ASSESSMENT OF TOBACCO SMALLHOLDER FARMING PRACTICES: THE CASE OF NZEGA DISTRICT, TANZANIA.

BY

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ABSTRACT

A study was conducted to assess smallholder tobacco farming practices in Nzega District. The objective of the study was to assess tobacco production and curing practices aiming at increasing tobacco production and decreasing environmental degradation. The methodology involved a cross-sectional research design, with a sample of 240 farmers, randomly selected from 6 villages in Mambali, Milambo Itobo and Magengati wards. Questionnaire, focus group discussions, physical observations and consultations with key informants were the main methods of data collection. Data collected were analysed using SSPS software. Results indicated that most farmers use inorganic fertilizers organic fertilizers are rarely used. Major forms of environmental degradation identified were deforestation, land degradation and loss of biodiversity. Major introduced farming technologies were woodlots establishment and improved barn structures. Majority of the farmers (95%) did not adopt improved barn technology. Low adoption of introduced technologies was influenced by delivery of extension service which was largely due to inadequate number of extension workers. Findings also indicated that most farmers access credit facilities from tobacco companies. Study findings further showed that most farmers are members of primary cooperative societies. Based on the results it is recommended that, (i) Efforts should be directed towards use of organic fertilizers to sustain meaningful land management, (ii) Environment policies and development interventions should strengthen the involvement of well functioning informal institutions, (iii) Improved barn technology developed and disseminated should meet

and consider farmers' socio-economic situations, (iv) Tobacco companies should build capacity to tobacco farmers to raise their own seedlings for existing woodlots, (v) Research – Extension - Farmer linkage should be strengthened for effective dissemination of improved farming technologies and District should capacitate farmers to seek legal land ownership which has implication in long term agricultural investments.

DECLARATION

I, Amon Thomas Mchilasi, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

14.11.2012

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The above declaration is confirmed by

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God is almighty.

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LIST OF ABBREVIATIONS

AOTTL	Alliance One Tobacco Tanzania Limited
BOT	Bank of Tanzania
FAO	Food and Agriculture Organisation
IDRC	International Development Research Centre
ILO	International Labour Organisation
Kg	Kilogram
N	Nitrogen
NOK	Norwegian Kroner
ProBEC	Programme for Biomass Energy Conservation
RB	Rocket Barn
TLC	Tobacco Leaf Company
TLTC	Tanzania Leaf Tobacco Company
Tsh	Tanzania Shillings
UNEP	United Nations Environmental Programme
URT	United Republic of Tanzania
US	United States
USAID	United States Agency for International Development
USD	United States Dollars

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

Agriculture is the foundation of the Tanzanian economy. It accounts for about half of the national income, three quarters of the merchandise exports and is a source of food. It also provides employment opportunities to about 80% of Tanzanians. The agricultural sector has forward linkages to agro processing, consumption and exports, also provides raw materials to industries and a market for manufactured goods. The sector is dominated by smallholder farmers cultivating average farm sizes of between 0.9 hectare and 3.0 hectares. About 70% of Tanzanians crop area is cultivated by hand hoe, 20% by ox plough and only 10% by tractors (URT, 2009).

Tobacco, like other agricultural crops in Tanzania, contributes to employment, income, foreign exchange and other cash contributing effects. For example, during the financial year ending June, 2007 tobacco contributed 4.5% of all commodities with total export earning of USD 1856.3 (BOT, 2008). Major challenges in tobacco agriculture revolve around low level of technology on the crop production and adverse environmental effects related to desertification and land degradation. Mwita (2005) observed that tobacco production requires extensive virgin land to support shifting cultivation and therefore the availability of sufficient forest areas to supply the needed fuel wood. He also observed that an individual farmer clears about one hectare of woodland to grow tobacco and the cleared debris is used as domestic fuel wood and when tobacco becomes ready for curing, the farmer would clear another one more hectare to get fuel wood for curing the harvest.

Abdallah *et al.* (2007) observed that tobacco production in Tanzania is still dominated by small scale subsistence farming which is one of the major threats to forest growth mainly due to the sheer number of households involved and inefficient resources utilization. He also noted that smallholder farmers obtain their tobacco plots mostly by clearing forest land through shifting cultivation which is the leading land use change mechanism associated with nearly all deforestation cases.

In response to unsustainable farming practices in Tanzania, the government has over the years formulated various policies and strategies. Some of the major ones include; Agricultural and livestock Policy (ALP, 1997), National Environmental Policy (NEP, 1997), Agricultural Development Strategy (ADS, 2001), Rural Development Strategy (RDS, 2001), the National Conservation Strategy for Sustainable Development (NCSSD) and the Tanzania Forestry Action Plan (TFAP). In addition, Non Governmental Organizations (NGO's) and the private sector have been involved in various aspects aimed at reducing environmental problems resulting from tobacco farming. One of the major private sectors is Association of Tanzania Tobacco Traders Limited (ATTTL). This association contributes to the provision of extension services to farmers on adoption of improved tobacco production and post curing practices.

Sustainable tobacco farming practices is a necessity for sustainable economic growth, social development and rural development in Tanzania. Sustainable tobacco agricultural practices will largely depend on how natural and environmental resources are managed and utilized. Rural development planning should ensure that

uses of resources do not compromise future needs of society. National environmental policy provides fundamental changes that are needed to bring about sustainable agricultural development. The policy emphasizes on improvement of conditions and productivity of degraded areas including rural and urban areas (URT, 1997a). Athanasios *et al.* (2009) reported that introduction of new technology is the only way for potential keeping tobacco in proper production plans. He argues that existing institution could play an important role through the network of extension services. Sustainable agriculture is a knowledge intensive system and it requires a new kind of knowledge, which differs from other forms on the basis of conventional agricultural practices. Sustainability in agriculture will be attained through agricultural extension services which must consider environmental implications, social issues, and overall economic growth within the agriculture sector (Mohammad, 2009).

1.2 Problem statement and justification

Sustainable agricultural practices are considered to be an important element in enhancing the sustainability of human and rural development in Tanzania. Sustainable farming practices in Tobacco agriculture are crucial due to environmental challenges that Tanzania is currently undergoing. Deforestation and land degradation are among the major problems that result into loss of biodiversity and affect crop production leading to low productivity. Global assessment of deforestation related to tobacco farming approximate that in the mid-1980 Virginia (flue cured) tobacco consumed between 82.5 and 175 million cubic meter of wood harvested worldwide each year for curing. This translates into the equivalent of 1.2 to 2.5 million hectares of open forests or woodland removed annually (Helmut, 1999).

Sarah (2009) reported that around 600 million trees are cut down every year in the world resulted by tobacco production. In the developing world, trees are often cut down to make room for tobacco crops and more trees are cut down for use during the curing process. Trees are also felled for the construction of curing barns.

In Tanzania tobacco curing is the second largest consumer of wood after the domestic sector. Annual loss of forest cover between the years 1989 to 1990 due to tobacco curing was estimated to be 13 000 hectare (Siddiqui *et al.*, 1996). Waluye (1994) reported that the effects of tobacco related desertification were already visible in Urambo District Tabora Region, in terms of forest removal, drought, irregular rains and whirlwinds which had been uncommon in the area before.

Agricultural and Livestock policy (URT, 1997b) has an ultimate goal on soil conservation and land use planning. Land has to be managed in such a way that agricultural production is sustainable and that negative environmental externalities are avoided or at least kept to a minimum. To ensure sustainable agricultural development, problems relating to environmental and disaster management need to be addressed.

This study was therefore conducted to examine tobacco production and processing practices that will likely sustain tobacco production in terms of increasing yields and decreasing environment degradation. This study was also in line with current government development initiatives, strategies and programmes such as Agricultural sector Development programme (ASDP), the National Strategy for growth and

reduction of poverty (NSGRP), Agricultural Development Strategy (ADS), Rural Development Strategy (RDS), 2025 Development vision as well as the Millennium Development Goals (MDGs) all of which emphasize on sustainable use of resources as a means of attaining sustainable development. The study findings will serve as a framework for developing strategies that will ensure increased tobacco production and decreased environmental degradation.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this study was to assess tobacco production and curing practices aiming at increasing tobacco production and decreasing environmental degradation.

1.3.2 Specific objectives

The specific objectives of this study were to:

(i) Identify and analyze tobacco farming practices of smallholder farmers aiming at assessing production practices that are likely to be sustainable.

(ii) Identify and assess different forms of land degradation resulting from tobacco agriculture.

(iii) Identify and analyze tobacco curing practices with the aim of assessing alternative practices which are likely to be environmentally friendly.

(iv) Identify the constraints which are likely to hinder adoption and implementation of sustainable farming practices.

(v) Assess contribution of tobacco farming to household income and food security.

(vi) Come up with recommendations for improvement of sustainable tobacco farming and processing.

1.4 Conceptual framework

The conceptual framework for this study (Figure 1) is based on the assumption that smallholder tobacco farming practices are influenced by several factors. The majority of smallholder farmers in Tanzania living in rural areas and they lack access to information on new technologies and improved farming practices. However, it is arguable that, poor farming practices are the main factor which contributes to low production and environmental degradation. The study assumed that socio economic factors such as age, educational level, household size and income influence adoption and implementation of improved farming practices. The framework shows a set of independent variables which influence the process of adoption of improved farming practices. In this study land size and tillage, access to inputs and extension services, awareness on the forms of environment degradation and conservation measures, curing practices and household income and food security are independent variables while the dependent variable is improved farming practices.

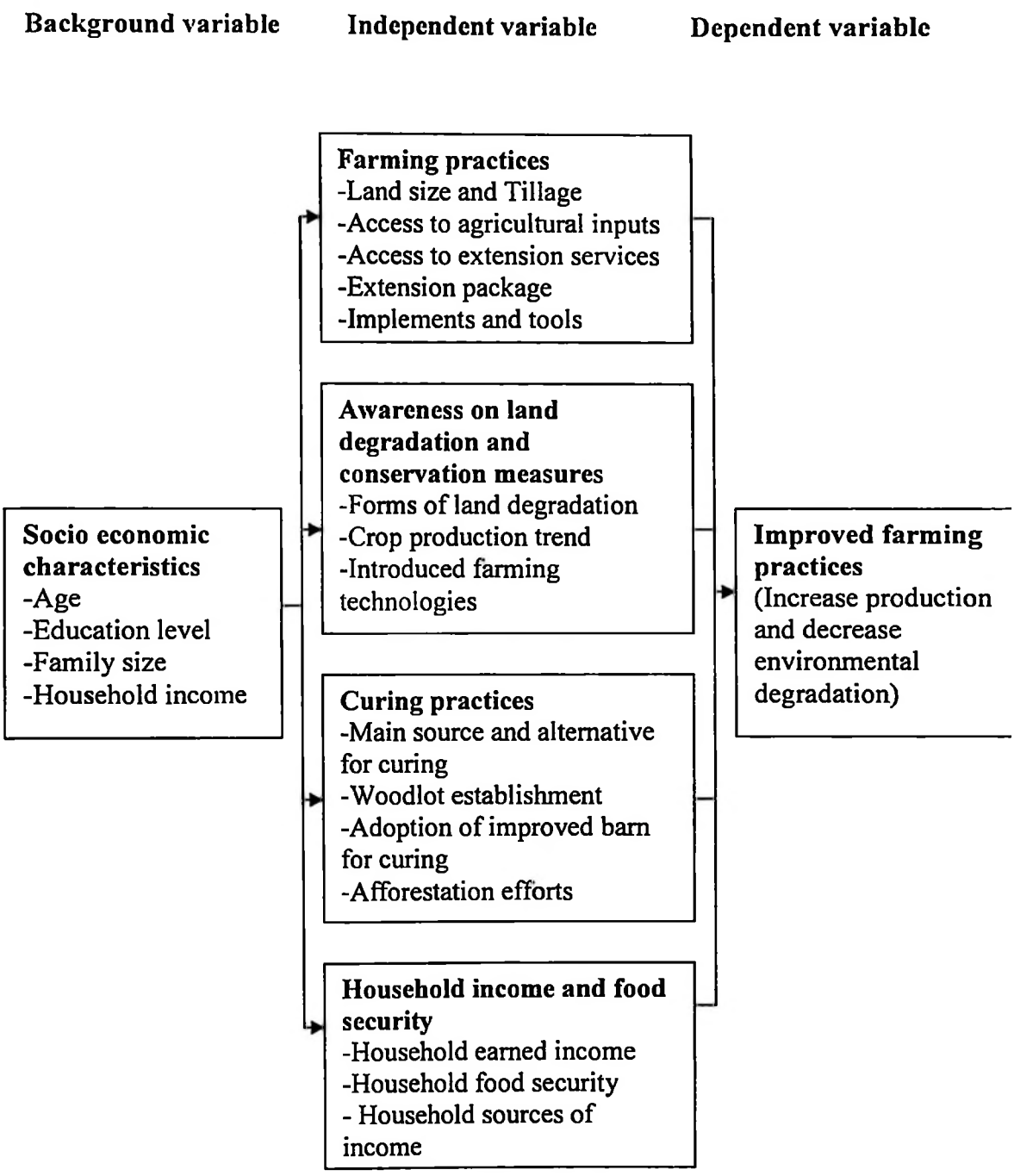

Figure 1: Conceptual framework.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 An overview

World tobacco demand was expected to increase until the year 2010 due to population and income growth but at lower rates than in the past. World tobacco production was projected to reach over 7.1 million tonnes of tobacco leaf in the year 2010. This is lower than the record of tobacco produced in 1992 of 7.5 million tonnes. About 100 countries in the World produce tobacco. The major producers are China, India, Brazil, the US, Turkey, Zimbabwe and Malawi, which together produces over 80 percent of the world's tobacco. China alone accounts for over 35 percent of world production (FAO, 2004). World tobacco leaf exports from 1998-2000 averaged 1.98 million tonnes per year which the FAO expects to grow by 1% to 2.2 million by 2010 where developing nations are responsible for almost 65% of global tobacco exports while developed countries account for the remainder. Domestic economies of Zimbabwe and Malawi depend most heavily on tobacco exports to the rest of the world (Workman, 2006). Tanzania produces 2 percent of worlds tobacco production and it is the third biggest African tobacco exporter after Zimbabwe and Malawi with export reaching 44 316 tonnes in 2004 (Traveller, 2005).

Irrespective of income generation, tobacco production in the world contributes to environmental degradation. Deforestation and soil erosion are the major forms of environmental degradation resulting from tobacco farming. Nearly nine million acres of land are deforested annually for tobacco production. In South Korea and Uruguay,

tobacco related deforestation accounts for more than 40 percent of the countries' total annual deforestation. Apart from land erosion, deforestation also affects the atmosphere, by raising the level of carbon dioxide emissions responsible for global warming. Scientists affiliated with the climate research group; Global Canopy Program in England have reported that nine million acres of land is deforested annually for tobacco production accounting for nearly five percent of greenhouse gas emissions (Farrell, 2007). In developing countries an estimate of 200 000 hectares of forests and woodlands are removed each year due to tobacco farming. For example, in one region of the Namweran Highlands in Malawi where only three percent of the farmers grow tobacco, nearly 80 percent of the trees cut down each year are used for the curing process. Such a rapid depletion of trees in an already semi arid climate will certainly lead to desertification. Parts of Uganda are currently losing much of their arable land as the topsoil eroded because of deforestation resulted by tobacco farming (Idrc, 2004).

