SOCIO-ECONOMIC IMPACTS OF SUGARCANE FARMING ON LIVELIHOODS AND THE BIOPHYSICAL ENVIRONMENT IN TRANSMARA SUB-COUNTY, KENYA.

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DECLARATION

This is my original work and has not been presented for a degree in any other University.

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DEDICATION

This thesis is dedicated to my parents, Mr. James O. Opany and Mrs. Pamela A. Oyugi, for all the sacrifices that you have made for me to get to this point in my life, even when it meant that you had to go out of your way and be uncomfortable for your children to succeed. May the good Lord keep you and guide you in all your endeavours.

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May the good Lord bless your hearts.

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ABBREVIATIONS AND ACRONYMS

CAI:	Consultancy Africa Intelligence
COMESA:	Common Market for East and Central Africa
EMCA:	The Environment Management and Coordination Act, 1999, No. 8 of 1999
FAO:	Food and Agriculture Organisation
GDP:	Gross Development Product
KESREF:	Kenya Sugar Research Foundation
KSB:	Kenya Sugar Board
KSI:	Kenya Sugar Industry
NACOSTI:	The National Commission for Science, Technology and Innovation
SONY:	South Nyanza Sugar Company
SPSS:	Statistical Package for Social Sciences
SSA:	Sub Saharan Africa
TSCL:	Transmara Sugar Company Limited

ABSTRACT

Sugarcane farming has been practiced the world over since the Persian farmers discovered the "reeds that produced honey without bees" between the 6th and 4th Centuries in India. Since then, sugarcane farming has been practiced in various tropical regions of the world with the major driver of the industry being the world's increasing demand for sugar. This has led to the expansion of arable land under sugarcane cultivation, with a myriad of problems presenting themselves ecologically, socially and economically. This descriptive survey was carried out in 2012-2014 to assess the effects of sugarcane farming on community livelihoods in Transmara sub-county, Kenya. A sample size of 384 farmers was randomly selected from an accessible population of 850, 920 people. Data was analysed using standard descriptive statistics. The study found that sugarcane farming has greatly enhanced household livelihoods through more access to income. Farmers now obtain Kshs. 37,554 from a tonne of sugarcane every six months as opposed to a mean of Ksh. 3,500 per hectare from leasing maize farms. Unlike other sugarcane belts, shift to sugarcane farming has not undermined food security in Transmara. Up to 95% of the respondents indicated having enough food from their farms (maize, bananas and indigenous vegetables) to feed their households all year round. Only 15% of the population interviewed has committed their entire arable land to sugarcane farming while 77% lease land for sugarcane while growing food crops on their individual farms. As expected, 62% of the respondents indicated that sugarcane farming has contributed to reduction in forest cover by about 12% during the last 18 years. Reduction in grazing fields also means that free range livestock farming has to change to space intensive systems like zero-grazing. Respondents also indicated that expansion in sugarcane fields has interfered with migratory corridors thus escalating human-wildlife conflicts. The cat family now hides in sugarcane plantations. Snake bites too, have increased. The contracts signed between farmers and the millers give more leeway to the millers who singly benefits from sugarcane by-products (i.e. bagasse, molasses and filter mud) while farmers only obtain the price of raw sugarcane per tonnage. In retrospect, 97% of the farmers who were introduced to sugarcane farming by either South Nyanza Sugar Company or Transmara Sugar Company Limited were made aware of what it would mean to them. Millers extend extension services and credit facilities to sugarcane farmers in line with contract arming principles. From a corporate social responsibility perspective millers invest in community water projects. None of the key natural resources in the study area are gazetted, hence the need to intensify integrated community-based conservation strategies such as issuing of tree seedlings alongside sugarcane by the millers. There is need to liberalize the sugar industry to allow farmers to be flexible against the constant price fluctuations that result in net losses. Millers should also advocate for practices that allow for environmental conservation as sugarcane can only be intercropped in the early stages before canopy formation and moreover, utilizes up to 50% of soil nutrients. The farmers' practice of maintaining sufficient for food crops should be encouraged and supported with appropriate extension.

CHAPTER ONE:

INTRODUCTION

1.1 Background to the study

The main driver behind the expansion of land under sugarcane farming and increasing sugarcane monoculture is the constant rise in the world's demand for sugar. Sugarcane accounts for 80% of the amount of sugar produced worldwide. However, industrialization has led to more investments in sugarcane farming for production of clean fuels, namely; ethanol and biogas.

In 2010, sugarcane was cultivated on about 23.8 million hectares in more than 90 countries with a worldwide harvest of 1.69 billion tonnes (FAO, 2010). This acreage under sugarcane agriculture is set to expand as sugarcane monoculture is being favoured at the expense of other food crops with resulting impacts on food prices, availability and variability of food commodities in the market and the livelihoods of those who had previously depended on the substituted crops as a source of income. The encroachment of pastoral land by sugarcane in the Afar region of Ethiopia has forced pastoralists to supplement their livelihoods with subsistence oriented cultivation of maize and sorghum and/or low paid wage labour like the picking of cotton (Altare *et al*., 2010).

Further complicating this state of affairs is the sensitive nature of the sugarcane crop that limits crop diversification. Moreover, the selective addition of fertilizer at different growth stages prompts varying responses. Due to the fact that sugarcane matures at 18-24

months, farmers need to obtain an income from other crops but research by KESREF shows that only similar crops such as sugar beets, sweet sorghum and leguminous crops like beans due to the nitrogen fixation element crucial in sugarcane agriculture can be used to practice mixed agronomy (KESREF, 2012). Such crops neither have an existing market nor have they been known to thrive in the study area.

As much as sugarcane farming promises to raise the standards of living of communities through job creation and profitable yields, it has created a cycle of poverty that threatens its very own sustainability. In Brazil, the world's number one producer of sugarcane over the years, the sugarcane industry employs over two million labourers who mainly engage in unskilled wage labour (Fischer *et al*., 2008). These wages are however below their living standards and are unreliable as they are contracted for only six months per year and as such, they are unable to maintain their families. The farmers are also constantly embroiled in debt as they borrow loans to meet the cost of production which, more often than not, seems unjustifiable by the net profits gained (Schneider, 2010).

For labourers in the rural Kigali area, the work is hard and wages are low compared with other forms of employment. Working for out growers provides better pay and conditions though wages are still considered insufficient to support a household (Lankhorst & Veldman, 2011). Furthermore, all year-round labourers consider themselves worse off than before sugarcane agriculture took over with some saying that the variety of their diet has significantly decreased.

Sugarcane plantations have also been known to flourish at the expense of natural resources, with additional land constantly cleared to facilitate their expansion. This has led to a total change in land use patterns in areas where sugarcane monoculture thrives. In North East Brazil, the *Zona da Malta* or Forest Region has been cleared continually, principally to be used for sugarcane production, since the 16th Century. In Pernambuco, Brazil, the forest region extends the entire north-south length of the state but is only about 80 km wide (Schneider, 2010).

Increased environmental degradation occurs over time due to exhaustion of nutrients, increased water usage and accumulation of chemical wastes. Increased water consumption in the sugar industry is likely to undermine ecosystem services which can only have negative consequences for poor people. Since employment on sugar farms is reconcilable with severe income poverty, it is doubtful that the trade-off between environmental degradation and the expansion of the sugar industry seem likely to reflect existing patterns of wealth and patronage on the one hand and poverty and vulnerability on the other (Lorentzen, 2009).

Farmers and millers get into sugarcane contracts to share the risks and benefits. However, most farmers feel short-changed as the miller banks profits from the by-products as the farmers only earn from sugar. Contracted farmers have also institutional problem of feeling that they are cheated as they believe they are weak in bargaining and negotiating for the contract on equal terms with the sugar company (Mosoti, 1997). Farmers have no say when payments are delayed after harvesting of sugarcane nor can they negotiate

when the produce is sub-standard. They bear the brunt in costs as the miller still gets to deduct the cost of seed cane, transport and harvesting services offered as well as fertilizer.

1.2 Problem Statement

Sugarcane farming gained popularity in Transmara sub-county since the mid-1970s in and around Keyian division due to close proximity to the SONY Sugar Company, hence an extension of the South Nyanza sugar belt. However, the commissioning of the Transmara Sugar Company Limited in November, 2011 with the slogan, "*panda miwa kwa wingi upate manufaa zaidi*", meaning "*grow lots of sugarcane for maximum benefits*", fuelled its expansion. The cost of leasing farmland at least doubled since, with land previously used for food crop, indigenous vegetables and cash crop cultivation steadily converted into sugarcane plantations with no prior capacity building. Consequently, food prices skyrocketed with comparably inadequate supply and variability.

The expansion of plantation sugarcane farming in Transmara sub-county without proper institutional mechanisms presents a myriad of problems ecologically, socially and economically. Being a semi-arid area, any extensive extractive venture would exacerbate competition for already scarce land and water resources. Over the years, the area has been able to produce adequate foodstuffs to feed the local population leaving a surplus for export. However, high production costs and lengthy maturity periods associated with sugarcane farming compromise community livelihoods as well as threaten food security

in the area as mixed crop farming is not encouraged in sugarcane farming, save for early stages.

Expansion of sugarcane plantations means that natural resources such as forests, grassland and shrubs, most of which double up as pastureland risk being encroached into. That none of these natural resources are under legal protection increases the risk of them being mismanaged contributing further to environmental degradation through soil erosion, loss of species, exhaustion of nutrients and interfering with other ecosystem services. Further, 80% of land in Transmara sub-county is communal and therefore no individuals reserve the right of use (ALRMP, 2012).

The study area has remained largely underdeveloped since time immemorial and sugarcane farming has brought with it mass optimism towards economic prosperity. Therefore, this study sought to assess whether sugarcane farming can be embraced as an alternative staircase towards economic success in Transmara sub-county while it has, by and large, failed in the neighbouring Migori County that is part of the Western Kenya sugar belt.

1.3 Objective of the Study

The overall objective of the study was to determine the effects brought about by sugarcane farming on community livelihoods in Transmara sub-county as well as the biophysical environment in order to inform decision making that contributes to attaining a balance between maximum benefits accrued and the well-being of the community for sustainable sugarcane agriculture.

1.3.1: Specific Objectives.

1. To assess the effects of sugarcane farming on community livelihoods with special focus on incomes.
2. To assess the effects of sugarcane farming on the biophysical environment.
3. To analyse the relative benefits from sugar processing and by-products between millers and farmers.

1.4 Research Questions

This study sought to answer the following key questions:

i. How has sugarcane farming affected communities living in Transmara West sub-county in terms of food security, income, education and health?

ii. How has the biophysical environment changed as a result of sugarcane farming with regards to vegetative cover, biodiversity, general air and water quality, tree cover and pasturelands?

iii. How are the benefits derived from harvested sugarcane distributed among farmers and the sugar companies? Are the benefits mutual?

1.5 Rationale of the study

This research study was in line with the Kenya Sugar Board's Strategic Plan, 2010-2014 that seeks to find ways to penetrate the liberalized sugar industry beyond 2012. Amongst its strategic goals, the industry seeks to enhance competitiveness through effective, efficient milling capacity, enhanced human resource capacity, efficient, reliable harvesting and transport operations, reduction in farm level risks and streamlined corporate governance. This study addresses the need to fulfil the above objective in order

to make the sugarcane industry less cost-productive, thus benefiting both the farmer and the miller.

The results of this study may be used by relevant institutions and stakeholders in the sugarcane industry as a basis for capacity building and education on the effects of practicing sugarcane monoculture so that it does not conflict with efforts to conserve natural resources while maintaining a steady pace of development. The output obtained from this study may also be used to advice communities on how to attain sustainable livelihoods from such high value cash crops that always tend to take precedence over other crops, especially food crops and substitute economic activities where they are introduced with the promise of maximum benefits accrued, even without relaying the bigger picture to the relevant stakeholders including farmers, Government agencies as well as Non-Governmental Organisations involved in agriculture and natural resource management in Transmara sub-county.

This study was in line with KSB's second goal that is aimed at expanding the product base to take advantage of opportunities created in the production process and increase factory profitability through value addition and product diversification. The research study looks at the extent that sugarcane farming has gone to in threatening food security in Transmara sub-county while noting that it has played a great role in TSCL where by-products such as bagasse have been utilised in power-generation while mud-plast is utilised as fertilizer.

The Transmara sub-county Integrated Development Plan (2013 – 2017) focuses on industrialization as key to contributing towards value addition of agricultural and livestock products, job creation, promotion of urbanization and promotion of balanced growth in the County. As far as the agro – processing sub sector is concerned, the County will focus on, amongst other projects, sugarcane processing. In this regard, the County will collaborate with the Private Sector to facilitate investment in construction of two sugar processing factories in Esoit Naibor and Lolgorian, both in Kilgoris (Transmara sub-county Government, 2013).

Kilgoris already has one sugar processing factory, TSCL. In light of this, the research study highlighted the challenges of having a sugar processing plant in Transmara sub-county. The proposed sites for the other two factories have been the preserve of large scale maize farmers coupled with commercial food crops that feed Transmara sub-county as well as its neighbouring communities. The area also experiences harsher weather conditions coupled with frequent political flares that will only be exacerbated with the introduction of such a high value commodity. The challenges associated with sugarcane farming in Transmara sub-county as far as the TSCL and SONY are concerned would not shape up any differently in Transmara East, where the additional factories have been proposed to be set up. However, the outcome of this study should be able to act as a guide, providing mitigation measures as far as sugarcane farming in Transmara sub-county is concerned.

Hopefully, this study will set a platform for coming up with policies that favour farmers at the expense of largely profitable sugar companies and also incorporate natural resource management techniques in areas where there has been a boom in high value cash crops such as sugarcane, tea, rice and coffee in the Kenyan context to foster sustainable agriculture.

1.6 Conceptual Framework

The study aimed at identifying the effects of sugarcane farming on community livelihoods and the biophysical environment in Transmara sub-county. Figure 1.1 encompasses looks at both the positive and negative impacts that sugarcane farming is bound to bring about in the study area based on studies by Fischer et al., (2009), Netondo *et al*., (2010), Schneider, (2010) and Waswa *et al*.,2012). Sugarcane farming affects food security in terms of food availability, variability and access. Just as well it has provides income to the farmers, skilled and unskilled labourers in the mills and the business community due to improved road and building infrastructure that has boosted business opportunities.

However, it can have negative impacts on the environment due to overutilization of water and soil nutrients. Expansive sugarcane plantations interfere with wildlife migratory corridors leading to increased human-wildlife conflicts. From the above studies, farmers are paid price per tonnage of raw sugarcane by the miller with benefits such as extension services and access to credit facilities. However, the miller benefits from sugarcane by products as well as transport and harvesting services offered to farmers.

