

*Full Length Research Paper*

# Effects of sugarcane farming on diversity of vegetable crops in Mumias Division, Western Kenya

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**Sugarcane farming is a commercial monocultural land use practice which often lead to reduction in agrobiodiversity. The study was carried out in Mumias Division of Western Kenya where 68% of the land is under commercial sugarcane cultivation while 32% is left for subsistence agriculture and other land uses. The objectives of the study were: to identify the indigenous vegetable grown in Mumias Division before the introduction of commercial sugarcane farming and to assess the effects of commercial sugarcane farming on indigenous vegetable in Mumias Division. With the introduction of commercial sugarcane farming in the 1970s, the land under subsistence agriculture declined thus affecting vegetable species diversity in the study area in the following ways: vine spinach became extinct, the number of farmers growing indigenous vegetable from 1970s to 2000s decline by between 4% and 57%. African kale was the least cultivated crop. The number of farmers growing sugarcane increased by 60% in 1970s and 6% in 1980s. The results imply that sugarcane farming is one of the major contributors to vegetable species diversity erosion. Other reasons for diversity erosion in the region included decline in livestock, expensive seeds, change in tastes and preference and pests and diseases.**

**Key words:** Agro- biodiversity, Monoculture, Indigenous Vegetables.

## INTRODUCTION

Agro- biodiversity refers to the aspects of biodiversity that affect agriculture and food production (FAO, 1999). Agro- biodiversity plays a key role in ensuring that there is increase productivity, food security and economic returns. Monocultural farming involves clearing of large tracts of land to create more space for the cultivation of the single crop. This in the end lead to other subsistence crops often abandoned with more focus and attention being given to the individual monocultural crop. In the end, this may lead to extinction of some crops that are very useful and are a source of food security to the community. FAO (2008) reported that monoculture (practice of planting and cultivating crops in large tracts containing a single species) reduces biodiversity, which is necessary for the

survival of healthy ecosystems. Cheesman (2006) indicated that commercial sugarcane farming completely transformed large tracts of land especially in the coastal regions north and south of Durban, South Africa. Netondo et al. (2010) confirms that monocultural sugarcane farming is associated with the loss of natural vegetation and cropland in Mumias and Nzoia sugar belt thus undermining the food security status of the region. Waswa et al. (2009) also reported that presently, sugarcane is the most widely grown commercial crop in Nzoia sugar belt, having replaced most indigenous crops like cassava and vegetables, despite their ecological suitability and high nutritive and income value.

Sugarcane farming is widespread in the tropics and subtropics (Rehm and Espig, 1991). Its production in Kenya started in the 1920s at Miwani and Ramisi in Nyanza and Coast provinces. In Mumias Division, commercial sugarcane farming has been practised for nearly forty years concomitant with the introduction of Mumias

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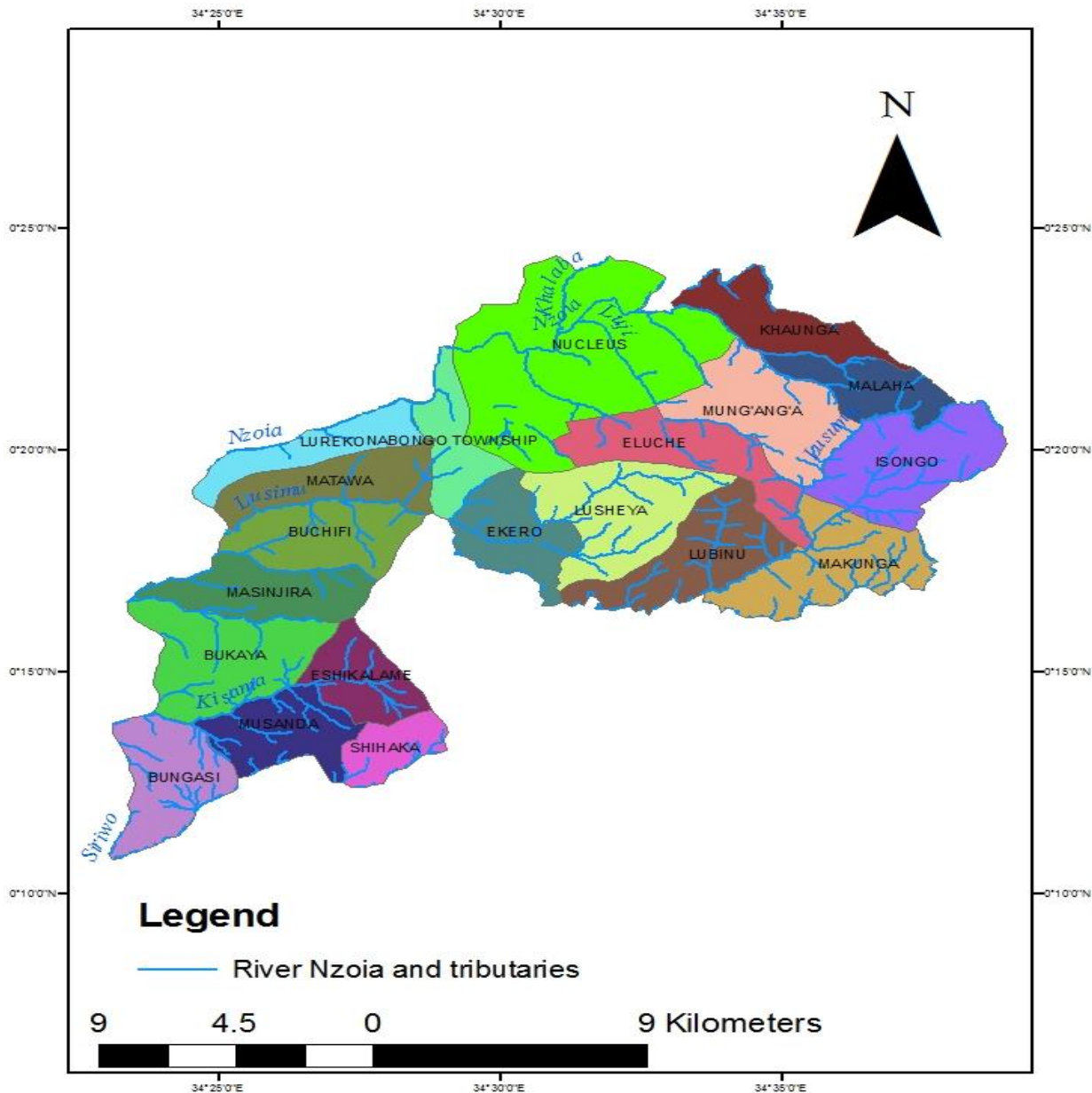


