Ecology and Evolutionary Biology
2020; 5(1): 6-12
http://www.sciencepublishinggroup.com/j/eeb
doi: 10.11648/j.eeb.20200501.12
ISSN: 2575-3789 (Print); ISSN: 2575-3762 (Online)

Smallholder Tobacco Farmers and Forest Conservation in Mutasa District, Zimbabwe

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To cite this article:

Mango Lawrence, Kugedera Andrew Tapiwa, Mango Lovemore, Mutenje Michael. Smallholder Tobacco Farmers and Forest Conservation in Mutasa District, Zimbabwe. *Ecology and Evolutionary Biology.* Vol. 5, No. 1, 2020, pp. 6-12. doi: 10.11648/j.eeb.20200501.12

Received: November 21, 2019; **Accepted**: December 12, 2019; **Published**: February 14, 2020

Abstract: Zimbabwe is among the poorest countries in the world and heavily depends on agriculture for rural livelihoods and income generation. Forests conversion into agricultural land and the use of forest products, in particular fuel wood for the construction of tobacco barns and the curing process has caused destruction to the already depleted forests. The study was carried out in Mutasa District in the eastern highlands, Zimbabwe. Quantitative and qualitative data techniques were used in the study. A total of 60 smallholder tobacco farmers were purposively sampled from a population of 280 tobacco producing households for the survey. The data was collected using a structured questionnaire and direct observations. The data were analysed using descriptive statistics and Binary logistic. Results show that proximity to the forest ($p < 0.001$), age of farmer ($p = 0.001$), agricultural training ($p = 0.028$) and unavailability of electricity ($p = 0.028$) were significantly influencing the conservation of miombo woodlands. In the contrary; household size ($p = 0.983$), level of education ($p = 0.525$), gender ($p = 0.113$), unavailability of coal ($p = 0.109$) and culture ($p = 0.078$) showed no significant difference in the conservation of miombo woodlands. It is recommended that the government embark on a more vigorous approach in the supply of energy for the curing of tobacco and conserving the existing forests to mitigate effects of deforestation and climate change. Most importantly, smallholder farmers should be educated to use other alternative sources of fuel to promote the regeneration of the already injured woodlands. All stakeholders should be involved in planning and decision making on issues related to forest conservation and technology in tobacco production.

Keywords: Deforestation, Forest Conservation, Fuel Wood, Miombo Woodlands, Smallholder Farmers, Tobacco Production

1. Introduction

Tobacco is a valuable cash crop worldwide and it plays an important role in the economies of many countries. Tobacco production seems to have impacts on the environment though the effects are undermined. In Zimbabwe, agriculture is the backbone of the economy and is a critical sector which significantly contributes to the Gross Domestic Product (GDP), employment and livelihood support for the rural majority. Agriculture and other economic activities are producing externalities that affect the environment such as deforestation, pollution among other factors [27, 38]. Smallholder farmers mainly use natural forests as the source of fuel wood for tobacco curing resulting in deforestation. This is because natural forests are cheap to access than other alternatives like coal or electricity which are logistically and financially beyond the reach of rural majority [30]. In Zimbabwe, the heavy reliance on fuel wood for the curing of tobacco is posing a dilemma to forest policy and livelihood strategies in relation to the sustainability of the natural forests.

In a common pool resource users will manage their resource prudently when they are inevitably faced with inherent sudden change in the rate of regeneration [22, 28]. Community management of forest resources has mixed results [8, 41].

Environmental degradation in the form of forest loss and soil abstraction are some of the negative effects which leads to the loss of biodiversity, increased rate of erosion as well as reduced prospects for sustainable management of forests in smallholder communities [16, 46]. Deforestation is the removal of trees from a forested site and the conversion of land to another use including; agriculture, urbanization process, illegal exploitation of forest resources for monetary gain and tremendous increase in population [34, 42]. Curing is the major cause of tree exploitation, with 69% of fuel wood consumption and 15% is used for poles and sticks during barn construction [10, 17]. Tobacco curing is the process of heating the harvested tobacco leaf with varying conditions as required to produce the desired quality. Agriculture has been noted as the major cause of forest loss, estimated to account for about 90% of all deforestation in the tropics [6]. Tobacco is grown in more than 100 countries in the world with China being the leading producer and other major producers include United States, India, Brazil, Turkey, Zimbabwe, Tanzania, Uganda and Malawi.

