanzania to formulate and implement forest policies that aimed at jointly pursuing both economic and ecological objectives. In 1998, the country introduced the National Forest Policy, which was reformed from former policy of 1953 (Blomley and Iddi 2009). After the introduction of the new policy, the government then introduced the Forest Act of 2002. Immediately after the commencement of the implementations of the policy and the act, the government was able to change the access to forest resources; using different initiatives like introduction of participatory forest management (PFM) which changed the extent to which surrounding communities are permitted to collect non-timber forest products (NTFPs) from village and government reserve forests (Robinson and Kajembe 2009). Hamza and Kimwer (2007) also indicated that implementation of the Forest Policy of 1998 and Forest Act of 2002 is responsible for the observed significant reduction of illegal harvesting of forest products, encroachment, unregulated activities, and fire incidences. It has now been around two decades since the commencement of the implementations, which calls for the follow up on the effectiveness of the policies; given the fact that the country now is trying to follow the footsteps of the transition to a green economy and takes forest resources as potential resources (URT 2012; Milder et al. 2013; URD 2013).

Table 1. Trends of forested lands from 1990 to 2015 in Tanzania

Year	Forest cover (1,000 ha) ¹	Change rate in five years (1,000 ha)	Change rate in five years (%)
1990	55,920	-	-
2000	51,920	-4,000	-7.1
2005	49,920	-2,000	-3.8
2010	47,920	-2,000	-4
2015	46,060	1,860	-3.9

¹Trends are in the total forest area which is forests and woodlands, Source (FAO 2015).

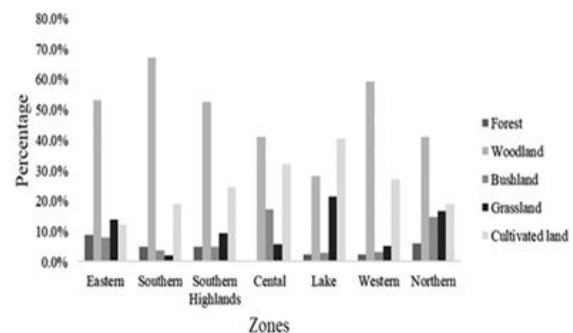


Fig. 1. Distributions of land use by percentage with zones in Tanzania showing Lake Zone with the lowest forested area. Source: NAFORMA (2015).

Thus, it is of importance to know how far the sustainable economic growth initiative is handling the challenges in the areas given the available national resources policies, regulations and bylaws as tools.

The Lake zone of Tanzania is a significant economic zone with a noticeable population and economic growth (URT 2018). It has been indicated that this kind of growth gives pressure to nature (Carr 2004, 2005; Omilola 2014). Report by NAFORMA (2015) shows that the Lake zone continues to have the lowest forest areas, the lowest woodland and bushland areas; on the other hand, have the highest cultivation area as shown in Fig. 1. With such a situation, it was of interest to know the current state of the forests in the area, and what are the determinants of that state, given the policies implemented in the country. Many related researches have been done in potential areas, with significant forests in the country (Blomley and Iddi 2009; Robinson and Kajembe 2009; Burgess et al. 2010). It is clear that Lake Zone does not have extensive potential forests, but it is important to know the state in which they are; given the economic developments and town planning activities that are taking place. This study intends to analyze the impact of the established policies on forest resources and identify the determinants of the current state of the resources in the Lake zone of Tanzania.

Materials and Methods

Theoretical perspective to explain the transitions of forests and land use

All around the globe, forests transit in different dimensions and perspectives. Forest transitions have been well explained by forest transition theory, which gives out an explanation on how the modification from shrinking to expanding of forest cover occurs (Mather and Needle 1998). There are many studies explaining different factors that play essential roles as determinants of forest transitions across the globe (Lambin and Meyfroidt 2010; Yu Li et al. 2013; Nguyen et al. 2015). According to Rudel (2005), there are two major arguments describing forest transitions. One argument establishes that a change in forest by deforestation increases the value of woods and wood products in terms of price, which result into more harvesting of the remaining primary forests and also encourages tree planta-

tions especially those with wood and wood products properties (Fairhead and Leach, 1995; Walters 1997).

