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*Full Length Research Paper*

# Assessing the contribution of alternative agriculture to poverty reduction and employment creation: A case study of sugar beet cultivation in Kenya

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**In Kenya, the government is promoting high-value and drought resistant crop varieties in an effort to reduce poverty in rural areas. Sugar beet is one such crop. This study was conducted with two objectives: 1) to assess the opportunities and challenges for sugar beet cultivation and adoption in the Nyandarua district of Kenya and 2) to assess whether sugar beet adoption can offer an opportunity for escaping poverty for smallholder farmers in the district. The factors favoring sugar beet cultivation and adoption in the district include: adequate land area suitable for sugar beet cultivation and the high sugar beet yield that can be attained per unit suitable land area, farmers' awareness of the positive aspects of sugar beet cultivation, and the willingness of many farmers to grow the sugar beet crop. Notwithstanding these favorable conditions, some socio-economic factors - mainly the affordability of sugar beet production and possible lack of appropriate farming technologies, will present challenges to widespread sugar beet adoption, particularly to those farmers in the low- and medium-income categories. The sugar beet profit analysis showed that depending on the market price, sugar beet can potentially increase household net income. However, since the majority of households are in the low- and medium-income categories, for sugar beet to pull the smallholder farmers out of poverty, interventions from government and other stakeholders is of vital necessity. The impact of sugar beet adoption and cultivation will vary from household to household. Those households within the high-income category who can raise the required start up capital are likely to benefit, while the low- and medium-income households may not, which is true for any new crop with high start up costs. Alternative agriculture alone is therefore not a sufficient strategy to address the problems of poverty and unemployment. Any successful strategy to address these issues must be broad-based, and include alternative agriculture and other growth and development strategies. Provision for the entire necessary infrastructure should precede or accompany all of these strategies in order to optimize implementation benefits.**

**Key words:** Kenya, sugar beet, poverty, household income, prospects, challenges, alternative agriculture.

## INTRODUCTION

Eradicating extreme poverty and hunger is the first priority of the Millennium Development Goals (MDGs) (UN, 2000). According to UN (2007), the poverty gap in Sub-Saharan Africa remains the highest in the world, as is the number of children going hungry. Kenya, like many other sub-Saharan African countries, suffers from poverty and hunger (Ministry of Agriculture and Ministry of Livestock and Fisheries Development, 2004). The problems of poverty and hunger in Kenya are mainly

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concentrated in the rural areas, where agriculture is the dominant source of livelihood (Ministry of Agriculture and Ministry of Livestock and Fisheries Development, 2004).

Agriculture is the leading economic sector in Kenya and contributes significantly to national income, export earnings, food security and employment. The majority of the farmers are smallholders. These farmers account for 75% of marketed agricultural produce as well as 70% of agricultural produce. In recent years, the performance of the agricultural sector has declined due to adverse weather conditions, lack of capital and credit access as well as high costs of inputs that negatively affect farm-level agricultural production. Recognizing the significant contribution of agriculture to the Kenyan economy, livelihood support, and food security, the government of Kenya has identified the sector as the springboard from which poverty and food problems can be addressed. The government has therefore developed a strategy to revitalize agriculture with the goal of reducing unemployment and poverty, consequently bringing about much-needed rural development (Ministry of Agriculture and Ministry of Livestock and Fisheries Development, 2004).

The government's plan to revitalize agriculture is to transform smallholder agriculture from subsistence to commercially profitable business (Ministry of Agriculture and Ministry of Livestock and Fisheries Development, 2004). To achieve this, the government has put much emphasis on the promotion of new "high-value crops" (Ministry of Agriculture and Ministry of Livestock and Fisheries Development, 2004) in addition to other sectors, such as coffee and pyrethrum. According to the World Food Summit (1996), food security should be tackled through a broader view, including poverty reduction, growth and economic development. This idea, that food security cannot be solved through emphasis on agriculture alone, is echoed by van Rooyen (1999). To adequately address the problems of poverty and food security, diversification of income sources is a strategy of increasing importance (Ellis, 2000; Barrett et al., 2001). According to Ellis (2000), diversification in the rural development context should not be seen only as a change in on-farm agricultural activities, but as inclusive of non-farm activities as well. The question to be explored is whether the adoption of new high-value crops has the potential to contribute towards reducing poverty and unemployment. According to Barkley and Wilson (1992), new crops introduced in a particular region can be referred to as alternative agriculture. Value-addition to an agricultural product by processing it in the new location and finding new industrial uses for specific agricultural products can also be categorized as alternative agriculture. In this context, this study investigates alternative agriculture's contribution to reducing poverty and creating employment through the assessment of the capacity of new crops and resultant business opportunities, using the case of sugar beet cultivation in Kenya.

**Sugar beet cultivation in Kenya**

Sugar beet is a crop that is considered an option in the plan to raise farming in Kenya to a profitable level, reduce poverty and create new employment opportunities (Mandere et al., 2009). The cultivation of sugar beet in tropical regions of Africa, and in this case Kenya, is a new venture. The crop is predominantly cultivated in the temperate climatic regions of Europe and North America (Draycott and Christenson, 2003). The Kiriita self-help group introduced the sugar beet crop in Nyandarua District of Kenya on a trial basis to assess whether it would be a suitable cash crop for being adopted in the region to help improve the farmers' livelihoods (Geita, 2004). The sugar beet crop is still under trial, so no commercial cultivation of the crop is yet taking place in the District. The yield achieved in these trials is 70 tons/ha of wet root weight and 17% sugar content. The yields compare well with published yield ranges in tropical climates (Doorenbos and Kassam, 1979). Therefore, the sugar beet trials in the Nyandarua District indicate that despite being associated with temperate climates (Draycott and Christenson, 2003), the crop has the potential for successful cultivation in some tropical conditions.

