A COST-BENEFIT ANALYSIS OF SUBSTITUTING BAMBOO FOR TOBACCO: A CASE STUDY OF SOUTH NYANZA, KENYA.

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DECLARATION

This research paper is my original work and has not been presented for the award of a degree in any other University.

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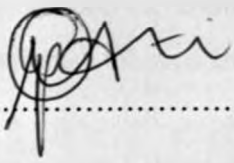
SIGNATURE: 

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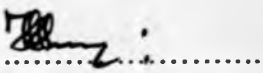
SIGNATURE: 

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ABSTRACT

This study examines the benefits and costs of farming bamboo as a substitute for tobacco in South Nyanza, Kenya. Using primary data, the study applied the framework of cost benefit analysis to analyze the cost and benefits of both tobacco and bamboo. In this study, the costs and benefits for the year 2006-2007 and 2009-2016 were extrapolated using the data for bamboo for 2008. The data for tobacco for 2006 was used to estimate the costs and benefits for tobacco from 2007-2016.

Results of the base scenario showed that bamboo farming is financially and economically beneficial to tobacco farmers since the incremental benefits are positive. This is shown by the results which indicate that whilst the financial net present value for tobacco farmers is KShs 155,445 that of bamboo farmers is KShs 663,272. A sensitivity analysis showed no change in the sign of the net incremental benefit. The study concluded that bamboo farming therefore, if well managed can meet the objective of the Framework Convention on Tobacco Control and also the government as it seeks to find an alternative to tobacco growing. The study therefore recommends that Bamboo be introduced as an alternative tobacco growing areas.

DEDICATION

I dedicated this research to my late mother Peninah Moraa. I cannot imagine anyone who would be proud of this achievement than her. My dad Meshack Magati who has sacrificed a lot to ensure I got the best academic opportunities. My sisters Prisca, Villa, Christine, Ann and Karen. Thanks for your support. I also thank my step mother Eunice Muia for her support. I love you all. To my fiancé Edna Polle whose patience has been tried but always gave me a reason to keep pushing to this end.

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I thank Alphoce, Asma and Arori of the tobacco to bamboo research project who took time to share resources on bamboo and tobacco. Their efforts are highly appreciated. I would also like to thank Dr. Ochola, whose initial research on the Cost-benefit analysis on tobacco has aided my research immensely.

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BAT(K)	British American Tobacco-Kenya
EAT	East African Tobacco Company
FCTC	Framework Convention on Tobacco Control
WHO	World Health Organization
UNIDO	United Nations Industrial Development Organization
CBA	Cost-Benefit Analysis
NPV	Net Present Value
GI	Gross Income
CBK	Central Bank of Kenya
TEC	Total Enterprise Costs
EGM	Enterprise Gross Margin
TEV	Total Economic Value
KEFRI	Kenya Forestry Research Institute

CHAPTER ONE
INTRODUCTION

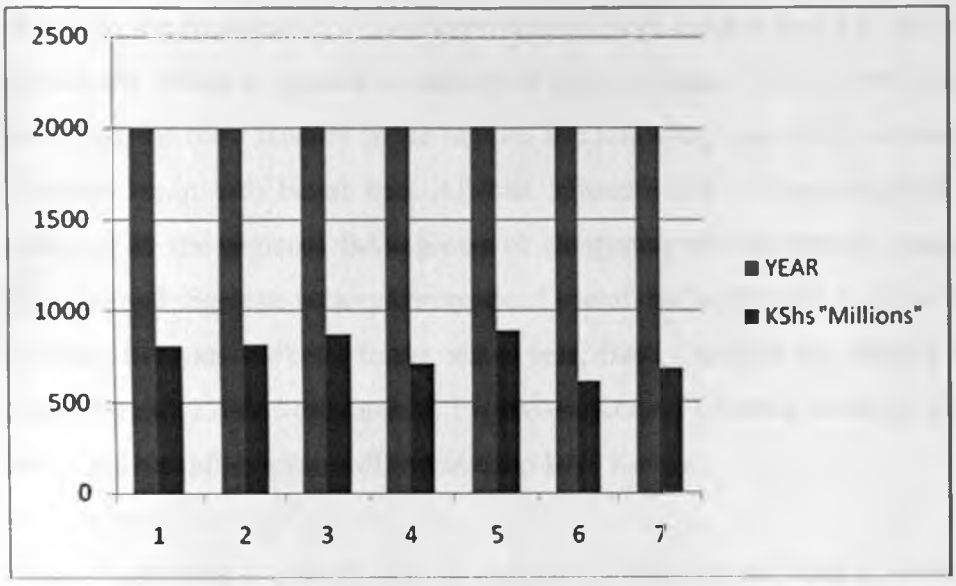
1.0 Background

Tobacco is a plant that grows in the tropics, semi-tropics and in the torrid zones. The plant grows luxuriantly on any soil where vegetables grow. Tobacco requires continuous nursing for an average, nine months-from planting to delivery to the leaf buying centers. Seed beds are normally prepared in October; farmers usually have one month, September for other activities. Seedbeds must be watered twice a day to maintain the right moisture levels. They must also be guarded against damage by birds and other animals. Planting, which begins in mid-March often goes on till around mid-May. First, the land is "ridged", followed by actual planting. Leaf-by-leaf checks are required and problems requiring pesticides, herbicides or fertilizer application must be diagnosed. This work including the careful curing (drying of leaves) where heat must be monitored, places a serious strain on the family as the whole family is often mobilized at these stages.

Tobacco is widely grown as a cash crop in many developing countries of the world where it owes its existence to wealthy multinational companies who act as growers, traders and manufacturers at the expense of the small holder farmer. In Kenya, tobacco is grown in four provinces, namely, Nyanza (Migori, Kuria, Suba and Homa bay districts), Western (Bungoma, Busia, Teso and Mount Elgon districts), Central (Kirinyaga, Muranga, and Thika districts) and Eastern (Meru, Kitui and Machakos districts). 80% of the country's tobacco production comes from South Nyanza region (mainly in Kuria, Migori and Homa bay districts). (GOK, 2002a; 2002b; 2002c; 2002d; Ministry of Agriculture, 2004a, 2004b; 2004c; 2004d).

Figure 1 shows a comparative analysis of the gross marketed production of tobacco at constant (2001) prices. The table shows tobacco production in the country over the last eight seasons and it illustrates the fact that there are a number of farmers dependant on this crop in the country. That the total annual production is valued at 750 million shillings is significant, considering that on average, each farmer utilizes no more than 2 acres of land in tobacco production.

Figure 1: A Comparative Analysis of Gross Marketed Production of Tobacco at Constant (2001) Prices from 2001 – 2007.



Source: Republic of Kenya (2008).

Figure1 show that there has been erratic production of tobacco in Kenya since 2000. Initially, there was a steady rise in the gross marketed production from 2000-2003, where it rose from 500 million in 2000 to 750 million in 2003. There is however a steady rise in tobacco production from 2006 to 2007.

Approximately 35,000 small-scale farmers grow tobacco in Kenya; in Eastern, Western, Central and Nyanza provinces. In all, 4,500 hectares of land is devoted to tobacco farming, representing 0.19% of total arable land (Patel et al 2007). BAT (K) has a contractual agreement with about 20,000 of these small scale farmers. It offers them crop inputs and advice, and buys leaves from them once dried (cured). The price the farmers receive for their tobacco leaf is dependent on BAT (K) evaluation of its quality. Usually, no independent assessment is done. Under BAT (K) contracts, crop inputs such as seeds, pesticides and fertilizers are given to the farmers at a loan, which is then deducted from their final earnings.

The history of tobacco in Kenya dates back to 1907 when British American Tobacco (BAT) set up a marketing organization with its base at Mombasa. The firm concentrated on building a

distribution and marketing network throughout East Africa – in what is now Kenya, Uganda, Tanzania and Eastern Zaire. Until 1928, BAT remained a distributor of imported cigarettes. However the emergence of a strong East African market saw the plant make its first major investment when it opened a factory in Jinja, Uganda. The factory was upgraded in 1948, becoming the most modern in the region. The following year, BAT acquired Tanganyika – (now Tanzania mainland) based East African Tobacco (EAT) Company, which became a holding company in the regional BAT group of companies for the next 15 years. In 1957, a modern Tobacco and cigarette factory commenced operations in Nairobi, to serve "the special needs of a growing Kenyan market". In the same year, BAT acquired the existing Rift Valley Cigarette Company. In 1966, Rothmans of Pall Mall (Kenya) Limited made an abortive entry, shutting down in 1967 after selling off its assets to BAT Kenya.

Tobacco growing increased with the entrance of Mastermind and Cut Tobacco into the market in the late 1980s. Despite being the country's largest manufacturer, by 2002 the market share of BAT had dropped from 90% to 71%, Mastermind had progressed to 22%, followed by Cut Tobacco at 7 % (Patel et al 2007).

