



The Untold Effects of Tobacco Farming on Biodiversity in Miombo Woodlands in Tabora and Kigoma Regions in Tanzania.

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abstract

This article focuses on the untold effects of tobacco farming on biodiversity in miombo woodlands in the Tabora and Kigoma Regions in Tanzania. Commercial tobacco farming has both positive and negative effects on the biodiversity in the selected regions. The study is exploratory designed to uncover the effects of tobacco farming on the miombo woodlands in the regions under investigation. The paper responds to three specific objectives including the identification of the tree species used for tobacco curing, an exploration of the effects of tobacco farming on miombo woodlands, and an investigation into the strategies established to conserve biodiversity in the miombo woodlands. The study was conducted in Kaliua District in the Tabora Region and Kasulu District in Kigoma Region. Data were collected using open-ended questionnaires, interviews, Focus Group Discussions and observations. The FGD recording was transcribed to produce verbatim text while notes from the observation sessions were compiled in an organized manner. A total of 336 questionnaires were administered to tobacco farmers, while 8 and 7 interviews were conducted with agronomists and field technicians, respectively. Data were analyzed using descriptive statistics where SPSS and MS Excel handled quantitative data, while content analysis handled qualitative data. Results were presented in narratives, frequencies and percentages. The findings showed that species preferred for tobacco curing, include *Brachystegia*, *Pterocarpus angolensis* and *Combretum silicoides*. Effects of tobacco farming on biodiversity included deforestation, emerging of exotic species and the disappearance of indigenous species/ trees. However, strategies established to conserve biodiversity in the study districts include tree planting, afforestation and using efficient tobacco barns. In conclusion, tobacco farming contributed to biodiversity loss as farmers cleared forests to make land available for growing tobacco and used wood for curing the tobacco leaves.

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Introduction

Commercial tobacco farming takes place on a massive scale in the world (FAO, 2021). In 2019, 6.7 million tonnes of tobacco leaf were grown in more than 120 countries in the world (FAO, 2021). However, almost two-thirds (63.7%) of tobacco leaf were produced in three countries: China (40.2%), India (12.0%) and Brazil (11.5%) (FAO, 2021). In recent decades, from the 2010s, transnational tobacco corporations have lowered production costs by shifting tobacco leaf production from high-income to low-income countries (Hu and Lee, 2015; Eriksen, 2017). For many tobacco farmers, particularly in low- and middle-income countries, tobacco is an important source of income (Appau et al., 2019), as well as for forex and employment. Tobacco farming and production continue to increase in low- and middle-income countries, creating complications for tobacco control efforts. Most African governments promote tobacco farming as a way of alleviating poverty and increasing revenues. The main tobacco leaf-growing countries in Africa are Zimbabwe (25.9% of Africa's output), Zambia (16.4%), the United Republic of Tanzania (14.4%), Malawi (13.3%) and Mozambique (12.9%) (WHO, 2021). Global trade liberalisation has increased access to new tobacco markets and the massive use of tobacco products. Due to the availability of a market for tobacco, many countries are increasing the production of tobacco for more income and poverty alleviation (Hu & Lee, 2015). The farming and production of tobacco in these three countries are on the increase due to the benefits accrued from it, which include income, employment and source of forex.

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Tobacco, being one of the cash crops produced in different regions in Tanzania, is mainly produced for export. Tobacco is the second export cash crop grown in the country after coffee (Mangora, 2018). This crop is mainly grown in several regions including Tabora, Shinyanga, Kigoma, Mbeya, Mpanda and Ruvuma (Songea). The climate and soil of these regions support its growth. Tobacco supports the livelihoods of growers in different ways, such as income and employment. It further contributes revenue and foreign exchange to the Government of Tanzania. Grown tobacco requires big size of land and a reliable energy source for drying the tobacco leaves. Most energy source used is biomass, which involves cutting trees to get fuel wood. Since tobacco grown needs big pieces of land, miombo woodlands are cleared to pave ways of land for grown tobacco.