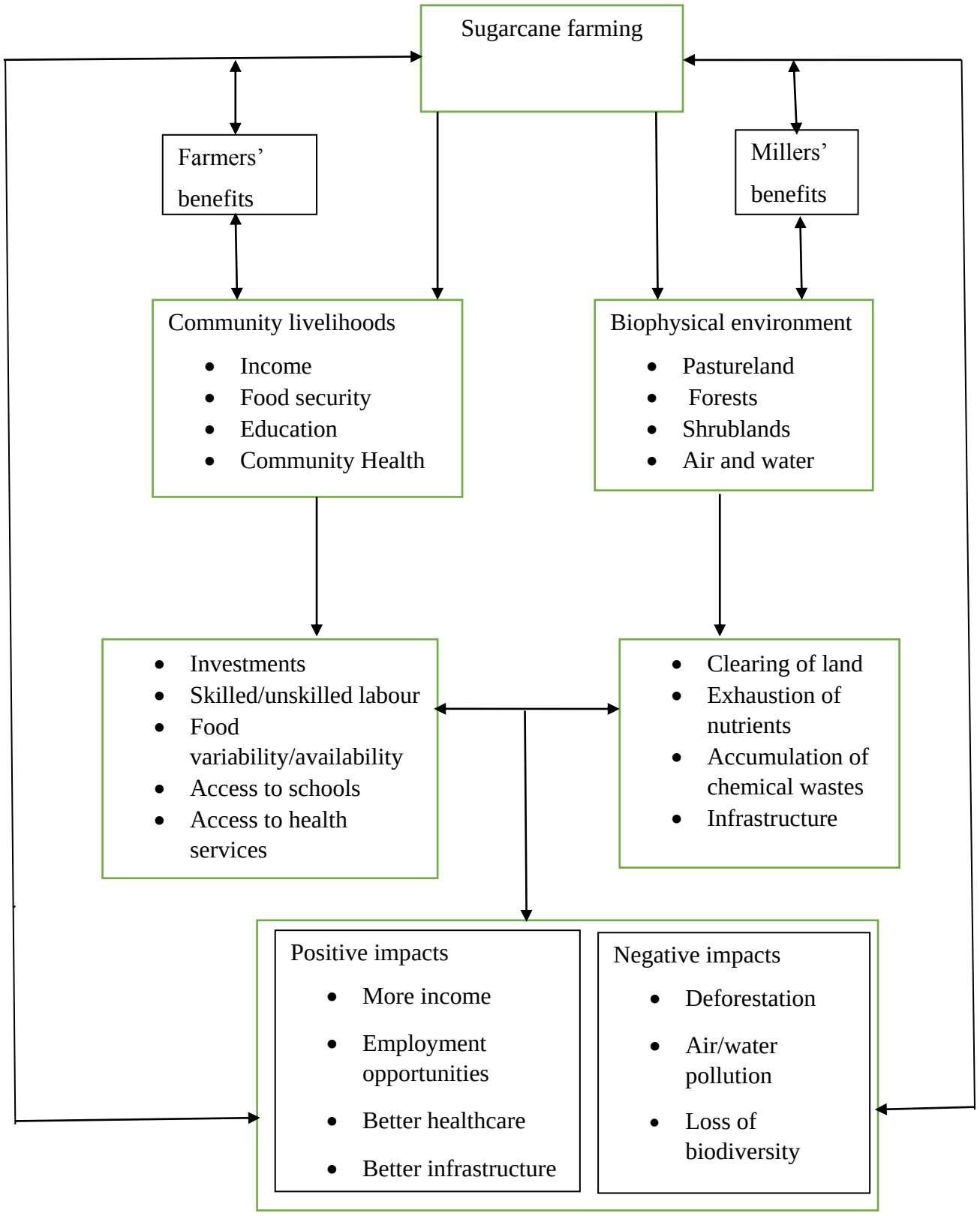


Figure 1.1: Conceptual framework (derived from literature research)

1.7 Limitations of the study

Access to sugarcane farms further away from the millers is a challenge as there is no reliable means of transport. This meant hiring alternative means of transport, which proved to be costly. Furthermore, poor road networks with expansive gravel roads makes the areas impassable during the rainy weather.

Lack of existing data on the ground to back up new information proved a challenge in showing trends and comparisons. Where it existed, secondary data from the sugarcane shareholders was scarce and unyielding. The local government agencies have not had a direct hand in sugarcane farming, thus making it hard for them to have an input regarding how the millers and farmers operate.

Access to farmers who live away from their sugarcane farms proved a herculean task. Up to 77% of farmers have leased the farms where their sugarcane grows making it extremely difficult to locate them on the ground. This delayed the data collection process as the only solution was to wait for them to come to TSCL on farmers' days (Mondays and Wednesdays) every other week.

1.8 Definitions and Terminologies

i. **Biodiversity –** According to the WWF, biodiversity is the variety of life on Earth. It is the variety within and between all species of plants, animals and micro-organisms and the ecosystems within which they live and interact.

ii. **Biophysical environment** – The biotic and abiotic surrounding of an organism or population which includes the factors that have an influence in their survival, development and evolution.

iii. **Ecosystem services** – The Millennium Ecosystem Assessment (MA, 2005) describes Ecosystem Services as the processes by which the environment produces resources utilised by humans such as clean air, water, food and materials.

iv. **Food Security** – The concept of food security is defined as including both physical and economic access to food that meets peoples' dietary needs as well as their food preferences. The World Food Summit of 1996 defined food security as existing when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.

v. **Livelihood** – According to the International Red Cross and Red Crescent Societies, a livelihood is a means of making a living. It encompasses people's capabilities, assets, income and activities required to secure the necessities of life. A livelihood is sustainable when it enables people to cope with and recover from shocks and stresses and enhance their well-being and that of future generations without undermining the natural environment or resource base.

vi. **Plant crop –** This is used to refer to the initial harvest of a mature sugarcane stalk in a given cycle. It grows from the seed cane.

vii. **Ratoon –** These are the subsequent sugarcane stalks after the plant crop has been harvested. These are usually 2-3 in a given cycle and grow after the plant crop has been harvested.

CHAPTER TWO:

LITERATURE REVIEW

2.1 Global Trends in Sugarcane Farming

The world demand for sugar is the main driver of sugarcane agriculture, which accounts for 80% of sugar produced. The rest is produced from sugar beets that grow in temperate regions. Brazil has the largest area under sugarcane cultivation in the world, representing one third of global harvested area and production (Fischer *et. al*., 2009).

The sugarcane industry is responsible for quite a substantial percentage of the agricultural industry's GDP in Sub Saharan Africa (SSA). South Africa makes the largest contribution to the sugarcane industry, accounting for almost 35% of the region's total output. SSA relies greatly on its agricultural industry whereby approximately 75% of employment is provided by agriculture. There are 28 countries that produce sugarcane, 11 of which can boast an output capacity of more than 200,000 tonnes (Vermeulen, 2011). The other countries include Mozambique, Mauritius, Cameroon, Swaziland, Peru, Egypt, Senegal, Malawi, Sudan, Ethiopia, Zambia and Tanzania.

The composition of the sugar industries in terms of size and scale vary amongst SSA countries. Sugarcane is grown on large estates or by smallholders and subsistence farmers. Large estates (nucleus) generally produce the bulk of sugarcane but smallholders contribute quite substantially in some countries. In Mauritius, approximately 26,000 smallholders contribute roughly 30% of sugarcane supply while in South Africa, 12% is

produced by approximately 45,000 small holder farmers and the rest is produced by 1,729 large scale growers (Vermeulen, 2011). In the Kenyan scenario, there are about 250,000 small scale farmers who supply 92% of sugarcane to the sugar millers, while the remainder is supplied by factory-owned nucleus estates (KSI, 2009).

According to the Kenya Sugar Board, the sugar sub sector generates an estimated Kshs. 12 billion annually, providing about 500,000 jobs and supporting the livelihoods of about 6 million people, directly or indirectly. This translates to about 15% of the country's GDP with a major impact on the economies of Western Kenya, Nyanza regions and Rift Valley (KSI. 2009). Total sugar production grew from 436,238 tonnes in 1980 to 523,652 tonnes in 2010, while sugar consumption increased from 300,000 tonnes in 1980 to 743,000 tonnes in 2010. Kenya's sugar deficit (about 200,000 tonnes) is mainly filled through imports of raw sugar from the Common Market for Eastern and Southern Africa (COMESA) region (Monroy *et al.,* 2012). This deficit is mainly brought about by sugar mills operating inefficiently and below capacity.

Between 80,000 and 100,000 tonnes of the imported sugar is used as raw materials in the manufacture of beverages, confectionary, pharmaceuticals and other industrial products (KSB, 2012). Consequently, there is a sense of urgency in making sugarcane farming sustainable so as to try and curb the socio-economic impacts of importation of sugar in the long term.

2.2 Plantation Sugarcane Farming and Environmental Quality

The agronomy department at the Kenya Sugar Research Foundation (KESREF) reckons that, in view of the fact that sugarcane takes 18-24 months to mature, the farmer must obtain income from other crops. To compound the situation, sugarcane yields are low and continue to decline in cane growing zones of Kenya despite availability of improved varieties that have been developed and transferred to farmers and millers from research. One of the factors leading to this is continuous sugarcane monoculture (KESREF, 2012). This land use monoculture is associated with loss of natural vegetation and cropland (Netondo *et al*., 2010).

The productive capacity of agricultural lands generally decreases after several seasons of a cane crop as sugarcane has a high demand for nutrients. Given that 50% of the crop is harvested, there is continuous mining of nutrients from the soil with successive crops, leading to a decline in land productivity and depressed yields (KESREF, 2012). Soil nutrients will be stressed further as more land is converted into sugarcane plantations. As a result, there is need to reconcile competing resource uses and resource users and to ensure full consideration of social and environmental aspects are crucial to minimize the risks

Sugarcane production in Kenya is heavily dependent on rainfall, a fact that exposes the industry to vagaries of weather. Consequently, there is over production of sugarcane in years after heavy rainfall and shortage in years after drought (KESREF, 2006). Yields often fluctuate with variations in the rainfall characteristics such as onset of rainy

seasons, total seasonal amounts and the distribution of rainfall during the growing seasons. This state of affairs further complicates sugarcane farming in Transmara sub-county, which is classified as a semi-arid area. This means that resources such as water and maximize the benefits of such investments (Nhantumbo & Salomao, 2010).

In North East Brazil, the *Zona da Malta* or Forest Region has been cleared continually, principally to be used for sugarcane production since the sixteenth century. Consequently, there are only a few remaining forests. In Pernambuco, for instance, the forest region extends the entire North-South length of the state but it is only about 80 kilometers wide. Once the Portuguese realized that sugarcane, a commodity of extremely high value in Europe thrived in their new colony, they focused on clearing the native Atlantic Forest in Pernambuco (as well as Bahia and other regions) and importing slaves in order to constantly expand and intensify the production of sugar for export. The region consequently experienced mismanagement of natural resources and poor human and social development (Schneider, 2010).

Given that Transmara sub-county is a political hotspot with recurrent ethnic clashes over land that intensify during election periods, (Kipsisei, 2011); (Jcoissaba, 2009), the expansion of the area under such a high value cash crop is most likely going to brew more of such tensions. The fact that the study area has no gazetted natural resources gives room to exacerbate clearing of forests and shrubs, pollution of water bodies and the replacement of indigenous crops with sugarcane plantations. The expansion of the area under sugarcane has also increased deforestation rates either ‘directly’ by intruding in

areas of native non-protected forest areas or ‘indirectly” by forcing other land uses (Fischer *et al*., 2008).

Recognizing the importance of forests as a natural resource, between February and August 1996, the Transmara Development Program (TDP) commissioned three consultants to carry out a study on natural resources in Transmara and provide baseline information on, amongst others, the composition of forests. Notably, the forest cover in Transmara was noted to be 40% of the total land area (TDP, 1996). However, clearing of land for cultivation in Keyian and Kilgoris divisions where sugarcane monoculture is practiced was already a cause for concern.

As such, efforts to conserve natural resources threatened by sugarcane farming should be introduced to farmers and relevant stakeholders for immediate implementation. In order to curb further loss of biodiversity, efforts should particularly focus on food crops and livelihood diversification and adoption of farming technologies such as agroforestry (Netondo *et al*., 2010)

2.3 Plantation Sugarcane Farming and Community Livelihoods

In most of the areas where high value cash crops such as sugarcane, tea, coffee or rice have been introduced, there was a resultant boom, at least in the beginning and this was seen as the answer to poverty in these areas. However, this did not prove to be true in the long term, especially where proper institutional mechanisms were lacking or weak due to the desire to maximize productivity. For instance, in the neighbouring Kisii County, the

shift to conventional cash crops, majorly coffee and tea was expected to enhance the District's food security.

According to the agricultural policy of the colonial administration and that of current thinking, farmers should engage in the cultivation of (export) crops where they enjoy a relative advantage and therefore use their incomes to meet their food needs on the market. It is, however, questionable how far this can be the case, given that world market prices for major commodities have progressively dropped. In Kisii, the fall in coffee prices has put those who invested in the crop in a predicament. The returns are low and given the multiplicity of household needs, these cash incomes cannot cover general subsistence (Omosa, 1998).

Although the initial aim of introducing sugarcane farming in Kenya was to create wealth through provision of income and employment opportunities, statistics and observations indicate that poverty in the sugarcane growing areas remains endemic. (Otieno *et al*, 2003) As it is, the sugar industry supports the livelihoods of at least 15% of the Kenyan population. (KSI, 2008). The sugar industry plays a significant role in Kenya's economy, contributing about 15 percent to the country's agricultural GDP (KSI, 2009).

A research study on sugarcane farmers in the Lake Victoria basin concluded that overall, most farmers engage in sugarcane farming to raise income for the education of their children, acquisition of additional property, notably, land and construction of decent family shelters now that thatching grass has been eliminated through conversion of land

to farming. Site specific differences in the benefits are also a reflection of differences in the felt needs, general community cultural orientations and education levels (Waswa *et al.*, 2012).

For instance, many farmers earn their income only to exhaust it on re-payment of debts accrued during the more than 24 months of waiting to harvest the sugarcane. Repayment of debts reduces the farmers' propensity to buy and/or grow food for their own subsistence, hence the persistent food insecurity and malnutrition. As a result, a cycle of poverty is born that continues on end.

In Chemelil, Lurambi and Koyonzo, on average, farmers retained only 34, 32 and 31% respectively of the gross income from contract sugarcane farming. The study proposes that such skewed sharing of income where the sugar companies retain at least 60% of the gross income raises sustainability concerns that need to be addressed through a participatory approach involving all key stakeholders. Consequently, farmers would be saved from a venture that they put so much into only for the company to benefit much more than they do.