The Kenyan government has a long standing stake in BAT (K), being its largest shareholder with 20% holding. Having a stake means that apart from receiving revenue in the form of taxes from its operations, the government also receives dividends from the company. Being a key shareholder has meant that the government has appointed directors in the company. The appointment of influential personalities over the years is indeed a show of the government's influence in the running of BAT (K). This may affect passage of laws controlling tobacco production and usage in Kenya.

Efforts have been made locally to reduce tobacco production in the country. To this end, the Tobacco bill 2007 was passed recently after amendments. The bill has been enacted by parliament and it includes smoke-free legislation and health warnings consistent with The Framework Convention on Tobacco Control (FCTC). The FCTC requires countries which are signatories to cut down tobacco production and consumption. Since supply, creates its own demand, The World Health Organization (WHO) is seeking other alternative crops to tobacco so

that not only would the demand on tobacco products reduce but also that the farmers who are the producers of tobacco can sustain themselves.

Globally, attempts are being made to reduce tobacco production. Despite these global policies aimed at reducing world tobacco productions and use, the Kenya Government's policies aimed at poverty reduction, are encouraging more tobacco production and crop diversification in this region (Republic of Kenya, 2002a; 2002b; 2002c; 2002d; Ministry of Agriculture, 2004a, 2004b; 2004c; 2004d). This is evidenced by the current plans of the British American Tobacco Company, Kenya (BATK) to expand its activities to other districts in the Nyanza Region, including Bondo and Siaya in the Central Nyanza region (Republic of Kenya, 2001). It is also estimated that the number of farmers contracted by tobacco companies in Kenya increased by 67% in the period 1972 to 1991, and by 36% from 1991 to 2000. Besides, the land under tobacco continues to grow rapidly at the expense of food crops because more farmers are shifting to tobacco production (Republic of Kenya, 2001; Ministry of Agriculture, 2004a, 2004b; 2004c; 2004d). It is evident that the Kenyan Government has no clear policy on tobacco production control. While the Ministry of Agriculture is promoting the growing of the crop, the Ministry of Health is seriously campaigning against the crop and smoking in particular.

The tobacco sector in the South Nyanza region is facing a multiple of economic and political problems, as well as socio-cultural and gender issues. The sector is confronted by food insecurity concerns, occupational and environmental health hazards, and environmental concerns (Kibwage et al., 2005).

Some of the key economic and political problems associated with tobacco production in the South Nyanza region include the fact that most farmers are attracted and trapped into tobacco production due to the belief that the crop has more and quicker cash returns than other crops. Farmers are initially induced and trapped by tobacco companies to grow the crop by being given inputs for free initially and later on credit.

Tobacco farming requires and demands a lot of labour and it is a very tedious activity compared to its returns/ profits. The farmers indicate that the cost of producing tobacco is very high and

when loans are deducted from total sales, they are left with very little earnings as compared to the high labour and time inputs. Furthermore, they have no control on prices of inputs and output (Ochola et al 2007).

Tobacco farmers also face serious harassment, cheating, and exploitation during the leaf weighing process and recovery of input loans. Besides, tobacco companies have zoned certain areas leaving farmers without the option of selecting a company of their choice. This has further enhanced exploitation of the farmers' ignorance, which is openly practiced by recruitment of new tobacco farmers mainly targeting the illiterate and the poor in their society (Kweyuh, 1997). In addition, tobacco companies indirectly use local political leaders to promote the crop in their constituencies, which has been a big blow to production of other crops like maize, sorghum, millet, etc. in the region (Patel et al, 2007).

The local tobacco cultivation activities are not insured against natural calamities like hailstones, disease and fire outbreaks, all of which are common in the South Nyanza region. This exposes the farmers to great losses should these events occur.

The key socio-cultural and gender issues in the South Nyanza region include the fact that there is high child labour among the tobacco growing families. This happens especially during the harvesting and curing periods when farmers attempt to avoid crop damage and losses arising from climatic changes when the crop has matured. Exploitation of children and women by men and tobacco growing companies is therefore rampant in the area (Ochola et al 2007).

Farmers' frustrations by companies is also a major factor responsible for the reportedly high cases of societal vices like mugging, robberies with violence, theft and cattle rustling in the region. Farmers' frustrations by companies arise from high debts from farm input loans, and crop damage caused by hailstones, pests and diseases. Since the tobacco companies don't take any responsibility in case of such losses, some of the affected farmers resort to these social vices for economic survival.

Tobacco production has also led to food insecurity concerns in the region in several ways. First, the South Nyanza region faces food shortages because of tobacco production since farmers spend most of their time in tobacco farming at the expense of food crops, which they eventually buy from surrounding districts at very high prices. Kuria district, for example, which used to produce and supply maize to most parts of Kenya, is currently categorized by the Kenyan Government as one of the areas that require and receive relief food every year (Economic survey, 2007).

Tobacco ranked 19th in agricultural land use and 14th in importance in the category of temporary industrial crops (Kweyuh, 1997). Of the total cultivated area of 5.17 million ha in 1983/84, tobacco occupied only 0.15%. However a study by Kweyuh (1997) established that on average for every six acre holding in Migori District, farmers cultivated four acres of tobacco, leaving two acres for all food crops. The study also found that some farmers planted all their land with tobacco, relying on tobacco income to buy food. A major constraint to agricultural activities/ diversification in the region among other things is generally the lack of market for the local produce. There is generally lack of protective devices required during the production and preliminary processing of tobacco leaves. These include, gum boots, nose masks, overall (coats), and gloves among others. During the harvesting and curing period, there also occurs a serious shortage of storage facilities. Most farmers use their own houses to store the leaves, an act which is hazardous to their health. Children and women are more vulnerable than men to tobacco-related health risks since they spend a lot of time in tobacco farming (Kibwage et al 2007).

Finally, tobacco farming in the region has raised several environmental concerns. The type of tobacco grown in the study areas is fire-cured. The curing process demands a lot of wood-fuel. Consequently, a lot of indigenous trees are felled for use causing deforestation. Consequently, soil erosion is rampant in these areas. In most instances, the eucalyptus tree seedlings are provided by tobacco companies to farmers. Scientific research has however shown that this type of tree puts a lot of demand on water and nutrients resulting to loss of soil fertility and reduction of water table. Farmers at the moment are forced to buy firewood for curing tobacco. This has led to further reduction in food crop production, hence, increased poverty levels in the area. Rainfall patterns and amounts are no longer predictable due to extreme deforestation caused by high demand for firewood for curing. The availability of firewood for tobacco curing and

domestic use is currently critical. The distance covered and time spent in firewood collection by women and children has been increasing from season to season and from one year to another (Kibwage et al 2007). This not only increases poverty, but also reduces economic productivity of the people.

The growing of tobacco along riverbanks and general use of fertilizers and pesticides has also caused the death of some valuable fish species in the local streams and rivers. The fish and aquatic life that used to be common in rivers and other water bodies have disappeared since the introduction of tobacco in the region. This finding is supported by recent studies in the region, e.g. Kibwage, et al, (2003). Environmental pollution due to poor disposal of wastes (expired fertilizers, chemicals, uncollected tobacco) by the tobacco companies was also reported to be high (Kibwage et al, 2007).

This kind of scenario calls for research that can resolve the multiplicity of problems facing tobacco farmers in the region, i.e. economic and political issues, socio-cultural and gender issues, food security concerns, occupational and environmental health hazards, and environmental concerns. The FCTC calls for choices to be made on alternative crops to tobacco. Even more important is that a crop that may address the shortcomings associated with tobacco be chosen especially as concerns environmental degradation, food security and sustainability of farmers' livelihood. This does not mean a drastic change to other crops, but rather a progressive change to ensure that farmers adapt to the new requirements. Since bamboo can address most of the shortcomings associated with tobacco growth, it has been chosen in this study as an alternative crop to tobacco.

1.1 Rationale for Selecting Bamboo as an Alternative to Tobacco

There are nearly 1,200 species of Bamboo in the world. Kenya has among other alternatives about 150,000 hectares of bamboo forests, partly pure and partly in mixture with trees and shrubs. In Kenya, the most common bamboo species is the indigenous Yushania alpina species (highland bamboo), which mainly grows at altitudes higher than 2,300 metres above sea level. Kenya now only has about 150,000 hectares of the indigenous species in irregular patches on the

Timboroa Plateau, and in the Aberdares, the Mau Ranges, Mt. Kenya, and Mt. Elgon. The bamboo resources in Kenya also consist of exotic species such as Oxytenanthera abyssinica, and Bambusa vulgaris. The later is widely distributed on farmlands and urban centers as ornamentals, with very few privately owned large commercial plantations of this species. This characteristic of the bamboo has rendered its management to be largely influenced by the forest department that controls the royalties of bamboo culms. The cutting ban has provided incentives to farmers who have consequently maintained their bamboo clumps in farms. Bamboo is used on commercial scale for production of toothpicks and small handicraft articles and also used in pea and flower farming for support purposes (Eastern Bamboo Project, 2006).

