



Environmental Management Practices amongst Tobacco Farmers in Migori County, Kenya

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Authors' contributions

This work was carried out in collaboration with all authors. Author LBM managed the literature searches, structured the article, designed framework and wrote the first draft of the manuscript. Authors JKK and GWN grammatically corrected and edited this article. All the authors read and approved the final manuscript.

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ABSTRACT

Aim: To assess environmental management practices carried out by both tobacco farmers and companies.

Methodology: Purposive sampling was employed for data collection where by tobacco farmers were randomly selected from the population. Sub-county Forest Officer and two field officers from Kenya Forest Service were also interviewed.

Results: Use of improved barn is among the environmental management practices that can reduce deforestation because of its high thermal efficiency. However, only 22% of the respondents used improved barn while 78% used traditional barn which is non-energy saving barn, therefore consuming tonnes of wood compared to improved barns. The study showed that 97.7% of the respondents had not been advised by tobacco companies to use any other method to control pests except chemical pesticides. Of the respondents, 97.1% believed tobacco companies did not promote alternative source of energy for curing tobacco other than wood.

Conclusion: Although not much was being done, farmers had adopted a few practices to prevent soil and forest degradation. Most of the soil management practices and alternative curing

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technologies were non-existent in the study area and tobacco companies were yet to introduce them and this had greatly compromised the status of the environment. Use of chemical pesticides was on a large scale in the study area. Some of the efforts by tobacco companies employed to mitigate the environmental impacts were promoting reforestation and appropriate use of fertilizers and pesticides. The very few existing environmental management practices carried out by few tobacco farmers and tobacco companies were not adequate to mitigate the negative impacts caused by tobacco farming.

Keywords: Tobacco; tobacco farming; environmental management; tobacco companies.

1. INTRODUCTION

The beginning of commercial tobacco production can be traced to the Chesapeake Bay area of Virginia (USA) in the early 17th century; As an enterprise of settlers making use of contract and slave labour to exploit natural environments [1]. Since then, it moved from North America and spread all over the world [2]. The biggest producer in the world at present is China, which produces a third of the world's tobacco [3]. Since the late 1970s, concerns have been registered by several environmental agencies including Food and Agriculture Organization (FAO) and the World Health Organization (WHO) regarding the impact of tobacco farming to the environment [4]. The tobacco crop itself entails a high degree of maintenance, including pest and disease control, use of firewood for curing, a regular water supply and fertilizers to enhance yield.

Tobacco farming was introduced in Kenya in the 1960's and cultivation has been increasing greatly over the years. Currently tobacco farming takes place in Migori (Kuria East, Kuria West and Migori), Homabay County (Suba, Homabay, Rachuonyo) Bungoma (Bungoma and Mt. Elgon), Busia, (Busia and Teso), Kirinyaga, Muranga, Kiambu (Thika), Meru, Kitui and Machakos Counties [5]. There were 36,000 tobacco farmers in Kenya and tobacco crop covered approximately 20,000 ha with estimated total output of 20 million kilograms of dried leaf worth about Kshs. 2.0 billion (Approx. 20 million US Dollar) [5]. The Kenyan Government just like other developing countries, treasures the tobacco companies because of the taxes the tobacco firms pay to the exchequer. Indeed, between the tobacco firms, the farmers and the government, it is the government that is the utmost beneficiary [6]. For instance, in 2015, British American Tobacco (BAT) Kenya Ltd - one of the leading tobacco firms in the country, had a net turn-over of over Kshs. 22 billion (approx. 220 Million US Dollar) and remitted over Kshs. 16 billion (approx. 160 Million USD) to the

government. During the same period the farmers in the country earned about Kshs. 1.2 billion (approx. 12 Million USD) [7].

The success of tobacco companies in Kenya is mostly because they provide free technical advice to farmers and loans to purchase fertilizers and pesticides. These have contributed to intensified tobacco production in various parts of the country. The intensified tobacco production is a major contributing factor to environmental degradation through excessive use of fertilizers, pesticides and deforestation. Deforestation is a serious environmental impact caused by tobacco farming. Malawi loses about 3% of its forest cover to tobacco production yearly [8]. Similarly, countries like Pakistan, Uruguay, Bangladesh, China, Zimbabwe among others lose up to 4.6% of forest cover to tobacco production yearly [8]. There is high demand for wood for curing tobacco in the study area (Kuria West) [9]. Loss of soil fertility due to tobacco cultivation has also been recorded [10,11].

