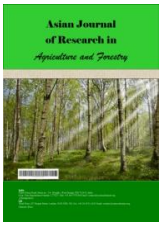

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Socio-Economic Drivers for Farming Households' Decision to Conserve Nature around Mount Uluguru, Tanzania

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Authors' contributions

This work was carried out in collaboration among all authors. Author ST designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors YJM and CH discussed the findings of the study and provided the recommendations. All three authors managed the literature searches and approved the final manuscript.

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ABSTRACT

Nature conservation means preservation or restoration of the environment and wildlife. The activity is just beyond someone's will; it is highly influenced by socio-economic factors. This study examined the drivers for farming households to conserve the nature around Mount Uluguru in Morogoro, Tanzania. A survey was conducted in five villages around the Arc Uluguru Mountain, and only 106 respondents were randomly selected. To supplement the information, focus group discussions were held with village leaders and environmental committee members in each village who gave their precious information for analysis. Descriptive analysis was done using frequencies, percentage, and mean for examining characteristics of the sampled population, while the binary logistic model was used to analyze the factors that drive farmers to participate in nature conservation. It was found that farming experience, access to support services and awareness in bylaws and regulations increase the chances of participating in environmental conservation

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amongst the household members. Also, being a male individual and having old age decreases the chances of engagement to nature conservation activities. The study recommends that, in conservation activities, gender roles should be taken into consideration, as anyone can take charge and participate in nature conservation. Furthermore, more training, materials, and equipment are needed from governmental and NGO's to help nature conservation in Mount Uluguru.

Keywords: Socio-economic drivers, nature conservation, Mount Uluguru.

1. INTRODUCTION

Conservation simply can mean preservation or restoration of the natural environment and wildlife; however, in broad perspective can include preservation of archaeological, historical, and cultural sites and artefacts [1]. According to the Tanzania Environmental Policy of 1997, the state of the country's environment requires urgent attention in six major areas (land degradation; lack of accessible, good quality water for both urban and rural inhabitants; Environmental pollution; loss of wildlife habitats and biodiversity; deterioration of aquatic systems; and deforestation), of which one of the causes for that is the failure to conserve the nature. Over the years, now the Tanzanian government has promoted participatory forest management (both joint forest management and community-based forest management) as an essential strategy for managing natural forests for sustainable use and conservation [2-3].

The Uluguru Mountains Nature Reserve (UMNR), like other nature reserves in the Eastern Arc Mountains (EAMs), are of global importance for their biological values and of national significance in providing water to millions of Tanzanians. The Uluguru Forest Reserves (FRs) have also been identified as an Important Bird Area in Tanzania by Birdlife International [4]. Based on the rates of endemism, Uluguru Forest Reserve ranks first among the different blocks of EAM [5]. So far, there is no information on the economic value of the Uluguru FRs. A study by FBD [1] in 2003 covering all catchment FRs in Arusha, Kilimanjaro, Morogoro, and Tanga showed the FRs to have actual total economic value of USD 496,109,543 in terms of timber and timber-related goods, non-timber forest products (NTFPs), water, soils, tourism, carbon, option value, biodiversity and non-use values [6].

In spite of the indicated values, the FRs face many threats: conversion to agriculture, illegal grazing, illegal logging, mining, forest fires, invasive species, unsustainable collection for the pet trade, hunting, and climate change (FBD, 2008; CMEAMF[2], 2006;2007). The root causes of the anthropogenic threats include widespread poverty, which is exacerbated by population growth and population pressure (FBD, 2002; 2008). Other root causes include extensive and inefficient land-use practices, limited local environmental awareness, weak law enforcement, lack of transparency, corruption, weak management capacity, inadequate and poorly targeted fiscal resources, high national and international demands and the high price of electricity (Hartley and Kaare, 2001; FBD, 2002;2008). The threats have caused losses of timber and biodiversity as well as reduced the catchment values resulting in hydrological imbalance, reflected in reduced water in rivers and streams during the dry seasons and floods during the wet seasons (URT, 2001; FBD, 2005). Between 1975 and 2000, the Uluguru forest and woodland cover decreased by 11.8% and 39%, respectively (CMEAMF, 2006). The objective of the study was to examine the determinants of farming households' decision to conserve nature, taking the case of Uluguru Mountain slopes. Therefore, the study categorized the villages based on the history of environmental management; the intent is to test whether there is a variation between villages with good and bad environmental history. This study considers conservation as an output derived from a series of inputs. According to Jehle and Reny [7]. Such models with a relationship between inputs and output variables assumes a production function. In this study, conservation is taken as a function of socio-economic variables and institution characteristics.