Presently, the socio-economic benefits of bamboo to the locational, regional or national economy have proved largely negligible since the ban on cutting of bamboo was effected in 1986 through a presidential directive. This could be largely attributable to the lack of regulation on bamboo exploitation, which resulted in wanton and wasteful harvesting and utilization of bamboo to the extent that the then government needed to act, through a presidential ban to protect further depletion of the resource. The imposition of the ban has restricted the use of bamboo to some select users and government institutions, limiting the harvesting of bamboo grown on private farms for markets without interference from the government inspectors, chiefs and officials from the forest department. As a result of the imposition of presidential ban on exploitation of bamboo, hardly any bamboo finds its way to the markets.

In Asia, over 1,500 uses of bamboo have been recorded (RELMA, 2003; Madhab, 2003, National Mission on Bamboo Applications, 2004). But in Africa, largely due to lack of awareness, bamboo's great potential is rarely exploited. Bamboo in Kenya plays a very important role in fencing, house construction and water harvesting. It is also used in cottage industries, in the manufacturing of matchstick, baskets, tooth-picks, and various other handicrafts. It is also used in agricultural farming especially for supporting horticultural crops. Kenya has so far recorded up to 48 local bamboo uses (Ongugo et al, 2000).

Bamboo has been selected for experimentation in this study because of its economic productivity which can reach up to an annual yield of 20-40 tons per hectare on a managed plantation

(Kibwage et al 2007). This has been well documented in Asian countries. Due to its lightweight, high elasticity and great resistance to rapture, bamboo is ideal for numerous construction uses. It can also be used in the production of pulp and paper, handicrafts, household goods, rehabilitation and stabilization of gullies and riverbeds and recycling and filtration of domestic and industrial wastewater.

Bamboo shoots are a good source of human food, while the leaves are widely used for animal fodder. With a growth rate that is three times faster than eucalyptus, bamboo matures in about 3-5 years (depending on different environmental field conditions), after which harvests are possible for up to 80-120 years. Given the numerous problems associated with tobacco farming in Kenya as earlier outlined, tobacco is so far used only for cigarette manufacture. Farmers have no local alternative use of the tobacco produce as compared to bamboo which has a multiple of uses.

1.1.1 Introducing Bamboo Resource

Previous studies under the East African Bamboo Project (UNIDO, 2006; Omenda and Kariuki, 2006) have given detailed treatment of bamboo resources in Kenya and its potential as a plantation crop.

Bamboo is the fastest growing woody plant on this planet (Omenda and Kariuki, 2006). It grows one third faster than the fastest growing tree. Some species can grow up to 1 meter per day. Under favourable conditions, the growth pattern of bamboo makes it available as a home-grown building product in a minimal amount of time. It is possible to plant, grow, and harvest your own bamboo at home. On a plot of 60' x 60', less than a twelfth of an acre, in the course of only 5 years, one can harvest enough bamboo to build a 1,500 square foot home and harvest enough each subsequent year to build an additional house (Omenda and Kariuki, 2006).

In addition, bamboo has important direct and indirect economic and ecological benefits such as providing food (shoots), housing, furniture, artisan products and soil and water conservation. The above characteristics make bamboo an important non-timber forest resource for most developing countries in Asia, Latin America and Africa. Bamboo can play an important role in the reduction of timber consumption, environmental and forest protection, poverty alleviation and sustainable development for the rural economy. Bamboo is one of the strongest natural building materials

known to man with tensile strength similar to mild steel. Bamboo is a high-yield, renewable natural resource and a viable replacement for wood in many construction scenarios. It is already a critical component of the global economy because it and its related industries provide income, food implements, and housing to over 2.2 billion people worldwide.

India today exploits just a tenth of its bamboo-producing potential. India's share in the global market is estimated to be $1 billion and is expected to increase to $5.7 billion by 2015. China's share in the world bamboo market is currently the highest at $5 billion. To make bamboo cultivation more attractive for farmers, the India's agriculture ministry has been pressing the government to declare it a horticultural crop (Omenda and Kariuki 2006).

Kenya currently has 150,000 ha of bamboo in the highlands of Mau, Elgon, Mt. Kenya and the Aberdares. This acreage is equavalent to the current acreage of plantation forests. Inspite of the ban, there is substantial harvesting of indigenous *Yushania alpina* bamboo from Government Forests. Unfortunately most of this is illegal. In fact it is estimated that 88% of all bamboo in the Kenyan market is harvested illegally.

Table 1: Present Income Scenarios from Natural Forests, 2006

Cost per Culm	**Total Value**	**Total Value of Bamboo from Government Forest**	**Lost Revenue**	**Accruing to Farmers**
35	113,225,000.00	106,431,500.00	93,659,720.00	6,793,500.00
40	129,400,000.00	121,636,000.00	107,039,680.00	7,764,000.00
60	194,100,000.00	182,454,000.00	160,559,520.00	11,646,000.00
100	323,500,000.00	304,090,000.00	267,599,200.00	19,410,000.00
150	485,250,000.00	456,135,000.00	401,398,800.00	29,115,000.00

Source: UNIDO (2006)

Table 1 shows losses that accrued to the government at different estimate prices for 2006. It gives an indication of the volume harvested and incomes / losses accruing to the farmers and the Government in 2006. It is estimated that 3,235,000 culms were illegally harvested from the forests in 2006 (UNIDO, 2006). Studies indicate that only about 0.06% of bamboo is from farms,

and out of this, the farmers get about Sh. 6.7 million (UNIDO, 2006). The Government loses about 83% of potential revenue to poachers, translating to about 94 million at the present royalty rate of Sh. 35.00. If the value of culms at the hardware shops is taken as a guide, then the current Kenyan bamboo economy is more than Sh. 456 million annually. Of this amount, only about 12% accrues to the Government as revenue. It is possible that if the ban was lifted and the trade regularized, most of the poachers may opt to pay royalties, which would be direct revenue to the Government.

1.1.2 Global Economic Benefits of Bamboo

Commercial consumption of bamboo the world over is to the tune of US $ 10 billion, which is expected to reach US $ 20 billion by 2015. There has been a growing awareness in recent years that bamboo is a vital component of development and an effective means to improve the livelihoods of rural poor people.

Bamboo's lightweight, high elasticity and resistance to rupture makes it ideal for housing in areas prone to natural calamities. More than a billion people live in homes made of bamboo, or employ it as the key element in their structural cladding or roofing. Bamboo is commonly used to make fences and shade homes, and to construct bridges. With tensile strength contending that of steel, and a weight-to-strength ratio greater than graphite, bamboo poles have been lashed together for scaffolding for many years. It is an important species for landscape and provides shade, windbreak and acoustical barriers. Bamboo and its related industries provide income, food and housing to over 2.5 billion people in the developing countries. It is a viable replacement for wood as an industrial raw material for traditional and modern sectors and is integrally involved in culture and arts (UNIDO, 2006).

Large and continually growing local, national and international markets exist for handicrafts, boards, fibre products, paper and pulp, different types of sticks, charcoal and intermediate products for further processing, such as slivers and splits. Bamboo poles are widely used for house construction in many countries, while bamboo shoots have become high value food exports in China, worth $150 million per annum. Appropriate market-based selection of products can provide flexibility to producers to ensure income during crop failures, thus promoting sustainable resource use and development.

1.1.3 Classification of Bamboo

Although it belongs to the grass family, bamboo is long-lived, woody and grows tall. By definition, the Forest Act of 1992 recognizes bamboo as a tree. The Act states that the terminology 'Tree' includes not only timber trees, but trees, shrubs, bushes of all kinds, seedlings, saplings and re-shoots of all ages, palms, bamboos, and any part of the tree. On the other hand, timber is defined as 'any tree which has been felled or which has fallen' or 'the part of any tree which has been cut off or fallen, and all wood whether sawn, split, hewn, or otherwise fashioned'. Therefore as a plant, bamboo is categorized as a tree, however, as a forest product, it is categorized as a non-wood product. The difference according to the Act, being that all timber must be from trees, while not all 'trees' provide timber. This classification is, therefore purely technical. Surprisingly wood is not defined in the Act, yet its definition could have distinguished very clearly between dry biomass from bamboo and that from trees of certain minimum dimensions. Republic of Kenya; Sessional Paper No. 9 of 2005 on Forest policy defines non-wood products to include, among many others, fibres, but the policy does not mention bamboo by name. Fortunately and unlike the previous Act and policy, both the new Act and the policy have avoided attempts to classify any forest product as 'minor forest product'. Instead, both the Act and the policy have divided the products into four main categories, namely: timber and wood products, wood fuel, non-wood forest products and non-consumptive use of forests. This new Act and policy have, thus, presented an excellent platform for the recognition of bamboo as a major forest product.

1.1.4. The Framework Convention on Tobacco Control (FCTC)

The World Health Organization Framework Convention on Tobacco Control (WHO FCTC) is the first treaty negotiated under the auspices of the World Health Organization. The WHO FCTC is an evidence-based treaty that reaffirms the right of all people to the highest standard of health. The WHO FCTC represents a paradigm shift in developing a regulatory strategy to address addictive substances. In contrast to previous drug control treaties, the WHO FCTC asserts the importance of demand reduction strategies as well as supply issues.

