ECONOMICS OF SMALLHOLDER TOBACCO PRODUCTION AND IMPLICATIONS OF TOBACCO GROWING ON DEFORESTATION IN HURUNGWE DISTRICT OF ZIMBABWE.

By

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A thesis submitted in partial fulfilment of the requirements for the degree of Masters of Science in Agricultural and Applied Economics

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CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

The undersigned certify that they have read, and recommended to the Department of Agricultural Economics and Extension for acceptance, the thesis entitled;

ECONOMICS OF SMALLHOLDER TOBACCO PRODUCTION AND IMPLICATIONS OF TOBACCO GROWING ON DEFORESTATION IN HURUNGWE DISTRICT OF ZIMBABWE

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ABSTRACT

Natural environment is of great importance to both human life and animals. It supports agricultural activities and this calls for environmental conservation and sustainability. However, there are fears that the tobacco crop negatively affects the environment though it is one of the major cash crops. Deforestation is one of the major effects posed by tobacco growing. This is because smallholder farmers heavily depend on firewood sourced from natural forest. The objective of the study was to investigate the economics of smallholder tobacco production and the impacts of tobacco production on deforestation in Hurungwe District. The study, first determined the gross margins for the farmers using gross margin analysis (GMA) which represent the farmer' benefits. The costs to the environment by the tobacco farmers based on the firewood used for curing tobacco were also determined. Based on benefit cost ratio (BCR) the net benefits or cost were obtained. The study determined the cost of firewood for tobacco curing based on the farmers' willingness to pay (WTP). This was further added to the costs of producing tobacco to see the effects of the firewood cost to the gross margin. The study further used the binary logistic regression model to explain the significance of factors influencing natural forest harvesting. The farmers interviewed in Hurungwe District were 60. Results from the gross margin analysis indicated that all farmers benefited from tobacco production (GM > 0) with an average of US$ 3 396 and ranged from US$540 to US$9700. Benefits and costs were compared and the BCR for tobacco production indicated that the benefits outweigh the costs ranging from 1.74 to 1.76. Cost of firewood based on WTP of farmers ranged from US$5 to US$304 with an average of US$74. It was noted that with the inclusion of cost of firewood, the farmers' income is reduced to an average of US$3 322 and ranged from US$535 to US$9 453. Using the binary logistic regression model, results have shown that farmer experience, tobacco selling price and agricultural training level negatively affect the harvesting of natural forest (to obtain firewood) for curing tobacco significantly ($p < 0.05$). However, gender, size of the household, tobacco yield and level of education were insignificant ($p > 0.05$) in influencing natural forest harvesting. Though farmers are exploiting the environment at the same time increasing foreign currency earning through tobacco production, there is therefore the need to put in place policies that govern natural forest depletion such as gum plantations, subsidizing price of coal and introduce fees, penalties or taxes to the offenders. The fees must in turn be channelled towards environmental management and sustainability.

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ACRONYMS AND ABBREVIATIONS

AGRITEX	Agricultural, Technical and Extension Services
BCR	Benefit Cost Ratio
CSO	Central Statistics Organisation
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GI	Gross Income
GMA	Gross Margin Analysis
GR	Gross Revenue
HOD	Head of Household
IAD	Institutional Analysis and Development
IFRI	International Forestry Resources and Institutions
ITGA	International Tobacco Growers' Association
LDC	Less Developed Countries
LSC	Large Scale Commercial
SADC	Southern African Development Community
SSC	Small Scale Commercial
TIMB	Tobacco Industry and Marketing Board
TSF	Tobacco Sales Floor
US$	United States dollar
USA	United States of America
USDA	United States Department of Agriculture
VC	Variable Costs
WTP	Willingness to Pay
ZTA	Zimbabwe Tobacco Association
ZTFA	Zimbabwe Tobacco Farmers' Association

DEDICATION

This is a special dedication to my parents and my family who were the major source of motivation.

CHAPTER 1: INTRODUCTION

1.1 Background

African region is one of the poorest parts of the world economy, and as such heavily depends on agriculture for employment and income generation to sustain itself (Rukuni and Eicher, 1994). Agriculture is the backbone of most economies particularly the developing countries as it is the major source of revenue (Keyser, 2002). In the wake of increased environmental and sustainability concerns with improvement in agricultural production, countries are faced with the dilemma of choices in resource allocation and use especially in agriculture. Short – run technological gains and long-run environmental conservation are the two choices concerned in sustainable development. These require the adoption of appropriate technology that would suit particular level of different global communities. There is need to optimize the use of scarce resources in the management of natural resources to obtain the best services from the environment. Agriculture and other economic activities are producing externalities that affect the environment such as deforestation, pollution and so on (Pearce and Brown, 1994).

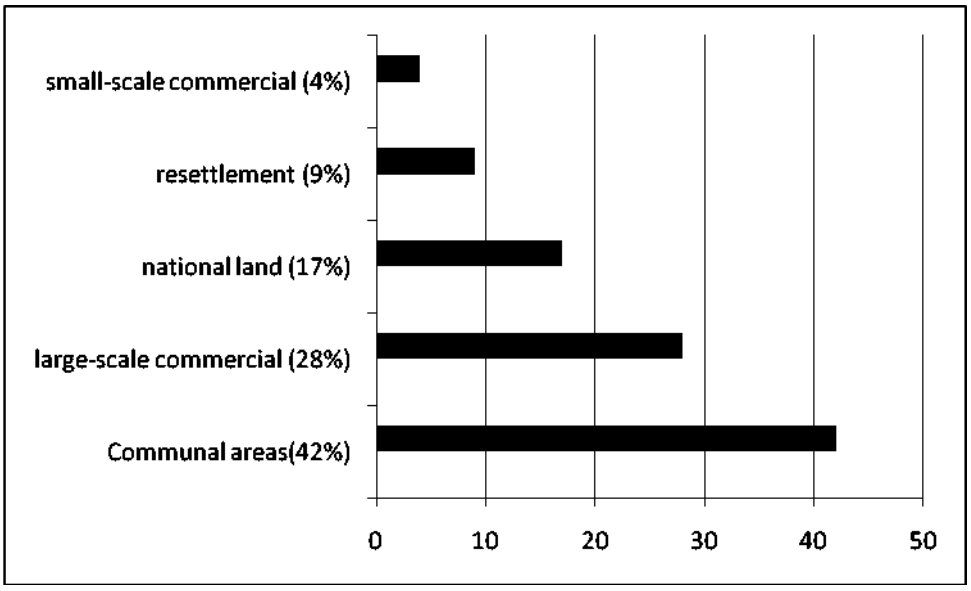
Zimbabwe heavily depends on agriculture for economic development. Tobacco production seems to have impacts on the environment but the impacts are undermined or not considered. Smallholder farmers mainly use natural forest as the source of firewood for tobacco curing. They use natural forest because it is cheap to access and this lead to deforestation problems. Deforestation is one of the major impacts caused by the production of tobacco (ITGA, 1996). It is therefore important to consider such impacts if tobacco production is to be sustainable.

Most smallholder farmers are diversifying into tobacco production with the perception that the crop is profitable. This decision has led to an increased demand for natural forest as source firewood for tobacco curing due to an increase in the number of smallholder tobacco farmers. Tobacco leaf is cured using different sources of fuel. The sources of fuel include the

following: coal, fossil fuels, electricity and natural forest. However, the majority of the farmers use natural forest as the source of firewood resulting in deforestation. Environmental degradation in the form of forest loss and soil due to mining continue at unprecedented rates in the country, eroding biodiversity and prospects for sustainable economic development of agricultural and forest resources (Bensel, 2008).

Tobacco is a strategic crop in Zimbabwe as it provides employment, foreign currency and also improves the livelihoods of the farmers and the nation at large. Three main types of tobacco grown in Zimbabwe are Virginia (flue-cured), burley (air-cured) and oriental (sun-cured) tobacco. Of these, flue-cured is by far the most important and is generally produced in the better rainfall areas in natural regions II and III. Air-cured and sun-cured tobacco is predominantly smallholder crops though they are grown in the same natural regions with the flue-cured tobacco (Rukuni and Eicher, 1994). In contrast to sun-cured and air-cured tobacco, flue-cured tobacco was mainly grown by the Large Scale Commercial farmers (LSC). In Zimbabwe there are three groups of farmers involved in tobacco production namely LSC, small-scale commercial (SSC) and smallholder (communal and resettlement). Although not as advanced as LSC growers, most SSC farmers used to produce at a reasonably high level and enjoy good access to basic equipments (Bishop *et.al*., 1985). Figure 1 shows the land classification in Zimbabwe based on these sectors. The smallholder constitutes 51% and more since some of the LSC was further redistributed through the fast track land reform programme in 2000.

Figure 1: Distribution of total land area by classification in Zimbabwe



Source: *Zimbabwe Farmers' Union, 2001*

It generated between 25 and 50% of domestic foreign currency earnings for the period 1995 and 2000 (ZTA, 2001). Its importance is further illustrated by the fact that it contributed 8.2% to the Gross Domestic Product (GDP) in the year 2000. However, tobacco production declined from 267 million kg in 2000 to 73 million kg in 2007. Tobacco production used to be the country's main export product with US$650 million/ year of export earnings and employed more than 700 000 people (Chipika and Kowero, 2000). In addition, 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 of America. The country does not have a large tobacco manufacturing industry and produces only enough cigarettes to supply domestic demand and provide a relatively small volume for export. Therefore 98 percent of all tobacco production is exported (Chaloupka *et.al*., 1996).

Smallholder farmers use firewood for tobacco curing. The major sources of firewood used are the surrounding forest areas. This results in deforestation leading to reduced availability of firewood for the rural community. Environmental degradation in the form of forest loss and

soil mining are some of the negative impacts leading to biodiversity, erosion and reduced prospects for sustainable economic development of agricultural and forest resources. The challenge faced by the smallholder farmers is therefore the development of measures or strategies to maximize use of natural resources while minimizing the effect of resource degradation. The alternative to enhance sustainable development is the conservation of forests, habitats and biodiversity to increase the productivity and efficiency of natural resource utilization in the different agricultural production activities. It may be difficult to assess exactly how much wood is needed for curing tobacco, but Madeley (1993) found out that it takes as much as three hectares of trees to cure one hectare of tobacco in some countries. Therefore, it is importance for Zimbabwe to tackle this deforestation problem given the high rate of deforestation, the population growth rate and continued poverty.

1.2 Problem Statement

African states emphasize development interest and ignore issues of environmental consequences as a result of agricultural production (Pearce and Brown, 1994). Environmental problems caused by farming are a direct result of an increasingly intensive and specialized agriculture (Jules, 1996). This is due to dependence on its natural resources which is a major feature of its environmental problem. There is excessive deforestation due to population pressure and agricultural expansion. Many tree species in Zimbabwe are at risk as they can be cut down is the major cash crop, for example in Hurungwe district. This requires special attention to protect not a single tree species but rather the ecosystem as a whole. Deforestation is one of the severe environmental problems in areas where tobacco production is practised worldwide.

Furthermore, deforestation is leading to loss of biodiversity and land degradation particularly in the smallholder sector. This led to reduction in the supply of timber and non-timber forest products to rural folk. There is also an increase in number of tobacco farmers leading to

increase in fuel wood demand causing deforestation leading to serious environmental degradation. Poor farming practices results in soil erosion, overgrazing and deforestation due to increased demand for tree products for several uses such as fuel wood for tobacco curing, timber and many other industrial uses.

1.3 Research Objectives

The broad objective of this study is to investigate the economics and impact of smallholder tobacco production on the level of deforestation in Hurungwe District.

Specific objectives are to:

a) Determine the benefits to smallholder farmers from tobacco production.
b) Determine smallholder farmers' Willingness To Pay (WTP) for firewood used in tobacco curing.
c) Determine factors that influence smallholder tobacco farmers' natural forests harvesting.

1.4 Research Questions

a) Do smallholder farmers benefit from tobacco production?
b) What are the smallholder farmers WTP for firewood used in tobacco curing.
c) What are the factors that affect harvesting of natural forests?

1.5 Research Hypotheses

a) The benefits to smallholder tobacco farmer are less than the costs to the environment.
b) WTP represents the value of the firewood used for tobacco curing, which, if it was the cost paid by farmers would reduce the returns to tobacco production.
c) Natural forest harvesting is influenced by sex, level of education, level of agricultural training and occupation of the head of the household (HOH).

1.6 Justification of the study

Although tobacco is a major foreign currency earner in Zimbabwe, there are however few studies on the effects of tobacco production to the environment. The smallholder sector use firewood sourced from natural forest as an alternative to other sources like electricity and coal. Firewood is cheap for the farmers as they can get it from the surrounding forests. Most smallholder farmers are now growing tobacco instead of maize because they are paid on delivery as opposed to maize which the payments take some months by the Grain Marketing Board (GMB). The study seeks to add to the literature and pave the way for policy makers in managing the environment sustainably.

1.7 Organization of the thesis

This thesis comprises seven chapters with the first chapter covering the introduction where background, research objectives, questions, hypotheses and justification of the study are highlighted. Chapter two provides a detailed literature review on smallholder tobacco production and its impact on deforestation where tobacco production is discussed globally, in Africa as well as in Zimbabwe. Thus this chapter provides the information on tobacco production and also its importance to the economy. This chapter provide empirical evidence on the issue of deforestation and agriculture with tobacco production in particular. Finally, the analytical tools used in the thesis are reviewed.

Chapter three outlines the methodology used in this study. The study area, data used as well as the analytical tools used are discussed. Chapter four presents the socio-economic characteristics of tobacco farmers and the benefits of smallholder tobacco production in Hurungwe District using the Gross Margin Analysis. This chapter addresses the first objective. Firstly, the general information obtained from the study is discussed, thus the demographic data and asset base for the farmers. Furthermore, the chapter consider the

variations of gross income, variable costs and the gross margin. It also considers the cost to the environment, which is further weighed against the benefits using benefit cost ratio (BCR). Chapter five presents another objective where the costs associated with fuel wood harvesting for smallholder tobacco production based on the willingness to pay (WTP) of the farmers are discussed. The variations in the WTP for the cost of fuel wood will be presented. This will be addressing the second objective. It further includes the costs of firewood use to the gross margin to observe if there are any changes to the farmers' benefits. Chapter six focuses on addressing the third objective on the factors affecting the harvesting of natural forests. This was done through the use of the binary logistic regression analysis. The impacts of the factors are outlined. Chapter seven outlines the possible policy options, recommendations, summary and conclusions drawn from the study as well as highlighting future possible areas of further study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature on the economics of tobacco production and the impact of tobacco production on deforestation. Tobacco production within the African and Zimbabwean context is reviewed. The economic importance of tobacco crop and forest resources is also outlined. The study then reviews empirical studies on deforestation and tobacco production, including relevant analytical tools used in the study.

2.2 Tobacco production and its impact on deforestation

One of the major problems in the third world countries is the issue of the environment (Benhin, 2006). Human activities have been viewed as one of the major sources of the environmental degradation. Hassan and Hertzler (1988) postulated that overgrazing, the extensive removal of tree cover for dry-land farming (both mechanized and traditional) and the excessive cutting of wood resources for fuel purposes are the main causes of deforestation in arid and semi-arid environments. The World Bank (1984) highlighted that more than 50% of the wood stock removed annually is burnt for energy in central and east African countries. In addition, the cost of tobacco cultivation has been summarized by Lightwood *et.al*., (2000) to include among other, environmental damage such as soil degradation, deforestation and water pollution.