Studies done on environmental management practices in some countries have shown remarkable positive results. For instance, use of improved furnace can save up to 10-20% of fuel consumed per tobacco leaves cure [12]. However, studies on the environmental management practices in the study area were lacking. Therefore, it was essential to examine environmental management practices carried out by tobacco farmers to restrain further deterioration of the forest and soil resources. In addition, there was need to cross examine the environmental management practices being promoted by tobacco companies to protect soil and forest resources.

Kuria West Sub-county is one of the best producing tobacco zones in Kenya, therefore, it was selected for this study. The study focussed on two major environmental resources that are the most affected by tobacco farming; forest and soil resources. Environmental management

practices such as crop rotation, use of renewable sources of energy, cover crops, contour farming, and strip cropping were yet to be reported in tobacco farming areas particularly in Kenya.

2. METHODOLOGY

The study was carried out in Nyametaburo and Ikerege wards of Kuria West Sub-county, in Migori County. The Sub-county is the southernmost with -1.195289, 34.556851 coordinates [13]. It borders the Republic of Tanzania to the South, Kuria East Sub-county to the North-East and Migori Sub-county to the North-West. The total population in Kuria West Sub-county is estimated to be 174,253 and comprises of a total area of 316.9 km² [14]. The socio-economic activity in the study area include crop farming, livestock keeping, brick making and sand harvesting along River Hibwa [14].

The type of soil in the said study area is loamy soils and black sandy soils. The Sub-county is mostly characterized by undulating slopes ranging from 1% to about 60% [15]. Farmers have adopted Soil Water conservation measures/Agroforestry on their farms but mostly cultural/biological measures, some are purely cultural e.g. ridging [15]. The type of climate is tropical humid with temperature ranges between 17°C to 30°C [5]. Rainfall occurs most part of the year with a maximum in April to May while December to February is usually a dry season [5].

Purposive sampling was employed for data collection where by tobacco farmers were randomly selected from the population. The study targeted only tobacco farmers who had grown tobacco for more than one year from the two wards because of their versed knowledge and experience in tobacco farming. Sub-county Forest Officer and two field officers from Kenya Forest Service were also interviewed. The number of tobacco farmers in Nyametaburo and Ekerege wards was 750 and 550, respectively. Out of these, a sample of 173 farmers was determined according to the formula of Yamane [16]. A precision of ten (10%) percent was used to determine the sample size. The main instrument of data collection was a semi structured questionnaire on environmental management practices being carried out by tobacco farmers and promoted by tobacco companies. The questionnaire was administered by the researcher and two trained research assistants.

The following is a summary of the questions asked during the interview:

2.1 Environmental Management Practices by Tobacco Farmers

- What Environmental management practices do you carry out in your tobacco farm as a soil management practice?
- What type of crops do you rotate tobacco with?
- Mention the tree species you plant after cutting down trees for curing tobacco?
- What other type of alternative energy apart from wood do you use for curing tobacco?
- What type of barn do you use for curing tobacco?
- What initiatives have you put in place to minimize excessive use of wood that leads to deforestation?
- What initiative have you put in place to prevent cutting down of endangered indigenous species?

2.2 Environmental Management Practices Promoted by Tobacco Companies

- Name any species of trees you have planted as an initiative by tobacco companies to promote afforestation/reforestation
- What alternative to chemical pesticides and inorganic fertilizer have you been advised by tobacco companies to use?
- What soil management practices are being promoted by tobacco companies?
- What alternative sources of energy do tobacco companies promote for curing tobacco other than wood?

Quantitative data was processed and analyzed using descriptive statistics such as means and percentages. Qualitative data was analyzed by first coding and organizing the data into categories.