The WHO FCTC was developed in response to the globalization of the tobacco epidemic. The spread of the tobacco epidemic is facilitated through a variety of complex factors with cross-border effects, including trade liberalization and direct foreign investment. Other factors such as global marketing, transnational tobacco advertising, promotion and sponsorship, and the international movement of contraband and counterfeit cigarettes have also contributed to the explosive increase in tobacco use. The Convention entered into force on 27 February 2005, 90 days after it had been acceded to, ratified, accepted, or approved by 40 States. Kenya is one of the 40 states. Beginning on that date, the forty contracting parties are legally bound by the treaty's provisions. Article 1 of the FCTC requires that the parties to the convention, among other measures, reduce the production of tobacco in their countries. The FCTC therefore requires that alternative crops to tobacco be researched upon so that the farmers who depend on tobacco for their livelihood, can have alternative sources of income.

1.2 Statement of the problem

The World Health Organization Framework Convention on Tobacco Control (WHO FCTC) was developed in response to the globalization of the tobacco epidemic. It requires signatories to this framework (which includes Kenya) to provide adequate legislation to reduce production of tobacco since in doing so, it is hoped that there will be reduction of tobacco, so will there be reduction in cigarette production. Farmers, who depend on tobacco production for their livelihood, will therefore be left with no option but to seek other alternative crops to produce.

Tobacco-related problems in the South Nyanza region have been prioritized in the current Development Plans of the South Nyanza tobacco growing Districts (Republic of Kenya, 2000a; 2000b; 2000c; 2000d). To address these issues, the Government policy encourages crop diversification as the long-term solution. Given this scenario, there's a definitive need for tobacco farmers to shift to other crops. Owing to its immense potential and adaptability to the tobacco growing regions, bamboo fits the bill perfectly. In fact a study by Kibwage et al (2003) experimented with the cultivation of two bamboo species (Dendrocalamus giganteus and Bambusa vulgaris), as an alternative crop and source of livelihood for tobacco-growing communities. The study concluded that all small-holder tobacco farmers were willing to shift to alternative agricultural crops, should these alternatives be viable.

Since farmers are keen on the market dynamics, this study proposes to undertake a market research on the cost-benefit-analysis of tobacco and bamboo in order to assess justification for farmers to shift from tobacco production to bamboo production in South Nyanza Region. This is especially critical since the farmers have no data on the costs and benefits on both crops.

1.3 Objectives of the Study

The broad objective of this study is to investigate and compare the costs and benefits of planting bamboo as opposed to tobacco in South Nyanza region, Kenya. The specific objectives of this study are

i. To estimate the financial and economic costs of planting bamboo viz a viz tobacco in South Nyanza region, Kenya.
ii. To estimate and compare the financial and economic benefits of farming bamboo and tobacco in South Nyanza, Kenya.
iii. To suggest recommendations for policy makers aimed at assisting tobacco farmers shift agricultural production from tobacco to alternative crops.

1.4 Justification of the Study

The WHO FCTC requires the scaling down of tobacco production. The farmers in Southern Nyanza are dependent on this crop and therefore have their income almost entirely dependent on tobacco farming. The alternative crop that should be sought is one that addresses a number of issues that have plagued tobacco farmers over the years. It should be a crop that looks into the environmental degradation and depletion of forest cover by years of farming tobacco. This study seeks to find out if this crop is bamboo. This is because bamboo in addition to environmental conservation, also contributes towards livelihood development and industrial utilization in countries like India and China. The study does not purport to re-invent the wheel but to provide new evidence as to the costs and benefits that arise to the society following the planting of bamboo as an alternative crop to tobacco.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

Different categories of costs and benefits that arise from farming bamboo are discussed and later analysed using the framework of Cost-Benefit Analysis (CBA). This chapter consists of review of theoretical and empirical literature; and an overview of the literature on bamboo farming.

2.1 Theoretical Literature

2.1.1 Concept of Cost Benefit Analysis

Cost-Benefit Analysis (CBA) is a technique for systematically estimating the efficiency impacts on policies (Weimer and Vining, 1991). It considers all benefits and costs to a society as a whole that is social costs and benefits hence it is referred to as a social cost benefit analysis (Boardman et al, 2006). Social cost benefit analysis is a process of identifying, measuring and comparing the social benefits and costs of a project or program. The broad purpose of CBA is to help in social decision making and more specifically to facilitate efficient allocation of a society's resources (Boardman et al, 2006).

There are two major types of CBA. *Ex ante* CBA is conducted while the project or policy is under consideration, before it is started or implemented. It is used in deciding whether some resources should be allocated to a certain project. *Ex post* CBA is conducted at the end of the project to help confirm whether the project was worthwhile. Some CBA are conducted in the course of the life of the project that is in *medias res*. For this case, some elements of such studies are similar to *ex ante* analyses while others are similar to *ex post* analyses. Like *ex ante* analysis, *medias res* analysis has the potential of directly influencing a decision and continuation of a project. Like *ex post* analysis, they can be based on observation rather than prediction of some costs and benefits. *Media res analysis* also provides information that can be used to predict costs and benefits in future *ex ante* analysis. A CBA that compares an *ex ante* CBA with an *ex post* (or in *medias res* CBA of the same project) is the most useful to policy makers for learning about the efficacy of CBA as a decision-making and evaluating tool (Boardman et al 2006).

Net benefits are connected to Pareto efficiency. CBA utilizes an alternative decision rule with somewhat less conceptual but much greater feasibility, than the actual Pareto efficiency rule. It is based on what is known as the Kaldor-Hicks criterion. A policy should be adopted if and only if

those who will gain could potentially fully compensate those who lose. The Kaldor-Hicks criterion provides the basis for potential Pareto efficiency rule, commonly known as the net benefit criterion that is, adopt only policies that have positive net benefits. As long as the net benefits are positive, it is at least possible that losers could be compensated so that the policy potential could be Pareto improving. Negative net benefits indicate the absence of this potential (Boardman et al 2006; and Campbell and Brown, 2003). In a CBA therefore, the final decision is informed (though not necessarily determined) by a comparison of the total costs and benefits.

2.1.2 Valuing Economic Costs and Benefits

Financial and economic analysis is used to value economic benefits. The objective of the society is to maximize the contribution of bamboo and/or tobacco production to the national income. Financial analysis is always carried out from a specific party's point of view (resident farmers in this case). It deals with private costs and benefits, and is evaluated at the prices and costs that accrue to the parties under consideration. For this study, the financial prices are the starting point for the economic analysis; they are adjusted as needed to reflect the value to the society as a whole of both inputs and outputs. The market value for tobacco to the farmers is assumed to represent the opportunity cost (the value of a good in its next best alternative) to the society, making it the new assigned value called the 'shadow price'/ 'accounting price' (Gittinger 1982). The market prices used in financial analysis do not always reflect scarcity values hence for economic analysis; our numeraire is the real market prices valued in opportunity cost (prices in the nearest formal market). Following Gittinger (1982), the costs and benefits are valued at their shadow prices because they are a better indicator of the value of a good or service to the society as a whole. I therefore propose to use shadow prices.

2.1.3 Concept of Discounting

Discounting is the process of finding the present value/worth of a project. The interest rate assumed for discounting is the 'discount rate'. The discount rate tells us the rate at which we are willing to give up consumption in exchange for additional consumption in future (Campbell and Brown, 2003). This takes place by discounting costs and benefits in each future time period and summarizing them to their present value.

The technique of discounting permits the determination of whether to accept the implementation of a project that has time streams. This can be done by subtracting, year-by-year, the costs from the benefits to arrive at the incremental net benefit stream (cash flow) and then discounting it (Gittinger, 1982). Three discounted cash flow measures of the project worth can be used in this approach namely; the net project worth, the internal rate of return and the net benefit-investment ratio. This study proposes to adapt net present value because it is the most straightforward discounted cash flow measure (Gittinger, 1982). Besides, it also allows us to take time dimension of cost and benefit streams into consideration (Mburu and Birner, 2002).

To calculate the net present worth of a project, a discount rate has to be selected. For financial analysis, the discount rate is usually the marginal cost of money to the farm. This often will be the rate at which the farm is able to borrow money. For economic analysis, the opportunity cost of capital, the borrowing rate to finance the project or the social time preference rate can be used. In social time preference, discount attached to the future returns by the society as a whole is different from the discount individuals would use. It is felt that the society has a longer time horizon, so that its discount rate would be lower (Gittinger, 1982). Due to market failure, the problem of having a high market rate can be addressed using a social time preference, lower than the market rate, as the social discount rate.

2.2 Empirical Literature

2.2.1 *Overview of Literature on Tobacco Production in Kenya*

Ochola and Kosura (2003) carried out an ad hoc study on alternative crops in South Nyanza in accordance with the FCTC. The study assessed the social and economic costs and benefits of tobacco cultivation against other commercial crops in Kenya. The study approach involved the use of both primary and secondary data. Literature review was carried out to determine the nature and structure of tobacco industry in Kenya. This entailed the collection of secondary data to document the trends in various industry variables including acreage, number of farmers, government revenue among others. Primary data was used to enable the assessement of the competitiveness of various enterprises so that farmers can subsequently be advised on the alternative avenues for raising farm income. Kuria and Migori districts in Nyanza province was

selected for primary data collection exercise. The districts were purposefully selected since they account for 80% of tobacco production in Kenya (Ochola and Kosura, 2003).