Tanzania is a significant producer of tobacco, with production levels varying over the past few decades. In the 2017/2018 crop season, the Chunya District led production with approximately 10,000 metric tons, followed by Kaliua and Kahama districts, producing around 7,200 and 7,000 metric tons, respectively. Over the past 30 years, tobacco production in Tanzania has experienced fluctuations due to factors such as changes in global demand, pricing and domestic agricultural policies (World Bank, 1998; Euromonitor, 2023). In the late 1990s, Tanzania's tobacco export values experienced significant fluctuations. For instance, during the 1997/1998 fiscal year, tobacco export value peaked at approximately USD 78.3 million, up from USD 31.6 million in 1996/1997 (World Bank, 1998). In recent years, the tobacco market in Tanzania has become moderately competitive. In 2023, the Herfindahl-Hirschman Index (HHI) for the market was 2,150, indicating a moderate level of market concentration, up from 1,383 in 2017.

Tobacco is mainly grown in the miombo woodland regions of central, western and southern highlands of Tanzania, where growers' clear vast areas for farms and consume large quantities of natural wood for curing tobacco (Mangora 2005, 2012). Tobacco doesn't just impact negatively on the health of individuals; but it also endangers the health of the environment. Drying

tobacco leaves requires a lot of wood accessed from the natural habitats, mainly miombo woodlands. The wood used for drying tobacco is acquired from the forests, which consequently results in deforestation and biodiversity loss.

The use of wood as an energy source for drying tobacco and sustaining farmers' livelihoods in many countries is inevitable. According to FAO (2020), all people engage in tobacco farming in one way, or another depend on forests and their biodiversity for their survival. Forests provide essential services for populations, including water supply, and habitats for plants and animals, including pollinators and are crucial in mitigating climate change. Fuels for curing tobacco are categorised into biogenic and fossil fuels, among others. Biogenic fuels include wood from sustainable and un-sustainable sources. With the review of the literature, a study focusing on the impacts of tobacco production on natural habitats is needed for the Tabora and Kigoma Regions. Thus, this article is designed to examine the effects of tobacco production and tobacco curing on biodiversity and further recommends measures towards the effects of tobacco production and curing on natural habitats. The article answered three specific objectives: one, identify species affected by tobacco farming and the associated processing; second, examine the effects of tobacco farming on biodiversity; and third, examine strategies established to conserve biodiversity against tobacco farming and processing.

Theoretical Framework

This article is guided by the theoretical framework of the tragedy of the commons, developed by Garrett Hardin in 1968. The concept of the tragedy of the commons was popularized by ecologist Garrett Hardin in his 1968 essay and explains the relationship between open-access resources and their usage. Hardin argued that when a shared resource is accessible to everyone without regulation or restrictions, it often results in the depletion or degradation of the resource. This depletion occurs when individuals prioritize their personal interests over the collective good (Cabal, 2022). It describes a situation in which shared environmental resources are overused, exploited, and eventually depleted because no one assumes responsibility for their management, ultimately posing risks to everyone involved. The tragedy of the commons refers to a situation where individuals with access to shared resources act in their own self-interest, leading to the depletion or degradation of those resources. Examples of common resources include fisheries, wildlife, surface and groundwater, rangelands, and forests, among others.

The tragedy of the commons theory illustrates this concept using the example of cattle farmers grazing their cows on an open pasture. Since there are no financial costs or restrictions on using the land; farmers are incentivized to bring more and more cattle to graze. It is expected that each herdsman will attempt to keep as many cattle as possible on the shared pasture. The ultimate consequence of overstocking cattle is the depletion of grass in the field due to overexploitation by the pastoralists. Garrett Hardin's explanation aligns closely with the context of this paper, as tobacco farmers similarly clear common lands, including forests and water catchment areas, to expand their farms for tobacco cultivation. Forests and water catchment areas held in common often become overexploited due to human activities, as they are initially untouched and highly fertile. Critics of the Tragedy of the Commons theory argue that it oversimplifies human behavior by overlooking other factors such as cooperation, collective action, and the role of institutions in managing resources (Frischmann, 2019). Nevertheless, the concept remains a valuable framework for understanding environmental degradation and emphasizing the importance of sustainable resource management practices.