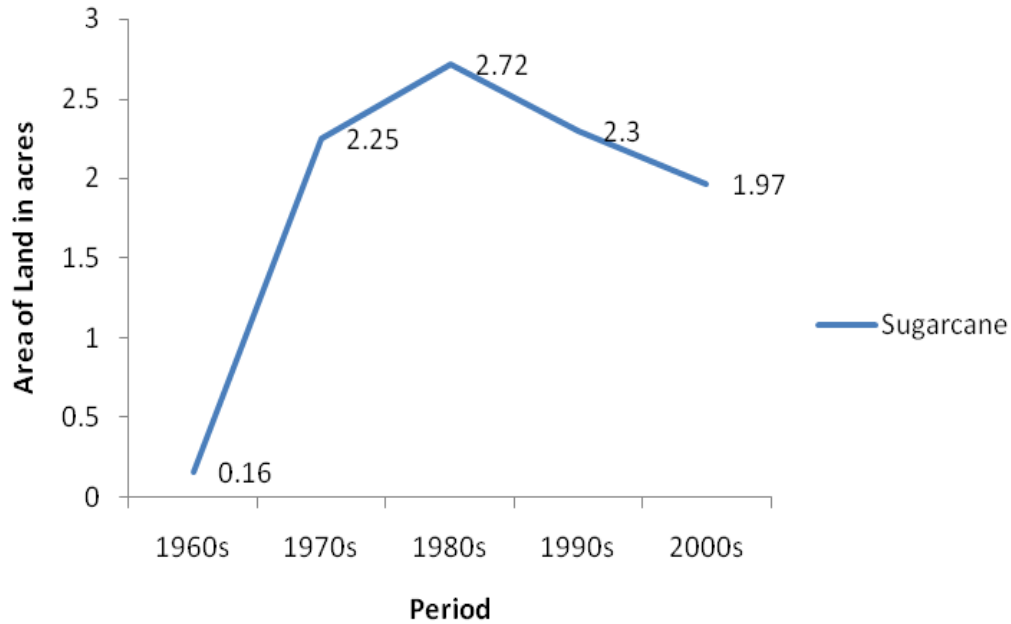
Figure 1. Study area.

Sugar Company (Netondo et al., 2010). Currently sugarcane occupies 107,622 ha of arable land and is grown primarily by small scale farmers followed by large-scale farmers and nucleus estates. Sixty eight percent (68%) of the land in Mumias Division is put under sugarcane cultivation; this implies that a very small portion of the land thirty two (32%) in the division is left for subsistence farming. The growing of sugarcane was generally considered to alleviate poverty by expanding income generation possibilities. However statistics and observation indicate that poverty in this region remains prevalent (GOK, 1999). It is widely recognized that if the remaining biodiversity is allowed to disappear as a result

of socio-economic activities such as sugarcane cultivation, man's future live hoods will be at stake (Netondo et al., 2010).

#### METHODOLOGY

The study was carried out in 2007 in Mumias Division of Western Kenya (Figure 1). Purposive sampling techniques were used to select the respondents who included both small scale farmers large scale farmers and key informants. The key informants included the chiefs, assistant chiefs, and District Agricultural officers. Both gender and age factors were put into consideration. The respondents were aged 50 years and above who had lived in the region



**Figure 2.** Mean size of land under sugarcane in Mumias Division from 1960s to 2000s.

for more than thirty years. Primary data were collected using researcher administered questionnaires to 90 respondents from Mumias Division and Focus Group Discussions (FGD) involving thirty individuals who were selected with the assistance of local authorities. Statistics on the size of the land under sugarcane was also obtained from the agricultural department of Mumias Sugar Company. Secondary data was collected from Kenya Agricultural Research Institute offices in Kakamega. Trend on changes in the number of farmers cultivating indigenous vegetable species were assessed by partitioning periods into ten year intervals. Data was analyzed using descriptive statistics focusing on frequency distribution and percentages. In all cases the SPSS statistical package was used.