2. METHODOLOGY

2.1 Study Area

The Uluguru Nature Reserve (UNR) is part of the Eastern Arc Mountains (EAM), which runs from

[1]*FBD=Forestry and Beekeeping Division*

[2]*CMEAMF=Conservation and Management of the Eastern Arc Mountain Forests*

Taita Hills in Southern Kenya to the Udzungwa Mountains in South Central Tanzania. UNR covers 24,115.09 hectares and is comprised of the former Uluguru North Forest Reserve, Uluguru South Forest Reserve, Bunduki I and II Forest Reserves, and Bunduki gap/corridor as shown in Fig. 1.

Due to resource limitation, the study covered only part of NRA that located in the Morogoro Rural District. Out of 57 villages found in reserve, five villages were selected purposively for the survey. The selection was based on the location from the forest borders, i.e. those located in the upper slopes (just immediate after the border), those which are in the mid slopes (a bit far from the border) and those which located in the down slopes (a bit far away from the border) Table 1. A socio-economic survey was conducted to gather primary data from people living around Uluguru Forest Reserve. Purposive sampling was used to select five villages, as shown in Table 1. Within these villages, random sampling was employed to select 106 respondents for interviewing using a semi-structured questionnaire. Using purposive sampling, Focus Group Discussions (FDGs) were held from village leaders, members of the environmental committee and extension officer in each village to supplement and substantiate the information.

Table1. Interviewed respondents by the village

Name of Village	Respondents Interview	FDG	% Share
Mvuha	25	12	23.4
Kibangire	16	9	15.8
Kiswira	18	10	17.7
Konde	20	10	19.0
KibungoJuu	27	11	24.1

Socio-economic drivers for farming households' decision to conserve nature around Mount Uluguru was analyzed by logistic regression. A binary logistic regression model was used to test the hypothesis that farming households' socio-economic variables and environmental knowledge do not influence farming households' decision to participate in nature conservation activities. The binary logistic regression model was used in the analysis because it allows one to predict a discrete outcome, such as group membership, from a set of variables that may be continuous, discrete, dichotomous, or a mix of any of these [8]. Using a model adapted from Wooldridge [8],

$$P_i = E\left(Y_i = {}^{1}/_{X_i}\right) = \frac{1}{1 + e^{-(\alpha_0 + \sum_{i=1}^{k} \alpha_i X_i)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, P_i represents the probability of household i to conserve nature or not $(Pi > 0), Y_i$ is the level of performing the environmental conservation activities by household i, X_i represents a set of explanatory variables that influence the performance of household i to conduct environmental conservation activities (such as; age, sex, education, additional occupation, income, household size, farming experience, farm ownership, farming labour, access to extension services, conservation support, and knowledge on environmental laws and by-laws), and α_i represents the parameters to be estimated.

Let: $-(\alpha_0 + \sum_{i=1}^{k} \alpha_i X_i) = A \ldots\ldots\ldots\ldots\ldots\ldots$ (2)

Then: $P_i = \frac{1}{1+e^{-A_i}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$(3)

If P_i is the probability of household i to conserve nature, given as equation (3), then $(1 - P_i)$ is the probability of not conservation, and is given as:

$$(1 - P_i) = \frac{1}{(1 + e^{A_i})} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Now, the odd-ration $P_i / (1\text{-}P_i)$ is given as:

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{A_i}}{1 + e^{-A_i}} e^{A_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Taking the natural logarithm of equation (5) gives rise to the logarithm of the odds ratio as:

$$L_i = \frac{P_i}{(1 - P_i)} = \alpha_0 + \sum_{i=1}^{k} \alpha_i X_i + \mu_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where L_i is the logit – hence the term "logit model." Upon rearranging equation (6), with the dependent variable in log odds, the logistic regression can be manipulated to calculate the conditional probabilities as:

$$P_i = \frac{e^{\left(\alpha_0 + \sum_{i=1}^{k} \alpha_i X_i\right)}}{1 + e^{(\alpha_0 + \sum_{i=1}^{k} \alpha_i X_i)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Given the calculated conditional probabilities for each sampled household, the partial (marginal) effects of the discrete (categorical) variables on the probability of the household performed nature

conservation activities determined from the expression:

$$\frac{\partial P_i}{\partial X_i} = P_i(1 - P_i)\alpha_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Hence, the partial effects are calculated by taking the differences of the mean probabilities estimated for the respective discrete variables, i.e., when $X_i = 0$ and $X_i = 1$. The partial effects of the continuous variables on the probability of the household performed conservation activities are determined by rescaling the parameter estimate from the logistic regression with a scale factor by merely subtracting the coefficient from the scale factor.

3. RESULTS AND DISCUSSION

3.1 Description of the Variables Specified in the Model

3.1.1 Age of respondents

The age composition of the population in the given economy can have a significant influence on economic development [9]. Results in Table 2 revealed that the ages of both categories of farmers ranged from 18 to 75 years, with a mean age of 40.32 years. Literature has associate economic development with people's participation in nature conservation; also, the age of respondents affects their attitude towards participating in community development projects. According to Angba et al. [10], it is more likely for younger people to participate in community development activities than older once. Young ages have been associated with being very active in community and development activities, and this is because the age of an individual affects some one's attitude and hence affects the decision-making ability [11]. The nature of the conservation activities together with the topography of the study area, demanding to work and walk long hours in the field (farm and forest reserve), which made most of the people with higher ages find it difficult and hence not interested in conservation activities.

3.1.2 Farming experience of respondents

In this study, the experience was categorized in two aspects, one is for those who have enough experience, given the value of 1 (having more than 10 years in farming business), while the other group was given a value of 0, indicating all those who are not well experienced in farming activities (those with 10 and fewer years). Results in Table 2 shows that there was a significant difference between the years of farming experience in the survey area with a mean of 16.21 years since the experience ranged from 1 to 60 years. According to Moges and Taye [12], formal education improves an individual's rationality in making various decisions; however, in farming activities experience matters a lot.

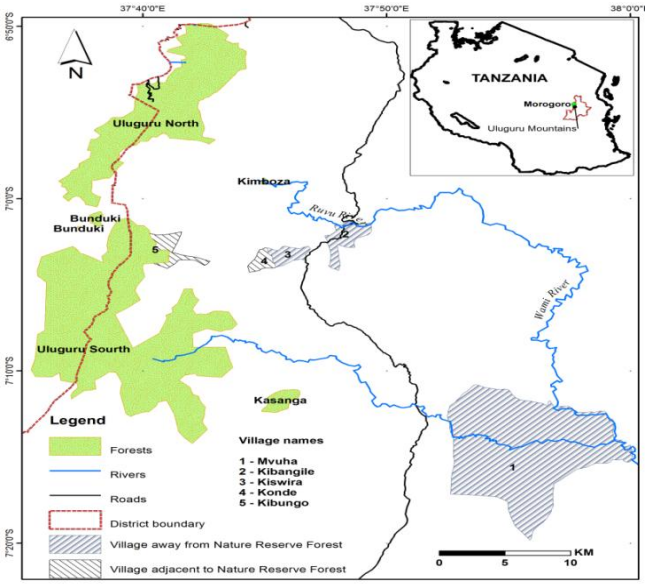

Fig. 1. Uluguru nature reserve

Table 2. Descriptive statistics (continuous variable) N=106

Variables	Min	Max	Mean	SD
Age of a respondent in years	18	75	40.32	12.928
Farming experience in years	1	60	16.21	11.938
Land owned for agricultural activities in acres	1.0	20.0	6.557	3.8100