Deforestation is the cutting down of trees to an extent of exploiting hence disturbing the normal functioning of the ecosystem. This is viewed as a problem caused by human activities to fulfil their interests at the expense of the environment. According to van Kooten (2000), deforestation is the removal of trees from a forested site and the conversion of land to another use, most often agriculture. This in turn affects biodiversity. Conversion of forest lands for agricultural production practices, the urbanization process, illegal exploitation of forest

resources for monetary gain and tremendous increase in population are all additional factors involved in the observed changes over time and the landscape degradation in this ecologically fragile region (Semwal et.al., 2004; Nautiyal and Kaechele, 2008). This entails that not only agriculture poses threats to the environment.

The statements that deforestation due to tobacco is insignificant especially in the developed countries were resources are available is debatable. This is in relation to environmental consequences as a result of tobacco production and in particular to the impact of flue- and fire cured tobacco on the indigenous forests. Thus, wood for tobacco curing is a major cause of damage. This is the case with Less Developed Countries that heavily depend on natural forest as a source of firewood for tobacco curing. Most of the smallholder farmers use firewood sourced from the natural forest as the cheapest method of curing their tobacco leaf. The environment is affected through deforestation as the farmers continuously cut down trees without any restrictions. In addition, this will threaten the environment through habitat destruction and also disturb the ecosystem (issue of biodiversity).

Curing is the major source in the industry's exploitation of wood, with 69% of fuel wood consumed during curing and 15% is used for poles and sticks for curing barn construction (Fraser, 1986). Tobacco curing is the process of burning the harvested tobacco leaf with varying conditions as stipulated to produce desired grades. Furthermore, flue-curing the green leaf must be kept at high temperatures by the circulated heat for about a week (USDA, 1992). Curing is the process that causes the destruction of the plants' chlorophyll, giving the tobacco leaves a yellow appearance by converting starch into sugar and removing the moisture (Sauer and Abdallar, 2005). By tobacco curing, the aroma and flavour of each variety of tobacco is brought out. After the completing the curing cycle which normally takes about seven to ten days, there is essentially no water left in the leaves. The number of curing cycles varies between five and seven, whereas the mid cycles (three to five) consume the highest volumes

of wood. The process can use a variety of fuels including coal, liquid petroleum gas or oil. Curing also affect the final grade of the leaf though there are some other factors that do affect the leaf grade.

Flue curing is the dominant method of curing Virginia tobacco which is on demand. Flue-curing means that heated air coming from the furnace usually outside the barn, is passed through the harvested leaves by means of metal pipes inside the barn. If furnace technology, barn construction and efficient loading are improved, high rates of wood use can be considerably reduced. Flue-curing produces sugar in the leaves and gives a mild alkaline flavour to light cigarettes. In contrast to flue curing, fire-curing is done in traditional barns where wood smoke is introduced during the process to produce a dark, smoky product, especially for pipe tobacco. The general problem with the fuel wood use for curing especially in the developing nations is the extreme lack of data to explain the tobacco and environment interaction.

Tobacco is viewed as a valuable crop worldwide and is regarded as a vital crop as it plays a significant role in the economies of many countries. However, a significant proportion of agricultural production occurs in the developing world. Moreover the production is concentrated in very few countries; this is due to quality and cost factors. World tobacco production is shifting towards developing countries (Myers, 1994). This has resulted in a high rate of deforestation and posing a serious threat to the sustainability of agriculture in the tropics as well as life on earth. Agriculture has been noted as the major cause of forest loss, estimated to account for about 90 percent of all deforestation in the tropics (Benhin, 2006).Tobacco is grown in more than 100 countries in the world with China being the leading producer with other major producers like United States, India, Brazil, Turkey, Zimbabwe and Malawi. Tobacco products are consumed all over the world and most of it is used for

smoking. China accounts for 30% of the world's production and consumption of cigarettes by volume with the United States being the second largest at 12%.

Tobacco production started in Chesapeake Bay area of Virginia during the 17th century and was an enterprise for settlers making use of contract and slave labour to colonize natural environments. In 1800, 70% of world tobacco production was concentrated in North America. Tobacco spread all over the world since the initiation of the American Revolution and the breakdown of the colonial rule (Goodman, 1995). For the first time in history, tobacco production shifted into the developing nations of the tropics and subtropics around 1940s (Geist, 1997). These nations have more fragile ecosystems than the temperate regions especially when it comes to fuel wood supply from natural forests. Production of tobacco leaf increased by 40% in 1971, during which 4.2 million tonnes of the leaf were produced and in 1997, 5.9 million tonnes of the leaf were produced (FAO, 2003). Tobacco leaf production is expected to reach up to 7.1 million tonnes by 2010. This figure was once exceeded in1992 where 7.5 million tonnes were produced but in the developing nations the production actually decreased (FAO, 2004). In addition, every year 6.7 million tonnes are produced throughout the whole world and the top producers are China (39.6%), India (8.3%), Brazil (7.0%) and United States (4.6%).

There are three types of tobacco grown on the globe; Virginia tobacco is named after the US state where it was first cultivated. It is also called "bright tobacco" because of its yellow to orange colour achieved during flue-curing. This type does particularly well in subtropical regions with light rainfall such as Georgia (USA), southern Brazil and Zimbabwe. Burley tobacco is another type which is slightly lighter shade of green than Virginia, after being air-cured it turns brown with virtually no sugar, giving it an almost cigar-like taste. It is a heavy feeder as compared to Virginia and the best of burley tobacco is grown in the USA, Central America, Malawi and Uganda (Goodman, 1995). With Virginia and oriental tobacco, it

makes up an American blend. Finally, oriental is the smallest and hardiest type, grown in the hot summer of the Balkans, Turkey and the Middle East. These conditions and a high planting density create an aromatic flavour, enhanced by sun-curing as in a traditional Turkish cigarette. The American blend which is the mixture of the three tobacco types is increasing whilst the dark cigarettes are declining (Gijsbert van Liemt, 2002).

Table 1: World unmanufactured tobacco: Production volume by regions and countries (percentages; selected years)

	1985	1990	1995	1998
Asia	56.9	61.0	62.8	59.9
(China)	(31.6)	(37.2)	(36.5)	(36.1)
(India)	(6.9)	(8.0)	(8.9)	(9.1)
(Turkey)	(2.6)	(4.3)	(3.6)	(3.8)
Africa	4.4	5.2	7.5	7.5
(Zimbabwe)	(1.6)	(1.9)	(3.3)	(3.0)
(Malawi)	(1.1)	(1.4)	(2.1)	(2.0)
South America	7.7	8.2	8.8	9.2
(Brazil)	(5.7)	(6.2)	(6.3)	(6.2)
North America	13.5	13.1	12.4	14.1
(United States)	(10.0)	(10.4)	(9.0)	(10.4)
Europe (Including former USSR)	17.1	12.7	9	10
Total	100	100	100	100
Million tonnes	6.85	7.106	6.354	7.066

Source: *Extracted from Gijsbert, 2002*

Table 1 shows the production levels of unmanufactured tobacco based on the regions with some of the countries mentioned. Asia is the major continent contributing to tobacco production since 1985 through to 1998. North America follows though in 1985 Europe contributed more. African continent's production levels are very low compared to other continents with Zimbabwe and Malawi being the major contributors to this production.

2.2.1 Tobacco production in Africa

Tobacco is also a cash crop in Africa with its production increasing from 250 000 tonnes to 500 000 tonnes during the past 20 years. In 1996, African production exceeded the European production for the first time in history of commercial tobacco (Geist, 1998). Tobacco is dominantly grown in countries which are rich with the miombo woodlands. These countries fall in the SADC Region, that is the Southern African Development Community. Zimbabwe, Tanzania and Malawi produce about 75% of all tobacco produced in the continent. In addition, Tanzania is ranked among the top 20 tobacco growing countries in the world and has consolidated its third position of being one of the largest producers in Africa (after Malawi and Zimbabwe) (FAO, 2008). Geist (1998) postulated that 90% of tobacco produced in Africa comes from countries covered by miombo woodlands.

In the world, Africa's contribution to tobacco production is the least though most of the active nations are producing at their maximum. Malawi, Zimbabwe and Tanzania are the very active nations in Africa participating in tobacco production. These countries do not produce for consumption but rather produce for export as they do not process the product. The issue is flue and fire cured tobacco are not naturally cured by air or sun but rather require artificial energy. Therefore, this causes the cutting down of indigenous forests for curing if there are no other alternatives. However, in Zimbabwe most large scale commercial farmers use coal as another alternative as well as gum plantations (*Eucalyptus spp*). Zimbabwe produces more of Virginia (flue cured) whilst Malawi produce more of burley (air cured) tobacco.

2.2.2 Tobacco production in Zimbabwe

Tobacco is one of the cash crops produced by most smallholder farmers in Zimbabwe. It improves the living standards of the farmers as it attracts a considerably higher selling price compared to other cash crops such as cotton. Historically, this crop was the single most important export commodity in the economy and has dominated value of agricultural production from the late 1920s (Rukuni, et al, 2006). The potential for tobacco expansion has not been anticipated partly because of the world campaign against smoking and also because of lack of infrastructure (Rukuni, et al, 2006). Virginia tobacco is highly rewarding in financial terms but at the same time it is associated with high cost of production. Virginia tobacco is produced most entirely for export.

Table 2**:** Zimbabwe tobacco production, area, yield and output (2000 – 2010)

Year/ Season	Area (ha)	Yield (t/ ha)	Production (tonne)
2000/01	76 000	2.65	202 000
2001/02	71 000	2.33	166 000
2002/03	54 000	1.51	82 000
2003/04	41 000	1.58	65 000
2004/05	56 000	1.33	75 000
2005/06	27 000	2.03	55 000
2006/07	53 000	1.5	79 000
2007/08	62 000	1.10	68 000
2008/09	48 000	1.33	64 000
2009/10	67 000	1.27	93 000

Source: *FAO, 2010*

Table 2 shows the tobacco production area, yield and output for the period of 2000 to 2010. Generally, there has been a decline in the production of tobacco from 2000 to 2005. The production has since increased in the year 2006 to 2010. This could be due to the increase in number of tobacco farmers. In 2005/ 2006 the yield was very high though in terms of area

planted and production it was low. If the trend is maintained it means the production of tobacco continues to grow and hence the call for environmental sustainability. To this end, all efforts must be made to improve on quantity and quality of our tobacco and conserve the environment.

2.2.3 Economic importance of tobacco crop in Zimbabwe

Tobacco crop is one of the top ranked crops in Zimbabwe in terms of output and returns. There are some of the periods where tobacco was ranked the first in terms of its contribution to GDP. Chipika and Kowero (2000) highlighted that agriculture's contribution was 14% (for the period 1975 – 1994) to the country's GDP on average and it was ranked second to manufacturing which contributed 24%. However, agriculture accounted for about 40 – 60% of manufacturing sector inputs and comprised of 40% of Zimbabwe's exports (Keyser, 2002). Tobacco production is economically important as it generates foreign currency. It also accounts for about 30% formal employment and manufacturing contributing 16% (Mumbengegwi, 1998; Chipika, 1998). Due to variable weather conditions, agricultural production fluctuated year by year but its contribution to GDP remained around 17 percent for 1985-1998. In other words, agriculture has grown at a rate similar to that of the national economy (Maravanyika, 1998). Agricultural output rose 15% in 2009 and 34% in 2010, largely from the increased tobacco output (African Economic Outlook, 2011). Tobacco, cotton, sugar and tea are the main export crops with Virginia tobacco being the country's top agricultural export.

2.3 Economic importance of forest resources

Natural forests are of great importance to both the human life and the economy. It is therefore important to take cognisance of the forest resource accounting and the system of national accounts to see the value of the environment. Forest and other woody resources provide many

products and services to production and consumption activities. They are classified according to the type of use, which is necessary as it has important implications for the required type of adjustment to the current system of national accounting (Hassan, 2002). The uses are highlighted as:

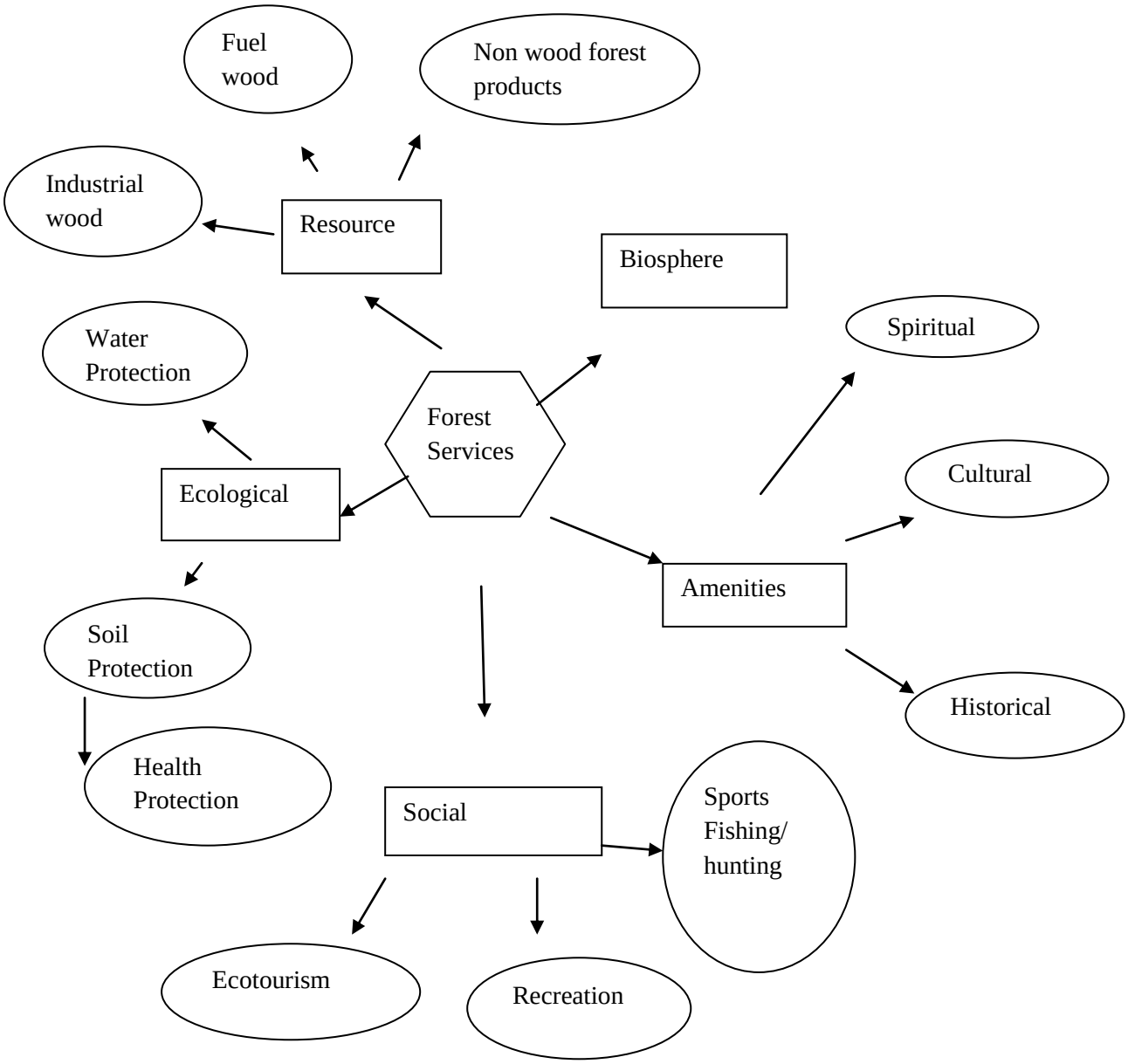
1. Products for direct, intermediate use by processing industries – these include tangible timber products for wood processing (such as commercial logs, craft wood) and tangible non timber resources for livestock production.
2. Products for final consumption – these also include tangible non market timber products, for example fuel wood for curing, construction poles and others. There is also the tangible non market non timber product (that is the whole or parts of plants and animals for food, medicinal and other purposes). Then the intangible, forest amenities (that is the use of the resource for social, religious and recreational purposes
3. Services for indirect, intermediate use by other industries – in this category, there is a wide range of environmental (ecological) services indirectly benefiting other industries. The examples include; (i) services benefiting other industries but causing no damage to forest health (watershed protection benefiting agriculture and the hydropower sectors, biological diversity, soil conservation and carbon sequestration benefiting source and non-source sectors); (ii) services benefiting source sectors which may be damaging to forest health such as pollution deposition (acid rain) benefiting manufacturing industries.