2.2 Tobacco production status in Tanzania

Tanzania produces three types of tobacco; which are Flue Cured Virginia (FCV), Fire Cured Tobacco (FCT) and Burley Tobacco (BT). The main tobacco growing areas are Iringa, Tabora and Mbeya regions, which grow flue-cured tobacco. Ruvuma, Kagera and Kigoma regions grow fire-cured tobacco while burley is widespread in Morogoro, Tanga, Lindi and Kagera regions (Obonyo, 2008). Flue cured virginia accounts for 80% of the total tobacco grown in the country. It is mainly produced in Iringa and Tabora region, Fire cured tobacco accounts for 15%, whereas 99% of the fire cured tobacco comes from Ruvuma region in the district of

Songea. Burley tobacco is only of minor commercial importance and its national production volume is relatively small (Johannes *et al.*, 2005). Tobacco production in Tanzania had increased by 95 per cent from 2701 in 1961 to 50 800 tonnes in 2008, while the area under tobacco production increased by 85 percent from 5261 to 36 000 hectares within the same period (Mirondo, 2010).

Traveller (2005) reported that tobacco production techniques in Tanzania remain very labour intensive and tobacco yields are generally low. For example, between 600 and 1500 kilograms per hectare were produced in Tanzania compared to 1800 kilograms per hectare in Malawi and 2000 kilograms per hectare in Zimbabwe. He further noted that the major reasons for low tobacco production in Tanzania include; weak links between extension services-research and farmers, poor crop husbandry practices and high level of post harvest losses. Other constraints are continued use of hand hoe, high cost and unreliable supply of agricultural inputs, lack of training to extension staff and farmers, low staff motivation and lack of supervision from District level, limited information about prices and quality information (USAID, 2006). Others are poor transport and communication infrastructure and erosion of natural resource base and environment degradation (Nyoni, 2007).

A ten year tobacco production programme which was launched in 2002 is among Government efforts and tobacco stakeholders to increase production in the Country. Under the programme an increase in production of up to 110 000 tonnes of tobacco by the year 2012 is anticipated with average yield of 1000 kilograms per hectare. The programme emphasizes appropriate use of inputs and extension personnel (DMG,

2002). According to Keenja (2004) other efforts taken by the Government to improve tobacco production include increasing partnership between the public and private sector in financing and carrying out tobacco research through Tobacco Research Institute of Tanzania (TORITA), provision of training opportunities to farmers and extension workers on tobacco production tailor made courses at Tumbi training Institute. Improvement of the research- extension-farmer linkages is also emphasized.

2.3 Socio-economic importance of tobacco production

FAO (2003a) reported that tobacco plays a significant role in the economies of many countries in the world because it is a source of employment and governments depend heavily on revenues raised from the value added tax on tobacco.

2.3.1 Economic contribution.

According to FAO (2003a) tobacco production significantly contributes to economic growth in most countries. In Brazil for example, some 135 000 families produce tobacco as their main economic activity in 2000/2001 cropping year average gross income per family farmer reached R$ 9165 (US$5000). Tobacco is regarded as one of the few crops that generate income on small plots of land and because it effectively utilizes family labour and helps to mitigate the rural exodus which has become a major problem in recent years. Zimbabwe is the largest producer of tobacco leaf in Africa and the world's fourth largest producer of flue-cured tobacco after China, Brazil and the United States. Malawi is one of seven countries that

derive at least 1 percent of export earnings from tobacco. Burley leaf from Malawi makes up 6.6 percent of the worlds tobacco exports and accounts for over 70 percent of Malawi's foreign earnings. Tobacco sales generate 165 million dollars per year for Malawi, with tobacco making up 53 percent of Malawi's exports (Wikipedia, 2010).

In Tanzania, the Virginia flue cured (VFC) is the major type of tobacco produced in Miombo woodlands. This type of tobacco is produced mainly for export and it fetches higher and reliable market prices, compared to the other types, which are produced mainly for local consumption. Tobacco production accounts for 9 percent of total exports earnings and 15 percent of all agricultural exports. During the year 2002 tobacco export earning was USD 50.3 million (Traveller, 2005) while total value of tobacco export in 2006 reached USD 65.2 million. The crop is a source of government revenue through various taxes. According to Joseph (2006) in 2004 the Tanzania Cigarette Company (TCC) paid taxes to the government amounting to USD 58.3million. Also tobacco production was highest in terms of fetching foreign exchange compared to other traditional crops (URT, 2007). A total of Tsh. 340 billion has been collected by Tanzanian Government as tobacco taxes in the last five years (Langa, 2010). Tobacco peasants in Urambo District had harvested a total of 15 million kilograms which earned them Tsh 41.1 billion at the average of Tsh 2500 per kilogram during financial year 2008/09. Also Urambo District council benefited from the crop by receiving taxes amounting to more than Tsh 1.2 billion (Kakwesi, 2010).

2.3.2. Employment

Tobacco, whether grown on small subsistence farms or large scale plantations, involves several stages and processes, which are predominantly labour intensive that require more human labour inputs than machinery and mechanization. The labour involved in producing tobacco is of considerable significance, and hence generate large scale rural employment (Abdallah, 2006). The crop offers employment opportunities in both tobacco farms and in the three processing factories in Morogoro and Ruvuma regions. In addition, the crop provides raw material for cigarette manufacturing factories, thus offering further employment opportunities in the country (Rweyemamu and Kimaro, 2006). In Tanzania tobacco farming and production employs 1.3 per cent of population, which is equal to 500 000 Tanzanians and their families depending on the crop for their live hoods (Jiang, 2009).

Selbar (2009) reported that tobacco production generates considerable rural employment in Zimbabwe. According to statistics, full time employment in the tobacco industry (whether directly or indirectly) accounted for approximately 250 000 jobs. This represented approximately five per cent of Zimbabwe's total labour force and approximately 25 per cent of formal employment, excluding all other incidental employment arrangements in the value chain that specifically services the tobacco industry. Tobacco is the leading export crop which accounts for 68.26 percent of Malawi foreign exchange earnings. The tobacco industry employs 1 728 000 people in tobacco production, grading and processing; almost twice total employment in the formal sector in Malawi (Agencia, 2006).

2.4 Environmental degradation

Tobacco agriculture in Tanzania is highly challenging due to environmental degradation; although it is one of the major cash crops which contribute to economic development. Deforestation is largely a result of shifting cultivation and tobacco curing process. Land degradation is a result of poor farming practices which results into poor tobacco yields.

Environmental degradation is deterioration of the Earth's natural surroundings as a result of excessive exploitation of the available resources. These resources include water, air, flora, fauna, soil etc. Basically, the life on the planet is interwoven to such an extent that a decrease in a particular attribute triggers a domino effect on all the other attributes dependent on it (Abhijit, 2010). Sharma (2008) reported that the greatest challenge facing humanity in the world is environmental degradation. Main forms of environmental degradation are deforestation, desertification, pollution and climate change, loss of biodiversity and soil degradation that is an issue of increasing concern for the international community. He further suggesting that the people hardest hit by climate change and environmental degradation are those living in the most vulnerable areas, including coastal communities, small island nations, Sub-Saharan Africa and Asian delta regions. It is the poorest of the poor, who lack the resources to prepare, adapt and rebuild.

Sarah (2009) reported that tobacco production in the developing world increased from 57% in 1961 to 86% in 2006 resulting into serious environmental problems such as deforestation, soil erosion and desertification.

2.4.1 Deforestation

Deforestation (whether deliberate or unintended) is the result of the removal of trees without sufficient reforestation. It occurs when forest is converted to another land cover or when the tree canopy cover falls below a minimum percentage threshold which is nomally10% (FAO, 2003b). Africa holds 16 percent of the global forest area. From 2000 to 2005 it lost about four million hectares of forests annually, close to one third of the area deforested globally. To date, conversion to small-scale permanent agriculture has been the main contributor to forest loss, but investment in large scale agriculture could become a major driver of deforestation in the future (Wolfram, 2010). Tanzania has a total of 35.3 million hectare of forests out of which 16 million hectare comprise of reserved forests, two million hectare are forests in national parks and the rest, 17.3 million hectare (49% of all forests), are unprotected forests in general land. The rate of deforestation in Tanzania, which is estimated at 412 000 hectare per annum, is taking place mostly in the general land forests (FAO, 2006a). Deforestation in Tanzania has spread rapidly, affecting both closed tropical forest and more open woodlands. Very crucial factor associated with deforestation is population growth reinforced by various underline causes such as poverty and unequal access to land. Since independence population has grown nearly threefold from slightly over nine million to over 24 million in 1990 and reach about 43 million in 2008. Estimates on deforestation from Tanzanian forestry division indicated that 130 000 to 500 000 hectare per year are deforested, 0.3 percent per year of rainforest area was converted from the forest to other more open land use classes. Also 0.5 percent per year of the area outside the reserved rainforest was converted from woody vegetation to cultivated land and wooded grasslands. Concerning closed

forest it was assumed that half the cleared area will not revert to forest because of soil degradation and soil erosion caused by clearing. Loss of forest not only results in temperature change but also loss of biodiversity dependent on this forests (Hunt, 2010).

Tobacco related deforestation is substantial and much larger than what had been anticipated by local communities and governments. It is estimated that 200 000 hectare of forests are removed by tobacco farming each year. Deforestation mainly occurs in the developing world, amounting to 1.7% of the global net losses of forest cover or, on an average of 4.6% of the total national deforestation in countries where tobacco is cultivated. Environmental degradation criticality exists in 35 countries with an estimated serious degree of tobacco related deforestation, mainly in southern Africa, the Middle East, south and East Asia, South America and the Caribbean (Reddy, 2004). Most significant environmental impact relates to deforestation caused by the huge demand for wood used in drying and curing tobacco. It is estimated that tobacco production accounts for five percent of Africa's total deforestation, 12 percent of deforestation in Southern Africa and for 20 percent of deforestation in Malawi. In Malawi, Tanzania and Zimbabwe deforestation caused by tobacco production is particularly serious and is not only a threat to biodiversity, but also to the sustainable production of tobacco itself. Wood shortages as a result of deforestation in the main tobacco producing areas are threatening both the volume and quality of output. In Malawi, where the problem is probably greatest, the quality of tobacco is being affected by shortages of poles and thatch for proper construction of curing barns (Stockbridge, 2006). Tobacco related deforestation destroys

vegetative cover that contributes to soil erosion, flooding and famine, and contributes to global warming. Deforestation affects the atmosphere, by raising the level of carbon dioxide emissions responsible for global warming. About 51 million acres cut down every year account for nearly 25 percent of heat trapping (Otañez, 2008). It is estimated that about 15,500 hectares of forests deforested by tobacco farmers every year in Tanzania (Mirondo, 2010). Forest clearing for tobacco production is the major factor for reduced biomass and changes in vegetation structure which results to the potential loss in ecological and hydrological function of the woodlands. Change in land ecology contributes to the changes in soil fertility, surface temperature, soil moisture and increase in wind speed. Changes in land hydrological cycle can influence droughts and the increase runoff of rainwater as a result into low recharge of the underground water and thus depletion of aquifers (Malley *et al.*, 2007).

2.4.2 Land degradation

Land degradation is reduction or loss of biological or economic productivity resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as soil erosion caused by wind or water, deterioration of the biological or economic properties of soil, and long-term loss of natural vegetation (Ian *et al.*, 2008). Agricultural productivity in most of Sub Saharan Africa has been stagnant or declining. This is the only region in the world where average cereal yields have not significantly increased and per capita food production has declined since the 1980. Land degradation is a major cause of poor agricultural performance. Nearly two thirds of agricultural lands in Africa were estimated to have degraded between 1945 and 1990

with serious degradation involving major loss of productivity on nearly one-fifth of agricultural land. The most important forms of degradation are soil erosion, caused by both water and wind and soil nutrient depletion, caused by overgrazing, devegetation, crop production on fragile lands without sufficient soil cover or use of conservation measures, declining use of fallow, and limited application of soil nutrients (Nkonya *et al.*, 2008). In the Southern Africa region land degradation occurs mostly from soil erosion, loss of nutrients, depletion of organic matter and acidification and biological depletion. Other factors which contribute to land degradation in the region include compaction from overgrazing of rangelands, uncontrolled burning and improper cultivation of steep slopes, alternating flooding and crusting, salinization and pollution which all combine to cause degeneration of the fragile ecosystems covering large expanses of the region. High poverty and low literacy levels common among the rural population, low technological capacity, poor governance, and poor management policies complicate land management process (Msangi, 2007).

Land degradation is a major problem in most areas of Tanzania. It is mostly manifested in the form of severe soil erosion, siltation, and loss of soil fertility. This problem is largely a function of various human activities including overgrazing, over-cultivation, and deforestation. Inappropriate farming techniques are probably the most important human activity that causes land degradation. These features of land degradation problem lead to low crop production in many areas that are severely affected (Madulu, 2004). Credit facilities in terms of agricultural inputs, coupled with other incentives by tobacco companies, have fuelled tobacco farming on agricultural lands, which,

has led to serious threat for food security and environment problems (Harun, 2010). Maitima *et al.* (2009) reported that land degradation results to a remarkable decline in soil nutrients results a decline in soil productivity due to deterioration of chemical, physical and biological properties. The main reasons for the decline, besides soil erosion, are decline in organic matter and soil biological activity, degradation of soil structure and loss of other soil physical qualities, reduction in availability of major nutrients Nitrogen (N), phosphorous (P), potassium (K) and micronutrients and increased toxicity, due to acidification and salinisation. He furher reported that decline in soil productivity in most cultivated soils in East Africa leads to yield declines. This decline in yield has been attributed to the loss of plant nutrients through plant removal, erosion, leaching and deterioration of so physical conditions soil organic carbon and major plant nutrients. In Tanzania, most farmers in the tobacco growing areas are switching into tobacco farming at the expense of the other crops due to provision of loans in terms of inputs such as fertilizers and pesticides by the tobacco companies. This has resulted into serious land degradation due to continuous use of inorganic fertilizers with little efforts directed into management of soil organic matter.

2.4.3 Tobacco curing practices.

Virginia flue cured (VFC) is the major type of tobacco produced in Miombo woodlands. It is a variety of choice as it sells at a higher price than air dried tobacco. Flue curing is the process in which the tobacco leaves are dried under artificial atmospheric conditions by regulating the temperature and humidity to obtain leaves with desired qualities. Flue curing takes its name from the fact that the barn is

provided with a system of large pipes or flues that carry the flue gases inside the barn through out the curing period. Flue curing is done in a specially constructed room called curing barn (Manickavasagan *et al.*, 2007).