3.1.3 Size of the farm owned and cultivated by respondents

The farm is the focal production unit for any farming household. The bigger the farm size, the higher the production level, which means the higher the farm revenues; hence, the more the income of farming households. Income is an essential factor for an individual to participate in a particular development activity [9]. In this regard, the ownership component was involved in taking care of farm investments, as most of the farmers cannot invest more in the hired land. In the surveyed farmers, the minimum farm size was 1 acre, while the maximum was 20 acres, with an average of 6.6 acres.

3.1.4 Household gender

Scientists have observed that an efficient way of making conservation activities successful is to involve gender [13]. Basically, gender is considered as the social attributes and opportunities associated with being male or female, and the relationships between the two groups (OCHA, 2012[3]). The result in Table 3 shows that nature conservation in Uluguru Mountain constituted more of males (70.8%) as compared to females (29.2%). Thus, although there are physical differences between the sexes in men and women, the circumstances, environment, and system in the community can influence their roles and hence affect their involvement in nature conservation activities. In many African countries, both men and women provide a significant part of the labour force involved in all sectors of production, including food production, processing, and marketing [14]. Compared to men, women have been imposed too many domestic roles that limit their participation in other developing activities, including nature conservation activities, regardless of their ability [14-17]. This study found that being a male in the villages surrounding Mount Uluguru increases the probability of engaging in nature conservation activities

3.1.5 Income of respondents

In this study, two major groups of incomes were identified; one is the group of the people who have an average income of over Tsh. 500,000/= per year, and it was given a value of one, while the second group earned less or equal to Tsh. 500,000/=, and were given a value of zero. Results in Table 3 revealed that 77.4% of the interviewed respondents had a higher income of more than five hundred thousand. Usually, people with higher incomes tend to reinvest in various activities within the community [18].

3.1.6. Environmental support obtained

The study considers a dummy with a value of 1 for those received any of the training, fund, material or equipment, and a zero for otherwise. The result shows that 55.7% obtained environmental support, and the rest 44.3% did not. It is evidenced by Burns et al. [19] that any help can motivate an individual to participate in a particular project. A major goal of many community-based environmental protection efforts, which is part of the nature conservation, is to ensure that local ecosystems are healthy enough to provide a range of valuable benefits today and in the future. But this can be achieved through community support, which ranges from being equipped with knowledge and skills of conservation, equipment, and in some cases, funds to conduct protection activities (WWF, 2014). However, according to the discussions with the environmental committee members, the support is still insufficient, as there are newcomers in every new village government, so the training should be repetitive; also the gears are worn out hence, replacement should be done frequently. Moreover, the exercise of protecting encroachment demanding a lot of time which can be used for other farming activities, thus temper with their income issues, and people may lose the ownership feelings which according to Wuyep [20] may cause "Tragedy of the Commons."

[3]*OCHA Gender Toolkit, 2012; Availableat:https://docs.unocha.org/sites/dms/Documents/GenderToolkit1_2_GenderDefinitionsandMandates.pdf*

3.1.7 Status of the environmental laws awareness

Many respondents (63.2%) admitted that at least they know some of the environmental laws holding in their locality. However, few (36.8%) are not aware of the existing environmental laws and regulations in their area, as shown in Table 3. The results are evidenced by Guiriba (2010) who concluded that women's awareness in environmental laws and regulation can have an impact in total community.

Furthermore, the findings show that being aware of any environmental law (local and countrywide) increases the probability of involvement in conservation activities. Many surveyed villages managed to have their environmental by-laws, which are often used to reinforce the nature conservation among villagers. All members of environmental committees, together with the village council are by default involved in the development of the bylaws. However, during focus group discussion it was observed that the details of the bylaws are not well understood by every individual in the committee. Furthermore, the national environmental law of 1994 is not well understood by many of the village environmental committee members as well as village council members; they only know the bylaws set by themselves, thus creating a lot of inconveniences when it comes to reinforcement.