The research discovered that Tobacco exhibited the lowest return per acre in the study area when compared with commercial crops including passion fruits, soya beans, pineapple and pepper in one production cycle. In addition, it was discovered that farmers are willing to shift from tobacco and would do so if the introduced crop has an assured market, the farmers have access to credit to purchase farm inputs, and technical support among others. Farmers indicated that they would adopt commercial crops which they would also use for home consumption. The research also found out that institutions promoting production of alternative crops in the study area faced capacity and resource constraints which impacted negatively on their operations. The study also revealed that those farmers who shifted to other crops exhibited higher standards of living compared to those who continued to grow tobacco.

A research carried out in Bangladesh (Naher and Efroymson, 2007) observed the situation of tobacco growing and vegetable areas. Research for this case study involved travel to key tobacco growing regions of Bangladesh as well as collection of information in Dhaka from various sources. During the fieldwork, researchers observed the situation of tobacco growing and vegetable growing areas, and spoke to current and former tobacco farmers about their economic situation and their reasons for growing tobacco or switching from tobacco to other crops.
It emerged that the principal reason behind farmers choosing to grow tobacco is that it is considered to be more profitable than other crops due to its guaranteed market and that the farmer receives his entire money for his produce at once. The study also observed that the key benefits of tobacco growing, meanwhile, accrue mainly to registered farmers only, while unregistered farmers often receive a lower price for their tobacco leaf, depending on registered farmers to buy whatever quantity they may need. (Naher and Efroymson, 2007).

Krishnankutty (2004) carried out a cost-benefit analysis of bamboo in comparison with other crops in mixed home gardens in Kerala State, India. A statistically designed survey was carried out in home gardens in two different agro-climatic zones in Kerala to analyse profitability of bamboo in comparison with seasonal-annual crops, perennial crops and tree crops. Benefit–cost

analysis shows that bamboo has at least a second position in terms of profitability among the crop groups in home gardens in the two zones. The high benefit–cost ratio of bamboo was due to negligible inputs and high farm price of bamboo. Advantages due to the existence of an organized wholesale market near the study area and the efficiency of the bamboo depots there make bamboo growing in home gardens profitable.

It is clear that tobacco is not as beneficial as is commonly perceived. Krishnankutty (2004) indicated that tobacco farmers' cost of living compared to other farmers within the same locality is not better (Ochola and Kosura 2003). It is also evident that there are economic and environmental benefits that communities derive from bamboo production (Krishnankutty 2004). Economic benefits can easily be monetized unlike environmental costs but can be given monetary values using indirect methods like contigent valuations and benefit transfers. These benefits and costs can be discounted so as to get their present values.

Empirical literature has shown that bamboo farming has both economic costs and benefits (Omenda and Kariuki, 2006; Krishnankutty, 2004; UNIDO, 2006). To the best of my knowledge, no study has been carried out on the cost benefit analysis of substituting bamboo for tobacco in Kenya. This study uses primary data to get direct costs and benefits of bamboo planting as opposed to tobacco farming to the farmer and its contribution to the environment.

CHAPTER THREE
METHODOLOGY

3.0 Introduction

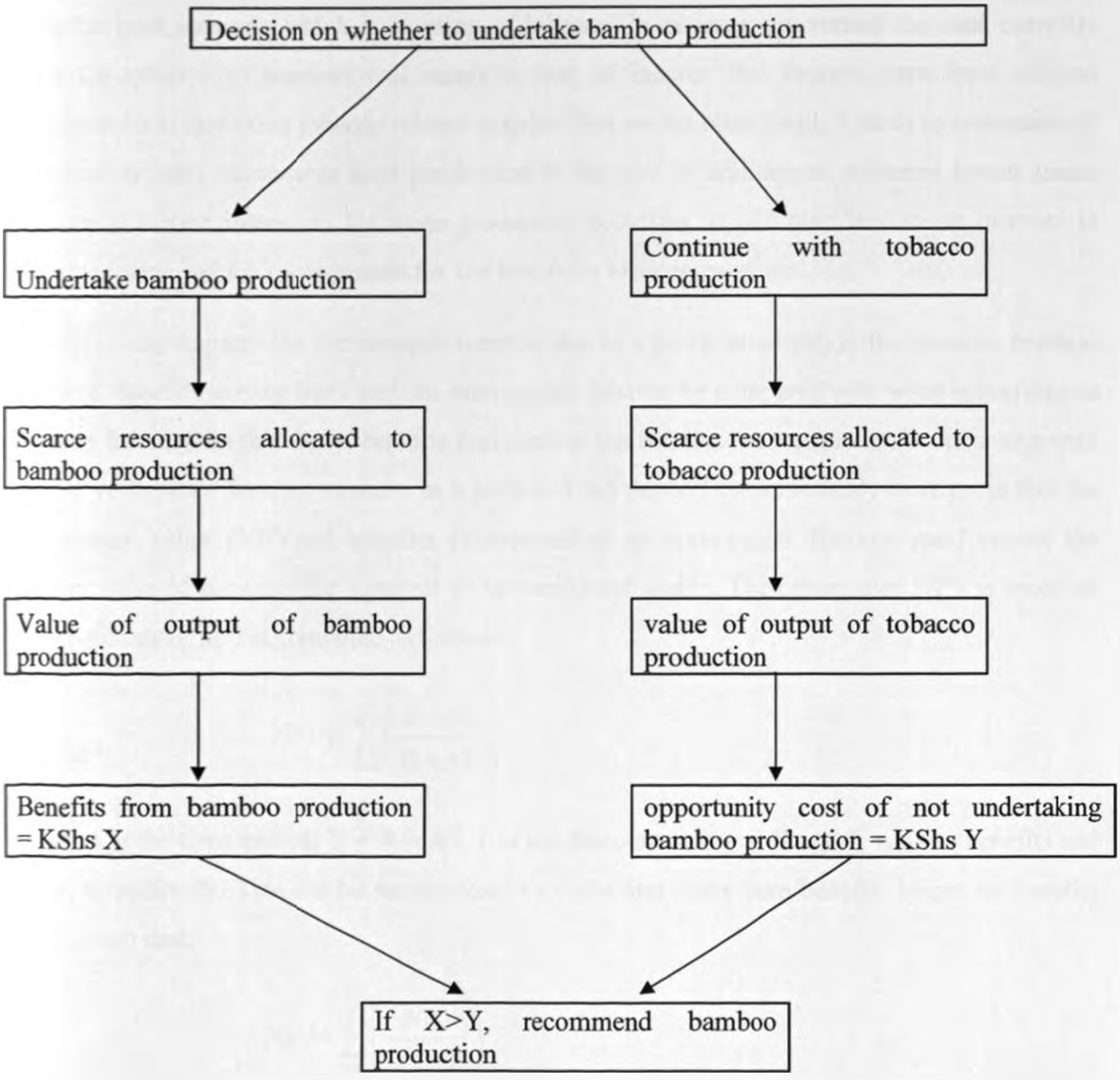
This chapter gives the conceptual framework, theoretical framework, model specification, sensitivity analysis, simulation of future cash flows of costs and benefits, area of study, sources of data and sampling procedure. We further discuss two cost benefit models; financial cost benefit model and economic cost benefit model.

3.1 Conceptual framework

The role of a CBA is to evaluate the difference brought about by a project or a policy. This study assumes two cases; the case involving growing of tobacco (which is widespread in South Nyanza) and the case of growing bamboo. A decision maker (the farmer) in this case has two alternatives; to plant tobacco or to plant bamboo. Figure 1 illustrates a decision tree where the decision maker is thought of as standing at a node.

The with-and-without approach is at the heart of cost-benefit analysis and also underlies the important concept of opportunity cost. Ceteris paribus, where planting of bamboo is practiced, the benefits (especially financial) accruing to the farmers may not be the same as when the farmer is involved in planting of tobacco. These farmers will also experience an opportunity cost that is, the farming benefits of tobacco. Since tobacco is a labour intensive crop, some of the factors of its production like labour and capital which would have otherwise been employed in the production cycle, would be idle. The decision maker's objective is to make a decision using the decision rule such that if the net benefits (benefits less costs) of bamboo production exceed that of tobacco, then bamboo production should be more worthwhile.

Figure 2: Bamboo Production Decision Tree



Source: Authors' own conceptualization, 2009.

3.2 Theoretical Framework

This study is based on the theory of Cost Benefit Analysis. Following Guthiga (2007) and Kimani (2008), we compared the net benefits that result from planting of bamboo by the farmer with the base scenario which is planting of tobacco. In essence, converting the land currently used for tobacco to bamboo will result to loss of income that farmers earn from tobacco companies and any other tobacco related activity. But on the other hand, it leads to restoration of soil fertility, and increase in food production in the area in addition to releasing labour (since tobacco is labour intensive) for more productive activities. It will also lead to an increase in money income, which compensates for the loss from tobacco earnings.

