ASSESSMENT OF THE ENVIRONMENTAL IMPACTS OF DARK FIRE TOBACCO FARMING IN SONGEA RURAL DISTRICT

BY

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ABSTRACT

The study was conducted in Songea rural district in Ruvuma region to investigate the environmental impact of dark fire tobacco. Community level data collection was carried out using structured questionnaires, focus group discussions, checklist guides and field survey in four villages selected purposively. A total of 120 tobacco growing households were interviewed. Analysis of both primary and secondary data was done using Ms Excel and SPSS. Results indicated that cultivation of tobacco in the district has resulted in the decimation of 333 033 hectares of forest land for the past three decades of which 282 441 hectares are due to field preparation, fuelwood demand for curing purpose consumed 52 957 hectares and 3389 hectares of catchment were cleared for seedbed preparation for tobacco seedlings. It was also found that forest land clearance has resulted into loss of biodiversity such as traditional medicines (*Anonas spp* which is used in treating sterility and dysentery), wild animals *(Gazella soemmeringi*), wild fruits (*Uapaka kirkiana*), and edible fungi (*Termitomyces aurantiacus*). Moreover, losses of precious top soil in form of sheet erosion particularly in sloping areas were reported by farmers. It is thus recommended that all stakeholders in the district should be involved in the conservation of environmental resources through the use of crop rotation, soil conservation techniques, planting both native and natural trees especially in catchment areas, and use of float seedbeds (box like trays) which use tobacco dust as medium for growth. In addition, introduction of subsidies on agricultural inputs such as fertilizers, herbicides and pesticides should be advocated as a means of reducing farmers' over-reliance on shifting cultivation, which has been found to be very detrimental to our precious environment.

DECLARATION

I, Nyoni Clarence Hugo, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and has not been or concurrently being submitted for a higher degree award in any other University.

_____ _____

Clarence Hugo Nyoni Date
(M.A. Candidate)

The above declaration is confirmed

_____ _____

Dr. J.K. Mwalilino Date
(Supervisor)

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This dissertation is dedicated to my late father Hugo Beda Nyoni (2008) and my mother Susan Herman Komba who raised me up and gave me the value of education. I will always love you and remain grateful to you. This work is also dedicated to all who strive to safeguard the environment.

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LIST OF ABBREVIATIONS

ASH	Action on Smoking and Health
ATTT	Association of Tanzania Tobacco Traders
BOT	Bank of Tanzania
DFC	Dark Fired Tobacco
DRC	Democratic Republic of Congo
DTU	Demographic Training Unit
EASD	Empowerment for African Sustainable Development
ECSA	East, Central and Southern Africa
EIUL	Economist Intelligence Unit Limited
FAO	Food and Agriculture Organization
FBD	Forest and Bee Division
FDG	Focus Group Discussion
GDP	Gross Domestic Product
IARI	Indian Agricultural Research Institute
IFSC	International Forest Sciences Consultancy
ILO	International Labour Organization
ITGA	International Tobacco Growers Association
MAM	Ministry of Agriculture of Mozambique
NGO	Non-Government Organizations
PAN	Pesticides Action Network
SDC	Songea District Council
SPSS	Statistical Package for Social Science

TARP II	Tanzania Agricultural Research Project Phase Two
TEAM	Tobacco Exporters Association of Malawi
URT	United Republic of Tanzania
USA	United States of America
VEO	Village Extension Officer
WCMC	World Conservation Monitoring Centre
WHO	World Health Organization

CHAPTER ONE

1.0. INTRODUCTION

1.1. Background information

Tobacco is a cash crop grown worldwide in more than 120 countries (ITGA, 1998; Mackay, 2002). The crop belongs to the family Solanaceae and the genus *Nicotiana*. According to Ngugi *et al*. (1996), there are about hundred species of tobacco but only two *Nicotiana tabacum* and *Nicotiana rustica* are of economic importance.

Based on the means of curing tobacco is categorized into seven types. These are light air cured, fire cured, flue cured, burley, dark air or sun dried, dark air cured cigar, and dark fire cured tobacco (Rweyemamu, 2002). DFC tobacco accounts about 18% of the total output of which 99% comes from Ruvuma region in Tanzania (Mwikila, 1992; BOT, 1999).

To obtain characteristic taste, aroma, color and the right traded form, dark fire tobacco requires a variety of fuel for curing leaves such as coal, liquid petroleum gas and fuel wood which is mostly used in Less Developed Countries (LCD). The curing process is done in barns where woody smoke is introduced during the process to produce dark smoky flavored leaves. The cured leaves can be easily stored, transported and processed (Mwikila, 1992; Svenningsson, 1994).

Tobacco production is an important source of employment (in research, marketing services and manufacturing) and cash income in all countries where it is grown (Van Liemt, 2002; FAO, 2003). In addition, the crop provides raw materials for cigarette

manufacturing industries where over 80% of world tobacco is used for making cigarettes to serve the increasing number of smokers globally (FAO, 1990). Northoff (2003) reported that the number of smokers is expected to increase to around 1.3 billion in the year 2010, up from 1.1 billion in 1998. This is an increase of about 1.5% annually. Such increase in the number of smokers is expected to force the industry to increase tobacco leaf production to 7.1 millions tons in 2010, up from 6.1 million tons for the year 2000. This increase in production will undoubtedly increase the total deforested area. The remaining portion of tobacco is used in making smokeless tobacco that is consumed in an unburned form such as snuff and chewing tobacco (FAO, 1990).

Despite such a significant role to the world's economy, there are also associated economic losses, food insecurity, adverse health impact and environmental effects that are less talked about but also need to be counted. The environmental effects associated with tobacco farming and processing are deforestation resulting from expanding more land for production to meet the demand of cigarette companies and use of wood curing some types of tobacco such as flue and fire cured. Others include soil erosion, desertification, wild land fires, loss of biodiversity particularly in river basins and watersheds areas, land and water pollution caused by the use of pesticides and fertilizers, air pollution and climate change.

Despite these problems, little research has been done in Tanzania to indicate the extent of the environmental degradation related to tobacco production. Most of the little information available is on areas where flue cured tobacco is produced (Chenje and Johnson, 1994). The environmental problems such as deforestation, soil erosion

and biodiversity loss associated with dark fired tobacco particularly in Songea district have been less studied and the information is scanty.

1.2. General objective

In view of the above, the broad objective of the study is to assess the environmental impacts of tobacco farming in Songea Rural district

1.3. Specific objectives

- To identify the preferred tree species required for dark fired tobacco curing.
- To estimate the extent of local area deforestation being brought about by tobacco production (curing and land preparation).
- To estimate the extent of soil erosion resulting from dark fire tobacco cultivation.
- To identify type of biodiversity lost as a result of dark fire tobacco farming.

1.4. Problem statement and justification of the study

Tobacco production is known to cause a number of environmental problems such as deforestation, soil erosion, desertification, wild land fires, loss of biodiversity particularly in river basins and watersheds areas, land and water pollution caused by the use of pesticides and fertilizers, air pollution and climate change (Geist, 1999). Cases from elsewhere like Tabora, Iringa, Kahama (Tanzania), Kenya and Malawi have shown that tobacco farming have resulted into fuel wood scarcity, pollution, severe soil erosion and change in rainfall patterns (Svenningsson, 1994; Geist, 1999; Missana, 1999; Chacha, 1999).

Curbing such problems where they exist needs the knowledge of their existence and their possible causes. To date, there is little information available on the extent of environmental damage associated with tobacco production in local area (ECSA, 1999). This study will assist to fill the present gap by exploring the environmental impact of tobacco farming in Songea Rural district particularly on deforestation due to DFC farming and curing, soil erosion and type of biodiversity lost. The information obtained is expected to assist in estimating the environmental costs associated with dark fire tobacco of which most policy makers in developing countries tend to neglect. It is also expected that results from the study will assist the government in developing correct interventions in conserving the ecosystem and ensure environmental sustainability, which is one of the millennium development goals.

1.5. Study limitation(s)

It was the intention of this study to use Landsat imagery as one of the primary data sources to determine the extent and rate of deforestation that has taken place for the past three decades. However, in the absence of funds to purchase the imagery, it was not possible to use this source for this purpose. However, data on production trends and cropping system were used to estimate deforestation in the study area. In addition, photographs on mode of land preparation used by farmers in the study area were taken to verify the contribution of DFC farming on degradation of forest cover.

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1. Terminological appraisal

2.1.1. Miombo woodlands

Miombo woodlands is a collective term representing various genera such as *Albizia, Burkea, Dodbergia, Erythrophloem, Ostryodersis, Swartizia, Combretum, Monotes, Strychnos, Sterculia, Periocopsis, Brachystidia* and *Uapaca* (Mafupa, 2006). They are prominent genera in most tropical areas as is the case of Songea. The mentioned tree genera are very essential in providing fuel wood for curing tobacco, home use, fruits, ropes and poles for barns construction for the people in the respective areas. Because of this, Miombo woodlands in Songea district are more prone to extinction.

2.1.2. Catchment forest

Catchment forest is the hydrological unit that has been described and used as physical, biological, socio economic, political unit for planning and management of natural resource (Power *et al*., 1997). It is synonymous to watersheds. This unit plays a crucial role in supplying fuel wood, medicines, area for nursery establishment of crops such as tobacco, water for home use and irrigation for the Songea population. In addition, the catchment forests in the district serve as sources of water for a number of streams which drain their water in River Ruvuma and protect the soil from erosion. URT (1999) reported that Songea Rural district has a catchment forest area of 307 977 hectares. Since the catchment forest offers favourable environment for seedbed preparation to raise tobacco seedlings is expected that seedbed preparation for tobacco will also have enormous impact on its existence in the district.

2.1.3. Soil erosion

Reeds (1996) defined soil erosion as loss of nutrients associated with removal of a large volume of soil and organic matter that deposit on the top layers at a greater frequency. It is accelerated by among many factors, forest clearing on sloping lands to open new land for cultivation and growth of erosive crops such as tobacco. Similarly, erosion is likely to occur in Songea district since tobacco farming is a dominant cash crop in the district.

2.1.4. Environment

The term environment refers to all the living and non living things that affect the life of an individual organism or population. It includes natural (forest, air, mountains) and social surroundings (culture, norms, taboos, and global economy) (Millington, 1990). From the definition it can be noted that the word environment includes a number of variables. However, in the case of this study, the major focus was on direct forest resources.

2.1.5. Biodiversity

This is the totality of genes and species in the ecosystem. It encompasses all species of plants, animals, microorganism, the ecosystem and ecological processes of which they are part (WCMC, 1996). In this study, wildlife (animals and fish), Fungi (mushrooms), wild fruits and plants with medicinal value were used to describe type of biodiversity affected by DFC tobacco farming in the study areas. Due to the growing in demand for tobacco it is expected that more forest land will be cleared to

open way for fresh tobacco farms. This is in turn expected to result into loss of useful biodiversity in the district.

2.1.6. Food Security

FAO (2004) defined food security as the physical and economic access by all people at all times to sufficient, safe and nutritious food to meet their dietary requirement for productive and healthy life. From this definition, three pillars of food security can be identified and these include food availability, adequacy and accessibility. With maize being the main staple food in Songea district, food security refers to maize security. A household is regarded as food secure if it has at least 300kg (equivalent to three bags) of maize for adult members in that household. Being classified as a labour intensive crop, it is expected that DFC tobacco will have a great influence on food security.

2.2. History of tobacco

Tobacco originated in South America from where it was introduced into Europe and later brought to Central and East Africa by Portuguese (Ngugi *et al*., 1990). In Tanzania, tobacco, specifically dark fired was introduced in Ruvuma region in 1930 and later in Kibondo and Biharamulo districts of Kigoma and Kagera region respectively (URT, 1992). Due to adverse climatic condition and economic factors, DFC production in Biharamulo and Kibondo collapsed.

DFC tobacco was regarded as a minor crop in Songea district in 1960s. In this period, the regional government under the leadership of Edward Barongo passed a

by-law which demanded every farmer to cultivate DFC as a cash crop. Heavy punishment was imposed for those who failed to obey the by-law. The by-law proved successful in 1970s when the highest yield of 4500 tons was achieved. Statistics for production trend for other seasons showed that in 2003/04 about 4329 tons of DFC was produced compared to 4998 tons in 2004/05 (TTB, 2005). The district is now regarded as leading producer contributing about 99% of all DFC produced in the country.

Based on the above facts the need to examine the side effects of DFC tobacco on environmental resources such as forest is of paramount importance.

2.3. Significance of tobacco

2.3.1. Employment

Tobacco represents an important source of permanent jobs at both farm and local industry level (FAO, 2003; Van Liemt, 2002). In Brazil, for example, statistics showed that for the year 1999/00, the total employment generated by the industry was around 2.2 million (equivalent to 3.2% of the total workforce). The majority of the workforce (1.5 million) was employed in activities such as transportation, wholesaling and retailing, input production and distribution to agriculture and manufacturing. About 500 000 people were directly employed in tobacco production while 200 000 jobs were created in farming related activities such as curing at farm level (FAO, 2003).

Estimates from Malawi showed that more than 1 million farmers and workers were employed in the tobacco industry (also referred to as green gold) as for the year 2000

of which the majority were farmers (900 000). The remaining workforce was employed as graders (13 200), processing workers (6500), workers in the storage sector (1200), workers in the distribution sector (14 900) and 2200 workers in other tobacco related business sectors (FAO, 2003; Mwasikakata, 2003).