3.2 Analysis of Socio-economic Drivers for Farming Households' Decision to Conserve Nature

The Socio-economic drivers for farming households' decision to conserve nature around Mount Uluguru were ascertained using a binary logistic model. Referring the modelling, the dependent variable for the study was whether the farmer was involved or not involved in nature. conservation activities (taking care of tree nurseries, planting trees, educating people on the issues of environmental conservation, involved in controlling bush fires, protecting the water sources by restricting people to do farming activities in them, stop mining activities along the river banks, scouting inside and along the forest etc.).

Concerning the predictive efficacy of the logistic model, the correlation coefficient (Nagelkerke R^2) was calculated. Results in Table 4 shows the R^2 value of about 0.89 which means that about 89% of the variation in participation in nature conservation was explained by socio-economic drivers for farming including age, gender, land owned, farming experience, household income, farm size, support obtained and awareness on environmental laws. Further analysis shows that only age, farming experience, and environmental laws awareness were significant at $P<0.05$

General analysis of the odds ratio [Exp (B)] values indicates that compared to other factors, age and gender have odd ratios values less than one [Exp(B)<1] and positive relationship with the dependent variable (whether household involved or not). The results show that the gender of respondents with lowest odds ratio [Exp(B)=0.849], meaning that being a male or female in communities surrounding the Arc of Mount Uluguru has a negative impact in participation since nature conservation activities in the study area depends on gender. The odds ratio associated with income of respondents, farming experience, farm size, and environmental laws awareness are all greater than one [Exp(B)>1] and have a positive relationship with the dependent variable (whether household involved or not). The higher the odds ratio values, the higher the probability of that particular factor to change as a result of changing the magnitude of independent

Table 3. Descriptive statistics of variables in the model (dummies) N=106

Variables	Description	Freq.	%
Gender of a respondent	1=Male;	75	70.8
	0= Female	31	29.2
Income of a respondent	1= high income;	82	77.4
	0=low income	24	22.6
Environmental support	1= respondent obtain any environmental support	59	55.7
	0= otherwise	47	44.3
Environmental laws awareness	1= respondent is aware of environmental law or by-law	67	63.2
	0= otherwise	39	36.8

Table 4. Drivers for farming households' decision

Variables	Coefficients	SE	Sig	Exp(B)
Constant	-3.359	2.552	0.188	0.035
Gender of a respondents	-0.163	1.347	0.904	0.849
Age of a respondents	-0.149	0.061	0.015*	0.862
Income of a respondents	0.614	1.131	0.587	1.848
Farming experience	6.924	2.105	0.001**	10.165
Farm size	0.271	0.168	0.108	1.311
Environmental support	2.244	1.311	0.087	8.428
Environmental laws awareness	5.577	1.548	0.000**	12.399

**Significant at P<0.05; **Significant at P<0.01; Nagelkerke R Square =0.89*

factor by one unit. The awareness on environmental laws was positively related to the dependent variable (whether household involved or not) with highest odds ratio [Exp(B)=12.399], meaning that increase in awareness in environmental laws and regulations increases participation (involvement) of households in nature conservation activities.

4. CONCLUSION

According to the findings, nature conservation activities are influenced by socio economic factors amongst which are age, farming experiences, access to support services, and awareness of by lays and regulations. Further analysis shows that being a male and having old age to some situations like the one in Mount Uluguru can reduce the engagement to conservation activities. On the other hand, the experienced farmers with bigger farm sizes have a higher probability of engaging themselves in conservation activities. Moreover, any environmental support such as training, materials, financial, together with knowledge on environmental laws/regulations, motivates people to participate more in conservation activities.

The study recommends that, in conservation activities, gender roles should be taken by care, as anyone can take charge and participate, the notion that demanding works are for men should be avoided. In line with this, youth should be the foremost people in the community to participate in development projects, including nature conservation activities as we all know that youth are the current and future generation, while elder ones are only living now. Also, more support is needed from national and multinational governmental and non-governmental organizations as the actions of one country could bring externality to another country.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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