Chapman (1997) reported that standard way of expressing the quantity of wood used in curing is Specific Fuel Consumption (SFC) which is the number of kilograms of wood required to cure one kilogram of tobacco. The International Forest Sciences Consultancy (IFSC) report suggests that an average cigarette contains 1.3 gram of tobacco and an average mature tree in the African Savannah has a volume of $0.12m^3$ and weighs about 90 kilogram, thus the SFC implied that 230 kilogram of wood for one kilogram of tobacco. Similarly, the report argues that if an average tobacco yield is 1200 kilogram per hectare and a typical savannah forest hectare contains $80m^3$ or 60 tonnes of wood, then one hectare of trees are felled to cure half hectare of tobacco. Wolfram *et al.* (2010) reported that in 2008, about 70% of the total global tobacco production equal to 4 175 400 tonnes farm sales weight purchased from the farmers was Flue Cured Virginia (FCV) tobacco. Fire cured tobacco represents less than 1% of the world production, with 54 400 tonnes. The largest producers of FCV are China (2 300 000 tonnes), Brazil (608 000 tonnes), India (279 300 tonnes), United States (218 600 tonnes), European Union (128 000 tonnes) and Argentina (84 800 tonnes). In Africa, major producers of FCV are Tanzania (51 233 tonnes), Zimbabwe (48 843 tonnes), Malawi (23 767 tonnes), Uganda (16 000 tonnes), Kenya (16 000 tonnes) and Zambia (14 069 tonnes). He further reported that flue cured and dark fire cured tobacco are the two types of tobacco which use wood for the curing process. Other common energy sources used for the curing process are coal, oil and

gas. The differences between the regions are considerable while the use of wood is of minor importance in Europe and North America. It is widely used in South America, Africa and to a lesser degree in Asia and the amount of wood used for curing varies substantially according to the barns used and the techniques applied. The range of estimations for the amount of wood used is between three kilograms of wood per kilogram of tobacco for an energy efficient barn up to 30 kilograms of wood per kilogram of tobacco for inefficient traditional barns.

Stockbridge (2006) reported that it is estimated that when wood is used as the fuel for curing tobacco, 19.9 cubic metres of it are used to cure one metric tonne of tobacco. The production of one kilogram of tobacco consumes 20 kilograms of fire wood for curing and between ten and forty tons of dry wood are used to cure one tonne of processed tobacco (Otañez, 2008). Sarah (2009) reported that in Brazil, the 200 000 tobacco-growing families use an average of three kilograms of wood to cure one kilogram of tobacco. Between 1990 and 1995, tobacco growing accounted for 26% of deforestation in Malawi and Urambo tobacco growing area in Tanzania land clearing for tobacco growing is responsible for 3.5% of annual deforestation while farmers use an average of $23m^3$ of stacked wood per season for curing. Tobacco growing in Tabora region has decimated the Miombo forests and the negative consequences of tobacco farming are clearly visible in the form of forest devastation, erosion and abnormally low water levels. Yanda (2010) reported that in Tanzania estimated total area cleared for tobacco growing and curing increased steadily from about 20 000 hectare in 1990/91 to about 65 000 hectare in 1995/96. The impact of free market economy and trade liberalization policy in Tanzania, which started in late

1980s to early 1990s, appears to be a sole factor behind such a pattern. Multinational tobacco companies such as DIMON Inc. and TLTC provide inputs to the peasants and increased producer prices, which becomes an incentive for clearing more land in order to produce more tobacco. Area transformed from natural vegetation to cultivated land between 1984 and 1995 was 4.7% compared to 11.2% that was transformed between 1995 and 2000. This implies that changes in land cover type from natural vegetation to cultivation that took place between 1995 and 2000 are about twice the changes that occurred between 1984 and 1995. Abdallah *et al.* (2007) reported that tobacco curing is among of the major causes of woodland degradation and contributes to declining of Miombo woodlands at a faster rate.

Traditional tobacco curing method is based on natural convection where fresh tobacco is hung loosely inside a curing barn and heat is provided from a hot flue pipe connected to a furnace and its thermal efficiency was reported to be very low, being around 10 to 15% or even less. Due to the adverse environmental effects of traditional tobacco-curing practice, there is an urgent necessity to improve efficiency of the curing process by improvements in the barn structure, the furnace and flue-pipe system design (Tippayawong *et al.*, 2004). Gwata (2010) reported that Flue-cured tobacco is the variety of choice (as it sells at a higher price than air dried tobacco) in developing countries, so curing is unavoidable. Farmers must be encouraged to use alternative fuels to wood, such as straw, sawdust and coal. For example, Zimbabwe's Hurungwe Rural District Council issued a directive in June 2010 which makes it mandatory for all tobacco farmers in the district to use coal for tobacco curing, and the District Council entered into a partnership with colliery

project whereby the District Council buys coal from the colliery at subsidised prices, which registered tobacco farmers subsequently purchase. He further suggested that improving the efficiency of the curing process is therefore imperative. Increased energy efficiency and better combustion in the furnace can be achieved through improvements in the barn structure and furnace, improved insulation is of particular importance as it will subsequently reduce fuel consumption. Another practical energy-efficient curing measure is harvesting only ripe tobacco which requires a shorter curing time and thus less heat loss. According to Gwata the use of alternative energy should also be coupled with modified barn designs to reduce emissions because it is estimated that a barn with well insulated walls, roof and floor can save 10 to 20% of fuel consumed per cure.

2.5 Efforts to address environmental degradation.

Tanzania has, in recent years, experienced a very high rate of land degradation particularly deforestation. Unsustainable agricultural practices lead to high rate of soil erosion, especially on slopes and in dry lands. All along the Government has been taking measures to address various environmental concerns through various interventions. Mugurusi (2006), reported that Tanzania has been involved in a number of regional and Multilateral Environmental Agreements such as United Nations Convention to Combat Desertification (UNCCD); United Nations Framework Convention on Climate Change (UNFCCC) and The Convention on Biological Diversity (CBD). He further reported that at a national level, the Government has put in place a number of policies, programmes, plans, strategies, action plans and legislations to deal with various emerging environmental issues.

Examples include: The National Environmental Policy (NEP); National Environmental Action Plan (NEAP); National Action Programme to Combat Desertification (NAP); National Biological Diversity Strategy and Action Plan (NBSAP); The Environmental Management Act (2004) and The National Strategy for Urgent Actions on Land Degradation and Water Catchments. The National Strategy for Urgent Actions on Land Degradation and Water Catchments is a recent effort by the Government to deal with the serious degradation of land and destruction of water catchments and it emphasizes that tobacco, tea farmers and other large consumers of trees, firewood and charcoal to establish woodlots. Mugarula (2007) reported that the government through the National Environmental Management Council (NEMC) has been advocating for environmental preservation.

Velaug (2008) reported that Tanzania government enters a partnership agreement with Norwegian Government on deforestation efforts to combat deforestation and Climate change in 2008. This partnership on deforestation the Norway government will grant NOK 500 million to Tanzania for the period of five years also will support research, education and the development of pilot areas for reduced deforestation. Norway will also develop technologies and methods for the measuring and verification of carbon level changes.

Tobacco companies in Tanzania have already taken measures to address various environmental concerns through various interventions. The companies supply tree seeds to the existing cooperative societies in order to raise seedlings for smallholder farmer's woodlots. They also disseminate improved barn technology for tobacco

curing. Wolfram (2010) reported that The Association of Tanzania Tobacco Traders (ATTT) started a programme of tree planting and land regeneration in 2002 to ensure the sustainability of wood production as source of fuel to cure tobacco. The objectives of the project were to address environmental issues with full village involvement, to train the community members in tree nursery and forest management, to ensure self-sufficiency for the tobacco-growing community in terms of wood and to regenerate natural forest land. He further noted that programme covered an average of 43 351 hectare in total and ensured the raising of about 53 million trees in total, with a successful survival rate of 73% since 2002. Scott (2007) reported that ProBEC, ATTT and TLTC in the year 2006 up to 2007 had facilitated construction of 17 rocket barn, and the results shows that fuel consumption was reduced by 50% compared to the existing traditional barns. A total of 70 rocket tobacco curing barns have been built and pilot tested with farmers in the Tabora region in 2009/2010 cropping season (ProBEC, 2009).

Policy measures and institutional arrangements for forest resource management and Community based institutional arrangements significantly will contribute to biodiversity conservation in the Miombo woodlands in Tanzania implying the need for an enhancement of such arrangements and supporting the view that government authorities should continue to transfer control over the woodland resources back to the community level. Such arrangements can even contribute to the enhancement of tobacco production efficiency by disseminating of information and experience among small-scale farmers via extension programs or other forms of non-formal education (Johannes and Abdallah, 2005).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the study area

The study was conducted in Nzega District which is one of the six Districts of Tabora Region and it lies between longitudes 32°30' and 33°30' East and latitudes 3°45' and 5°00' South of equator. Administratively, the District is divided into 4 divisions, 37 wards and 135 villages. The District forms part of the central plateau of Tanzania, an area of flat and gently undulating plains broken places by prominent hills, ranging from 1100m to 1300m above the sea level. Nzega District is characterized by unimodal type of rainfall with an average annual rainfall of 700mm. The main economic activities within the District include crop production, livestock keeping and petty business.

3.2 Research design

A cross sectional research design was employed. This design allows data to be collected at one single point in time. It is used in descriptive research studies and is appropriate to social science research. The design is considered to save time and resources and is eventually used for determination of relationship between variables (Bailey, 1998).

3.3. Sampling procedures

A combination of purposive and random sampling procedures was used. Three wards were purposively selected on the basis that they are the most producers of tobacco in the District. These were Mambali, Magengati and Milambo Itobo. Two

villages were randomly selected from each ward. Sample size for each village was 40 respondents and random sampling procedure was used. A total of 240 respondents were the key responses of this study. This selection was be based on Bailey's (1998) observation, that regardless of the population size, a sample of 30 respondents is the bare minimum for studies in which statistical data analysis is to be done. A list of households in a village was obtained from existing village primary cooperative society's register and was used as a sampling frame. The sampling units were both males and females. Respondents were selected using a table of random numbers where names were listed in alphabetical order and their names were selected by matching them with the first number encountered in the table of random numbers. Focus group discussions and consultations with key informants were carried out in order to obtain overview information of the problem under study.

3.4 Data collection methods

3.4.1 Primary data

Several methods were used for collection of primary data. Methods used included household questionnaire survey, focused group discussions and consultation with key informants by using a checklist of questions and physical observation. The aim was to cross check and verify information obtained through these different methods based on the objectives of the study.

3.4.1.1 Reconnaissance survey

A reconnaissance survey was undertaken in six villages to provide insight of natural features, agricultural activities and social environment of the study area.

3.4.1.2 Pre testing and administration of the questionnaire

Structured questionnaire was the main instrument of data collection designed to undertake specific objectives. Pre testing of the questionnaire was done in a village similar to the study villages in terms of tobacco farming practices and curing aspects. Main reason for pre testing was to carry out necessary adjustment and corrections of the research instrument before questionnaire administering. Sample of the used questionnaire is presented in Appendix 1.

3.4.1.3 Use of focus group discussion

Focus group discussion was conducted after carrying out household interview. Group of twelve members in each village under study based on gender and age were used. The purpose was to obtain more clarifications and details of the collected data from interviews. A checklist was used to guide the discussion as per specific objectives (Appendix 2).

3.4.1.4 Use of key informants

Discussion and consultations with key informants were carried out in order to obtain an overview information of the problem under study as well as complementing information collected through household questionnaire and focus group discussion. Key informants used were village leaders, extension officers and District agriculture and cooperative officers. (Appendix 3).

3.4.2 Physical observation

Physical observations were carried out to gather information such as forms of land degradation, curing practices, introduced environmental conservation technologies

and household livelihood patterns and resources. Information was collected mainly by way of taking photographs and documentation in tables.

3.4.3 Consultations

Consultations with officials from District Agriculture and Livestock Department office (DALDO), District cooperative department and village Agriculture Marketing Cooperative Society (AMCS) were carried out in order to complementing information collected from other methods.

3.4.4 Secondary data

Secondary data were collected from various reports and publications. Main sources of data were from central government, Nzega District Council and Sokoine National Agricultural Library (SNAL). Online reports, journals, magazines were another source of data for this study.

3.5 Data processing and analysis

Descriptive statistics was used for analyzing both collected data (qualitative and quantitative).Data collected were summarised, coded and analysed using the Statistical Package for Social Science (SSPS 12.0) computer software. Qualitative information from observation, verbal discussion was broken into units of information and synthesized their meaning by using contextual analysis. Frequencies, percentages and means from cross and multiple tabulations were used in descriptive analysis in order to determine distribution of variances among the respondents.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter examines respondents' opinions on tobacco farming practices in the study area and it is divided in six sections. Section 4.1 examine household characteristics, 4.2 farming practices, 4.3 major forms of land degradation and conservation measures adopted, 4.4 existing tobacco curing practices, 4.5 tobacco contribution to household income and food security and section 4.6 examines major constraints to sustainable farming practices in the study area.

4.1 Household characteristics

4.1.1 Age of the respondents

Results in Figure 2 indicate that most of respondents in the study area were adults with age ranging from 18 to 65 years. About 4% of the respondents were youth with age below 18 years. Results further show that 14% of the respondents were elders with age above 65 years. These results show that a significant proportion of the population in the study area is composed of adults suggesting a potential labour force in the area.

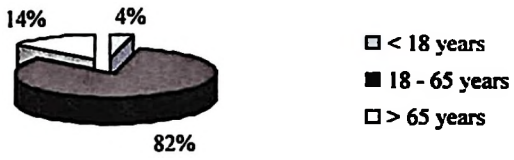

Figure 2: Age of respondents in the study area

Okike (2005) reported that adult farmers have more potential labour contribution in agricultural production, environmental conservation and other social activities. He

further observed that adult farmers may have more experience and are able to assess characteristics of a new technology before adopting it. Farmer's age is related to crop productivity, farmers with more than 45 years had a lot of experience and skills on farming practices (Epeju, 2010). More years of experience in farming is associated with higher levels of agricultural production. Experience makes farmers adoption decisions more efficient in carrying out the tasks necessary to expand the intensity of the technology, tasks such as the gathering and interpretation of information relevant to making the decisions (Teklewold *et al.*, 2006)

4.1.2 Education level

Table 1 summarizes results of education level of the respondents in the study area. Majority of the respondents (80%) had Primary School education level. About 9% of respondents had Secondary school education and 6% had adult education where as 5% of sampled households had no formal education. The results suggest that the majority of the respondents have modest level of education that can enable them to adopt extension services packages which will enable them to adopt improved tobacco farming practices.

Table 1: Education level of household in study area

Variable	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Education level	Frequency	%	Frequency	%	Frequency	%	Frequency	%
No formal education	2	3	5	6	6	8	13	5
Adult education	5	6	2	3	8	10	15	6
Primary education	66	83	69	86	56	70	191	80
Secondary education	7	9	4	5	10	13	21	9

Generally, farmer's education level is a significant aspect in adoption and implementation of improved farming practices and new introduced agricultural technologies. Amir (2006) observed that farmer's education background is an important factor in determining the readiness to accept and properly implementing different farming interventions. Yonghong and Katrina (2007) reported that skills and education increase working efficiency and productivity making the household able to use and adopt new agricultural technologies resulting into more income. Better education among the farmers might have influenced their positive disposition towards soil conservation and new agricultural introduced technologies, literates are usually more experienced and aware about the significance of new technologies to livelihood (Junge *et al.*, 2009).