Sugar beet is mainly used for white sugar (sucrose) production (Cookie and Scott, 1995; Draycott and Christenson, 2003; Biancardi et al., 2005). According to Harland (1995), sugar beet and its by-products have high nutrient value as a livestock feed. The sugar beet crop is drought tolerant and therefore may survive adverse weather (Dunham, 1995). The cultivation of sugar beet in Kenya specifically for sugar processing would help fill the one-third sugar deficit between the national sugar production and the demand from sugar factories (Kenya Sugar Board, 2001). The production would thus serve as a sugar import substitution strategy, which would save the country the much-needed foreign exchange.

Sugar beet yield performance can be affected by climatic conditions (Scott and Jaggard, 1992), soil characteristics (Blomoquist et al., 2003) as well as management practices (Blomoquist et al., 2003). The climatic and soil characteristics (here referred to as physical conditions) show a spatial variation (that is, vary from region to region) and hence are specific to a certain locality (Onduru and Preez, 2008). Management practices depend on the assets the farmers have for agricultural production (Ellis, 2000). Therefore, knowledge of the interaction between physical and socio-economic characteristics is vital to aid in assessing the performance of the land resource in regard to a specific land-use change (FAO, 1976). The understanding of such interactions will ensure that a land resource brings much-desired benefits for the current generation without

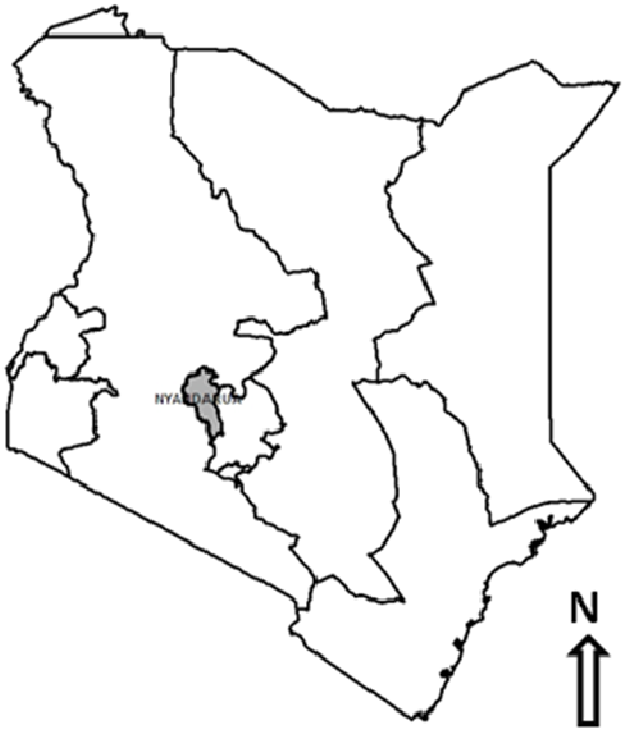


**Figure 1.** Geographical location of the Nyandarua District.

jeopardizing the potential for meeting the needs of future generations (World Development Commission on Environment and Development, 1987). Mandere et al. (2009) have shown that there is adequate land area with the physical conditions suitable for sugar beet cultivation in commercial quantities in the Nyandarua District. This study thus focuses particularly on the assessment of the socio-economic conditions. The aim is to assess the potential for sugar beet cultivation, adoption and commercialization in Kenya, as well as the contribution the adoption of sugar beet crop would have toward solving the problems of poverty and unemployment. To achieve this, the assessment is aimed towards meeting the following objectives:

1. To assess the opportunities and challenges for sugar beet cultivation and adoption in the Nyandarua District of Kenya.
2. To assess whether sugar beet adoption can offer an opportunity for smallholder farmers to escape poverty in this region.

## Study area description

This study focuses particularly on the Nyandarua District because sugar beet trials (led by the Kiriita Farmers Self-help Group) have been conducted in the region for the last seven years. The Nyandarua District is situated in the central province of Kenya (Figure 1). It has an area of 3,310 $km^2$ and a population of 479,902 inhabitants according to the 1999 population census. It is divided into six administrative divisions - Ndaragwa, Ol kalou, Ol joro orok, North Kinangop, South Kinangop, and Kipipiri. Approximately 80 and 20% of the population lives in rural and urban areas, respectively. The core urban centre is Nyahururu, but there are also many smaller urban centers (Ministry of Finance and Planning, 2002).

Low undulating hills, plateaus and mountain ranges characterize the topography of the region. The altitude of the land ranges from 2000 m to over 3000 m above sea level. The mean average temperature is 21°C, while the annual rainfall ranges between 1,000 to 1,400 mm. The rainfalls in two seasons, the long rain season being March to May and the short rain season from September to December (Ministry of Finance and Planning, 2002). The district has a high potential for agriculture, with fertile soils of volcanic origin (Ministry of Finance and Planning, 2002). The predominant soils are nitosols, andosols, leptosols, luvisols, phaezems and planosols (FAO, 1997). Smallholder farmers dominate the agricultural sector in the District. Agriculture (crop and livestock) is the predominant economic activity in the rural parts of Nyandarua, upon which 72% of the rural population depends on direct employment, income and food. Rain-fed agriculture dominates. The nearby urban centres provide the market for most of the local agricultural produce (Ministry of Finance and Planning, 2002).