Materials and Methods

The Tabora and Kigoma regions were selected for this study because of their favourable climate and soils suitable for tobacco farming. This study adopted a descriptive research design, which entailed collecting information by interviewing and interrogating individual tobacco farmers. A descriptive research design was adopted for this paper because it offers a detailed description of the effect of tobacco farming on the environment and natural habitats in the Tabora and Kigoma regions. A purposeful sampling technique was employed to select two districts in Tabora (Kaliua and Nzega districts) and one district in Kigoma Region (Kigoma Rural District). The popularity of these districts (Kaliua, Nzega and Kigoma Rural) in tobacco farming was the main criterion for their inclusion in this study. The target population for this study consisted of tobacco farmers and other tobacco stakeholders inclined to the conservation and management of the miombo woodlands. However, the purposive sampling technique was used in this study because it enabled the researcher to identify the participants who had appropriate knowledge to suit the needs of the study. Purposive sampling targeted tobacco farmers and government officials who are knowledgeable about the study area and have good knowledge on tobacco farming. Random sampling was used to select a total of 112 tobacco farmers (heads of the household) from each district, which made a total of 336 farmers. The sample size was the same across all districts because the study did not involve any comparisons; rather, it focused

on exploring the impact of tobacco farming on biodiversity. Since the study did not compare the three districts, the sample size did not account for the total population. The unit of analysis for this study was the heads of farming households.

Primary data were collected using questionnaires, interviews, Focus Group Discussions (FGDs) and observation methods. Questionnaires were self-administered to tobacco farmers. The data collected through questionnaires include the farmers' age, gender, education level, and farming experience, as well as information on land size, changes in biodiversity, water sources, soil quality, and income from tobacco farming compared to alternative livelihoods. The FGDs consisted of seven to eight tobacco farmers who were randomly selected in the study areas. Six FGDs were held, two in each district. FGDs involved diverse groups (e.g., male farmers, female farmers, and youth) to explore various issues, including community perceptions of biodiversity loss and community-led solutions to address and mitigate it. The physical observation was used to gain insight into tobacco farming activities practised in the study areas. Furthermore, interviews using checklists were conducted with the key informants (Agricultural Officers, Agronomists and Extension Officers). Semi-structured interviews with key informants (e.g., local leaders, agricultural officers, and environmentalists) enable the researcher to gather data on historical land-use changes, policies or programs addressing the impacts of tobacco farming, and challenges in balancing economic activities with biodiversity conservation. In addition, a documentary review of the literature was conducted, including a review of policies, reports and other documents with a bearing on tobacco farming. Through documentary review of literature, the information collected includes impacts of tobacco farming on biodiversity such as deforestation, land-use changes, habitat loss, and species decline caused by tobacco cultivation. However, insights into the dependence of rural communities on tobacco farming and comparisons with alternative livelihoods were also collected. Information on the conservation strategies was also collected geared to sustainable practices like agroforestry and community-based conservation initiatives that mitigate biodiversity loss. Results were presented in tables, figures, narratives and plates. The software/ statistical tools employed for efficient data analysis were SPSS Version 21. The data collected using questionnaires were analysed using descriptive statistics such as frequencies and percentages to summarize age, farming experience, land size and perceived biodiversity changes. Thus, the findings were presented in tables, plates, and narratives to highlight key insights effectively.

Results and Discussion

Tree species preferred for tobacco curing, as well as those affected by tobacco farming

The first objective of this paper was to identify tree species preferred for tobacco curing and those affected by tobacco farming. During the process of clearing the forests for tobacco farming, several tree species were adversely affected. One old man interrogated in Kaliua District said this,

"In clearing land for tobacco farming all trees in the cleared land are cut or removed". An agronomist interviewed added this, *"Environmentally, tobacco farming is destructive since it involves cutting of trees regardless of the value of the trees; this process leads to deforestation"*.