Tobacco is mainly grown in countries which are rich in miombo woodlands and these countries fall in the central, eastern and southern Africa covering about 2.7 million square kilometres [18, 31, 36]. In Zimbabwe 39 million land area, approximately 41% is under woodlands, with Miombo woodlands contributing 9% and *Colophospermum mopane* contributing up to 21% [10, 11]. Zimbabwe, Tanzania and Malawi produce about 75% of all tobacco produced in the continent while Tanzania has consolidated its third position of being one of the largest producers in Africa (after Malawi and Zimbabwe) [13]. According to FAO, Tanzania loses approximately 91,200 hectares of forests each year [12]. Similarly, Tanzania has no alternative sources of energy for the curing of tobacco. Afforestation and plantation mechanisms as sources of fuel wood for the curing of tobacco are still at the early stages of development. By increasing efficiency of natural resource utilization, conservation of forests, habitats, and biodiversity in different agricultural production activities represents a sensible alternative to enhance sustainable management [10, 36]. The entrance of previously disadvantaged majority into the once minority-dominated tobacco sector in the quest to improve rural livelihoods remains the major driving force in forest landscape changes [30, 33].

Household size is an important factor in the harvesting of forest resources [4, 45] and it influences the demand for forest products. In a study by Adhikari, fuel wood consumption by a household depends not only upon the number of people in the household, but also upon additional requirements for agricultural related activities (such as construction of animal enclosures, the availability of alternatives and the technology of fuel wood use [2].

Shackleton et al, found out that the more education one attains helps one better in forest resources management, if one is not educated it is difficult to understand forest management principles [43]. Since many agencies are potentially involved in wood fuel productions, processing trade, marketing and use, it is important that there is co-ordination and collaboration among them [14]. In Zimbabwe institutions such as Agricultural Technical and Extension Services (AGRITEX), Environmental Management Agency (EMA), Environment Africa, Forestry Commission, the media among other institutions help to educate and raise awareness on the importance of sustainable harvesting of trees. Since 2007, Zimbabwe had an increase in area under tobacco production (Table 1).

In Tanzania, the Udzunga forests are known to have significant cultural and spiritual value and the forest is seen as "life giving; hence referred to as *Kaajafiaki*, source of life [21]. However, understanding the local community perception of forest management and factors influencing perceptions is vital in designing management policies that are sensitive to their needs [20]. The problem of tropical woodland degradation cannot be addressed if the drivers of degradation are not singled out and properly understood particularly at the micro level where a strong dependence on forestry resources has been stated [25]. According to Adhikari, social economic differences among members of a resource use group may be associated with different degrees of control to and access over natural forests [2]. It is therefore necessary to understand the relationship between socio-economic factors and involvement in woodlands management [25]. In Zimbabwe, empirical evidence on sustainable conservation of miombo woodlands from intensive small-scale agricultural production such as tobacco cultivation is still lacking. However, this study aims to determine the factors that influence the conservation of miombo woodlands by smallholder tobacco farmers in Mutasa District and draw firm conclusions about forest management techniques.

Table 1. *Progress of the Zimbabwe flue-cured tobacco industry from 2007 to 2018.*

Year	Growers	Area (ha)	Average Price			Gross Value
			Mass sold (kg)	US$/kg	Average yield (Kg/ha)	US$
2018	140 895	133 000	252 603 251	2.92	1 899	737 603 251
2017	98 927	110 816	188 920 313	2.96	1 705	559 077 353
2016	81 801	102 537	202 275 688	2.95	1 972	595 927 523
2015	97 616	104 662	198 954 849	2.95	1 900	586 544 231
2014	106 372	102 537	216 196 83	3.17	2 108	685 244 013
2013	78 756	88 627	166 572 097	3.67	1 879	612 135 672

Year	Growers	Area (ha)	Average Price			Gross Value
			Mass sold (kg)	US$/kg	Average yield (Kg/ha)	US$
2012	60 047	76 359	144 565 253	3.65	1 893	527 805 943
2011	56 656	78 415	132 431 905	2.73	1 689	361 448 679
2010	51 685	67 054	123 503 681	2.88	1 842	355 572 326
2009	29 018	62 737	58 570 652	2.98	934	174 457 761
2008	35 094	61 622	48 775 178	3.21	792	156 663 816
2007	26 412	54 551	73 039 015	2.32	1 339	169 159 675

Source: Tobacco Industry and Marketing Board Report [48].