## MATERIALS AND METHODS

The unit of focus in this study is the individual household, because this is the level at which decisions regarding land use are made (Tschakert, 2003). In the same light, it is at the individual household level where the decision of whether or not to adopt sugar beet is expected to be made. To assess the prospects and challenges for sugar beet cultivation and adoption, the study concentrated on two kinds of data. First, we evaluated farmers' perceptions towards new crops and sugar beet. Farmers' perceptions were gathered to aid in understanding the advantages and disadvantages that are likely to occur with sugar beet adoption and commercialization in the study area as well as whether the farmers are willing to adopt the crop. Secondly, we looked at household resource endowments (hereafter referred to as 'household farming resources'). In regard to household farming resources, household land size, financial capital and farming technologies were assessed.

Potential income and employment opportunities from sugar beet cultivation were analyzed and used as indicators for the extent to which the sugar beet cultivation and adoption to aid smallholder farmers in escaping poverty. The assessment of the potential sugar beet income as compared to current dominant crops was achieved by first making an inventory of the current primary crops in the study area. Secondly, the production costs, yields and incomes for each of the dominant crops under the current farmers' management practices were computed. Third, a scenario capturing production costs, yields and incomes for the primary crops in addition to intensive management of sugar beet was developed. On the basis of the results, potential profits from sugar beet and the primary crops were evaluated. The analysis and discussion regarding employment creation accounted for: 1) direct jobs for employees at the sugar beet processing plants, 2) indirect jobs arising from the 'pull factor,' (that is, the location of the factory would create income

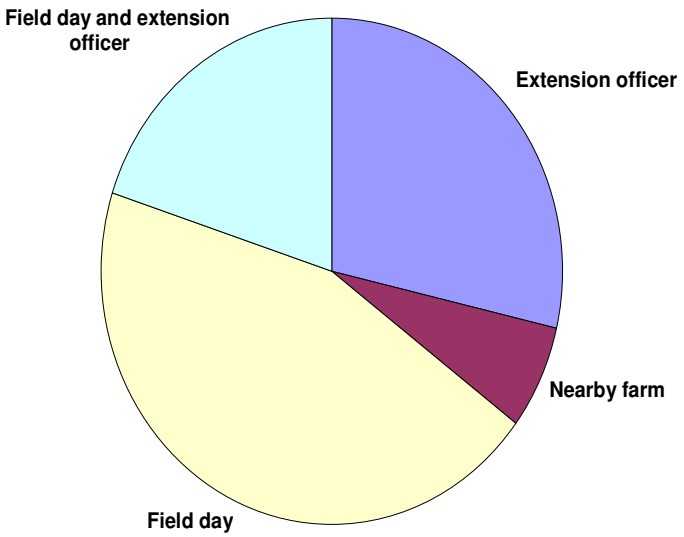


**Figure 2.** Sources of information about new crops used in this study.

opportunities for complementary sectors on the basis of production, expenditure and services) and 3) self-employment opportunities in sugar beet cultivation.

### Data collection

The data for this study were collected through interviews with smallholder farmers in the Nyandarua District and with agricultural officers from the District office. The interviews with the farmers were carried out with the aid of semi-structured questionnaires. Respondents were selected randomly from each of the administrative divisions in the District. Farmers who were testing sugar beet as an alternative cash crop in their farms (hereafter referred to as 'sugar beet farmers') as well as non-sugar beet farmers were interviewed to gauge differences of opinion or access to infrastructure and resource endowments between these two groups. The questionnaires were given to 150 farmers in the course of the interview sessions. During the interviews, the principal researcher read the questions to the respondent and recorded answers in writing. The interviews were carried out in July and August, 2008.

The interviews with the agricultural officers were conducted during the same period. Three agricultural officers were interviewed in a group using a semi-structured questionnaire. The aim of the interview was to gather general information about agriculture in the district and to gain insight about the potential crop production costs and yields under good agronomic management practices (hereafter referred to as 'intensive management').

## RESULTS

This section presents the main results and corresponding implications for the advantages and challenges of adopting sugar beet cultivation. The results are presented in the following order: first, farmers' perceptions towards new crops and sugar beet cultivation, then farmers' farming resources, and lastly, potential sugar beet profit analysis.

### Farmers' perceptions towards new crops and sugar beet cultivation

#### *Adoption of new crops*

Approximately 86% of the respondents had adopted new crops and or new crop varieties in their farms in recent years. A new crop that has been adopted recently is the tree tomato. The new varieties also include a wide range of hybrid maize seeds. All sugar beet farmers are among the 86% of the respondents who have adopted additional new crops besides sugar beet. The sources from which the respondents received information about new crops or new varieties are shown in Figure 2. The figure shows that field day and extension officers are the two main sources of information.

Additionally, 90% of the respondents expressed willingness to embrace new crops and technologies. They also proved ready to try cultivating new crops and technologies on their own farms. On average, respondents were willing to allocate 0.48 ha of land to any new profitable crop at the start on trial basis, a land area that they can increase or decrease depending on the actual profitability of the crop. A majority of respondents, particularly those with a larger portion of land, would create the land area for the new crop by reducing the land area of some of their current crops. A few others would acquire the area for the new crop by hiring additional land.

#### *Farmers' evaluation of sugar beet cultivation*

Approximately 80% of the respondents had heard about sugar beet as a crop. However among them, it was mainly the sugar beet farmers who had an in-depth understanding of the advantages and disadvantages of sugar beet cultivation. The sugar beet farmers' views about their perceived advantages and disadvantages of sugar beet cultivation are shown in Table 1. When asked whether they would be willing to cultivate the sugar beet crop in commercial quantities, all the sugar beet farmers unanimously agreed that the sugar beet is a good crop despite the disadvantages. They also were willing to take advantage of the market access and financial support for inputs. Only 70% of the non-sugar beet farmers were willing to cultivate sugar beet while the rest were unwilling, citing the current lack of market and skills to cultivate the crop.