## RESULTS AND DISCUSSION

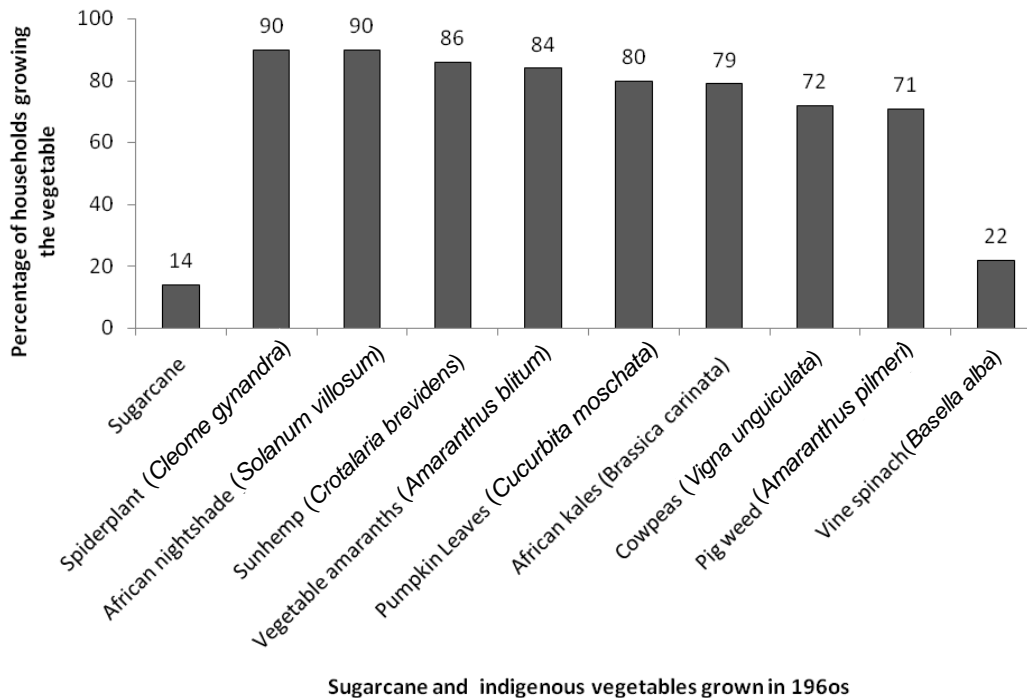
### Indigenous vegetable cultivated before the introduction of commercial sugarcane farming

In Mumias Division, commercial sugarcane farming was introduced in 1972 concomitant with the introduction of Mumias Sugar Company. In the 1960s sugarcane was cultivated on small pieces of land of about 0.16 acres of land per household. Field results showed that it occupied only 2% of the total size of land under subsistence crops. The results also revealed that it was cultivated by about 14% of the household (Figures 2 and 3). These were the local sugarcane varieties (mikhonye cha eshinyala and mikhonye cha kampala) that were either red or green in colour and were mainly chewed raw. These varieties were commonly planted along the banks of rivers such as river Nzoia or in kitchen gardens. Only ripe sugarcane is harvested while unripe plants were left on the plot. In this

way, the field was never cleared. This soft sugarcane comprised of sweet fibers that could be chewed raw. These species were often sold on the local markets such as Mumias to generate household income.

Indigenous vegetables (vegetables that are native to a particular region) that were very common before the introduction of commercial sugarcane farming mainly included spider plant (*Cleome gynandra*), jute mallow (*Corchorus olitorius*), african nightshade (*Solanum villosum*), vegetable amaranths (*Amaranthus blitum*), pig weed (*Amaranthus pilmeri*), cowpeas (*Vigna unguiculata*), pumpkin leaves (*Cucurbita moschata*), sunhemp (*Crotalaria brevidens*), african kales (*Brassica carinata*) and vine spinach (*Basella alba*) (Figure 3). These vegetables provided the body with necessary vitamins that is important in protecting the body against diseases. These vegetables grew in the wild, grew as weeds on farms or were cultivated by farmers. These vegetable species have high growth rates, especially in soils rich in organic matter. The main method of cooking these vegetables was boiling without fats.

The study established that spider plant (*Cleome gynandra*), African nightshade and Jute mallow were grown by 90% of the respondents in Mumias Division making them to be the joint most popular vegetable species in the region (Figure 3) in the 1960s. They were grown in small sectors of the farm such as kitchen gardens and along the rows of staple crops such as maize and along banks of rivers such as river Nzoia. They also grew in the wild, or grew as weeds in the farms. The focus group participants stated that most of the wild vegetables such as african nightshade had a



**Figure 3.** Percentage number of household in Mumias Division growing specific indigenous vegetable species in 1960s. Source: Field data (2007).

large number of seeds. Therefore, these wild vegetables would probably spread easily and continue to grow over the years, thus, there was no need perceived for cultivation. Their leaves were eaten as a cooked vegetable, often mixed with other vegetables such as vegetable amaranths. The common variety of nightshade in the region was the bitter taste. Water was discarded particularly, after being boiled. The vegetable has an appealing taste, were often fried with cows' fat which is less expensive and take long before spoiling.

Sunhemp was the fourth common indigenous vegetable in the region with 86% of the respondents growing the crop on their farms. Vegetable amaranths were cultivated by 84% of the respondents (Figure 3). Eighty percent (80%) of the households in Mumias Division cultivated pumpkin leaves in the 1960s (Figure 3). The younger leaves are collected and the outer tough skin of petioles (stalk of leaf) removed (together with the large leaf veins) then washed, chopped and boiled. Leaves and flowers of pumpkins are used as vegetables. Besides, is boiled and eaten as a meal. Pumpkin was usually grown in areas with high nutrient concentrations such as kitchen waste dumping sites, former cattle sheds and demolished mud huts. Pumpkins are drought tolerant plants and once established the leaves are harvested all the year round.

African kale was popular in the region in 1960s and was grown by 79% of the households (Figure 3). Abukutsa (2007) reported that African kale was popular in three countries of East Africa including Kenya and that

the crop has been grown and consumed by the people of East Africa for many years. Cowpea was cultivated by 72% of households in Mumias Division in 1960s (Figure 3). Cowpeas are basically annual crops grown for their leaves and seed. Their fresh leaves can be boiled and eaten or dried and preserved for future use. Pig weed was cultivated by 71% of the respondents (Figure 3). The vegetable mainly grows in the wild or semi cultivated land hence referred to wild amaranths.

The PRA discussion established that prior to the introduction of sugarcane in Mumias Division, pig weed grew naturally in the wild and on the fertile farms in the rain season. The PRA also established that this vegetable species also require fertile soils rich in organic manure from animal wastes and decomposing kitchen wastes.

Nekesa and Meso (1997) indicated that many traditional African vegetables including pigweed may be classified as 'edible weeds'. Vine spinach was the least common vegetable species in the region in 1960s being found on only 22% of the house holds farms (Figure 3). The research established that these Indigenous vegetables species were grown as intercrops in the region and on rotational basis in the same year.