To effectively capture the incremental benefits due to a given intervention for instance bamboo farming, benefits arising from such an intervention have to be compared with what is accruing to tobacco farming. In this study, benefits and costs to the farmers are assumed to occur over a span of five years since bamboo matures in a period of 3-5 years. Economic analysis requires that the net present value (NPV) of benefits (discounted at an appropriate discount rate) exceed the present value of the costs for a project to be considered viable. The criterion of NPV is based on this requirement and is computed as follows:

$$\text{NPV}=\sum_{t=0}^{T}\left(\frac{B_t - C_t}{(1+r)^t}\right)$$

Where t is the time period; T = 4 years, r is the discount rate and B and C are the benefits and costs, respectively. This can be summarized by deducting costs from benefits to get net benefits (*NBt*); such that;

$$\text{NPV}=\sum_{t=0}^{T}\left(\frac{NB_t}{(1+r)^t}\right)$$

As noted above, CBA is carried out from the perspective of 'with and without project' comparison to capture net incremental benefits that arise from the implementation of a project. In this particular case, the 'with project' is with farming bamboo (South Nyanza study area), while the 'without project' is the farming of bamboo (South Nyanza study area).

Since CBA involves projecting future cash flows of costs and benefits, likely future yield from planting bamboo as compared to tobacco on the same acreage is an important consideration in carrying out a cost-benefit analysis. Two closely related CBA models are applied for financial and economic analyses. The technical structures of the two models are very similar but there are two fundamental differences between them. First, the kind of costs and benefits included and; second, how costs and benefits are valued.

3.3 Model Specification

The study applies two empirical models for CBA; financial analysis and economic analysis. No inflation has been assumed for purposes of appraisal. The assumption is that it affects all costs and benefits in the same way and therefore will not affect the relative returns (Campbell and Brown, 2003). Nominal rate of interest is used as a discounting rate assuming that prices of all commodities inflate in the same rate and no risk is included in the discounting rate. Below is the model being to be estimated;

$$\text{NPV}=\sum_{t=0}^{T}\left(\frac{NB_t}{(1+r)^t}\right)$$

The following are the variables of the model being estimated;

Revenue:

Revenue which is measured by the Gross Income (GI) is the total value of output produced. GI will be computed by multiplying average yield by average price at farm level. GI includes output produced during the year, which may be sold, used for household consumption, used on the farm for seed, used for payments in kind; or kept in the store for future sale (ending stock). Non market transactions are valued at their opportunity cost (average market price).

Costs:

Costs are measured by;

a) Operating costs: These refer to the sum of input costs, traction contract costs and hired labour costs. Input costs consists of value of expenses incurred on seeds, fertilizers, insecticides, fungicides and herbicides while traction costs consists of opportunity costs for using tractors or oxen for primary land tillage. Non-purchased seeds are valued at their opportunity costs i.e. market price.
b) Opportunity cost of operating capital: This is estimated at 14% of cash/operating cost. 14% was chosen because it is based on average bank lending rate for 2006 (CBK 2006).
c) Opportunity cost of family labour: This is the value of family labour used, which is valued at local wage rate (this study has used the average of the cost paid for hired labour by operation).
d) Total Enterprise Costs (TEC): This refers to values of all inputs used in production. It is the sum of operating costs, opportunity cost of equity capital, and opportunity cost of family labour. Total costs are generally divided into total variable costs and total fixed costs. In this study, fixed costs will be excluded. The study will focus on evaluating the farm's profitability on a short term basis because in the short run, a firm's output level is determined by variable factor inputs (Koutsoyiannis (1993). Since in the short term fixed costs are ignored, net returns is defined as gross income per unit of activity, and expressed in Kenya Shillings per acre.

Returns:

Returns are measured by;

a) Enterprise Gross Margin (EGM): This is defined as the difference between GI and operating costs.
b) Return on family land, labour and management: This is computed by deducting operation costs and opportunity cost of equity capital from GI.
c) Return on family land and management: This is the difference between GI and TEC, which includes the opportunity cost of family labour and equity capital as part of cost. It measures the reward to the family for farmers' management and land.

3.31 Financial Cost-Benefit Model

$$\text{NPV}=\sum_{t=0}^{T}\left(\frac{NB_t}{(1+r)^t}\right)$$

This study conducts a financial CBA carried out from the perspective of an individual stakeholder for example, individual farmer or local community. Market prices are applied for valuing costs and benefits. It considers costs they incur and benefits they obtain by planting bamboo and tobacco valued at the prevailing local market prices. Another important component of cost as noted earlier is the foregone opportunity costs of the benefits of farming tobacco. Opportunity costs are valued as the net returns from small holder agriculture as practiced in the study area. Opportunity costs are valued as the net returns from smallholder agriculture as practiced in the study area as reported by Ryaner (1991), and supported by Norton Griffiths and Southey (1995).

3.32 Economic Cost-Benefit Model

$$\text{NPV}=\sum_{t=0}^{T}\left(\frac{NB_t}{(1+r)^t}\right)$$

In Guthiga (2007) and Kimani (2008), economic CBA is carried out from the societal point of view and costs and benefits are valued at their shadow prices. Goods and services are valued at their shadow prices because they are a better indicator of the value of good or service to the society as a whole. I adapted the same method in valuing the costs and benefits. Generating economic values from financial prices involves: (a) adjusting for direct transfer payments such as taxes, direct subsidies and credit transaction; (b) adjusting for prices in traded items and; finally (c) adjusting for price distortions in non-traded items (Gittinger, 1982). In Kenya, farmers benefit from some level of government subsidy on fertilizers, save for taxes on farm implements and seeds. As a result, for their costs to reflect real values to the society they should be adjusted upward. With the exception of fertilizers, all costs and benefits are valued at their local market prices which are assumed to be competitive, thereby reflecting their economic value.

3.4 Sensitivity Analysis:

Sensitivity analysis is carried out to capture different possible scenarios with different discount rates. Since CBA involves projecting likely future cash flows, future flows must be discounted to obtain their present value. Rural people generally have a higher discounting rate than the wider society especially because the benefit that accrues to them today and the future is uncertain (Guthiga *et al*, 2006). The sensitivity of the CBA models is tested by changing the discounting rates. The discounting rate is adjusted upwards and downwards by 50 % of the face value (Kimani 2008).

3.5 Simulation of Future Flows of Costs and Benefits:

A CBA involves projecting future flows of costs and benefits. In this study, the costs and benefits for the year 2006-2007 and 2009-2016 are extrapolated using the data for bamboo for 2008. The data for tobacco for 2006 has been used to estimate the costs and benefits for tobacco from 2007-2016. This is done based on assumptions made about the future and past scenarios depending on the available information. There are factors that affect the state of environmental resources like population growth rate, government policy and change in economic conditions (Guthiga, 2007).

3.6 Area of Study:

This research is carried out in South Nyanza region, Kenya which accounts for 80% of tobacco production in Kenya. The areas of concentration are Migori, Suba, Kuria and Homabay districts. The study is part of an ongoing research by Kibwage et al (2006). The project team in the research in collaboration with the Ministry of Agriculture identified 120 field experimental sites (farms) i.e. 30 farms/farmers in each district. The criteria used in the selection of farmers included: whether one is a tobacco farmer or not, sex, age, poverty status, farming scale, access to water and the willingness to provide land for bamboo experimentation/ farming.

3.7 Sources of Data:

The major source of data for this study was primary data collected from a cross-section of 440 rural households in South Nyanza using structured questionnaires. For the purpose of this study, each bamboo farmer utilizes an acre of their land on bamboo production. For comparison purposes, the case study on tobacco cultivation and other alternative crops (Ochola et al, 2007) will be used to get the total enterprise cost and benefit to tobacco farmers per acre.

CHAPTER FOUR

EMPIRICAL RESULTS

4.0 Introduction

This chapter gives an account of the research findings starting with the descriptive statistics followed by the CBA of substituting bamboo for tobacco.

4.1 Descriptive Statistics for Sampled Households

4.1.1 Socio-economic Characteristics

Table 2: Descriptive Statistics for Sampled Households

Variable	Mean	Std. Dev	Min	Max
Male Head	0.784	0.216	0	1
Age of Head	44.29	12.858	19	83
No. education	0.08		0	1
Primary education	0.693		0	1
Secondary	0.187		0	1
Post-secondary education	0.04		0	1
Household size	9.02	4.31	1	36

Source: Author's survey, 2009

Table 2 gives the socio-economic characteristics of the 440 households sampled in South Nyanza, Kenya. Majority of the households are male headed; 78.4 % to 21.6 % headed by female. On average, the households have basic education. This is confirmed by the education variables which indicate 69.3 % for primary, 18.7 % for secondary education and 4 % for post-secondary education. The average age of household heads is 44.29 years with the youngest at 19 years and the oldest at 83 years.