In Tanzania, there are so far more than 100 000 families containing more than 500 000 people who make a living from the tobacco industry (Msuya, 2006). The figure given exclude the work force employed in other tobacco related sectors such as extension officers, processing workers, workers in the distribution and storage.

In the case of Mozambique where tobacco production is incorporated with legumes, approximately 150 000 farmers were reported directly to be engaged in tobacco production in 2007 (MAM, 2007).

Statistics of employment from other part of the world for the tobacco industry as a whole, encompassing also other tobacco products other than cigarettes (although the latter is usually its main component) revealed that more than a million workers were employed in Asia (China, Indonesia and India) while about 44 459 workers were employed in Turkey, Germany and Romania respectively (Mackay, 2002). The summary of employment for other countries is given in Table 1.

Table 1: Employment trends in some selected countries

Region/Country	Workers in the cigarette manufacturing

East Africa	
Kenya	1701
Uganda	719
Southern Africa	
South Africa	3110
Zimbabwe	4290
Zambia	503
West Africa	
Burkina Faso	195
Sierra Leone	194
Cameroon	436
North Africa	
Egypt	17 469
Algeria	6096
Tunisia	3554
North America	
United States of America	27 300
Mexico	5122
Canada	4600

Source: Mackay (2002)

2.3.2. Economic role

Tobacco and its products (e.g. cigarettes) play a vital role in the economics of both developing and developed countries. The industry serves as an important source of revenue both at household and state levels through export revenue and associated taxes (FAO, 2003). In Tanzania for example, between the years 1996 to 2005, the industry contributed about 65 million US dollars, which is equivalent to 81 billions Tanzanian shillings (Msuya, 2006).

In Malawi, FAO (2003) conceded that in 1999 tobacco generated about 22 000 Kwacha per household (nearly 89% of the household cash income) which was derived from tobacco. At the state level, it generated about 12 billion kwacha as

export revenue [one third of total revenue and about 15% of the agricultural Gross Domestic Product (GDP) in the same year]. The same FAO report showed that between the years 1996 to 1998, the tobacco industry generated about 875 millions US dollars as export revenue in Zimbabwe which is nearly 10% of the country's GDP.

In respect to the contribution of the industry on government revenues from excise taxes for other countries, statistics show that between the years 1998/02, the industry contributed about 411 and 128 millions US dollars in Kenya and Uganda respectively (Obwona *et al.*, 2005). On the other hand, Mackay (2002) reported that the industry contributed about 7.37%, 2.79%, 2.43%, 3.38%, 1.15% and 0.04% for the year 1999 as tobacco excise tax revenue for countries like Brazil, China, India, Indonesia, South Africa and Zambia respectively.

Despite its contribution in the national income, tobacco farming is associated with a number of economic losses which are a consequence of health care spending. For example, Lightwood *et al*. (2003) reported that China and New Zealand lost about 6.940 billions Yuan and 0.185 billions New Zealand dollars in 1989 as a medical care costs (hospital, physician, prescription drugs and nursing home services) for treating tobacco smoking related diseases. The amount spent were equivalent to 0.43% and 0.29% of GDP respectively. The details for other countries are given in Table 2.

Table 2: Medical care costs of tobacco smoking related diseases

Country	Year of estimates	Currency type	Total attributable medical care costs in billions	% of GDP
Australia	1988	Australian dollar	0.760	0.24
Canada	1988	Canadian dollar	0.765	0.30
New Zealand	1989	New Zealand dollar	0.185	0.29
United States of America	1983	United States dollar	53.400	0.84
United Kingdom	1985	British Pound	0.497	0.13
South Africa	1985	Rand	0.129	0.10
Puerto Rico	1983	United States dollar	0.559	0.43
India	1990	Rupees	0.833	0.02
China	1989	Yuan	6.940	0.43
Venezuela	1997	Bolivares	129.000	0.30

Source: Lightwood *et al*. (2003).

A similar study done by Nassar (2003) found that Egypt lost about 545.5 millions US dollars as direct costs of treating diseases caused by tobacco use alone. Another study conducted by Barnum (1994) also estimated that when all costs of tobacco around the world are subtracted from all the benefits, the net result is a global economic loss of 200 billions US dollars each year. He also estimated that for every additional thousands tones of consumption, 650 additional pre mature deaths will occur and the world economy will suffer a further economic of loss of 27.2 millions US dollars. Such estimates could apply to Tanzania too and this makes this study for Songea of paramount importance especially in recognition of the fact that such estimates have not been given before.

Regarding economic losses resulting from cost of fires caused by tobacco smoking Mackay (2002) reported annual losses of 2.7 billions US dollars worldwide. Other economic losses include environmental costs ranging from deforestation to collection of smokers litters.

2.3.3. Agricultural importance of tobacco

Tobacco and its extract play a significant agricultural role in various ways. For example, Ngugi *et al.* (1990) reported that low grade leaf, stalks, stems are used as fertilizers supplying essential plant nutrients such as Nitrogen, Potassium and Phosphorus crucial for plant growth.

In addition, the nicotine content contained in industrial remains of leaves and other parts plays a significant role in the production of cost effective insecticides known as Nicotine Sulphate. The insecticide is usually diluted in water and applied as a spray. The chemical is known to be an effective exterminator of germs such as aphids, whiteflies, leaf hoppers, thrips and mites without secondary negative effects on the environment and health compared to insecticides of chemical synthesis (Buss, 2002).

The insect pests are known to serve as vector for various diseases causing organism such as Groundnuts Rosette Virus transmitted by (Aphids) *Aphis crassivora* and Maize Streak Virus transmitted by (Maize leafhoppers) (Ngugi *et al.*, 1990). All the mentioned insect pests can be managed below economic injury level using nicotine derived from tobacco extracts. However, great care should be taken into

consideration when using tobacco extracts in dust form as insecticides or fertilizers since they are known to cause skin irritation.

2.3.4. Cultural importance of tobacco

Tobacco has been used by many North American and Indian tribe for various cultural aspects such as religious ceremony. NTRHI (2007) reported that the North American and Indian tribes use tobacco for communication with Mother Earth spirit, thanking the Creator, sealing peace with the enemies. In addition, the crop is used in praying for good harvest of better fish catch, payment to the Healer and welcome guests. The above mentioned tribes used to place tobacco leaves on ground, water or sacred places as offerings. Many of these uses do not include any burning of leaves at all. For these societies, tobacco use in the form of smoking, chewing as snuffs was regarded as non religious.

However, after the coming of Europeans the non-religious (also known as recreational) use such as smoking became more common. Currently recreational use of tobacco has overpowered the religious use where by two out of three people were reported to prefer using tobacco for recreational purposes (NTRHI, 2007).

2.3.5. Medicinal use of tobacco

Tobacco is also regarded as a crucial plant with medicinal value. This is evidenced by Mackay (2002) and NTRHI (2007) who have reported that the early American Indians used it for curing wounds, snake bites swelling, coughs, tooth ache, treatment of insect bites and stomach disorders. However, detailed studies need to be done to

examine if the use of tobacco as medicine has any negative physiological implication in human beings, which is possible with the current level of technology.

2.4. Environmental impacts of tobacco and its related products

2.4.1. Deforestation

Tobacco and its products are blamed for environmental degradation in a number of ways. First is the deforestation resulting from the use of fuelwood for curing purposes. For example, Geist (1999) found that in 1990/95 flue tobacco curing alone contributed to the loss of 15.9% and 45% of natural forests in Zimbabwe and South Korea respectively. Statistics for the other countries are given in Table 3.

Table 3: Contribution of flue cured tobacco on deforestation

Country	Deforestation in percent
South Korea	45.0
Uruguay	40.6
Bangladesh	30.6
Malawi	26.1
Jordan	25.2
Pakistan	19.0
Syria	18.2
China	17.8
Zimbabwe	15.9
Tanzania	-

Source: Geist (1999)

In Tanzania, Chenje and Johnson (1994) reported that about 13 000 hectares of forest trees are lost only for curing flue without considering fire cured tobacco. This study is expected to fill this information gap concerning the contribution of dark fired tobacco (curing and land preparation) on deforestation which is one of the parameter to be assessed.

Apart from curing, additional pressure on forests comes from fires caused by careless use of tobacco related products such as cigarettes. For example, MacKay (2002) reported that in 1987 China lost about 1.3 million hectares of forest land. The incidence was categorized as the World's worst forest fires caused by cigarettes which claimed 300 lives while rendering 5000 people homeless.

The use of paper associated with wrapping, packaging, and advertising cigarettes also adds another dimension on deforestation of forest land. Being wrapped in paper and sold in packs, cigarettes are voracious users of paper and paperboard. According to Chapman (1994), paper part comprises approximately 5% of the weight of a typical cigarette which on average is 1.3gm. In 1992/94 respectively, some 7 009 562 million tones of paper were used in cigarette wrapping which is equivalent to 778 840 222 mature trees in the African savannah. The conversion has been made from IFSC (International Forest Sciences Consultancy) report which suggests that an average mature tree in the African savannah has a volume of $0.12m^3$ and weighs about 0.090 tones.

FAO (1992) cited by Mgurusi (1994) reported that deforestation has profound effects on the environment through loss of biodiversity and decrease in water balance in catchment forest. For example, Munishi and Temu (2005) found that the encroachment of tobacco farmers on the Muswina and Iyondo Forest Reserve in Ileje-Mbeya by tobacco growers could also be the contributing factor on the reduction of water volume in the Great Ruaha River.

In addition, deforestation intensifies the process of soil erosion and overall rainfall pattern in a given area. For instance, since 1991, the average annual rainfall in Kahama district has changed dramatically due to progressive reduction of forest cover caused by population pressure and need for more land in tobacco farming (Missana, 1999).

2.4.2. Pollution

Tobacco is a sensitive plant prone to many pests and diseases. Consequently, huge amounts of herbicide and pesticides are used in the production of the tobacco crop to get rid of pests. PAN (1998) documented that over 5.5 million pounds of methyl bromide (an ozone-depleting and a toxic contaminant of groundwater chemical commonly used to fumigate the soil prior to planting tobacco seedlings) were applied to tobacco fields worldwide in 1997. The effects of most pesticides are not generally monitored but it is known that they leach into the soil and find their way into streams, rivers, and food chains.

The other forms of pollutants from tobacco and its related products (cigarettes) are cigarettes smoke (smoke contains chemicals, which are carcinogens, irritants and toxic gases) and pollution due to cigarettes related litter. Traces of heavy metals in fertilizers such as Cadmium and Chromium, Phosphates, Nitrates, (substance known to cause eutrophication of water bodies) are also other forms of pollutants resulting from the intensive use of fertilizers. Bond (1996) reported that these chemicals also have cementing effects on the soil making it to be more compact.

The ill effect of compaction is that it reduces biological activity in the soil making air less available to plants and microorganisms too. The other pollutant is carbon dioxide which results from burning of fuel to cure tobacco leading to global warming.

2.5. Other impacts of tobacco and its related products

2.5.1. Health impact

Worldwide, tobacco is one of the most important causes of disability, sufferings and pre-mature deaths. More than 4000 chemicals have been identified in cigarette smoke (key tobacco product). Many are poisonous and some are radioactive. More than 40 are known to be carcinogenic and cause physiological and psychological addictions. Undesirable chemicals in cigarette smoke include carbon monoxide, nicotine, hydrogen cyanide and heavy metals such as lead. Currently, tobacco kills 1 in 10 adults. By the year 2030, it is expected to kill 1 in 6 adults or more than 10 millions a year (Crofton, 2002). WHO (2004) reported that in 1995/99 alone, tobacco use accounted for 444 000 premature deaths in United States of America.

With respect to Tanzania, report from the Tanzania Tobacco Control Forum revealed that 60 percent of deaths recorded in hospitals in areas where tobacco is grown are due to tobacco (Shekighenda, 2006). Apart from health consequences, the use of tobacco and its related products can yellow fingers, cause green tobacco sickness (caused by the absorption of nicotine through the skin from contact with wet tobacco leaves), yellow teeth, speed the onset of facial wrinkles and make kissing a smoker taste like kissing an ashtray (Cunningham, 1996).

2.5.2. Food security

Tobacco farming impacts on food security in several ways. These include loss of time which can be used to grow food crops since tobacco is regarded as a labour intensive crop, loss of money which is used to buy tobacco products instead of food and less land for cultivation particularly in countries with limited land areas (Peters and Herrera, 1986; Cunningham, 1996; WHO, 2004; Mackay, 2002 and Shekighenda, 2006). According to China Daily Press (1994) cited by Cunningham (1996) amount of land used to grow tobacco was enough to feed 50 millions people in 1994.

Regarding the influence of cost incurred on smoking tobacco products (cigarettes) on food security, WHO (2004) found that the cost of consuming tobacco product such as five cigarettes in a day by someone in poor household in Bangladesh could lead to a monthly dietary deficit of approximately 8000 calories for that household.

Another study by Mackay (2002) on the effect of tobacco on food security found that the cost of consuming a pack of Marlboro or equivalent international brand will buy 1.5 kg of cucumber in Georgia, a dozen eggs in Panama, a dozen coconuts in Papua New Guinea, one kilogram of fish in France, Ghana or Moldova and six kilograms of rice in Bangladesh. A similar study by WB (2003) reported that in 2002 alone a household in China spent 17 percent of its income to buy tobacco products. All this can make a very substantial contribution in combating food insecurity.