#### **Changes in the size of land under sugarcane between 1960s and 2000s**

The size of land under sugarcane increased to 2.25(35%)

**Table 1.** Respondents perception of the causes of the decline in the size of land under sugarcane.

Causes	Percentage number of respondent
Expensive charges on input	95
Poor payment	95
Delayed payment	95
Delayed harvesting	92
Cane spillage	92
Manipulation of weighing bridge	90
Poor harvesting technique	80
Poor quality of seed cane	67
Risk of burning	67

acres in 1970s to 2.72(48%) acres in 1980s (Figure 2). The size then declined to 2.3(43%) acres in 1990s and a further decline to 1.97(38%) acres in 2000s. When the respondents were asked to give the reasons for the increase in the size of land under sugarcane in 1970s and 1980s, (50%) indicated that Mumias sugarcane Company provided ready market for the crop.

Sales from sugarcane improved farmers' living standard. Thirty percent (30%) of the respondents stated that the company provided the farmers with soft loans used for school fees and medical services. Twenty percent (20%) reported that the factory provided employment and hence income to supplement the subsistence agriculture. Njue (1993) indicated that the sugar industry directly and indirectly supports 5 million Kenyans representing about 16% of the entire Kenyan population. Sugar cane growing is also a major source of income to over 150,000 people in Kenya (Government of Kenya, 2004: Export Processing Zones report 2005).

Ninety five percent (95%) of the respondents indicated that the decline in the size of land under sugarcane farming in 1990s and 2000s were attributed to low payment, delayed payment and expensive charges on input from the Mumias Sugar Company as reported by (Table 1). Ninety two percent (92%) indicated that delayed harvesting of sugarcane from the farms resulted into sugarcane spoilage in farms, declining in value. A similar number (92%) attributed the decline to poor transportation resulting into sugarcane spillage on the way to the factory. Ninety percent (90%) reported Mumias Out growers Company (MOCO) corruptly stole from farmers during weighing and this made farmers to incur losses. Eighty percent (80%) of the respondents attributed the decline to poor harvesting of sugarcane leading to sugarcane being left on farms. Sixty seven percent (67%) attributed the decline to poor quality seed cane offered by the factory. Finally sixty seven percent (67%) of the respondents reported that arsonist burnt sugarcane while still in the farms making farmers to incur great losses (Table 1). Kenya Water for Health Organisation (2005) pointed out that in the last five years, cash flow from the sugar industry had not been very reliable due to delayed

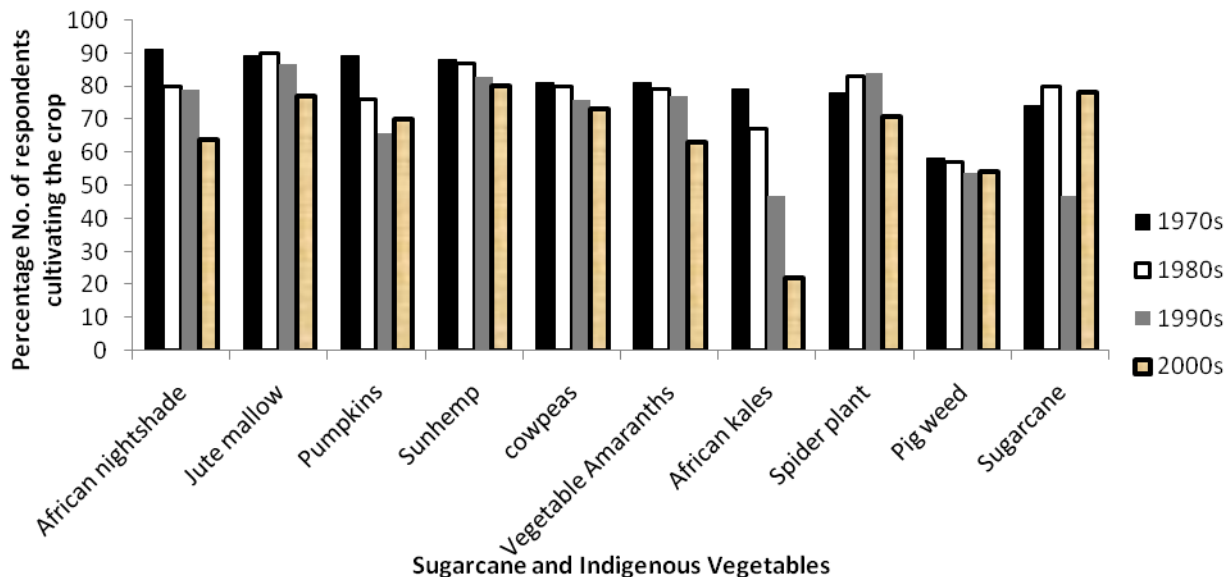
payments to farmers. Wawire et al. (2010) reported that Farmers in Trans-Mara zone ranked low cane prices and high cost of inputs as a major problem, while in Awendo delayed payment for delivered cane was ranked as the first problem affecting sugarcane farmers in the regions.

#### **Effects of sugarcane farming on the diversity of vegetable crops in Mumias Division in 1970s to 2000s**

Agricultural diversity in Mumias Division started deteriorating with the introduction of sugarcane as a monoculture crop which was believed to generate more income. The research established that sugarcane farming had an indirect effect on the cultivation of these indigenous vegetables. Large tracts of land that used to be bare were transformed into sugarcane plantations. These led to a change in the natural habitats for various indigenous vegetables. Most of the kitchen gardens cattle shed that were previously used for cultivation of indigenous vegetables were transformed into sugarcane plantations. Sugarcane farming also led to a decline in soil fertility and this made the soil unsuitable for the cultivation of these vegetables. Figure 3 shows the trends in the number of respondents who cultivated sugarcane and these indigenous vegetables between 1970s and 2000s.