Cultivated forest provides almost similar products with environmental services and cause environmental externalities such as conversion of natural vegetation into tree plantations (for industrial use) which narrow biological diversity (Hassan, 2002). Other examples of the negative impacts of cultivated forests are soil erosion, sedimentation, reduction in stream

flow, acidification and compaction from management and harvesting practices. The problem is that the economic cost or losses of social welfare associated with such environmental impacts are not incorporated in the national accounts.

Figure 2 shows the services of the forest within an environment and highlights some of the services that can be destroyed due to deforestation. In Hurungwe, for example, forest services such as fuel wood provision for curing. Tobacco production returns have to cover the opportunity costs for the remaining forest services for it to compensate the lost forest services. It is also important to take into account the importance of these forests that are being destroyed.

Figure 2: Services provided by forests and woodlands



Source: *U.N Forest Principles (1992)*

2.4 Empirical Review

2.4.1 Review of Studies on tobacco production and deforestation

Little research has been done on tobacco and deforestation in Zimbabwe. However, studies focusing on deforestation and tobacco production were reviewed. The production of tobacco has since the 1960s, been moving from North and South America to Asia and Africa to

developing countries where deforestation is of economic concern (Angelsen *et al*., 1999). Eckholm, (1975) was influenced to publish on the issue entitled "the other energy crisis: fuel wood."Muller, 1978 supported the fuel crisis existence in the 1970s with emphasis placed on deforestation caused by rate of soil nutrient depletion and wood fuel use. Wood fuel demand was seen to be outpacing sustainable supply. A study by FAO in 1981 estimated that two billion people were dependent on fuel wood and other biomass fuel of which more than 100 million people were unable to meet minimum requirements sustainably. The perception of fuel wood crisis was further encouraged by a widespread assumption that by the end of the century much of Africa (and other areas) would have been deforested to provide fuel wood for the poor. Goodland *et.al*., (1984) revealed that tobacco production poses difficult dilemma for development as it generates a range of benefits such as employment, income, foreign currency and other cash contributing effects. In addition, it poses damage to public health and to the environment in the long run hence appears to outweigh the benefits thus the costs are more. This was supported by the Bellagio statement on tobacco and sustainable development which concluded that 'in the developing world tobacco poses a major challenge not just to health but also to the environmental sustainability.

Data for the mid 1980suggested that flue cured tobacco consumes between 82.5 and 175 million cubic metres of round wood harvested worldwide each year for curing. This translate to the equivalent of 1.2 to 2.5 million hectares of open forests or woodlands removed annually (Goodland et.al., 1984 and World Bank, 1984). In addition, Fraser (1986) revealed that tobacco production in the developing world leads to serious wood deficit or prospective wood deficit situations and Zimbabwe is among the list of the countries affected. There is need to find alternative sources of firewood for tobacco curing so that farmers can stop using natural forest. The study also highlighted that area of forest in the developing world is now below the sustainable firewood demand level. This may result in a potentially increasing

deforestation and serious ecological consequences. Similarly, FAO in 1998 noted the consequences of tobacco related deforestation in the form of fuel wood shortage among rural people in the developing world.

It was believed that wood fuel use in the developing regions is the key factor in tropical deforestation and loss of forests was projected to result in wide spread wood fuel shortage (Bensel, 2008).The level of deforestation may be underestimated but Geist, 1999 estimated that the production of tobacco caused 11.3 million hectares of deforestation over a five year period. Chipika and Kowero in (2000) contributed to the deforestation debate by identifying a number of deforestation causes which included expansion of arable land, demand for fuel wood, construction of poles and urban expansion. They further evaluated agricultural policies (including removal of subsidies, high nominal prices) could have encouraged modest deforestation of woodlands in Zimbabwean communal and resettlement areas in the period 1980 to 1995. Another study by Garcia, (2006) examines both the spatial distribution of forest loss and the total amount of deforestation within a given community, showing how the outcome is jointly determined. The study highlighted that total deforestation depends upon the value of deforested land which is determined by its physical attributes as well as the characteristics of the community that affects collective choice problems. Smaller group sizes, higher secondary education and greater inequality correspond to lower deforestation (Garcia, 2006).

Another study by Abdallar et.al., (2007) in Iringa region of Tanzania revealed that annual miombo woodlands deforestation rate for period 1959 to 1978 was 319.03ha/ year (3.3% per year) while 1978 to 1999 the deforestation rate was 26.59ha/ year (3.04% per year). The difference was attributed to the increase in the hectarage under tobacco production in the period with a higher deforestation rate. The findings were supported by the use of the aerial photograph interpretation based on shape, pattern, tone, texture, shadow and association. The

regression factors for tobacco production by Abdallar et.al., (2007) show that output prices, cash loans received, amount of family labour engaged, level of education, fertilizer availability were significant in explaining why people engaged in tobacco production. Bensel (2008) highlighted that in other regions of Philippines, intensive wood fuel use is still maintained and natural forest remains the primary source resulting in deforestation. The Cebu area in Phillippines is widely perceived as an environmental disaster in terms of tree cutting for fuel wood production. In contrast, the paper argues that environmental conditions in Cebu are improving since tree planting and environmental management is wide spreading to all smallholder farmers leading to increased afforestation. A similar study by Yanda, (2010) in western Tanzania concluded that between 1975 and 1989 tobacco production was fluctuating hence the size of land cleared show low correlation with time. From 1990 to 1995 the size of cleared land for tobacco production and curing increased, showing some correlation with time. Total cleared land for tobacco production and curing was projected to double by year 2016.

Kibwage et.al, (2008) examines the current and historical changes in household livelihood strategies used by tobacco farmers in comparison with non-tobacco farmers. Furthermore, experiment on the potential and people's attitudes of adopting Bamboo as an alternative crop or source of livelihood to tobacco farming in the Kenyan region was done. The study revealed that a tobacco farmer spends more income on medical/ healthcare services than a non-tobacco farmer an indication of rampant ill health related issues to tobacco cultivation. A non-tobacco farmer on the other hand spends more income on education as compared to a tobacco farmer. The land under tobacco farming had been increasing overtime as reported by43.9% of the respondents and it has interfered with the traditional land tenure systems. Tobacco gross margin is about Ksh 24,146 per acre per annum and per household (Kibwage et al, 2008). This low level of earning from tobacco farming for a household averagely of 9+

people do not contribute to the Kenyan Government program of rural poverty alleviation. This is in agreement with the findings of Ochola and Kosura (2007). Most indigenous tree species in the forests have continued to disappear in the region due to high demands in terms of wood fuel for curing purposes. Rampant soil erosion and low soil fertility among tobacco farmers is very high.

The study recommends that detailed environmental impact assessment of tobacco activities in the south Nyanza region should be done. There is need for detailed studies on the impact of tobacco production on forests/vegetation through the use of Geographical Information Systems (GIS), assessment of water quality and hydrological changes over time since tobacco introduction in the area, soil quality and fertility analysis in tobacco farms in comparison to non-tobacco farms.

Kohlins and Parks, (2001) investigated a major strategy to combat deforestation caused by household fuel collection through the establishment of plantations in India. A household model was specified with a number of collection possibilities and analyzed empirically using household, vegetation, and GIS data, and the potential decrease in collection from the natural forest was estimated. The results showed reduced pressure on the natural forest due to the establishment of plantations. This is in line with argument that tobacco production is likely putting pressure on natural forest through the curing process. This study follows the argument that the plantations potential to reduce deforestation from fuel wood collection in developing countries is unknown at the same time the scarcity of biomass will continue to degrade the environment. Ali and Benjaminsen (2004) investigated the theory of Himalayan environmental degradation on natural resource management. It further entails that increased demand for natural resources leads to severe resource depletion, in particular deforestation. The study investigated whether such general perceptions regarding forest depletion could be supported by an empirical case study using local data on fuel wood consumption and timber

extraction from Basho Valley in northern Parkistan. The results indicated that local fuel wood collection was not the main cause of deforestation. Instead, the estimated deforestation of about 30% during the last three decades is primarily due to commercial harvesting and mismanagement by the government. In support to this, other authors concluded that deforestation associated with tobacco curing cannot be considered a significant negative externality (ITGA, 1995 and 1996).

2.4.2 Review of the analytical tools used in the thesis

2.4.2.1 Gross Margin Analysis

An enterprise budget is a planning document. Gross margins are a useful first step in deciding on the combination of activities on a farm. The activity with the highest gross margin per unit of the most common limiting resource is chosen. Labour, capital or land as a production unit common to all the farm activities is the most appropriate basis for comparison in the gross margins. It also shows a breakdown of gross revenue/ income and variable costs as it pertains to a crop/ livestock enterprise. Gross margin is calculated as follows;

Figure 3: Gross Margin Equation

$$GM = P_yY - \sum P_tX_t \quad \text{.....(1)}$$

Where;

GM = Gross Margin,

P_y = Price of the commodity,

Y = Quantity of production output per hectare,

P_t = Price for each i^{th} input unit and

X_t = Quantity of i^{th} input unit used per hectare.

Source: *Malaiyandi et. al., (2010)*

To calculate the gross margin, first calculate the gross revenue/ income, GR/ GI (the amount of money received after selling the product without deducting any encountered costs) based on the selling price and the yield of the crop and the formula is given below which is extracted in figure 3 and is normally calculated per ha for the crops;

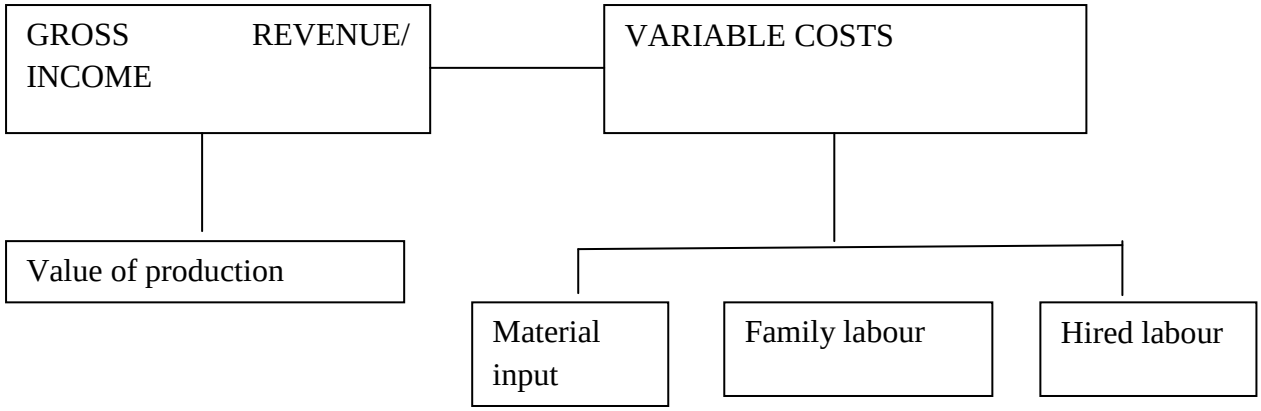
GI/ GR $= P_y Y$ .....(2)

After getting the gross revenue calculate the variable costs (VC) for the hectare and these are the costs that directly vary with the level of production such as seed, fertilizers, chemicals and labour among others. VC is obtained based on the prices/ unit of input used such that all the different inputs used have to be incorporated to constitute the variable cost and is given by;

$VC = \sum P_t X_t$ .....(3)

Having the VC and GR implies that GM can now be calculated as per figure 4. This will lead to the final decision basing on the gross margin where the enterprise with the highest gross margin is chosen.

Figure 4: Gross Margin components



Source: *Malaiyandi et. al., (2010)*

Figure 4 shows the breakdown of gross income/ revenue and the variable costs, where gross income/ revenue constitute the value of the production for example the total amount that the farmer gets after selling tobacco output for a hectare. On the other hand, variable costs are divided into three costs that are material inputs such as fertilizer, fuel wood, seeds among others, family labour and hired labour. As for the smallholder farmers, the problem is on the variable cost especially with labour issues in tobacco as most of them do not value family labour in their crop budgets but rather consider only hired labour if ever they hire. They do not consider family labour as costs of which most of them do not hire labour but use the family labour. On the VC the contribution of the labour is about 41% (hired labour being 24% and family labour 17%) and the material input constituting 59% with fuel wood contributing about 26% of the material input (Malaiyandi et al, 2010). Flue-cured tobacco has the highest gross margin compared to other crop enterprise such as coffee, wheat, cotton and soyabeans in Uganda. This entails that the manager responsible, assuming that from all these crops the choice is to choose one enterprise, should choose the flue-cured tobacco based on the gross margin. The gross margin is about 67% of the gross revenue whilst the variable costs are 33% of the gross revenue. This is supported by the study carried out by Malaiyandi

et. al (2010) in Uganda, the gross margin for tobacco production was 66% of the gross revenue. Another study carried out in Kenya concluded that tobacco gross margin was 39% of the gross revenue (IDRC, 2008). The reason for the lower gross margin was attributed to the ranking of the crop based on its ability to generate income (ranked number seven).

2.4.2.2Regression Analysis

Most of the studies reviewed used the regression model to assess the level of significance of the factors affecting deforestation. This model is widely used but simple linear regression is limited to a single independent variable hence the use of multiple regression and binary logistic model.

A multiple regression model is a summary of relationship between a dependent, Y and various/ multiple independent variables X. After running the model it will show the variables that may be significant, thus the variables will show changes to the behaviour of the dependent variable. The idea is to observe the behaviour of Y with the changing X variables. The multiple regression model is given by;

$$\mathbf{Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_q X_q + \varepsilon} \quad \textbf{.....(4)}$$

Where;

Y = the dependent variable for example deforestation,

X_i = all the independent variables (where i = 1 to q),

α = the intercept or regression intercept (it gives the value of Y where the regression line meets the Y axis at X = 0),

β_i= the regression coefficient for each independent variable (it gives the measure of change in the value of Y for a unit change in the value of X) and

ε = the error term or disturbance. It contains factors other than X_1 to Xq that affect Y and these factors are collectively referred to as the error term. These factors are those that are not specified when developing the model that do affect Y.

Multiple regression model is used to investigate the relationship of a continuous (interval scale) dependent variable not categorical as its assumptions are not met by use of categorical data.