The other explains the effect of economic growth, especially from industrialization. This kind of growth creates many non-agriculture job opportunities that attract laborers to move from farm to non-farm economic activities, leading to the negligence of farmland and its re-conversion to forests related jobs (Bentley 1989), and consequently enhancing plantation of trees. However, wood scarcity and economic development cannot explain all forest transition phenomena (Yu Li et al. 2013). The economy-wide influences such as government policy, technological change and demographic factors have not been considered (Barbier et al. 2010). There is a variety of different environmental, social, and political factors that can also be responsible for forest transitions (Mather 2007; Perz 2007).

The role of Governments in facilitating forest transitions through the establishment of different mechanisms (such as policies) cannot be ignored. Governments are trying to manage, restore and conserve forest cover through these mentioned mechanisms, which are done by different responsible agencies in the countries (Grainger 1995b; Nagendra 2007). Governments have also been trying to introduce Payment for Environment Services (PES) (Yu Li et al. 2013). PES has been practiced globally for the past few years (Ferraro and Kiss, 2002; Ferraro and Pattanayak, 2006). These programs provide direct incentives (e.g., land purchases, leases, and easements) or indirect incentives (i.e., alternative economic and social benefits) to individuals or communities to restore natural resources and stopping the degradations of natural systems associated with them (Ferraro and Kiss 2002; Fajar and Kim 2019).

Most of economic-related studies have not focused on forest transitions in isolation, but have also focused on analyzing the factors causing agricultural land conversion and deforestation, especially in developing countries (Barbier and Burgess 2001). These studies suggest the environmental Kuznets curve (EKC) hypothesis (Choumert et al. 2013; Indarto and Mutaqin 2016) and competing land-use models (Canziani and Benitez 2012; Duguma et al. 2019) as distinct analytical frameworks to study the related factors and relationships.

Some studies have emphasized that the long-run modifications in forest cover in a place should not be far from

the overall pattern of land-use changes for that area (Kumar et al. 2013; Yan Li et al. 2017). A long-term trend in a country's forest cover is best viewed in terms of changes in its national land-use morphology (Grainger 1995a, 1995b). Meyfroidt et al. (2010) suggest that the U-shaped forest cover curve is, in fact, the aggregate of two separate land-use change curves, the decline in forest area, known as the national land-use transition, and the restoration of a forest area after the transition, which is known as the forest replenishment period.

If the observed forest cover is declining, it is because the land in the forest is being converted to other land uses (Lima et al. 2012; Aryono et al. 2018). On the contrary, when afforestation, reforestation or natural regrowth occurs, it is because land under an alternative use is less preferred than forested land. The use of that land is determined by its value compare to the values of other competing uses (Barbier et al. 2010); for example, the land can be used as a forested land if the surrounding community value related uses as timber production, recreation, nature reserves more than different land uses like agriculture, urban development, residential housing etc. Therefore, some studies suggest that, the forest transition studies be broadened to land use allocation. Because under competing uses, it is the value of land which is the core determinant of increase or decrease of forest cover.

Methodology

Description of the study area

This study was done on forested lands found in four administrative regions in the Lake (Victoria) zone of Tanzania. The regions are Mwanza and Geita, which both border the southern shore of Lake Victoria; Kagera that borders the western shore and Mara, which borders the eastern shore. Kagera has the largest forested area (2,627,312 ha followed by Mara, and Geita while Mwanza has the smallest area (NAFROMA 2015)). The regions' climate is tropical humid with average temperatures ranging from 15°C, to 28°C (Awange and Ong'ang'a, 2006). The mean annual rainfall varies from a minimum of about 886 mm to 2600 mm. The mean evaporative rate range from 1100 to 2040 mm; it decreases with increasing altitude, but in some months exceeds rainfall (Nyeko-Ogiramoi et al. 2013). Mwanza is the most developed region in the lake zone and its capital

Mwanza city is the regions' economic hub. The economy of the area is highly dominated by agriculture (farming, livestock and fishery) which accounts for 62.8 percent; the other population is preoccupied with elementary occupations, trade and small businesses, and works of arts (URT 2013).