Higher tobacco input prices due to market liberalization coupled with poor contracts between tobacco industries and farmers has led to poor returns that can assist farmers to buy food crops. Based on the experience from other countries, it is expected that the same situation is occurring in Songea. However, precise answer of what is happening can be obtained through research.

CHAPTER THREE

3.0. METHODOLOGY

3.1. Description of the study area

Songea district (before splitting into Songea Rural and Namtumbo districts) is located between latitudes 9° 15′ and 11°45′ South of Equator and longitudes 35° 5 and 37° 5′ East of Greenwich. The Republic of Mozambique borders the district to the South, Tunduru district to the east, Mbinga district to the west, Ulanga and Njombe districts to the north (URT, 1999). The district has a total land area of 33 825 km² of which 12 491 km² is arable land and forest reserve constitutes 21 334 km².

The district has a total population of 232 781 people mainly Ngoni and Ndendeule tribes dominating the district accounting to 95% of the total population. The remaining portion includes Bena, Yao, Nindi, Matengo and others (URT, 2003).

The predominant climatic feature of the district is one long rain season occurring between November and May. Annual average rainfall ranges between 800mm and 1200mm (URT, 1999). However, based on statistics from the District Council in recent years, the rainfall trend has shown a downward trend with deforestation related to tobacco thought to be the primary factor for such trend. The rainfall pattern for the district is summarized in Fig. 1.

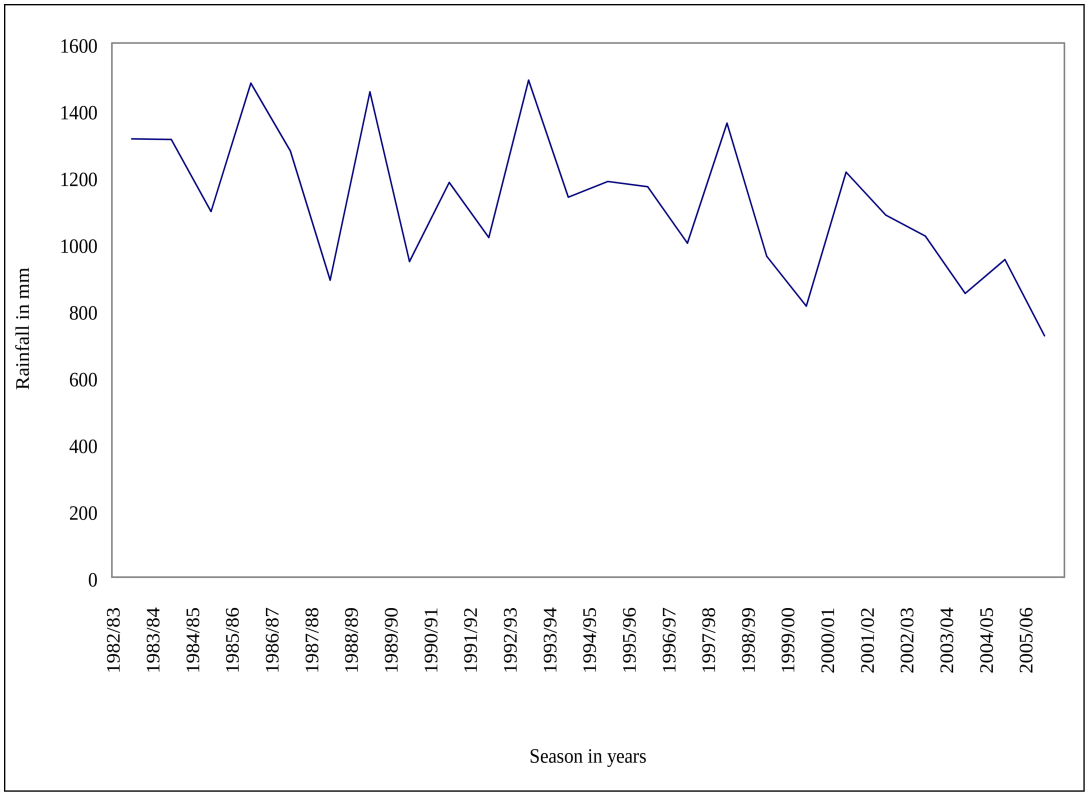

Figure 1: Rainfall pattern in Songea rural district

Source: SDC (2006)

With respect to temperature, it ranges between 20°C to 25°C (daytime) and during the night temperatures range between 15°C to 17°C with altitude being the main factor influencing it. Based on altitude, the district is divided into intermediate and highland zone. Intermediate zone ranges between 600-1000 meters above sea level while that of highland ranges between 1200-1800 meters above sea level. The other details such as road networks, wards, and villages of Songea district are as shown in Appendix 4.

3.2. Sampling procedure

Purposive area sampling was used to obtain four representative villages cultivating tobacco for data collection. The villages include Muungano-Zomba, Morogoro, Kumbara and Nahoro. To obtain respondents/tobacco farmers from each village, simple random probability method was used.

3.3. Sample size

For statistical analysis, a sample size of 120 respondents/tobacco growers (each village among four contributing 30 randomly selected tobacco growers) was used to obtain information required in the study. Bailey (1994) reported that for studies in which statistical analysis is to be done, a sample of 30 is required regardless of population size. For this reason, a sample size of 30 respondents from each village was included in this study. In addition, District Forest Officer, Agronomy Officer and Tanzanian Tobacco Board staff-Songea branch were included in the study.

3.3. Data collection methods

Primary data were collected from the household survey using structured interviews to obtain information on the tree species preffered mostly for the curing of tobacco crop, size of watersheds destroyed due to nursery establishment and soil erosion problem. Comprehensive field survey supported with photos particularly on watersheds areas was done. Participatory approaches such as FGD with key informants (farmers with more than 10 years of tobacco growing experience and forest officers) was employed to gain the detailed understanding of farmer’s views on biodiversity loss. Data on fuelwood consumption and production trends from TTB

were used to estimate the total forest area cleared so far due to dark fire tobacco production. Information from Sokoine National Agricultural university library on the rate of soil erosion caused by various field crops particularly tobacco were aslo empolyed to estimate soil erosion (soil and nutrient loss due to dark fired tobacco) in the district.

3.4. Data analysis

Informations obtained from the study were processed using Ms Excel and analysed using SPSS. Results were summarised and presented both qualitatively and quantitatively using frequencies, tables, graphs and charts to verify the environmnetal impact of dark fired cured tobacco in the district.

CHAPTER FOUR

4.0. RESULTS AND DISCUSSION

4.1. Socio economic profile of respondents

4.1. 1. Distribution of respondents by sex

The cross-sectional sample of 120 subsistence tobacco farmers was collected from four villages in Songea district. It was found that about 97.5% of respondents were males (Fig. 2).

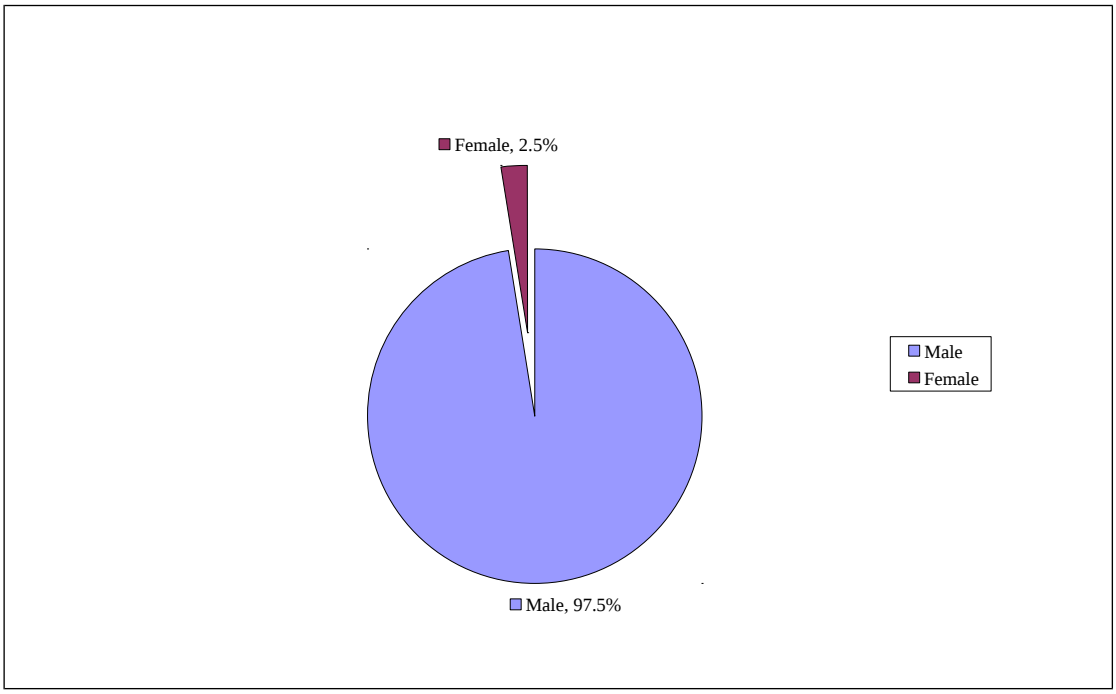

Figure 2: Distribution of respondents by sex

The dominance of males in the research area reflects the persistence of patriarchy community where men are found to be heads of households dominating the decision making process. On the other hand, the proportion of female individuals was 2.5% (Fig. 2). Low response of female in tobacco cultivation is thought to be due to the nature of physical work involved in tobacco farming such as cutting trees using axes,

carrying trees on shoulders and tedious work of curing. As a result, women find it difficult to participate in this type of agriculture. In addition, heavy load of domestic work such taking care of children, fetching water and searching of firewood are also thought to be responsible for the low involvement of women in tobacco farming compared to the male counterparts.

Regarding the influence of sex on environmental degradation, Fisher and Shively (2000) found that there is a positive relation between adult male labor and forest degrading occupation. Based on this observation, it is believed that male counterparts in the study areas will have a greater influence on the degradation of environmental resources such as forest compared to female counterparts. Land clearing is generally a male specific task in the study area.

4.1.2. Distribution of respondents by education level

Fig. 3: reveals that more than half of all farmers in the study areas have received primary education (74.2%). The implementation of the Universal Primary Education of 1970s all over the country and involvement of missionaries in primary school support projects may explain why the proportions of individuals with primary education in the study areas are high. On the other hand, 15.0%, 10.0% and 0.8% of the respondents reported having non-formal, adult and catechist education respectively (Fig. 3). High school fees and poor infrastructures to support other forms of education could be the

major reasons for low proportion of individuals with other forms of education.

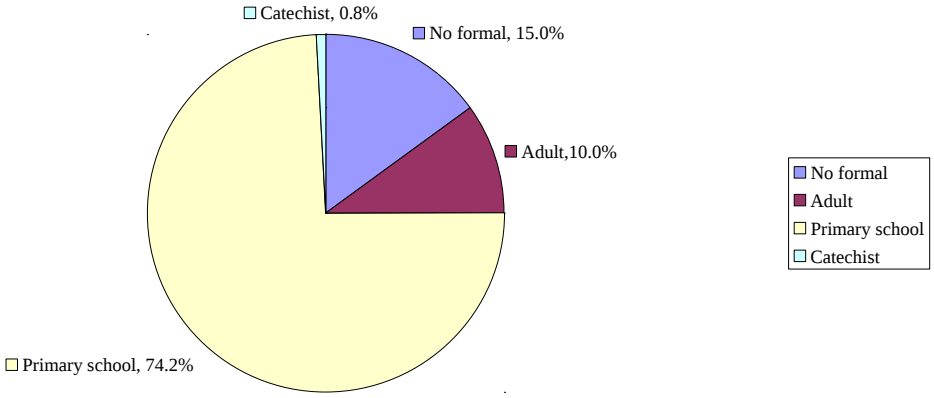

Figure 3: Distribution of respondents by education level

Education is an important socio economic variable influencing the choice of economic activities to support livelihood. For example, Aryal (2002) reported that individuals with low education always tend to engage in on farm activities compared to educated ones who generally prefer white-collar jobs. This probably may hold true in the study villages where individuals with primary education dominated tobacco farming.

Regarding the influence of education on degradation of environmental resources such as forest, Kahyarara *et al*. (2002)

acknowledged that individual with low literacy low tend to utilize environmentally degrading farming techniques such as shifting cultivation. Relatively many farmers (98.6%) in the study areas were found to practice shifting cultivation of which this study found to contribute in destroying the natural forest of Songea district.

4.1.3. Distribution of respondents by marital status

It was found that the majority of the respondents were married (98.3%) compared to 0.8% of the respondents who were divorced and single (Fig. 4). The need for enough earnings to sustain family members and availability of family labour might have contributed to the involvement of large proportion of married farmers in tobacco cultivation compared to the single farmers who are rarely pressurised by family responsibilities. Nypan (1991) reported that marriage can offer a solution to possible hardship in life especially for most women

The presence of small proportion of divorced individual suggests that household based violence in the district is minimal.

Since the majority of respondents are of married there is a great potential of population growth in future and consequently accelerated conversion of environmental resources such as forest into farmland to support both cash and food crops production. DTU (2003) reported that rapid population increase exerts more

pressure for expansion of cultivation into forest land in search for virgin territories.