Binary logistic regression model had been popular to address dependent variable that is dichotomous or binary in nature like success or failure or a yes or no response (Gujarati, 2003). It can be used to predict a dependent variable on the basis of continous and/ or categorical independent variables. It determines the percent of variance in the dependent variable explained by the independent variables. It also ranks the relative importance of independent variables to assess interaction effect and to understand the impact of covariate control variables. The impacts of the predictor variables are usually explained in terms of odds ratios (Gujarati, 2003).

The model can be written in odds as:

$$\mathbf{P_i/ (1 - P_i) = 1+e^{Zi}/ 1+ e^{-Zi} = e^{Zi}} \quad \mathbf{.....(5)}$$

In terms of the probability of the outcome occurring and $P_i/ (1 - P_i)$ is simply the odds ratio in favour of the outcome occurring.

Conversely, the probability of the outcome not occurring is;

$$\mathbf{1 - P_i = 1/ 1 + e^{Zi}} \quad \mathbf{.....(6)}$$

In terms of the natural log, the model can be presented as;

$$\mathbf{L_i = In (P_i/ 1 - P_i) = Z_i = \beta_1 + \beta_2 X_i} \quad \mathbf{.....(7)}$$

The left hand side of the equation is the log odds ratio which is a linear function of the explanatory variables (Madalla, 1992).

2.4.2.3Willingness to Pay Analysis

Contingent valuation method is referred to as a stated preference method because it directly asks people to state their values. It originated from the estimation of non-marketed goods but is widely used to evaluate WTP for new products such as organic products. It is also commonly used to measure consumer preferences for non-market (such as environmental) goods based on WTP. This method gives rise to the willingness to pay from the people concerned. The concept of willingness to pay explains consumer demand for a particular non marketed good's benefit in monetary terms. Similarly, it is a stated preference approach namely contingent valuation which is widely used. It also involves asking consumers to state their preferences directly in terms of hypothetical markets or payments (Bishop, 1999).

The two main variants of the contingent valuation method are open ended and dichotomous choice format though there are also some including payment card approach and bidding game approach. The open ended format involves letting respondents determine their bids freely while the dichotomous choice format present respondents with two alternatives among which they are asked to choose. Open ended formats typically generate lower estimates of WTP than the dichotomous choice format (Williamson, 1999). In a case study of forest recreation in the Costa Rica by Echeverria et. al., 1995 used a "take-it-or-leave-it" personal interview survey of eco-tourists to estimate WTP for the Monteverde Cloud Forest Preserve. Willis et. al., (1998) used contingent valuation method together with an individual travel cost method to estimate consumer demand for forest recreational sites in Perunsular, Malaysia. The results indicated that the two methods generated comparable results. Contingent valuation was also used to assess Peruvian farmers' WTP for forest use benefits. The resulting estimates covered a wide range of direct, indirect uses and non-use values (Smith et. al., 1997). Similarly,

Kramer et. al., (1992, 1995) used this method to evaluate the direct use benefits to rural communities from harvesting non-timber forest products and using forest areas for agriculture and residential space near the Mantadia National Park in Madagascar.

However, this method of analysis has the following weaknesses; the stated preference method fails to measure preferences accurately and does not provide useful information for policy (Diamond and Hausmann, 1994). If the technique is poorly or badly implemented, it can influence and distort responses leading to results that bear little representation of the relevant population's true WTP. Since there is no payment that is made instantly in most cases, then the observers question its validity.

2.4.2.4 Benefit Cost Ratio (BCR)

It is a technique for assessing the monetary social costs and benefits of a capital investment over a given time period. It is an economic technique for appraising projects and is widely used in businesses. The benefit cost ratio is given by;

$$\mathbf{BCR} = \frac{\textbf{Benefit}}{\textbf{Cost.}} \quad \textbf{……(8)}$$

This ratio shows the relationship between benefits and costs of projects. BCR that equates to one implies that the benefits and costs are equal (the project is operating at breakeven point, thus no profit or loss). BCR greater than one implies that the benefits exceeds the costs, the BCR is most preferred whilst BCR less than one entails that the costs exceeds the benefits such that the project is running losses and the BCR is undesirable to the farmer. The selection criterion based on the BCR for independent projects, the farmer must accept all projects with BCR of one or greater.

2.5Conclusion and Insights from literature

This chapter reviewed literature on both tobacco production and deforestation. It has been noted that tobacco production is a strategic enterprise in terms of its returns both to the farmer as well as the nation at large. However, it causes deforestation in the nations were the production is done intensively with farmers relying heavily on the natural forests. The industry is the backbone of the most developing economies. In the case of Zimbabwe, its production is of great importance as it improves the economy through various attributes such as employment creation, improving the standards of living for the rural household, foreign currency earner among other things. Tobacco production seems to be a threat to the environment though the question is, 'Is the threat significant?' The issue is on the level of deforestation emanating from tobacco production such that some countries experience less severe occurrence of deforestation and others face the deforestation challenges. Based on the literature reviewed, deforestation results in a disruption of processes that leads to the provision of forest services including soil protection, non-wood products, recreational and many others.

The question is 'tobacco production's impact to the environment is it significant or it's of no harm?'Studies focusing on tobacco and deforestation issues reveal different results from country to country depending on the importance of the tobacco crop. This calls for this study to try and investigate this debate starting at district level in Zimbabwe. There is no study which has been done to focus on this matter in Zimbabwe. It is therefore, ideal to have a study at national level that will be done and this could be the answer to the current debate especially in terms of deforestation rate for Zimbabwe as one of the less developed countries stating their position. Zimbabwe is the major tobacco producer in Africa hence the need for such a study to be carried out. On the other hand, if tobacco proves to be causing problems to the environment. There is the need to consider an alternative crop to replace tobacco. The

crop replacing tobacco should be the one that seeks to address the number of issues faced by smallholder tobacco farmers. In addition, the crop has to cater for the environmental degradation and depletion of forest cover by years of farming tobacco as well as sustaining the farmers financially.

CHAPTER 3: METHODOLOGY

3.1 Introduction

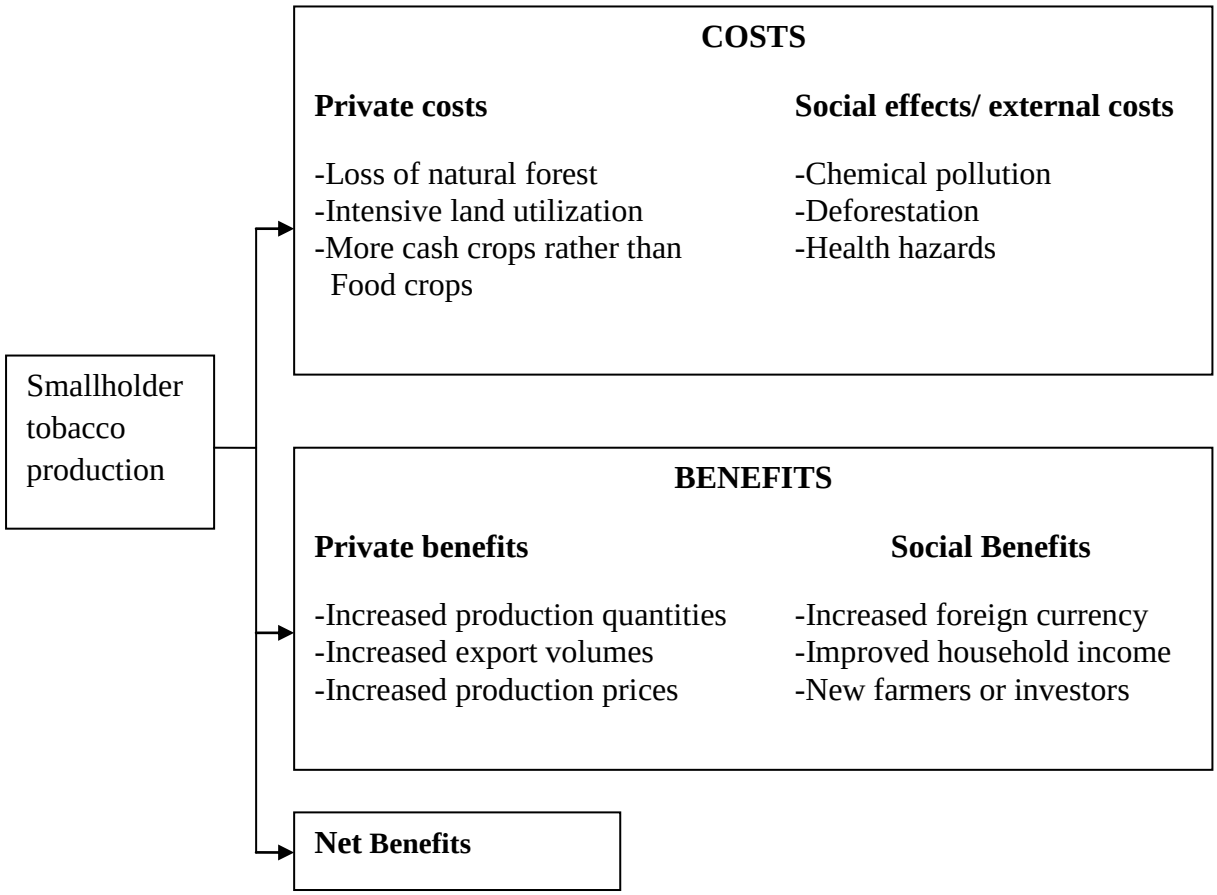
This chapter presents the conceptual framework on the linkage between tobacco production and the environment (deforestation in particular). It also shows the benefits and costs of tobacco production. It further provides the brief background of the area of study, data collection methods, sampling techniques and analytical tools used. It further explains the analytical tools used which include Gross Margin Analysis, binary logistic regression model as well as descriptive statistics and the data required to address the problems.

3.2 Conceptual framework: Impacts of tobacco production on the environment in Zimbabwe.

The conceptual framework used in this study emanates from the relationship between tobacco production and deforestation as is the issue of concern. It has been noted that, besides deforestation, tobacco production and other agricultural practises are causing serious damages to the environment. However, this study focuses more on the economics of tobacco production and its implications on deforestation. Figure 5shows the impacts of smallholder tobacco production on the environment. Smallholder tobacco production is the key agent that affects the environment. The effects are represented by either costs or benefits. After comparing the costs and benefits, if the costs are greater than the benefits then the result is a net loss/ cost. On the other hand, if the costs are outweighed by the benefits then the result is the net gain/ benefit (which are anticipated by most farmers). Smallholder tobacco production is associated with private benefits (gain realised by the farmer) such as increased production volumes, increased export quantities and increased production prices. The private benefits are at individual farmer's level hence the gain to the farmer. Apart from individual farmer benefiting, the society as a whole will also benefit from the smallholder tobacco production through increased foreign currency earnings hence improved economic development. It further improves household income leading to the improved rural livelihood. This will also

attract other farmers who may not be producing tobacco leading to increased tobacco production. The new farmers for smallholder tobacco production are likely to increase hence the production is boosted.

Figure 5: The conceptual framework: Smallholder tobacco production and the environment.



Source: *Author's compilation, 2010*

Smallholder tobacco production is causing environment damage through intensive use of natural forests and deforestation (both the private costs and the social costs). Farmers are using the natural forest as their source of fuel wood to an extent that the forests are degraded causing deforestation both at farm level and the national level. This is due to lack of institutional enforcement governing the natural forest use. The indigenous tree species are likely to be eliminated if strict measures are not enforced urgently. Smallholder tobacco

farmers wants to maximize profits through intensive land utilization for tobacco production which may results in chemical pollution thereby degrading the environment. In addition, there is also the intensive use of chemicals that is promoted especially when a single crop is cultivated/ grown continuously. The farmers produce crops that earn cash to increase their income at the expense of food crops.

Apart from the private costs discussed, there are some social costs that exist as a result of smallholder tobacco production. Chemical pollution is experienced through the intensive use of chemicals which degrade the soils in the long run. The soils are then unsuitable for most food crops as they may not be fertile. Deforestation is occurring due to the increase in demand for fire wood by many users in the society for different uses. Firewood uses in the society include household consumption (cooking), tobacco curing and non-timber use such as poles and fruit harvesting. Smallholder tobacco production is also associated with health hazards during its production, processing and through to the final product. The costs and benefits constitute the effects of smallholder tobacco production to the environment. This shows the negative and positive effects of tobacco production by smallholder farmers at both farmer and national levels. Weighing of costs and benefits will also indicate whether the farmers obtain net benefits/ costs. This will suggest whether smallholder tobacco is growing or declining considering its environmental sustainability.

3.3 Study area

Hurungwe District falls under Mashonaland West province of Zimbabwe. It falls under natural region IIb characterised by an annual rainfall ranging from 900 to 1200mm It is located in the northern part of Zimbabwe and is approximately 210 km west of Harare, the capital city of Zimbabwe. The soil types in this district vary from clay loam to black clay soils where the production of the following crops are suitable; maize, soya beans, groundnuts, cotton, tobacco, sugar beans, sunflower and paprika, among others. In terms of the

vegetation, it is a typically miombo, dominated by *Brachystegia species* and *Julbernadia species*. *Julbernadia globiflora*, common name is Dubbel kroon – boom, also called munondo in shona. It is a medium to large tree with a rounded crown. It is found in mixed woodland, frequently co-dominant with *Brachystegia spiciformis* in miombo woodland, and is easily confused with this species though there are some differences (Braam and Piet, 1997). *Brachystegia boehmi*, also called mufuti, is a medium sized deciduous tree with a spreading flat topped crown and attractive.

The area constitute A1 (newly resettled farmers) and communal farmers who are actively participating in tobacco production. The smallholder tobacco farmers were 185 according to the extension workers records.

3.4 Data collection and sampling techniques

To collect the primary data, a structured questionnaire was used and the survey data collected provided information about the following variables; farmers demographic information, land area under tobacco, period into tobacco production, measures done by farmers to ensure they guarded against deforestation, methods of curing, factors influencing tobacco production, challenges in tobacco production and other questions related to tobacco production and the environment. Secondary data were also used to support the primary data collected.

This study was conducted in Hurungwe District in the 2009/10 season, and 60 farmers were randomly selected and interviewed with the assistance of the extension workers from (AGRITEX) in the area. The visits were made to each individual farmer with the assistance of the extension workers. Smallholder tobacco farmers were interviewed using a structured questionnaire. The stratified random sampling method was employed from a population of 185 farmers (among these A1farmers were 68 and communal farmers were 117).

3.5 Analytical Framework

This section highlights the different analytical tools used to address the study objectives. This study uses descriptive statistics, gross margin analysis and binary logistic regression analysis. These tools will be explained in brief for better understanding and how they are to be used in testing the hypothesis. Table 3shows the summary of the objectives, hypothesis and analytical tools used in this study.

Table 3: Summary of the objectives, hypothesis and analytical tool

Objective	**Hypothesis**	**Analytical tool**
1. To determine the benefits to smallholder tobacco farmers	The benefits to smallholder tobacco farmer are less than the costs to the environment.	Gross Margin Analysis
2. To determine the smallholder farmers' WTP for firewood used in tobacco curing.	WTP represents the value of firewood used for tobacco curing which, if it was cost paid by farmers would reduce the returns to tobacco production.	Gross Margin Analysis and Cost Benefit Analysis
3. To determine the factors influencing smallholder tobacco farmers natural forests harvesting.	Natural forest harvesting is influenced by sex, level of education, level of agricultural training and occupation of the HOH.	Binary Logistic Regression model

3.5.1 Gross Margin Analysis

In analyzing the data, for the first objective, Gross Margin Analysis was used with and without firewood as one of the inputs. An enterprise budget is a planning document. Gross margins are a useful first step in deciding on the best combination of activities on a farm. The activity with a positive gross margin per unit of the most common limiting resource is

chosen. It also shows a breakdown of gross revenue/ income and variable costs as it pertains to a crop/ livestock enterprise. Gross margin is calculated as follows;

$$\mathbf{GM = P_yY - \sum P_tX_t} \quad \text{.....(1)}$$

Where;

GM = Gross Margin,

P_y = Price of the commodity,

Y = Quantity of production output per hectare,

P_t = Price for each i^{th} input unit and

X_t = Quantity of i^{th} input unit used per hectare.