4.1.2 Occupation of Household Head

Table 3 shows information on occupation of the household head in the study area. The data shows that the majority of the sampled household heads (61.82 %) of the 440 sampled

households are farmers, 13.64 % are involved in retail business and at least 17.05 % have no occupation therefore stay at home. Those employed in the formal sector constitute 4.55 %.

Table 3: Occupation Data

Variable	%
Farming	61.82
Formal sector employment	4.55
Retail business	13.64
House wife	1.59
Informal sector employment	1.36
None	17.05

Source: Author's Survey, 2009

4.1.3 Land Characteristics

Statistics on land are shown in Table 4. From the sampled data the average land per person on food crop is 3.2 acres while that under cash crop is 1.72 acres.

Table 4: Land Uses

Variable	Mean	Std. Dev	Min	Max
Land under food crop	3.26	4.39	0.04	55
Land under cash crops	1.72	2.02	2.22	25
Unutilized land	3.17	5.43	4.55	41.5
Total acreage of your land	7.13	8.63	4.55	90

Source: Author's Survey, 2009

4.2 Results of Cost Benefit Analysis

This study carries out a CBA from the perspective of 'with and without project' comparison to capture net incremental benefit that arise from implementation of the bamboo project. Specifically 'with project' is with bamboo and 'without project' is with tobacco. This section gives CBA using financial and economic models for tobacco cultivation and possible alternative crops (Ochola et al) as the control variable.

4.2.1 Financial Cost-Benefit Analysis - Tobacco

The financial analysis has been carried out from the view point of the participants (farmer) and local market prices have been used to get the financial value of costs and benefits. The results are shown in table 5.

Table 5: Financial Costs of Farming Tobacco (Labour costs – average man days per acre)

Operation and Labour Type	Labour Type	No. of Days	Cost per unit (KShs)	Total Cost (Kshs/acre)
Nursery Management	Family	15	150	2,250.00
Land Preparation	Family	9	150	1,350.00
Ridging	Family	3	150	450.00
Planting	Family	16	60	960.00
	Hired	20	60	1,200.00
Weeding	Family	73	60	4,380.00
	Hired	17	60	1,020.00
Applying fertilizer	Family	5	60	300.00
Applying Agrohemicals	Family	2	60	120.00
Manual desuckering	Family	1	60	60.00
	Hired	1	300	300.00
Manual pest control	Family	10	60	600.00
Harvesting	Family	4	130	130.00
	Hired	9	130	1,170.00
(Tying on curing sticks)	Hired	10	180	1,800.00
Transporting to the barn	Family	2	60	120.00
Transporting to the barn	Hired	3	60	180.00
Curing	Family	10	200	2,000.00
Sorting/Grading	Family	12	60	720.00
Balling	Family	2	60	120.00
Packing	Family	3	60	180.00
Total	**Family**	**167**		**13,740.00**
	Hired	**60**		**5,670.00**
	Total	**227**		**19,410.00**

Source: Ochola et al (2007)

Tobacco is a labour intensive crop. Table 5 shows that on average farmers use a total of 227 man days per acre per crop season (Ochola et al, 2007). Table 4 reports mean number of man-days and the associated costs by type (family or hired) and operation. The results indicate that a large share of total labour is used for weeding (39.6%), followed by planting (20.0%) and tending of the crop in the nursery (7.0%). Family labour also constitutes about 74% of total labour used in tobacco production. (Ochola et al, 2007).

Table 6: Average Quantity and Cost of Input Use Per Acre

Item	Type	Units	Unit price	Total cost
Fertilizer	NPK	3 KG	1,895.00	5,685.00
Agro chemicals	Confidor	350MLS	2,250.00	2,250.00
	Pygro	300MLS	900.00	900.00
	Off shoot – T	5 LITRES	2,000.00	2,000.00
	Copper	-	75.00	75.00
Curing pipes	1	N.A	N.A	138.80
Sprayer	1	N.A	N.A	625.00
Curing wood	1	N.A	N.A	4,000.00
Total				**15,673.80**

Source: Ochola et al (2007)

Table 6 shows the other costs that would be incurred in planting tobacco per acre. It shows that an additional cost of KShs 15,674 would be used in the cultivation of tobacco.

4.2.1.1 Direct Benefits to the Farmer - Tobacco

The average gross income of a farmer per acre has been estimated at KShs 58,452 (Ochola et al, 2007). Total enterprise cost (TEC) averaged KShs 35,083.80. The operating costs excluding the opportunity cost of operating capital and family labour averaged KShs 21,343.80 (Ochola et al, 2007). The average gross income per acre and the TEC are results from Ochola et al, 2007. This study used the results of that research as a basis of comparison with the Cost Benefit Analysis of bamboo.

4.2.1.2 Financial Cost Benefit Analysis - Bamboo

Table 7: Financial Costs of Farming Bamboo (Labour Costs – average man days per acre)

Operation and Labour Type	Labour Type	No. of Days	Cost per unit (KShs)	Total Cost (Kshs/acre)
Nursery Management	Family	5	150	750.00
Land Preparation	Family	30	150	4,500.00
Ridging	Family	4	150	600.00
Planting	Family	10	150	1,500.00
Weeding	Family	48	150	7,200.00
Applying fertilizer	Family	4	150	600.00
Applying Agrochemicals	Family	4	150	600.00
Manual desuckering	Family	4	150	600.00
Prunning	Family	24	150	3,600.00
Harvesting	Family	45.9	150	6,885.00
Total		**178.9**	**150**	**26,835.00**

Source: Authors survey and estimation, 2009

Table 7 shows that on average farmers use a total of 179 man days per acre per crop season. It is also clear that unlike tobacco, the family would not have to use hired labour in bamboo cultivation. Converting the labour hours into monetary terms would show that the total cost in bamboo cultivation in a crop season is KShs 26,835.

Table 8 shows the cost of 200 seedlings in a one acre piece of land.

Table 8: Average quantity and cost of input use per acre (one time cost)

Item	Type	Units	Unit price	Total cost
Seedlings	**One time cost**	**200**	**150**	**30,000.00**

Source: Authors Survey, 2009

The cost of seedlings is a onetime cost and is estimated at KShs 30,000 as shown in table 8.

4.2.1.3 Direct Benefits to the Farmer - Bamboo

Bamboo harvesting takes place after 2-3 years. The study makes the assumption that a bamboo culm of 2 years is ready for harvesting. This study estimates the mean rate of harvesting as 11.477 culms per clump per year. For a farm with 200 clumps, the expected harvest per year is 2295 culms per annum.

The price per culm in the study area is KShs 80 (UNIDO, 2006). This means that *ceteris paribus*, the annual revenue per acre will be KShs 183,600. But the farmers can only start harvesting bamboo two years after planting. The farmers will therefore need to get an alternative in the two years before harvesting. This study therefore proposes that another crop can be planted in the two years while bamboo grows. This is because bamboo can be intercropped with other crops. The study recommends either kales which have a net income per acre of KShs 48,000.00 (Ochola et al 2007) or beans which have a net income per acre of KShs 20,000.00. The two have been tested in this area.

4.2.1.4 Simulation Results

As noted above, CBA requires a stream of costs and benefits so as to calculate incremental net benefits. This involves projecting future flows of costs and benefits, discounting them and then applying a decision criterion to decide whether a project is worthwhile. For this study, it is possible to collect data for the year 2006 for tobacco (Ochola et al 2007) and for kales for the same year (Ochola et al 2007). Farmers covered by this study are estimated to start harvesting in the year 2010. This necessitated projection so as to get the data from 2006 to 2016, the period covered by this study. The best method would have been regression analysis with the yield as the dependent variable and the independent variables would include among others; the determinants of yield- rainfall, temperature, soil fertility, farmers age and experience. In this case, the coefficients for the year 2006 would have been used to project various costs and benefits for the period covered by the study. However, due to data limitation this was not possible. The regression could not be run without varying independent variables such as rainfall and temperature. Data on some independent variables were only available for one year, 2006, making projection using regression analysis for 2006 impossible for other years. Consequently, simulation was done using population growth rate for the region at 3.0 %.

The financial CBA at 14 % (average bank lending rate in 2006) indicate that the net present value is positive when excluding national costs and benefits. This implies that for local people, land would be beneficial when converted to agriculture. Table 9 and 10 below indicates the Net Present Value (NPV) at the end of the project will be KShs 155,444.51 for tobacco farmers and KShs 663,272.10 for bamboo farmers.

