Journal of Ecology and the Natural Environment Vol. 2(1) pp 010-016 January, 2010
Available online at http://www.academicjournals.org/jene
ISSN 2006- 9847 © 2010 Academic Journals

Full Length Research Paper

Impact of small scale tobacco growing on the spatial and temporal distribution of Miombo woodlands in Western Tanzania

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Accepted 15 December, 2009

This paper examines the impact of tobacco farming on Miombo ecosystem in Western Tanzania. Methods employed include literature review, secondary data collection, data sets generation from satellite images (1984, 1995 and 2000) and fieldwork for ground verification. Data sets on tobacco production were computed to generate hectarage cleared for tobacco farming and tree felling for tobacco curing. Trend of tobacco production over time was determined. Findings demonstrate that between 1975 and 1989 production of tobacco was fluctuating. Hence the size of land cleared shows low correlation (R^2 = 0.19) with time (years). From 1990 to 1996 tobacco production and the size of cleared land for tobacco farming and curing increased consistently with high correlation coefficiency (R^2 = 0.76) with time (years). Land converted from natural vegetation to cultivated land between 1984 and 1995 was 4.7% compared to 11.2% that was converted between 1995 and 2000. Also, about 7.8% of the cultivated land in 1984 had been, by 1995, regenerated into woodland. Between 1995 and 2000 regenerated land is only 2.4% of the total cultivated land. Total cleared land for tobacco growing and curing is projected to double by year 2016. From this study, it is evident that much as deforestation is high, there is vegetation regeneration indicating the ability of Miombo vegetation to recover. Macro-policies have contributed to the land use changes, and consequently on the Miombo ecosystem.

Key words: Miombo, tobacco farming, ecosystem degradation.

INTRODUCTION

Rural communities in Africa depend mainly on natural resources for their livelihoods (Desanker, 2003). Miombo woodland is one of the ecosystems that support the majority of the population in south central Africa, as it is the dominant vegetation type in the region. It covers 2.7 million km² extending from Tanzania and Southern Zaire in the north to the Northern provinces of South Africa and across the continent from Angola through Zambia to Malawi and Mozambique (Chidumayo, 1994).

In Tanzania, Miombo woodland extends from the southeastern part of the country to the western parts (Mwamsamali, 1997). Over most of its range, mature undisturbed Miombo is deciduous woodland, that is, classified with savanna ecosystems but grades into seasonal closed dry forests (Frost, 1996). Miombo woodlands are characteristically dominated by the genera *Brachystegia, Isoberlinia* and *Julbernadia,* all of the family Leguminosae (Chidumayo, 1994). Numerous factors affect the structure and composition of Miombo woodland in the region. These factors include edaphic conditions such as nitrogen or phosphorus concentrations (Stromgaard, 1992; Chidumayo, 1994) and disturbances such as fire (Kikula, 1986; Chidumayo, 1988). There are also biotic factors such as damage by herbivores, especially by elephants (*Loxodonta africana* Blumenbach) (Campbell et al., 1996) and anthropogenic factors, such as commercial charcoal production, collection of fuel wood and cutting of building poles (Abbot and Homewood, 1999; Luoga et al., 2002). Of these, anthropogenic factors give cause for the greatest concern over forest diversity (Schwartz and Caro, 2003). Specifically, the quality of Miombo woodlands is largely altered through clearance of land for cultivation and subsequent abandonment, selective harvesting of treesfor different purposes and initiation of fires (Frost, 1996).

Despite worldwide criticism on the tobacco industry arising mainly from environmental and health concerns (Geist, 1997 and 1999), tobacco is still one of the major