Gross margin analysis was chosen because of its simplicity on calculations and shows the net income the farmer gets thus the gross margin, which represents the benefits. The gross margin is about 67% and 66% of the gross revenue whilst the variable costs are 33% and 34% of the gross revenue (Maravanyika, 1998 and Malaiyandi et. al., 2010).

3.5.2 Binary Logistic Regression model

The binary logistic regression analysis is used to investigate the relationship between a categorical dependent variable thus natural forest harvesting and some of the major factors causing deforestation identified in Hurungwe District. It is preferred for socio-economic factors investigations as opposed to multiple regression as it considers continuous dependent variable. It determines the percent of variance in the dependent variable explained by the independent variables. It also ranks the relative importance of independent variables to assess interaction effect and to understand the impact of covariate control variables. The impacts of the predictor variables are usually explained in terms of odds ratios (Garcia, 2006).

The binary logistic regression model in this study is given below:

$NFHARVST = \beta_0 + \beta_1 AGRICTR + \beta_2 PRTOB + \beta_3 FARMEXP + \beta_4 SEX + \beta_5 LVLEDUC + \beta_6 TOBYIELD + \beta_7 SIZEHHLD + \mu$.....(9)

Where;

NFHARVST = natural forest harvesting (1=yes, 0=no)

AGRICTR = agricultural training (master farmer) (1=yes, 0=no)

PRTOB = selling price of tobacco (continuous)

FARMEXP = farm experience (1=yes, 0=no)

SEX (GENDER) = sex of the HOH (1=male, 0=female)

LVLEDUC = level of education (1=yes, 0=no)

TOBYIELD = tobacco yield per hectare (continuous)

SIZEHHLD = size of household (1 =1 to 3, 2= 4 to 6, 3= above 6)

μ = error term (consists of other factors not specified in the model)

3.5.3 Willingness to Pay (WTP)

Willingness to pay (WTP) concept relate to the hectarage to get the environmental costs per hectare associated with deforestation. WTP is one method that is used to determine the price of a good in the absence of a market price. This concept is very useful in cases where the prices are unknown. This method tries to determine what the people are willing to pay for a particular good. It also entails that willingness (and the ability) to pay is the foundation of the economic theory of value. The idea behind is that when it is worth having a good then it is

also worth paying for it. This applies to the environmental resources such as water quality and natural resources like trees.

This method was used to come up with the costs associated with natural forest harvesting. This entails the acknowledgement by the farmers that they are damaging the environment through harvesting the natural forest for tobacco curing. They were probed to come up with a figure they are willing to pay for damaging the environment as well as the cost they are willing to purchase a scotch cart of fuel wood given the option that if the natural forest is sold not harvested for free.

3.6 Conclusion

This chapter presented different analytical tools that will be used in this study. Gross margin analysis is used to calculate the benefits from tobacco production. It is a simple method to use. It will further be used to calculate the benefits the farmers get after deducting the farmers' WTP for firewood used to cure tobacco. Binary logistic model will be used to explain the factors influencing natural forest harvesting as a source of firewood for curing tobacco. This was used because it caters for both continuous and categorical data for the independent variables though the dependent variable should be categorical but binary in nature.

CHAPTER 4: SOCIO-ECONOMIC CHARACTERISTICS OF TOBACCO FARMERS AND THE BENEFITS OF TOBACCO PRODUCTION IN HURUNGWE DISTRICT

4.1 Introduction

This chapter presents the descriptive statistics from the data collected including the demographic, resource endowments and the land use data. It further presents the benefits smallholder farmers in Hurungwe District get from tobacco production using the gross margin analysis. This chapter also presents the costs to the environment in the production of tobacco. Using BCR, the benefits and costs are weighed to draw the conclusion whether farmers benefit or not from tobacco production. This chapter addresses the objective of determining the smallholder farmers' benefits from tobacco production. The chapter also presents the discussion of the results.

4.2 Descriptive statistics

This section presents the survey data collected in tabular form for the demographic, land use (that is crop and livestock production) and asset ownership data. This includes the socio-economic characteristics of the smallholder tobacco farmers in Hurungwe District

4.2.1 Demographic data

The demographic data collected is presented in Table 4 including type of the farmer, head of the household (HOH), sex, education level and agricultural training. This gives an insight on the smallholder farmers' background in terms of the social and economic aspects in relation to the environment and tobacco production.

Table 4: Demographic data for smallholder tobacco farmers in Hurungwe District

	Communal	**AI**	**Total**
Number of farmers interviewed	11	49	60
	% of farmers reporting		
Type of farmer	18	82	100
Head of Household: No	8	3	11
(HOH): Yes	10	79	89
Sex of the HOH: Male	18	78	96
Female	0	4	4
Level of Education: Primary	10	42	52
Secondary	8	40	48
Level of agric. Training:			
Master Farmer	7	32	39
Farm experience	6	33	39
None	5	17	22
Occupation of the HOH:			
Family farm work	15	80	95
Rural non-agricultural work	1	2	3
Employed in town	2	0	2
Size of the household:			
1 – 3 members	3	10	13
4 – 6 members	10	52	62
Above 6 members	5	20	25

Source: *Survey data, 2010*

Among the smallholder farmers interviewed 18% were communal and 82% were A1 because the population in the area is dominated by the A1 farmers. Furthermore, most of the interviewed farmers were the HOH (89%) and the remaining were either wives or sons. Male

headed household dominate in this district with 96% and the remainder are female (who are widows). All the farmers interviewed were educated with 52% having attained primary education and 48% attained secondary education. In addition, 39% of the farmers completed the master farmer training offered by Agricultural, Technical and Extension Services (AGRITEX), another 39% use the experience obtained in farms and 22% of the farmers were not agriculturally trained. Most of these farmers specialise in agricultural farming with the few working in town (2%) and others working in rural non-agricultural work (3%). This implies that most farmers are always on their farms practising agriculture. In terms of household labour, the household size ranged one to three to above six. However, the size that dominated is the four to six people per household (62%) followed by the size above six (25%). It has been noted that the farmers heavily depend on family labour since very few of them hire labour (about 10%).

4.2.2 Land use

The farmers in Hurungwe District use their land for agricultural crop and livestock production. Table 5 shows how the land is utilized in this district. They grow their crops for both cash and consumption with tobacco mainly for cash.

Table 5: Total land area and land use

CROPS	**Average Area grown (Ha)**	**Area Standard deviation (Ha)**	**Minimum Area Grown (Ha)**	**Maximum Area Grown (Ha)**
Maize	1.73	0.95	1.00	4.00
Soyabean	1.60	0.85	0.00	2.50
Groundnuts	0.49	0.37	0.00	2.00
Tobacco	1.17	0.38	0.50	2.00
Total land	6.64	4.90	2.5	25
Total Arable Land	4.39	2.17	2	14

Source: *Survey data, 2010*

The land holding in this district ranges from 2 to 25 ha total land whilst for the arable land it ranges from 2 to 14 ha. Farmers grow maize, soyabean, groundnuts and tobacco with maize occupying a larger area, four hectare and the smallest area the farmers grew maize was a hectare. Soyabean and groundnuts were grown on a maximum of 2 and 2.5 ha respectively, although some farmers did not grow these crops. All farmers grew tobacco with some growing the crop on a half hectare and others up to two hectares. The farmers highlighted that tobacco production is labour intensive hence the need to grow a small area.

4.2.3 Livestock and asset ownership

The farmers kept dairy and beef cattle, sheep and goats as illustrated in Table 6. Most farmers were not practising dairy production with the majority keeping sheep and goats. The majority of the farmers own beef cattle and most farmers combine dairy and beef cattle.

Table 6: Livestock ownership in Hurungwe District for smallholder tobacco farmers

Livestock	**% farmer's livestock ownership**	**Minimum number of livestock owned**	**Maximum number of livestock owned by a farmer**
Dairy cattle	43	0	4
Beef cattle	98	1	10
Sheep and goats	63	0	20

Source: *Survey data, 2010*

The farmers own ploughs, riggers, cultivators and scotch carts though the minimum number for each asset was zero implying that there were some farmers who did not possess an asset. Tractors and vehicles were possessed by the minority of the farmers. Most of the farmers in Hurungwe District owned one rigger, plough, cultivator and scotch cart whilst for tractor and vehicle ownership most farmers did not own these assets as illustrated in Table 7.

Table 7: Asset ownership for smallholder tobacco farmers in Hurungwe District

Asset	**% asset ownership**	**Number of Asset owned by the majority of the farmers**	**Maximum number of Asset owned by a farmer**
Tractor	2	0	1
Plough	98	1	2
Rigger	65	1	1
Cultivator	52	1	2
Scotch cart	93	1	2
Vehicle	3	0	1

Source: *Survey data, 2010*

4.3 Gross Margin Analysis

This analysis is used to calculate the returns to smallholder tobacco farmers which represent the returns/ benefits to the farmers. The equation (1) in Chapter 2 shows how to calculate the gross margin for any given enterprise. Table 8 shows the summary of the gross income, variable costs and gross margin for the farmers.

Table 8: Smallholder tobacco farmers' gross income, variable costs and gross Margin for Hurungwe District(US$/per ha).

Variable	**Average**	**Standard deviation**	**Lowest**	**Highest**
Gross Income	5 050.03	2 316.97	840.00	14 400.00
Variable Cost	1 653.42	749.93	300.00	4 700.00
Gross Margin	3 396.62	1 569.11	540.00	9 700.00

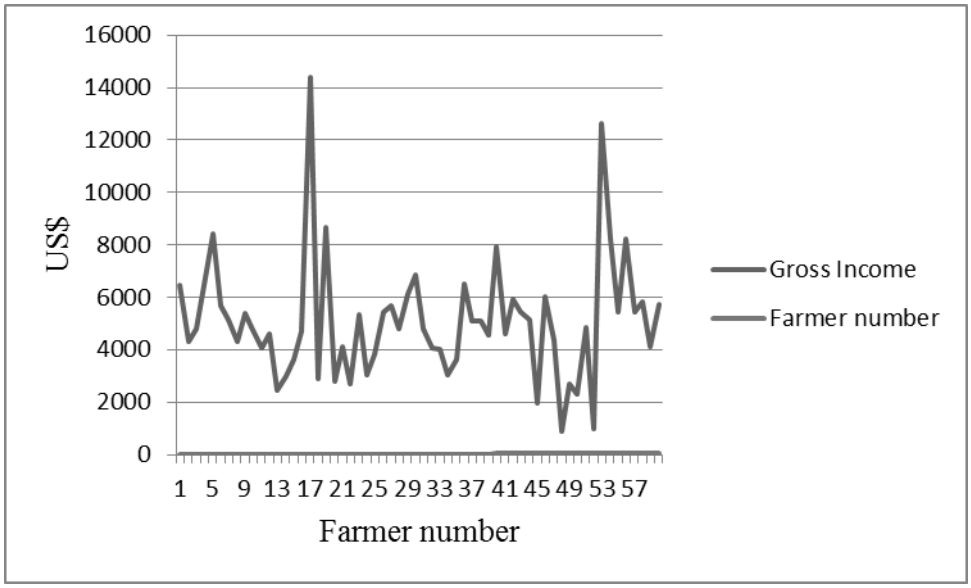
Source: *Survey data, 2010*

NB: n=60

Among the farmers the highest gross income obtained was US$14 400/ ha without taking into consideration the inputs used and the lowest being US$840/ ha. The variable costs incurred ranged from US$ 300 to US$4 700/ ha and this implies that some farmers used more than others for acquiring inputs. The gross margin/ ha ranged from US$540 to US$9700.

This can further be illustrated in the Figures 6, 7 and 8 where the variations of the farmers' gross income, variable costs and gross margin are shown. The variations in the gross income, variable costs and gross margins were compared to the experience of the farmer. Farmers growing tobacco for more than three times (thus three seasons) have experience compared to the farmers who are into tobacco production for the first time. Some farmers pointed out late purchasing of the inputs. This affects the yield and results in reduced gross income.

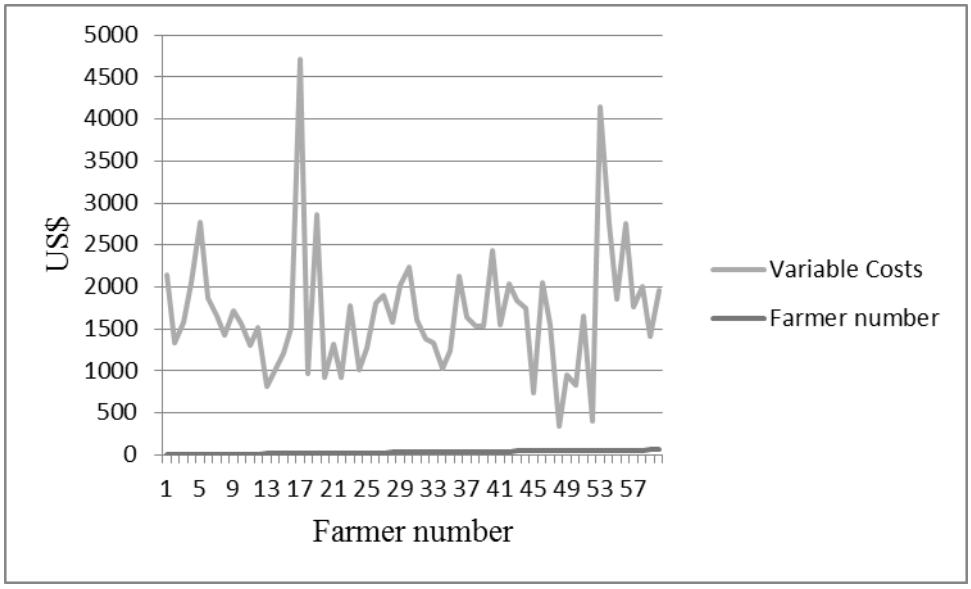
Figure 6: Gross income variations for smallholder tobacco farmers in Hurungwe District.



Source: *Survey data, 2010*

The variations in the variable costs takes the shape of the gross income implying that the farmers with high gross income also incur high costs.