#### **Vine Spinach (*Basella alba*)**

The research findings established that vine spinach (*Basella alba*) which used to be common in the region in 1960s before the introduction of sugarcane was no longer cultivated by all the respondents interviewed. During the Focus Group discussions, the respondents reported that the clearing of large pieces of land to create space for sugarcane farming altered the natural habitat for the growing of vine spinach which used to grow in the wild. The respondents also reported that change in tastes and preference with more preference being put on exotic vegetables such as kales has led to a decline in vine



**Figure 4.** Percentage number of household in Mumias Division growing specific indigenous vegetable species from 1970s to 2000s. Source: Field data (2007).

spinach. Abukutsa (2007) confirmed that of the approximately 200 indigenous species of plants that were used by Kenyans as vegetables in the past, most were either collected in the wild, semi-cultivated, or cultivated. Now many are either unknown or extinct. The research established that vine spinach is one such indigenous vegetable in Mumias Division.

#### **African night shade (*Solanum villosum*)**

The research established that in 1970s African nightshade was the most common vegetable species in the region with 91% of the respondents growing it (Figure 3). The number reduced to 80% in 1980s, 79% in 1990s and 64% in 2000s. This was a 27% decline from 1970s to 2000s. Forty five percent (45%) of the respondents attributed the decline in the number of household cultivating African nightshade to sugarcane farming. They reported that this vegetable species would grow in the wild or semi cultivated land. However they are uprooted as weeds in sugarcane plantations hence reducing their population. The crop is also destroyed from its natural habitat when the land is being cleared to create space for sugarcane farming. Thirty four percent (34%) of the respondents indicated that the decline in the number of households growing African night shade was change in tastes and preference with preference being given to exotic kales. Other reasons given by the respondents for the decline was expensive seeds as reported by 10% of the respondents. They indicated that the cost of a glass of nightshade seeds was approximately Ksh 200 which was deemed to be expensive. Pests and diseases

especially the birds were reported by 5% of the respondents as one of the reasons for the decline. Five percent (5%) of the respondents indicated that the decline was due to the long time of approximately one hour required in the cooking of the vegetable. The respondents also indicated that these vegetable species is medicinal and were used in curing stomach ache. The respondents indicated that these vegetable species can stay for many days after cooking without getting spoilt. Grivetti (1976) and Fleuret (1979) reported that most farmers' through out Africa have been abandoning traditional varieties of crops in preference to introducing high yielding varieties. However, eighty percent (80%) of the respondents reported that the extension officers are introducing exotic varieties which yielded more, hard broader leaves and were less bitter in taste. According to Oniang'o (2001), African Vegetable Research Development (AVRDC), have developed one cultivar that does well in Kenya, known as Giant Nightshade. This variety has a bigger, sweeter leaf, and would likely appeal to adults as well as children. In addition, they reported that the promotion of the nightshade plant in Kenya, especially Nairobi, has created a strong market for this crop, with a high profit potential.

#### **Jute Mallow (*Corchorus olitorius*)**

A reducing trend was noted in the number of the respondents growing jute plant vegetable species in 1970s. Eighty nine percent (89%) of the respondents grew the vegetable species in 1970s, 90% in 1980s, 87% in 1990s, and 77% in 2000s (Figure 4). Jute mallow was

ranked second in popularity in the region in 2000s. Ninety percent (90%) of the respondents attributed the decline identified in the number of farmers growing jute plant to change in eating habits with preference being given to exotic vegetable species such as exotic kales. The research findings are also in agreement with Netondo et al. (2010) who reported that sugarcane farming was one of the factors responsible for the decline in jute mallow in Mumias and Nzoia sugar belt. The Focus Group Discussion established that the crop is still popular in the region because it is either cultivated or grows in the wild. It also revealed that the crop has a ready market in the major towns such as Nairobi. The respondents reported that vegetable is nutritious and therefore good for breast feeding mothers. Jute mallow (*Corchorus olitorius*) is noted for its important contribution to diet by supplying nutrients and rendering food more palatable (Fasinmirin and Olufayo, 2009). Ekesa et al. (2009) reported that jute mallow was popular in the nearby Matungu division because it was either grown in the wild or was cultivated. However they also mentioned that the popularity of Jute mallow could be attributed to the fact that it is common among the community in western Kenya to cook two or three indigenous vegetables together and the most common mixture is that of cowpea leaves, jute mallow and slender leaf.

### **Pumpkins (*Cucurbita moschata*)**

Eighty nine percent (89%) of the respondents cultivated pumpkins on their farms in 1970s. This showed that there was a 9% increase in the number of households growing pumpkins from 1960s to 1970s. It was ranked second together with jute mallow in popularity in the region. Ninety percent (90%) of the respondents attributed the increase in the size of land under pumpkins to the fact that pumpkins playing a key role in nutrition. They reported that the fruit is eaten as a meal and the leaves as vegetable. The respondents also pointed out that the crop occupies a very small piece land and could easily be grown and managed on both cultivated and non cultivated piece of land. The crop was grown in areas with high nutrient concentrations such as kitchen waste dumping sites, former cattle sheds and demolished mud huts (Nekesa and Meso, 1997). Swai (1991) confirmed that malnutrition among children, pregnant and lactating mothers can be partially alleviated by consumption of dark green leafy vegetables such as pumpkin leaves, which are excellent sources of proteins, vitamins and minerals.

Seventy six percent (76%) of the respondents cultivated pumpkins on their farms in 1980s, 66% in 1990s, and 70% in 2000s (Figure 4). Eighty percent (80%) of the respondents reported that the main causes of decline in the number of households growing pumpkin leaves in 1980s and 1990s were change in tastes and preference.

The young generation prefer exotic kales (sukumawiki) as compared to pumpkin leaves. Twenty percent (20%) of the respondents attributed the decline to the decline in the number of livestock reared which led to decline in manure. They reported that the vegetable requires soils that are very fertile. Four percent (4%) increase in the number of farmers cultivating pumpkin leaves was noted in 2000s.