In 1974, the Brazillian government set up an ethanol fuel programme called *Proalcool* (Pro-Alcohol) from sugarcane. One of the impacts that the programme is thought to have had on rural livelihoods in Pernambuco is the motivation for a new wave of expulsion of sugarcane labourers from the rural areas to the cities. *Proalcool* led to increased value of the land in sugarcane producing areas, meaning that for plantation and mill owners, it

made little sense to dedicate land to housing employees when it could be instead used to produce more sugarcane (Schneider, 2010). This state of affairs is already being witnessed in the study area where the price for hiring farms for contract farming has at least doubled since January 2012 with farmers projecting a boom in the sugar industry. Land owners are also holding out on leasing their farms, preferring to plant sugarcane themselves.

Contract sugarcane farming is a costly business to ordinary farmers due to the deductions the company undertakes, particularly from the main crop. For instance, a deduction by the company for the main crop can cost farmers up to 71% loss in profits (Waswa *et al*, 2009). This has been the case all round in the sugarcane growing areas with farmers constantly embroiled in debt as the production costs constantly overweigh the proceeds from sugarcane. Farmers are only paid for the raw sugarcane tonnage presented on arrival at the millers' weighbridges while the millers retain proceeds from all the by - products.

Farmers need to find a way of balancing the inputs *vis a vis* benefits obtained from sugarcane farming in order to attain sustainable livelihoods. Millers should look into equal distribution of sugarcane by-products such as baggasse and molasses. There's also need to empower farmers to find alternative sources of income before their cane matures. Empowered farmers have a 25% chance of being food secure (SUCAM, 2002).

2.4 Summary of Research Gaps

The sugar industry is one of the biggest drivers of the economy, in Kenya, Africa and globally, both directly and indirectly. It is not an industry that we can do away with altogether without serious socio-economic repercussions. Under efficient management, sugarcane is one of the most viable crops to grow economically compared to other crops (SUCAM, 2002).

Most of the studies aforementioned focus on the negative impacts of sugarcane farming without focusing on the well-being of the specific community affected. The sugarcane growing communities in different study areas are all unique in their settings and therefore, solutions to the challenges facing the sugar industry need to be tailored to favour their very existence. Sugarcane farming may be a global undertaking with similar problems but the solutions need to be engineered to cater to the different socio-cultural, political and economic characteristics of each and every community in order to achieve sustainable livelihoods. What may work in Pernambuco, Brazil may not be relevant to problems affecting Transmara sub-county and vice versa.

According to (KSB, 2012), Kenya aims at increasing sugarcane production to curb the shortage of about 200,000 tonnes. However, by expansion of existing farms and clearing virgin lands consisting of forests, herbs and shrubs, the effects on the environment are not outlined. There are no guidelines put in place to counter the resultant stress that this will have on natural resources, which will ultimately lead to environmental degradation.

The agronomy department at KESREF also reckons that the sugarcane yields are low and continue declining. However, KESREF is responsible for research steered at increased production of better quality sugarcane and in this case, it does not specify why millers continue to process low quality while they are at a position to produce improved varieties with new technologies in the market. Intensifying sugarcane monoculture only serves to spin the cycle as in due time, the yields will have declined again due to maximum utilisation of natural resources, namely soil nutrients. As a result, combating this situation by increasing the fusion of fertilizer leads to further environmental degradation which simply exacerbates the situation in the long run. Ultimately, the farmers bear the brunt of increased production costs that considerably reduce the net profits accrued.

According to Schneider, (2010), constant clearing of the Atlantic Forest in Pernambuco, Brazil, to meet Europe's demand for sugar ultimately led to poor and unbalanced nutrition, mismanagement of natural resources and poor human and social development. In Transmara sub-county, this myriad of adverse effects is inevitable due to the lack of prior capacity building that brews the perfect recipe for ultimate disaster. The fact that there are no gazetted lands in the sugarcane growing zone that is Transmara sub-county makes it hard to intervene in matters regarding the land use system in the area.

In Schneider, (2011), the *Proalcool* programme facilitated outmigration of labourers form the rural areas to the cities. In Transmara, a similar trend is emerging, with the growth of towns from sugarcane income. This has led to rapid urbanisation as well as steady in migration especially in towns close to the factory such as Keyian, Enoosaen and Kilgoris.

Failure to plan to account for growth spurts resultant from the boom from sugarcane proceed will simply intensify these economic, social and political imbalances (Fischer *et al.*,2008).

Stakeholders of sugarcane farming would do well to borrow lessons learnt from other high value crops that have failed to bring the desired economic prosperity to their communities. Moreover, farmers in the study area have been earning well from maize and other indigenous crops. It is therefore perplexing why they would want to shift to small scale sugarcane farming while there is no significant difference, with the pay taking as long as two years to materialise.

Only the farm owners who quit leasing their land to actually farm their own cane have been known to reap a sizeable profit from sugarcane farming. The study found that sugarcane farming brings an income of Kshs. 37, 554 per tonne every six months as opposed to leasing that brings about Kshs. 2,000 – 5,000 per ha in the same period.

According to Omosa, (1998), farmers in neighbouring Kisii abandoned food crop farming for coffee farming so that they could use the additional income to satisfy their food needs on the market. Resultant coffee prices have however, been low, with endemic poverty as has been witnessed in the neighbouring Western sugar belt. Proper institutional mechanisms would ensure that farmers have a fall back option if sugarcane fails to be sustainable in Transmara sub-county just like coffee did in the neighbouring land, being that there are too many external factors at play. As yet, stakeholders such as the

Agricultural Ministry have minimal influence on the sugarcane sector in Transmara sub-county which is quite worrying.

However, it is clear that with advancements in technology, improved seed cane varieties that mature faster and capacity building to empower farmers to embrace new and improved methods, sugarcane farming can prove to be booming business. There's already light at the end of the tunnel as the global production for 2013/14 is estimated to outpace consumption, albeit at a lower rate (FAS/USDA, 2013). If it can be done globally, with proper mechanisms in place, we can replicate the scenario locally to curb the 200,000 tonne annual sugar deficit in the country that we import from COMESA (KSI, 2008) and channel those resources towards increased production.

CHAPTER THREE:

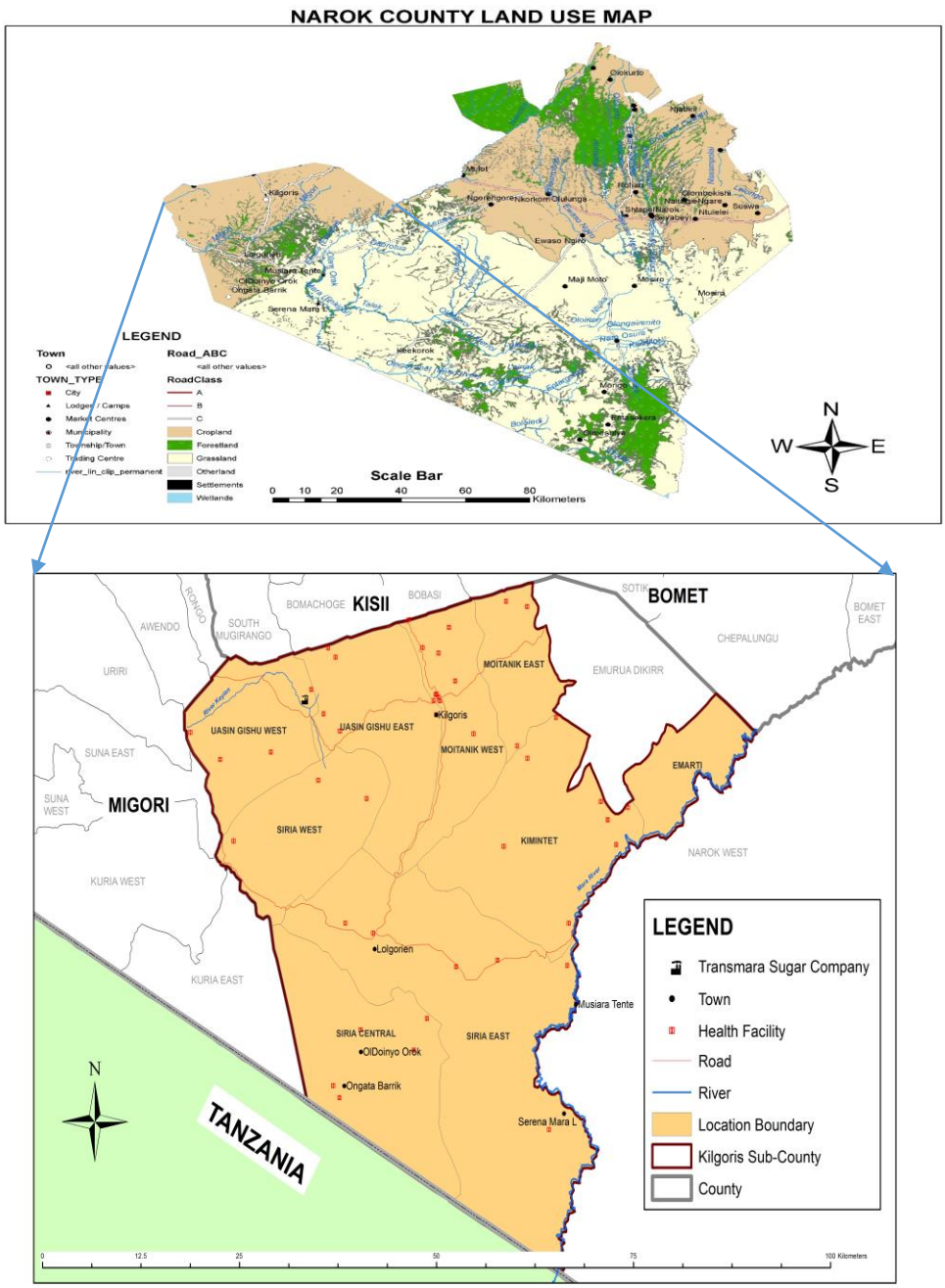
METHODOLOGY

3.1: Study Area

This research study was conducted in the Transmara West region of Transmara sub-county, which predominantly grows sugarcane. This sugarcane growing area is an extension of the South Nyanza sugar belt that originally supplied its sugarcane to SONY. Sugarcane farming begun in this area in the 1980's, predominantly in what is now Keyian ward because of favourable weather conditions and proximity to the SONY which was established in 1979. Since the commissioning of the TSCL in November 2011, sugarcane farmers who are not obligated to SONY now take their harvested cane to TSCL, cutting down on transportation costs. The newly established milling company is also convenient as there is less congestion with payments to the farmers being relatively faster (30-45 days).

3.1.1 Location and Socio-Economic Dimensions

Transmara sub-county is located in the South Rift Valley bordering Tanzania to the South (Figure 3.1). It covers an area of 17,921.20 square kilometres with a population of 850,920 people. It borders six counties with Nakuru to the North; Bomet, Nyamira and Kisii to the North West, Kajiado to the East and Migori to the West. The study area lies within Latitudes $0^0$50' South & $1^0$50' North and Longitudes $34^0$35' East & $35^0$14' West (KNBS, 2009).



Source: Derived from research study parameters (2014)

Figure 3.1: Position of Transmara sub-county in Narok County showing land use systems and an enlarged map of Transmara sub-County

There are six constituencies in Transmara sub-county, namely, Kilgoris, Emurua Dikirr, Narok North, Narok East, Narok South and Narok West. Sugarcane farming in the County has, over the years, mainly been concentrated in the Western part of Kilgoris Constituency (former Transmara District) due to its proximity to the South Nyanza Sugar Company (SONY) as well as favourable climatic conditions as the area borders the Western Kenya Sugar belt. (ALRMP, 2012) However, this has changed over time as more farmers have been motivated to establish sugarcane plantations and more so since the commissioning of the Transmara Sugar Company in November 2011.

The area is also known to be a political and land hotspot which is aggravated by recurrent ethnic clashes especially around the election periods between the Kisii and Maasai at the Nyangusu border, Maasai and Kuria in Kehancha, Maasai and Kalenjin in Kirindon and the Maasai and Luo communities at Ogwedhi. This dates back to the 1980s and 1990s when these communities moved into Transmara in search of land for cultivation, fleeing from conflicts or searching for better opportunities. The Abagusii moved in areas such as Enkoperiai and Nkararu in Lolgorian and Keiyan divisions while the Kipsigis moved over to Pirrar, Kirindoni and Ang'ata-Barrikoi in Lolgorian Division (Shelton 1993).

Further, based on this history, there is a lot of rivalry, suspicion and tension among the different ethnic groups in the district (Pander 1996). This leads to frequent disagreements, animosity and clashes (Pander 1996; Shelton 1993; Koissaba 2009). Sugarcane farmers, especially those in close vicinity to either borders bear the brunt as during these clashes,

there is a rise in the number of sugarcane plantations set ablaze as well as disruption of operations in the sugar milling companies.

3.1.2 Agro-ecological characteristics

The land tenure system in the study area falls under commercial and individual land ownership. Commercial land covers about 82% of this land area with a great concentration of group ranches. The main economic activity in these ranches is livestock rearing. Most of the indigenous forest reserves are also found in the group ranches. The main forest products include timber, charcoal, firewood and medicinal plants. Individual land covers about 18% of the total land area, where farmers practice mixed farming. The most predominant cash crop in the area is maize followed by sugarcane, vegetables and fruits in that order. The main food crops produced include maize, beans, finger millets, tea and sugarcane, (ALRMP II, 2012). The total arable area covers 1,321 square kilometres while the non-arable land covers 1,580 square kilometres. Water masses average 1,300 square kilometres, with the Mara River and its tributaries (Amala and Nyangores) forming the lion's share of 847.6 square kilometres. Other rivers include Enkare O Nkitua and Mogor. Average farm size is 5-30 acres for small scale farming and 50,000 acres for large scale farming.

The study area enjoys temperatures ranging from 14.8 to 20.3 degrees centigrade. Highest temperatures are experienced in February and the lowest in the months of June and July. These temperature ranges are influenced by the altitude while other modifying factors include cool winds blowing from Lake Victoria mainly between the months of August to November and also between February and April.

The amount of rainfall is influenced by the passage of the inter-tropical convergence zone, giving rise to a bimodal rainfall pattern in the range of 500 to 1800 mm per annum, classifying it under the semi-humid to semi-arid agro ecological zone. Long rains are experienced between February and June, peaking in April while short rains are experienced between August and November (ALRMP II, 2012). There are no registered sugarcane co-operatives in this study area. Soils are sandy loam, high in calcium and magnesium.

The study area has three major types of forests. Plain forests include: Nyakweri, Kirindon group, Olemeyioloi/Olemomposhi (Shartuka), Oloonkolin and Ntulele forests. Hill forests include: Olenkapune, Olomismis and Kerinkani ridge forests. Riverine forests constitute Mogor riverine forest and Laila along Enkare O Nkituak River.

3.2 Research Design

The research design involved a descriptive survey of the area under sugarcane farming to generate qualitative data. The study sought to determine the current acreage under sugarcane farming while identifying changes in land use from pastoralism to maize farming and ultimately to accommodate the expansion of sugarcane plantations. A descriptive survey of the area under sugarcane farming seemed most appropriate as the study area is remote and under-researched, hence the need to generate as much primary data as possible.