The sugar beet root yield attained in sugar beet trials in Nyandarua was not uniform across all respondent trial sites and years. The root yield ranged from 40 to 80 t/ha with an average of 70 t/ha. The lowest root yield across

all sites was recorded in the years 2002 and 2005 following drought in the District. The yield range is well above the published sugar beet root yield in a tropical environment (Doorenbos and Kassam, 1979). The high

**Table 1.** Sugar beet farmers' perceptions about the advantages and disadvantages of sugar beet crops (N=30).

| Advantages | Number of respondents |
|---|---|
| High yield | 28 |
| Keeping quality | 25 |
| Drought and frost tolerance | 22 |
| Livestock feed | 15 |
| | |
| **Disadvantages** | **Number of respondents** |
| Lack of sugar beet market | 30 |
| Labour intensive in sowing | 26 |
| Labour intensive in land preparation | 22 |

yield indicates opportunities for a stable surplus that can be sold for income.

The respondents currently use the whole sugar beet crop after harvesting for dairy feed, as no sugar beet processing factories are currently available in the district. The respondents observed that sugar beet has been essential as a livestock feed, especially during drought and frost periods, when natural pasture grass is limited. Furthermore, the dairy stocks that are fed with sugar beet have produced more milk. This is in line with Harland (1995), who found that the sugar beet crop and its by-products possess high livestock nutrient levels.

According to a majority of respondents, sugar beet has tolerated drought and frost periods while under trial in Nyandarua. Specifically, the crop tolerated adverse drought seasons in the years 2002 and 2005 that affected yields of maize, which is one of the predominant crops in the District. Other predominant crops (that is, beans and potato) were not affected since they have shorter maturation periods, and were already mature by the time drought set in. Frost has been a common problem in some parts of the district, such as Wanjohi, where sugar beet has survived comparatively well. These observations corroborate Dunham (1995), who said that sugar beet is drought and frost tolerant. The respondents found it positive that sugar beet can survive drought and frost, hence providing them the opportunity for alternative feed during these adverse periods when it is needed most.

The 'keeping quality' of sugar beet is another advantage that most farmers felt positive about. A majority of respondents have delayed the sugar beet harvest in their own farms for up to four months awaiting periods of need and managed to harvest the crop while in a good state. According to Elliott and Weston (1995), sugar beet is a biannual crop. When cultivated for sugar production, the crop is harvested within the first year when it has accumulated enough sugar. However, the crop produces seed only in the second year, implying that if it is to be cultivated for seed, the farmer must wait until the second year to harvest it. This characteristic therefore may explain the sugar beet's keeping quality. In the Kenyan sugar beet trials, the crop is harvested at the end of six months for sugar analysis. Therefore, delaying sugar beet harvest for a few more months or even longer would not be a problem unless disease or adverse weather such as flooding becomes a factor. The keeping quality will play an important role in harvest scheduling, because it could allow the farmers the flexibility to plan the harvest at a time that is convenient regarding market availability, labour availability, when by-products can supplement feed, etc.

Most respondents observed that land preparation and sowing for sugar beet crops were labour-intensive, and therefore a disadvantage. They estimated that these early stages of crop production require two to three times more labour input than what is required for the cultivation of other crops. Land preparation is more labour-intensive due to the extra digging needed to achieve the depth necessary for sugar beet cultivation, while the small seeds that are sown by hand at close spacing require more labour.

The sugar beet market is currently poor due to the absence of sugar beet processing factories in the district and the region. The main reason given by the respondents regarding the absence of the factories was that the crop is new in the region and has only been cultivated on a trial basis in the district. Most respondents however, felt that the sugar beet trials have taken too long and that the government should intervene to ensure that a sugar beet factory is established in the district to create a market. The current lack of a market implies that the farmers may continue engaging in their current activities or explore alternative crops or activities that already have an established market. The lack of a market is often an obstacle to new developments. For example, Bhandari and Grant (2006) showed that lack of market access prohibited adoption of cash crops in the highlands of the Kali Khola watershed in Nepal.

## Farmers' resources

### *Household land size*

The household land area used for agriculture owned by

**Table 2.** Farming technologies employed by smallholder farming households (N=150).

| Farming operation | Technology | Number of respondents |
|---|---|---|
| Land preparation | Own tractor | 4 |
| | Hired tractor | 15 |
| | Hand hoe and tractor | 21 |
| | Hand hoe only | 110 |
| Sowing | Hand hoe | 150 |
| Weeding | Hand hoe | 150 |
| Crop spray | Hand spray | 113 |
| | Do not spray | 37 |
| Crop harvesting | Hand tools | 150 |
| Irrigation | Furrow | 12 |
| | Hand sprinkler | 4 |
| | No irrigation | 134 |

respondents ranged between 0.5 and 9 ha. The average household land area was 2.5 ha. The majority of the sugar beet farmers had a household land area of not more than 2 ha, with the exception of three, who had a land size greater than 5 ha. Besides cultivating their own land, 25% of the respondents hired additional land for their farming activities. According to majority of respondents, land for hire is not very accessible and quite costly. When asked how much land area they were willing to allocate to new crop, the respondents were willing to allocate an average of 0.48 ha of land to any new profitable crop. According to Mandere et al. (2009), there is adequate suitable land area for sugar beet cultivation in the Nyandarua District that can produce feedstock able to support a sugar beet processing factory as large as 7,000 tons per day slicing capacity TCD[5]. With the exception of Mumias Sugar Company with a capacity 8,400 TCD, the 7,000 TCD capacity is larger than the capacity of all other sugar factories in Kenya, which range from 900 to 3,500 TCD (Kenya Sugar Board, 2001; Export Processing Zones Authority, 2005). The willingness of farmers to allocate land to profitable crops as well as the large land area available to support commercial sugar beet production indicates an opportunity for sugar beet cultivation and commercialization if the conditions for profits are provided for.