4.1.3 Household size

Results of the household size are summarized in Table 2. These results indicate that about 35% of the households in the study area had family size ranging from 7 to 10 members where as about 27% of households had family size ranging from three to six members. About 32% of households in study area had family size with more than 10 members and 6% had family size with less than three members. The results suggest that the majority of respondents had family size with more than seven members which could be an important source of labour force for agricultural production in the study area if properly utilized.

Table 2: Household size variation in study area

Variables	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Household size	Frequency	%	Frequency	%	Frequency	%	Frequency	%
< 3	4	5	3	4	8	10	15	6
3 – 6	21	26	20	25	23	29	64	27
7 – 10	30	38	32	40	22	28	84	35
> 10	25	31	25	31	27	34	77	32

Tiamiyu *et al.* (2009) observed that family size determines how much family labour will be put into use on the farm and also determines the extent to which a household is able to respond to innovative change. He reported that family size influence technology adoption positively. Makarius (2006) observed that with large size of labour force it is relatively easier to participate in various interventions as opposed to smaller labour force that merely concentrates on production of basic needs. He further observed that inadequate labour force in most cases is one of major limiting factors associated with low implementation of agricultural practices. Mitinje *et al.* (2007) observed that big household size influences the size of the land to be cultivated because there could be enough labour for the farming activities. They noted that house hold size is the major source of farming labour force in rural areas .Aikaeli (2010) observed that rural household per capita income increased as the size of the household labour force increased with the proportion of active working household members aged 15 to 71 years. He further noted that statistically, a 1% increase in the household labour force could increase household per capita income by around 0.5%.

4.1.4 Household income

Figure 3 shows results of household income. These results indicate significant variation of household income in the study area. Most of the household (49%) had income ranging from Tsh 1 000 000 to 5 000 000 per year. Respondents with income lower than Tsh 1 000 000 per annum constitute 40% where as few respondents 11% had income of more than Tsh 5 000 000.

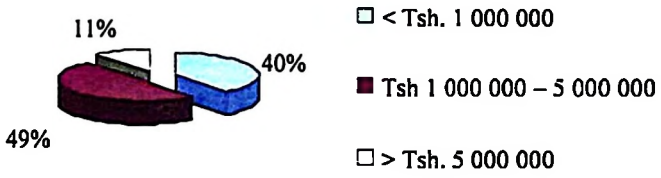

Figure 3: Household income in the study area.

Generally, results indicate that a significant proportion of the population has moderate income. According to World Bank (2009) Tanzania Per Capita averages USD 500 which is about Tsh. 800 000 per year. This is in conformity with the obtained results which indicate that the majority of the respondents have income ranging from Tsh 1 000 000 to 5 000 000. Household income has an implication on the adoption of improved farming practices and new introduced farming technologies. Zaibet and Dunn (2005) who observed that farmers with high income are more likely to implement new interventions than those with low incomes because high income increases farmer's ability to hire labour, purchase inputs and meet other costs associated with agricultural production and land conservation practices. Watengere (2009) observed that the adoption of farming technology is financially demanding farmers rich in terms of income are more likely to adopt new farming technology than poor farmers. Chitakira and Emmanuel (2010) reported that many

smallholder farmers would not have adequate resources to make meaningful investment in agriculture because of their low income.

4.2 Farming practices

4.2.1 Land size and tenure system.

Results in Figure 4 indicate that the majority of respondents in the study area (66%) own land ranging from 2 to 5 hectares. About 15% respondents have less than 2 hectare where as 19% of respondents own land more than 5 hectares. Generally, these results indicate deficiency in terms of land resource. This correlates with physical observations and responses from the consultations with key informants that land availability is decreasing over time due to fragmentation which is mainly caused by increased population.

Figure 4: Land size

Abdallah and Monela (2007) reported that demand for land has still been driven by demands in agricultural production, villagelization programme and habitation due to increased population. Fidelia and chiddi (2009) observed that a unit increase in hectare of farm size cultivated resulted to increase in the probability of the sustained adoption decision behaviours. This could be explained by the fact that large farm size pre-supposes large farm asset. Thus, farmers who had more assets had more dispositions to sustain technologies than those who had less.

The results in Table 3 indicate significant variation in land acquisition in the study area. Most of the respondents (68%) acquired land as communal, family or inherited land. Results further indicate that 19% owned land by purchasing, 8% of the respondents owned land through clearing forests where as only 5% rented land.

Table 3: Land acquisition

Variable	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Land acquisition	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Inherited/Communal	51	64	61	76	51	64	163	68
Bought	18	23	12	15	15	19	45	19
Hired	5	6	4	5	3	4	12	5
Cleared forest	6	8	3	4	11	14	20	8

These results indicate that majority of the respondents in the study area do not posses their own land rights suggesting insecurity in terms of land ownership; this force them to depend on credit facilities in form of agricultural inputs from tobacco companies only. Legal land ownership has an implication in long term agricultural investments with multiple option on accessing services from other existing financial institutional. Kerr and Ghihn (2005) observed that farmers cultivating on their own pieces of land were significantly characterized by high and long term investment on land conservation technologies. Quan (2006) reported that communal, family and individual are principal forms of land tenure in Africa with customary rights. Main features of customary rights are a legitimate land rights derived from kinship with or inheritance from members of a land holding group who have established rights historically by kinship. He further observed that adequate guarantees of land rights security form a critical part of the enabling environment for smallholder farming in

order to facilitate access to credit services. Smallholder farmers must adapt to forms of documentary evidence of ownership other than the traditional land titles. Sebopetji and Belete (2009) observed that most of the land owned by small-scale farmers' is communal or inherited without title deeds, so there are little possibilities of long term financing and access to credit. Small scale farmers face the problem of lack of collateral in most areas. Deininger (2010) reported that land is an ideal form of collateral. Its usefulness for this purpose can be enhanced if a formal and low-cost way to unambiguously identify land ownership without the need for physical inspection, inquiries to neighbors or interaction with an extensive bureaucracy is available. Such easy access to reliable information on land rights reduces the transaction cost of selling the land in case of default and, if land sales markets are sufficiently liquid, will make it easier for banks to use land as collateral for credit.

4.2.2 Land preparation.

Figure 5 shows methods of land preparation in the study area. Ox ploughing is the most common method used for land preparation followed by hand cultivation. During the field study the questionnaire was designed to identify the use of tractors in the study area. Responses from identified sample under study indicated that Ox ploughing with hand cultivation is the only methods used in land preparation in the study area. That being the case, the results suggest that efforts should be directed into enabling the farmers to access credits of improved farming preparation technologies like tractors aimed at increasing production and reducing dependence on labour intensive techniques instead of provision of credit facilities in terms of agricultural inputs only (Fertilizers, seeds and pesticides).

Figure 5: Land preparation

FAO (2008) observed that farm power in African agriculture, especially Sub Saharan Africa (SSA), relies to an overwhelming extent on human muscle power, based on operations that depend on the hoe and other hand tools. Animal and tractor power have both declined in African agriculture in the past few years, making agriculture yet more reliant on manual methods. FAO (2006b) reported that typical farm family that is reliant solely on human power can only cultivate in the region of 1.5 hectare per year. This will rise to 4 hectare if Draught animal power (DAP) is available and to over 8 hectare if tractor power can be accessed. Draught animal power (DAP) is generally considered to be an affordable and sustainable source of power for small scale-farmers. Apart from tillage, transport and other field operations, work animals can also be used for logging, pond excavation, and rural road maintenance

4.2.3 Major agricultural inputs used by tobacco farmers.

Inorganic fertilizers, improved tobacco seeds and pesticides are the main agricultural inputs used by most of the interviewed respondents in the study area. The use of organic manure is very minimal. Table 4 shows agricultural inputs used in the study area. Only six out of 240 interviewed households indicated that they use organic manure as a fertilizer source in tobacco farming.

Table 4: Agricultural inputs used mainly by respondents

Responses	Tobacco agricultural inputs (n=240)					
	Inorganic manure		Organic manure		Other chemicals	
	Frequency	%	Frequency	%	Frequency	%
Apply	6	3	234	97	222	92
Don't apply	234	97	6	3	18	8

Generally, the results in Table 4 relate with key informants that farmers depend on agricultural in puts from the existing primary cooperative societies under loan scheme. Farmers involved in tobacco production register themselves to the existing primary cooperative societies in order to access services provided in tobacco production and marketing. These primary cooperative societies make projections of the input needs for member farmers and the projected type and amount of inputs for both maize and tobacco is sent to the leaf dealers to which the society is affiliated. Then these primary cooperative societies distribute agricultural inputs to the members under loan scheme according to the agreement with leaf dealers.

4.2.3.1 Types of fertilizers and Agro-chemicals used.

Table 5 shows multiple responses on types of fertilizers used. Animal manure are hardly used for tobacco production. Most common fertilizers used are N carriers. These are CAN, Urea and NPK fertilizers. Results indicate that on average farmers use 42 Kg N/ha which is very low compared to recommended fertilizer application rates in Zimbabwe which is 160 Kg N/ha (FAO, 2006c).

Table 5: Types of fertilizers used

Variable	Frequency	Percent
UREA	126	24
NPK	173	32
CAN	234	44

Figure 6 shows type of agricultural chemicals mainly used by respondents. Confidor and Decis are the main chemicals used in the study area. Confidor is the agricultural chemical used by most of the interviewed respondents and its count for 62% Decis count for 38%.

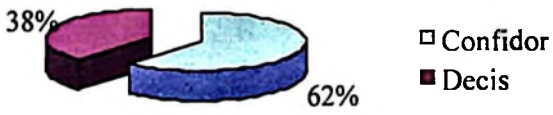

Figure 6: Tobacco agro-chemicals used in the study area.

4.2.3.2 Tobacco seeds.

Figure 7 shows type of seeds mainly used by respondents in the study area. Most of the interviewed respondents (95%) indicated that they use improved tobacco seeds where as 5% use local seeds.

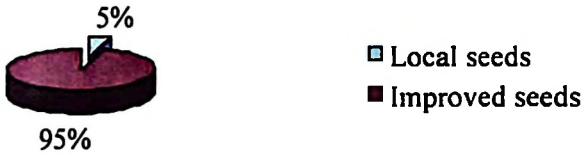

Figure 7: Types of seeds mainly used by respondents

Alliance for a Green Revolution in Africa (AGRA) which aims at improving productivity and incomes of smallholder farmers in Africa has already released 68 new varieties of improved seedbred for traits such as resistance to insects, disease, and drought; educated thousands of local agro-dealers to share agricultural knowledge with small farmers, Tanzania Seed (Tanseed), an AGRA grantee, provide high quality improved seeds, as well as provision of training in proper agricultural techniques, to smallholder farmers (Bill and Melinda gates foundation, 2010). Smallholder farmers live at subsistence level that attracts them to adopt improved varieties of seeds which can possess high yielding and early maturing characteristics, earn more income and thereby helping in raising their standard of living (Idrisa *et al.*, 2010).

Figure 8 Shows suppliers of improved seed to tobacco farmers in the study area. Most of the interviewed respondents (74%) received seeds from tobacco companies whereas 20% received from the existing cooperative society and 6% from private input suppliers.

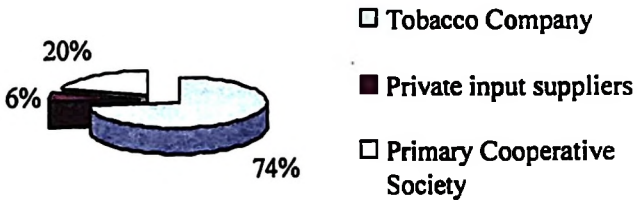

Figure 8: Suppliers of improved seeds to respondents

4.2.4 Extension services

Figure 9 shows the status of extension services in the study area. Most of the responds (93%) are able to access extension services whereas 7% of the respondents are not able to do so. These results suggest that there is adequate extension service for the tobacco farmers in the study area.

Figure 9: Extension services on tobacco farming practices received by Respondents.

Extension services is an important input in adoption of improved farming practices because extension services involve interaction between extension agents and farmers to induce changes attitude towards adoption of improved farming approaches and new farming technologies. FAO (2006d) observed that transfer of knowledge generated at field level with the aim of acquiring useful information and upward feedback from farmer is largely facilitated by extension agents. Atsan *et al.* (2009) reported that in today's world, market oriented economies agricultural extension has become an important structural policy tool to help farmers to be more competitive in the world market.

Figure 10 shows the main provider of extension services in the study area. Most of the respondents (82%) received extension services from tobacco companies and about 18% received extension services from the District Council through ward

extension officers. These results indicate that most of tobacco farmers depend on an extension officers provided to them by Tobacco companies which is not adequate.

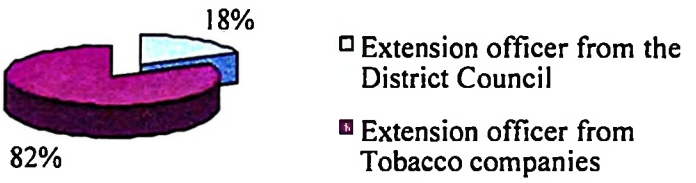

Figure 10: Provider of extension services in the study area.

Generally, the results are consistent with those of focus group discussions and consultations with key informants which indicated that Tobacco companies provide one extension officer to serve all registered tobacco farmers in each primary cooperative society. They also indicated that extension officers from the District Council are allocated at ward level and they are mainly responsible to provide extension services in other cash crops, food crops and animal husbandry. As it was expected, extension workers under District Council face a number of problems such as transport and other facilities for smooth extension delivery. This is a common situation in most villages in Tanzania. Extension workers from Tobacco Companies are supervising and or serving farmers who are under contract farming and provide extension services for tobacco farming practices only.

Mvuna (2010) reported that contract farming is not well known as an extension approach but as a commercial arrangement between an agricultural company and farmers driven by economic interests. Contractual arrangements have been initiated

for some crops (tea, tobacco, sugar cane), mostly by private agricultural business companies, to secure access to smallholders' produce. Under these arrangements, companies provide smallholders with inputs, credit and extension services while the smallholders agree to supply a specified quality and quantity of produce and to make repayments on any loan advanced to them. Anim (2010) observed that extension services should be designed to provide learning effects that go beyond production of the contract crop. It is difficult to assess the trade-off between the technical superiority that comes from specialization and the efficiency in delivery that comes from multi crop extension. In most cases, specialized extension services are often not feasible in very poor countries because farmers need much freedom as possible in managing their enterprises, particularly with respect to choice of crop mix and off-farm activities.

Figure 11 shows kind of advice on farming practices received by respondent's in the study area. About 50% of interviewed respondents received extension advice on farm preparation followed by harvesting and leaf grading (44%). Few (6%) respondents received advice on tobacco curing practices.