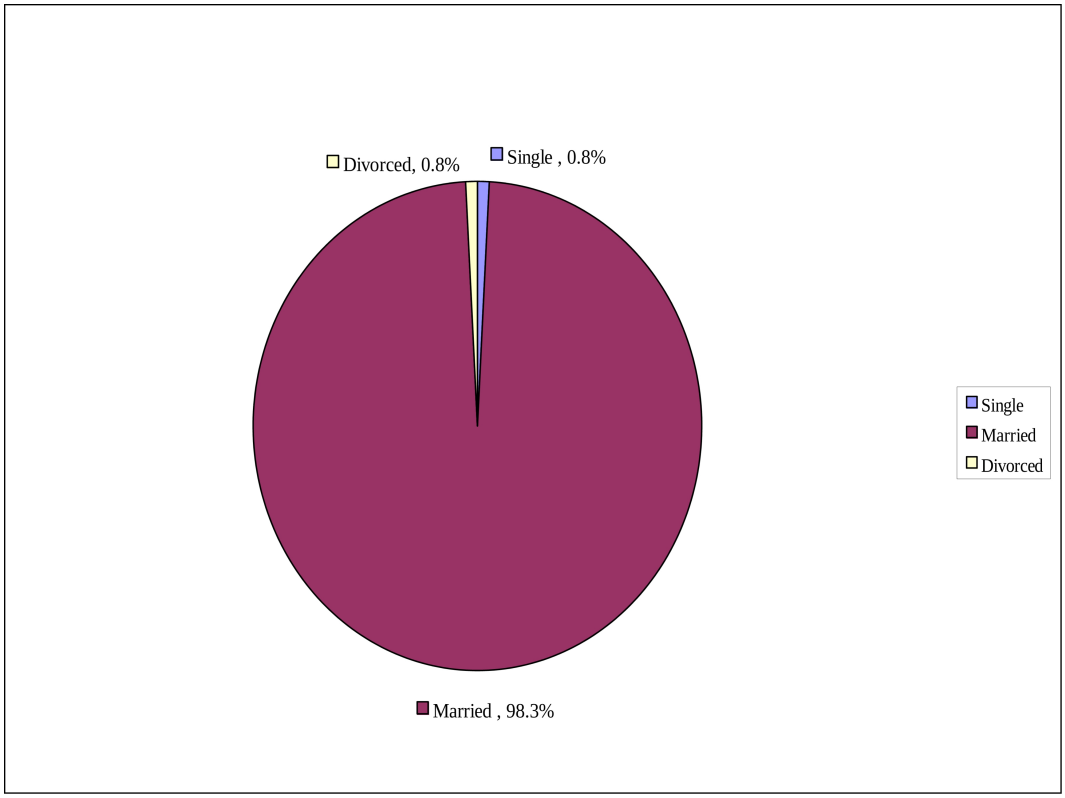

Figure 4: Distribution of respondents by marital status

4.1.4. Distribution of respondents based on age group

Results on the distribution of respondents based on age group are shown in Fig. 5. It was found that respondents with the ages of between 15 to 60 years dominated tobacco farming in the study area totaling more than 85% of all age groups found in the study area. This group is regarded as energetic and economically active to carry

out difficult work such as tobacco farming compared to elders while respondents with 61 years and above was 13.3% only (Fig. 5). It is believed that the reason behind the involvement of a small proportion of age group of 61 years and above in tobacco cultivation may be similar to the one documented by Kalamata (2006) who reported that advancement in age above 64 years reduces body strength to engage in labour intensive farming activities like tobacco farming leading to retirement from active physical works.

The dominance of young and energetic respondents in the study area on DFC farming is expected to have enormous impact on the depletion of natural forest to support tobacco farming compared to the aged who are thought to be not strong enough to do tedious work such as land clearing. On the other hand, young individuals can be more useful if conservation program such as tree planting is introduced in the study areas compared to elders. Generally, elder participation in conservation program is minimum compared to the youth (Kangalawe, 1995).

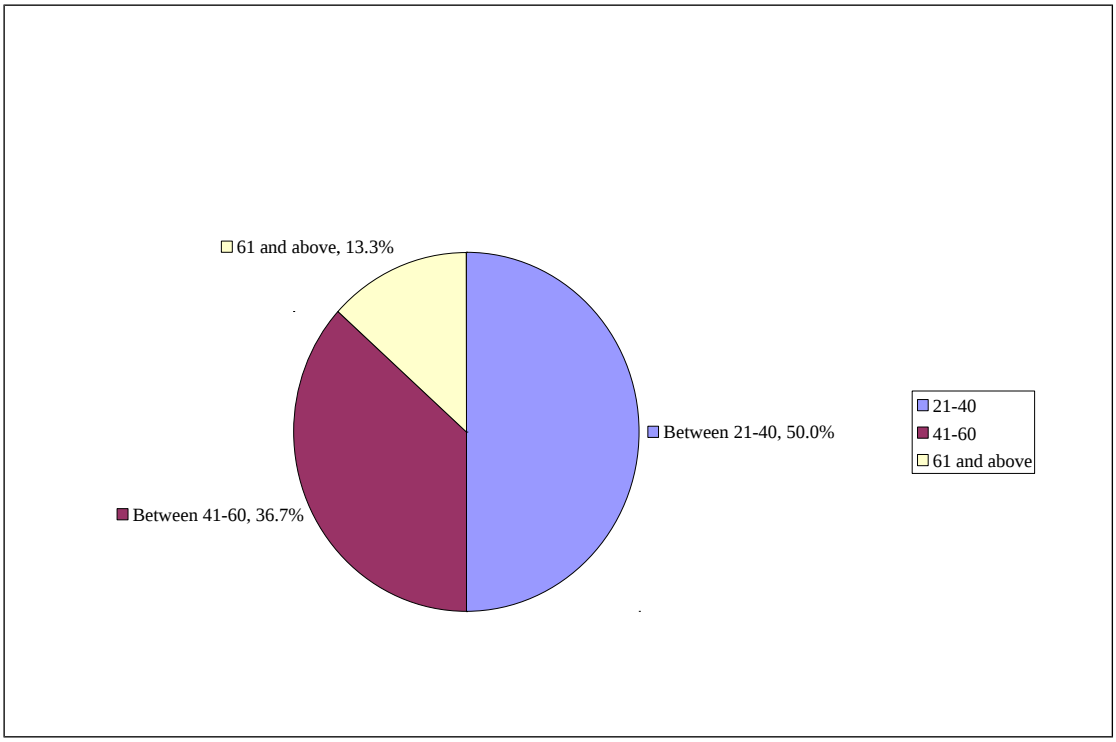

Figure 5: Distribution of respondents by age

4.1.5. Distribution of respondents based on growing experience

The study showed that 56.8% of the respondents were regular growers of dark fired tobacco. This group reported growing dark fired tobacco for about nine to forty four years. The remaining respondents (43.2%) reported growing the crop for about less than eight years (Fig. 6). Mkanta and Chimtembo (2002) found that this high rate of depletion of natural forest in Urambo district among other factors was the result of larger proportion (63%) of regular flue cured tobacco growers. The same (high rates of forest depletion) is expected to happen in Songea district where by more than half of the respondents (56.8%) interviewed were reported to be regular DFC growers.

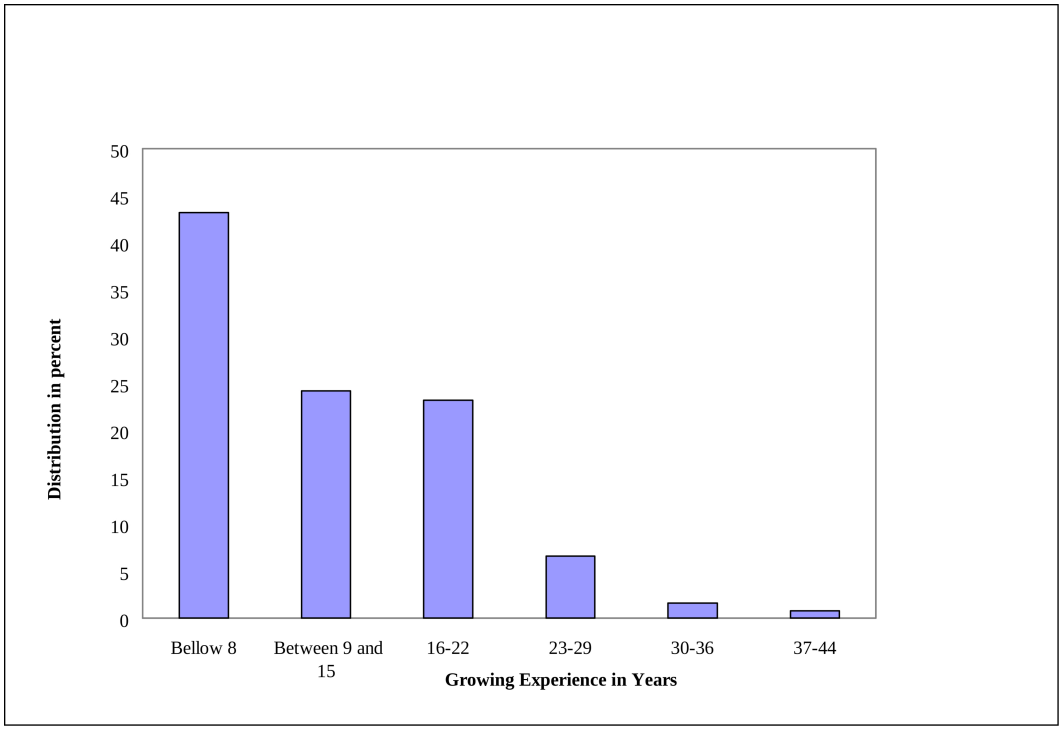

Figure 6: Distribution of respondents based on growing experience

It is believed that lack of other reliable permanent cash crop that could be used as a source of household income might be a contributing factor for the over-dependence of a large proportion of farmers on tobacco cultivation in the study areas. In addition, the provision of inputs such as fertilizers and pesticides that can also be used in food crops production such as maize and rice could be another reason for having a large proportion of regular tobacco growers in the districts.

4.2. Tree species used in curing dark fired tobacco

The details on the type of tree species commonly used in curing dark fired tobacco in Songea district is given in Table 4.

Table 4: Tree species commonly used in dark fire tobacco curing

No	Local name	Scientific name

1	Misuku	*Uapaka kirkiana*
2	Mchenga	*Strychnos innocua*
3	Mheveheve	*Erythrina abyssinica*
4	Mtopetope	*Anonas spp*
5	Mkohozi	*Syzigium guineense*
6	Mbuni	*Parinari curatellifolia*
7	Msegesi	*Piliostigma thonningii*
8	Mnyonyo	*Syzygium cordatum*
9	Mng'eng'e	*Paurosa spp*
10	Mitumbitumbi	*Cussonea kirkii*
11	Mtumbati	*Pterocarpus spp*
12	Mtetereka	*Faurea robusta*
13	Misederera	*Cedral toona/odorata*
14	Miombo	*Brachystidia spp*
13	Mwembe	*Mangifera indica*

It was found that not all tree species found in the forest land are used for tobacco curing. Generally people prefer species such as *Uapaka kirkiana, Strychnos innocua, Erythrina abyssinica, Anonas spp, Syzigium guineense, Piliostigma thonningii* and *Syzygium cordatum.* Other species used are *Cussonea kirkii, Faurea robusta, Pterocarpus spp* and *Paurosa spp.*

Despite their role as the main fuel wood used in the study areas for curing purposes, the first eight species are also used as sources of wild fruits. Ruffo (2002) has further classified some of the mentioned tree species above as plants with medicinal value. These include *Anonas spp* which is used in treating sterility and dysentery, ashes from *Piliostigma thonningii* leaves are used to hasten healing of snake bites. Other species with medicinal value are *Strychnos innocua* whose root part is used to treat sexually transmitted diseases, *Uapaka kirkiana* roots decoction is used as a remedy for ingestion and intestinal problems.

Various reasons were given by respondents for selection of the mentioned tree species above. The majority of the respondents (68.3%) reported that the tree species give enough smoke which determines the aroma of final cured leaves, a key necessary requirement during marketing of leaves. Kenya's Ministry of Economic Planning, Economic Review of Agriculture Report (1977) cited in Chacha (1999) reported the same reason as to explain why farmers in Kenya prefer using indigenous tree species in curing tobacco instead of exotic trees which give unwanted smell.

The response from other farmers showed about 13% prefer the mentioned tree species because they are responsible for the production of the chocolate color on the leaves, another key criterion used in quality assessment. Few respondents (0.8%) reported the influence of modal farmers and extension officer as major reason for the choice of the selected tree species respectively (Table 5).

Table 5: Reasons for selection of mentioned tree species for curing purpose

Reason	Frequency	Percent
Give enough smoke	82	68.3
Recommended by extension officer	3	2.5
Give good taste on leaves	2	1.7
Give enough smoke and produce chocolate color on leaves	16	13.3
Give enough smoke and has high moisture content	2	1.7
Give enough smoke and taste on leaves	6	5.0
Give enough smoke, good taste and advice from VEO	1	0.8
Tradition	1	0.8

Give enough smoke and influence of nearby farmer	1	0.8
Give enough smoke, good chocolate color and odor	5	4.2
Influenced by modal farmer	1	0.8
Total	**120**	**100.0**

The over-utilization of the mentioned tree species in curing process has resulted into a number of problems among households in the study area. Results from individual household interview revealed that it was very difficult to find fuel wood from the nearby forest for curing purpose (Table 6).