### *Farming technologies*

The technologies used by respondents are shown in Table 2. With the exception of a few high-income farmers who use tractors for land preparation, the majority of farmers use hand-driven tools in all land operations. Three sugar beet farmers are among the farmers who use tractors in land preparation. The respondents offered many reasons for the limited use of mechanized farming methods. The most prevalent among them were the high cost of hiring a tractor (30%), a lack of access to tractors for hire (10%) and small land sizes not fit for tractor use (14%). Other respondents did not cite any specific reasons for not using mechanized technologies.

According to Draycott and Christenson (2003), a plough depth at least 25 cm is necessary to achieve high sugar beet yields. The hand tools used by majority respondents are incapable of achieving the sugar beet plough depth requirement in a single operation. To achieve the right sugar beet plough depth requirement using current tools, households will expend more time and labour for extra ploughing. Sowing sugar beet by hand is a slow process that takes time and requires many hours of human labour to sow a unit hectare. Thus, it can be argued that the tools in use by the majority of respondents, particularly for land preparation and sowing, may not be appropriate for the cultivation of sugar beets in commercial quantities. Kristjanson et al. (2003) found the lack of necessary tools to be one of the critical factors that discouraged adoption of dual purpose cowpea to a sample of farmers in the dry savannas of Nigeria. This example emphasizes the significance of access to appropriate tools. Access to appropriate technologies is a very important determinant of the extent to which sugar beet crop can be adopted by smallholders in the district.

### *Farmers' financial capital*

The respondents draw their income from crops, livestock and off-farm activities. The dominant crops are maize, beans and potato. The primary livestock raised are sheep

[5] This is on the assumptions: 1) One third of the highly suitable land area in the District will be available for sugar beet cultivation each year; 2) An average sugar beet root yield of 70 t/ha; and 3) 270 days of factory operation time per year.

**Table 3.** Categories of households according to income activities (N=150).

| Category of households | Average land size (ha) | Income activities | Total income (KES/yr) | Number of respondents |
|---|---|---|---|---|
| Low | <2 | Crops<br>Sheep<br>Farm labour | 25000 - 48300 | 51 |
| Medium income | 2-4 | Crops<br>Sheep<br>Dairy | 65000 - 130000 | 80 |
| High income | >4 but <10 | Crops<br>Sheep<br>Dairy<br>Formal jobs<br>Small business | 140000 - 500000 | 19 |

**Table 4.** Current crop production costs, yields, market price and income per hectare (N=150).

| Land operation | Average production cost (KES/ha) | | |
|---|---|---|---|
| | Maize | Beans | Potato |
| Fertilizer | 3000 | 1800 | 1800 |
| Seeds | 2500 | 4500 | 0 |
| Land preparation | 3500 | 4940 | 3200 |
| Sowing | 1700 | 2223 | 1700 |
| Weeding | 6000 | 2000 | 1500 |
| Harvesting | 4000 | 494 | 1000 |
| Disease and pest | 0 | 400 | 400 |
| Total cost | 20700 | 16357 | 9600 |
| Yield (t/ha) | 3 | 1 | 4 |
| Market price (KES/t) | 15556 | 33333 | 3636 |
| Profit (KES/ha) | 25968 | 16976 | 4944 |

and dairy cattle. Off-farm activities include farm labour, small-scale business and formal jobs. The gross annual income for the respondent farming households varied widely based on household land size and household income-generating activities. The respondents can be categorized into three groups, as shown in Table 3. The table indicates that the more the property owned by a household, the more diversified the crops can be, and subsequently a higher income is earned. The Table 3 also shows that majority of the households' incomes fall in the medium-income category. The second most common income level was the low-income category. The low-income category has the smallest land holding size along with the least diversification in terms of income-generating activities and number of crops under cultivation. These findings that land holding size has a positive effect on level of diversification and income are in line with Ellis (2000). Ellis argues that larger land holding size enhances the household's chances for diversification and income by providing a necessary base to directly or indirectly generate seed capital. Sugar beet farmers' household incomes were spread over all the three income categories, as were the non-sugar beet farmers.

## Potential sugar beet profit analysis

The production cost, yield, market price and incomes for one hectare of each of the main crops under the current farmers' crop management practices are shown in Table 4. The table shows that maize, with a comparatively higher production cost, generates the highest profit per hectare due to its yield and market price. Under current crop management practices, farmers achieve low yields for all primary crops. Several reasons were given for the low yields. The majority of respondents apply very low

**Table 5.** Crop production costs, yields, and income per hectare under the intensive crop management scenario.

| Cost description | Production cost (KES/ha) | | | |
|---|---|---|---|---|
| | Maize | Potato | Beans | Sugar beet |
| Fertilizer | 12000 | 6000 | 7000 | 12000 |
| Seed | 5000 | 4000 | 6000 | 17000 |
| Land preparation | 7500 | 7500 | 7500 | 10000 |
| Sowing | 2500 | 2500 | 2500 | 2500 |
| Pest & disease control | 6000.0 | 5000 | 5000 | 7000 |
| Weeding | 3600 | 1800 | 1800 | 3600 |
| Irrigation | 15000 | 10000 | 10000 | 15000 |
| Harvesting | 6000 | 6500 | 5000 | 12000 |
| Total production cost | 57600 | 43300 | 44800 | 79100 |
| Yield (t/ha) | 7 | 30 | 3.5 | 70 |
| Market price (KES/t) | 15556 | 3636 | 33333 | 2200 |
| Profit (KES/ha) | 51288.89 | 65780 | 71865.5 | 74900 |

One KES = 0.0128287 (USD).

quantities of fertilizers due to a lack of sufficient financial capital. With the exception of maize, most respondents use local non-hybrid seeds for sowing, which often result in poor yields. Finally, crop pests and diseases most commonly go untreated due to related costs. No differences were observed between sugar beet and non-sugar beet farmers regarding their current crop management practices.