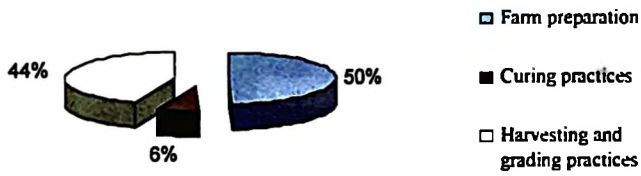

Figure 11: Kind of advice on farming practices received by respondents

Results correlates with responses from key informants that tobacco curing is the most challenging stage for the most of tobacco farmers in the study area. Key informants observed that most farmers do not follow extension advice on harvesting techniques and curing procedures. Most of the farmers use traditional barns for tobacco curing which can hardly cure harvested tobacco from one hectare according to harvested stages and number of days for curing. Key informants indicated that for proper tobacco curing a farmer must have at least three traditional barns in order to cure tobacco from one hectare based on the number of harvesting stages.

4.2.4.1 Frequency of visits from extension officer and training on farming practices

Figure 12 shows frequency of visits of extension officer to tobacco farmers in the study area. Most of interviewed respondents (79%) indicate that extension officers make visits during the crop season whereas 13% observed that extension workers make visits once per week and 8% observed that extension workers visit farmers once per month.

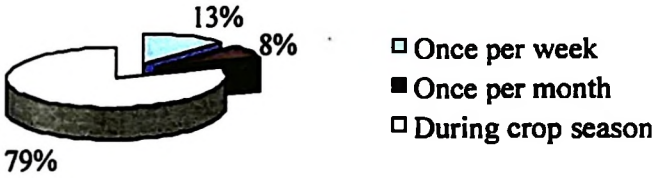

Figure 12: Visits of extension officer.

The results suggest that extension staffs are available for extension service throughout the growing season. But consultations with key informants indicated that

extension services are still inadequate in terms of number of extension workers. Tobacco companies provide one extension officer to serve registered tobacco farmers in each primary cooperative society but still do not satisfy the needs and requirements of farmers. The results are con Dogbe (2006) observed that frequency of visits is an important factor in adoption of technologies since extension is an open system service and a two way exchange between the farmer and the extension agent, although the decision is made by the farmer who must be provided with necessary information.

Figure 13 show that most of the respondents (94%) received training on tobacco farming practices whereas 6% did not receive training on tobacco farming practices.

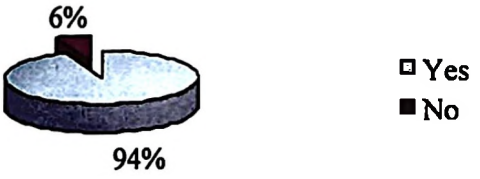

Figure 13: Access of train on farming practices

Generally, these results suggest that most of farmers in the study area are receiving training on tobacco farming practices. The results are in agreement with the previous ones which suggest that provision of extension service to tobacco farmers is not a major problem in the study area. Tesfaye (2010) observed that training is an important element in improving farmer's knowledge and changing attitudes towards adoption of technology. He further observed that education of farmers, wealth status, and level of aspiration, information seeking behavior; extension contact and family

size had significant influence on the knowledge of trained farmers compared to untrained ones. Mebalo *et al.* (2010) reported that great success has been achieved from farmers training in South African which helped some producers to form working groups, agricultural forums and associations.

4.2.4.2 Major training methods.

Results in Table 6 shows tobacco major training methods used in a study area. Demonstrations are the major training methods followed by farmer's field school and farmer's field study.

Table 6: Major training methods used in the study area

Variable	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Training methods	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Demonstration plots	45	56	51	64	45	56	141	59
Farmers field school	13	16	23	29	23	29	59	25
Farmers field study	17	21	6	8	12	15	35	15
In agricultural centre	5	6	0	0	0	0	5	2

Chowa (2010) observed that demonstrations are one of the most effective training methods. He noted that harmonized demonstrations are strategically mounted in the farming clusters and the village; these are plots or sites on a farm, field, garden or village used to train farmers on improved technologies, with resource limitations, a combination of methods and strategies in dissemination of messages and technologies helps to make an impact and improving livelihoods of smallholder farmers who have low literacy levels. Gillespie *et al.* (2009) reported that demonstration plots are of significant value in motivating small-scale growers to

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adopt better farming practices and offer greater access to cheaper disease-free seeds. The demonstration plots also act as a catalyst for development and potentially higher economic returns, resulting in sustainable and improved livelihoods. On-farm demonstration plots were used by most Agricultural extension agents to show different cropping methods and seed varieties (Timothy *et al.*, 2010).

4.3 Forms of Land degradation and conservation measures.

4.3.1 Awareness on existing forms of land degradation and major forms of Environmental degradation.

Results in figure 14 shows that most of the respondents (88%) are aware of the existing forms of environmental degradation while 12% are not aware. These results show that most of tobacco farmers in the study area understand the existing forms of environmental degradation which is an important aspect in terms of introducing environmental conservation strategies and new farming technologies.

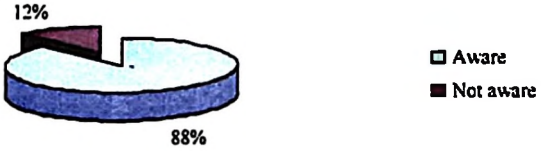

Figure 14: Respondents awareness on forms of land degradation.

Chizana *et al.* (2007) observed that farmer's perception, understanding and interpretation of factors and indicators that they relate to land degradation and soil fertility decline is an important factor in introducing and promoting soil and water conservation technologies.

Results in fig. 15 indicate that most of the respondents (89%) identified deforestation as one of the most serious environmental degradation followed by land degradation and loss of biodiversity in the study area.

Figure 15: Main forms of environmental degradation in the study area.

Mwita (2005) reported that growing of tobacco posses a lot of threats to the woodlands. Ecological functions of the woodlands are particularly threatened by the production of flue-cured tobacco, which accounts for 70 to 80% of the crop's total production in Tanzania. The threat comes from the large quantities of wood harvested from the natural Miombo woodlands for curing tobacco. One hectare of Miombo woodland is usually used to cure 450 kilogram (0.45 tones) of tobacco. Maitima *et al.* (2009) observed that land use has changed to more cultivated area and less bush, forests and grasslands. These changes have tremendously reduced areas with natural vegetation where in some sites there is hardly any natural vegetation, land cover conversion from natural vegetation to cultivation or grazing, land use becomes more complicated due to intensification and diversification as a result contributes to land degradation. The natural environment, with effects on food production through its role in water, nutrients, soils, climate and weather as well as on insects that are important for pollination and regulating infestations. The state of

ecosystems also influence the abundance of pathogens, weeds and pests, all factors with a direct bearing on the quality of available cropland, yields and harvests. Environmental degradation due to unsustainable human practices and activities seriously endangers the entire production platform of the planet (UNEP, 2009).

4.3.2 Major environmental problems

Table 7 shows results of major environmental problems associated by desertification. Most respondents (64%) indicate that drought is the major environmental problem whereas 22% of the respondents identified increase of wind speed. About 13% indicate that depletion of aquifers followed by increase in surface temperature and increase of rainwater runoff are in the study area.

Table 7: Major Environmental problems resulting from desertification

Variable	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Desertification problems	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Increase in wind speed	14	18	16	20	21	26	51	22
Increase in surface temperature	0	0	3	4	0	0	3	1
Rainwater runoff	0	0	0	0	1	1	1	0
Depletion of aquifers	17	21	4	5	11	14	32	13
Droughts	49	61	57	71	47	59	153	64

Generally, the results show that respondents are aware on the existing deforestation impacts in the study area which is an important aspect for planners and other environmental conservation partners in introducing forest conservation interventions. According to Mumoki (2006) deforestation is described as the cutting down of trees without planting others in their place. Demand for land for cultivation, need for

firewood, building poles and timber production are the main factors contributing to deforestation. Deforestation has so many consequences such as destruction of carbon sinks, greenhouse effect and global warming, increased of strong winds and storms. Other threat includes soil erosion which leads to loss of productivity of the land due to loss of mineral nutrients and soil micro organisms and destruction of animal habitats. Sileshi *et al.* (2007) observed that when properly designed and strategically located, agroforestry practices can contribute to ecosystem services by mitigating land degradation, climate change and desertification, while adding structural and functional diversity to the agricultural landscapes. Where agroforestry is applied to restore degraded lands, it also is likely to provide tree-based goods and services while keeping the land in agricultural production.

Table 8 shows results of major environmental problems associated with land degradation. Most respondents (71%) indicated that loss of soil fertility is the main problem associated with land degradation. About 27% of the identify soil erosion followed by 2% which indicate wind whirl.

Table 8: Environmental problems associated with land degradation.

Variable	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Problems	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Soil erosion	29	36	15	19	20	25	64	27
Loss of soil fertility	49	61	63	79	60	75	172	71
Wind whirl	2	3	2	3	0	0	4	2

Generally, overall impact of land degradation is reduced land productivity. UNEP (2009) reported that soil erosion and depletion of fertility as well as climate change will reduce world current yields by at least an additional 5 to 25% by 2050. Nutrient depletion as a form of land degradation has a severe economic impact at the global scale, especially in Sub-Saharan Africa. Annual depletion rates of soil fertility were estimated at 22 kilogram nitrogen (N), 3 kilogram phosphorus (P), and 15 kilogram potassium (K) per hectare. Soil erosion in Sub-Saharan Africa is even more serious. In some countries land productivity has declined in over 40% of the cropland area in two decades while population has doubled. Yield reduction in Africa due to past soil erosion may range from 2 to 40%, with a mean loss of 8.2% for the continent. According to UNEP, Africa is the continent which is most severely impacted by land degradation.

4.3.3 Trend of crop production.

Results of crop production trend in study area were summarized in Table 9; most of respondents (75%) indicated that crop production is decreasing. About 24% observed that crop production is increasing while 1% indicated that there were no changes in production. These observations are consistent with the previous results which indicated that crop productivity is drastically declining due to increased problem of land degradation.

Table 9: Trend of crop production

Variable	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Trend	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Increasing	20	25	16	20	22	28	58	24
Decreasing	60	75	63	79	56	70	179	75
No changes	0	0	1	1	2	3	3	1

Focus group discussions and responses from key informants indicated that the decline in crop production is due to factors such as unreliable rainfall, soil erosion, loss of soil fertility, use of inferior seeds, pest and diseases, inadequate extension services and droughts.

Assessment of production trend of major crops in the District was also carried out in order to get an overview of land degradation effects in crop productivity. Table 10 shows significant variation in production for the past ten years in the District. Major food crops grown are maize, paddy, millet, cassava, cotton, tobacco and groundnuts. Generally, the results suggest that production of major crops has been decreasing over the years.

Table 10: Production trend of major crops in Nzega District

Major crops	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09
	Tons/ha									
Maize	1.38	1.20	1.15	1.10	1.20	1.10	0.97	0.79	0.96	0.66
Paddy	3.45	2.30	1.87	1.20	0.96	1.02	1.37	1.19	0.98	0.85
Cassava	2.45	2.50	2.34	1.95	1.96	1.83	1.23	1.77	1.38	1.24
Groundnuts	0.87	0.82	0.97	0.73	0.61	0.40	0.35	0.19	0.65	0.50

Source: *District Agricultural Statistics Office – Nzega (2010)*

Maitima *et al.* (2009) observed that decline in soil productivity in terms of crop yields is largely remarkable decline in soil nutrients due to deterioration of chemical, physical and biological properties. Declining soil organic matter is also one of the major reasons calling for increased use of organic fertilizer sources such as animal manure. UNEP (2009) observed that global climate change may impact food production across a range of ways by changing overall growing conditions such as general rainfall distribution, temperature regime and carbon; extreme weather such as floods, drought and storms. Extreme climate events are predicted to have more serious consequences for food and food security.

4.3.4 Awareness to existing environmental conservation by laws.

Figure 16 shows respondents awareness on the existing environmental conservation bylaws. Most of the respondents (91%) in the study area were aware on the existing bylaws and about 9% of interviewed respondents were not aware. These, results suggest that most of tobacco farmers in study area were aware of existing environmental conservation bylaws which is an important aspect for the future environmental conservation measures. Sandbrook and Roe (2010) reported that by laws provide village governments and communities with a powerful tool for creating statutory land and natural resource management rules and procedures at the local level.

Figure 16: Respondents awareness of the existing by laws.

Table 11 is a multiple response table which shows the main focus of the existing environmental conservation by-laws in the study area. Interviewed households show that conservation of forest reserve count for 77% followed by conservation of natural forest (13%) and conservation of water catchments count for (5%) whereas tree planting efforts count for (5%).

Table 11: Main focus of existing bylaws

Variable	Multiple responses (n=240)	
Areas	Frequency	Percent
Conservation of natural forests	35	13
Tree planting efforts (Afforestation)	12	5
Conservation of reserved forests	205	77
Conservation of water catchments	14	5

Generally, these results indicate that a lot of efforts were directed to conservation of reserved forest without focusing on tree planting and woodlot establishment for tobacco curing. Inadequate firewood which is the main source of energy for tobacco curing will certainly contributes to destruction of forest reserves in study area; there is therefore an argent need to come up with by-laws which focus on establishments of woodlot.

Massawe (2008) reported that the financial and human resources available to the forest departments are often inadequate to carry out the task of effective policing of forested areas without the participation of the local communities. Many forest resources are scattered over large areas which make monitoring and rule enforcement by the state institution or organ very costly, if not impossible. This situation calls for local community participation in ensuring that there is sustainable forest resources

management. Under the Local Government Act of 1982, villages are entitled to make their own by-laws which are legally binding as long as they do not violate any state laws. This provides communities with a powerful tool for creating statutory land and natural resource management rules and procedures at the local level. By-laws passed by communities commonly address issues such as use of natural resources (trees, hunting, grazing) as well as sanctions and fines for those who infringe local rules but Forest Act of 2002 calls for Participatory Forest Management at the lowest possible level of government and provides flexible institutional arrangements for local forest management and ownership (Sandbrook and Roe, 2010).

4.3.5 Introduced technologies aimed at reducing desertification problem.

Table 12 is a multiple response table which shows introduced farming technologies aimed at reducing desertification problem in the study area. Woodlots establishment count for 77%, the use of improved barn structure count for 17%, and conservation of natural forest 6%. Results suggest that respondents are aware on the introduced technologies which are an important aspect to combat desertification.

Table 12: New introduced farming technologies

Variable	Multiple responses (n=240)	
Areas	Frequency	Percent
Conservation of natural forests	18	6
Woodlot establishment	214	77
Improved barn structure	47	17

Generally, these results indicate that the majority of respondents are aware of woodlot establishment as a potential option or have already establish their own

woodlots. The results also indicate that few farmers are aware of improved barn for tobacco curing or have already used it. Efforts should be focused on multiple uses of options.