According to Katsvanga et al, the growing of tobacco for export has lead to large losses of woodland for both land and fuel wood [23]. The curing of tobacco is presently carried out using charcoal or fresh green wood, compounding environmental problems. According to Geist, a total area of 200 000 hectares of forests are cleared for tobacco farming each year and the deforestation mainly occurring in the developing world accounts for 2-4% of all global deforestation [19]. However, penalties can act as a deterrent if they are high enough and commensurate with the economic value of the offence [24].

2. Materials and Methods

2.1. Study Area

The study was carried out in ward 23 of Mutasa District in Manicaland Province, Zimbabwe. The study area was made up of two old farm areas; Grange and Laverstock (32°34 E; 18°52 S). Grange farm is located 20km from the city of Mutare and Laverstock is 5km from Mutare-Nyanga highway road. Grange resettlement area is located at an elevation of 1140 metres and Laverstock resettlement is 1169 metres above sea level. This area was selected for the study because it is where most farmers settled during the fast track land reform programme in 2000/1. The study area has infrastructure in the form of tobacco barns, canals and dams for irrigation. The main economic activity of Mutasa District is farming, and mining activity mainly in the Penhalonga area.

Soil types in Grange and Laverstock range from sand loamy to clay soils. Loam soils dominate the areas and are most suitable for tobacco production. Some isolated pockets of red soils are found particularly on the eastern part of Grange. The Grange area is located in the dryer farming region 2b with mean annual rainfall of 400mm and Laverstock area is in the farming region 2 with mean annual rainfall of 600mm. Annual temperatures range from 18-21°C in winter and 27-30°C in summer. The climate is suitable for dairy farming, forestry, tobacco, tea, coffee, fruit, beef and maize production [14]. The farmers also keep cattle, pigs, goats and poultry.

The district is rich in miombo woodlands/forests which provide a good source of fuel wood for the curing of tobacco and occur on well-drained slopes. It therefore covers most parts of the mountain and hill slopes. These woodlands vary from closed to open and are dominated by the deciduous tree species. It is a mixture of *Brachystegia spiciformis*, *B. tamarinodoide, Julbenardia globiflora* and *Uapaca kirkian*a [44]. The trees are fairly small at higher altitudes and bigger at lower altitudes. *Acacia* and *Brachystegia spiciformis* species are common at lower altitudes.

2.2. Research Design

The study followed a cross sectional design. It is a quantitative, descriptive and interpretive case study analysed through quantitative methods.

2.3. Sampling Procedure and Sample Size

Household heads were chosen from a list of beneficiaries of the land reform programme collected from the Ministry of Lands and Agriculture. A total of 1591 households in Grange and Laverstock were stratified into tobacco farming households (280) and non-tobacco farming households (1311). Sixty households were purposively sampled from a list of 280 smallholder farmers engaged in tobacco farming and these were interviewed at their homesteads. In the absence of the household head an elderly member of the household was interviewed. In the event that there were no people on the day of the survey at a selected household, a return visit was organized for the interview.

2.4. Data Collection

Data was collected using questionnaires. The questionnaires were pilot tested using farmers who were not selected for the survey. The questionnaire was used as it contained items which focused on the factors that can influence the harvesting of fuel wood from miombo woodlands. Five Agricultural Extension Officers within the area of study were recruited and trained to assist in the collection of data based on willingness to participate. The extension officers were selected because they had broader knowledge of their working areas as well as the culture and socio-economic activities prevalent in the district.