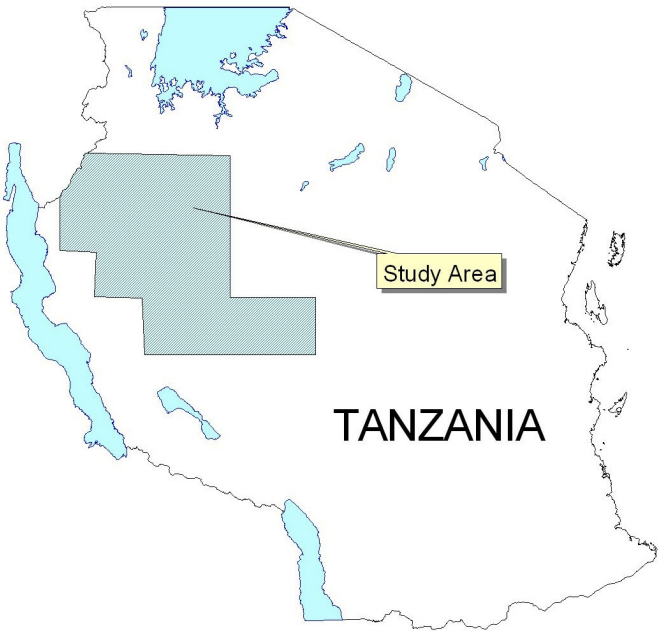

Figure 1. Location of the study area.

cash crops grown in the Miombo woodland areas in Tanzania. The total number of people employed in the tobacco industry in Tanzania is estimated to be about 70,081 (http://www.forces.org/assorted/tob-dev.htm).

Today, the growing of tobacco is posing threats to the woodlands. Ecological functions of the woodlands are particularly threatened by the production of flue-cured tobacco, which accounts for 70 - 80% of the crop's total production in Tanzania (Mangora, 2005). The threat comes from the large quantities of wood harvested from the natural Miombo woodlands for curing tobacco. One ha of Miombo woodland is used to cure 450 kg (0.45 tones) of tobacco. Tobacco production also requires extensive virgin land to support shifting cultivation and the need for sufficient forest areas to supply fuel wood and fresh land for tobacco growing (Openshaw, 1971; Temu, 1978 and 1980).

A number of studies reveal that tobacco-related deforestation is almost half the total annual loss of forests in Tanzania and other countries characterized by Miombo woodland (Chidumayo, 1997; Shackleton, 1993; Werren et al., 1995). According to Misana (1988), by the end of 1980, the steady increase of tobacco production since independence had been predicted to cause "overexploitation" of 42, 000 ha of Miombo woodlands (Misana, 1988). Excessive uses of wood for tobacco curing and unsustainable tobacco cultivation are crucial factors for deforestation (Abdallah and Sauer, 2005). Fire wood collectors are reported to have a limited destructive impact because they utilize small-sized branches (Bringham et al., 1996). However, most of the previous studies did not provide a quantitative account of the deforestation trends, which would form a basis for identifying factors influencing the changes. Also, in most of the previous studies, focus has been mainly on deforestation without due consideration on vegetation regeneration in the abandoned fields.

This paper presents findings from a study that examined the impact of tobacco farming on Miombo ecosystem in Western Tanzania. Specific objectives of the study were the following;

- To establish magnitude of temporal and spatial changes in land cover/use types in Miombo woodland due to tobacco farming
- To establish the extent of Miombo vegetation recovery in abandoned fields
- To document factors contributed to changes in land cover/use types

METHODOLOGY

Study area

This study was conducted in Tabora Region, Western Tanzania (Figure 1). About 60% of the farmers in Tabora Region grow tobacco on an average of 1.0 ha per farmer. The availability of extensive Miombo woodlands was among the major criteria used by the policy makers after independence to designate Tabora Region as a major flue-cured tobacco-growing region (ibid). However, both policy makers and farmers are concerned about the rapid deforestation. By early 1990s, farmers travelled as far as 10 km to get firewood (Waluye, 1994). According to Boesen and Mohele (1979), the area of Tabora/Urambo had earlier been identified as a region at risk of land degradation, if mitigation of the losses of natural forest cover due to tobacco were not undertaken.

Data collection

Different methods were employed to collect the data; literature review, review of secondary data and data sets generated from satellite images of 1984, 1995 and 2000. Fieldwork was done for ground verification.

Most of the literature and secondary data were accessed from university libraries and documentation centers in Dar es Salaam, relevant government ministries and district and regional offices. Some published materials were acquired through the Internet.

Data analysis

Secondary data trends per year were computed to generate actual acreage cleared for tobacco farming and tree felling for tobacco curing based on rates established by Openshaw (1971) and Temu (1978; 1980).