3. RESULTS AND DISCUSSION

3.1 Environmental Management Practices by Tobacco Farmers

3.1.1 Soil management practices

Of the respondents 95.3% indicated that they practised crop rotation (Fig. 1). Only 1.2% showed that they practice revegetation as a soil management practice.

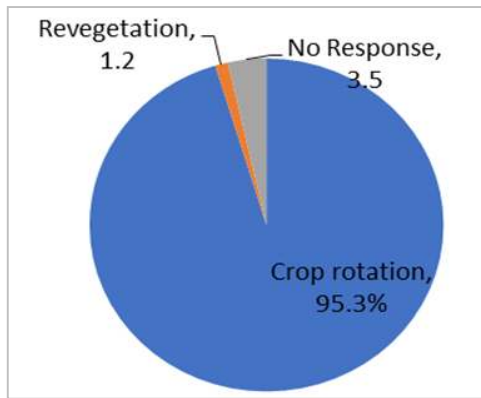


Fig. 1. Soil management practices by tobacco farmers

Continuous growing of tobacco leads to soil pollution and exhausts soil nutrients. Therefore, the rationale behind crop rotation is to plant a crop that returns the nutrients to the soil that the previous plant has drawn. Growing the same crop on the same piece of land season after season results in low yields but cultivating a sequence of crops over several seasons improves soil fertility and hence increases in crop production. This agrees with the results of this study where majority of the respondents' practised crop rotation. Indeed, growing tobacco exhausts nutrients from the soil. Crop rotation helps to improve or retain soil fertility, reduce erosion, reduce the upsurge of pests, spread the workload, reduce risk of weather damage, reduce dependence on agricultural chemicals and increase net profit [17]. Crop rotation prevents pests and diseases such as black shank, Granville wilt, most nematodes, and tobacco mosaic virus as well as offers numerous agronomic benefits [18]. The longer the rotation, the better and the crop to be alternated with should be considered [18].

Of the respondents, 65% preferred to rotate tobacco with maize compared to other crops (Fig. 2). On the other hand, 31% respondents rotated tobacco with beans while 3% rotated with sorghum 1% did not respond.

Farmers preferred to rotate maize with tobacco in the study area since maize is the staple food in the region. Tobacco crop occupies the land for six months, which denies the farmers opportunity to produce sufficient food for their households. Thus, maize is grown immediately after the tobacco crop for food security during the next season when they grew tobacco. Rotating

tobacco with maize is not sustainable because maize has high nutrient needs but significantly less compared to tobacco [8]. Beans were also grown by farmers. Being a legume, beans fix nitrogen to the soil that had been depleted by the tobacco plant restoring partially soil fertility. Farmers should therefore be encouraged to carry out this rotation. Notably, rotation with crops like cassava was not favourable because cassava takes long to mature (10-18 months) depending on the variety. Rotating tobacco with tomatoes and sweet potatoes was also less favourable because the crops were easily attacked by insects and pests that linger in the soil after tobacco harvesting [19].

3.1.2 Reforestation

Reforestation was found to be practised by tobacco farmers. Of the respondents 53.8% planted *Eucalyptus spp* after cutting down trees for curing tobacco, 23.7% of the respondents planted *Cupressuss spp.*, 15.6% of the respondents grew *Grevillea robusta*, 4.6% of the respondents cultivated *Jacaranda spp* while 2.3% of the respondents grew *Olea africana* (Table 1).

Tobacco farmers cut down trees to cure tobacco leaves. The study established that due to tobacco farming, forests have been depleted. Therefore, reforestation in the study area was required and that some measures were in place to ensure the natural and man-made vegetation was not being depleted. The tobacco companies promoted planting of eucalyptus trees because they matured fast compared to other species. On the other hand, farmers in the study area did not prefer planting indigenous species because they took relatively long time to mature. Furthermore, the Kenya Forest Service (KFS) could not give them permit to cut down any indigenous species as a forest management measure. These among other reasons made tobacco farmers to opt for exotic species.