Tobacco grown in Tanzania is cured using smoke from wood. Table 1 present species preferred for curing tobacco and reasons for its preference. The people interviewed listed different species found in their area of residence used for drying/curing tobacco. Several reasons were given for the choice and use of the trees for curing tobacco such as making good charcoal, lasting long and produce smoke. Trees mentioned used for curing tobacco were grouped into two, natural and planted. Natural trees identified include *Brachystegia*, *Pterocarpus angolensis*, *Combretum silicoides*, *Kigelia Africana*, *Vitex doniana*, *Dichrostachys cinerea*, *Schrebera trichoclada*, *Albizia harveyi*, *Azelia quanzensis*, *Brachystegia bussei*, *Bridelia cathartica*, among others (Table 1). The planted trees preferred for curing tobacco include *Senna siamea*, *Leucaena leucocephala*, *Albizia antunesiana*, eucalyptus, Acacia, Cena, Teak, Jacaranda and Cypress. Since natural species are hard to find, tobacco farmers are curing tobacco with planted trees as indicated by "others" in Table 1 where majority of the responded i.e. 50.9% prefer it. The lesson from the list is that natural trees are still available although not as is used to be. However, the available natural trees, they are of different rates, sizes and difficulty to find. Trees like *Pterocarpus angolensis* are hard to get, while others have become scarce, and their size is smaller than it used to be. The shortage of indigenous trees has forced people to plant fast-growing trees like *Albizia antunesiana*, acacia and eucalyptus. Fast-growing trees give time for natural trees/ species to regenerate. A villager interviewed in Kasulu said this, *"some of the trees suitable for curing tobacco are not anymore available and the available species are very small in size and difficult to find"*.

Table 1 Tree species used for tobacco curing and reasons (n = 336)

Tree species preferred	Frequencies	Percentages
<i>Brachystegia</i>	97	28.9
<i>Pterocarpus angolensis</i>	93	27.7
<i>Combretum silicoides</i>	91	27.1
<i>Kigelia Africana</i>	85	25.3
<i>Vitex doniana</i>	77	22.9
<i>Dichrostachys cinerea</i>	63	18.8
<i>Schrebera trichoclada</i>	61	18.2
<i>Albizia harveyi</i>	57	17.0
<i>Azelia quanzenensis</i>	48	14.3
<i>Brachystegia bussei</i>	39	11.6
<i>Bridelia cathartica</i>	28	8.3
Others	171	50.9

As explained in the previous paragraphs, different tree species were identified being used for tobacco curing. It was further noted in the study area and through literature review that, tree species used for tobacco curing vary from one area to the other. The most important fuel property is its calorific or its heat value (Muna et al., 2022). The study by Muna et al. (2022) revealed that firewood from *brachystegia* spp has a higher heat value than the sawdust of the same species. The variations in wood consumption are linked to several factors including the types of barns used, state of the wood and wood species. However, the indigenous tree species were more preferred for tobacco curing than exotic species because the indigenous species have high calorific values and last for longtime compared to exotic species. The study revealed that, indigenous tree species are no longer available and the available once are very small and hard to find. Natural or indigenous tree species identified and preferred in the study area include *Brachystegia*, *Pterocarpus angolensis*, *Combretum psidioides*, *Kigelia Africana*, *Vitex doniana*, *Azelia quanzenensis*, and *Bridelia cathartica*, among others. The planted trees species preferred for curing tobacco include *Senna siamea*, *Albizia antunesiana*, eucalyptus, Acacia, Teak and Cypress, among others. The firewood consumption in flue cured tobacco is accompanied by forest woodland clearance. According to Chenge and Johnson (1994) in Muna et al. (2022), more than 300,000 ha of indigenous forests in Zimbabwe are destroyed annually by new small-scale tobacco farmers.

Effects of tobacco farming on miombo woodlands

The second objective of this paper was to examine effects of tobacco farming on the miombo woodlands and the biodiversity at large. The tobacco farmers were asked to identify the effects of tobacco farming on forests and miombo woodlands. The findings showed that respondents were cognizant of the effects of tobacco farming on the forests and miombo woodlands at large. The respondents took tobacco farming as the survival strategy; thus, there were no alternative means of gaining income apart from tobacco farming. The use of wood for curing tobacco was the first effect of tobacco farming facing forests and miombo woodlands, as supported by 76.5% of the respondents (Table 2; Plate 1). Tonnes of wood were cut for curing tobacco and to provide space for growing tobacco as supported by 71.7% of the respondents (Table 2; Plate 1). Tobacco farmers had no alternative ways to expand their tobacco farms apart from clearing forests to acquire land for growing tobacco. One of the tobacco farmers interviewed at the Kasulu District said this,

“deforestation due to clearing new land for growing tobacco and other crops like maize, cassava and sunflower is rampant here at Kasulu District”.

A woman farmer we met planting tobacco in Kaliua District commented that, “during land preparation for growing tobacco, people are clearing and burn forests since it speeds the process, save time and chase bad animals”.