2.5. Data Analysis

A binary regression analysis was used to determine the factors that influence the harvesting of miombo woodlands by smallholder tobacco farmers. This estimates the relationship between one or more explanatory variables and single out binary variable. The probability of the two alternatives was modelled instead of simply outputting a single value. In situations where the dependent variable (Y) is continuous and can be reasonably assumed to have a normal distribution, simple linear regression can be made. In situations where the dependent variable is dichotomous or

0/1 a logistic regression can be run using the logit modelling. In this study the multiple regression model was used as shown below;

$$Y = \beta_0 + \beta_1 AvalEc + \beta_2 AgricTr + \beta_3 TobYi + \beta_4 AgFr + \beta_5 PrFr + \beta_p X_p + \varepsilon \quad (1)$$

Y = the dependent variable, Fuel wood harvesting (1 = yes, 0 = no)

AvalEc = availability of electricity (1 = yes, 0 = no)

AgricTr = agriculture training (1 = yes, 0 = no)

TobYi = Tobacco yield (continuous)

AgFr = age of farmer (continuous)

PrFr = proximity to forest (1 = yes, 0 = no)

AvalWd = availability of wood (1 = yes, 0 = no)

LevEd = level of education (1 = yes, 0 = no)

HsehldSize = Household size (continuous)

WdAb = wood in abundance (continuous)

β_0 = the intercept or regression intercept (it gives the value of Y where the regression line meets the Y axis at X = 0),

βi = the regression coefficient for each independent variable (it gives the measure of change in the value of Y for a unit change in the value of X) and

ε = the error term or disturbance.

3. Results and Discussions

3.1. Smallholder Tobacco Farmers and Forest Conservation in Mutasa District

Results from the study show that electricity, agriculture training, tobacco yield, age of farmer and proximity to forest were significant factors in the conservation of miombo woodlands (Table 2). Availability of electricity ($p = 0.028$), agriculture training ($p = 0.028$), tobacco yield ($p = 0.008$), unavailability of coal ($p = 0.011$), age of farmer ($p = 0.001$) and proximity to forest ($p < 0.001$) significantly affects the conservation of forest.

Table 2. *Factors affecting the conservation of miombo woodlands (n = 60).*

Variable	Score	P value
Unavailability of coal	3.574	0.011****
Unavailability of Electricity	4.855	0.028****
Wood readily available	0.386	0.534**
Indigenous wood more effective	0.469	0.493
Wood in abundance	0.452	0.501**
Level of education	0.404	0.525**
Agriculture training	4.859	0.028****
Household size	0.000	0.983**
Selling price of tobacco	0.743	0.389*
Farming experience	2.744	0.098
Sex	2.511	0.113*
Tobacco yield	6.993	0.008****
Age of farmer	11.599	0.001****
Proximity to forest	12.873	0.000****
Culture	3.106	0.078*
Having Livestock	2.562	0.109*
Overall Statistics	30.713	0.015****

Cox & Nell R2 = 0.571, Model Chi-square = 33.817, Sig. = 0.019.

The table gives the score value and level of significance (p value) at 1 degree of freedom. Significance $p > 0.1^{*}$ $p > 0.5^{**}$ $p > 0.01^{***}$ $p < 0.05^{****}$.

3.2. Gender

Results from this showed that gender had no significant difference in the conservation of miombo woodlands. According to Buyinza and Naguula, men dominate in community forestry management than women since they are constrained in forest management participation [9]. Similarly, Kugonza et al, acknowledged that women face inaccessibility to tree resources, inequitable sharing of revenue accruing from tree products and have little ownership or control over productive resources which places them in a sub-ordinate and disempowered position relative to men and are therefore forever dependant [26]. Women are the primary custodians and executive officials of environmental resources by virtue of their position in the household [4, 49]. According to Rocheleau and Edmunds; resource use, access control, and responsibility with respect to trees and forests are highly complex and gender sensitive [39].

3.3. Availability of Electricity and Other Alternative Sources of Fuel

The unavailability of electricity and coal significantly affects the conservation of miombo woodlands. This is because electricity is an alternative source of fuel which can be used by farmers for both tobacco production and domestic uses. When electricity supply is limited, more trees are cut to meet the energy demands. When farmers get enough electricity it is likely that less forest harvesting takes place and as a result more forests are conserved. In order to reduce the consumption of wood for curing tobacco many have turned their attention to the curing technology. Various alternatives energy sources to fuel wood have been investigated to power curing barns [15]. Several countries are also considering agricultural biomass as a source of energy and the establishment of energy crops that are expanding fast [15]. Extensive use of wood could affect forest sustainability and reduce the supply of raw materials for the wood processing industry. The costs of curing tobacco with alternative technologies are significantly lower by 9-12% when compared to curing costs using traditional technologies [35]. Rice straw and other biomass fuels have been excellent alternatives to wood for curing tobacco in Bangladesh [5].