Table 1. Plant species used for reforestation

Species	Frequency	Percent (%)
<i>Cupressus spp</i>	41	23.7
<i>Eucalyptus spp</i>	93	53.8
<i>Grevillea robusta</i>	27	15.6
<i>Jacaranda spp</i>	8	4.6
<i>Olea africana</i>	4	2.3
Total	173	100.0

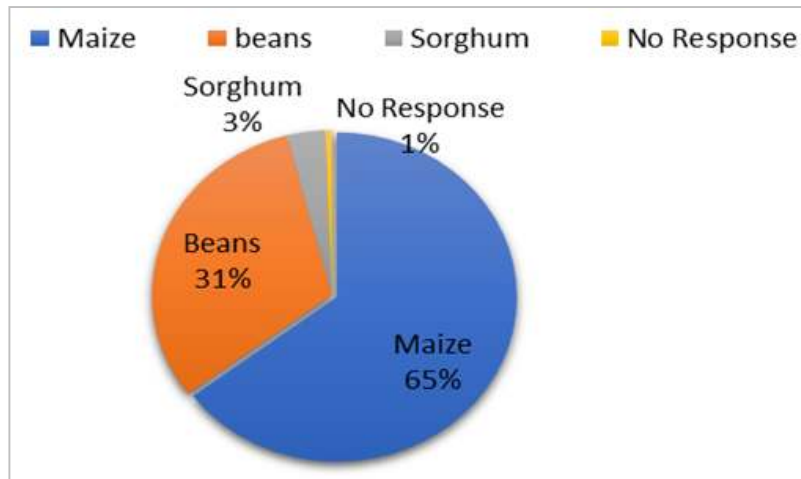


Fig. 2. Crops rotated with tobacco

Reforestation programs are very necessary in the study area to make Kenya attain the required 10% forest cover [20]. Flue-cured tobacco practised in the study area highly contributes to deforestation. Thus, combating deforestation in tobacco growing zones entails reforestation i.e. restocking of the existing forests that have been depleted [21]. Forests play a vital role in the environment, besides being a natural habitat of wide variety of animals and plants, trees also control carbon dioxide flux and soil erosion.

The results show that farmers opted to plant exotic trees compared to indigenous trees despite the tremendous disappearances of the indigenous tree species. In essence, this is not a good practice as the indigenous tree species with sentimental, religious and medicinal values, food, and fodder et cetera vanish and they are replaced with exotic species. The reforestation practice (where only exotic trees were used) in the study area was likely to encourage tobacco farmers to cut down indigenous trees. This was because farmers cut down indigenous trees knowing they would be replaced with exotic ones without considering the value they add to the livelihood of the community. It is noteworthy that during the study, most tobacco farmers had woodlots of *Eucalyptus spp* and not indigenous species.

With reforestation, the choice of species is equally vital. It is important to consider the climatic condition of a given place before deciding on the species to use for reforestation. This study showed that most farmers preferred *Eucalyptus spp* to other species because of its

high adaptability to any condition of soil and rainfall and low maintenance [22]. As much as most farmers preferred planting eucalyptus trees, there was lack of awareness amongst them on the negative impacts of *Eucalyptus spp* on the hydrological patterns especially if planted near water sources. *Eucalyptus spp* have been known to cause drying up of water sources for rivers and springs on the landscape [23]. KFS recommends that the best areas to plant *Eucalyptus spp* include; marginal lands degraded through soil erosion and loss of soil fertility [20]. Moreover, eucalyptus can be planted as shelter belts and wind breaks on large scale farms, on areas with saline soils, water logged areas for purposes of draining the area for agricultural production and on farm lands as plantations or woodlots [20]. Furthermore, the species should not be grown in wetlands and marshy areas, riparian areas, around lakes, ponds, swamps, estuary, sea shores and any other body of standing water, irrigated farm lands and areas with less than 400 mm of rainfall unless for the purpose of draining the area [20].

3.1.3 Alternative sources of energy for curing tobacco

The study findings showed that twigs and leaves were the only alternatives to wood fuel as indicated by 5.2% of the respondents (Table 2). On the other hand, 94.8% of the respondents indicated that there was no other alternative for curing tobacco other than wood.