Data and methods

The forest policy of Tanzania (1998) and the forest act (2002) emphasize the sustainability of forests and forest products by maintaining sufficient forest area and effective forest management (URT 1998; URT 2002). As a result, policies promote defined owner of the forest and therefore allocate forests to different management authorities. It was assumed that with proper management, it would be easy to protect and conserve. Therefore, the country established the principal central government forest management agency by the name of Tanzania Forest Services Agency (TFS). The agency collaborates with other agencies such as Tanzania National Parks (TANAPA) in managing many forests all over the country. The Agency is well established with a significant number of staff and resources to manage the forests (TFS 2014). Moreover, there are other established management authorities such as municipal and village councils (governments). However, Kideghesho (2015) and URT reports (2013) mention that about 50% of forested land that falls under village management authorities and other management regimes than TFS are more susceptible to severe deforestation and degradation, due to unclear forest management roles. It implies forests under central government management and other related managements with clear roles are not expected to be destroyed. Policies have also emphasized sustainable management of forest plantations by allocating plantation forests into one or several executive agencies. Therefore, the study uses forest management and type of forests as policy elements.

In addition to the policy elements, administrative regions/provinces in which the forests are located have also been incorporated as determinants. Although the regions in the Lake zone interact economically and in other development activities, they are at different levels of economic and urban-development with different prevailing conditions. Specific characteristics of the regions may influence the forests in the area. Thus, this study uses; type of management (private, village, municipal, TFS), type of forest (whether

plantation or natural forest), forest area and the region in which the forests are located as the determinants of the forest resources' status in the area.

The main analysis method used in identifying the determinants of the destruction is regression analysis. The dependent variable for determinants of destruction was in dichotomous (dummy) form; that is the status of the forest destruction; (destruction and no destruction). The forest destruction has been ranked based on the explanation from the forest experts in the respective forest areas; a forest is considered destroyed when 20 percent or more of it has been destroyed otherwise not destroyed. In this case, a binary logistic model is the most appropriate econometric tool for analysis (Greene 2003). The binary logit model based on the logistic distribution is specified as the likelihood of the forest to be destroyed is predicted by odds ($Y=1$); that is, the ratio of the probability that $Y=1$ to the probability that $Y \neq 1$:

$$Odds\ Y = \frac{P(Y=1)}{(1-P(Y=1))} \quad (1)$$

The logit (Y) is given by natural log of Odds

$$\ln\left(\frac{P(Y=1)}{(1-P(Y=1))}\right) = \log Odds = \text{logit}(Y) \quad (2)$$

$$\text{Logit}(Y) = \alpha + \beta_1 X_1 + \dots + \beta_n X_n + \varepsilon \quad (3)$$

Where Y =dependent variable (destroyed) with 1=yes and 0=otherwise; α =intercept, β =coefficients of the independent variables, X =is the independent variable, P (p)=probability of forest being destroyed; $1-P$ =probability that a forest is not destroyed; and \ln =natural log. The independent variables of this model are region, type of forest, forest area and management.\

Results

Descriptive results

Based on available documents, 82 main forests were studied. This part presents variation of the variables around

Table 2. Summary statistic of independent variables used

Variable	Description	Unit	Mean	SD	Variable type	Expected sign
Area	Forest area	Hectare (ha)	21180.74	6881.239	Continuous	+
Type	Type of forest	1=Natural forest, 0=plantation	0.6829	0.4681	Dummy	+
Region					Categorical	
Geita	Forest located in Geita region	1=Geita, 0=otherwise	0.0853	0.2811		±
Mara	Forest located in Mara region	1=Mara, 0=otherwise	0.5121	0.5029		±
Mwanza	Forest located in Mwanza region	1=Mwanza, 0=otherwise	0.2073	0.4078		±
Kagera	Forest located in Kagera region	1=Kagera, 0=otherwise	0.1951	0.3987		+
Management					Categorical	
Central government-Tanzania forest services (TFS)	Forest managed by central government	1=TFS, 0=otherwise	0.4268	0.4976		+
Municipal	Forest managed by municipal councils	1=Municipal, 0=otherwise	0.2804	0.4520		±
Village	Forest managed by village governments	1=Village, 0=otherwise	0.1707	0.3785		±
Private	Private companies and individuals	1=Private, 0=otherwise	0.1219	0.3292		+