### **Sunhemp (*Crotalaria brevidens*)**

The study established that in 1970s, sunhemp was cultivated by 88% of the respondents. This was a two percent (2%) increase from the 86% of the respondents who cultivated the crop in 1960s (Figure 3). Sunhemp was ranked fourth in popularity in 1970s. However the Focus Group Discussion reported that the increase in sunhemp's popularity was because the crop is delicious and preferred by people of all generations. Wambani et al., (2008) noted that sunhemp is a nutritious vegetable species. The study also established that in 1980s, sunhemp was cultivated by eighty seven percent (87%) of the respondents which is a 1% decline between 1970s and 1980s (Figure 4). In 1990s and 2000s sunhemp was cultivated by 83% and 80% of the respondents respectively. The reasons given by the respondents for the decline in sunhemp cultivation were pests and diseases as reported by 59% of the respondents. The respondents reported that this crop is easily attacked by white fly which lower yield. Obuoyo (2005) reported that sunhemp is found in most parts of the tropics and sub tropics of the world including Africa. Mirghali et al. (2007) pointed out that the average yields in vegetable species such as *Corchorus* spp is low in Sudan compared to the potential due to pests and diseases and the availability of high costs of pesticides. However, despite the decline, the crop still ranked first in popularity in 2000s. The respondents reported that this is mainly because the seeds are less expensive and readily available in the local markets such as Mumias as compared to the seeds of other indigenous vegetables. The cost of a glass of this seeds ranges from Ksh 50 to Ksh. 60 in the nearby Mumias Market.

### **Cowpeas (*Vigna unguiculata*)**

The research established that the number of farmers growing cowpeas in 1970s were 81%, 80% in 1980s, 76% in 1990s, and 73% in 2000s (Figure 4). There was a 9% increase from the 72% of respondents who grew the crop in 1960s. Fifty percent (50%) of the respondents attributed the increase to ready market of the crop on the market. Thirty Percent (30%) of the respondents reported that the increase in cowpeas was due to its delicious tastes and nutritional value. Cowpeas leaves contain 4% protein, 4% carbohydrates and are rich in carbohydrates,

calcium, phosphorous and vitamin B (Obuoyo, 2005). Ten (10%) also reported that cowpeas yield more as compared to other indigenous vegetables. They reported that it has a higher vegetative value and the seeds are also used for food. Ten percent (10%) of the respondents attributed the increase in cowpeas to the availability of seeds on the market at a cheaper price. The seeds cost lower (Ksh40 per glass) as compared to the other indigenous vegetables. A recent study by Ekesa et al. (2008) indicated that cowpeas are the most popular vegetable species in the neighbouring Matungu division. The yields of cowpeas are always higher and the crop can withstand harsh conditions (Ekesa et al., 2008). Wanjekeche et al. (1997) confirmed that basing on tastes and preference cowpeas was the second highly accepted legume in the Cheptuya village of North Western Kenya.

Forty percent (40%) of respondents reported that the main causes of decline in the number of households growing cowpeas leaves were change in tastes and preference with more preference being given to exotic kales. Thirty Percent (30%) of the respondents reported that the decline was as a result of pests such as aphids and diseases such as fusarium wilt which lower the yield. Thirty Percent (30%) of the respondents reported that the decline was as a result of sugarcane farming that occupied large pieces of land including kitchen garden reducing the size of land available for the cultivation of cowpeas. Ekesa et al. (2008) confirmed that the decline in the number of households growing indigenous vegetables such as cowpeas in the neighbouring Matungu division was due to commercial sugarcane and changing dietary patterns. However, the PRA research findings established that cowpeas become more popular in 2000s. The respondents reported that this was because the vegetable yields more, has ready market, and is nutritious. Oiyee et al. (2009) confirmed in western Kenya that the most abundant and consumed African leafy vegetable, accounting for most of the dietary vitamin A is the cowpea leaves.

#### **Vegetable Amaranths (*Amaranthus blitum*)**

In the 1970s vegetable amaranths was either cultivated or at times grew as weeds in farms. They also used to grow in abandoned cow sheds which were normally very fertile. The research established that 81% of the respondents grew vegetable amaranths in Mumias Division in 1970s (Figure 4). This was a three percent (3%) decline from the 84% of household who grew the vegetable in 1960s. A further decline was noted in 1980s 1990s and 2000s with 79%, 77% and 63% of the respondents growing the crop respectively (Figure 3). Various reasons were advanced to have attributed to the decline in vegetable amaranths in the region. Forty percent (40%) of the respondents reported that that this vegetable species growing in sugarcane farms were usually

considered as weeds hence are uprooted. Nekesa and Meso (1997) indicated that many traditional African vegetables may be classified as 'edible weeds'. This is in agreement with recent reports of (FAO, 2008), who reported that herbicides are reported to kill the edible weeds in sugarcane farms in South Africa. Thirty percent (30%) of the respondents attributed the decline to the decline in the number of livestock reared which led to decline in manure. They reported that the vegetable requires soils that are very fertile. Twenty percent (20%) of the respondents attributed the decline to the lifespan of vegetable amaranths. They reported that vegetable amaranths wither within one and a half months making it unreliable for food security. The crop is therefore not preferred by most households. Ten percent (10%) of the respondents attributed the decline to change in tastes and preference with preferences being given to exotic kales. Rhoades and Nazarea (1999) reported that the introduction of new varieties of vegetables like exotic kales lead to the number of local landraces as well as associated local knowledge being diminished.