Table 6: State of availability of tree species commonly used for curing

State of availability	Frequency	Percent
Difficult to find	109	90.8
Easily available	11	9.2
Total	**120**	**100.0**

Furthermore, it was reported that due to the inadequate availability of the required tree species, farmers are forced to walk long distances to procure the required tree species. In general, this has resulted into a decrease in working hours because farmers spend more than two hours travelling from their homesteads to their farms everyday. A similar situation has also been reported by Missana (1999) in Kahama district. Due to this, tobacco farmers have been forced to establish tobacco farms near the sources of these tree species (Fig. 7). It was also reported that farmers who

can hire a tractor to collect the required fuel wood have maintained their tobacco farms close to homesteads and village centres.

Figure 7: Tobacco farm established near the forest for easy access of fuel wood in Nahoro village

The scarcity of fuel wood has also resulted in the emergence of another production costs which farmers never experienced before. This is the cost of hiring means of transport for carrying fuel wood for curing purposes. During the survey, one farmer in Morogoro village reported to have spent 10 000 Tshs for transporting firewood from Nakahuga village which is about four kilometers away from his farm. This puts another burden to resource-poor farmers in the area. If this situation persist in the area without interventions it will be very difficult for farmers in the area to escape from poverty menace.

Results from FDG also revealed that farmers have gone to the extent of utilizing fruit trees such as *Mangifera indica* for curing purposes as a coping strategy. The findings correspond to those found by Sempebwa (2002) who reported that tobacco farmers in Arua district (Uganda) have gone to the extent of cutting citrus trees for curing purposes. Utilization of these fruit tree which serve as a source of Vitamin C is expected to result into nutritional disorders particularly to vulnerable groups such as children in the near future. Correcting these disorders will require a farmer in the study area to spend another shilling for taking care of sick children.

Cedral toona/odorata, another tree species commonly used for timber production were also discovered to be used by tobacco farmers in the study area as one of the coping strategy to curb fuel wood scarcity for curing purposes. The tree species is commonly used for making furniture in the district hence reducing the over-reliance of the tobacco farmers on natural trees for timber. If this situation is left unchecked, residents in the study area will be subjected to additional timber transport costs from other areas.

4.3. Deforestation due to tobacco production and curing

Information obtained from ATTT agronomy department concerning fuel wood requirements was used to estimate deforestation due to DFC curing. It was found that a fire cured tobacco smallholder farmer in Songea district consumes 7.5m^3 of firewood per year per hectare only for curing purposes.

Using 7.5m^3 of fuel wood per year per hectare and the area under tobacco cultivation for the period between 1973 and 2006 as base, it is estimated that 2 118 307.5m^3 of

trees from natural forest have been decimated to support DFC curing. If converted into actual area 2 118 307.5m³ is equivalent to 52 957.7ha. Findings from Bosesn and Mohele (1979) and Mzava (1981) who reported that one hectare of forest land is equivalent to between 40m³- 50m³ of fuel wood were used to convert the given volume into actual area. Details of annual fuel wood consumption for DFC curing are shown in Fig. 8.

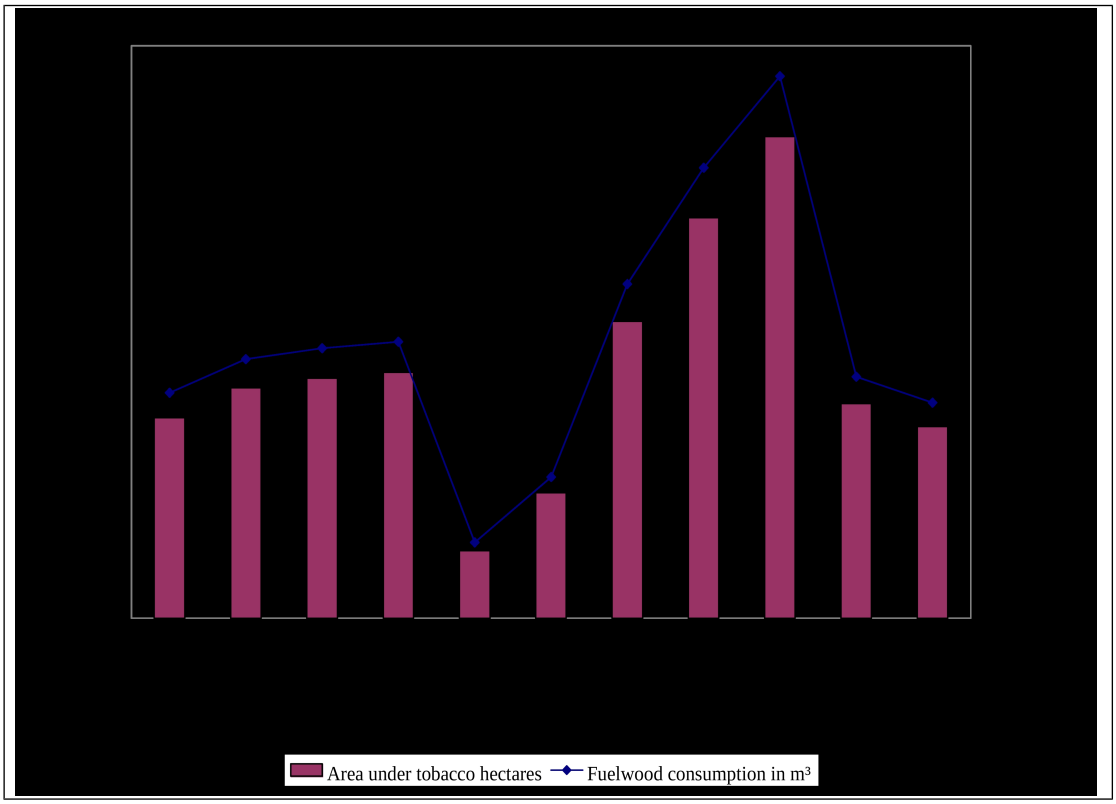

Figure 8: Estimation of Fuel wood consumption for curing dark fire tobacco

According to UN (1993), an individual farmer requires 1m³-2 m³ of fuel wood per year or 5m³ -7m³ per household per year for domestic use. If converted into energy requirement for domestic consumption, 2 118 307.5m³ is sufficient to provide fuel

wood for cooking and other domestic consumption to 106 003 regular homelets currently available in the study area in 3 to 4 years.

Evidence from other regions in the country where tobacco farming rely on tropical forest show that nearly 1 684 491m³ of fuel wood equivalent to 41 922 hectares or 419km² (Table 7) were depleted to support curing of flue tobacco in Tabora region since 1985/95 (Mkanta and Chimtembo, 2002). The fuel wood mainly came from *Pterocarpus angolensis, Jubernadia globiflora*, *Brachystidia* and *Boehmii spp*, tree species which have a regeneration period ranging from 30-50 years.

Table 7: Tobacco production, fuelwood consumption and estimated forest cleared in Tabora region

Year/season	Tobacco production in kg	Estimated fuel wood consumption (m³)	Estimated area cleared in hectares
1985/86	9 672 764.00	173 529.38	4 338.33
1986/87	6 613 252.00	118 641.74	2 966.04
1987/88	6 176 310.00	110 803.00	2 770.10
1988/89	5 640 292.00	101 186.83	2 259.70
1989/90	4 632 817.00	83 112.74	2 077.82
1990/91	5 961 349.00	106 946.60	2 673.67
1991/92	12 122 903.00	217 484.87	5 537.12
1992/93	14,443 381.00	259 114.25	6 477.86
1993/94	11 499 472.50	206 300.52	5 157.50
1994/95	17 133 300.00	307 371.40	7 664.29
Total	**93 895 840.50**	**1 684 491.33**	**41 922.43**

Source: Mkanta and Chimtembo (2002)

Statistics for Iringa, another major tobacco producing region in Tanzania show that more than 20 000m³ of highly calorific value Miombo are used to cure tobacco annually (Mallango, 2001).

In comparison with other countries, Bayego (1994) reported that more than 60 000m³ mostly from the gazetted forests were used to cure tobacco in Uganda's West Nile region. Curing tobacco alone by estates in Malawi consume 56 329.5m³ of woodland per annum, the fuel wood being mainly from the Miombo forest (EASD, 1998). A similar study by Geist (1999) on the global assessment of deforestation related to tobacco curing in Southern Malawi showed that several hundred hectares of natural woodland were cleared in a wood energy project funded by the World Bank to provide fuel wood to cure tobacco to the nearby tobacco farms in Southern Malawi. The area under the project was the environmentally critical watershed zone of the East African Rift Valley (Fig. 9).

Figure 9: Deforestation due to tobacco in Southern Malawi
Source: Geist (1997)

With regard to India, WB (1997) reported that tobacco curing and manufacture of cigarettes and other smoking consumables, has degraded 680km² of scrub forests, or

nearly 868 million tones of wood (220 million tones of construction quality wood and 668 million tones of fuelwood). In calorific terms, the wood energy lost is enough to run a thermal power plant to provide electricity to Delhi and western Uttar Pradesh for an entire year.

Massive forest clearance for cultivation of dark fired tobacco was discovered to put an additional strain on natural forest in the district. The majority of farmers (98.3%) cultivate virgin land each year on a shifting cultivation basis while 1.7% of farmers reported practicing rotational farming (Table 8)**.**

Table 8: Type of cropping system practiced in dark fired tobacco production

Cropping system	Frequency	Percent
Shifting cultivation	118	98.3
Rotational	2	1.7
Total	**120**	**100.0**

When asked why they practiced shifting cultivation, the majority of the farmers (70%) responded that search for fertile land was the major reason. Farmers believe that tobacco planted on virgin land gives the best results at a lower fertilizer application rate than the one which was optimal for tobacco grown after fallowing. Similar response was also given by tobacco farmers in Uganda who believed that to reap a bumper harvest of tobacco, virgin land is needed yearly (Aryal, 2002).

Timberlake (1985) reported that in order avoid pests and diseases farmers were forced to practice shifting cultivation in Sub-Saharan countries growing tobacco. Similar reason was reported by 5% of all tobacco farmers interviewed in the study

areas. Farmers reported that it is very expensive to buy all the necessary pesticides required to get rid of insect pests in tobacco production. Thus, in order to cut down production costs resulting from use of pesticides, the growing area is abandoned after one year. Few farmers (1.7%) reported that it was the traditional way of farming. The remainder of the farmers gave multiple responses (Table 9). The common pests attacking the crop are nematodes attacking roots, Aphids which attack seedlings during germination, ants and termites which carry off ungerminated seeds.

Table 9: Reasons for practicing shifting cultivation

Reasons	Frequency	Percent
Traditional way of farming	2	1.7
Search for fertile land	84	70.0
Advised by extension officer	3	2.5
Escape from pests and diseases	6	5.0
Search for fertile land and extension officer advice	1	0.8
Search for fertile land, easy weeding and escape from pests	1	0.8
Traditional way of farming, escape from pests and search for fertile land	1	0.8
Escape from pests and search for fertile land	20	16.7
No response	2	1.7
Total	**120**	**100.0**

Based on the above information and production trends, it is estimated that for the period between 1973/74 to 2005/06 about 282 441 hectares (or annual average of

8558 hectares) of natural forest trees were cut down to open new area for cultivating DFC without considering catchment forest in Songea districts (Fig. 10). The average annual clearance of the land exceeds that of the catchment forest of neighbouring Ludewa district by 1054 hectares which is made up of a forest area of 7504 hectares (URT, 2002).

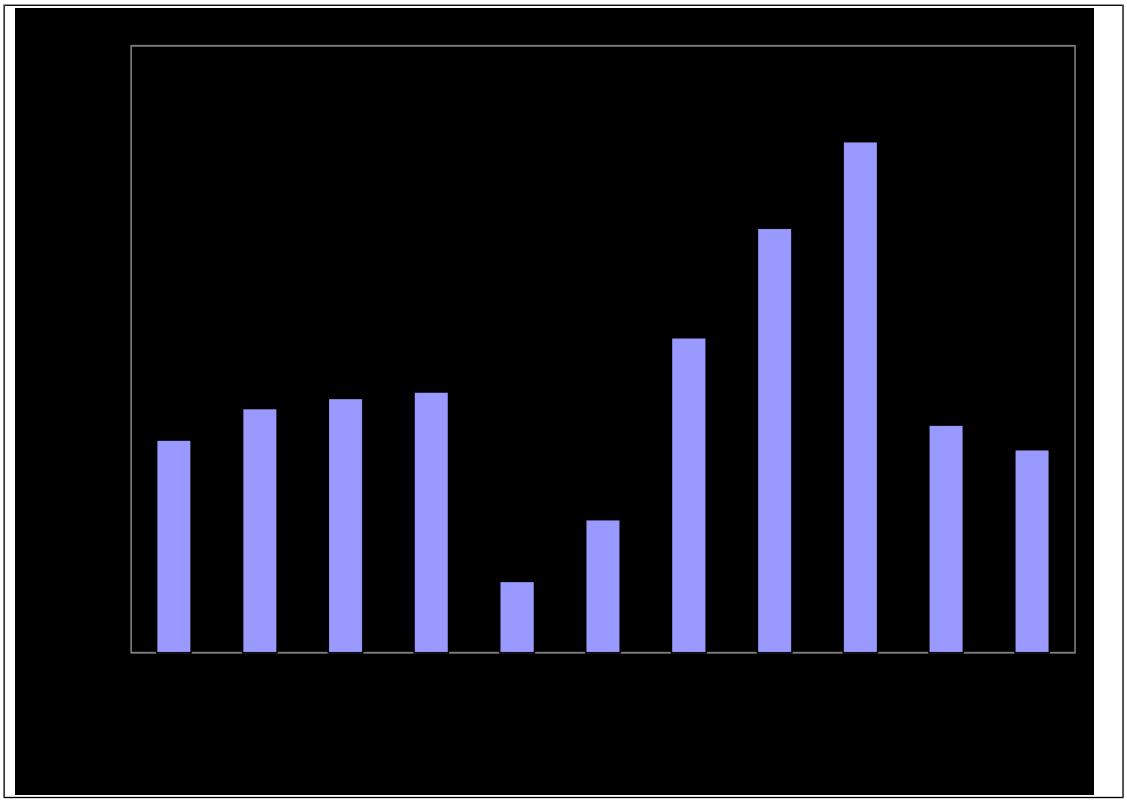

Figure 10: Estimates of forest area cleared for tobacco cultivation

The study also found that the practice of shifting cultivation is still rapidly depleting tree stocks to obtain new land for tobacco farming (Fig.11 and 12). A similar situation was observed by Mnkabenga (2001) on the impact of shifting cultivation and its implication on sustainable use of land resource in Manyoni district.