The field technicians interviewed about the quantity of firewood required for curing one tonne of tobacco said this, “curing 1 tonne of tobacco requires approximately 19.9 cubic meters of firewood”.

Table 2: Effects of tobacco farming on the biodiversity (N=336)

Activities	Frequencies	Percentages
Wood cut – curing tobacco	257	76.5
Wood cut – clearing tobacco farm	241	71.7
Introduction of eucalyptus and acacia	233	69.4
Outbreak of invasive species	198	59.2
Outbreak of fire	157	46.7

Multiple responses were allowed; hence the percents do not add up to 100%

Planted trees like eucalyptus and acacia do not allow indigenous tree species to grow under it; they suppress indigenous species and undergrowth. This effect was supported by 69.4% of the respondents (Table 2). Another challenge mentioned was the emergence of invasive species (59.2%) and

outbreak of fires (46.7%) ignited during the clearing and cleaning of the farms. Sometimes, pastoralists burn the forest intentionally for them to get good and ample fodder for their animals during the rain seasons. Differently, people are using fire to clear the forest as a way of chasing wild and dangerous animals like snakes and scorpions. The extension officer interrogated at the Kaliua District was of the view that, “fire is used in the process of clearing the land which sometimes leads to a change in plant species composition”.



Plate 1: Logs/ woods used for curing tobacco

Plate 2 shows area cleared for the growing of tobacco. The plate showed that, the area before was a forest which was then cleared for tobacco farming. The stumps seen in Plate 2 are the sign that, tobacco farming influences people to clear forests to pave the ways for tobacco farming. The stumps left after clearing the forest is an indication that forest clearing is a challenge to the environment and contributes to biodiversity loss. A common observation made in several areas where tree stumps were found was that the trees had been cut either for the burning of tobacco or providing plots for grown tobacco. It was further revealed that the indigenous trees have disappeared due to cuttings for curing tobacco and the use of fire to clear the forest to get land for grown tobacco and other uses. Other indigenous trees have disappeared due to domestic animals eating the tops of the trees and seedlings. However, some of the indigenous tree species that were used or preferred have disappeared while others are difficult to find. They are very rare nowadays. Challenges including exotic species like acacia and eucalyptus have been observed in the study areas, killing indigenous species.



Plate 2: Area cleared for growing tobacco

Land preparation for tobacco growing was another cause of destruction or damage of biodiversity. When a new land for tobacco farming is cleared, wild animals, microorganisms, and plants are killed. Land preparation involves use of fire and clear cutting of trees. Fire and clear-cutting kill most of the biodiversity in the area cleared. The tobacco farmer met clearing new land for tobacco farming said this,

“We are forced to clear a new land with fire because of two reasons; one, to frighten or to kill dangerous wilds like snakes and scorpions; second, to simplify the farming activity and improve fertility or nutrients in the soil”.

The statement is positive on the side of farmers, but environmentally, it destroys the soil and damages the environment, which in turn contributed to both soil and air pollution.

Different effects of tobacco farming on miombo woodlands identified in this paper included deforestation, land degradation, biodiversity loss and soil erosion among others. Tobacco curing using wood resources has serious environmental implications on forest biodiversity particularly miombo woodlands (Manyanhaire and Kurangwa, 2014). The tobacco farming affects both genetic, species and ecological diversities (Magurran, 1988; Krishann, 2008). Tobacco farming has significantly affected the miombo woodlands in Africa and in different regions in Tanzania (Msigwa, 2019). Woodlands which cover a vast area of southern Africa are essential ecosystems that support biodiversity, soil health and provide various ecosystem services. However, the cultivation of tobacco has contributed to large-scale deforestation and environmental degradation in different areas.

One of the primary drivers of deforestation is the demand for firewood used to cure tobacco leaves. In Tanzania, studies have shown that extensive areas of the miombo woodlands including in Tabora Region, are cleared to meet the needs of tobacco production (Msigwa, 2019). Farmers rely on trees for wood, which leads to habitat destruction and a decline in biodiversity. Indigenous tree species and wildlife have been particularly affected as the destruction of their habitats reduces ecosystem services like clean water, air, and natural soil fertility (Nyoni, 2008; Mangora, 2018). Moreover, the deforestation associated with tobacco farming exacerbates soil erosion and reduces the land's productivity over time. This degradation also leads to an increase in desertification in some regions, where the once-forested areas have become barren (Nyoni, 2008). Beyond environmental consequences, tobacco farming often does not provide sustainable income for farmers, and alternative livelihoods are encouraged to mitigate these impacts.