Curing tobacco leaf in the study area involved burning of huge quantities of wood fuel. While

some types of tobacco require air curing or sun curing especially in the developed countries, in the study area, tobacco leaves were flue-cured where heat was introduced into a curing barn through pipes from an exterior furnace. And of course, the most readily available fuel for farmers to burn in these furnaces was often wood. Curing is an inevitable process for tobacco farmers since it improves the flavour of tobacco and reduces the moisture level of the leaf hence can be stored for a comparatively long time without perishing.

Table 2. Alternative sources of energy for curing tobacco other than wood

Alternative sources of energy	Frequency	Percent (%)
using twigs and leaves only	9	5.2
There is no other alternative other than wood	164	94.8
Total	173	100.0

There are other sources of energy for curing tobacco that can be used and are environmentally friendly but were yet to be introduced in the study area. Some are also expensive for instance solar curing which involves installation of powerful but expensive solar panels that a poor farmer in the study area could not afford. Replacement of fuelwood for curing tobacco is recommended because solar energy is a feasible substitute for fuel wood [24]. Assessments show that solar curing can contribute about 12% of the entire heat essential for tobacco curing [24], however more research needs to be done on this. Although solar energy appears to be a significant, nevertheless add-on source of energy, its use for tobacco curing should be well thought-out to save the environment [24]. In addition to solar energy, coal has been considered as another possible substitute. For instance, coal was the main source of energy for tobacco curing in Zimbabwe [24], however the farmers were gradually substituting it with wood, because of the doubled costs of coal, and the farmers found eucalyptus wood to be cheaper. In the light of Zimbabwe's experience, and the fact that coal is pricier than wood in most countries, it seems to have diminutive prospect as a substitute fuel for tobacco curing [24].

The Virginia type of tobacco grown in the study area was flue-cured, thus required wood fuel. Air

curing is specifically for burley and oriental tobacco that were not grown in the study area. It therefore appears as if the use of fuelwood as the major source of tobacco curing is likely to continue, thus contributing to massive forest destruction. Alternatives to the use of wood must also be researched [25]. For example, thought may well be given to the use of bio-waste material and solar energy to supplement the use of fuelwood. Reasons why farmers in India opted for fuelwood and not substitute fuels included: the need for an improved barn for the use of substitute fuels; Impairment of curing tubes if alternative fuels are used; unavailability of alternate fuels in needed amount [26]. The other reason was that it was easier to obtain storage facilities for fuelwood than alternative fuels [26]. This study therefore shows that chances of totally replacing wood fuel with an alternate fuel are rather remote.

3.1.4 Type of barn used for curing tobacco

Table 3 below shows that 78% of the respondents used traditional/conventional barn to cure tobacco while 22% used improved barns with well insulated walls.

Table 3. Type of barn used for curing tobacco

Type of barn	Frequency	Percent (%)
Improved barn/furnace	38	22.0
Traditional barn (Non-energy saving)	135	78.0
Total	173	100.0

The study established that the majority of the respondents preferred to use traditional barns to cure tobacco over improved barns. From the farmers' perspective, the materials required to make an improved barn were comparatively expensive and that was why most farmers opted for a traditional barn.

There are no extra insulators installed on the roofs or the walls of the traditional barn, therefore a lot of heat is lost to the surrounding. The modern improved barns have better insulation fitting and a modified furnace that prevents heat loss through the walls and the roofs [27]. This minimizes the amount of wood that is required to cure tobacco.

This study has shown that destruction of the forest resources was compounded by using