Since sugarcane monoculture in the area is just taking shape, the need to observe the trends in land use from pastoralism to maize farming and now sugarcane farming

necessitated a descriptive survey in order to document this shift in detail. The tools used included questionnaires, key informant interviews and livelihood analysis forms to generate both qualitative and quantitative data.

3.3. Target Population and Sampling Procedures

The target population included farmers and their dependants/beneficiaries; labourers in the sugarcane industry, that is, skilled, semi-skilled and unskilled; stakeholder representatives from the key agencies involved in sugarcane farming in the area; village elders; factory officials and field extension officers. The key agencies involved in sugarcane farming include; The Ministry of Environment, Natural Resources and Disaster Management, Ministry of Water and Irrigation, Ministry of Lands, Housing and Urban Development, Ministry of Agriculture, Livestock and Fisheries, Ministry of Labour and East Africa Affairs and Ministry of Health.

Since the target population of the area under sugarcane farming was larger than 10,000, the Fischer Formula as given by Kothari (2004) and also described by Mugenda and Mugenda (2003) was used to calculate the sample size thus:

$$n = \frac{Z^2 * (p) * (1-p)}{C^2}$$

Where, n = sample size

Z = 1.96, the tabulated Z value for 95% confidence level

p = sample proportion expressed as a decimal (0.5 is the maximum that can yield at least the desired precision

C = degree of accuracy expressed as a decimal (0.05 because the estimate of the study should be within 5% of the true value

Hence, $n = \frac{1.96^2\ 0.5\ X\ (1-0.5)}{0.05^2} = 384$ respondents

Households were randomly sampled along main roads in the study area which acted as transect lines to identify sugarcane farmers to interview in areas where sugarcane farming is concentrated such as Keyian, Enoosaen, Endonyo Nkopit and Kilgoris. Purposive sampling was used to identify recently established sugarcane plantations which were categorized as farms that have had a single harvesting season. Stratified sampling was used where the sugarcane farms are thinly spread out and within relatively long distances from each other. Purposive sampling using the snowballing technique was used to identify key respondents such as village elders, factory representatives, field extension officers and officials from the key agencies involved in the sugarcane industry as listed above.

3.4 Data Collection Methods

Primary data was collected from the respondents by the use of questionnaires, livelihood analysis forms and key informant interviews. The questionnaires and livelihood analysis forms were distributed evenly within the study area with focus on the locations that grew the most amount of sugarcane. Automatically, these happened to be the areas closest to the millers due to ease of transport services.

Questionnaires were used to generate both qualitative and quantitative data. Semi-structured questionnaire guides with both closed and open-ended questions were

administered to the farmers selected along a transect line. In order to generate quality data, questionnaires were only administered to farmers who've had at least one harvesting season. The questionnaires were standardised, in English and subject to interpretation in a language that the respondent preferred.

Key informant interviews were purposed to generate data that shows a trend in sugarcane farming and its effects as well as to offer more insight into the cane industry in Transmara sub-county. Interview forms were standardized for all respondents and used to interview key respondents based on the information they possessed on sugarcane farming in Transmara sub-county over the years. These key informants were drawn from various stakeholders in the sugarcane industry as stated above.

Livelihood analysis forms were used to interview the farmers and their dependants/beneficiaries, labourers (skilled, semi-skilled and unskilled) and factory representatives to collect information that portrayed the financial outlook of the sugarcane industry. Information collected was used only for the purposes of the research. Where possible, farmers provided a copy of the contracts signed between them and the sugarcane miller for verification.

Secondary data was collected from the agricultural offices at the County and Ward levels as well as relevant institutions such as the TSCL, SONY and the relevant line ministries and Non-Governmental Organisations. Of utmost priority was the data from Keyian Ward as it has been a prime sugarcane growing area over time due to its proximity to the

South Nyanza Sugar belt that supplies its cane to SONY. Various publications done in separate sugarcane growing areas also sufficed.

3.5 Data Analysis

Questionnaires and livelihood analysis forms were initially pre-processed to identify and correct problems arising. Problems arising included incorrect demographic information, inconsistencies in finances, that is, production costs and net returns from raw cane tonnage and varying contractual obligations with the same miller. The raw data collected using questionnaires and livelihood analysis forms was then coded and subjected to descriptive analysis using SPSS. .

Quantitative data obtained was used to draw calculations based on the study objectives and research questions. Qualitative data obtained from key informant interviews and Focus Group Discussions was transcribed, translated and analysed to show trends, deviations and relationships based on the study objectives and research questions as well. Data presentation was then done using Microsoft Excel and presented in the form of tables, charts, figures, numbers and percentages.

3.6 Ethical Issues

Interviews and questionnaires were only conducted upon consent by the respondent. Sensitive information such as income earned was kept confidential by the researcher and only used for the purposes of the research. The researcher and research assistants provided proof of right to obtain information from Kenyatta University, Ministry of

Higher Education, Science and Technology (NACOSTI) and the County and Ward levels where necessary.

CHAPTER FOUR:

RESULTS AND DISCUSSION

4.1 Overview

The study found that sugarcane farming has expanded three – fold since 2011, when the TSCL was commissioned to over 11,000 hectares in August 2014, up from just 3,500 hectares at the beginning of the same year. Most of the farmers (57.1%) were introduced to sugarcane farming by TSCL and they opted for the trade as it seemed more lucrative and less labour intensive as opposed to maize farming and/or pastoralism. Sugarcane farming has impacted negatively on food security as sugarcane plantations have taken over maize fields due to projected economic prosperity from the former. The expansion of sugarcane in Transmara sub-county has had adverse effects on the biophysical environment, with a reduced tree cover of 12% in the last 18 years, coupled with reduced pasturelands, herbs and shrubs. Most of the farmers ventured into sugarcane farming for economic prosperity, with 15% of the population having committed their entire acreage without bearing in mind the effects it would have on food security and the biophysical environment. Extensive sugarcane farming is a fairly new concept to the study area and research carried out so far has only covered comparisons between the latter *vis a vis* maize farming and / or pastoralism.

4.2 Socio-economic Overview

4.2.1 Gender of respondents

The number of male sugarcane farmers greatly outnumbers their female counterparts at 89% and 11% respectively. This is because in the native Maasai community, the male is the sole custodian of the community and family property. As such, they are in charge of the decision-making process which includes how to utilize land resources. Most of the women growing sugarcane are widowers who have inherited their husbands' land while the rest have leased land for sugarcane farming.

There also seems to be a shift in ideology as women continue to be empowered to take up an active role in sugarcane farming. As such, there are more women providing labour for planting, weeding, fertilizer addition and skilled labour in the sugar milling companies. This is largely attributed to population influx as a result of in migration. Also, due to the shift in land use from pastoralism, women are seen at the milling companies following up on payments for harvested sugarcane or seeking for transport and harvesting services. More are also venturing into sugarcane farming as farmers are opting for dairy farming (Fig 4.5) which is more manageable due to the zero grazing factor. As such, the women do not need to take the livestock out to pasture and water under supervision.

4.2.2: Age of respondents

There is a fair age distribution from the young to the old as far as sugarcane farming is concerned. Most of the sugarcane farmers (78%) are above thirty years old. There are fewer sugarcane farmers after the age of fifty, only 15% as compared to 64% between the ages of 30 and 49 as evidenced in Figure 4.1.

This is attributed to high energy levels within these age groups and income attributed to stable employment, hence the ability to invest in sugarcane farming. Inheritance also plays a part as they get to utilize land handed down from higher up the family hierarchy. Moreover, sugarcane farming is a family tradition within Keyian and Enoosaen hence, the next lineage tends to continue with the trade.

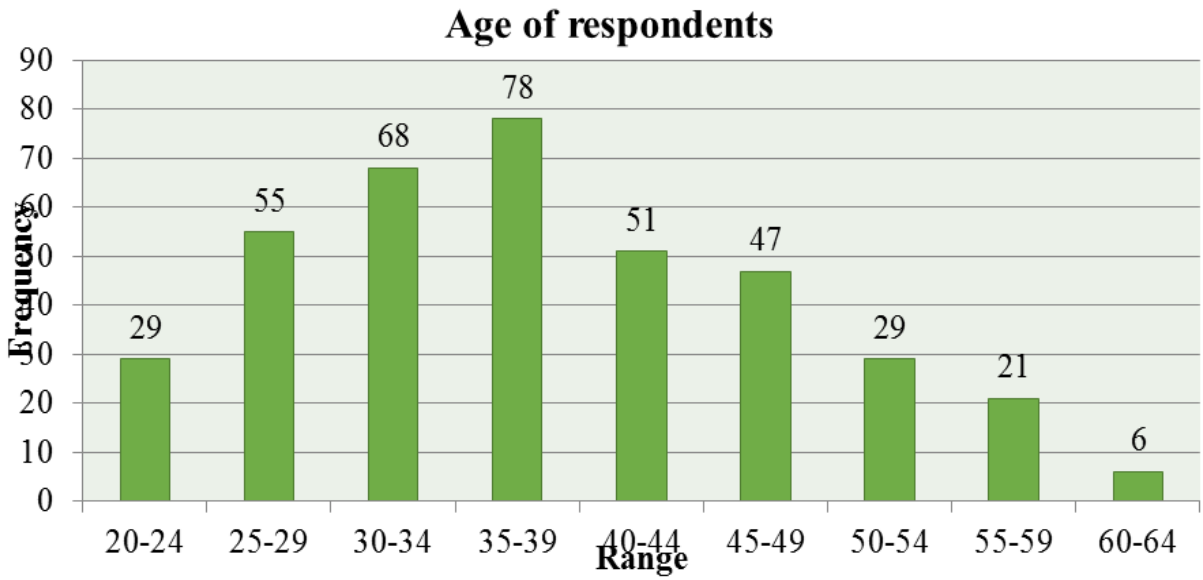


Figure 4.1: Age distribution in sugarcane farmers

Farmers below thirty years of age only account for 22%. Young farmers are more educated and therefore take extreme caution before delving into sugarcane farming as they study the optics and options. Most of them also reside away from home where they partake in white collar jobs. As such, farming comes as an afterthought, when they feel they have invested enough in their day to day lives.

However, the age of the farmer has no direct bearing on production optics as the methods employed by the farmers are more or less the same ones advocated for by the millers. The seedlings distributed for planting, type of fertilizer used, when and how to plough and harvest are all implemented by the millers through extension services and farmers' barazas.

There is a higher concentration of farmers closer to the milling companies, evidenced by Figure 4.2 as it guarantees better service delivery and lower production costs in terms of lower transportation costs incurred especially during harvesting and seed cane delivery. TSCL recommends that farmers should plant their sugarcane within a 21 kilometer radius from the factory for the proceeds to make economic sense after deduction of transport and harvesting costs.

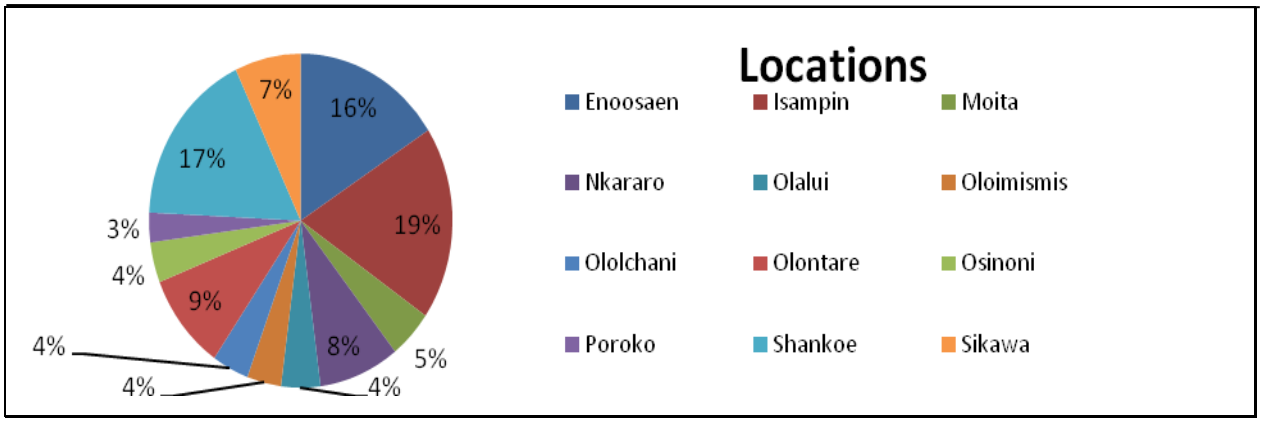


Figure 4.2: Distribution of sugarcane in Transmara sub-county

TSCL is located in Enoosaen town. The wards closest to the factory include Isampin, which has 19% of the farmers, Enoosaen, with 16% and Shankoe with 17%. These three

are the oldest sugarcane producing areas, previously supplying their sugarcane to SONY due to the proximity to the Western sugar belt and a good road network between Awendo and Enoosaen. Poroko, which is the farthest off has only 3% of the total sugarcane farming population. Growing of sugarcane in this area has been facilitated by the expansion of feeder roads between Enoosaen and Shankoe, enroute to Poroko. Moita has 5%, and is growing rapidly due to plenty of virgin lands while Olalui, Sikawa, Ololchani and Osinoni equally have 4%, facilitated by an all-weather road between Enoosaen and Kilgoris and ease of deploying extension services to these areas.

4.2.3 Household size of respondents

According to the 2009 Kenya National Population and Housing Census, the average household size in Transmara District was found to consist of 5.4 people (KNBS, 2009). Figure 4.3 corroborates the results from this research study whereby the mode is 5 people and above per household.