Using data obtained during interviews with the agricultural officers, Table 5 shows the production costs, yields and profit per hectare under intensive management practices of the dominant crops in addition to sugar beet. Table 5 indicates that the yields of the dominant crops increase significantly under intensive management. The production costs for each of the crops also increase substantially. It is worth noting that the profit margins for each of the crops increase significantly as well. The sugar beet price was set at 2,200 Kenya shillings on the assumption that it will fetch the minimum price currently paid for sugar feedstock supplies to factories. Though currently the sugar feedstock supplies is obtained from sugar cane, the sugar cane yield of 72.25 t/ha (Kenya Sugar Board, 2004) is at the same level as the sugar beet yield obtained from Nyandarua sugar beet trials. The sugar beet production cost shown in the table also compares well with the sugar cane production cost of 75,000 KES/ha (Kenya Sugar Board, 2004). The sugar content for sugar beet is 17% as observed from the trials, while the sugar content for sugar cane is 12% (Kenya Sugar Board, 2004). It is on this basis that the sugar beet price was chosen. The study, however, acknowledges that the price of sugar beet could be determined by many complex factors outside the current scope, such as growers' and processors' integrated profits per unit of white sugar, which is driven by producers' and processors' efficiency (Bogetoft, et al., 2007), and existing market pressure both from other locally produced sugar as well as imported sugar. Most sugar imports to Kenya are drawn from the Common Market for East and South Africa (COMESA) region (Kenya Sugar Board, 2001).

From Tables 2 and 5, it can be seen that the cost of cultivating one hectare of sugar beet or maize under intensive management is higher than the gross annual income of the low-income category households. The cost of producing sugar beet is also higher than the lower margin of the medium-income category respondents. On their own, the low-income households therefore will only be able to plant small amounts of sugar beet or maize under intensive management. The low-income households and bottom margin medium households may not financially benefit from the economies of scale. Therefore, despite the high yields and profits that can be accrued through intensive management, due to high production costs most households may not have sufficient financial capital to engage in intensive cultivation of sugar beet and other crops in commercial quantities unless they are supported with some credit access. This finding lends support to Reardon et al. (2000), Abdulai and CroleRees (2001) and Zhou et al. (2008), who have also shown that income disparities tend to bar low-income earners from engaging in high-income generating activities due to financial constraints related to high entry costs. The household income level and credit access will therefore be important determinants of how widespread the sugar beet adoption will be among the three income categories.

## DISCUSSION

The results show some good prospects for sugar beet cultivation, and also some important challenges for widespread adoption of the crop in the study area. The

favorable factors are in regard to: 1) adequate land area with physical conditions that are suitable for cultivation of sugar beet in commercial quantities, 2) widespread awareness of many positive qualities of sugar beet, 3) willingness of the majority of farmers to adopt the sugar beet crop, 4) high sugar beet root yield per unit area. The challenges are: costs related to sugar beet production, inadequate farming technologies and absence of sugar beet market. With these opportunities and challenges in mind, one question becomes important: Can sugar beet adoption offer an opportunity for smallholder farmers in Nyandarua to escape poverty?

The domestic sugar deficit in Kenya (Kenya Sugar Board, 2001) and the aforementioned factors favoring sugar beet cultivation in the Nyandarua District indicate some business potential for investment in sugar beet sugar cultivation and processing. Domestic sugar processing may thus serve as an import substitution strategy that can help save much-needed foreign exchange. Additionally, the business potential is enhanced by the fact that the government policy is open to such investments and willing to support new agro-industries (Ministry of Agriculture and Ministry of Livestock and Fisheries Development, 2004). However, according to Barkley and Wilson (1992), a new business opportunity can only exist if the investor can have "strategic advantage" in the line of business. The strategic advantage can be gained through adopting technologies that lower the cost, differentiate the product and create a "unique market focus" (Barkley and Wilson, 1992). Given that there are already a number of factories producing sugar locally in Kenya, and that sugar is imported from COMESA countries (Kenya Sugar Board 2001), a fledgling sugar beet industry in Nyandarua will certainly face intense market competition. To ascertain whether the business can withstand the competition and survive, a more comprehensive analysis of the strategic advantage, outside the scope of the current study, is recommended.

Recognizing the opportunity for a sugar beet business in the Nyandarua District is a first positive step, but can the business offer an opportunity out of poverty for smallholder farmers in the district? According to the Ministry of Agriculture and the Ministry of Livestock and Fisheries Development (2004), the main goal for revitalizing agriculture is to reduce poverty and unemployment. The sugar beet business therefore has to increase the net income of smallholder households as well as create employment opportunities, among other goals.