their averages/means, as well as the descriptions, distribution pattern of the investigated variables. Results in Table 2 show that standard deviations of type of forest, regions (with exception of Mara region), and type of management are higher than their means. This usually occurs when there is a wide range of variation amongst the data sets, and this is expected, as there is a 0 value in the data set of the variables, as the variables are dummy. Forest area's standard deviation is smaller than mean, which implies that more of the data is clustered about the mean.

The data shows that a total of 52 forests have been destroyed, which is about 63% as indicated in Table 3. The remaining forested area has little destruction or no destruction. Most of the disturbances and degradations are from agriculture and residential areas mainly villages and streets. The rest of the disturbances come from cutting trees for timber, charcoal production, firewood and mining

Table 3. Distribution of forests and their destructions

Disturbance	Frequency	Percentage
Little or no destructions	30	36.59
Destruction	52	63.41
Total	82	100

activities.

Determinants of forests destructions

The binary Logit regression model was fitted to identify the causes of the current state of forested land. The destruction and no destruction were used as dummy dependent variables. Coefficients in the model only give out the direct impact (whether positive or negative) of independent variables, on the dependent variables; they give neither the real magnitude of change nor probability levels (Eshete 2007). However, the marginal effects give out the expected change in probability of a particular choice being made in respect to a unit change of an independent variable. Therefore, coefficients, odds ratios and magnitude are presented.

The results presented in Table 4 revealed that the size of the forested land area has no significant effect on the destruction of the forests, that is to say, whether the forests are big or small, cutting of trees and other destructions are still the same. The type of forest, whether natural forest or a plantation, has a significant positive effect on the destruction of the forests at 0.01 level of significance; according to its marginal effect, natural forests are 50% more likely to be destroyed than plantation forests. The policies require proper management of the plantation forests, consequently

Table 4. Logit estimation of determinants of the distraction

Explanatory variable	Coefficient	Odds ratios	Marginal effect
Area	7.97e-06	1.000008	1.74e-06
Type	2.253528	9.521271	0.5003**
Region			
Geita	2.4772	11.9085	0.5399*
Mara	1.0165	2.7635	0.2281
Mwanza	0.8782	2.4065	0.1797
Kagera	-3.6300	0.0265	-0.7141**
Management			
TFS	0.8625	2.369	0.1870
Municipal	1.1046	3.0181	0.2235*
Village	-0.4898	0.6127	-0.1148
Private	-2.2066	0.110	-0.4989**
Constant	3.8248***	45.8271	
Number of observations	82		
LR chi ² of PRA	25.41***		
Pseudo R ²	0.23		

Explanatory variables region and management have been referred as a category, illegal as dummy and area as continuous.

***p < 0.001, ** p < 0.01, *p < 0.05.

enhance protection, and this has been shown by the results. This is mainly because many of plantation forests are as a result of the remedy activities (biodiversity conservation) of the planted forests, there are also specific reasons like timber, recreation etc. (Onyekwelu and Olabiwonna 2016), even though there is a debate that many forest plantations are mainly because of economic purposes. Therefore based on these, plantation forests are expected to have proper management and well taken care of. These results are also supported by the survey done by NAFROMA in 2014 which indicate decrease of natural forests stock average by 32% in the country from 2009 to 2014 (NAFORMA 2015) while forest plantations have increased.

In the case of the administrative regions, only Geita and Kagera have significant effects on the destruction of the forests. Geita has a positive significant effect at 0.05 level of significance, which means the region has a higher chance of having destructed forests by about 53%. This might be because the region has been recently established (2012) taking some parts of Mwanza and Kagera regions, so responsible authorities are still building up and making plans for the region, and the bad thing is, the development planning might be occurring at the expense of natural resources (forests). In addition to that, there are also many forest destruction activities like mining (the region is the potential mining area), agriculture etc. As Javed and Khan (2012); Peterson and Heemskerk (2001) indicated in their studies, major losses of forest cover is mainly due to the charcoal production, mining activities, small scale mining and agriculture, this is because people see virgin forest lands as more fertile and productive than old agricultural lands (Kideghesho 2015). Kagera has a negative significant effect at 0.01 level of significance, which indicate that the region is less likely to have destructed forests. Forests in the area are dense and wet, this condition makes it difficult for people invade the forests.