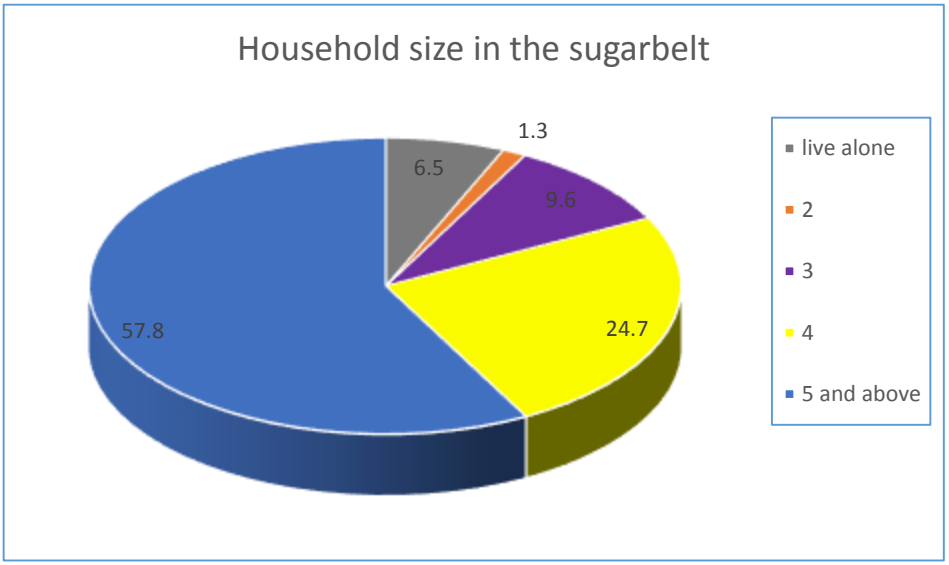


Figure 4.3: Average household size in the sugarcane growing zone

4.3 Effects of Plantation Sugarcane farming on Community Livelihoods

The first objective of this study was to assess the effects of sugarcane farming on community livelihoods in Transmara sub-county. Up to 87% of the respondents reported having their well-being enhanced through sugarcane farming. Since they began growing sugarcane, 31% could now pay their children's school fees due to the lump sum amount from sugarcane. They could also afford to transfer their children from affordable public schools to better performing private schools which were more costly. Also, 25% cited more income from sugarcane farming in comparison to maize farming with a further 15% being empowered to make investments from the surplus accrued. Figure 4.4 further depicts the various ways the respondents felt that sugarcane farming has enhanced their well-being.

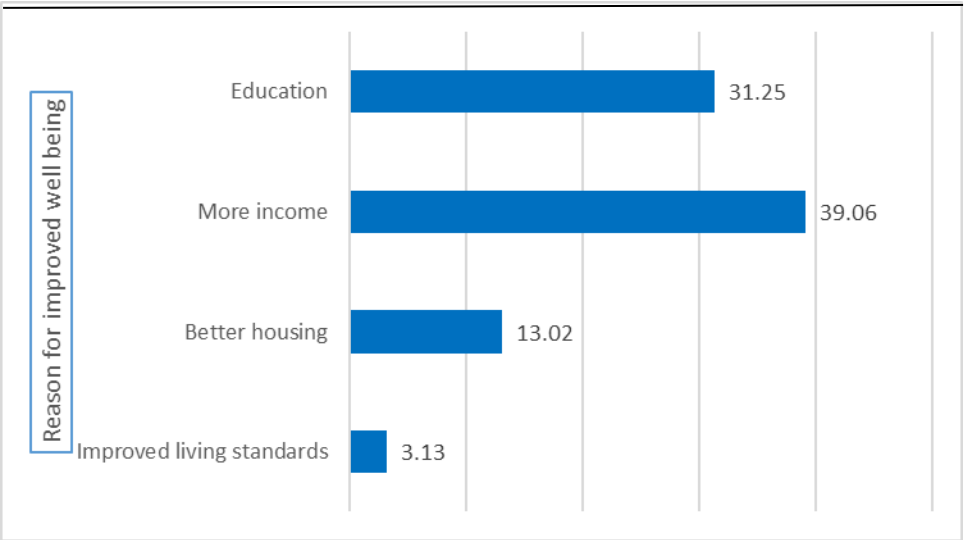


Figure 4.4: Contributing factors to community well-being

An additional 3% could now well raise their living standards by purchasing items beyond their basic needs such as quality clothing and luxurious equipment such as television sets

and radios in their houses. Also, 13% of the respondents cited better housing conditions, reflected by the shift in housing structures from mud and thatch houses to brick and iron sheet clad houses.

The Transmara Zonal Education office confirmed that there was a continued influx of students at Abosi Academy, Christ the King Academy and Kilgoris Academy from the sugarcane growing region since 2011, due to a direct and indirect increase in revenue from sugarcane farming. More income also enabled parents to take their children for advanced studies, mainly colleges and universities, something they were not able to do with the trickling returns from maize farming.

Farmers derive direct revenue from harvested cane while indirect revenue comes from opportunities created by the sugarcane industry such as business investments mostly in the form of retail and wholesale shops, transport services (both motorbikes and motor vehicles) and reinvestment if the food crop industry. Some 25.0% of the farmers felt that the lump sum of money that they received from sugarcane farming acted like a saving scheme while their cane matured in the farm, hence they obtained more income at the end of the maturity period.

The remaining 13.0% of the respondents thought that sugarcane farming has low returns and hence their livelihoods had not improved as compared to when they practiced sugarcane farming. They lamented about the high prices levied upon farmers by millers for seed cane, fertilizer, harvesting and transport as the main reason for net losses in

sugarcane farming due to the resultant exorbitant production costs. The effects of sugarcane farming on community well-being was further broken down into four variables, namely: income, community health, food security and education

4.3.1 Effects of sugarcane farming on Income

The sugarcane growing zone of Transmara sub-county was previously dominated by maize. The Maasai community who are the natives of this area are traditionally pastoralists. However, there has been a shift over time to maize farming and now sugarcane farming especially due to in migration from neighbouring communities such as the Kalenjin and Kisii who leased land from the Maasai community for farming purposes. This is in agreement with Kipsisei, (2011) who stated that the reasons for respondents' migration in order of importance included search for land (40.7%) and new opportunities (11.7%). With the commissioning of the TSCL in 2011, the interest in sugarcane farming grew and as a result, most of the land owners took back their land and started practicing sugarcane farming as it was seen to be less labour intensive with high returns as compared to pastoralism and/or maize farming.

Maize farmers cater for their own labour needs from land preparation to harvesting. This is time consuming to supervise on top of it being labour intensive. Aside from that, the farm owners used to get between Kshs. 2,000 to Kshs. 5,000 per hectare every six months they leased their land for maize farming. Sugarcane farming gives them the option of earning Kshs. 37,854 per hectare every six months as shown in appendices 7.5 and 7.6. This considerable difference in returns has greatly contributed to the shift in land use from maize farming to sugarcane farming in the study area. For sugarcane farming, the

elimination of the land preparation stage, seed cane and supply stages considerably reduces input in terms of labour and capital for about two thirds of the growth period, thereby resulting in lower production costs and higher returns at the ratoon stages, compared to the plant crop stage.

The ratoons only become involving from the fertiliser addition stage, doing away with the first and second stage processes. The fact that the millers provide the option of farm labourers for harvesting and transport is also cheaper and manageable for the farmers. Figure 4.5 summarises how farmers spend the money they earn from sugarcane farming.

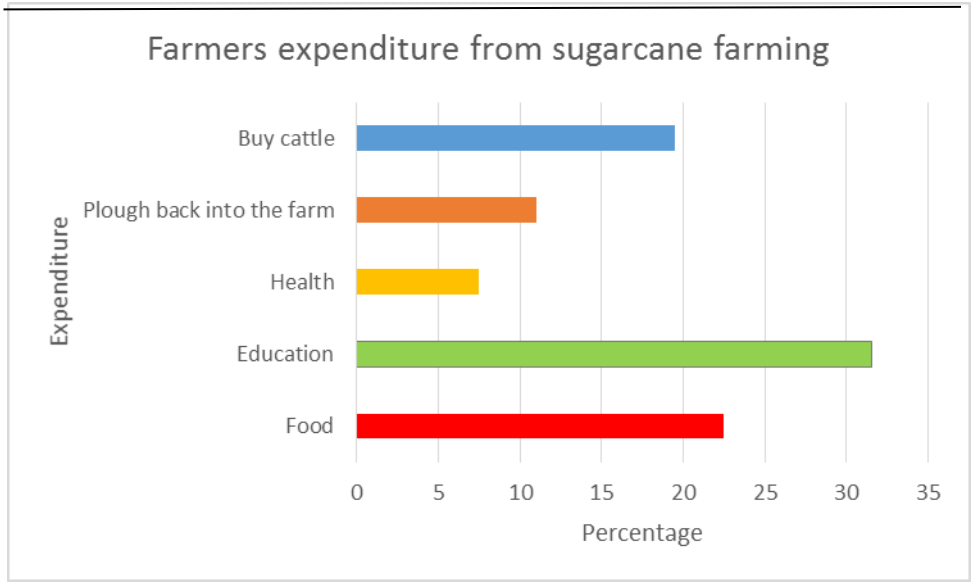


Figure 4.5: How farmers spend sugarcane earnings

Sugarcane farming is more profitable when the land owners engage in the trade themselves rather than leasing out their farms. Leasing out farmlands for sugarcane farming also does not compare as the farm owner still gets between Kshs. 8,000 – Kshs.

20,000 per hectare annually. The land owners understand that most of the farmers (70%) are bound by contract by the miller until all harvesting seasons, usually one plant crop and two ratoon crops, are complete, making the leases sustainable.

Since sugarcane is a high value cash crop, the desire to maximize on returns has continued to fuel its expansion. As such, farmers are able to invest in other ventures such as dairy farming after ploughing money back into their farms. Its less labour intensive nature gives farmers more time to focus on other money generating ventures as they wait for the crop to mature. As a result, a trend has developed with sugarcane farmers in Transmara sub-county whereby they sell off their indigenous cattle breeds in order to raise money to cater for the production costs of sugarcane. In return, they use the proceeds from sugarcane to invest in dairy cattle which are easier to manage given the limited resources, namely pasturelands and labour, due to zero grazing.

Sugarcane farming has also greatly enhanced the interactions of neighbouring communities, namely Kisii and Luo, by fostering peace in a political hotspot that has experienced ethnic strife between the native Maasai community and either of the two communities at any given time since time immemorial, as narrated by Kipsisei, (2011), and Jcoissaba, (2009). The fight that broke out in September 2014 in Shankoe area between the Maasai and Kisii would have lasted longer if the elders hadn't convinced the two warring sides to calm down and stop burning the cane farms which now cover an expansive 13,000 hectares. The two-day strife had caused a backlog at the TSCL as farm hands could not report to the farms and harvest or ferry cane to the factory. Ethnic

clashes between the two communities during the 1996 and 2007 general elections lasted for no less than two weeks, spreading to the Bomet – Transmara border which lasted even longer. At the end of the fiasco, Kilgoris, was a ghost town, rival communities having been driven out of town, houses and farms torched with no food produce as the borders proved impenetrable.

Due to a cultural bias towards hard labour amongst the natives who are traditional pastoralists, the labour for sugarcane farming in Narok country is imported from these two neighbouring communities. According to the Agricultural Manager at TSCL, the Maasai community are pastoralists who rarely engage in ventures which are involving. "Sugarcane is the first cash crop they are directly engaging in as farmers because, among other reasons, hired labour required is easily available from neighbouring Kisii and Luo communities. At times payment is on barter/symbiotic basis in exchange for some land on temporary basis to the latter for cultivation," he stated. Sugarcane farming in the area has largely been the preserve of immigrant communities who leased land for the same purpose. Some migrated into the area as labourers on sugarcane plantations, only to end up settling in with their land lords and ultimately acquiring land. While studying the migratory patterns into the study area, Kipsisei, (2011) noted that Gusii migration into Nkararu and Enkoperiai settlements began in 1958 and 1971, respectively. Recent migrations took place in the 980s and 1990s, mainly for land leasing unlike the earlier migrations which were on a permanent basis.

The harvesting of a tonne of sugarcane costs Kshs. 270, payable to the miller if transport and harvesting services are offered or deducted from the gross tonnage in case of an existing contract (See appendix 7.7). The contractor obtains a commission of Kshs. 40 per cutter while the cutters obtain about Kshs. 460 per day. As per the World Bank's World Development Indicators, this income is sufficient for the average household's survival and places these sugarcane labourers above the poverty line of 2 dollars per day, seeing as 58.0% of Kenyans live on less than 2 dollars a day (World Bank, 2005).

This amount is payable every fortnight, making it convenient for the labourers to cater for their families. These wages are also more than what many menial jobs pay and 90.0% of the cutters say that it is enough to cater for their families' needs as they would otherwise be jobless or earning way less in building and construction works (Kshs. 200 – 300) or maize farming (Kshs. 150 – 250 daily per harvest season). The cutters operate between Sukari Sugar Company, SONY and TSCL depending on the availability of sugarcane thus guaranteeing them employment.

The proximity of Transmara sub-county to other sugarcane growing areas allowed for its expansion led to the commissioning of TSCL on 23rd November 2011. As such, TSCL has created skilled labour within the factory for residents and non-residents as well, thus fostering the growth of towns such as Enoosaen, Keyian, Nkararo and Kilgoris. In migration of labour, both skilled and unskilled has created a cultural mix in an area previously inhabited by the native Maasai community, hence facilitating infrastructural growth that has led to economic development in the area.

Sugarcane farming in Transmara sub-county has also fostered the rehabilitation of roads such as the Enoosaen – Kiango road, Mapashi – Magenche road, Shankoe – Osinoni road and also the expansion of feeder roads such as the Enoosaen – Shankoe road, Sikawa – Karda – Ulanda roads among other access roads that have opened up the area for development purposes and access to facilities such as water, health centres, schools and shopping centres. Travelling to bigger towns such as Kilgoris, Kisii and Awendo has also been made much easier as a result of better road infrastructure and optional means of transport, including motorbikes.

4.3.2 Effects of sugarcane farming on community health in Transmara sub-county

Sugarcane farming has had a positive impact on the health of communities in Transmara sub-county. Out of the sample population living within the sugar belt interviewed, (N=384) 52.0% said that sugarcane farming has had a positive impact on the health of communities while 45.0% disagree. The 3.0% that did not respond did not understand the implications of the question.

Most of the respondents are able to afford better healthcare for their beneficiaries as a result of greater earnings from sugarcane farming as compared to maize farming and/or pastoralism. Moreover, residents now have better access to health facilities as a result of better road infrastructure. However, 53.0% of the respondents thought that the smoke from the TSCL factory was a nuisance. One respondent mentioned an instance when a black cloud covered the air for about two days emanating from the factory which turned out to be from burning of wastes.

Some of the respondents residing close to the factory, especially in the nearby Enoosaen town reported cases of soot on their clothes when they brought in their washed clothes and on their roofs. Teachers from the nearby Enoosaen Primary School also reported cases of soot on books and desks. Even so, the Health and Safety Officer at TSCL clarified that the soot-like substance was fly-ash from bagasse, which is harmless and not smoke effluent from the factory.

Others claimed that their livestock got sick with running stomachs when they drank water from the nearby Keyian River which supplied the factory with water for domestic and commercial purposes. These claims could, however, not be verified by neither the zonal Environment office nor Ministry of Health officials. The pH levels of water samples obtained from Keyian River were found to be between 6 and 9. This confirms that the factory treats its liquid effluents before being discharged into the river. The same water is recycled aerobically and supplied to the local community for domestic purposes. The Environment and Safety Officer at TSCL also refuted the claims insisting that the water released into Keyian River from the factory was fully treated and devoid of any harmful chemicals. Besides, this is the same water they tapped back into the factory for industrial as well as domestic purposes. Table 4.1 below shows the relationship between sugarcane farming and community health.