Table 9: Financial Net Present Values for Tobacco Farmers

Year	Benefits	Costs	Net Benefits	NPV (14%)
2006	58,452.00	35,083.80	23,368.20	12,136.71
2007	60,205.56	36,136.31	24,069.25	12,500.81
2008	62,011.73	37,220.40	24,791.32	12,875.84
2009	63,872.08	38,337.02	25,535.06	13,262.11
2010	65,788.24	39,487.13	26,301.11	13,659.97
2011	67,761.89	40,671.74	27,090.15	14,069.77
2012	69,794.74	41,891.89	27,902.85	14,491.87
2013	71,888.59	43,148.65	28,739.94	14,926.62
2014	74,045.24	44,443.11	29,602.14	15,374.42
2015	76,266.60	45,776.40	30,490.20	15,835.65
2016	78,554.60	47,149.69	31,404.91	16,310.72
			TOTAL	155,444.51

Source: Authors Survey, 2009; Ochola 2007

Table 10: Financial Net Present Values for Bamboo Farmers

Year	Benefits	Costs	Net Benefits	NPV (14%)
2006	-	-	48,000.00	24,929.70
2007	-	-	49,920.00	25,926.88
2008	-	-	51,916.80	26,963.96
2009	56,835.00	183,600.00	126,765.00	65,837.77
2010	58,540.05	189,108.00	130,567.95	67,812.90
2011	60,296.25	194,781.24	134,484.99	69,847.29
2012	62,105.14	200,624.68	138,519.54	71,942.71
2013	63,968.29	206,643.42	142,675.12	74,100.99
2014	65,887.34	212,842.72	146,955.38	76,324.02
2015	67,863.96	219,228.00	151,364.04	78,613.74
2016	69,899.88	225,804.84	155,904.96	80,972.15
				663,272.10

Source: Authors survey, 2009; Ochola 2007

To get the financial incremental benefits, the net benefits for not farming tobacco is deducted from the net benefits from farming bamboo.

Table 11: Financial Incremental Net Benefits

Net Benefits Bamboo	Net Benefits Tobacco	Net incremental benefits	Net Incremental benefit at (14%)
48,000.00	23,368.20	24,631.80	12,792.99
49,920.00	24,069.25	25,850.75	13,426.07
51,916.80	24,791.32	27,125.48	14,088.12
126,765.00	25,535.06	101,229.94	52,575.66
130,567.95	26,301.11	104,266.84	54,152.93
134,484.99	27,090.15	107,394.84	55,777.51
138,519.54	27,902.85	110,616.69	57,450.84
142,675.12	28,739.94	113,935.19	59,174.37
146,955.38	29,602.14	117,353.24	60,949.60
151,364.04	30,490.20	120,873.84	62,778.08
155,904.96	31,404.91	124,500.05	64,661.43
1,277,073.78	299,295.13	977,778.65	507,827.59

Source: Authors own survey, 2009

As indicated in Table 11, the results point to a positive incremental net benefit at 14 % discount rate; that is, the average local bank lending rate in 2006. Following the analysis, farming bamboo is found to be financially profitable since there is a net incremental benefit of KShs 507,828.

4.3 Results of Sensitivity Analysis

The sensitivity analysis of the financial model was run by changing the discount rates while holding the time horizon at 10 years. The discount rates were adjusted upwards and downwards by 50 % of the base value. The results are shown in table 12 below.

Table 12: Change of Discount Rate Effect on Net Present Value of Financial Values

Parameters	Financial Incremental net benefit at 14%
NPV at 7%	697,142.66
NPV at base value (14)%	507,827.59
NPV at 21%	376,976.00

Table 12 shows that the change in interest rate for financial analysis does not change the status of the NPV; they are all positive. This implies that the models are stable to changes in discount rate. The financial NPV is positive indicating bamboo farming should be initiated.

CHAPTER FIVE

SUMMARY AND POLICY IMPLICATIONS

5.0 Summary and Main Findings

This study examined the costs and benefits of substituting bamboo in South Nyanza for tobacco. The analysis was performed under the framework of cost-benefit analysis. The study was motivated by the Framework Convention on Tobacco Control (FCTC). Efforts have been made locally to reduce tobacco production in the country. To this end, the Tobacco bill 2007 was passed. The bill has been enacted by parliament and it includes smoke-free legislation and health warnings consistent with The Framework Convention on Tobacco Control (FCTC). The FCTC requires countries which are signatories to cut down tobacco production and consumption. Since supply, creates its own demand, The World Health Organization (WHO) is seeking other alternative crops to tobacco so that not only would the demand for tobacco products reduce but also that the farmers who are the producers of tobacco can sustain themselves.

The main study hypothesis was that; bamboo cultivation will be beneficial to the local community since in growing the crop; the farmers will have a higher level of income in addition to preserving the environment which has been worn out due to years of farming tobacco. This study closely followed the Total Economic Value (TEV) approach in eliciting various types of benefits arising from farming bamboo. There are other benefits other than the monetary ones, which accrue to the bamboo farmers. They include firewood for domestic cooking without any of the following consequences; damage to the natural forests, soil conservation, shelter from wind in addition to soil erosion control and watershed protection. The direct farming benefits were valued using the prevailing prices at local markets for financial valuation. Projection of future flows of costs and benefits was a critical part of the study. Given the uncertainty of the future, the study applied the most conservative projections to come up with the base scenario based on information about future trends in population growth rates and such other information.

Results of the base scenario showed that bamboo farming is financially and economically beneficial to tobacco farmers since the incremental benefits are positive. This is shown by the

results which indicate that whilst the financial net present value for tobacco farmers is KShs 155,445 that of bamboo farmers is KShs 663,272.

It is also evident that bamboo farming takes on average 179 days of labour per season as opposed to the 227 man days for tobacco farming. Holding other factors constant, this leaves the community with 48 more days to diversify to other income generating activities.

The results also indicate that the Total Enterprise Cost (TEC) of farming bamboo is higher at KShs 56,835 compared to KShs 35,084 for tobacco. This is however offset by the fact that the gross average income for bamboo is KShs 183,600 and that of tobacco is KShs 58,452.

Bamboo farming therefore, if well managed can meet the objective of the Framework Convention on Tobacco Control and also the government as it seeks to find an alternative to tobacco growing.

5.1Conclusions and Implications

From the research findings, there are possible policy interventions that are worthy of consideration by conservation policy makers. There are several constraints that hinder the development of the bamboo sector. Some of the constraints are short supply of bamboo from state forests as a result of the government ban on the utilization of the resource, poor infrastructure, poor processing techniques, poorly developed marketing structures and lack of alternative sources.

The following interventions have thus been recommended in the short run: establishment of on-farm bamboo plantations, provision of new technologies for toothpick producers and provision of financial support to the basket producers to improve design, quality, value and diversification of the products. These interventions can enhance efficient utilization of bamboo, generate income to the local communities and increase the supply of raw materials.

This research also suggests the following potential activity models to enhance bamboo growing. First, awareness creation and training of stakeholders on the potentials of bamboo and that need to encourage on-farm bamboo planting, improve roads for extraction and make budgetary

allocations for the management of natural stands of bamboo. Also policy and legislative reforms to lift the ban, improve management regimes, classify bamboo as a major product need to be put in place.

There is need for dissemination of KEFRI guidelines to improve on propagation, establishment, management, and harvesting techniques. This will involve both the farmers and government staff charged with the responsibility of managing natural bamboo stands. There is need for establishment of on-farm bamboo plantation for supply of bamboo shoots, fencing and construction materials to alleviate the current short supply from natural forests. This will involve facilitating the farmers to achieve this goal.

Finally, there is need for technology improvement in the handicraft (artisan) industry: fancy items, toothpicks, and baskets. This involves importing machines or working closely with informal sector to fabricate the machines. Organizing the bamboo cutters and collectors in groups also needs to be initiated to ease marketing difficulties of the product.

If the government and the people in South Nyanza are committed towards bamboo cultivation, then environmental restoration can be initiated. It will also allow for farmers to increase food production in the area since bamboo is amenable to intercropping in the first two years and restores degraded areas as is the case in tobacco growing areas. The government should contribute towards encouraging farmers to grow bamboo and provide incentives to the farmers for growing the crop. The incentives may be in the form of cash advance and supply of inputs such as seedlings.

5.2 Limitations of the Study

Cost benefit analysis in itself was a challenge especially in valuing environmental costs and benefits. Since there is no market for environmental goods and services, we could not give monetary values. This study also focuses on local costs and benefits from farming bamboo. Carbon sequestration and recreational benefits which come as a result of planting bamboo were assumed to accrue at a global level. The study could be having forecasting errors, especially those associated with benefits.

5.3Areas for Further Research

The findings of this study provide an insight on the areas that require further research in the future. The study concentrated in justifying that bamboo has incremental benefits but further studies need to establish that there is indeed a market for bamboo products in Kenya. This would provide information on the viability of the project. The study also concentrated on costs and benefits to the local community and the nation yet bamboo production has global benefits too. Future bamboo studies could explore the costs and benefits of bamboo at the national and global level. This would provide a wider scope of information for policy decision on bamboo growing.

This study was limited to the practice of tobacco growing in South Nyanza (Migori, Kuria, Suba and Homa bay districts). Further studies could look into other areas where tobacco is grown such as Western (Bungoma, Busia, Teso and Mount Elgon districts), Central (Kirinyaga, Muranga, and Thika districts) and Eastern (Meru, Kitui and Machakos districts). This could give a comparison of the net benefits from farming bamboo as opposed to tobacco.

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