traditional barns that were preferred by majority of the tobacco farmers. The traditional barns have low thermal efficiency hence consume larger quantities of firewood thus contributing to accelerated deforestation, with serious ecological implications. In Miombo woodland where deforestation is a main concern majorly contributed by tobacco farming, 60% of farmers used traditional barns whose energy efficiency is low [28]. Experimental results [28] strongly propose that agricultural policy actions ought to emphasize on promotion of improved barns in Miombo woodland to reduce deforestation in the region. In Malawi, 55,000 hectares of land is cleared annually to cure tobacco accounting for 12% deforestation in the region [29]. Consequently, Limbe Leaf and German Technical Cooperation teamed up to promote rocket barns (improved barns) that reduce wood use by 50% for curing [29]. An experimental study on the performance and efficiency of Malakisi barn (a traditional barn common in East and Southern Africa and is normally used by tobacco farmers to cure tobacco) concluded that 97% of heat is lost in a traditional barn, therefore rendering it inefficient [24]. In view of the adverse environmental effects of existing tobacco curing practice, there is an urgent necessity to increase the efficiency of the procedure by enhancements in the furnace and flue pipe system design [24]. In addition, sufficient emphasis has not been given by tobacco companies and relevant government sectors on energy conservation and ecological consideration in tobacco curing practice. Considering the above, there is an urgent necessity for the farmers in the study area to be encouraged to use barns with improved structure to minimize excessive use of wood to cure tobacco.

3.1.5 Initiatives by farmers to minimize excessive use of wood

Table 4 below indicate that 50% of respondents harvested only ripe tobacco leaves that required less curing. Of the respondents, 31% re-used wood in construction of curing barns, while 10% used improved barns. Those who did not practice any initiative to minimize excessive use of wood were at 4%.

Use of improved barns with well insulated walls by some farmers minimized heat loss through roofs and walls hence less wood consumption. Similarly, re-use of wood in the construction and modification of barns from demolished structures

reduced cost of construction and preserved the trees. Re-using wood for construction of barns ensured that farmers did not throw away perfectly good pieces of wood when demolishing an old house and in doing so they minimized cutting down of more trees for construction. However, the efforts by the small percentage of farmers who employed the method of reusing wood was inconsequential since curing of tobacco is the main cause of deforestation in tobacco growing zones. Improved barns that capitalized on the heat they produce and alternative sources of fuel like coal should be explored to reduce wood consumption [30]. Harvesting only ripe tobacco ensured shorter curing time and lesser heat loss and more efficient curing [31]. This study finding corroborates this assertion.

3.1.6 Initiatives by tobacco farmers to prevent cutting down of indigenous trees species

Table 5 shows the various initiatives employed by tobacco farmers to prevent cutting down of indigenous trees for curing tobacco. Of the respondents, 78% planted exotic trees and they preferred eucalyptus as advised by tobacco companies. Those who did not employ any initiative were 18.5% while only 3.5% used other alternatives for curing tobacco other than wood from indigenous tree and this include use of leaves and twigs cut from exotic trees.

Eucalyptus spp were promoted by tobacco companies owing to their fast growth and their ability to grow in many agro-ecological environments. However, some farmers preferred wood from indigenous trees for curing the tobacco leaves due to the belief that their use in the furnace produces good quality tobacco leaves. Similar results have been recorded in Tanzania where smallholder farmers used an even less efficient curing system using only indigenous forests [29]. Use of alternatives like twigs and leaves as source of fuel as established in this study is negligible. Preference on the use of wood from indigenous tree species for curing tobacco has also been noted in Malawi [7] and in Tanzania (Miombo woodland) [32]. In the former case, indigenous forests provide about 90% of the energy for curing. Widespread deforestation and the felling of indigenous trees for curing tobacco are rampant in tobacco growing zones [33]. The cutting down of trees is done without replacement.

Table 4. Initiatives by tobacco farmers to minimize use of wood

Initiatives by tobacco farmers to minimize use of excessive wood fuel	Frequency	Percent (%)
Using improved barns	18	10
Reusing wood in construction of curing barns	62	36
Harvesting only ripe tobacco which needs less curing	86	50
None	7	4
Total	173	100.0

3.2 Environmental Management Practices Promoted by Tobacco Companies

3.2.1 Afforestation/reforestation

The study showed that 45.6% of the respondents had planted eucalyptus trees as an initiative by tobacco companies to promote reforestation, 19.7% had planted *Grevillea robusta*. Of the respondents, 17.9% indicated that they had not planted trees because of tobacco companies' initiative, 16.2% had planted *Cupressus spp* while 0.6% had planted *Jacaranda spp* (Table 6).