3.4. Agriculture Training

Agriculture training was a positive and significant factor to the harvesting of forest in the ward ($p = 0.028$). This implies that the current farmer training programmes in colleges and farms are effective in inducing a sense of environmental awareness and conservation. The better the training, the lesser the amount of trees likely to be cut as farmers would adopt modern techniques of conserving tree resources. According to Shackleton et al, the more education one attains the better management of forest resources [43].

3.5. Tobacco Yield

The results of the study are indicative that tobacco yield

significantly (p = 0.008) affects conservation of miombo woodlands. The reason could be that as the yield increases there is an incentive to produce more in the next season. This will in turn trigger an increase in the amount of fuel wood required for curing the tobacco hence an increase in the harvesting of forest to meet the extra demand. The increase in yields has a negative impact on forest conservation [10, 30]. The growing of tobacco for export has lead to large losses of woodland for both land and fuel wood [23].

3.6. Age of Farmer

The results showed that age of farmer significantly affect the conservation of miombo woodlands (p = 0.001). This could be attributed to the fact that younger ages may negatively affect the harvesting of forest in that they have the energy to cut and transport the wood. The findings by Kugonza et al, also indicated a significant difference between age groups and their participation in forestry management [26]. This also concurred with the findings by Ozturk et al, who found out that younger people are more sensitive towards protection of forests since their relatively higher education drives them to be more pessimistic and concerned about the future of forests [37]. A study by Abdel and Kobbail maintained that age has a positive significance on tree planting which could be due to the fact that young people who have more livelihood alternatives go to towns in search of jobs leaving the older people to do the job [1]. Contrary, Thorai and Ranola noted that older people participate more in forest management since their opportunities for employment are limited as compared to the younger people [47]. A study by Mehta and Heinen found age as one of the social economic characteristics determining attitudes towards conservation [32]. The result from a study by Beyene in Ethiopia suggested that as the age of the household head increases the probability of participating in community forestry will increase [7]. The same study reports that younger and male households are less interested in collecting forest products from one source.

3.7. Proximity to Forest

One of the factors that also had a positive effect on forest conservation was proximity to forest/woodland, (p = 0.000). People living closer to forest easily access the forest products than those living far away [29]. It therefore follows that those woodlands close to the farms or homesteads are harvested more than those which are miles away. Those forests close to the homesteads are much difficult to conserve. The above findings are in agreement with those obtained in Nepal by Sayer and Margules and by Adhikari et al, in Botswana [3, 41]. Sayer and Margules found out that the closer the homesteads to the forests, the more the farmers collect fuel wood from the forests [41].

4. Conclusions

Results from this study shows that forest conservation in the smallholder tobacco farming community of Mutasa District is significantly influenced by the age of farmer, the unavailability of electricity and coal, agriculture training, tobacco yield and proximity to the forest. The availability of trees, selling price of tobacco, household size, level of education, gender and culture showed no significant difference in the conservation of miombo woodlands. Thus conservation of forest resources, trees in particular should be promoted at all levels to reduce the effects of deforestation and climate change.

5. Recommendations

This study recommends that forest conservation should directly focus on the socio-economic factors that influence live tree harvesting; that is electricity supply, coal supply, and training and conservation awareness. Both the government and tobacco contracting companies should supply electricity and coal to tobacco farmers at subsidized prices to promote regeneration of the already damaged forests. However, there is also need to look at specific target trees being harvested and establish the rate of distraction and/or regeneration and means to redress the selective harvesting which promotes deforestation.

Acknowledgements

I would like to express my heartfelt gratitude to the Agriculture Extension officers for ward 23 in Mutasa District and smallholder farmers of the area for their valuable assistance in the conduct of this study. Special thanks to Makombe Traders for the financial assistance.

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