Strategies established to conserve biodiversity in the miombo woodlands

Several strategies have been put in place to conserve biodiversity in the miombo woodlands. The first strategy identified in the study area by 76.5% of the respondents was tree planting, which involves communities and individuals (Table 3; Figure 3). The local people are encouraged to plant trees in all deforested areas. People are encouraged to plant fast-growing trees which will provide wood for different uses including domestic use and for curing/ drying tobacco. It was revealed that burning tobacco consumes a large volume of wood. To rescue biodiversity in the miombo woodlands, tobacco farmers are urged to use modern, efficient barns, the barns which use less wood and are efficient (Plate 4). The use of efficient barns was supported by 46.7% of the respondents (Table 3).

Table 3: Strategies employed to conserve biodiversity

Strategies	Frequencies	Percentages
Tree planting	257	76.5
Use modern, efficient barns	157	46.7
Afforestation programme	132	39.3
Regeneration	99	29.5



Plate 3: Tree planting



Plate 4: Modern efficient barn

As explained by tobacco the farmers interviewed, tree planting and tree cutting for wood used in tobacco curing is not proportional. It is a condition for tobacco farmers to allocate piece of land for planting trees before allowed to grow tobacco (Plate 3). Afforestation programme which involves rescuing areas which has been deforested is practiced in the study areas. Afforestation involves planting of fast grown trees like Cyprus, Eucalyptus and Acacia as supported by 39.3% of the respondents. In line with the afforestation programme meant to protect indigenous tree and other plants, it is strictly prohibited to harvest them but allowed to re-plant them and allow them to regenerate (Plate 5). Regeneration allows re-growth of trees which have been cut. Regeneration is a word used to describe small trees or young trees revived from stumps. Regeneration was supported by 29.5% of the respondents (Table 3).



Plate 5a: A photo showing an area which has been cleared to provide wood for curing tobacco.

Energy efficient and alternative energy sources for curing tobacco is another strategy of rescuing miombo woodlands. Rural communities heavily rely on fuelwood for cooking and for curing tobacco. Promotion of fast-growing trees as an alternative source of fuel wood apart from indigenous trees is recommended. Examples of fast-growing trees recommended include *Acacia mearnsii* (black wattle) and *Eucalyptus* genus. Sawdust briquette is one of the alternative sources of energy which does not affect trees in the study area. Sawdust is used as source of energy for curing tobacco in Tabora Region.

One of the tobacco farmers in Kaliua who was seen drying tobacco in the barn had this to say,
“most of the tobacco farmers are using wood to dry tobacco because wood is available at zero cost. On my side, I am also using wood, but the time wood is not available I used sawdust from timber and husks from rice”.



Plate 5b: A photos showing an area which has been cleared to provide wood for curing tobacco.

Land preparation for growing tobacco should be done with care. This care of land preparation is for all lands proximity to forests. During land preparation, it is possible to cause fires which could destroy forests. Controlled cultivation is recommended because it does not have any harm to the forest. Some innocent people clandestinely cultivate in the forest and grow crops which damage the forest. There is a notion that, forest land is a virgin land; it has not been cultivated; thus, it is very fertile which leads to bumper harvest. This thinking is what encourages people to clear forest for other uses including growing tobacco.