Table 5. Initiatives by tobacco farmers to prevent cutting down of indigenous trees species

Tobacco farmers' initiative	Frequency	Percent (%)
Planting exotic trees for curing tobacco	135	78.0
Using other alternative for curing tobacco other than wood	6	3.5
I have done nothing	32	18.5
Total	173	100.0

Table 6. Tree species promoted by tobacco companies for afforestation/reforestation

Tree species promoted by tobacco companies	Frequency	Percent (%)
<i>Cupressus spp</i>	28	16.2
<i>Eucalyptus spp</i>	79	45.6
<i>Grevillea robusta</i>	34	19.7
<i>Jacaranda spp</i>	1	.6
None	31	17.9
Total	173	100.0

The findings show that *Eucalyptus spp* was the most preferred for reforestation promoted by tobacco companies. Key setback in the reforestation program is that it involves only

fast-growing exotic trees such as cypress and eucalyptus [34]. This shows that the environmentally appropriate indigenous trees of the region were not substituted. The species used for reforestation were unsuitable because of the additional attention and large amounts of ground water required, leading to further hostile environmental consequences.

According to this study tobacco companies are on the forefront promoting reforestation using exotic species. This is, however, ecologically intolerable due to the undesirable impacts eucalyptus is likely to have to the environment. Tobacco companies' reforestation systems had little or no progressive impact since the trees planted were not indigenous and were used for tobacco production [21]. Growing eucalyptus, cypress and other non-indigenous trees is challenging because the plants absorb too much water that damage food crops and reduce drinking water tables [21]. Furthermore, the aroma of the final cured tobacco especially the flue-cured tobacco depends on the nature of tree used in curing [35]. Hence, tobacco companies continue to encourage farmers to use other sources than eucalyptus. In the end, there is a transformation of indigenous vegetation into an exotic eucalyptus one [35]. Lack of funds to support reforestation activities in less developed countries also contributes to the loss of indigenous trees [36]. Therefore, it is presumable that since there are no strong policies to guide reforestation programs or because tobacco companies jeopardize the implementation of the existing policies, reforestation initiatives will remain unsuccessful.

The high demand for firewood also makes reforestation programs to have little impact because forests are cut down before they regenerate to meet the high demand for wood to cure tobacco [37]. This is because reforestation has been specifically introduced to provide wood for curing ripe tobacco therefore making the process insignificant [38]. Tobacco companies support reforestation programs with the intention

of wanting to appear endorsing environmentally sustainable initiatives to improve their companies' images without essentially altering their fundamental business practices [39].

3.2.2 Use of alternatives to chemical pesticides and inorganic fertilizers

Tobacco companies preferred to use chemical pesticides to control pest. That is why 97.7% of respondents had not been advised to use other methods while 2.3% of the respondents said they had been advised to use biological control method to control pests (Table 7).

All respondents (100%) indicated that they had not been encouraged to use any other type of fertilizer apart from inorganic based fertilizer for their tobacco crop.

Most farmers believed that biological control did not eliminate pests from tobacco crop. Besides, it was not a common practice in the study area and most farmers did not know how it worked. The use of chemical pesticides to control pest is effective but is detrimental to the environment. Massive chemical pesticide application causes reduction of important microorganisms and insects in the soil.

Table 7. Alternative methods to chemical pesticides as advised by tobacco companies

Type of pesticide	Frequency	Percent (%)
Biological control	4	2.3
We have not been advised to use any other type but chemical pesticides	169	97.7
Total	173	100.0

Excessive use of harmful agrochemicals and the shifting of tobacco growing into more fertile lands encouraged by tobacco industry contribute to the environmental health impact of tobacco cultivation in low and medium income countries (LMICs) [33].

This study established that tobacco companies clearly encourage the use of chemical pesticides. The chemical pesticides are injurious to the environment. Up to 16 applications of pesticides are required by BAT of its contract farmers [40]. Therefore, a new way of controlling pests that is effective and does not harm the environment must be adopted. Such methods include

biological control that uses a parasite or a predator that causes harm only to the targeted pests [41].

3.2.3 Soil management practices promoted by tobacco companies

Tobacco companies only promoted crop rotation, as indicated by 28% of respondents (Fig. 3). On the other hand, 72% of respondents indicated soil management practices like crop rotation, use of cover crops, strip cropping, multiple cropping; zero tillage and re-vegetation were not being promoted by the tobacco companies.