Figure 11: Forestland cleared for tobacco farming in Muungano-Zomba village

Figure 12: Forest land cleared for tobacco farming in Morogoro village

The catchment forest despite being mentioned in the National Forest Policy of 1998 to be an important area which need to be protected, has been shown to be heavily threatened by dark fired tobacco production particularly seedbed preparation.

Figure 13: Catchment forest depleted for tobacco seedbed preparation in Songea district

In the survey conducted in the district, it was revealed that about 96.7% of farmers establish nursery around the catchment forests to access water for irrigation. Land preparation involves both clearing of trees around the area intended to establish the nursery and the trees are then used for soil sterilization to get rid of soil borne disease-causing organisms such as *Meloidogyne spp*, which attacks the roots of tobacco seedlings. Few respondents (3.3%) reported preparing nurseries on open land but obtain firewood from the natural forest for soil sterilization. Farmers' responses on the choice of area for nursery establishment and mode of land preparation are shown in the Table 10.

Table 10: Choice of area for nursery establishment and mode of land preparation

Area used to establish nursery	Frequency	Percent
Near the catchment with total clearance of trees	116	96.7
Open land with no clearance	4	3.3
Total	**120**	**100.0**

According to ATTT (2005), four seedbeds with the dimension of 30m×1m or 0.0003 hectare each are required for one hectare of tobacco. This means that 0.0012 hectares of catchment forests is decimated each year to support one hectare of tobacco farm. Using this figure, it is estimated that the practice of land preparation for seedbed has consumed about 1.0072 hectare of catchment forest based on the survey conducted to 120 respondents in 2005/06 (Table 11).

Table 11: Estimation of catchment forest depleted for nursery establishment

Area cleared per farmer in hectares	Farmers involved	Area cleared in hectares
0.0000	4	0.0000
0.0030	4	0.0120
0.0045	2	0.0090
0.0048	1	0.0048
0.0050	1	0.0050
0.0060	63	0.3780
0.0090	8	0.0072
0.0096	1	0.0096
0.0120	29	0.3480
0.0144	1	0.0144
0.0150	1	0.0150
0.0180	2	0.0360
0.0240	2	0.0480
0.1200	1	0.1200
Total	**120**	**1.0072**

Taking into account of the same information as a base, calculation was made to estimate catchment forest lost for the past three decades, which revealed that 3389 hectares of catchment forest has been destroyed in Songea districts only to support nursery establishment in the past three decades (Fig. 14). Estimates showed that the largest clearance occurred in 1997/00 growing season where a total of 605.92 hectares were cleared followed by 1994/97 (503.60 hectares) and 373.58 hectares in 1991/94. The least clearance was noted in 1985/88 where a total of 84.78 hectares were cleared to support nursery establishment. The variations of the area cleared are caused by fluctuations in the area under cultivation. Estimates for other tobacco growing seasons are shown in Fig. 14:

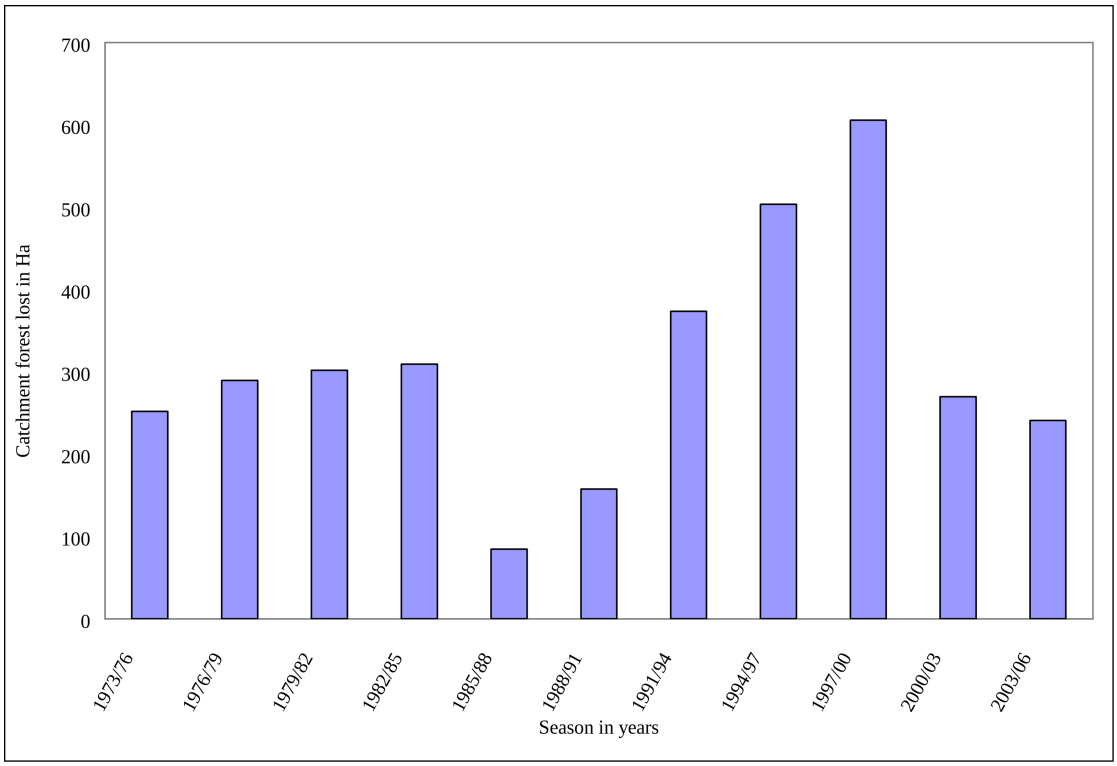

Figure 14: Estimates of catchment forest area cleared for seedbed preparation

Conclusively it is estimated that dark fire tobacco farming in the study area has caused the decimation of about 338 787 hectares of forest land of which 282 441 hectares are due to land clearing for field establishment, 52 957 hectares for fuel wood for curing purposes and nursery establishment has claimed 3389 hectares (about half of the catchment forest area of Ludewa district) from the year 1973 to 2005. Compared to Mufindi district which is reported to have forest area of about 64 028 hectares (URT, 2002), it is estimated that the forest area cleared in Songea district is about five times that of Mufindi.

It is estimated dark fired cultivation in the district is decimating about 11 962 hectares of natural forest in Songea district annually. Comparing this loss with the one given by FBD (2002) Tanzania is loosing about of 130 000 to 500 000 hectares of forest land annually mainly due to subsistence agriculture especially the practice of shifting cultivation, dark fire tobacco cultivation contribution on deforestation is estimated to be between 9.2% to 23.9% of the overall deforestation caused by subsistence farming in Tanzania.

If the present trend is left unchecked, the district will lose all its forest in the coming three decades due to dark fire tobacco cultivation without taking into consideration deforestation caused by other factors such lumbering, poles for construction, influence of bush fires, population pressure and etc. Given the rate of deforestation resulting from dark fire tobacco cultivation excarbated by shifting cultivation in the district which has an area 624 874 hectares of forest (URT, 1999) the possibility of diminishing area covered by forest is greater.

4.4. Soil erosion resulting from dark fire tobacco cultivation

As indicated in Table 12, farmers reported that forest clearing for DFC tobacco cultivation in Songea district has resulted into accelerated soil erosion. This conforms findings given by Reeds (1996) who reported that accelerated soil erosion is a consequence of land clearing for agriculture, poor farming practices and cultivation of erosive crops.

Soil erosion in form of sheet erosion was reported by 45 respondents (37.5%) to be evident particularly in areas where tobacco growing is done on hilly areas although not at an alarming rate. Ngugi *et al.* (1990) reported that sheet erosion though least noticeable is dangerous because it leads to the steady loss of top soil (the most fertile) and a reduction in soil depth.

Table 12: List of farmers who have noted soil erosion in the farm holdings used to grow tobacco

Response	Frequency	Percent
Yes	45	37.5
No	75	62.5
Total	**120**	**100.0**

When asked to classify the extent of the problem, 22% of farmers reported that it was moderate, 11% reported to be low, 5% reported it to be high. The rest, 63% did not respond to the question (Table 13).

Table 13: The extent of soil erosion in the area

Response	Frequency	Percent
High	6	5
Moderate	26	22
Low	13	11
No response	75	63
Total	**120**	**100**

A similar study on the extent of soil erosion due to tobacco farming by Chacha (1999) in Kuria Kenya found that parts of the district experienced disastrous soil erosion in tobacco farms. In due course, permanent rivers such as Nyangoto and Kwigancha became intermittent. In Uganda, Aliro (1993) and Bayego (1994) reported that soil erosion is a severe problem in a number of tobacco cultivating areas. In parts of the tobacco-growing Arua district and Western Nile region, soil erosion in the form of sheet erosion is now very evident. Top soil has been washed away leaving a hard pan and infertile sun baked soils.

In the case of Sri Lanka, Aliro (1993) revealed that tobacco growing on hillsides close to the Mahaweli River has caused the hillsides to become almost bare, and without the protection of trees, the topsoil is washed into the river which can lead to severe problems downstream, with the build-up of soil sedimentation in the river causing silt problems to the Victoria dam built in the 1980s.

Tobacco farming is also blamed for erosion of vital soil nutrients (Table 14). Goodland *et al.* (1984) reported that despite causing loss of 45 kg of top soil per acre per year, tobacco also depletes nitrogen, phosphorus and potassium in soil at much higher rates compared to any other food and cash crops. This was also repeated by

Geist (1999) who contended that tobacco is a highly macro nutrient absorbing crop and indeed a driving force of environmental change.

Table 14: Average annual depletion of soil nutrients in Africa by tobacco and other crops

Crop (1 tone/hectare)	Nutrient loss (kg/hectare)		
	Nitrogen	Phosphorus	Potassium
Tobacco	24.4	15.0	9.8
Coffee	2.2	14.4	2.5
Maize	1.9	0.4	46.4
Cassava	19.5	6.7	1.9

Source: Goodland *et al.* (1984)

Tobacco is particularly potassium-hungry, absorbing up to six times as much as other crops. One of the reasons for tobacco's high uptake of soil nutrients is the practice of topping the plants to stimulate leaf growth for ensuring higher nicotine content. A similar practice was also found to be done by DFC farmers in the study areas. Since it depletes nutrients at a much higher rates, tobacco requires regular inputs of chemical fertilizers of which the majority of farmers under liberalized economy in developing countries cannot afford hence they are forced to access virgin land annually as coping a strategy.

With majority of farmers (98.3%) reporting to practice shifting cultivation in the study areas due to soil fertility, pest build up and cost of fertilizers it is estimated that the same amount of nutrients given in Table 15 are lost annually in Songea district. This loss of nutrients from soil is likely to contribute to poor vegetation cover exposing

it to agents of soil erosion such as runoff and wind. This in turn will result into other forms of soil erosion such as rill and gully erosion which are very difficult to control.

In addition, loss of top soil and nutrients are expected to have enormous effect on food production, erosion of savings/income insecurity and loss of property in the district in the near future.

4.5. Loss of biodiversity as a result of dark fire tobacco farming

The study mainly focused on the human perception of biodiversity loss with reference to the following biodiversity categories: medicinal plants, wild fruit plants, wildlife (animal and fish) and Fungi (mushrooms). Similar indicators were used by Nanyunja (2002) in the assessment of biodiversity loss in Uganda.

The majority of discussants (68%) revealed that dark fired tobacco farming has resulted into the rapid loss of medicinal plants such as *Uapaka kirkiana*, *Piliostigma thonningii* and *Strychnos innocua*. The details of the diseases cured by the above mentioned tree species have already been explained section 4.2.