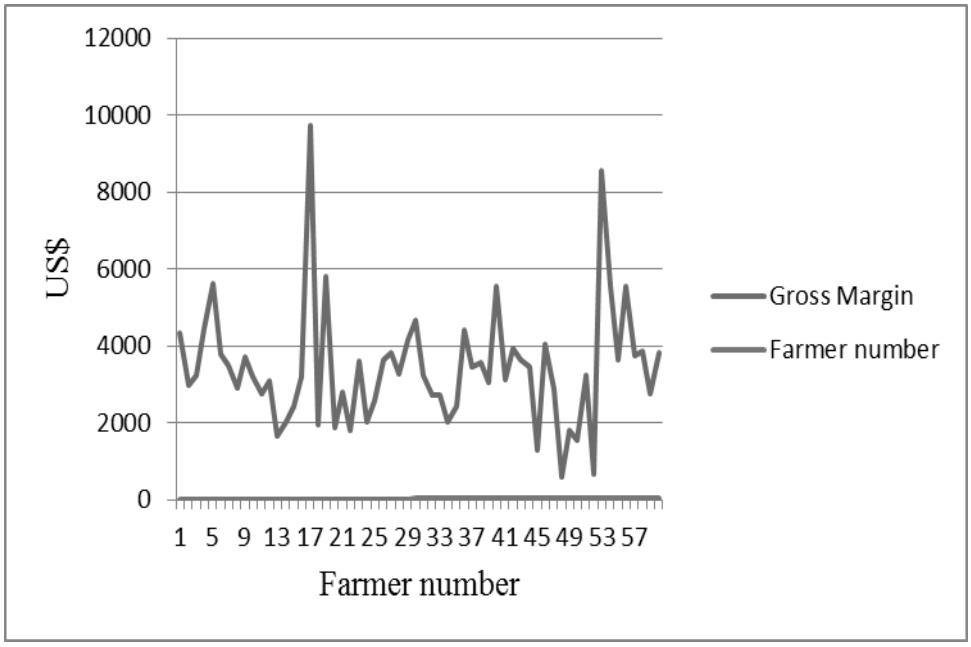
Figure 7: Variations in the variable costs per ha for the smallholder tobacco farmers in Hurungwe District.



Source: *Survey data, 2010*

According to the data collected, the farmers in Hurungwe District are realising benefits from tobacco production. This is evidenced in the Figure 8 where the gross margins are positive. Every farmer who grew tobacco during the study period gained from tobacco production though the levels of benefits differ from farmer to farmer.

Figure 8: Hurungwe District smallholder tobacco farmers' variations in the gross margin.

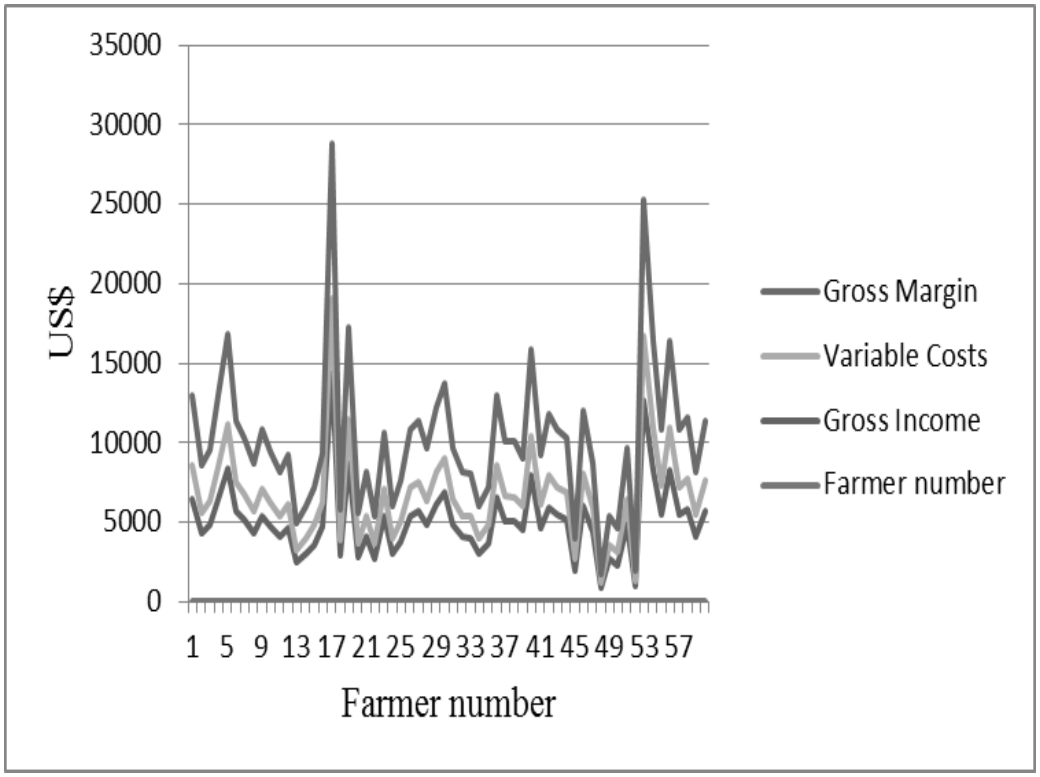


Source: *Survey data, 2010*

The reasons for such gross margin variations was attributed to the selling prices of the tobacco leaf which ranged from US$1.90 to US$4.20 with an average price of US$3.23. In addition, the yield contributed to high income as it ranged from 3.5 bales to 30 bales/ ha with an average of 16 bales. The bales were weighing an average of 97kg/ bale. The farmers were satisfied with tobacco production especially on the way the payments are done compared to maize and other cash crops. Attributes leading to an increased gross margin for smallholder tobacco farmers included the non-inclusion of labour costs and firewood costs. The farmers were not considering labour costs as they used family labour which they regard as free. Non inclusion of labour costs increases the farmers benefits. The costs that are saved are the family and hired labour(if the farmer do not hire) if the farmers are engaging both. Family labour constitutes 17% of the variable costs and hired labour 24% (Malaiyandi *et al*, 2010). In total, most smallholder farmers are saving 41% of the variable costs, if not hiring labour but using only family labour.

The farmers are also saving the cost of firewood for tobacco curing for example in Hurungwe District, farmers are using firewood sourced from the natural forest. Firewood costs used per hectare constitute about 26% of the material inputs which inturn constitute 59% of the variable costs (Malaiyandi *et al*, 2010). The firewood cost translate to 15% of the variable costs. The costs farmers are saving translate to 56% (labour and firewood costs) of the variable costs if hired labour is excluded. With the inclusion of hired labour the farmer saves 32% of the variable costs.

Figure 9: Gross income, variable costs and gross margin per ha for the smallholder tobacco farmers in Hurungwe District



Source: *Survey data, 2010*

4.4 Costs to the environment

There are some costs that are associated with the environmental damage due to tobacco production. The costs are calculated based on the quantity of firewood used per hectare and the cost of firewood per scotch cart. In this study, the assumption is that the cost to the environment is based on the cost of firewood which represents the value of the tree that the farmer cuts down. Table 9 shows the summary of the costs to the environment for the farmers in Hurungwe District. The farmers' environmental costs due to the production of tobacco range from US$10 to US$800 per hectare with an average of US$202. The quantities the farmers used rnged from 1 to 7 scotch carts per barn and this was translated to the costs based on the price of a scotch cart which was pegged at US$10.

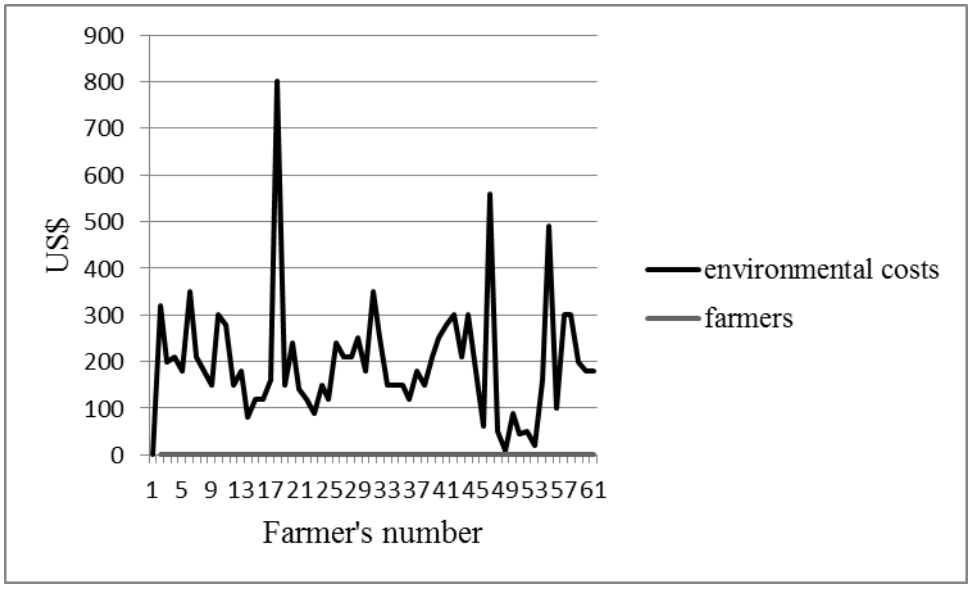
Table 9: Summary of the quantity of firewood used and costs to the environment for the farmers in Hurungwe District.

Variables	**Average**	**Standard deviation**	**Lowest**	**Highest**
Quantity/ barn (scotch cart)	3.7	1.5	1	7
Environmental costs US$/ ha	201.9	128.5	10	800

Source: *Survey data, 2010*

The variations of the costs to the environment is illustrated in Figure 10 for the farmers in Hurungwe District through the production of tobacco. The variation is because the farmers used different number of scotch carts for curing a barn, at the same time with different barn capacity.

Figure 10: Variations of the costs to the environment for the farmers in Hurungwe District



Source: *Survey data, 2010*

4.5 Benefit/ Cost Ratio for smallholder tobacco production

Benefit/ Cost Ratio (BCR) are used to weigh the costs and benefits of a given enterprise and are given by;

BCR = Benefits/ Costs ..... (8)

BCR that is equal to one implies that the costs and benefits are the same. This means that there are neither benefits nor costs (BCR = 1). The ratio above one is recommended since it implies benefits exceed costs and vice-versa.

The assumption for this thesis is that the farmers' cost to the environment is the value of the tree that is cut down for firewood. It is then added to the variable costs, to give the total variable costs.

Table 10: Summary of the environmental costs, total costs and benefits for the smallholder farmers in Hurungwe District.

Variables	Average	Standard deviation	Minimum	Maximum
Environmental Costs/ ha (US$)	201.90	128.50	10.00	800.00
Total costs/ ha (US$)	1 855.32	878.43	310	5 500
Benefits/ ha (US$)	3 396.62	1 569.11	540.00	9700.00

Source: *Survey data, 2010*

The benefits are greater than the costs and the bigger the ratio the larger the extent of the farmer benefits. The larger ratio is 1.83 and the lowest is 1.74 and this is after the inclusion of the costs to the environment. The costs and benefits associated with tobacco production are presented.

BCR is used to weigh the costs and benefit associated with smallholder tobacco production. Table 11 shows the summary of either net costs or benefits and BCR for the smallholder tobacco farmers in Hurungwe District.

Table 11: Summary of either net costs or benefits and BCR for the Hurungwe farmers

Variable	Average	Standard deviation	Minimum	Maximum
Net Benefit (US$)	1 541.30	690.68	230	4 200
BCR	1.83	1.79	1.74	1.76

Source: *Survey data, 2010*

4.6 Discussion of Results

The farmers in Hurungwe District benefit from the production of tobacco. The objective was to determines the benefits of the smallholder farmers from tobacco production. The hypothesis states that the benefits to the smallholder farmers from tobacco production are less than the costs to the environment. Most of the farmers in Hurungwe District do not hire

labour (90%) and 10% hire labour. The farmers who hire labour get slightly reduced returns due to the payments for the hired labour. The gross margin findings were supported by Malaiyandi et. al., (2010) and IDRC (2008) where the former indicates that the gross margin was 67% of the gross income for tobacco while the latter indicated a 39% of the gross revenue. The reason for the lower rate was because tobacco has a lower crop rank in Kenya (ranked the seventh crop).

There are few studies linking tobacco production and the environment. There was therefore, little of comparisons to the literature. The farmers' intentions are to maximize profits such that they try to reduce variable cost asmuch as possible through the use of cheap inputs to realise their profits. The farmers however benefited more from tobacco production in terms of the returns they get. The gross margin figures are high because of other variable costs that the farmers regard as free source of firewood. Another issue is that of labour, where family labour and hired labour are not valued by the farmers who rely heavily on family labour.

The gross margin variations show that there are some farmers who realise large returns at the same time there are some farmes who obtain small returns in the produuction of tobacco. Even with the inclusion of the cost to the environment the benefits were still there, though there was areduction in returns due to the inclusion of the cost to the environment. The findings indicated that considering the benefits and costs of tobacco production, the benefits outweigh the costs with BCR minimum being1.74 and maximum 1.76 with an average of 1.83. This is ideal for the farmers but to the environment it may be costly in terms of losing the indigeneous tree species without replacement.

This chapter addressed the first objective adequately through highlighting the descriptive statistics for the socio-economic characteristics and further developed some gross margins to

calculate the benefits for small holder tobacco farmers. This further presented the benefits and costs with the inclusion of the costs to the environment due to the production of tobacco. The benefits and costs were weighed to come up with either, net benefit or costs based on the BCR. Though the farmers benefits, there is the need to value the cost to the environment based on the different uses and approach to estimate a better and more realistic or more comparable findings.

4.7Summary and Conclusions

The farmers interviewed were Communal (18%) and AI (82%) in Hurungwe District with the landholding ranging from 2.5 to 25ha. The farmers attained at least primary education though some did not attain agricultural training depending on experience for farming. Livestock possession included dairy, beef cattle, sheep and goats though some were not in possession of dairy cattle, sheep and goats because of time spent in crop production. Most farmers have an asset base including plough, rigger, cultivators and scotch cart but however very few farmers owned vehicle and a tractor.

Based on the gross margin calculations, all the farmers benefit from tobacco production with the minimum amount of US$540 per hectare and US$9 700 per hectare is the highest gross margin/ha with an average of US$3 396 per hectare. All farmers operating above the mean are high performers and low performers being those farmers operating below the mean for the sake of this study. This implies that about 50% of the farmers are high and another 50% are low performers. However, the farmers are all benefiting from tobacco production though the level of benefits are different from farmer to farmer due to management and tobacco farming experience.

CHAPTER 5: COST OF FIREWOOD FOR TOBACCO CURING BASED ON WILLINGNESS TO PAY

5.1 Introduction

This chapter presents the findings on the source of firewood for tobacco curing and natural forest used. It further presents the WTP concept to estimate the costs of firewood used in tobacco curing by the smallholder farmers. This chapter seeks to address the objective of determining the smallholder farmers' WTP for firewood used in tobacco curing. With the hypothesis that WTP represents the value of the firewood used for curing, which if it was the cost paid by the farmers would reduce the returns to tobacco production. The chapter highlights the sources of firewood and natural forest harvested in Hurungwe District the major tree species and discusses the results.

5.2 Sources of firewood for tobacco curing

Table 12 shows that the sources of firewood for tobacco curing are mainly from the natural forest (85%) and gum plantation (15%). Most farmers rely on natural forest as the cheap source of firewood. Farmers using gum plantation are resettled A1 farmers who took advantage of the plantations on the former white owned farms. Other sources of firewood such as coal and electricity are perceived costly and not readily available to the farmers.

Table 12: Sources of firewood for smallholder tobacco curing in Hurungwe District

Sources of firewood	**Farmers using the Source (%)**
Number of farmers interviewed	n=60

Natural forests	85
Gum plantation	15
Total	100

Source: *Survey data, 2010*

Farmers are forced to use firewood sourced from natural forests since other alternatives are costly to them reducing the benefits obtained from tobacco. This leads to deforestation and most indigenous tree species are at risk. Use of the natural forest in Hurungwe District results in the excessive cutting down of the following tree species (as indicated in Table 13);

i. *Brachystegia boehmi* and/ or *Brachystegia spiciformis* – it is known as *mupfuti* in vernacular

ii. *Julbernadia globiflora* – it is also known as *mutondo*/ *munhondo* in vernacular.