These study findings show that most soil management practices were hardly promoted by tobacco companies. This undoubtedly confirms that not much was being done by tobacco companies to manage and protect soil resources from degradation. Tobacco companies by not encouraging soil management practices may have, led for instance to reduced pH of soil and elevated contents of effective N, P and K significantly under the standard application condition and release of poisonous substances into soil [42].

3.2.4 Alternative sources of energy promoted by tobacco companies other than wood

Only 1.7% of respondents indicated that companies promoted alternative sources of energy for tobacco curing. On the other hand, 97.1% of the respondents believed that tobacco companies did not promote alternative source of energy for curing tobacco other than wood. Those who held that tobacco companies promoted use of solar energy but none of the farmers used it was at 12% (Table 8).

Table 8. Alternative sources of energy promoted by tobacco companies

Alternative sources of energy	Frequency	Percent (%)
Solar energy	2	1.2
Use twigs and leaves only	3	1.7
None	168	97.1
Total	173	100.0

Almost all the tobacco farmers believed tobacco companies did not promote alternative sources of energy other than wood. Other sources of energy such as solar were non-existent in the study area. Some of the appropriate, locally available

alternative fuels include gas, sawdust, coal, candlenut shells or liquid petroleum gas, as well as coffee or rice paddy husks. However, most of these alternatives are expensive and some unavailable in several tobacco growing zones. In most countries, there is no alternative fuel other than wood as seen in Tanzania and Malawi [40] and in India [26].

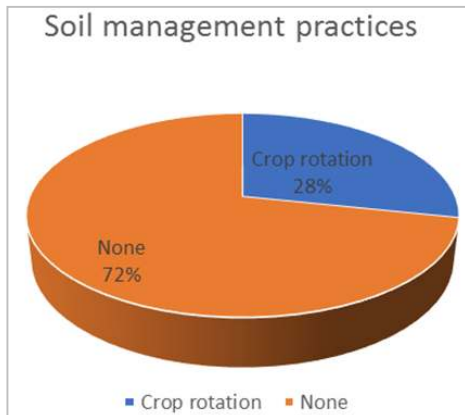


Fig. 3. Soil management practices promoted by tobacco companies

From the findings of this study, practically nothing is being done by tobacco companies to provide other alternatives to curing tobacco other than wood in the study area. This is likely to compromise further the tree cover.

4. CONCLUSION

This study has shown that the only major environmental management practices being carried out by tobacco farmers were reforestation/afforestation and crop rotation. Nevertheless, the two environmental management practices are implemented using less desirable species i.e *Eucalyptus spp* for reforestation and maize for crop rotation.

The study revealed that most of the respondents used wood to cure tobacco while very few used twigs and leaves from trees. Other curing methods such as solar and air curing were virtually absent in the study area partly because they were expensive and have not been popularized and because the type of tobacco grown in the study required flue curing only. This has contributed to the high rate of deforestation in the study area. Furthermore, traditional barns were preferred by most farmers over the improved barns, although traditional barns

consume more wood as compared to improved barns. This exacerbates the problem of deforestation.

It is ostensible that there were very few environmental management practices promoted by tobacco companies to combat deforestation, tree planting being the common practice in the area. However, other practices that could control forest resources degradation such as sustainable agriculture and use of improved barns though in existence were not common amongst farmers. Tobacco companies encouraged their farmers to grow *Eucalyptus spp* because of their ability to grow faster and they can thrive in harsh conditions.

Environmental management awareness by tobacco companies was poor. Tree planting practice alone cannot eradicate forest and soil resources degradation without incorporating other practices such as use of improved barns and use of alternative sources of energy which were not common in the study area.

The study indicates that not much was being done by tobacco companies to promote soil management practices. Nevertheless, crop rotation is encouraged by tobacco companies in order to give the soil time to recover the lost nutrients. However, as seen in the study, the crop (maize) mainly used for rotation is equally a nutrient demanding crop and therefore puts more pressure on the remaining soil nutrients.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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