Idrisa *et al.* (2008) reported that farmers should be given informal education through extension service with a view to enhance their understanding of modern agricultural production techniques and easy access to improved technologies in order to boost agricultural production. Ogunsumi (2008) observed that Agricultural technologies developed and disseminated should meet and consider farmers' socio-cultural, economic and environmental changing situations; Government should fund research and extension to enhance sustainable agriculture. Namwata *et al.* (2010) observed that household income, farming experience, access to credit and extension services were positively and significantly associated with adoption of improved agricultural technologies. They further noted that extension personnel should not only concentrate with more experienced farmers, they should also work closely with new and less experienced farmers so as to stimulate more adoption of technologies.

4.4 Tobacco curing Practices.

4.4.1 Source of energy for tobacco curing.

Firewood is the only source of energy for tobacco curing in the study area. During the field study the respondents were interviewed on the main source of energy for tobacco curing, also the questionnaire was designed to identify the alternative source for tobacco curing. Responses from identified sample under study indicated that firewood is the main source and there is no other alternative source for tobacco curing in the study area. That being the case, the results suggest that efforts should be

directed into establishment of woodlots coupled with technologies aimed at energy saving such as use of improved barn structures.

Table 13 shows the results of hours taken to collect firewood which is the only source of energy for tobacco curing in the study area. About 64% use between 1 and 3 hours to collect firewood whereas 19% use more than five hours and 17% use less than one hour to collect firewood. These results suggest that most of the respondents use more than one hour to collect firewood.

Table 13: Hours taken to collect firewood by the respondents

Variables	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Hours	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Less than 1 hour	11	14	16	20	13	16	40	17
Between 1 to 3 hours	56	70	46	58	53	66	155	64
More than five hours	13	16	18	23	14	18	45	19

Generally, these results indicate deficiency in terms of firewood for tobacco curing and household consumption. This correlates with responses from the consultations with key informants that sources of firewood within the villages in study area is decreasing over time due to reasons such as highest need of charcoal in urban centres, increased number of tobacco farmers and extension of cultivated areas. Results suggest that most of the tobacco farmers collect firewood from the nearby villages and others invade the reserved forest contributing to deforestation.

Reddy (2004) reported that in many developing countries source of fuel wood for curing of tobacco is still done surreptitiously from neighbouring forests or is obtained from regions as far away as 50 to 200 kilometres, thereby causing indirect deforestation. Otañez (2008) reported that tobacco farmers use trees to process tobacco in flue-curing barns that require wood fuel also trees are used to construct poles for hanging tobacco and barns for air drying tobacco. He further noted that the farmers obtain 50% of the wood from their own lands and purchase another 50% in Brazil, or gather 30% of the wood from private and 70% from general lands, including forest reserves in Tanzania. As forests are depleted, women and children have to travel even greater distances to obtain firewood.

4.4.2 Establishment of woodlot as a major source of energy.

Figure 17 shows respondents opinion that woodlot establishment as a source of energy. Most of the respondents (60%) in the study area are of the opinion that woodlot establishment is the only source of energy for tobacco curing whereas 40% are of the opinion that multiple option should be sought.

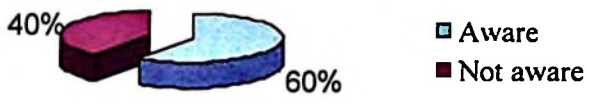

Figure 17: Respondents opinion on establishment woodlot.

Capacity building to the farmers on this aspect is very important because if all tobacco farmers will be well capacitated and can manage their woodlots

deforestation will be reduced. Chitakira and Emmanuel (2010) observed that external support, perhaps the assistance more readily available to the farmers would be in form of knowledge and skills, information about how to nurse and raise trees, especially indigenous ones, needs to be disseminated to all farmers and practical steps are taken, farmers would be better equipped and to implement with a wider range of options to choose from.

The fact that significant proportions (40%) are of the opinion that multiple approaches should be used points to the need to look at all potential options in order to reduce the problem of deforestation.

Table 14 indicates responses from the respondents on woodlot size established by the farmers. The results indicate that majority of respondents in the study area (40%) own woodlots ranging from 1 to 3 acres whereas 23% less than 1. Those with woodlot size more than 3 acres count for 1% and 36% are respondents who do not establish woodlots. Generally, the results suggest that woodlot establishment is very low and most of the tobacco farmers have small woodlots which are not consistent with the rate of deforestation; efforts should be directed towards encouraging farmers to establish more woodlots for the purpose of tobacco curing and source of firewood.

Table 14: Established woodlot and its size.

Variable	Ward of the respondents						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Woodlot size	Frequency	%	Frequenc y	%	Frequenc y	%	Frequenc y	%
< 1	17	21	19	24	19	24	55	23
1 – 3	39	49	26	33	32	40	97	40
> 3	1	1	1	1	0	0	2	1
Without woodlots	23	29	34	43	29	36	86	36

Chapman (1997) reported that according to Tobacco International each flue-cured farmer is expected to establish a total of not less than 3000 surviving trees while the target for each fire- cured farmer is 1500 surviving trees. He further reported that three thousand trees require 1.5 hectares. Abdallah *et al.* (2007) reported that efforts of tobacco sector to establish woodlot specifically for tobacco curing were very low. Observation in his study in Iringa region shows that each tobacco household planted about 0.02 hectare in the year 2004 while approximately 60% of these household opened about 0.1 hectare of forest for tobacco plots and each grower cut about 0.15 hectare for curing purposes annually. This means that the grower afforested only 6.7% of the total Miombo area cleared annually. Wolfram (2010) reported that one tonne of cured tobacco needs about 181 trees to be cut each year, which leads to about 9.5 million trees that are needed to be cut each year for the annual tobacco production of about 53 000 tonnes in Tanzania. Assuming that a tree needs to grow on average 5 to 7 years before it can be cut, about 57 million trees (of different ages) are needed to be grown to be self-sufficient.

Figure 18 shows the results of seedling provider for the established woodlot in the study area. Most of the respondents (88%) in the study area depend on seedlings from tobacco companies which serve their tobacco primary cooperative society and about 12% of interviewed respondents depend on the existing degeneration from natural forest.

Figure 18: Seedling provider for the established woodlot

Generally, these results suggest that this approach is unsustainable. The most ideal approach would be to build capacity to the tobacco primary cooperative societies and farmers in particular to raise their own seedlings.

4.4.3 Improved barn structure

Figure 19 indicate that most (89%) of the respondents are aware about the improved barn technology which could improve tobacco curing efficiency. Irrespective to high level of awareness most farmers (95%) do not use the technology suggesting that adoption of this technology is low (Table 15).

Figure 19: Respondent's awareness of improved burn technology

Generally, the results correlate with physical observations and responses from key informants that farmer's adoption of improved barn technology is very low in the study area. For example responses from focus group discussions in Kaloleni village shows that only one tobacco farmer out of 154 registered farmers from Kaloleni Agricultural and Marketing Cooperative Society (AMCS) use improved barn from the past three crop seasons. These results suggesting that dissemination plan of this technology to tobacco farmers by tobacco companies is very low. The most ideal approach would be to train rocket barn builders from each affiliated primary cooperative societies who will continue constructing the barns for the farmers in collaboration with existing tobacco grower's cooperative unions.

Table 15: Respondent's use of improved barn technology for tobacco curing

Variable	Ward of the respondent						Total	
	Magengati (n=80)		Milambo Itobo (n=80)		Mambali (n=80)		(n=240)	
Use of improved barn.	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Yes	4	5	0	0	9	11	13	5
No	76	95	80	100	71	89	227	95

Leonardo and Nuthall (2010) observed that farmer's adoption of new technology requires a flexible approach to allow farmers to observe; learn and decide the most suitable way of applying a new technology. A participatory dissemination process is very important in creation of consensus among the farmers and other relevant parties. They further noted that dissemination requires a balanced flow of information accessible during and beyond the introduction period and for everyone in the target areas so that adoption can get the full support of family and community at large.

Plate 1: Photograph of a rocket barn for tobacco curing at Mambali Village.

Majogoro (2009) reported that improved barns (Rocket Barns) project which was implemented in Tabora during the 2008/9 tobacco growing season in collaboration with ProBEC, TLC and the tobacco industry (AOTTL & TLTC) 14 new barns (RB 3.0) and 56 barns (RB 2.0) were constructed and monitored in pilot project area. Results of field test showed that Rocket Barn is indicatively the most efficient barn. The average results from the field test shows that saving in wood for curing for both RB 2.0 and RB 3.0 are 41% and 56.2%, respectively.

Table 16: Comparison between traditional barn and improved barn in tobacco curing

Barn type	Wood: Tobacco ratio	% Savings
Traditional Barn	10.5	0
Rocket (RB 2.0)	6.2	41.0
Rocket (RB 3.0)	4.6	56.2

Source: Majogoro (2009)

Majogoro (2009) reported that laboratory tests from Malawi where the barn was designed shows that RB 3.0 consumes 2.2 kilogram of wood to cure 1 kilogram of tobacco, a saving of 71% as compared to a traditional barn that consumes 7.6 kilogram of wood. In Kenya tests show that the barn used only 429 kilogram to cure 240 sticks of tobacco. This is to say the rocket barn if properly used is more efficient than the other introduced curing technologies.

Plate 2: Firewood size used in improved barn

4.4.4 Comparison between deforestation and afforestation efforts.

Figure 20 shows result of comparison between afforestation efforts and deforestation rate in the study area. Most of respondents (97%) indicated that deforestation rate is

higher than afforestation efforts. About 3% responded that afforestation efforts are higher than deforestation rate. The results suggest that there is a need to increase afforestation efforts if meaningful and sustainable land management and productivity is to be achieved.

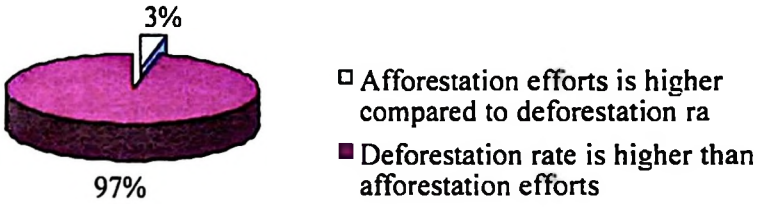

Figure 20: Comparison between deforestation rate and afforestation effort

Table 17 is a multiple response table which shows reasons for increase in deforestation rate. Tobacco curing counts for 30% followed closely by increase of charcoal production for urban needs 29%. About 20% accounts for household consumption, production of timber and increase needs for building poles in urban areas count for 17% whereas expansion for cultivated land counts for 4%.

Table 17: Reasons for high rate of deforestation

Variable	Multiple responses (n=240)	
Areas	Frequency	Percent
Increase of cultivated land	24	4
Tobacco curing	194	30
Firewood for household consumption	125	20
Charcoal production	187	29
Timber production and building poles	108	17

The results correlate with responses from the consultations with key informants and Focus group discussion which indicated that deforestation rate is highly associated with largest consumption of firewood for tobacco curing and charcoal production for urban consumption. The results further suggest that there is a need to come up with alternative tobacco curing methods or improve on the existing ones by improving efficiency and therefore reducing firewood consumption. These results are consistent with earlier reports by Stockbridge (2006) who observed that tobacco curing is a major consumer of firewood in Malawi and Zimbabwe.

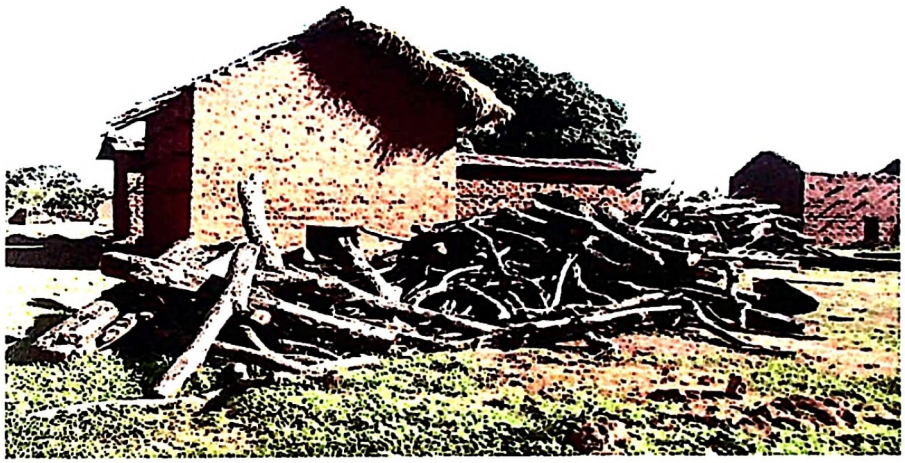

Plate 3: Harvested firewood for tobacco curing

Sagar and Kartha (2007) reported that traditional biomass remains the dominant contributor to energy supply for more than a third of the global population, mainly living in developing countries. Otañez (2008) reported that in Brazil, eucalyptus as an exotic species is the main type of wood, either used solely (44%) or in combination with native tree species (66%). In Tanzania, indigenous trees of the miombo species are mainly preferred by tobacco growers. The rates of wood consumption are similar in both growing zones, 2.8 cubic meter (Brazil) and 3.4 cubic meter (Tanzania) of fuelwood per (one) curing charge, but total wood

consumption on a farm level is higher in Tanzania (24 cubic meter) than in Brazil (14 cubic meter). Ecological functions of the woodlands are particularly threatened by the deforestation resulted from production of flue cured tobacco. The threat comes from the large quantities of wood harvested from the natural Miombo woodlands for curing tobacco. One hectare of Miombo woodland is used to cure 450 kilogram (0.45 tones) of tobacco (Yanda, 2010). Charcoal making is crucial activity in miombo woodlands and is increasingly becoming a lucrative business. A traditional kiln in Tabora can take an average volume of 13.96 m^3 of billetts of various tree species to produce 20 to 30 charcoal bags each weighing 40 to 55 kilogram depending on species used. The incentives from the already existing markets in cities and towns encourage charcoal production as a full-time income generating work (Abdallah and Monela, 2007). Ngetich *et al.* (2009) observed that promotion of alternative sources of energy such as biogas and solar energy is very important. Biogas is a promising alternative for the households who rear livestock especially cattle. The potential for solar energy is high even if the area is located in a tropical area. Promotion of agro forestry is necessary. Efforts can be targeted towards promotion of fast growing agro forestry and hedge or boundaries tree species so as to match wood fuel consumption.

4.5 Tobacco contribution to household income and Food security

4.5.1 Tobacco production.

Table 18 shows average production of tobacco produced by respondents in the year 2009. Total respondents were 240 and the average production of tobacco per hectare was 1151 kilograms. Minimum respondent's production was 200 kilograms per hectare while the maximum kilograms produced was 7000.