Table 13: Natural forest used in Hurungwe District

Tree Species	**Farmers using the tree species (%)**
Julbernadia globiflora	7
Brachystegia boehmi/ spiciformis	23
Julbernadia globiflora and *Brachystegia boehmi/ spiciformis*	70

Source: *Survey data, 2010*

Farmers use natural forest either *mutondo* or *mupfuti* and also most of them use both tree species. This is because the tree species dominate the Hurungwe District.

5.3 Cost of firewood for tobacco curing based on WTP

The farmers were probed on the amount of money they are willing to pay to compensate using natural forest as their source of firewood for tobacco curing. The WTP was an amount per bale sold. The researcher further probed the farmers on the amount they were willing to

pay for disturbing the environment (that is environmental damage imposed by tobacco production). The farmers also highlighted the amount they were willing to pay for a scotch cart of firewood. With this data, calculation of the WTP/ ha was done. Table 14 shows the summary of the WTP/ ha.

Table 14: Cost of using firewood for tobacco curing by the smallholder tobacco farmers in Hurungwe District based on WTP.

Costs	**Average Costs**	**Most preferred costs**	**Costs Standard deviation**	**Minimum Costs**	**Maximum Cost**
WTP/ ha (US$)	74.40	63.00	54.20	5.00	305.00

Source: *Survey data, 2010*

The farmers in Hurungwe district assigned different amounts for cutting down trees for firewood. The amount ranged from US$5 to US$305 per hectare with the average cost pegged at US$54.20 per hectare. The farmers who assigned firewood costs of US$5 to US$50 per hectare were 33%, then US$51 to US$100 per hectare were 50% and US$101 to US$305per hectare were 17%.The problem encountered was that the farmers were hesitating to indicate their WTP fearing that their payments may be deducted. The researcher explained that the information was only used for carrying out the study and the information they gave was treated confidential.

Table 15: The range of farmers' WTP and percentage of farmers within the ranges

Range of farmers' WTP per hectare	**% of farmers within the range**
US$5 – US$50	33

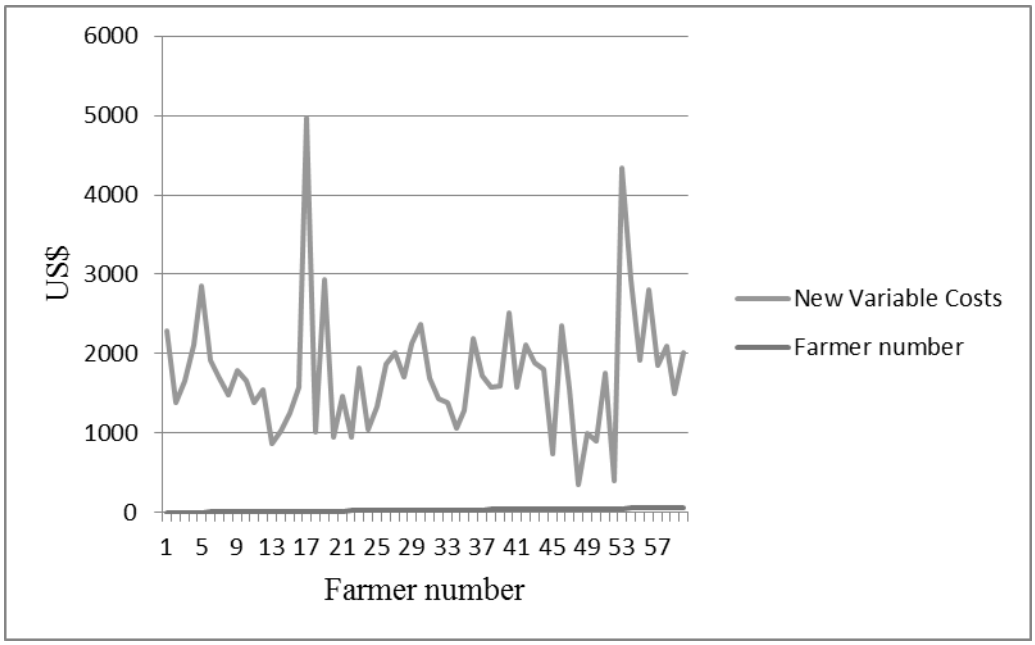
US$51 – US$100	50
US$101 – US$305	17

Source: *Survey data, 2010*

5.4 Gross margin analysis including WTP/ ha of the smallholder tobacco farmers in Hurungwe District.

In this gross margin calculation, the WTP/ ha representing the costs of firewood for tobacco curing were treated as part of the variable costs. The variations that need to be observed were for the farmers' variable costs and the gross margins. The gross income will remain the same since there are no additions to the benefits. Figure 11 shows the variations in the variable costs where the costs of firewood are included.

Figure 11: Variations of the variable costs with the inclusion of the firewood cost



Source: *Survey data, 2010*

The variations due to the inclusion are very small such that they can be difficult to pin point on the graphs for both the new variable costs and the new gross margin for the

smallholder farmers in Hurungwe District. The data for the gross margins and variable costs without the inclusion of the cost of firewood refer to Table 16 for comparison.

Table 16: Smallholder tobacco farmers' gross income, variable costs and gross margin for Hurungwe District(US$/per ha before the inclusion of firewood costs).

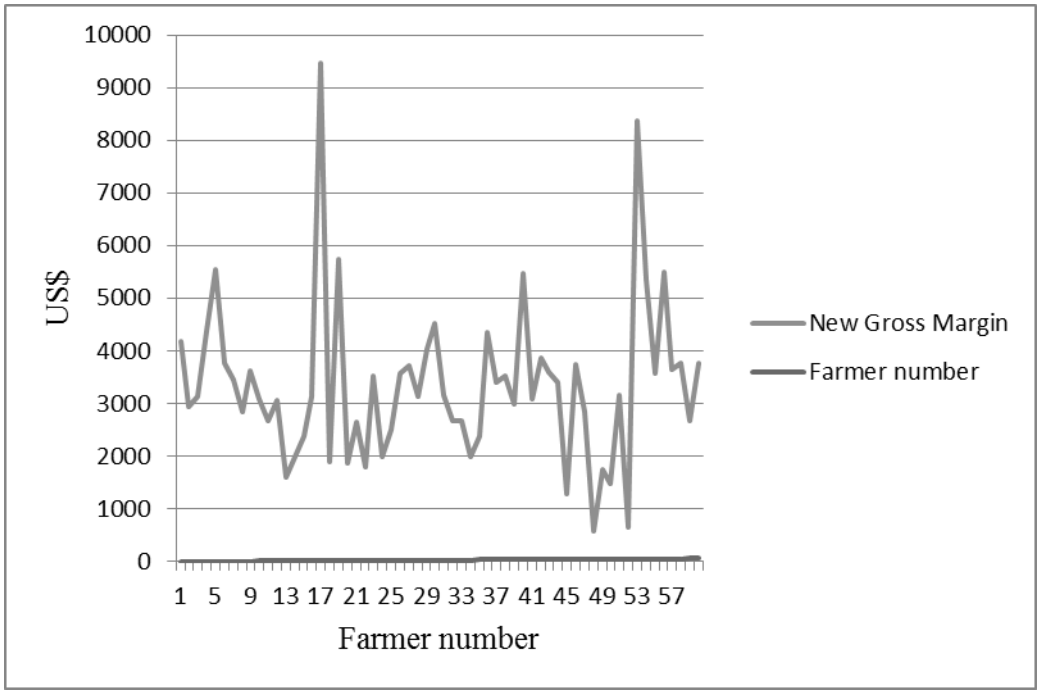
Variable	**Average**	**Standard deviation**	**Lowest**	**Highest**
Gross Income	5 050.03	2 316.97	840.00	14 400.00
Variable Cost	1 653.42	749.93	300.00	4 700.00
Gross Margin	3 396.62	1 569.11	540.00	9 700.00

Source: *Survey data, 2010*

NB: n=60

The inclusion of the firewood cost affects the farmers' benefits with a small change. The new variable costs ranged from US$300 to US$4 700 with an average of US$1 653 and the new gross margin ranged from US$540 to US$9 700 with an average of US$3 396.

Figure 12: Variations of the gross margin with the inclusion of firewood cost



Source: *Survey, 2010*

The minute variations can be illustrated in Table 17 where it shows the summary of the new variable costs and new gross margin after the inclusion of the cost of firewood.The data provided shows that the inclusion of firewood cost based on the WTP results in small changes such as a decrease in the minimum variable cost of US$305 from US$350 and a decrease of the minimum gross margin of US$535 from US$540. There is a decrease in the maximum gross margin of US$9 453 from US$9 700. In addition, there is an increase in the maximum variable costs of US$4 948 from US$ 4 700.

Table 17: Summary of the gross income; new variable costs and new gross margin for Hurungwe District farmers.

(US$)	Average costs/ benefit	Standard deviation	Minimum cost/ benefit	Maximum cost/ benefit
New Variable Costs	1 727.82	786.20	305.00	4 948.00
New Gross Margin	3 322.28	1 534.74	535.00	9 453.00
Gross income	5 050.03	2 316.97	840.00	14 400

Source: *Survey data, 2010*

The farmers' WTP representing the cost of firewood used by the farmers for curing tobacco were small in such a way that there were small effects to the gross margin. Malaiyandi et.al (2010) highlighted that fuel for tobacco curing constitutes about 15% of the variable costs. However, this study found that for the average, minimum and maximum firewood costs, the average variable costs increased by 4.5%, minimum variable costs increased by 2% and the maximum variable costs increased by 6.5%. The inclusion of the cost of firewood reduces the average gross margin by 2.2%, minimum gross margin by 1% and the maximum gross margin by 2.5%.

5.5 Discussion of Results

The results obtained indicate that the cost of firewood reduces the benefits the farmers get from tobacco production. The hypothesis that WTP represents the value of firewood used for tobacco curing, which, if it was the cost paid by farmers would reduce the returns to tobacco production is accepted. Farmers in Hurungwe District rely heavily on natural forest to source firewood for tobacco curing though there are some using gum plantations. This leads to the cutting down of the dorminant tree species in the area namely *Julbernadia globiflora* and *Brachystegia boehmi*/ *spiciformis*. However, in this study the farmers were probed to indicate their WTP for firewood used. This was done in order to determine the costs of firewood farmers used for tobacco curing.

The value for firewood used was small because the farmers were used to the cheap source of firewood to an extent that the value for firewood was maintained low. This also was due to the farmers fear that the costs were to be deducted from their income. The costs associated with tobacco curing for the Hurungwe District when compared with the findings of other researchers are low for example, the study by Malaiyandi et.al., (2010) highlighted that firewood cost constitute 15% of the variable costs. The costs for firewood in Hurungwe district ranged from 2 to 6.5% of the variable costs. The costs are low due to low valuation of firewood by the farmers may be because it is easily accessible. There are however, few studies focusing on tobacco and deforestation issue and these results in limited sources to compare with.

The hypothesis was partly addressed since the costs of firewood were computed with low values which are not very reflective of the total value of the forests (thus the trees cut for firewood use). In addition, it was noted that the farmers still benefit from the production of tobacco after the inclusion of the firewood cost based on the farmers' WTP. However, the concept of WTP is effective if the farmers indicate realistic or true figures. It is therefore recommended to use a combination of approaches to firewood valuations so that the best can be selected instead of using one approach. The natural forest provides several goods and services that are valued different from farmer to farmer. This requires different techniques in asking and approaches to natural resource valuations for example the revealed preference methods.

5.6 Summary and Conclusions

Most of the farmers relied on the natural forest as the source for firewood for tobacco curing. This led to the cutting down of the following tree species; *Julbernadia globiflora* and *Brachystegia boehmi*/*spiciformis*. This is due to the high demand of firewood for tobacco farmers in Hurungwe District. This study find out that the cost of using firewood for tobacco

curing based on the farmers' WTP were low such that their inclusions to the gross margin analysis did not affect much on the farmers' gross income. The differences with the gross margin without the inclusion of the firewood cost were very small implying that the benefits for the farmers remain high. However, it has been noted that the contribution of fuel based on other studies highlighted that firewood for tobacco curing contribute about 17% of the variable costs but this study highlighted 2 to 6.5%.Firewood cost contribution to the variable costs.

CHAPTER 6: FACTORS INFLUENCING NATURAL FOREST HARVESTING BY SMALLHOLDER TOBACCO FARMERS IN HURUNGWE DISTRICT

6.1 Introduction

This chapter presents the binary logistic regression model results on the factors affecting natural forest harvesting by smallholder tobacco farmers to obtain firewood for tobacco curing. The objective being addressed is that of determining the factors that influence smallholder tobacco farmers' natural forest harvesting. This chapter provides an answer to the hypothesis that natural forest harvesting is influenced by sex, level of education, level of agricultural training and occupation of the HOH. It further focuses on the factors affecting natural forest based on literature. The chapter also presents the discussion of the results.

6.2 Factors affecting natural forest harvesting

Farmers harvest natural forest for many uses including firewood for tobacco curing and land clearing for farming. A study by Mkanta and Chimtembo in (2000) highlighted the following factors to influence collection of natural forest resources; income, household size, time for collection, total area owned and size of the lands cleared. This study showed that collection of resources increases with the total land area owned which is positively correlated to household income. There is a decrease in collection with the size of newly cleared land. A family with relatively many children is regarded as holding larger investment in labour for farming. In relation to this, the study by Mkanta and Kamuzora in (2000) has shown that households with a large family size were less poor than those with small family size. However, this study considered the following factors; agricultural training level, selling price for tobacco, farm experience, gender, level of education, tobacco yield and size of household. These factors were chosen because the researcher thought that they contribute to the harvesting of natural forest.

6.3 Binary logistic regression model

The regression model was used to predict the impacts of different factors on natural forest harvesting to cure tobacco through the provision of firewood. The binary logistic regression model in this study is given below:

$$\mathbf{NFHARVST = \beta_0 + \beta_1 AGRICTR + \beta_2 PRTOB + \beta_3 FARMEXP + \beta_4 SEX + \beta_5 LVLEDUC + \beta_6 TOBYIELD + \beta_7 SIZEHHLD + \mu} \quad \mathbf{(9)}$$

Where;

NFHARVST = natural forest harvesting (1=yes, 0=no)

AGRICTR = agricultural training (master farmer) (1=yes, 0=no)

PRTOB = selling price of tobacco (continuous)

FARMEXP = farm experience (1=yes, 0=no)

SEX (GENDER) = sex of the HOH (1=male, 0=female)

LVLEDUC = level of education (1=yes, 0=no)

TOBYIELD = tobacco yield per hectare (continuous)

SIZEHHLD = size of household (1 =1 to 3, 2= 4 to 6, 3= above 6)

μ = error term (consists of other factors not specified in the model)

6.3.1 Findings

The model findings are presented in Table 18showing the beta coefficients, odds and the figures of significance. Selling price of tobacco, farm experience and agricultural training variables were found to be significant ($p < 0.05$), while sex, education level, tobacco yield and the size of household variables were not significant ($p > 0.05$) to the contribution of natural forest harvesting.