Table 15: Reasons for Biodiversity loss in Songea Rural District

Reasons	Frequency	Percent
Land clearing for tobacco cultivation and curing	8	68
Population increase	2	16
Firewood and charcoal	1	8
Land clearing for other crops e.g. maize	1	8
Total	**12**	**100**

Wild fruits such as *Uapaka kirkiana*, *Strychnos innocua, Erythrina abyssinica, Anonas spp, Syzigium guineense*, *Parinari curatellifolia, Piliostigma thonningii* and

Syzygium cordatum were also reported by discussants to be declining rapidly in the study area due to dark fire tobacco farming. Wild fruits play a significant part in raising household income, which is a vital tool for fighting income poverty. For instance, Peter *et al.* (2004) have observed that some women in Tabora region were each obtaining between Tshs 33 000 – 140 000 per week from the sale of processed wild fruits. In addition, wild fruits serve as the source of food to the community supplementing vital nutrients such as vitamins.

FDGs Discussant reported that loss of the wild animal habitat because of over-exploitation of their natural habitats for dark fire tobacco farming has also contributed in a decrease in number and type of wildlife (Table 15). Wild animals such as *Gazella soemmeringi and* Guinea fowl have moved away from the villages forcing villagers to rely heavily on domesticated animals for nutrition and income. Chanyenga (2000) reported that one can fetch as high as USD 4.5 to 5.0 due to the sale of one Guinea fowl at the market. Availability of fishes such *Clarias gariepinus* and *Tilapia spp* were also reported to have declined tremendously in the past 10 years. Establishment of nursery for dark fire tobacco seedlings around streams and natural ponds were mentioned to be the major contributing factors.

Mushrooms in general have always been known to provide supplementary food, especially during the rain season for many families (Chipompha, 1985; Kajembe *et al.*, 2004). Most of these wild edible mushrooms grow on dead wood and leaf litter, which is normally found in indigenous woodlands. Discussants in the study area reported scarcity of mushrooms such as *Amanita loosii, Lactarius pumilus and*

Termitomyces aurantiacus due to deforestation mainly resulting from tobacco cultivation.

From the above explanation, it is evident that dark fire tobacco farming is threatening the presence of high value economic resources such as wild food, traditional medicine, fresh air, plant nutrients, water and genetic material for crop hybridization e.g. *Faurea robusta*. This steady erosion of biodiversity which is taking place today due to poor farming practices predicts the distinction of the above mentioned species in the near future. This is expected to undermine both progress towards better life and sustainable development.

CHAPTER FIVE

5.0. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

It is evident from the above discussion that dark fire tobacco farming in the district heavily relies on natural forest. This over reliance on natural resources has resulted into a number of environmental problems. These include deforestation caused by the demand of fuelwood for curing purposes, seedbed preparation for tobacco seedlings and fields for planting tobacco. It was clear from this discussion that forest clearance for field establishment was a leading cause of deforestation. About 282 441 hectares of forest land were estimated to have been lost for the past three decades. Demand of fuelwood for curing ranked second in decimating 52 957 hectares while seedbed

preparation ranked third for decimating about 3389 hectares of catchment forest almost equal to half of the catchment of forest of Ludewa district.

In addition, DFC farming has resulted into a decline of vital biodiversity. Plants including tree species with medicinal value (*Uapaka kirkiana*), wild fruits (*Anonas spp*) and wild animals *(Gazella soemmeringi*) and edible Fungi (*Termitomyces aurantiacus*) are becoming extinct. Findings also revealed that farmers in the study areas are now utilizing even fruit trees around their homesteads such as *Mangifera indica* for curing tobacco. Valuable tree species used for timber production (*Cedral toona/odorata*) were also discovered to be used in tobacco curing. If this practice is not put under control, it is expected to have an extra ordinary harmful and irreplaceable effect on the livelihood and integrity of Songea district residents and the nation at large in the long run.

Loss of top soil which could be used to produce environmentally friendly food crops to feed the ever increasing and vulnerable population was also discovered to be happening in the study areas. Forest clearance to obtain land for cultivation of tobacco was mentioned to be the major driving force.

5.2. Recommendations

In view of the findings above, the study recommends the following urgent measures to be taken in the study areas.

- Awareness raising programme on the value of forest resources should be enhanced.

- Motivation of all stakeholders as suggested by National Forest Policy of 1998 to embark in reforestation and afforestation programmes for non-tobacco farmers, tobacco farmers and business communities. Non Government Organizations (NGOs) and schools should be encouraged to plant and trained in the management of native and natural tree species around the homestead, catchment areas and open land. The need to involve a wide range of stakeholders is very important because experience from other regions where tobacco is grown show that the majority of tobacco farmers resist to plant trees simply because it coincides with tobacco planting. It should also be noted that tobacco farming is labour intensive work. Participatory approaches should be used in conducting conservation programs rather than ad hoc military style as suggested by URT (1998). This will assist in ensuring the sustainability of conservation programs.
- Local governments need to play a major role in implementation of directives given both in the environmental and forest policy in activities which threaten the existence of the environment such as production of cash crops at large scale including the tobacco crop.
- Incorporation of tobacco crop with legumes which adds vital nitrogen nutrient in the soil. Studies done in Mozambique show that such mixing has worked with great success without impacting on the output level of tobacco.
- Since the majority of the farmers practice shifting cultivation in order to search for virgin land which requires minimum level of fertilization, the government should assist tobacco farmers by subsidizing the necessary inputs

such as fertilizers. This will reduce the farmers' dependency on virgin land for cultivation of tobacco and protect the high value environmental resources.

- Tobacco companies should introduce a float system to the farmers. Float seedbeds are small trays with numerous holes normally filled with tobacco dusts residues as medium for growth. The float system will reduce the farmers' over-reliance on catchment forest for seedbed preparation. In addition, adoption of floats reduces the need for methyl bromide (an ozone depleting fumigant used to reduce weed), insect and disease pressure in conventional beds.
- Since other countries such as Zimbabwe have reported to use coal for tobacco curing purposes, research on the economics of using coal should be done to see whether it is economically and viable worthwhile. The country is endowed with a lot of coal reserves which are still under utilized in Kiwira Mbeya and Mbinga district in Ruvuma region. This will help in minimize pressure on the natural forest where tobacco is concerned.
- Farmers should be encouraged to use soil conservation techniques such as terracing particularly in areas where tobacco production is conducted on fragile land such as sloping lands.
- Farmers' should be encouraged to engage themselves on other environmentally friendly activities such as bee keeping.

REFERENCES

Aliro, O.K. (1993). Uganda paying the price of growing tobacco. [http://www.who.int/entity/tobacco/framework/public_hearings/panos_institute.pdf] site visited on 2/1/2007.

Aryal, B. (2002). Are the trees for the poor? A study from Budongo Forest Uganda. Dissertation for award of MSc Degree at Agriculture University of Norway, Norway, 141pp.

ATTT (2005). *Agronomic aspects related to DFC tobacco farming in Songea*. ATTT Ltd, Songea, 20pp.

Bailey, D.K. (1994). *Methods of Social Science Research*. The Free Press Collier Macmillan Publisher, London. 478pp.

Barnum, H. (1994). The Economic Burden of Global Trade in Tobacco. *Journal of Tobacco control* 3(4): 358-361.

Bayego, M.H. (1994). Tobacco growing in Uganda: The Environment and Women Pay the Price. *Journal of Tobacco Control* 3:255-256.

Bond, J.W. (1996). *How European Commission and World Bank Policies are Destroying Agriculture and Environment*. Printed by AgBe Publisher, Alkmaar, Holland. 152pp.

Bosesn, J. and Mohele, A. T. (1979). *The Success Story of Peasant Tobacco Production in Tanzania*. Uppsala Publication, Scandinavian Institute of African Studies. 169pp.

BOT (1999). *Economic and Operation Annual Report*. Government Printer, Dar es salaam, Tanzania. 128 pp.

Buss, E.A. (2002). Natural product for insect pest management. [http://www.edis.ifas.ufl.edu] site visited on 26/5/2008.

Chacha, B.K. (1999). From pastoralists to tobacco peasants: The British American Tobacco and socio-ecological change in Kuria District Kenya 1969-99, Egerton University, Njoro, Kenya. [http://www.archive.idrc.ca/ritc/winner2.pdf] site visited on 22/4/2006.

Chanyenga, T. F. (2000). Non-wood forest production in Malawi, Forest Research. [http://www.fao.org/DOCREP/003/X6692E/X6692E00.HTM-5k] site visited on 3/4/2008.

Chapman, S. (1994). Tobacco and Deforestation in the Developing World. *Journal of Tobacco Control* 3: 191-193.

Chenje, M. and Johnson, P. (Eds) (1994). *State of the Environment in Southern Africa*. Southern Africa Research and Documentation Centre publication, Harare, Zimbabwe. 332pp.

Chipompha, N. W. S. (1985): Some mushrooms of Malawi, Forest Research Record No.63. [http://www.frim.org.mw/publications.html] site visited on 20/4/2008.

Crofton, J. (2002). *Tobacco: A Global Threat*, printed in Hong Kong. 147pp.

Cunningham, R. (1996). *Smoke and Mirrors: The Canadian Tobacco War*. International Development Research Centre Publications, Ottawa, Canada. 361pp.

DTU (2003). *Integration of Population Variables in Development Planning Training Manual Part II*. University of Dar es Salaam, Tanzania. 254pp.

EASD (1998). Environmental report for Malawi. [http://www.easd.org .za] site visited on 23/5/2007.

ECSA (1999). Tobacco control research priorities for East, Central and Southern Africa region. [http: //www.idrc.ca/en/ev-84116-201-1-DO_TOPIC.html] site visited on 9/6/ 2006.

FAO (1990). *Tobacco: Supply, Demand and Trade Projection from 1985 to 2000*. Food and Agriculture Organization of the United Nations, Rome, Italy. 77pp.

FAO (2003). *Issues in the Global Tobacco Economy: Selected Case Studies*. Food and Agriculture Organization of the United Nations, Rome, Italy. 120pp.

FAO (2004). The twenty sixth FAO regional conferences for Latin America and the Caribbean. [http://www.fao.org/docrep/htm] site visited on 14/9/2007.

FBD (2002). *Wood Fuel Consumption in Selected Urban Areas of Tanzania*. Ministry of Natural Resources and Tourism, Dar es Salaam. 109pp.

Fisher, M. G. and Shively, G. (2000). Links between agricultural intensification and smallholder led forest degradation in Southern Malawi. [http://www.aem.cornell.edu/special_programs/AFSNRM/Poverty/Papers/individual/Papers/Fisher%20&%20Shively.pdf] site visited on 12/82007.

Geist, H. (1997). Tobacco: A driving force of environmental change in the Miombo woodland zone *in* Southern Africa. Paper presented at St. Anthony's Conference of "African Environment, Past and Present. [http://www. Tobaccocontrol.bmj.com] site visited on 2/4/2007.

Geist, H. (1999). Global Assessment of Deforestation Related to Tobacco Farming. *Journal of Tobacco Control 8:18*–28.

Goodland, J.A., Watson, C., and Ledec, G. (1984). *Environmental Management in Tropical Agriculture*. Westview Press Boulder, Colorado United States of America. 237pp.

IITGA, (1998). *Who Gets the Added Value from Tobacco Leaf?* ITGA, West Sussex. 80pp.

Kahyarara, G., Mbowe, W. and Kimweri, O. (2002). *Poverty and Deforestation around the Gazetted Forest Reserve of the Coastal Belt of Tanzania*. Research on Poverty Alleviation (REPOA), Report No: 02.3. Printed by Mkuki and Nyota Publishers, Dar es Salaam, Tanzania. 44pp.

Kajembe, G. C., Nyingili, R. B., Msuya, J., Nduwamungu, J. and Katani J. K. (2004) Non wood forest products and their contribution to house hold food security in Mbozi district: Agricultural technology development through Participatory

Research TARP II SUA. In: *Proceedings of the Third Collaborative Research Workshop Jointly Organized by the Ministry of Agriculture and Food Security and Sokoine University of Agriculture*, held in Morogoro, 24 – 26 May 2004, Morogoro, Tanzania. pp. 30-62.

Kalamata, S.L. (2006). Performance assessment of extension service under contract farming arrangement. A Case Study of the Flue Cured Tobacco in Urambo District. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 56pp.

Kangalawe, R.Y.M. (1995). Fighting soil degradation in Kondoa eroded areas, Kondoa district, Tanzania: Socio Economic Attributes, Farmers Perception and Nutrient Balance Assessment. Dissertation for Award of MSc Degree at Agriculture University of Norway, Norway, 129pp.

Lightwood, J; Collins, D; Lapsley, H and Novotny1, T.E (2003). Estimating the Costs of Tobacco Use. [http://www1.worldbank.org/tobacco/tcdc/063TO104.PDF] site visited on 13/9/2007.

Mackay, J. (2002). *The Tobacco Atlas*. WHO Publications, Geneva, Switzerland. 128pp.

Mafupa, C.J. (2006). Impact of human disturbance in Miombo woodland of Igombe River Forest Reserve, Nzega district. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 120pp.

Mallango, A.S. (2001). Management crisis in the catchment areas in Tanzania. A case study of Iringa district, Tanzania. A paper presented at the Fourth DANIDA International Workshop on Integrated Watershed Development in Asmara, Eritrea held in 3-18 November 2001. [http://easternarc.or.tz/downloads/Udz/MEMA/MEMA %20Studies/Management%20Crisis%20in%20Catchment%20by %20Mallango%202001.pdf] site visited on 14/03/2008.