The formula used for computation was:

CTA = ACTG + CACTC;
Where *CACTC = (WTH/0.45),*
CTA = Computed total area (ha) of Miombo woodlands cleared for tobacco growing and curing,
ACTG = Area cleared for tobacco growing (ha),
CACTC = Computed area (ha) of Miombo woodlands cleared for tobacco curing and VTH = Weight of tobacco harvested (metric tones).The data on tobacco production and area cleared for tobacco growing were used to compute correlation between

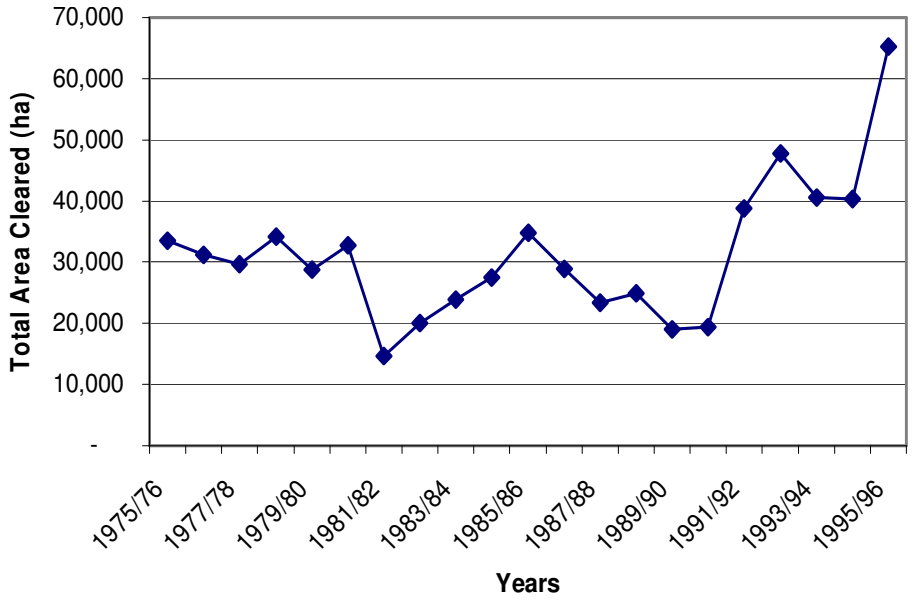

Figure 2. Computed total area (ha) of Miombo woodlands cleared for tobacco growing and curing in Tabora Region from 1975/76 to 1995/96 (Source: Raw data extracted from Tabora Region Agricultural and Livestock Development Office).

tobacco production and deforestation of Miombo woodland. The equation generated was used to project the size of land *(Y)* to be cleared at time *(X)* from the present. The model assumes that: (1) factors driving the current tobacco farming will remain the same; (2) the socio-economic set-up of the community in the area will remain unchanged and (3) land will continue to be available for tobacco growing.

Satellite images (LandSat MSS from 1984, LanSat TM from 1995 and LandSat 7 from 2000) were interpreted in the laboratory into various polygons reflecting different land cover/use types. Tonal signature (colour, texture and shape) was the basis for classification of the different cover/use types. Fieldwork was conducted to ascertain representative features registered on satellite images. Computation was done through the use of Geographical Information System (GIS) to establish the extent of the different cover types in the different years. Areas cultivated and those covered by natural vegetation were mapped out.

RESULTS AND DISCUSSION

Temporal and spatial changes in land cover/use types

Figure 2 shows the pattern of total cleared land for tobacco production from 1975/76 to 1995/96. Between 1975 and 1989, production of tobacco fluctuated, as did the size of land cleared. As a result, trend analysis based on 1975/76 - 1995/96 data shows weak correlation (R^2 = 0.19) between total area cleared and time (years) as in Figure 3. However, from 1990 to 1996 tobacco production and the size of cleared land for tobacco farming and curing increased consistently (R^2 = 0.76) as shown in Figures 4 and 5. For example, estimated total area cleared for tobacco growing and curing increased steadily from about 20,000 ha in 1990/91 to about 65,000 ha in 1995/96. The impact of free market economy or trade liberalization policy in Tanzania, which started in late 1980s to early 1990s, appears to be a sole factor behind such a pattern. Multinational tobacco companies such as DIMON Inc. and TLTC arrived in Tabora Region during that time.