Table 18: Average tobacco produced in 2009 with average price

Descriptive Statistics	Frequency	Minimum	Maximum	Mean
Kilograms of tobacco produced by respondents in 2009	240	200	7 000	1 151.44
Average price in Tsh per kg for the best grade tobacco	214	2 300	4 200	3 634.11
Average price in Tsh per kg for the lower grade tobacco	240	500	3 800	2 303.85
Best grade tobacco in kg sold by the respondents	196	20	3 600	415.95
Other grades tobacco in kg sold by the respondents	240	100	4 600	789.74

Comparison between results of average tobacco produced and average application rate of inorganic fertilizer in study area suggests that tobacco production per hectare is still low. Average farm size from interviewed respondents was 2 hectare while average produced tobacco was 1151 kilograms. This comparison indicates that average tobacco produced in the study area was 575.5 kilograms per hectare which is below than aspiration of a ten year tobacco production programme which was launched in the 2002. The programme aiming to increase tobacco production by the year 2012 and is anticipated with average yield of 1000 kilogram per hectare (DMG, 2002).

Table 18 shows average market price in Tanzanian shillings for tobacco produced according to grades. Average price for the best grade of tobacco was Tsh 3634 whereas average price for the lower grade was Tsh 2304. Maximum price for the best grade tobacco was Tsh 4200 whereas minimum price for the lower grade tobacco was Tsh 500. These results suggest that there were high variation of tobacco price

when you compare grades produced and sold to the market. Svobodova'a *et al.* (2008) observed that poor machinery, infrastructure and remoteness make farmers fully dependent on company's transportation, which is disadvantage in terms of price negotiation and make them more dependent on resource owners, such as moneylenders. Small-holders under contracts can not control their tobacco business themselves due to short-term character (for one harvest) causing a huge uncertainty for farmers' future product, purchasing and decision-making process on price of their commodities. Farmers under contractual obligations to tobacco companies are vulnerable to leaf downgrading, suppressed tobacco prices, and inflated prices for inputs (Otañez, 2008).

4.5.2 Access to cooperative societies.

Most of respondents in the study area are members of cooperative society. Agriculture Marketing Cooperative Societies (AMCS) is the main type of cooperative which provides cooperative services to most of the tobacco farmers. Main role of these cooperative societies relates with observation of Rweyemamu and Kimaro (2006) that Primary Cooperative societies (PCSs) are the major link between tobacco farmers and leaf-dealers. The marketing functions of purchasing cured tobacco, cash payments, supplies of inputs to tobacco farmers and similar activities are done by the leaf dealers through the Primary Cooperative societies. Each Primary Cooperative societies is therefore, linked to a commercial company with which they have contracts. Each Primary Cooperative society is under the leadership of a chairperson, vice chairperson and a secretary.

Figure 21 shows that 99% of interviewed households did not manage to purchase agricultural inputs from their annual income, suggesting that most of tobacco farmers depend on the agricultural inputs under credit scheme.

Figure 21: Respondents access to credit.

Table 19 shows recovering methods of credit received by the respondents in the study area. Selling of crops especially tobacco is the main method (87%) of credit recovery. About 97% of respondents pay at once when they sell produced tobacco to the market whereas payment by instalments accounts for 3%.

Table 19: Respondents credit recovering method and payment schedule.

Payment schedule of credit received (n=240)				Credit recovering methods (n=240)			
At once		By instalment		Selling crops (Tobacco)		Selling livestock	
Frequency	%	Frequency	%	Frequency	%	Frequency	%
232	97	8	3	209	87	31	13

Result in Figure 22 indicate that a significant proportion of the respondents (56%) is satisfied by the services from existing cooperative societies indicating a potential for improved delivery of education and basic services through cooperative societies.

Figure 22: Satisfaction with cooperative services.

Bibby (2006) observed that Tanzanian Cooperative societies face problems of poor management, inappropriate cooperative structures, corruption and embezzlement, lack of working capital, lack of cooperative democracy and education, weakness of supporting institutions and, in general, an inability to compete in a liberalized market economy. He further noted that good governance and accountability are key factors in encouraging more people to join cooperative societies. ILO (2009) noted that one of the core benefits of cooperatives is the fact that they allow individuals to increase their bargaining power, through aggregation of their purchasing/selling power.

4.5.3 Household food secure from tobacco income earned

Figure 23 indicates that most of the interviewed respondents (87%) the income earned from tobacco can not satisfy household food security. These, results suggest that most of tobacco farmers in the study area must cultivate food crops in order to become food secure.

Figure 23: Contribution of tobacco income to household food security.

Table 20 is a multiple response table which show food crops grown to supplement household food security in the study area. A result shows that Maize count for 28% Paddy count for 24% and Cassava count for 22%. Other crops grown are groundnuts which counts 13%, sweet potatoes (10%) and beans (3%).

Table 20: Food crops grown to supplement household food security

Variable	Multiple responses (n=240)	
Food crops	Frequency	Percent
Maize	209	28
Paddy	179	24
Cassava	165	22
Beans	19	3
Sweet potatoes	71	10
Groundnuts	93	13

The results suggest that maize is the most important food crop cultivated by tobacco farmers in the study area for household food security. Chianu *et al.* (2008) observed that most households embarked on mixed cropping to reduce the risk and impact of crop failure on food, nutrition, and cash security a strategy that has largely failed to improve the livelihoods of majority of the households because of continued low farm

productivity accentuated by harsh production environments. These are characterized by limited access to and use of inputs (especially organic and inorganic fertilizers), limited access to output markets that offer good prices due to high transport cost.

Plate 4: Maize farm grown by tobacco farmer to supplement food security

4.5.4 Future plans to increase tobacco production and reduce environmental degradation.

Table 21 is a multiple response table which shows respondents future plan to increase tobacco production and reduce environmental degradation in the study area. Results indicate that tree planting counts for 45%, implementation of farming approaches and advice from Agricultural extension officer count for 29% followed by use of improved barn for tobacco curing. Whereas reducing farm size count for 8% and use of organic manure which counts 1%. Generally, the results suggest that most of the farmers were aware of approaches and interventions of the improved farming practices in tobacco farming which is likely to be sustainable, all of which can be translated into reality if effective dissemination strategies are in place.

Table 21: Future plan to increase tobacco production

Variable	Multiple responses (n=240)	
Future plan	Frequency	Percent
Use of improved barn	79	17
Tree planting	213	45
Implement advice from AEO	136	29
Reducing farm size	37	8
Use inorganic manure	2	1

Nhongonhema (2010) reported that experience from Zimbabwe shows that no single approach on its own is effective enough for technology adoption. This is more so because of differences in ecological and socio-economic backgrounds of farmers. There is therefore a need for diversion from a prescriptive approach where farmers are prescribed technologies which are perceived to suit their problems to a menu approach where a variety of extension approaches are tabled and one or a number of approaches suited for the community are used. However, for this to be successful there is need for highly competent extension agents who understands the socio-economic, ecological and management skills of farmers he/she will be dealing with.

4.6 Constraints to sustainable farming practices.

4.6.1 Provision of extension services

Figure 24 shows respondents satisfaction with provision of extension services. About 47% of interviewed respondents were satisfied while 53% were not satisfied with extension services in tobacco production in the study area.

Figure 24: Satisfaction with extension services

Table 22 is a multiple response table which shows respondents reasons for dissatisfaction with provision of extension services. Inadequate visits, lack of commitment and inadequate extension education are among the main reasons for dissatisfaction according to the respondent's views. Inadequate visits count for 45% and lack of commitment from extension service provider count for 38% whereas inadequate extension education counts for 17%.

Table 22: Reasons for dissatisfaction with extension services

Variable	Multiple responses (n=240)	
Reasons	Frequency	Percent
Inadequate visits	124	45
Lack of commitment	104	38
Inadequate extension education	46	17

This correlates with responses from the consultations with key informants and conducted focus group discussions which indicated that extension services are inadequate in terms of number of extension workers and their availability. Tobacco companies provide one extension officer to serve registered tobacco farmers in each primary cooperative society but still do not satisfy the needs of farmers. Extension officers from the District Council are allocated at ward level and they are only

responsible to provide extension services for only food crops production, and animal husbandry.

Kyaruzi *et al.* (2010) reported that agricultural extension agents in Tanzania face a number of problems in delivering extension service. These include inadequate resources such as extension kits, teaching equipment and facilities, lack of transport facilities, inadequate supervision, and absence of working office, stationeries and a large number of scattered farmers to contact. Mngumi (2010) observed that farmers are likely to benefit more when they receive technological packages from a qualified personnel. Uneducated extension agents are likely to deliver poor messages to farmers which may have a negative impact on adoption rate. For effective flow of information from research to farmers there must be a participatory nature of communication and training on the subject matter. Elisha *et al.* (2010) observed that in order agricultural extension service to be improved, integrated approach is required and impact could be measured by improved agricultural production and livelihoods. Scientific research should incorporate new methodologies which is participatory and client in an existing extension delivery system. Re thinking of present legal, framework, market opportunities, extension provider and harnessing indigenous knowledge must be done before adopting any approach. Marume (2010) observed that Government should play a leading role in ensuring that infrastructure, transportation and other extension tools are put in place to ensure efficient and effective dissemination of information through extension. Interpersonal relationship between extension supervisors and field workers could serve as a motivator towards better job performance in order to achieve sustainable agricultural development over

time. Factors such as wages, salaries and allowances, staff mobility, in-service training, welfare, opportunities for promotion and work challenge need to be given attention by the Government (Fabusoro *et al.*, 2008).

4.6.2 Existing environmental conservation by-laws

Figure 25 shows respondents satisfaction with implementation of the existing environmental conservation by-laws. Most of the respondents (55%) in the study area are not satisfied with implementation of the existing environmental conservation by-laws suggesting a need to sensitize the communities or even reviewing the existing by-laws.

Figure 25: Satisfaction with existing environmental conservation bylaws.

Table 23 is a multiple response table which shows respondents reasons for dissatisfaction with implementation of the existing environmental conservation by laws in the study area. Poor supervision, lack of awareness and poor implementation are among of the major reasons for dissatisfaction according to the respondent's views. Generally, the result suggests that most of the respondents were not satisfied with implementation of existing environmental conservation by-laws in the study area. Community awareness and involvement in formulation of environmental conservation by-laws could be attractive solution.

Table 23: Reasons for dissatisfaction with existing environmental conservation bylaws

Variable	Multiple responses (n=240)	
Reasons	Frequency	Percent
Poor supervision	181	63
Lack of awareness	61	21
Poor implementation	46	16

Sandbrook and Roe (2010) observed that Participatory Forest Management (PFM) which is contained in the Forest Act, 2002 provides a legal basis for communities to own, manage or co-manage forest under wide range of conditions, including benefits from the forest resources. According to the local Government Act of 1982, villages are entitled to formulate their own by laws which are legally binding. PFM allows formation of Village Land Forest Reserves (VLFRs) which are managed by villages, as well as Community Forest Reserves (CFRs) which may be managed by a sub-group of people within the village. This legal and policy framework is very supportive of community management and ownership of forests and has led to the rapid expansion of statutorily recognized local forest reserves. Common Pool Resources (CPRs) have been important productive resources in the livelihoods of rural communities in Sub Saharan Africa. Sustainable CPRs management is an essential component in the intervention of rural poverty reduction. The need for effective institutions to mobilise the community at the grassroots level has been highlighted by various donors and development agencies. Policies and development interventions should strengthen the involvement of well functioning informal institutions in decision making so that sustainable CPRs management can be

achieved. CPRs include forest, grazing lands, wetlands that have multiple users or user groups (Yami *et al.*, 2009).

Table 24 is a multiple response table which show other constraints associated with implementation of best farming practices in the study area. Shortage of capital counts for 62% followed by low household education (36%) and low market price of tobacco (2%). Generally, the results relate with the farmers household characteristics (Tables 1 and Figure 3) shows that education and income level are among of the important determinants in adoption of new farming technology and interventions.

Table 24: Other constraints to improved farming practices

Variable	Multiple responses (n=240)	
Other constraints	Frequency	Percent
Shortage of Capital	199	62
Low education	115	36
Low market price of tobacco	6	2

Modibo *et al.* (2010) observed that smallholder farmers' levels of adoption of innovations are very low which means very low yields.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion.

The objective of this study was to assess tobacco production and curing practices aiming at increasing tobacco production and decreasing environmental degradation. The results indicated that most farmers use inorganic fertilizers and the common fertilizers used are mainly Nitrogen carriers. Very few farmers use organic fertilizers. Results also showed that the major forms of environmental degradation in Nzega District are deforestation, land degradation and loss of biodiversity. Results showed that the major introduced farming technologies are woodlots establishment and improved barn structure. Household income and low education are important factors that limit farmers in adoption of introduced technologies. Study findings indicated that the approaches used in dissemination of improved technologies are deficient in terms of extension delivery. Inadequate extension service is one of the factors influencing low adoption rates of the introduced farming technologies. Findings also indicated that most farmers access credit facilities in form of agricultural inputs from tobacco companies only. Lack of legal land ownership limit farmers to access credit facilities from financial institutions. Study findings further showed that most farmers are members of cooperative society. Existing primary cooperative societies are the major link between tobacco farmers and a commercial company with which they have contracts.

5.2 Recommendations.

Based on the results it is recommended that:

(i) District authorities should increase efforts towards utilization of organic fertilizers in order to sustain meaningful land management.

(ii) District authorities should increase community awareness and involvement in environmental conservation. Policies and development interventions should strengthen the involvement of well functioning informal institutions in management and ownership of forests resources.

(iii) Improved barn technology developed and disseminated in the District should meet and consider farmers' socio-cultural, economic and environmental changing situations.

(iv) Tobacco companies should build capacity to tobacco primary cooperative societies and farmers to raise their own seedlings for existing woodlots.

(v) Research – Extension - Farmer linkage should be strengthened for effective dissemination of improved farming technologies. Government should ensure that infrastructure; transportation and other extension tools are put in place to ensure efficient and effective extension services.

(vi) District authorities should capacitate farmers to seek for legal land ownership which has implication in long term agricultural investments as collateral on accessing credit services from existing financial institutional.

(vii) Government should empower cooperative societies through provision of soft loans in order to become organizations which are member owned and controlled, able to compete in a liberalized market economy, sustainable and with capacity of fulfilling members' economic and social needs.

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APPENDICES

Appendix 1: Household members structured questionnaire

QUESTIONS FOR AN INTERVIEW SCHEDULE

Ward name..... Village name .....

Respondents name ..... Date of interview .....

A: General information: Tick (√) the correct answers where necessary

1. Sex of respondents Male [ ] Female [ ]

2. How old are you? (i) <18 [ ] (ii) 18 – 65 years [ ] (iii) 65> [ ]

3. What is your highest level of education?
   (i) No formal education [ ] (ii) Adult education [ ]
   (iii) Primary education [ ] (iv) Secondary education [ ]
   (v) Other level (specify).....

4. What is your marital status?
   (i) Single [ ] (ii) Married [ ] (iii) Divorced [ ]
   (iv) Widowed [ ] (v) Widower [ ]

5. How many family members you have? (i) <3 [ ] (ii) 3-6 [ ]
   (iii) 7 – 10 [.] (iv) >10 [ ]

6. What is your main occupation?
   (a) Business [ ] (b) Civil Servant [ ]
   (c) Farming [ ] (d) Other Specify.....

7. What is your annual household income (Estimated income from all activities)
   (a) Tsh 1,000,000 [ ] (b) Between 1 million and 5 million [ ]
   (c) Above 5 million [ ]

B: Farming practices that are likely to be sustainable

1. Do you own land for agricultural purposes?
   Yes [ ] No [ ]

2. If No, who own it .....

3. How do you acquire this land?

(a) Inherited [ ] (b) Bought [ ] (c) Hired [ ]
(d) Other (specify).....