	Impact of sugarcane farming on health			
Yearly Income (Kshs)	No	Yes	X^2(df)	P value
0-50,000	25	26	**24.102**	**0.001**
	49.0%	51.0%		
50,001-100,000	62	62		
	50.0%	50.0%		
100,001-150,000	42	46		
	47.7%	52.3%		
150,001-200,000	38	15		
	71.7%	28.3%		
200,001-250,000	11	37		
	22.9%	77.1%		

Table 4.1: Cross-tabulation between health and sugarcane farming (Annual Income)

The table above displays a cross-tabulation between sugarcane farming and its perceived on health in the study area. The chi-square analysis X^2 =24.102 *df*=4, P=0.001 indicates an association between perceived effect of sugarcane farming on health and income. The above table shows that those earned a high annual income (77.1%) that is (Ksh 200001-250,000) perceived that sugarcane farming has had a positive impact on their health.

When interviewed about the impact that sugarcane farming has had on the health of the community in Transmara sub-county, a nutritionist from the Transmara West Sub-County hospital stated that there was an increase in prostitution with high rates of STD's, STI's and HIV contraction being reported in the blooming town centers propelled by sugarcane farming such as Enoosaen, Nkararo, Kilgoris and Keyian. Cases of snake bites have also been on the rise as farmers grow sugarcane up to their homesteads to maximize on returns.

4.1.3 Effects of sugarcane farming on food security

Majority of the sugarcane farmers in Transmara sub-county have enough food to last them a whole year even as they wait for their cane to mature. Out of the sample population interviewed, (N=384) 95.0% said that they had enough food to feed their households all year round before extensive sugarcane farming begun. A further 94.0% of the farmers obtained food from their own farms while the remaining percentage bought their food produce from the local market. This is highly attributed to the fact that most of the farmers, 77.0%, have leased land for sugarcane farming while growing food crops on their own farms. Table 4.2 is evidence of this.

	Enough Food in Households all year round			
Yearly Income (Kshs)	No	Yes	X^2(df)	P-value
0-50,000	20	33	6.437(4)	0.169
	37.7%	62.3%		
50,001-100,000	35	94		
	27.1%	72.9%		
100,001-150,000	23	70		
	24.7%	75.3%		
150,001-200,000	17	36		
	32.1%	67.9%		
200,001-250,000	23	33		
	41.1%	58.9%		

Table 4.2: Cross-tabulation between food security and sugarcane farming

From the table above, cross-tabulation between availability of food in individual households and the income they obtain from sugarcane farming shows that sugarcane farming has not interfered with food security in the study area, X^2=6.437(4) (P=0.169). This is because, despite the expansion of sugarcane plantations, majority of the farmers

across the board still have enough food in their households to feed their dependants all year round.

However, since extensive sugarcane farming begun in Transmara sub-county in 2011, this figure has drastically reduced to 70.0% in just three years. Of the 30% that do not have enough food from their farms to feed their families all year round anymore, 15.0% of the farmers have committed their entire arable land to sugarcane farming as a means of ensuring maximum returns on investment. The other 15% buy food produce from the local market when their farm supply runs out. Figure 4.6 illustrates the reasons farmers gave for having unlimited food from their farms to feed their families throughout the year.

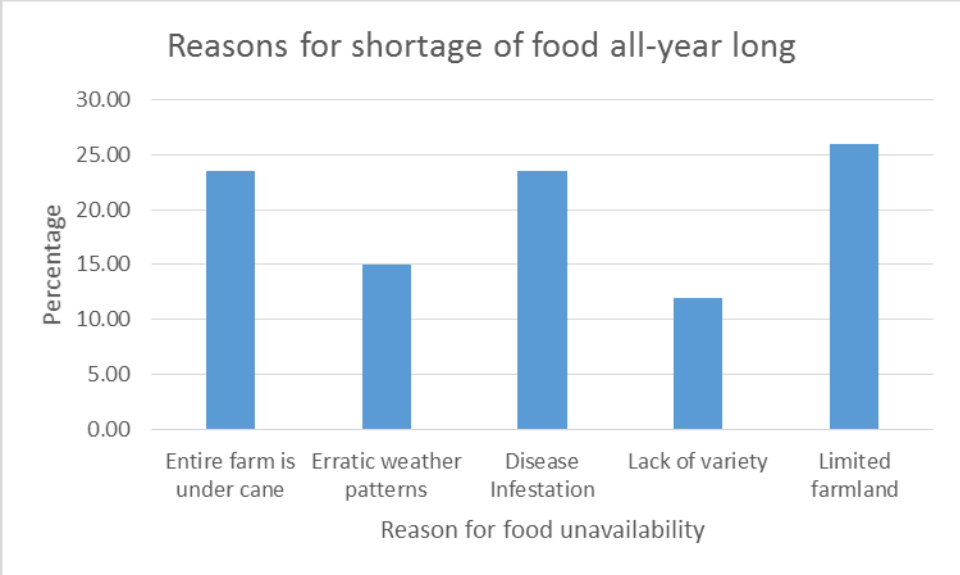


Figure 4.6: Factors affecting all year long food availability

This is in agreement with Omosa, (1998) whereby farmers would rather engage in the farming of crops such as sugarcane and use the incomes to meet their food needs on the

market. Pressure on land resources has also led to inadequate food to feed households all year round. This has been further exacerbated by population pressure which had led to land segregation which automatically means additional competition for resources such as land and water.

This is why a majority of the respondents (40%) who did not have enough food from their farms to feed their households all year round indicated limited farmlands as the reason. It is worrying that some of the farmers have leased their farms to other sugarcane farmers right up to their doorsteps due to the increasing demand for land. Leases get up to Kshs. 20,000 per hectare of land leased for cane farming, up from a maximum of Kshs. 5,000 obtained from maize farming. The high production costs involved mean that they cannot grow their own cane, hence they opt to lease out their land to those who are capable.

A nutritionist at the Transmara West Sub - County Hospital reckons that sugarcane has replaced indigenous food leading to high malnutrition rates as well as an increase in underweight children especially in Shankoe, Enoosaen and Oldanyati areas which produce the most cane in the study area. Exclusive breastfeeding has also been hindered as women are busy in the farms supervising and chasing for payments from the factory. Milk production, vegetables and maize production have also reduced leading signifying future threats to food security. This is further compounded by expensive lifestyles with food commodities harder to afford as well as access resultant from export from neighbouring communities.

The area under cane in Kenya increased 4.25% from 173,910 ha in 2011 to 181,313 ha in 2012. (KSB, 2012) Within the same period, sugarcane farming increased threefold in Transmara sub-county from 3,000 hectares to 9,600 hectares and now over 12,000 hectares. (TSCL, 2014) This was primarily due to higher demand for cane, resulting from increased competition by millers who sought to reinforce sugarcane monoculture for maximum productivity. This period coincided with the commissioning of the TSCL, high food prices, decreased variability and availability of food commodities in Transmara sub-county as food produce serving the local markets is largely imported food from Kisii, Bomet and Migori Counties.

Food prices sky-rocketed in this period and continue trading at exorbitant prices. An onion bulb that used to sell at Kshs. 5 in 2011 ballooned to Kshs. 20 by December 2011. The best measure of food prices, maize, doubled prices and became scarce in the market as the market's middle men hoarded their stores and/or exported outside the County. The general perception is that there is a lot of money from cane that has been injected into the local economy and as such, people are able to afford the overpriced commodities.

4.3.4 Effects of sugarcane farming on education

The study sought to determine the education standards in the sugar belt in order to establish whether it had any bearing on aspects of sugarcane farming such as quality of sugarcane grown, outputs and utilisation of technology. Out of the sample population interviewed, (N=384) 43.0% of the respondents have secondary education, 35.0% have

tertiary education, while 21.0% have primary education. Only 1% of the respondents did not attend school. This is illustrated in figure 4.7.

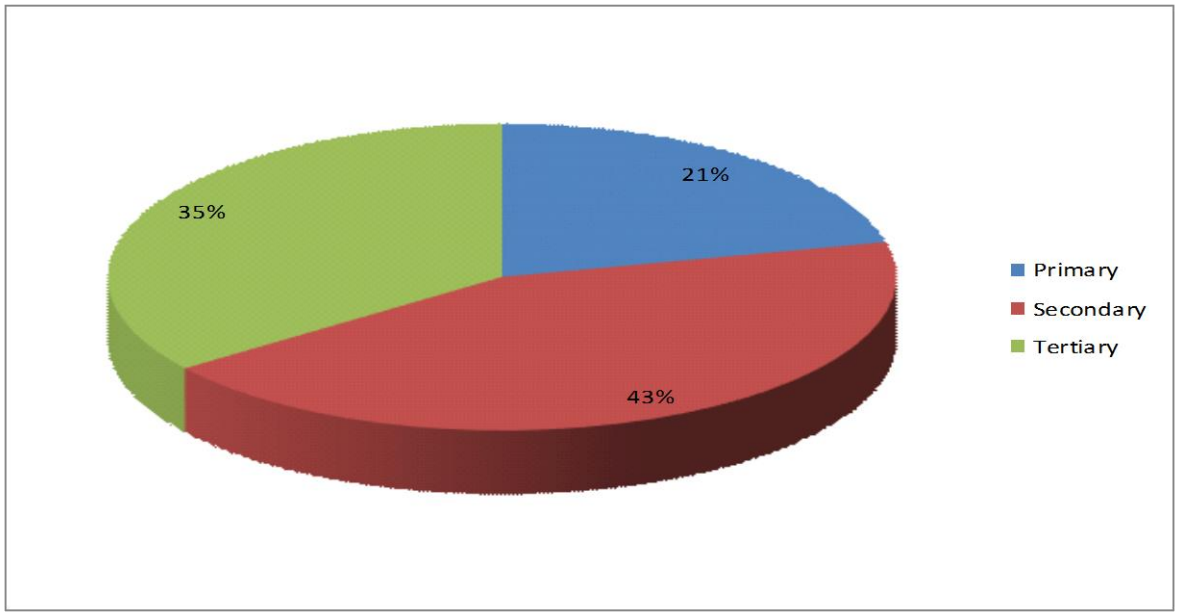


Figure 4.7: Level of Education of Respondents

The study found out that the level of education does not have a direct implication on the adoption of farming techniques as 57.0% of the farmers in Transmara sub-county were introduced to sugarcane farming by TSCL. A further 12.0% were introduced to the trade by SONY while only 1.0% of the farmers interviewed were motivated by the government to grow sugarcane as illustrated in table 4.3. As a result, there is generally a uniformed approach to sugarcane farming as both millers use similar farming methods. Also, lack of direct government involvement in sugarcane farming in Transmara sub-county, notably the Zonal Agricultural offices in Kilgoris and Enoosaen, as evidenced by lack of prior

capacity building in a bid to practice sugarcane monoculture has meant that farmers largely adopt farming techniques advocated for by the millers.

INTRODUCED BY	**Frequency**	**Percentage (%)**
Government	4	1.04
Transmara Sugar company	222	57.81
SONY	48	12.50
Fellow farmer	62	16.15
Personal initiative	48	12.50
Total	**384**	**100.00**

Table 4.3: Mode of introduction to sugarcane farming

Majority of the farmers, as aforementioned, also stated that sugarcane farming has boosted their chances of taking their children to school, especially for higher education due to the lump sum amount of money obtained from sugarcane farming. There are more enrollments in the primary schools within the sugar belt in Transmara sub-county. On the other hand, some schools have gone a step further and turned their playgrounds into sugarcane farms in order to earn more income at the expense of the physical health of their pupils. These include Enoosaen Primary School, Olereko Primary School and Shankoe Primary School.

Sugarcane farming has also opened up the area to development in terms of accessibility to education as evidenced by the setting up of a satellite campus for Jomo Kenyatta

University of Science and Technology at Keyian in July 2014, which is at the heart of the sugar belt. Strategically located, the school started by conveniently offering agricultural and mechanical courses. It is expected that the increasing number of college students in this area attributed to sugarcane farming will be catered for in this campus.

4.4 Effects of Plantation Sugarcane farming on the Biophysical Environment

As earlier stated in chapter two, forest cover constituted 40% of the total land surface area before extensive cultivation begun taking place in Trasmara sub-county. Sugarcane monoculture in Keyian and Kilgoris is mentioned as one of the reasons for decreased forest cover in the study area as far back as 18 years ago TDP, (1996). From the population interviewed (N=384), 62% of the respondents stated that the biophysical environment had changed since the widespread shift to sugarcane farming while 38% said that there was no change.

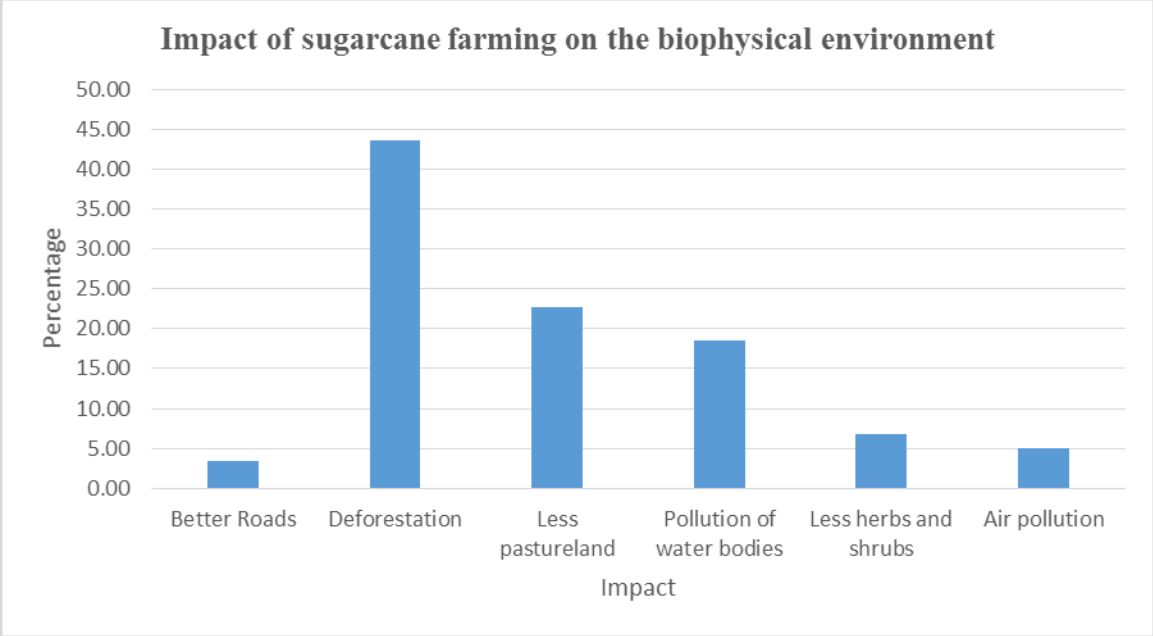


Figure 4.8: Impacts of sugarcane farming on the biophysical environment

Figure 4.8 illustrates the impacts that sugarcane farming has had on the biophysical environment since the inception of sugarcane farming in Transmara sub-county.