#### **African Kales (*Brassica carinata*)**

The research established that just like in 1960, 79% of the respondents grew African kales in 1970s (Figure 3). Sixty seven (67%) of the respondents grew African kales in 1980s, 47% in 1990s and only 22% of the respondents grew African kales in 2000s (Figure 4). This was a fifty seven (57%) decline from 1970s to 2000s. In the 2000s, African kale was the least grown crop in the region. The research established that African kales grew in kitchen gardens and semi cultivated field. These vegetable species were reported to be delicious and preferred by households of all age groups because of their nutritive value. Fifty percent (50%) of the respondents stated that the decline was due to change in tastes and preference among the young generation aged below 40 years who prefer exotic kales over the African kales. Twenty five (25%) of the respondents reported that African kales are uprooted as weeds from sugarcane farms. Fifteen percent (15%) of the respondents reported that the decline was due to African kales taking a lot of time in cooking. The respondents indicated that cooking of African kales often mixed with other vegetables such as spider plant takes approximately one hour. Ten percent (10%) of the respondents indicated these vegetable species no longer thrives well due to the decline in the number of livestock in the region which has led to decline in animal manure. Abukutsa, (2007) indicated that African kales face strong competition from exotic Kales (sukumawiki, swahili) which is preferred by most of the young generation in the Western Kenya. Kimiywe et al., (2007) indicated that indigenous vegetables to take a long time of more than 40 min when boiling the vegetables for a long time before frying.



### Spider plant (*Cleome gynandra*)

Spider plant was cultivated by 78% of the respondents (Figure 4). This was a 12% decline from the 90% of households who grew the vegetable in 1960 (Figure 3). There was a 5% increase in the number of respondents growing spider plant in 1980s to 83%. There was a further one (1%) increase from the 83% of households who grew the vegetable in 1980 to 84% in 1990s. In 2000 there was then a thirteen percent (13%) drastic decline in the number of households who grew the vegetable.

Various reasons were reported to have attributed to the increase in spider plant in 1980s and 1990s. Fifty one (51%) of the respondents attributed the increase to the nutritional value of the crop. They reported that during this time, agricultural extension officers had sensitised the local community on the importance of spider plant in nutrition. Spider plant contains 5% protein, 6% carbohydrates and is rich in vitamin A and C (Obuoyo, 2005). Thirty percent (30%) of the respondents indicated that the increase in spider plant is because of its medicinal value. The crop is reported to control constipation. Francisca and Eyzayuirre (2006) pointed out that the government programs increasingly supported the consumption of indigenous vegetables such as spider plant through public advertisements and partnership with major Kenyan supermarkets who market these vegetables.

Various reasons were reported to have contributed to the great decline in spider plant in 2000s. Thirty one (31%) of the respondents attributed the decline experienced in the 2000s to sugarcane farming. They reported that the vegetable was uprooted from sugarcane farms as weeds. Forty percent (40%) of the respondents attributed the decline to change in tastes and preferences especially among the young generation with preference being given to exotic kales (sukumawiki). Nine percent (9%) of the respondents indicated that they did not have enough skill in the cooking of indigenous vegetable. They reported that spider plant takes a long time in preparation and requires special skill during cooking. Poor cooking skills would lead to it being bitter and less delicious. Twenty percent (20%) of the respondents indicated that that the decline was as result of expensive seeds. The research established that in the nearby Mumias market, the cost of a glass of spider plant seeds ranges from Ksh 130 to Ksh. 150 which the cost of cowpeas of the same quantity ranges from Ksh. 30 to Ksh. 50. This is quite expensive. Mathenge (1995) and Nekesa and Meso (1997) pointed out one problem facing indigenous vegetable in Kenya is lack of awareness of their nutritive value and the general notion that African traditional vegetables are 'backward'.

### Pigweed (*Amaranthus dubians*)

This vegetable species was given negligible attention by the respondents interviewed. They reported that pigweed

grows in the wild mostly in cowshed and kitchen dumping site. The crop is normally not grown but thrives on its own. Fifty eight percent (58%) of the respondents reported that they had pigweed on their farms in 1970s, 57% in 1980s, 54 % in 1990s and 2000s (Figure 4). The reasons given for the decline in this vegetable species were the decline in the number of livestock in the region as reported by 21% of the respondents. They reported that the decline in livestock has led to a decline in animal wastes. Fifty percent (50%) of the respondents attributed the decline to change in tastes and preference with many community members preferring exotic species. The PRA findings indicated that this vegetable is viewed as a poor man's crop and not cultivated by many people. Twenty nine percent (29%) of the respondents reported that weeding especially in sugarcane plantations destroys most the pigweed. FAO (2008) reported that the disappearance of vegetable such as pigweed puts the world's food supply at risk. In a study by Maundu et al. (1999) on Kenyan indigenous vegetables, it is assumed that due to clearing of land, over-stocking, over-exploitation and possibly climate change, there occurred a continual loss of wild food species at the farm and village level. This would mainly concern wild vegetables that grew only in uncultivated land for example, in forests.

### Conclusion

Indigenous vegetables that were cultivated before the introduction of commercial sugarcane farming included spiderplant, sunhemp, african nightshade, african kales, vegetable amaranthus, cowpeas, pigweed and jute mallow. Once sugarcane was introduced in 1970s, it occupied land of varying land percentages starting from 35% in 1970s, increasing to 48% in 1980s then declining to 43% in 1990s and 38% in 2000s. It was established that the clearing of vegetation to create land for commercial sugarcane farming led to the destruction of vine spinach and their natural habitats. This in the end led to the extinction of vine spinach vegetable species. African kale is the least cultivated vegetable species while sunhemp is the most cultivated vegetable species in the region.