4. what is the total size of your farm (Hectare?)
1. >2 [ ] 2. 2-5 [ ] 3. <5 [ ]

5. What type of land preparation (tillage) do you use?
(i) Hand hoe [ ] (ii) Oxy plough [ ]
(iii) Tractor [ ] (iv) Use of five [ ]

6. Do you cultivate Tobacco in the same land (farm) in each year?
(a) Yes [ ] (b) No [ ]

7. If No in the above question, what is the type of cultivation you practice?
(a) Shifting cultivation [ ] (b) Crop rotation [ ]

8. If the answer is (a) in the question above, what type of shifting do you use.
(a) Shifting to the new land (Virgin land) [ ]
(b) Shifting to the existing land (Rotation crop) [ ]

9. What type of crops grown in the shifting land as crop rotation?
(i) Maize [ ] (ii) Legumes [ ] (iii) Cassava [ ]
(iv) Other (specify).....

10. Shifting cultivation which you practice involves cutting down of trees
(a) Yes [ ] (b) No [ ]

11. If the answer is Yes in the question above, how do you use harvested trees?
(a) Fire wood [ ] (b) Making charcoal [ ] (c) Tobacco curing [ ]
(d) Other (specify) .....

12. Do you use agricultural inputs in tobacco production (a)Yes [ ] (b)No [ ]

If the answer is Yes in the question above,

13 Do you use inorganic fertilizers (a) Yes [ ](b) No [ ]

14. If the answer is Yes, What types of inorganic manure do you use?
(a)..... (b).....(c).....

15. What is application rates of inorganic manure do you use?.....

16 Do you use organic fertilizers (a) Yes [ ](b) No [ ]

17. If the answer is Yes, What types of organic manure do you use?
(a)..... (b).....(c).....

18. What is application rates of organic manure do you use?.....

19 Do you use other chemicals eg. Pesticides (a) Yes [ ](b) No [ ]

20. If the answer is Yes, What types of other chemicals eg. Pesticides do you use?
(a)..... (b).....(c).....

21. What is application rates of other chemicals eg. Pesticides do you use?.....

22. Which type of seeds do you mainly use?
(a) Local seeds (b) Improved seeds

23. If it is improved seeds, where do you get it?.....

24. In terms of crop production how do you compare between improved seeds and local seeds?.....

25. Do you receive extension services on tobacco farming practices?
(a) Yes [ ] (b) No [ ]

26. If the answer is Yes in the question above, who provide you extension services?
(a) Extension officer from the District Council [ ]
(b) Extension officer from Tobacco companies [ ]
(c) Other (specify)
.....

27. What kind of advice on farming practices do you receive?
(a) Farm preparation [ ] (b) Curing practices [ ]
(c) Harvesting and grading practices [ ]

28. Did you receive any training on farming practices?
(a) Yes [ ] (b) No [ ]

29. If the answer is Yes, where did you get such training?
(a) Existing demonstration plots [ ] (b) Farmers field school [ ]
(c) Farmers field study in other area [ ]
(d) In agricultural centre [ ] (e) Other (specify).....

30. Did you follow and practice the training you get with other farmers in the area?
(a) Yes [ ] (b) No [ ]

31. Training which you get improve your farming practice in what area?
(a) Farm preparation [ ] (b) Curing practices [ ]
(c) Harvesting and grading practices [ ]

32. Which institution provided such training?
(a) District Council [ ] (b) Private sector (Tobacco Company) [ ]
(c) NGO [ ] (d) Other (specify).....

33. When do you receive training?
(a) During crop season [ ] (b) During off season [ ]
(c) Before crop season [ ] (d) Other (specify) .....

34. How after did the extension officer make visit to your farm
(i) Once per week [ ] (ii) Once per month [ ]
(iii) During crop season [ ] (iv) Other (specify) .....

35. Agricultural inputs like fertilizer and chemicals are available during all crop seasons?
(a) Yes [ ] (b) No [ ]

36. Agricultural inputs price is affordable to you according to your farming requirements
(a) Yes [ ] (b) No [ ]

37. Do you have your own machinery /equipments for
(a) Land preparation [ ]
(b) Planting [ ]
(c) Weeding [ ]
(d) Spraying [ ]
(e) Transport [ ]
(f) Other specify.....

38. Mention the machineries and tools you own.

(a).....(b).....(c).....

Forms of land degradation

1. Are you aware about environmental degradation?
(a) Yes [ ] (b) No [ ]

2. If the answer is Yes above, what are the main forms of environment degradation in your village?
   (a) Deforestation [ ] (b) Land degradation [ ]
   (c) Loss of biodiversity [ ]

3. Do you observe desertification problems in your village?
   (a) Yes [ ] (b) No [ ]

4. What are the main problems resulted by desertification which you observe (Tick appropriate)
   (i) Increase in wind speed [ ] (ii) Increase in surface temperature [ ]
   (iii) Rainwater runoff [ ] (iv)Depletion of aquifers (local wills) [ ]
   (v) Droughts [ ] (vi) Other (specify).....

5. What are the main problems resulted by land degradation observed (Tick appropriate answer)
   (i) Soil erosion [ ] (ii) Loss of soil fertility [ ]
   (iii) Wind whirl [ ]
   (vi) Other (specify).....

6. What is the trend of crop production in your village?
   (i) Increasing] (ii) Decreasing [ ] (iii) No changes [ ]

7. Your village has existing environmental conservation bylaws?
   (a) Yes [ ] (b) No [ ]

8. If the answer is Yes above, the existing environmental by laws focus on what area?
   (i)..... (ii)..... (iii).....

9. The existing by laws is implemented properly by the village community?
   (a) Yes [ ] (b) No [ ]

10. What are the new farming technologies introduced in this village to reduce desertification problem

(a).....(b).....(c).....

11. Which institutions introduce to you those technologies?
   (a) District council [ ] (b)Private sector (Tobacco companies officers) [ ]
   (c) NGO [ ] (d) Other (specify).....

C: Tobacco curing practices

1. What is the main source of energy for tobacco curing? .....

2. If the main source is firewood, where do you get it for tobacco curing?

3. How many hours do you use to take firewood?
   (a) Less than 1 hour [ ] (b) Between 1 and 3 hours [ ]
   (c) More than five hours [ ]

4. What is the other source of energy for tobacco curing? Rather than fire wood
   (i)..... (ii)..... (iii).....

5. Have you heard that each tobacco farmers must establish a woodlot
   (a) Yes [ ] (b) No [ ]

6. If the answer is Yes, are you already establish a woodlot
   (a) Yes [ ] (b) No [ ]

7. What is the size of your woodlot.....

8. Who provide you with seedlings
   (a) District council [ ] (b)Private sector (Tobacco companies officers) [ ]
   (c) NGO [ ] (d) Other (specify).....

9. Where do you get alterative source of energy?

10 Have you heard about improved burn structure
   (a) Yes [ ] (b) No [ ]

11. If the answer is Yes, do you use improved burn structure for tobacco curing?
   (a) Yes [ ] (b) No [ ]

12. In terms of firewood consumption how do you compare between the local burn and the improved burn .....

13. Improved burn structure technology is cheap to all Tobacco farmers in this village (a) Yes [ ] (b) No [ ]

14. How do you compare between deforestation and afforestation efforts in your Village?

   (a) Afforestation efforts is higher compared to deforestation rate
   (b) Deforestation rate is higher than afforestation efforts

15. If the answer is b in question above, What are the reasons?

(a).....(b).....(c).....

16. Did you receive training on Tobacco curing and leaf grading skills?
(a) Yes [ ] (b) No [ ]

17. Which institutions provide you with skills on leaf grading and improved burn structure?
(a) District council [ ] (b)Private sector (Tobacco companies officers) [ ]
(c) NGO [ ] (d) Other (specify).....

D: Contribution of tobacco to household income and food security

1. How many Kilograms of tobacco do you produce in the 2009? .....

2. What is the market price of tobacco in this year according to the grades?
(a) Best grade Tshs..... (b) Other grade .....

3. How many kilograms do you send to the market according to the grade?
(a) Best grade kg..... (b) Other grade kg.....

4. For the past five years what activities do you implement by the income earned?

(a) .....(b).....(c).....

5. In terms of income generated in your family, how do you rank tobacco with other activities.
(a).....(b).....(c).....

6. Are you a member of Primary Cooperative society?
(a) Yes [ ] (b) No [ ]

7. How many types of Cooperative societies established in this area?
(a) SACCOS [ ] (b) Tobacco primary cooperative society [ ]
(c) Other specify.....

8. Do you manage to buy agricultural inputs from your annual income?
(a) Yes [ ] (b) No [ ]

9. If the answer is No, Primary cooperative society offer small credit to farmers?
(a) Yes [ ] (b) No [ ]

10. Which type of credit do you receive?
(a) Finance [ ] (b) Agricultural inputs [ ] (c) Other specify.....

11. Which type of agricultural inputs did you receive in terms of credit
(a).....(b).....(c).....

12. Did you utilize the credit obtained for the required purpose
(a) Yes [ ] (b) No [ ]

13. If No, what hindered you from utilizing the credit for the purpose acquired?
(a) .....(b).....(c).....

14. Agricultural inputs did you receive in terms of credit, satisfy your farming requirements? (a) Yes [ ] (b) No [ ]

15. There is any interest in loan/ credit recovery?
(a) Yes [ ] (b) No [ ]

16. If yes, are you satisfied with interest charged?
(a) Yes [ ] (b) No [ ]

17. If the answer is No, what are the reasons?
(a).....(b).....(c).....

18. How do you recover the credit obtained
(a) Selling crops [ ]
(b) Selling livestock [ ]
(c) Other specify [ ]

19. How do you pay the credit received
(a) At once [ ] (b) By installment [ ]

20. How many times have you requested for credit?
(a) Once [ ] (b) Twice [ ] (c) In each farming season [ ]

21. Do you think that your income position has changed since joining the Cooperative society?
(a) Yes [ ] (b) No [ ]

22. If Yes, What other benefits and kind of support do you receive from Cooperative society compared to non members?
(a).....(b).....(c).....

23. Are you satisfied with Cooperative society services?
(a) Yes [ ] (b) No [ ]

24. If No, what should be done to ensure member satisfaction?
(a).....(b).....(c).....

25. What is the main source of farming labour force in the last crop season?
(a) Family labour [ ] (b) Hired labour [ ] (c) Combination of the above. [ ]

26. How much do you pay your labour force?
(a) Per day Tshs..... (b) Per week Tshs.....
(c) Per month Tshs..... (e) Other specify Tshs.....

27. What activities do you implement in this year from the income earned from tobacco?
(a)..... (b)..... (c).....
(d).....

28. Are the earned income satisfies food security to your household?
(a) Yes [ ] (b) No [ ]

29. If the answer is No, what food crops your cultivate to complement your household food security?
(a)..... (b)..... (c)..... (d).....

30. What is your future plan in order to increase tobacco production and reduction of environmental degradation?
(a).....
(b).....
(c).....
(d).....

E: Constraints which hinder adoption and implementation of sustainable farming practices

Note: Sustainable farming practices aiming at increasing crop production and decreasing environmental degradation.

1. Are you satisfied with extension services?
   (a) Yes [ ] (b) No [ ]

2. If the answer is no, why you are not satisfied with extension services
   (a).....
   (b).....(c).....

3. Are you comfortable with existing environmental conservation by laws in your village?
   (a) Yes [ ] (b) No [ ]

4. If you are not comfortable with existing by laws what are the reasons
   (a)..... (b)..... (c).....
   (d).....

5. If the answer is No, what are the constraints?
   (a)..... (b)..... (c).....
   (d).....

6. What are other constraints which hinder you in implementation of sustainable farming?
   (i)..... (ii).....
   (iii)..... (iv).....
   (v)..... (vi).....

Appendix 2: Checklist for focus group discussion

1. What s the total size of your farm
2. What type of land preparation (tillage) do you use?
3. Are you practice tobacco production
4. Do you cultivate tobacco in the same land in each year?
5. Shifting cultivation involves cutting down of trees in each year?
6. What is the use of harvested trees?
7. Do you use agricultural inputs in tobacco production?
8. Agricultural inputs are available and the price is affordable to all farmers during crop season
9. Have you received extension services on agricultural practices?
10. Does the extension services adequate to you
11. Have you ever received any type of training on agricultural practices?
12. Is there any kind of practices introduced in your area?
13. Who introduce the technology and when
14. Which practices are relevant to you and why?
15. Where do you practice the above mentioned technologies in your village?
17. What are the main forms of environmental degradation in your village?
18. What are the main problems resulted by desertification
19. What are the main problems resulted by land degradation
20. What is the trend of crop production in your village?
21. Your village has any existing environmental conservation by laws?
22. The existing by laws is implemented properly by the community.
23. What is the main source of energy for tobacco curing?
24. Where do you get it and how many hours used
25. There is an alterative energy source in your area
26. Do you heard about improved burn structure
27. Tobacco farmers use improved burn structure in this village
28. Do you heard that each tobacco farmers must establish a woodlot
29. Are all farmers in this village already establish woodlots
30. Tobacco production contributes to household income and food security in this village
31. What areas of improvement observe by you are resulted by tobacco production
32. Do you think there is any problem in implementation of sustainable tobacco farming practices in your village
33. What are the problems hindering the implementation of sustainable agriculture practices in the village.
34. How many types of Cooperative societies established in this area?
35. What kind of support do you receive from Cooperative society?
36. Are you satisfied with Cooperative society services?
37 Do you use inorganic fertilizers, what types of inorganic manure do you use?
38 Do you use organic fertilizers, what types of organic manure do you use?
39. If the answer is Yes, What types of organic manure do you use?
40. What is application rates of organic manure do you use?
41. Which type of seeds do you mainly use?

Appendix 3: Checklist for key informants

1. Do tobacco farmers aware about the objectives of National agricultural and Environment policies
2. What is the trend of tobacco production?
3. What is your view on the level of the community in farming practices which increase production and reduce environmental degradation?
4. Do you think the package delivered to the farmer for farming practices is adequately and well understood?
5. Are agricultural inputs available and affordable to the farmers during the crop season?
6. The extension services provided are adequate to all tobacco farmers
7. Which are the main constraints in provision of extension services according to your experience?
8. What is the trend of desertification in the area for the past 5 years?
9. Do the farmers aware on desertification
10. What is the solution taken to reduce the situation?
11. What is the trend of land degradation for the past 5 years?
12. What are you views on level of understanding of the community on land degradation?
13. Is there any land conservation technologies in the area, who introduce and when
14. What are the constraints do farmers faces during the implementation of the introduced practices
15. What is the alternative source of energy for tobacco curing?
16. Improved burn structure technology for tobacco curing is adapted to all tobacco farmers
17. What are the constraints in dissemination of technology?
18. Tobacco production contributes to household income and food security.