This particular group alluded to the fact that the land where sugarcane now grew was previously utilized for maize farming and as such, nothing much had changed save for a few areas of virgin land where trees and shrubs had to be cut down to make way for expansion of already existing sugarcane plantations. A summary of the changes to the biophysical environment since the expansion of sugarcane farming begun in Transmara sub-county is outlined in Appendix 7.4.

The presence of better road infrastructure was lauded upon by 3% of the respondents. The construction of the TSCL necessitated the need for accessibility hence construction of the feeder roads in newly established sugarcane plantations as well as movement to and from the factory. Consequently, the Kilgoris-Awendo road was upgraded and the Magena-Enoosaen road opened up to facilitate better movement to Shankoe, Poroko and Ololchani. Building infrastructure has also improved with brick rental units coming up around the factory for residential and commercial purposes alike.

The 2011 annual report at the Transmara Zonal office states that an estimated 28% of the total land area (Transmara) is covered by forests and bush land, although the area has increasingly reduced due to changes in land tenure, change of land use system for agricultural purposes and settlement (KFS, 2012). The Zonal Forest Officer attributed, in part, this shift in land use system to that from traditional maize farming and/or

pastoralism to extensive sugarcane farming. This has led to continuously clearing land of shrubs, herbs and cutting down trees in order to plant more cane for maximum productivity. This gradual degradation has led to aggravated human-wildlife conflicts as well as interference with migratory corridors

The Deputy Warden, Kenya Wildlife Service, Transmara West station, ascertained that human – wildlife conflicts have further been fuelled by plantation sugarcane farming. For instance, the cat family has adopted peculiar predating habits as a result of their habitats being encroached into by sugarcane plantations especially around Osinoni and Moita areas. Cases of predation have also been on the rise as the animals roam free, namely, hyenas and leopards hibernating in sugarcane plantations and feeding on livestock.

Migratory corridors have also been tampered with leading to injuries and deaths as clearing of more land for sugarcane farming leads to congestion of species and limited dispersal areas. There has been a rise in cases of elephant – human conflicts reported in Moita area with increased cases of poaching in sugarcane growing areas. Due to the expansion of land under sugarcane farming, wild animals happen to be more dispersed, moving into human habitats. Notably, vultures have increasingly been poisoned, killing endangered species.

Corroborating these results, the zonal Forest Officer noted that sugarcane farming has infringed on pasturelands thus affecting indigenous tree species as livestock are directed to graze in the forests. Ultimately, there would be no forest cover as grazing of both

livestock and wildlife would destroy the 22% of exotic forest cover present as documented by ALRMP, (2012). A number of elderly respondents making up 18% of the population decried the clearing of land for the expansion of sugarcane plantations saying that it meant getting rid of traditional medicine in the form of roots, herbs and shrubs to maximize on productivity. This interfered with Indigenous Knowledge Systems (IKS) and education.

Also, 7% of the respondents cited pollution of water bodies while 5% noted that the air quality had deteriorated since the TSCL was commissioned. Notably, residents relying on the Keyian river as a water source for their domestic needs complained of the water purity having been compromised by effluents discharged into it from the factory. Some even stated that their cattle had running stomachs when they drank from the river. However, tests carried out revealed that the pH levels of effluents discharged from the factory were averaged 7.5. The series of tests recorded pH level of 6.5-9 which is within the required effluent discharge standards of 6-9 pH levels set by the Kenya Bureau of Standards. This is the same water that was safe enough to be recycled back to the community for domestic purposes through aerobic treatment.

However, the factory boasted of its elaborate water recycling plant and insisted that all its effluent is treated before being released back into the river, which turned out to be true as per the results of the water tests. Of the compromised air quality that respondents complained of leaving soot behind, the factory's Environmental Health and Safety Department verified that it was merely fly ash from baggasse and therefore, harmless.

Table 4.5 shows a very strong correlation between sugarcane farming and the biophysical environment.

Impact on the Biophysical Environment			X^2(df)	P-value
Income (Kshs)	No	Yes		
0-50,000	14	38		
	26.9%	73.1%		
50,001-100,000	42	86		
	32.8%	67.2%		
100,001-150,000	22	70	124.124 (4)	0.001
	23.9%	76.1%		
150,001-200,000	44	6		
	88.0%	12.0%		
200,001-250,000	20	30		
	40.0%	60.0%		

Table 4.5: Cross-tabulation between the biophysical environment and sugarcane farming

The chi square analysis from the table above shows that there is an association between sugarcane farming and bio-physical environment X^2= 124.124, (P=0.001). Income earned from sugarcane farming has been used against the respondents' responses as to whether sugarcane farming has had an impact on the biophysical environment. There is no particular trend attributed to how much farmers earn from sugarcane farming and how they perceive it has affected the biophysical environment. For instance, only 27% of farmers who earn a net profit of Kshs. 50,000 or less from sugarcane farming think it has an impact on the biophysical environment. Only 40% of those that earn over Kshs. 200,000 have noted an impact on the biophysical environment due to sugarcane farming, as opposed to the highest percentage, (88%) who earn between Kshs. 150,000 and Kshs. 200,000.

Sugarcane farming continually mines up to 50% of nutrients from the soil during harvesting as stated by (KESREF, 2012) sugarcane farming also forces changes in land use as evidenced in the study area, which corroborates Fischer *et al*., (2008) on sugarcane farming increasing deforestation rates directly or indirectly by forcing other land uses such as dairy farming, zero grazing and sugarcane monoculture in the study area. Table 4.6 illustrates the shift to sugarcane farming.

Crops grown before	Frequency	Percentage
Bananas	9	2.34
Indigenous vegetables	6	1.56
Maize	195	50.78
Maize & bananas	28	7.29
Maize & beans	130	33.85
Maize & livestock	16	4.17
Total	384	100

Table 4.6: Crops grown by farmers before sugarcane

Aside from 2% of the farmers who grew bananas and 2% who grew indigenous vegetables before venturing into sugarcane farming, 97% of the population used to practice maize farming. The majority of farmers, 51%, used to practice purely maize farming for commercial purposes. Maize and beans was farming was practiced by 34% of the population. Mixed farming was undertaken by 4% of the population who engaged in both livestock rearing and maize farming.

Since cane is a high value cash crop, the desire to maximize on returns has continued to fuel its expansion thereby resulting in the encroachment of pasturelands which has resulted in zero grazing as cited by 23% of the respondents. As a result, a trend has developed with sugarcane farmers in Transmara sub-county whereby they sell off their

indigenous cattle breeds in order to raise money to cater for the production costs of sugarcane. In return, they use the proceeds from cane to invest in dairy cattle which are easier to manage given the limited resources required in zero-grazing.

One of the main causes of alterations to the biophysical environment as a result of cane farming is spillage. Although most of the farmers are unaware, spillage accounts for 1% of the gross tonnage registered at the factory's weighbridge. Currently, the weighbridges are far apart and as such, the farmer bears the loss brought about by the spillage. Since the spillage is not cleared, it lies along the road, breeding bacteria which are especially harmful during the rainy season aside from creating an eyesore. Of utmost concern are the pupils who trod these paths barefoot to and from school every other day.

4.3 Analysis of farmer-miller contracts for policy assessment purposes

The final objective of this study was to analyze the contracts signed between farmers and the sugar companies and how they influence outputs accrued for policy assessment purposes. The farmers in this study area supply their sugarcane to SONY and TSCL. A minority have begun supplying their sugarcane to Sukari Sugar Company. The contract between TSCL and the farmers was subjected to grounded analysis, focusing on the benefits accrued by either parties.

The main attraction for farmers to TSCL from SONY is the cutting down on transport and harvesting costs within the 21 kilometre radius (See Appendix 7.7). It is also more efficient as farmers are paid within 45 days of their sugarcane being processed as compared to SONY where farmers were reportedly paid after seven months.

The opening clause of the contract states, on the part of the miller, that "sugar milling companies get into binding contracts with farmers in order to purchase sugarcane from them for extraction and manufacturing of sugar and its by-products" (Page 2, TSCL 2011). By-products are namely; molasses, subsequently used for ethanol production, baggasse, which is used as a biofuel in its raw form or used in the manufacture of briquettes and press mud which is used as a fertilizer if correctly detoxified (left idle for three months to detoxify).

Generally, the terms of the contract dictate sugarcane outputs as the quality of goods and services offered by the miller to the farmer. The miller determines the quality and quantity of cane harvested. Subject to weather changes, productivity and overall cane availability is stated as: plant crop, harvested within 18-26 months, 1st ratoon, 16-24 months and 2nd ratoon, 16-24 months (part 1, TSCL, 2011). Millers also offer related products such as jaggery and other services in the form of agricultural extension services, transport and harvesting of cane. On this clause, there is a fair distribution of returns as the miller provides quality and timely services in return for raw sugarcane of acceptable standards.

Transport and harvesting services offered by the millers is done at a fee deducted from the price or raw cane tonnage (Appendix 7.7). The same applies to the cost of seedlings delivered (Clause 10c, 10p, TSCL, 2011). Furthermore, millers organize meetings and field days which farmers are encouraged to attend for learning purposes aimed at proper

sugarcane husbandry, operation and application of goods and services obtained from the miller for the satisfactory yield of sugarcane (Clause 10v, TSCL, 2011). In this case, the miller profits from services offered while the farmer gets guaranteed and reliable goods and services during the production period.

Clause 11 (d) allows the miller to extend credit facilities to farmers in exceptional circumstances and its sole discretion, provided set agreeable terms such as those regarding principal, interest and other statutory taxes are met (Sec (i), (ii) and (iii). This allows the farmer to cultivate his farm on credit, only to be deducted upon the agreed amount when the cane is harvested and processed by the miller. Debt balances accrued by the farmer in the case of a bad season can also be warded off after agreeable terms of repayment are set with the miller. This flexibility allows farmers to be able to survive ever fluctuating sugar prices as well as vagaries of weather that occasion bad harvests. These terms also allow farmers to obtain payments for burnt sugarcane from arson, although at significantly low tonnages (8, TSCL, 2011).

Out of the total population of farmers interviewed, 97% of them were made aware of what sugarcane farming would mean to them if they took it up (Fig 4.3). The milling companies educated them on the various varieties of cane available and the fact that sugarcane farming takes roughly two years to mature and that it was important for them to find an alternative means of income as they wait for their cane to mature. The miller is bound by contract to the farmer to harvest upon maturity, one plant crop and two ratoon crops or for a period of about six years from the date the crop is planted, assuming cane

matures between 18-24 months. In this case, the miller supplies the farmer with the seed cane, fertilizer, harvesting and transport of sugarcane to the factory (1, TSCL, 2011).

However, the farmer is not bound by contract to purchase fertilizer from the miller or use the millers' transport services. These expenses are then deducted from the gross tonnage of harvested cane delivered to miller.{10 (o)} In this case, the miller has the upper hand as the farmer only gets paid for the tonnage of harvested cane while the proceeds from the by - products such as molasses and baggasse are pocketed by the miller. This represents the skewed nature of this contract as farmers only benefit from sugar itself as the miller pockets the benefits accrued from the by-products. High production of sugarcane and constantly fluctuating sugarcane prices compound farmers' woes at times resulting in net losses.

In an effort to contribute to Corporate Social Responsibility (CSR), the miller has also been seen to offer services that benefit the community as a whole. The refurbishment of the Kilgoris - Keyian road as a result of more farmers engaging in sugarcane farming is one of them (See Fig 4.8). Farmers are deducted 1% of their proceeds from sugarcane to aid in opening up of access roads and maintenance of already existing ones. Just as well, TSCL generates 80% of their electric power from burning molasses to produce ethanol. The neighbouring Mlimani estate where most of TSCL staff reside are beneficiaries of this electrification plan, accessing the commodity for free.

In a bid to promote environmental conservation, farmers are encouraged to plant one row between cane rows of common beans, soya beans, groundnuts, mbabara nuts, Irish potatoes, tomatoes, onions, cabbages and carrots (10 m (vii)TSCL, 2011) for up to the first six months of a given sugarcane cycle. This is as important for nitrogen fixation as it is in ensuring food security in an area that has largely embraced sugarcane monoculture.

CHAPTER FIVE:

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

The research study sought to determine the effects of sugarcane farming on community livelihoods in Transmara sub-county as well the biophysical environment in order to inform decision making that contributes to attaining a balance between maximum benefits accrued and the well-being of the community for sustainable sugarcane agriculture.

Sugarcane farming has taken precedence over maize, which was the main cash crop in the study area until 2011. Farmers are gradually abandoning growing maize and other indigenous crops, thus posing a looming threat to food security, especially for small scale farmers who commit their entire land to sugarcane seeing as it cannot be intercropped beyond six months without interfering with productivity. The prices of food commodities have since soared with the need for variety creating a market for food exportation from as far as Tanzania on the Southern border. The commissioning of the TSCL has created direct and indirect employment in Transmara sub-county with nearby towns such as Enoosaen and Magena experiencing growth spurts as a result of urbanisation. As a result, there is better road and housing infrastructure with due to the rise in socio-economic status of the residents, sugarcane being a high value commodity.

The lump sum of money obtained from sugarcane farming has empowered farmers to take their children for post-secondary school education. More schools have come up due

to the expansion of sugarcane farming as a result, such as the JKUAT campus in Keyian Ward. Majority of the pupils who have enrolled in schools in Transmara West have also originated from the sugar belt. Most of them have been moved to slightly pricy private schools that their parents can now afford. In terms of community health, sugarcane farming has ensured accessibility to health facilities due to the opening up of access roads. Urbanisation has also brought forth quality health services. There have been no reports of serious negative health impacts as the TSCL treats all its wastes before release. However, fly ash from baggasse as well as smoke emitted by the factories' chimneys has compromised the air quality.

The acreage under sugarcane in Transmara sub-county increased three-fold between 2011 and 2014 when the study was undertaken. Trees have been cut down to make way for sugarcane plantations with pasturelands and virgin lands infringed upon, considerably decreasing forest as well as vegetative cover. The clearing of herbs and shrubs has ensured a near extinction of medicinal plants in areas where they existed in plenty such as Moita and Oldanyati wards. However, the expansion of sugarcane farms in Transmara sub-county has also brought about better utilisation of virgin lands, otherwise lying idle.

Both the farmers and the millers benefit from their contractual obligations. Farmers closer to the factory incur lower transport costs hence, less overall deductions. The millers offer farmers fertiliser and seed cane at subsidised prices and services such as agricultural extension, meetings and seminars, credit facilities, harvesting and transport.

However, the benefits are skewed as the miller benefits from sugar and sugarcane by-products while the farmer only benefits from raw cane tonnage.