These companies provided inputs to the peasants and increased producer prices, which became an incentive for clearing more land in order to produce more tobacco. With the liberalization of the tobacco market under the structural adjustment programmes, land clearing by tobacco farmers increased and 90% of farmers cleared new land for tobacco within four years during the 1990s compared to only 30% during the 1980s (Geist, 1997). Before 1990, tobacco production was fluctuated, as did the areas under tobacco cultivation. According to Mwamsamali, (1997), the fluctuations were due to unreliable climate, low producer prices and poor marketing systems which discouraged peasants from producing tobacco; resulting into reduced rate of tobacco-related deforestation of Miombo woodlands.

Interpretations of satellite imagery (1984, 1995 and 2000) support the tobacco production trends and the associated land cleared for tobacco growing and curing. For example, the area transformed from natural vegetation to cultivated land between 1984 and 1995 was 4.7% compared to 11.2% that was transformed between 1995 and 2000. This implies that changes in land cover type from natural vegetation to cultivation that took place between 1995 and 2000 are about twice the changes between 1984 and 1995 (Table 1). Land that is under natural vegetation constitutes a significant proportion of

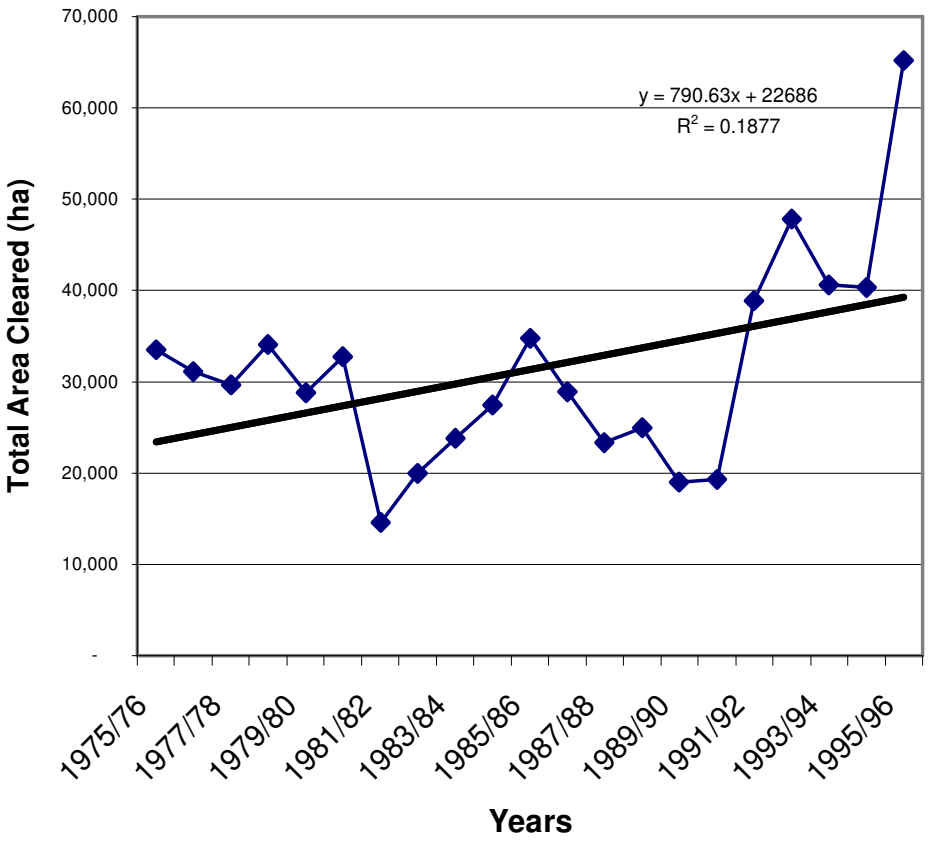

Figure 3. Trend analysis of computed total area (ha) of Miombo woodlands cleared for tobacco growing and curing in Tabora Region between 1975/76 and 1995/96(Source: Generated from raw data extracted from Tabora Region Agricultural and Livestock Development Office).