To increase the net income of smallholder farming households, the profit accrued from the cultivation of sugar beet should be comparatively higher than their current farming activities. Higher sugar beet profit can be achieved if the growers' and processors' integrated profit per unit is optimized (Bogetoft et al., 2007). 'Integrated profit' is defined per Bogetoft et al. (2007, p. 3) as "the price of refined sugar minus upstream cost for producing and delivering sugar beet and the downstream cost of processing the sugar beet (as per a unit of white sugar output)." From the definition, the price of white sugar and upstream and down stream production costs would be key determinants of profit level. To achieve high integrated profit, the sugar price should be high while both the upstream and down stream costs are kept at a minimal. Because the sugar market in Kenya is liberalized, the sugar price may be determined by many factors relating to existing market pressure from competitors as well as the quality of the product. Improving farm level efficiency and processing efficiency would help cut down the costs (Bogetoft et al., 2007). However, even if high integrated profit is achieved, whether the smallholder sugar beet farmers can benefit financially will depend on the actual price they receive for the sugar beet root that supplies the processor. Nevertheless, the results of the sugar beet profit analysis have shown that sugar beet has the potential to increase household net income provided its market price is not less than the current minimum for sugar feedstock supplies.

The sugar beet business can bring about new employment opportunities in the Nyandarua District in at least three ways: 1) direct jobs for employees at the sugar beet processing plant, 2) indirect jobs arising from the "pull factor"(that is, the location of the factory would create income opportunities for complementary sectors on the basis of production, expenditure and services), and 3) self-employment opportunities in sugar beet cultivation. Given that the structure of the Kenyan agriculture is dominated by smallholder farmers, the self employment is likely to offer the highest number of employment opportunities. However, due to high sugar beet production costs, low-income farmers and likely a large proportion of medium-income farmers will be left out unless they get support by credit access. According to Ministry of Planning and National Development (2007), credit access is constrained, particularly to low-income farmers, due to lack of collateral and high interest rates. It can therefore be argued that if significant employment increases are to be realized from sugar beet cultivation and processing, it is necessary for policy intervention to ensure that the low-income and medium-income farmers get support with affordable credit to help them raise the start up capital.

It can thus be said that even if the sugar beet would fetch higher profits compared to other farming activities, its high production cost would likely be a barrier for low-income earners to engage in the cultivation. Therefore, in regard to whether sugar beet can lift smallholder farmers from poverty, it is a possibility if access to affordable credit support and appropriate technologies are improved to cater to farmers at all income levels. Otherwise, if these conditions are not provided for, sugar beet production may favour the few who are financially secure,

to the detriment of the poor and hence widen the economic gap among different income groups. Reardon et al. (2000), Abdulai and CroleRees (2001) and Zhou et al. (2008) have also shown that income disparities tend to bar low-income earners from engaging in high-income generating activities due to financial constraints related to entry costs. By excluding them, the sugar beet business will not reach its goal of lifting the needy poor out of poverty.

Nyandarua has shown physical conditions favorable to the adoption of sugar beet, but some important socio-economic challenges to widespread adoption remain. The findings that physical conditions vary spatially (Onduru and Preez, 2008) and that socio-economic conditions vary from farmer to farmer based on capital assets (Ellis, 2000) underscore the importance of the physical geographical location in which the new crop or investment is located. This therefore implies that in order to ensure long-term business from the adoption of sugar beet or any other new crop, both strategic advantage and physical location (in terms of physical and socio-economic conditions) must be comprehensively assessed prior to the commencement of the project. It can then be said that the contribution of alternative agriculture to poverty reduction and employment creation will not be uniform across all rural communities, but rather will vary from community to community as well as among farmer categories within a community. Communities whose farmers have adequate capital assets stand to benefit in regard to increased net income and employment, but the opposite is true for low-income farmers. Thus, alternative agriculture must not be taken as a stand-alone strategy to address the problems of poverty and unemployment, but rather the government should adopt a broad-based strategy that includes other relevant economic growth and development strategies.

## Conclusions

The possibility of sugar beet cultivation offers an opportunity for a profitable sugar beet business in the study area. Conditions favoring the development of this business include: 1) physical suitability (that is, adequate land area that is suitable for sugar beet cultivation and the high sugar beet yield that can be attained per unit suitable land area) and 2) socio-economic factors in regard to farmers' awareness of the positive properties of sugar beet cultivation and willingness to grow the sugar beet crop.

Notwithstanding the factors favoring sugar beet, cultivation, some socio-economic factors, mainly the affordability of sugar beet production and possible lack of appropriate farming technologies, will present challenges to widespread sugar beet adoption. Consequently, the benefits of the sugar beet business in regard to income and employment may end up in the hands of only a few farmers who have adequate capital assets, at the expense of the majority of (low-income) farmers. Therefore, for sugar beet to aid in pulling smallholder farmers out of poverty, interventions from government and other stakeholders to ensure external support with affordable credit sources is of vital necessity.

Alternative agriculture may present opportunities for job creation and income generation in rural communities. However, the level of impact will vary from community to community, depending both on 'strategic and 'location advantage.' Alternative agriculture alone is therefore not a sufficient strategy to address the problems of poverty and unemployment. Any successful strategy to address these problems must be broad-based, including alternative agriculture and other growth and development strategies. Provision for the necessary infrastructure should precede and/or accompany all of these strategies in order to optimize benefits from the implementation.

## REFERENCES


Abdulai A, CroleRees A (2001). Determinants of household diversification amongst rural households in Southern Mali. Food Policy, 26: 437-452.

Barkley LD, Wilson NP (1992). Is Alternative Agriculture a Viable Rural Development Strategy? Growth and change, Spring, pp. 240-253.

Barret BC, Reardon T, Webb P (2001). Nonfarm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics, and policy implications. Food Policy, 26: 315-331.

Bhandari SB, Grant M (2006). Analysis of livelihood security: A case study in the Kali-Khola watershed of Nepal. J. Environ. Manage., 85:17-26.