The type of management has also an impact on the state of the forests. Most of the forests, especially extensive forests and forests transcending more than one region or district borders are managed by the central government agency, but it gives out insignificant results. Results reveal that private management has a negative significant impact on the destruction at 0.01 level of significance. Private owned forests are less likely to be destructed. Privately managed

forests comply with common goods and public goods concepts. Forests are one of the widely known public good (Kaul et al. 1999). However, when managed as private property it gives out the control and conservation as private one.

In order to test the adequacy of the fitted model, some diagnostics tests were conducted after fitting the logistic model. The tests largely support the stability of the coefficients of regression equations. The Hosmer-Lemeshow goodness-of-fit test is found to be insignificant ($\chi^2=79.44$, d.f=8, p-value=0.11), and link-test for specification error was insignificant (p-value=0.547) indicating no specification error.

Discussion

This study uses the least forested zone in Tanzania to analyze the impacts of implemented forests policies on the forests resources in the country. Policy elements and other control variables have been used to determine the status. The results presented above, to some extent, indicate that policies have managed to enhance forests conservation in the area. However, available policies have not completely succeeded to preserve the least forest resources Lake Zone is having. In the country's efforts to promote sustainable economic growth such as green economy, the results suggest that efforts to develop and conserve forests resources in the zone are inadequate. It is apparent that policies cannot be the only strategy in achieving sustainable development. For a country to have a sustainable economy, formation, and implementation of policies can be the easiest strategy to communicate; but, the fact is that efforts have to go further, and other strategies should not be ignored. With the current mentioned rate of deforestation (0.4 million ha) in Tanzania, it indicates that available measures are either inadequate or poorly implemented or both; and if this is left to continue, the country is expected to lose most of its forests in the coming 50 to 80 years (Sangeda et al. 2017). Therefore, it is important to reinforce available measures and adopt new ones to complement the existing measures.

In addition, the concept of ownership has been found to improve the conservation status of the forests in the respective areas. The results show that, private owned forests have little or no destructions, therefore the sense of owner-

ship at different levels could increase the appreciation and protection the resources. Respecting and appreciating the value of forests can enhance conserving and protection of the resources (Barbier et al. 2010). According to Helfrich and Bollier (2012), collectively taking care of a shared pool of goods at the same time respecting its value beyond use have been proven to safeguard resources for long periods. Hence, responsible authorities need to promote and introduce the concept of ownership to the communities and individuals surrounding the resources.

This study recommends promotion of alternative, renewable and affordable sources of energy to the communities surrounding the forests by the responsible authorities in the area. NAFROMA report (2015) mention firewood as the main source of energy to the households; additionally, unsustainable charcoal production is the most important driver of forest degradation in large parts of Africa (Kissinger et al. 2012). Cutting trees for firewood and charcoal production, which contribute to forest depletion, is a widespread practice in the lake zone. The country has made an effort to introduce and promote sustainable energy use, including the use of improved cooking stoves (ICS) for the conservation of forests (Massawe and Bengesi 2017; Kulindwa et al. 2018; Bishoge et al. 2019). These programs and other conservation related projects need to be vigorously promoted in the lake zone and other resource-poor areas.

The results suggest that the development and planning of the towns in the area do not or do very little consider nature conservation, which includes forest cover. The role played by natural resources in empowering the economy need not be overlooked. Therefore, with unsustainable urbanization and unsustainably managed consumption of the natural resources, the area may eventually experience an economic downfall and jeopardize the lives of people whose livelihood depends on the resources. The study hence suggests to the responsible authorities in the area, when planning Development of urban-areas, they should consider and not compromise natural resources. For good results, policies need to be crosscutting, integrating essential sectors such as conservation, environment, infrastructure, economy, energy, education, community development and other natural resources and economy related sectors.

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