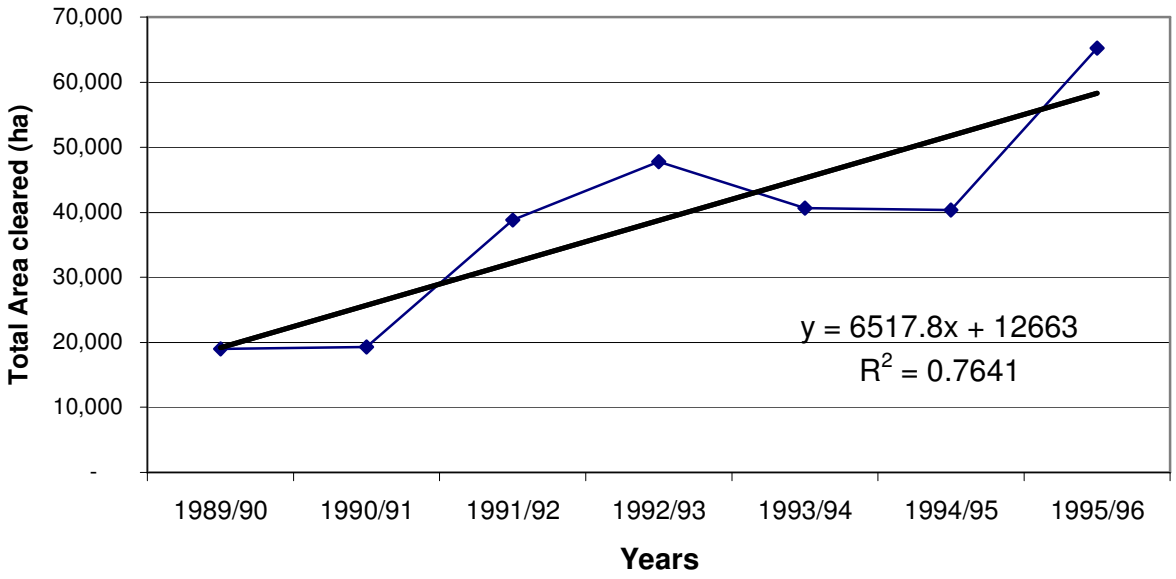

Figure 4. Trend analysis of computed total area (ha) of Miombo woodlands cleared for tobacco growing and curing in Tabora Region between 1989/90 and 1995/96 (Source: Generated from raw data Extracted from Tabora Region Agricultural and Livestock Development Office).

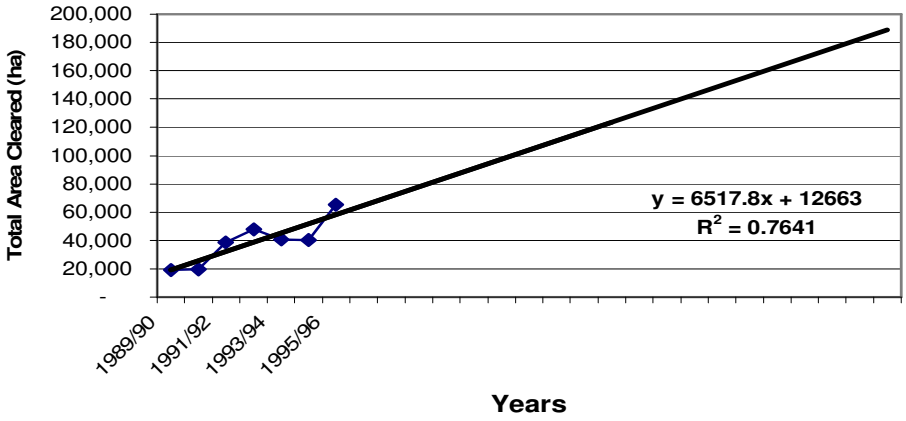

Figure 5. Trend analysis of projected total area (ha) of Miombo woodlands cleared for tobacco growing and curing in Tabora Region to ten years from present (Source: Generated from raw data extracted from Tabora Region Agricultural and Livestock Development Office).

Table 1. Matrix on land use/cover changes in part of Tabora region.