5.2 Conclusions

Sugarcane farming has had a great impact on community livelihoods in Transmara sub-county. More income attributed to proceeds from the sugar industry has been pumped into the local economy. This has seen gradual urbanisation of the sugar belt especially in terms of better roads and building infrastructure. There is stability in the industry, mainly attributed to the fact that farmers engage in alternative income generating activities as their sugarcane matures. Resultant threats to food security associated with sugarcane farming has not manifested in Transmara sub-county as 77% of farmers lease land for sugarcane while growing food crops on their farms. Further, 94% of the population interviewed have enough food from their farms to feed their families all year-round with 6% having to buy from the market once their farms run out of produce.

The natives are traditional pastoralists thus ensuring agricultural diversification. Majority of the farmers are unaware of the potential health effects of sugarcane farming as well as threats to the biophysical environment, save for deforestation, decried upon by 43% of the population. Tree cover has reduced by 12% within the last eighteen years and this is bound to worsen given the continued expansion of sugarcane farming. Famers are quickly shifting to zero grazing of dairy cattle due to it being less labour intensive and also as a result of diminishing pasturelands cited by 22% of the population.

The analysis of the farmer – miller contracts shows skewed benefits. The farmer only benefits from raw sugarcane tonnage while millers benefit from refined sugar and sugarcane by-products such as bagasse, molasses and ethanol. The miller, however, offers maintenance of roads, with farmers deducted a 1% levy towards the same. The miller has also set up a watering point just outside the factory gates providing clean treated water from river Keyian as well as supplying electricity for free to the nearby Milimani estate. Moreover, the formation of farmers' out growers associations entitles farmers to benefits such as credit services.

5.3 Recommendations

- So far, sugarcane farming has greatly enhanced livelihoods in Transmara sub-county. There is need to encourage farmers to grow keep growing food crops as they await their sugarcane to mature so as they do not end up food insecure as has been noted in Kisii and Mumias. The Government, through the Ministry of Education should also take a stern action against schools that are grabbing playgrounds and converting them to farmland before the vice spreads as is the case in Shankoe Primary School.
- All the Government agencies, namely; The Ministry of Environment, Natural Resources and Disaster Management, Water and Irrigation and the Ministry of Agriculture, Livestock and Fisheries should take up an active role in sugarcane farming in Transmara sub-county so as to enable farmers to make informed decisions before delving into sugarcane farming. This would aid in curbing environmental issues such as deforestation, water, and air and soil pollution. Since sugarcane cannot be intercropped at an advanced stage, farmers need to be

educated on environmental conservation measures that compliment sugarcane farming while ensuring that there is minimum environmental degradation, if any. TSCL should also institute an environmental management plan in their company policy to ensure the environment is not degraded further by sugarcane farming.

- The government should look at subsidising further seed cane and fertilizer in order to ensure that farmers are not embroiled in constant debt. There is need for revision of the interest rates accrued on seed cane as well as credit issued to farmers by the miller to cut back on overreliance on such services. The millers should also look to redistribute the benefits of sugarcane by – products amongst the farmers especially due to the fluctuating prices of sugar that never guarantee farmers a net profit margin. This would go a long way in liberalising the sugar industry as it would empower farmers while acting as an additional incentive to motivate them as far as sugarcane farming is concerned.

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QNo.

7. APPENDICES

Appendix 7.1: Questionnaire

This questionnaire is administered to assess the effects of plantation sugarcane farming on community livelihoods and the biophysical environment in Transmara sub-county, Kenya.

Introduction

I, Oyugi Beryl Akoth, would like your assistance in filling this questionnaire as a partial requirement for the fulfilment of my Degree of Master of Environmental Studies and Community Development in the School of Environmental Studies of Kenyatta University. The responses shall be confidential and used for the sole purpose of this thesis. Your co-operation is highly appreciated.

Section A:

A1: Respondent's Personal Data

i. Name (optional).....

ii. Gender

- □ Male
- □ Female

iii. Age ..... iii. Location.....

i. What is your highest level of education

- □ Primary
- □ Secondary
- □ Tertiary

ii. What is the size of your household?

- Live alone
- 2
- 3
- 4
- 5 and above

SECTION B: Plantation sugarcane farming and Community Livelihoods

i. How did you get introduced to sugarcane farming?

- Government
- Transmara sugar company
- SONY
- Fellow farmer
- Other (state)

ii. Were you made aware of what it would mean to you?

- Yes
- No

iii. Do you have enough food from your farm for 12 months a year?

- Yes
- No

iv. If No, why?

v. Before plantation sugarcane farming was introduced, did you have enough food to feed your family for 12 months a year?

- Yes
- No

vi. If Yes, where did you obtain your food from?

vii. Has sugarcane farming enhanced your chances of well-being?

- Yes
- No

viii. If Yes, how?

ix. If No, How?

x. If you were to abandon sugarcane farming, what options would you go for to obtain a source of income?

xi. Does plantation sugarcane farming impact the health of communities in Transmara sub-county?

- Yes
- No

xii. If Yes, how?

SECTION C: Plantation sugarcane farming and the Biophysical Environment

i. When did you start growing sugarcane?

ii. What crop(s) did you grow before?

iii. How much of your land is under sugarcane?

iv. What is the percentage of land under sugarcane based on the total land area?

v. Has the biophysical environment changed since the introduction of plantation sugarcane farming in Transmara sub-county?

- Yes
- No

vi. If Yes, how?

vii. Do you like the changes?

- Yes
- No

viii. If Yes, why?

ix. If No, why?

x. What do you think should be done to make sugarcane farming environmentally friendly?

Appendix 7.2: Livelihood Analysis Form

Introduction

I, Oyugi Beryl Akoth, would like your assistance in conducting this research on the effects of sugarcane farming on community livelihoods and the biophysical environment in Transmara sub-county as a partial requirement for the fulfilment of my Degree of Master of Environmental Studies and Community Development in the School of

Environmental Studies of Kenyatta University. The responses shall be confidential and used for the sole purpose of this thesis. Your co-operation is highly appreciated.

i. Name (Optional) …….

ii. Indicate whether:

- Farmer
- Factory labourer
- Farm labourer

iii. Has plantation sugarcane farming provided you with a steady source of income?

- Yes
- No

iv. How many beneficiaries do you cater for?

v. Is the income you obtain enough to cater for your needs and those of your beneficiaries?

- Yes
- No

vi. How do you spend the income that you obtain from plantation sugarcane farming?

- Food
- Education
- Health
- Others (state)

vii. How much do you earn in a month/year?

viii. How much do you obtain from plantation sugarcane farming? (on average per acre)

ix. What is the average cost of production per acre of sugarcane?

x. When was the last time you obtained an income from sugarcane farming?

Appendix 7.3: Key Informant Guide

Introduction

I, Oyugi Beryl Akoth, would like your assistance in conducting this research on the effects of sugarcane farming on community livelihoods and the biophysical environment in Transmara sub-county as a partial requirement for the fulfilment of my Degree of Master of Environmental Studies and Community Development in the School of Environmental Studies of Kenyatta University. The responses shall be confidential and used for the sole purpose of this thesis. Your co-operation is highly appreciated.

i. Name (optional) …….

ii. Occupation …….

iii. Do you support the introduction of plantation sugarcane farming in Transmara sub-county?

- Yes
- No

iv. If Yes, why?

v. If No. why?

vi. For how long has sugarcane farming been practiced in Transmara sub-county?

vii. On average, how much land is under sugarcane cultivation in Transmara sub-county?

viii. What has been the impact of sugarcane farming on the economy of Transmara sub-county?

ix. How has sugarcane farming impacted the education levels in Transmara sub-county?

x. Is sugarcane farming self-sustaining?

- Yes
- No

xi. If No, what can be done to make it self sustaining?

xii. What has been the effect of sugarcane farming on the bio-physical environment?

xiii. Has sugarcane farming affected food availability in Transmara sub-county?

xiv. Has sugarcane farming affected food variability in Transmara sub-county?

xv. Which crops are favourable with the climate in Transmara sub-county and can be intercropped with sugarcane without interfering with its productivity?

xvi. How has sugarcane farming impacted the socio-cultural environment of Transmara sub-county?

xvii. Is the expanding sugarcane industry likely to impact the political climate of Transmara sub-county

Appendix 7.4: Environmental Observation Check List

	Environmental Indicator	**Remark**
1	Evidence of Erosion	Minimal erosion due to proper farming techniques and plenty of plant cover for pasture. Sugarcane is also believed to hold the soil together.
2	Tree cover	Reduced tree cover in new sugarcane plantations, that is, Moita area, Olioborsoitio, Shankoe and Oloimismis locations. The sugar millers however advocate for tree conservation with SONY issuing farmers with tree seedlings for free.
3	Road network	The feeder roads have been refurbished due to need for accessibility to sugarcane farms for seed cane delivery and harvesting. The need to access facilities and amenities within the sugar belt has also led to improved road networks such as the recently refurbished Kilgoris - Awendo road.
4	Water resources	Tapping of water from Keyian river by the TSCL affects its volume especially in the dry season. However, the factory taps water from the river, treats it and provides clean water to its environs for domestic purposes.
5	Pastureland	There is reduced pastureland due to the clearing of land for sugarcane plantations. Farmers are embracing dairy farming due to the zero-grazing factor.
6	Soil Compaction	Soil compaction is evident due to the numerous trucks traversing the sugarcane belt to deliver seed cane to farms and harvested sugarcane to the factory.
7	General Air Quality	The air around the TSCL is foul due to the constant crushing of sugarcane. Fly ash from baggasse in the air also settles on surfaces as a black substance akin to soot. Dark smoke emitted from the factory's chimneys also pollutes the fresh area within.
8	Bio-diversity	Increased cases of snake bites with sugarcane planted even closer to the homesteads as cases of predation increase due to encroachment of animals' habitats. Shrubs have also been cleared to expand sugarcane plantations leading to extinction of herbs, harbouring indigenous knowledge systems.
9	Migratory Corridors	Wildlife migratory paths have been altered by sugarcane plantations leading to animals such as the cat family to migrate into sugarcane plantations. Human-wildlife conflicts have been on the increase, as a result, due to human encroachment into wildlife habitats.
10.	Vegetative Cover	There has been a shift from traditional food crop farming of indigenous vegetables, bananas, beans and maize to sugarcane farming. Sugarcane forms a canopy that depicts an increase in vegetative cover but inability to intercrop after the first few months has led to a general decrease in vegetative cover. Herbs and shrubs have also been cleared out leading to the same decrease.

Appendix 7.5: Maize Production Guideline Per Ha

Activity	**Unit Cost**
Ploughing	15,000.00
Seed	4,375.00
Fertilizer	8,750.00
Planting	7,500.00
Weeding	10,000.00
Harvesting	5,000.00
Miscellaneous (Shelling and Transport)	7,500.00
Total	**58,125.00**
GROSS RETURN	
Yield 62.5 Bags/HA = 5.63 Tons	**168,750.00**
One ton of maize = 29,973 Kshs	
NET	**110,625.00**
The maize cycle takes six months	
This implies that for six months is equal to:	
Kshs. 110,625.00 per Ha	
One ton of maize is equivalent to 11.11 bags	

Source: Agriculture Department, TSCL (2012)

Appendix 7.6: Cane Production Guideline Per Ha

	Activity	**Units**	**Ksh/Unit**	**Qty**	**Plant Crop**	**Ratoons**
A:	**Land Preparation:**					
	Ploughing	Ha	8,250.00	1	8,250.00	
	Re-plough	Ha	7,500.00	1	7,500.00	
	Furrowing	Ha	5,000.00	1	5,000.00	
	Survey/Demarcation	Ha	400	1	400	
	Sub Total				**21,150**	**-**
B:	**Seed cane Supply & Planting:**					
	Seed cane	Tons/Ha	3,600.00	9	32,400.00	
	Seed cane transport	Tons/Zone	1,050.00	9	9,450.00	
	Planting	Ha	7,500.00	1	7,500.00	
	Gap filling (optional)	Ha	1,000.00	1	1,000.00	
	Miscellaneous	Ha	1,000.00	1	1,000.00	
	Sub Total				**51,350.00**	
C:	**Fertilizers:**					
	Planting fertilizer	Bags/Ha	3,800.00	3	11,400.00	
	Top dressing fertilizer(Plant crop)	Bags/Ha	3,000.00	3	9,000.00	
	Top dressing fertilizer(Ratoon	Bags/Ha	3,000.00	4	-	12,000

	crop)					
	Fertilizer transport	Zone	50	3	300	200
	Loading & offloading	Mds /Bags	50	3	300	200
	Application	Bags	100		600	400
	Sub Total				**21,600.00**	**12,800**
D:	**Herbicides**					
	Pre-emergence	Ltrs/Ha	1,000.00	3	3,000.00	
	Post-emergence	Ltrs/Ha	1,000.00	3	3,000.00	
	Post-emergence (Ratoon crop)	Ltrs/Ha	1,000.00	3		3,000
	Herbicide transport	Zone			1,000.00	1,000
	Application	Mds/Ha	300	4	2,400.00	1,200
	Sub Total				**9,400.00**	**5,200**
E:	**Others field operations**					
	Trash lining	Ha	1,500.00	1		1,500
	Stool chopping	Ha	1,050.00	1		1,050
	Sub soiling	Ha	4,500.00	1		
	Oxen weeding	Ha	3,500.00	1		3,500
	Hand weeding (Plant crop)	Ha	7,500.00	3	22,500.00	
	Hand weeding (Ratoon crop)	Ha	7,500.00	4		30,000
	Hilling up	Ha	3,500.00	1		3,500
	Smut Rouging	Mds/Ha	200	2	1,000	1,000
	Sub Total				**23,500**	**40,550**
F:	**Total development cost before interest**				**127,000**	**58,550**
1	**Borrowing costs**					
	Interest	%	5%		10,583.33	4,391.25
2	**Total pre-harvest cost per Ha.**				**137,583.33**	**62,941.25**
	Zonal mean cane yields (plant crop & Ratoons)				120	100
	Cane price per tone				3,000	3,000
3	**Gross revenue to farmers**				**360,000**	**300,000**
	Statutory deductions = Harvesting/Transport/VAT/Cess Zone C				1,112	1,112
	Net to farmers per tone				1,888.00	1,888
4	**Net to farmers per Ha**				**88,976.67**	**125,858.75**
5	**Break even yield**				**72.87**	**33.34**
For comparison take net for (Plant crop + RI + RII)/3 = Kshs. 113,564.72						
The above is average net return per crop (PC, RI, RII)						
Above cycle takes 18 months						
Implies for six months is equal to: Kshs. 37,854.91						

Source: Agriculture Department, TSCL (2012)

Appendix 7.7: Mill cane pricing (June 2014)

Appendix 7.8: Area under sugarcane cultivation (August 2014)