MAM (2007). Agricultural diversification and crop alternatives to Tobacco: Perspectives and Experience of the Tobacco Sub Sector in Mozambique. [http://www.tobaccoleaf.org/files/6/Moz_Agricultural_diversification_and_ crop_altrenative_to_tobacco_Mozambique1.pdf] site visited on 12/5/2008.

Mgurusi, E.K. (1994). *Environmental Consideration for Sustainable Agriculture, Ministry of Tourism, Natural Resource and Environment, Dar es Salaam.* Proceeding of the Sokoine University of Agriculture Convocation 1st Workshop, Morogoro, Tanzania, 26-27 July 1994. 65pp.

Millington, A.C. (1990). Soil Erosion and Conservation. In: *Environmental Issues in the 1990 (Edited by Mannion, A.M. and Bowlby, S.R.)*, John Wiley and Sons Limited, West Sussex, England. pp 227-244.

Missana, S.B. (1999). Deforestation in Tanzania: A development crisis? The Experience of Kahama District. Social Science Research Report Series No

13. Addis Ababa: OSSREA, 1999. [http://www.ossrea.net/ssrr/no13/no13.htm] site visited on 7/3/2006.

Mkanta, W.N. and Chimtembo, M.M.B. (2002). Towards natural resource accounting in Tanzania: A Study on the Contribution of Natural Forests to National Income. CEEPA Discussion Paper Series ISBN 0-9584508-1-1 Discussion Paper ISBN 0-9584508-7-0. [http://www.ceepa.co.za] site visited on 11/5/2007.

Mnkabenga, F.M.D. (2001). Assessment of the effect of shifting cultivation and its implication on sustainable use of land resource: A Case Study of Manyoni district, Tanzania. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 90pp.

Msuya, S. (2006). Tumbaku Yaingiza Shilingi 81 Bilioni. Mwananchi, Issue No. 02207. p. 4.

Munishi, P.K.T. and Temu, R.P.C. (2005). The Natural Forests and Environmental Conservation in the Southern Highlands of Tanzania, Sokoine University of Agriculture. [http:// www. tzonline.org] site visited on 12/08/2006.

Mwasikakata, M. (2003). Tobacco: An Economic Lifeline? The Case of Tobacco Farming in the Kasungu Agricultural Development Division, Malawi. Sectoral Activities Programme Working Paper 184, Geneva, International

Labour Office. [http://www-ilo mirror.cornell.edu/public/english/ dialogue/ sector/papers/tobacco/wp184.pdf] site visited on 15/09/2007.

Mwikila, T.R. (1992). An economic analysis of factors influencing flue cured tobacco production in Tanzania: A Case Study of Iringa District. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 122pp.

Mzava, E.M. (1981). Village industries versus savanna forests with reference to Tanzania. *Unasylva* 33(13):24-29.

Nanyunja, R.K. (2002). Land Use Change Impacts and Dynamics (LUCID) Project Working Paper No: 29, Nairobi, Kenya: International Livestock Research Institute. [http://www.lucideastafrica. org] site visited on 23/3/2007.

Nassar, H. (2003). The Economics of Tobacco in Egypt: A New Analysis of Demand. Economics of Tobacco Control Discussion Paper. [http://www.worldbank.org/tobacco/pdf/Nassar%20-20%The%20Economics %20-%20whole.pdf] site visited on 4/4/2008.

Ngugi, D.N., Karau, P.K. and Nguyo, W. (1990). *East African Agriculture 3rd Edition*. Macmillan Education limited, London, United Kingdom. 330pp.

Northoff, E. (2003). Higher world tobacco use expected by 2010 - growth rate slowing down. [http://www.fao.org/english/newsroom/news/2003/26919-en.html] site visited on 11/11/2008.

NTRHI (2007). Traditional Use of Tobacco. [http://www.smokefreecalgary.com/bins/contens_page.asp?cid=3102&lang=1] site visited on 25/05/2008.

Nypan, A. (1991). Women's Strategies for Control of Resources: Change in the Position of Rural Women in Tanzania. *Journal for Utviklingsstudies* 1:79-97.

Obwona, M., Wasswa, F. and Nabwaayo, V. (2005). Taxation of the Tobacco Industry in Uganda: The Case for Excise Duty on Cigarettes. Economic Policy Research Centre, Research Series No: 44. [http://www.eprc.or.ug/pdf_files/researchseries/series44.pdf] site visited on 11/09/2007.

PAN (1998). Tobacco, Farmers and Pesticides. [http://www.ash.org.uk/html/factsheets/pdfs/fact22.pdf] site visited on 7/3/2006.

Peter A., Oduo, R., Swai, K. and Mbambo, L. (2004). Vulgarization of Miombo biodiversity for poverty alleviation and food security. Paper presented at the 4th region of the global biodiversity forum of Africa. Biodiversity and Livelihoods in Africa: Delivering on the Millennium Development Goals. -11 June 2004. [http: //www.fao.org/globe/bio/poverty/ foodsecurity.pdf] site visited on 12/9/2007.

Peters, P.E. and Herrera, M.G. (1986). Tobacco Cultivation, Food Production and Nutrition among Smallholders in Malawi. [http://www.ifpri.org/pubs/books/vonbraun94/vonbraun94ch20.pdf] site visited on 13/09/2007.

Power, S., Makungu, P. and Quraeen, A. (Eds) (1997). *Watersheds Management, Participatory and Sustainable Development.* Proceedings of Danida's Second International Workshop on Watershed Development, Iringa, Tanzania, 26/May/-5/June/1997. 99pp.

Reeds, D. (1996). *Structural Adjustment, the Environment and Sustainable Development*. An Earthscan Publication, Printed and Bound in Great Britain. 386pp.

Ruffo, C.K. (2002). *Edible Wild Plants of Tanzania*. Printed by English Press Nairobi, Kenya. 766pp.

Rweyemamu, D.C. (2002). Economic analysis of cash crop production and marketing in Tanzania under a liberalized market economy: A case study of Tobacco in Songea Rural District. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 121pp.

SDC, (2006*). Rainfall Statistical Data Annual Reports from 1982/83 up to 2005/06*. SDC Publication, Songea, Tanzania. 30pp.

Sempebwa, J.S. (2002). Arua District Participatory Poverty Assessment Report. [http: //www.finance.go.ug/docs/Baito%20site%/20report.pdf] site visited on 13/3/2007.

Shekighenda, L. (2006). Tobacco Production Threatens Food Cultivation. Guardian, Issue No. 3591. p. 1.

Svenningsson, P. J. (1994). Wood fuel Use by Small Industries in Tanzania. [http: //www. sei.se/red/red9405f.html] site visited on 15/4/2006.

Timberlake, l. (1985). *Africa in Crisis: The Causes, the Cures of Environmental Bankruptcy.* An Earthscan Publication, printed by Russell Press, Nottingham United Kingdom. 232pp.

TTB (2005). *Dark Fire Tobacco Production Trend in Ruvuma Region for the period between 1985/86 up to 2004/05*. TTB Publications, Ruvuma, Tanzania. 23pp.

UN (1993). *Population, Environment and Development in Tanzania*. Demographic Training Unit University of Dar es Salaam and United Nation Department of Economics and Social Development Publication. 189pp.

URT (1992). *1990/1991 Review of Tobacco*. Marketing Development Bureau, Dar es Salaam, Tanzania. 44pp.

URT (1998). *National Forest Policy*. President's Office Planning and Privatization Publication, Dar es Salaam, Tanzania. 69pp.

URT (1999). *Socio Economic Profile of Ruvuma Region.* President's Office Planning and Privatization Publication, Dar es Salaam, Tanzania. 145pp.

URT (2002). *Socio Economic Profile of Iringa Region*. President's Office Planning and Privatization Publication, Dar es Salaam, Tanzania. 180pp.

URT (2003). *2002 Population and Housing Census*. National Bureau of Statistics President's Office Planning and Privatization Publication, Dar es salaam, Tanzania. 203pp.

Van Liemt, G. (2002). The World Tobacco Industry: Trends and Prospects. Sectoral Working Paper 179-2002.doc/v2. ILO, Geneva, Switzerland. [http://www.ilo.org/public/English/dialogue/sector/papers/tobacco/wp.179.pdf] site visited on 12/06/2006.

WB (1997). Causes and Consequences of Tropical Deforestation. World Bank Report. Washington DC: Environmentally Sustainable Development Division [http://www.whoindia.org/LinkFiles/Tobacco_Free_Initiative_03-Chapter-05.2.pdf] site visited on 22/3/2007.

WB (2003). The Economics of Tobacco Use & Tobacco Control in the Developing World. A Background Paper for the High Level Round Table on Tobacco Control and Development Policy. [http://ec.europa.eu/health/ph_determinants/life_style/Tobacco/Documents/world_bank_en.pdf] site visited on 15/9/2007.

WCMC (1996). *Assessing Biodiversity Status and Sustainability*. Groombridge, B and Jenkins, M D (Eds), World Conservation Press, Cambridge, United Kingdom. 104pp.

WHO (2004). Tobacco and Poverty: A Vicious Circle. [http://www.who.int/tobacco/communications/events/wntd/2004/en/wntd 2004_brochure_en.pdf] site visited on 7/6/2006.

APPENDICES

Appendix 1: Structured questionnaire for household level

A: DEMOGRAPHIC INFORMATION

1. Name of respondent

2. Age…….years

3. Sex

    01. Male

    02. Female

4. Marital status

    01. Single

02. Married

03. Divorced

04. Widow

5. Education Level

01. No formal

02. Adult

03. Primary School

04. Secondary school

05. Others (Specify)

6. For how long have you been growing tobacco in this village?..... Years

B: Tree species used in curing tobacco

7. What is the main supply of fuel wood?

01. Natural forest

02. Farm trees

03. Forest reserves

04. Others (Specify)

8. Which tree species do you prefer in curing the crop?

No	Local name	Common name	Scientific name
1			
2			
3			
4			
5			

9. Give reasons for you selection

01. Give enough smoke

02. Recommended by extension officer

03. Easily available

04. Others (Specify)

10. Availability of tree species mentioned above for curing purposes

01. Available

02. Easily available

03. Difficult to find

04. Others (Specify)

C. Cropping system used to grow tobacco

11. What cropping system do you practice normally?

01. Mixed cropping

02. Shifting cultivation

03. Agro forestry

12. If shifting cultivation, why?

01. Traditional way of farming

02. Search for fertile land

03. Advised by the extension officer

04. Others (specify)

13. After what period do you return to the land previously grown with tobacco?.....

Years

D. Estimate on forest area cleared

14. What was the area under tobacco cultivation in the last season?

Area used (hectares)	Amount of tobacco (kilograms)

15. How was the land for tobacco production acquired?

01. Bush clearing in open land

02. Clearing forest reserve

03. Others (specify)

16. On average how many acres of forest do you clear each year for tobacco cultivation……?

17. What is the acrage of the cleared land for the current season?.....acres

18. For how long have you been obtaining new land through forest clearance for tobacco production?

01. 1-5 years

02. 5-10 years

03. 10-15 years

04. More than 20 years

E: Extent of damage of watersheds areas/size of watersheds destroyed annually

19. Where do you normally establish nursery?

01. Around homestead

02. Near the catchment

03. Others (Specify)

20. When preparing nursery do you select trees or clear the area completely?

01. Yes

02. No

21. If yes, give the size of the land cleared for nursery establishment.....Hectares

22. How did you use the trees cut from the plot?

01. Fire wood

02. Soil sterilization

03. Charcoal productions

05 Others (Specify)

23. For how long have you been preparing nursery around the watersheds areas?

01. 1-5 years

02. 5-10 years

03. 10-15 years

04. More than 20 years

F: Information on Biodiversity Loss

24**.** Based on your growing experience indicate trees species which have disappeared/are disappearing in your area due to tobacco production under the named categories below.

Medicinal plants	wildlife	Wild fruits	Edible Fungi

G: Information on soil erosion

25. Have you ever noted soil erosion in farm holdings used to grow tobacco?

01. Yes

02. No

26. If yes, what is the extent of soil erosion?

01. High

02. Moderate

03. Low

27. What is the main driving force?

Appendix 2: Checklist for focus group discussion

A: Key informants guide for growers with more than 10 years of farming experience

1. Based on your growing experience indicate trees species which have disappeared in your area due to tobacco production under the named categories below.

01. Medicinal plants

02. Wildlife

03. Wild fruits

04. Edible fungi

2. Which trend do the following indirect forest products/services have been in the past 10 years?

Product or services	Trend in the 10 past years 1. Increase	Possible causes of decrease	Possible causes of increase

	2. Decrease 3. Constant		
Rainfall amount			
Water sources			
Soil erosion			
Others (specify)			

3. In your opinion what are the possible solutions for problem discovered in the area

Appendix 3: Checklist for Forest Officer

1. Name	2. Sex	3. Age	4. Education level

5. For how long have you been working in the village? ……

6. Based on your working experience indicate trees species which are disappearing/or have disappeared in the area due to tobacco production in each category given below

01. Medicinal plants

02. Wildlife

03. Wild fruits

04. Edible fungi

2. Which trend do the following indirect forest products/services have been in the past 10 years?

Product or services	Trend in the 10 past years 1. Increase 2. Decrease	Possible causes of decrease	Possible causes of increase

	3. Constant		
Rainfall amount			
Water sources			
Soil erosion			
Fuel wood			

3. In your opinion what are the possible solutions for problem discovered in the area

Appendix 4: Map of Songea Rural District