Between 1984 and 1995	Cultivation		Natural vegetation		Settlements		Water bodies	
	Km^2	%	Km^2	%	Km^2	%	Km^2	%
Cultivation	16,236.3	13.5	5,678.8	4.7	13.1	0.0	9.9	0.0
Natural vegetation	9,322.5	7.8	86,033.6	71.7			219.4	0.2
Settlements	19.8	0.0	5.4	0.0	7.9	0.0		0.0
Water bodies	11.6	0.0	33.2	0.0			372.9	0.3
Between 1995 and 2000	**Cultivation**		**Natural Vegetation**		**Settlements**		**Water bodies**	
	Km^2	%	Km^2	%	Km^2	%	Km^2	%
Cultivation	19,038.7	15.9	13,471.8	11.2	13.8	0.0	6.6	0.0
Natural vegetation	2,822.7	2.4	82,062.5	68.4	1.5	0.0	132.1	0.1
Settlements	60.3	0.1	1.4	0.0	17.9	0.0		0.0
Water bodies	6.9	0.0	33.9	0.0		0.0	278.9	0.2

Source: LandSat images interpretation and field verification.

the study site. Areas that are not available for agricultural expansion are forest and game reserves.

Miombo vegetation recovery/regeneration

Table 1 shows that by 1995 about 7.8% of the land that was under cultivation in 1984 had been transformed into natural vegetation through natural regeneration. Such regenerated Miombo vegetation is in areas that were abandoned during the resettlement programme in 1974/75. Areas that were opened up for cultivation in 1980s were exhausted by 1995 and left under fallow. This was not the case for the period between 1995 and 2000 as only 2.4% of the total cultivated land in 1995 was transformed into natural vegetation by 2000. This is because of too short a time to allow vegetation to regenerate in abandoned fields after 1995. Abandoned areas that were under tobacco growing are usually put under food crop cultivation, particularly maize, cassava, peanut, sweet potatoes and beans.

Furthermore, there have been shorter fallow periods due to limited forestland for further agricultural expansion. Findings from this study are also supported by other previous studies (Luoga et al., 2004; Mangora, 2005; Malaise, 1978; Nduwamungu, 2001). Tobacco fallow lands that have been studied elsewhere tended to remain rich in Miombo vegetation species, indicating less biodiversity loss (Luoga, 2002). The number of vegetation species in tobacco fallow lands is due to land preparation technique by small scale tobacco farmers who rarely uproot stumps from the cut trees and shrubs. Most of the regeneration is, therefore, from the sprouting stumps and root suckers; adaptations that make most Miombo trees

and shrubs regenerate and survive extinction from disturbance (Mangora, 2005; Malaise, 1978; Nduwamungu, 2001).

It appears that land clearing for growing tobacco and other subsistence crops by small scale farmers does not necessarily alter the Miombo ecosystems in terms of stem abundance as long as enough fallow periods are maintained. Mangora (2005) reported that cleared areas also make regeneration by seed much easier as the ground litter is reduced and contact with the soil is not obstructed. Miombo tree species generally have both vertically and horizontally extensive root systems that facilitate rapid recuperation after cutting (Malimbwi et al., 1994; Luoga et al., 2004). However, as already pointed out, rate of vegetation regeneration depends on the clearing method employed.

Conclusion

This paper has examined the impact of tobacco farming on Miombo ecosystem in Western Tanzania. It is evident from this paper that macro policies like the structural adjustment programme had significant impact on land use and consequently on the Miombo ecosystem. From this study, it is also evident that much as deforestation is high, there is evidence of vegetation regeneration indicating the ability of Miombo vegetation to recover. However, vegetation recovery is dependent on land management practices. The current land clearing practice through tree debarking and burning around tree stems affect the regeneration rate. This is an area that requires further investigation. The other threat to the Miombo ecosystem is that with population increase and diminishing public forest land (land that is not protected by law), fallow period is being reduced, thus not allowing full regeneration.

ACKNOWLEDGEMENTS

The author would like to thank Mr. Simon Mwansasu for the assistance he provided for GIS analysis of the remotely sensed data. Thanks also go to Mr. Juma Kayonko for his assistance in literature search. I also thank CLIP project for providing funds to undertake this study.

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