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### REFERENCES

Abukutsa OMO (2007). The diversity of cultivated African Leafy Vegetables in three Communities in Western Kenya. *Afr. J. Food*

- Agric. Nutri. Dev. 7:1-5
- Cheesman OD (2006). Environmental impact of sugar production. Cambridge MA. Cabi Publishers Brazil.
- Ekesa BN, Walingo MK, Abukutsa MO (2008). Influence of Agricultural Biodiversity on Dietary Diversity of Pre school Children in Matungu Division, Western Kenya. *Afr. J. Food Agric. Nutr. Dev.* 8:390-404.
- Ekesa BN Walingo MK, Abukutsa MO (2009). Accessibility to and Consumption of Indigenous Vegetables and Fruits By Rural Households in Matungu Division, Western Kenya *Afr. J. Food, Agric. Nutri. Develop. Rural Outreach Program* ISSN: 1684-5358 EISSN: 1684-5374. 9(8):1725-1738.
- FAO (1999). What is agro biodiversity.? Food and Agricultural organization of the UN, Rome. [http://www.fao.org/SD/LINKS/documents\\_download/FS1WhatisAgrobiodiversity.pdf](http://www.fao.org/SD/LINKS/documents_download/FS1WhatisAgrobiodiversity.pdf).
- FAO (2008). Agriculture Outlook 2008. ? Food and Agricultural organization of the UN, Rome <http://www.oecd.org/dataoecd/44/18/40713249.pdf>.
- Fasinmirin JT, Olufayo AA (2009). Yield and water use efficiency of jute mallow *Corchorus olitorius* under varying soil water management strategies. *J. Med. Plants Res.* 3(4):186-191
- Fleuret (1979). Methods for evolution of the role of fruits and wild greens in shamba. diet. A case study from Lushoto, Tanzania. *Ecologist Food Nutr.* 8:87-93.
- Francisca SI, Eyzayuirre P (2006). African leafy vegetables: Their Role in the World Health Organization's. Global Fruit and Vegetable Initiative.
- Government of Kenya, GOK (1999). National Poverty Eradication Plan 1999-2015.
- Grivetti LE (1976). Dietary Resources and Social Aspects of food use in Tswana tribe. PhD Dissertation, Dept. Geography, University of California, Davis.
- Kimiye J, Waudo J, Dorcus M, Maundu P (2007). Utilization and Medicinal Value of Indigenous Leafy Vegetables Consumed in Urban and Peri-Urban Nairobi, *Afr. J. Food Agric. Nutr. Dev.* 7:1684-537.
- Maundu WP, Ngugi WG, Kabuye HSC (1999). Traditional Food Plants of Kenya. Nairobi, Kenya Resource Centre for Indigenous Knowledge (KENRIK).
- Mirghali KA, Tahir EI, Mohammed TI (2007). Indigenous vegetables of sudan; Production, utilisation and conservation. Agricultural Research Corporation, Wad Medani, Sudan p.1-4.
- Mathenge L (1995). Nutritional value and utilization of indigenous vegetables in Kenya. Paper presented at the workshop on "Genetic resources of Traditional vegetable in Africa". Options for conservation and use. Nairobi Kenya.
- Nekesa P, Meso B (1997). Traditional African vegetables in Kenya: production, marketing and utilization. In: Traditional African Vegetables. Promoting the conservation and use of underutilized and neglected crops. 16. Guarino L editor. Proceedings of the IPGRI International workshop on genetic Resources of Traditional Vegetables in Africa: Conservation and Use, 29-31 August 1995, ICRAF-HQ, Nairobi, Kenya. Institute of Plant Genetic and Crop Plant Research, Gatersleben International Plant Genetic Resources Institute, Rome, Italy pp.98-103.
- Netondo GW, Fuchaka W, Maina L, Naisiko T, Masayi N, Gaira JK (2010) Agro- biodiversity endangered by sugarcane farming in Mumias and Nzoia Sugar belts of Western Kenya. *Afr. J. Environ. Sci. Technol.* 4:437-445.
- Obuoyo JA (2005). The role of traditional crops in promoting food security in the dry Siaya district, Kenya. M.A Thesis. Maseno University.
- Oiye SO, Oniang'o RK, Shiundu KM (2009). The contribution of African Leafy Vegetables to vitamin A intake and the influence of income in Rural Kenya. *Afr. J. Food Agric. Nutr. Dev.* 9:1309-1324
- Oniang'o RK (2001). Enhancing People's nutritional status through revitalization of Agriculture and Related activities in *Afr. J. Food Nutr. Sci.* 1:43-49.
- Rehm S, Espig G (1991). The Cultivated Plants of the Tropics and Subtropics. Cultivation, Economic value, Utilisation. Technical Centre for Agriculture and Rural Cooperation, Wageningen Netherlands. Margraf publishers.
- Rhoades RE, Nazarea VD (1999). Local Management of Biodiversity in Traditional Agroecosystems. In: Collins Wanda W & Qualset Calvin O (eds.), Biodiversity in agro ecosystems. CRC Press LLC, New York, USA. pp.215-236.
- Swai REA (1991). Genetic resources of horticultural crops in Tanzanian. Proceedings of the First National Workshop on Plant Genetic Resources and Biotechnology; held at Arusha, Tanzania, (Shao FM, Magingo FSS, Minjas AN, Bitanyi HF and Mahunnah R eds.), Benedictine Publications, Ndanda, Peramiho Tanzania pp.251-266.
- Wambani H, Nyambati EM, Kamidi M (2008). Evaluation of Legumes as Components of Integrated Soil Nutrient Management For Kale Production .Kenya Agricultural Research Institute, National Agricultural Research Centre, P. O. Box 450, Kitale, Kenya. *Afr. J. Hort. Sci.* 1:91-99
- Wanjekeche E, Mwangi TJ, Kamidi1 M, Powon P Khaemba J (1997). Farmer Participation in the Evaluation of Grain Legumes in North - Western Kenya pp. 273-279.
- Waswa F, Mcharo M, Netondo G (2009). Enhancing household food and income security through crop diversification in the Nzoia and Mumias Sugar belts in Kenya. *J. Appl. Biosci.* 23:1406-1415.
- Wawire NWO, Shiundu RM, Kipruto KB (2010). Identification and Ranking of Sugarcane Production Constraints: The Case of Sony Sugar Zone. Kenya Sugar Research Foundation (KESREF), Kisumu, pp.1-6