Table 18: Binary logistic regression model for factors influencing natural forest harvesting

Variables	**Coefficients (β)**	**S.E.**	**Sig.**	**Odds Ratio**
Agricultural training	-2.64	9704.98	0.04*	0.15
Selling price of tobacco	-2.09	0.87	0.02*	0.52
Farm experience	-1.10	9704.98	0.03*	0.23
Sex	0.09	2.47	0.72	2.40
Education level	0.92	1.01	0.36	2.51
Tobacco yield per hectare	0.09	0.10	0.37	1.09
Size of the household	0.15	0.72	0.83	1.17
Constant	0.57	9704.98	1.00	1.18

Source: *Survey data, 2010*

NB: * *Statistical significance at 5% level*

Farmers with agricultural training tend to influence natural forest harvesting negatively ($\beta = -2.64$).This means that with the increased level of agricultural training the level of harvesting of natural forest for tobacco curing is reduced. The reduction of harvesting is due to the knowledge the farmers get from the training concerning conservation measures and consequences of deforestation to the environment. This makes the farmers desist from cutting down trees. On the other hand, untrained farmers (though some are educated) are not knowledgeable on the issue of environmental sustainability.

The selling price of tobacco affect natural forest harvesting negatively (β = -2.07). This entails that when tobacco selling price decreases the farmers harvest more quantities of firewood sourced from natural forest. The farmers' disposable income is reduced such that farmers cannot afford using substitutes of firewood for curing tobacco such as coal, gum plantation. With increased disposable income, the farmers in future are likely to use other sources of firewood. Reduction in the level of cutting down trees is necessitated because the farmers afford to use other alternative sources. In addition to tobacco selling price, experience of the farmer also influence the harvesting of natural forest negatively ($p = 0.03$). Increase in the years of experiences the farmers is likely to reduce the reliance on natural forest to obtain firewood for curing. The level of preparedness for tobacco production is high for experienced farmers and they tend to conserve the environment through switching to other sources of fuel instead of firewood. The farmers are knowledgeable on the impacts and government policies (such as penalties, taxes) for exploiting the natural forest. In contrast, the less experienced farmers are likely to increase natural forest depletion as they are not aware of environmental sustainability issues. These farmers are concentrating much on the production of tobacco relying more on firewood which is cheap to improve their income.

Gender is not significant in explaining natural forest harvesting, that is, the difference in gender does not influence natural forest harvesting. Level of education is also insignificant implying that behaviour of a farmer with or without education is the same in natural forest harvesting. This is in contrast with the level of agricultural training. Tobacco yield is also insignificant in explaining the harvesting of natural forest by smallholder tobacco farmers. This entails that whether there is an increase or decrease in the tobacco yield, the farmer cuts down trees for tobacco curing based on the perception that natural forest is cheaper to them compared to other sources.

Further to that, size of the household is not affecting natural forest harvesting significantly. This is because the size of household contributes more on labour for farming. This is supported by Mkanta and Chimtembo in (2002) who highlighted that a family with relatively many children is regarded as well equipped with labour for farming. Related to this, Mkata and Kamuzora in (2000) indicated that households with large family size are less poor than those with small sizes.

6.3 Discussion of Results

The results indicated that three factors namely selling price of tobacco, farm experience and agricultural training have a significant influence on natural forest harvesting as a source of firewood for tobacco curing. All these factors negatively affect natural forest harvesting .When selling price of tobacco increases the harvesting of natural forest is reduced because farmers are likely to increase income and prefer to use other firewood alternatives. What drives the farmers to use natural forest is that they do not afford other alternatives because of the low incomes they get. Decrease in the selling price of tobacco leads to reduced income such that the farmer cannot afford other alternative sources of firewood and opt to cut down tree to cure tobacco.

Farmers with advanced level of agricultural training, tend to be equipped in terms of conservation measures and impacts of certain agricultural activities to the environment. This leads to the reduction in the reliance of natural forest as a source of firewood for tobacco curing. The farmers who are trained are likely to implement what they gained from the training and this will result in the farmers desisting from natural resource exploitation. Farmers who are not agriculturally trained are not equipped in terms of environmental conservation and possible future consequences resulting in tobacco production. These farmers are likely to increase the level of cutting down trees with the aim of maximising tobacco production.

Farm experience is the number of years the farmer worked under farm conditions and is two years and above. Increased years of farm experience leads to the reduction on the reliance of natural forest harvesting sourcing firewood for tobacco curing. The farmer would have switched to alternative sources of firewood such as coal and gum plantations. Farmers who are not experienced depend largely on natural forest as it is the cheap source of firewood available.

Sex (gender), size of the household, tobacco yield and level of education were insignificant in explaining the variations in the harvesting of natural forests. These factors are important in the model though their contributions to natural forest harvesting are not of use. The reason why tobacco yield is not important is that whether tobacco yields increases that does not necessarily mean that firewood demand increases. Increased or decreased tobacco yield will not affect the barn capacity meaning that the quantity of firewood required per barn remains the same.In addition, the level of education also do not influence natural forest harvesting because whether the farmer is educated or not that do not affect the level of natural forest harvesting.

Sex is another factor that is insignificant in explaining the natural forest harvesting because being a male or female would not hinder harvesting of natural forest regardless of sex. This could be because the natural forests are accessible to both males and females such that there are equal chances of cutting down the trees. Size of the household was noted to be insignificant meaning that the families with larger numbers of members and those with smaller numbers do not influence natural forest harvesting. Mkanta and Chimtembo in (2002) highlighted family size has an influence to human labour. Mkata and Kamuzora in (2000) postulated that larger sized households are less poor than those with smaller sizes.

The hypothesis that natural forest harvesting is influenced by sex, level of education, level of agricultural training and occupation of the head of the household is not accepted but however agricultural training influence the harvesting of natural forest negatively while the rest of the hypothesized factors are insignificantly affecting natural forest harvesting. The objective of determining the factors influencing harvesting natural forest in Hurungwe District was adequately addressed.

6.4 Summary

This chapter presented the binary logistic regression model which was used to address the objective of determining the factors that influence natural forest harvesting as source for firewood to cure tobacco. The following factors were significantly ($p < 0.05$) affecting natural forest harvesting in the Hurungwe District; agricultural training, selling price of tobacco and farm experience. Other factors including sex, education level, tobacco yield and size of the household were not significant in influencing the harvesting of natural forest in Hurungwe District.

CHAPTER 7: POLICY IMPLICATIONS, SUMMARY AND CONCLUSIONS

7.1 Introduction

This chapter presents firstly, the summary of the research findings and draws the conclusions. It further recommends policies taking into account the implications of smallholder tobacco production in Hurungwe District. The areas of further studies are highlighted to ensure that deforestation is reduced leading to environmental sustainability in Zimbabwe.

7.2 Summary of the research findings

The research determined the benefits associated with tobacco production based on the gross margin analysis. Based on the gross margin calculations, all the farmers benefit from tobacco production with the minimum amount of US$540 and maximum of US$9 700 with an average of US$3 396. However, the farmers are all benefiting from tobacco production though the level of benefits are different from farmer to farmer due to management and tobacco farming experience. This is shown by the farmers' gross margins which are positive.

The study also considered the costs associated with tobacco curing based on the farmers' WTP to address the second objective. Most of the farmers relied on the natural forest as the source for firewood for tobacco curing. This led to the cutting down of the following tree species; *Julbernadia globiflora* and *Brachystegia boehmi*/*spiciformis*. This is due to the high demand of firewood for tobacco farmers in Hurungwe District. This study revealed that the cost of using firewood for tobacco curing based on the farmers' WTP were small amounts(average being US$74.40 per hectare, minimum US$5 and the maximum US$305 per hectare) because the inclusions to the gross margin analysis did not affect the gross income to the farmer . The difference with the gross margin without the inclusion of the firewood cost were very small (the average gross margin was US$3 322.28, minimum US$535 and the maximum US$9453) implying that the benefits for the farmers remain high. However, it has been noted that the contribution of firewood or fuels based on other studies

highlighted that fuels for tobacco curing contribute about 15% of the variable costs. The study also highlighted that the benefits for tobacco production exceeds the costs with the BCR ranging from 1.74 to 1.76. However, the insight from other studies have highlighted that family labour constitute about 17% of the variable costs in which the smallholder farmers are not considering as a cost. The farmers benefit from tobacco production but in reality the benefits can be further reduced if some environmental benefits are valued correctly which are lost during tobacco production. It is however difficult to conclude that the actual benefits and value of tobacco production their actual value and also the costs of tobacco production to the environment because some of the environmental benefits that are lost due to tobacco production are difficult to measure.

The third objective was addressed using the binary logistic regression model to explain the impacts of each identified variable to the level of natural forest harvesting as a source of firewood for tobacco curing. It was used to address the objective of determining the factors that influence natural forest harvesting to source for firewood to cure tobacco. The factors which were significantly ($p < 0.05$) affecting natural forest harvesting in the Hurungwe District are agricultural training, selling price of tobacco and farm experience. Other factors including sex, education level, tobacco yield and size of the household were not significant in influencing the harvesting of natural forest in Hurungwe District.

7.3 Conclusions

Environmental concern was the major issue in this study with tobacco production identified as one of the major threat through tobacco curing. This is because curing of tobacco makes use of firewood sourced from natural forests. However the study serves as the pilot study for future studies in exploring the costs and benefits associated with tobacco production to the natural environment. There is the need therefore, for the researchers to use the collaborative

approach in order to identify all possible costs and benefits of tobacco production to the environment.

It has been noted that most of the farmers are aware of the environmental consequences caused by the production of tobacco in the smallholder sector. Farmers in Hurungwe District are raising gum plantations at the same time benefiting from the former white farmers' plantations and also advocate for penalties or fees the farmers must pay for exploiting the environment. Moreover, they also advocate for the availability of coal to the smallholder farmers when required and at the affordable prices.

7.4 Recommendations

There is the need to conserve the environment at the same time producing more of tobacco which contributes much on the Zimbabwean economy in terms of foreign currency earnings. The results from the study may be used in environmental policy, planning and implementation. This may lead to the protection of the environment and natural resources from being overexploited at the same time increase generation of foreign currency through smallholder tobacco production. It is recommended therefore, for the Ministry of Agriculture, Mechanisation and Irrigation Development, and the Environment and Natural Resource Management to recommend the maximum harvesting limit for the smallholder tobacco farmers so that maximum sustainable yield (MSY) is not exceeded by the farmers. The MSY is the yield that allows regrowth such that any yield beyond this point will tend to affect negatively the environment. The government must provide subsidies to the smallholder tobacco farmers coal and make sure the needed quantities are available when farmers are in need of it for tobacco curing. This is done to reduce pressure on natural forest, boost tobacco production major foreign currency earner and conserve the environment for future generation the issue of environmental sustainability. In addition, the policies governing the use of natural resources through spot penalties, taxes and fees towards environmental protection. The

researcher recommends that fees/ charges for smallholder tobacco production have to be channelled towards managing the environment. The farmers' plight was for coal to be made available at affordable prices. If true costs of forest products are paid by current generation, forest management for the future generation made possible.

7.5 Area of further studies

It has been noted that little studies were conducted in Zimbabwe on the economics of tobacco and the impacts of the crop to the environment. There is the need to carry out such studies in all areas where the crop is grown and must be carried out after every two to five years to monitor progress and impacts to the environment. In addition, use of aerial photographs to support the study through air photo interpretation or (GIS). This will enable the nation to see its position on the rate of deforestation and how best to eradicate the problem. Furthermore, in terms of the environmental costs computations, there is the need to carry out a research using the different approaches to non-marketed resource valuations (such as fruits, shade). This will enable the researchers to recommend the best approach that is close to reality. There is the need to carry out a study that develops an econometric model that can be used to determine the maximum sustainable yield of natural forest harvesting for the farmers either per district or provinces. This further gives the guideline on the charges of the fees for the farmers using natural forest for different household consumption (that is cooking, timber, curing tobacco). The study must also project the future management of the forests based on the previous years and the current trends. This adds to the country's literature on the deforestation debate and fills in the literature gap.

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APPENDIX
Questionnaire

Name of farmer ……..

Date of Interview ……..

Type of farmer ……..

A. <u>DEMOGRAPHIC DATA</u>

1. Are you the head of the household, (HOH)? i. Yes ii. No

(If no) What is your relationship to the HOH?

i. Wife ii. Husband iii. Daughter iv. Son v. other

2. Sex of the HOH? i. Male ii. Female

3. Highest educational level attained?

i. none ii. Primary iii. Secondary iv. Tertiary v. Other specify…….

4. Level of agricultural training? i. master farmer ii. Certificate iii. Diploma

iv. degree and above v. other specify ……

5. What is the full time occupation of the HOH?

i. family farm work ii. Rural agricultural work iii. Rural non- agricultural work

iv. employed in town v. Other specify ……

6. What is the size of the household? …….

B. <u>LAND USE</u>

7. How much land (total) do you own (in acres / hectares)? ……..

8. How much arable land do you use for farming (in acres / hectares)?.....

9. For how many years has been farming in this region? ……

10. Fill in the table below;

CROP	**HECTARES/ ACRES**	**PURPOSE OF PRODUCTION**
Maize		
Soyabean		

Groundnuts		
Tobacco		
Other		

11. How many do you have?

Farm assets	Quantity
Tractor	
Plough	
Ridger	
Cultivator	
Scotch cart	
Vehicle	
Other	

12.

CLASS	NUMBER	USE
Dairy cattle		
Beef cattle		
Shoats		
donkeys		

13. In the past 3 years, what farm venture generated the highest amount of money?

i…….. ii…… iii…….

C. TOBACCO PRODUCTION

14. How many hectare s/ acres did you grow tobacco? ……..

15. Is this the first time to grow tobacco? ……..

16. Why do you choose to venture into tobacco production? ……

……
……

17. Do you intent to continue with tobacco production in the future? i. Yes ii. No

18. Why? ……

……
……

19. Do you hire labour for tobacco curing? i. Yes ii. No

20. If yes, at what rate? ……

21. Which method of tobacco curing do you use?

i. Coal ii. Natural forests iii. Gum plantation iv. Other specify

22. If using natural forests, which species do you use? (probe the farmer to mention the mostly used ones) i…….ii. …….iii. …….

23. What approximate yield do you get from a hectare/ acre in terms of bales? …….....

24. Approximately, how many kilogrammes constitute a bale? …….

25. How much firewood do you require to cure a bale (using Scotch cart)?.....

26. Who is the supplier of your firewood? ……..

27. What are the charge rates of the firewood, ($/ Scotch cart/ Code)? ……

28. If the firewood is not charged, what amount of money are you willing to pay for a scotch cart/ Code? ……..

29. What is the selling price of your tobacco per kilogramme? ……...

30 What amount of variable costs did you incur per hectare?

31. Do you have your own barn? i. Yes ii. No

32. If no, how much do you pay to cure a bale elsewhere? …….

33. What has been your best yield in tobacco production (bales/ hectare)? ……..

34. What has been the worst yield (bales/ hectare)? …….

35. What was the reason for such a drop in your yield? …….

……
……

D. CONSTRAINTS AND POLICY MEASURES FOR DEFORESTATION

36. Are you facing any problems during curing periods? i. Yes ii. No

37. If yes, what are the problems?.....

……
……
……
……

38. What do you think are the possible solutions to these problems?

……
……
……
……

39. What current measures do you take to reduce deforestation?

……
……
……

40. Any future proposition that you feel will cater for deforestation minimization?

……
……
……
……
……

41. What amount are you willing to pay for damaging the environment through cutting down of trees, ($/ Bale)? ……..