It was disclosed that; tobacco farmers are registered with companies buying tobacco (Box 1). For the farmer to qualify for the contract must have a sustainable source of wood to be used in curing tobacco. The tobacco farmers before signing a contract with tobacco buyers must grow a minimum of 600 trees equivalent to hectare of tobacco grown (Plate 6). The companies buying tobacco must ensure that its members whom they have signed the contract with must use only the wood sourced from planted forests or supplied from the government plantation or government-licensed entity in full compliance with all applicable laws and regulations. The Focus Group Discussion proved that, *“Engaging the local community in tree planting has significantly improved our conservation efforts. They are the real stewards of the land. Sustainable farming practices not only help in conservation but also improve our livelihoods.”*



Plate 6: Tree planted for curing tobacco

Box 1: Forestation and Biodiversity

The issue of forestation and biodiversity is highly considered by the tobacco companies. Tobacco farmers are not allowed to sign contract with AMCOS (Cooperative Unions) before agreeing that they adhere to plant trees, protect and conserve the forest in their locality and protect biodiversity. Biodiversity conservation is a key issue to tobacco farming. For all farmers interviewed, none of them was found misusing high conservation area like water sources, cemetery area, protected areas and other forests. Conservation areas are marked and protected by the government through policies, laws and by-laws. Based on the interviews with management of the tobacco companies, it was proved that they are committed in protecting the natural habitats in their agricultural supply chain. This was supported by training to farmers on tree planting, afforestation, efficient use of barns (barns using less wood) and control harvesting of wood for curing tobacco from the natural forest. Other commitment is this, Alliance One Tobacco Tanzania Limited established tree plantation (Figure 1) while Premium Active Tanzania Limited had a land where they allow natural regeneration (Plate 2 & 3).

Tobacco farming leads to serious environmental threat to the miombo woodlands which calls for urgent actions to reverse the damage and promote sustainable land-use practices. The efforts to address threats caused by tobacco production include tree planting, afforestation and reforestation initiatives, sustainable land management practices, and finding alternative livelihoods for communities involved in tobacco farming to restore and protect the miombo woodlands (Mangora, 2018; Table 3). Regeneration was also emphasised in the study area to give time for degraded forests to rejuvenate and come back to the original situation. It was further observed in the study areas efforts done by Tanzania Forest Services (TFS) including growing trees and sell wood (firewood) to tobacco farmers for curing tobacco. It was also noted that, TFS supply seedlings to tobacco farmers to grow them in their farms to be used for curing tobacco and other uses like timber and poles for building their house.

The conservation strategies for the miombo woodlands in Africa have become increasingly urgent due to ongoing deforestation, climate change and human pressures (REDD and Academy. 2021). In the period from 2020 to 2024, several approaches have been developed, involving government actions and community engagement, and international support to rescue miombo woodlands (Chirwa and Larwanou, 2022); Global Landscapes Forum, 2023). Another strategy for protecting miombo woodlands is providing alternative livelihoods means for communities depending on the miombo woodlands as a source of energy and income. One aspect of the alternative livelihood strategy includes the development of income-generating activities such as sustainable agriculture, eco-tourism, and harvesting of non-timber forest products like honey and medicinal plants. These alternative sources of income can reduce the reliance on wood fuel and destructive farming practices, which have contributed to significant deforestation in the miombo woodlands. The people can be encouraged and supported to establish woodlots by providing them with seedlings and market for their trees. Carbon trade can be introduced in the study areas which will give people income rather than relying on tobacco farming where it's processing consumes a lot of wood which is destructive to miombo woodlands.

Educational programs have been conducted to capacitate farmers on forest conservation and protections against deforestation and other threats. There has been a focus on employing new technologies and enhancing education around forest conservation (Cairney et al., 2011; Environmental News Network, 2024). These new technologies assistance includes using satellite imagery and Geographic Information Systems (GIS) to monitor deforestation and identify areas in need of protection (Macao News, 2024). The universities and local educational programs are also playing a part by educating communities about the value of biodiversity and sustainable forest management practices.

Conclusions and Recommendation

This paper determined the untold effects of tobacco farming on biodiversity in the miombo woodlands in the Tabora and Kigoma Regions in Tanzania. Tobacco has negative effects on biodiversity and on environment at large. The results showed that effects of tobacco farming on biodiversity are different including deforestation land degradation and soil erosion. It was disclosed that tobacco farmers are aware of deforestation and land degradation risks associated with tobacco farming and have a valid due diligence system in place towards tobacco farming. This paper recommends that the buyer of tobacco must encourage farmers to plant fast growing trees like eucalyptus and acacia to reduce dependence on natural forest. For anyone violating this rule his/ her tobacco will not be bought. Farmers without tree woodlots should buy wood from TFS or private owned woodlots.

CONFLICT OF INTEREST STATEMENT

The author declares no conflicts of interest.

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