Biancardi E, Campbell GL, Skaracis NG, Biaggi DM (2005). Genetic and breeding of sugar beet. Science Publishers, Inc., Enfield, NH, USA,

Blomquist J, Hellgren O, Larsson H (2003). Limiting and Promoting Factors for High Sugar Yield in Sweden. In: INRA, IIRB and ITB (Eds.), Sugar Beet Growth and Growth Modeling. Adv. Sugar Beet Res., IIRB, 5: 19-32.

Bogetoft P, Boye K, Neergaard-Petersen H, Nielsen K (2007). Reallocating sugar beet contracts: can sugar production survive in Denmark? Eur. Rev. Agric. Econ., 34: 1:1-20.

Cooke AD, Scott KR (1995). The sugar beet crop: Science into practice. Chapman and Hall, University Press Cambridge, UK.

Doorenbos J, Kassam AH (1979). Yield response to water. Irrigation and drainage paper 33. In Landon, J.R. (Eds.), 1979. Booker Tropical Soil Manual. Longman Inc, New York, U.S.A.

Draycott PA, Christenson RD (2003). Nutrients for sugar beet production: Soil-plant relationships. CABI Publishing, Cromwell Press, Trowbridge, UK.

Dunham RJ (1995). Water use and irrigation. In Cooke AD Scott KR (Eds.) (1995). The sugar beet crop: Science into practice. Chapman and Hall, University Press Cambridge, UK.

Elliott CM, Weston DG (1995). Biology and physiology of the sugar-beet plant. In Cooke AD and Scott KR (Eds.) (1995). The sugar beet crop: Science into practice. Chapman and Hall, University Press Cambridge, UK.

Ellis F (2000). Rural livelihoods and diversity in developing countries. Oxford University press, New York.

Export Processing Zone Authority (2005). Kenya's sugar industry 2005. http://www.epzakenya.com/UserFiles/File/Kenyasugar.pdf, Accessed January 18, 2009.

FAO Agricultural Organization of the United Nations (1976). A framework for land evaluation. FAO Soils bulletin 32. FAO, Rome http://www.fao.org/docrep/X5310E/X5310E00.htm. Accessed June 15, 2008.

FAO (1997). Slope class dominant soil in Kenya. http://www.fao.org/geonetwork/srv/en/metadata.show?id=57&currTab=simple. Accessed June 15, 2008.
Geita W (2004). Tropical Sugar beet: from a business idea to sustaining sugar production in tropical areas. J. Swedish Seed Assoc., 1(2): 17-19
Harland IJ (1995). By products. In Cooke AD and Scott KR (Eds.) (1995). The sugar beet crop: Science into practice. Chapman and Hall, University Press Cambridge, UK.
Kenya Sugar Board (2001). Year book of sugar statistics: Comparative sugar production 2000 and 2001, Sukari Plaza Complex off Waiyaki Way, Nairobi.
Kenya Sugar Board (2004). Quarterly Bulletin of Sugar Statistics January – March 2004. Sukari Plaza Complex off Waiyaki Way, Nairobi.
Kristjanson P, Okike I, Tarawali S, Singh BB, Manyong MV (2003). Farmers' perceptions of benefits and factors affecting the adoption of improved dual-purpose cowpea in the dry savannas of Nigeria. Agric. Econ., 32: 195-210.
Mandere, NM, Persson A., Anderberg S, Pilesjö P (2009). Tropical Sugar Beet Land Evaluation Scheme – TSBLES: Development, validation and application under Kenyan conditions. GeoJournal. DOI: 10.1007/s10708-009-9302-9.
Ministry of Agriculture and the Ministry of Livestock and Fisheries Development (2004). Strategy for revitalizing Agriculture 2004-2014. Government Press, Nairobi.
Ministry of Finance and Planning (2002). Nyandarua district development plan 2002-2008: Effective management for sustainable economic growth and poverty reduction. Government Press, Nairobi.
Ministry of Planning and National Development (2007). Basic report: Kenya integrated household budget survey 2005/06 revised edition. Kenya National Bureau of Statistics (KNBS), Nairobi.
Onduru Davies D, Du Preez Chris C (2008). Spatial and temporal aspects of agricultural sustainability in the semi-arid tropics: a case study in Mbeere district, Eastern Kenya. Trop. Sci., 47, 3:134-148.
Reardon T, Taylor JE, Stamoulis K, Lanjouw P, Balisacan A (2000). Effects of nonfarm employment on rural income inequality in developing countries: an investment perspective. J. Agric. Econ., 51: 2: 266-288.
Scott RK, Jaggard KW (1992). Crop growth and weather: can yield forecast be reliable? Proceedings of the IIRB 55th winter congress, Brussel:IIRB, pp. 169-118.
Tschakert P (2003). Soil Carbon Sequestration in Small-Scale Farming Systems: A Case Study from the Old Peanut Basin in Senegal. PhD dissertation, Arid Lands Resource Sciences, University of Arizona.
UN (2000). UN Millennium Development Goals. United Nations, New York.
UN (2007). The Millennium Development Goals Report. United Nations, New York.
Van Rooyen J (1999). Towards regional food security in southern Africa: a (new) policy framework for agricultural sector. Food Policy, 23(6): 491-504
World Commission on Environment and Development (1987). Our common future. Oxford University Press, Oxford.
World Food Summit (1996). FAO, Vol. 1, Rome, Italy. World. Irwin McGraw-Hill. Boston, USA.
Zhou S, Herzfeld T, Glauben YZ, Hu B (2008). Factors affecting Chinese farmers' decisions to adopt a water saving technology. Can. J. Agric. Econ., 56: 51-61.