International Scholars Journals

African Journal of Tropical Agriculture ISSN 2375-091X Vol. 4 (10), pp. 001-009, October, 2016. Available online at www.internationalscholarsjournals.org © International Scholars Journals



*Full Length Research Paper*

# Agrobiodiversity endangered by sugarcane farming in Mumias and Nzoia Sugarbelts of Western Kenya

**Godfrey Wafula Netondo[1]*, Fuchaka Waswa[2], Lucy Maina[2], Tabitha Naisiko[3], Nelly Masayi[4] and Josephine K. Ngaira[4]**

[1]Department of Botany and Horticulture, Faculty of Science, Maseno University, P. O. Box 333- 40105, Maseno, Kenya.
[2]Kenyatta University, P. O. Box 43844-00100, Nairobi, Kenya.
[3]Uganda Martyrs University, P. O. Box 5498, Kampala, Uganda.
[4]School of Environment and Earth Sciences, Maseno University, P. O. Box 333 – 40105, Maseno, Kenya.

Accepted 28 April, 2016

**Commercial sugarcane farming has been practised in western Kenya for nearly forty years. This monocultural land use is associated with loss of natural vegetation and cropland, thus undermining food security status of a place. Further, sugarcane farming is a major contributor to loss of biodiversity in western Kenya. This study was therefore aimed at determining the long-term effects of sugarcane farming on indigenous food crops and vegetables in Mumias and Nzoia sugarbelts of western Kenya. Up to 188 respondents in three divisions of Mumias and 178 respondents of three divisions in Nzoia were purposively selected. These included small-scale and large-scale farmers. Data were collected using questionnaires, Participatory Rural Appraisal tool, interviews and field observations. Secondary data were obtained from documented materials. Land under indigenous food crops and vegetable has been declining since the introduction of sugarcane. Indigenous food crops and vegetable cultivation by farmers in the sugarbelts has been declining. Furthermore, some farmers have abandoned the growing of these crops altogether. Our results imply that sugarcane farming is a major contributor to agrobiodiversity erosion, but that there are also other important reasons such as change of consumer preference, land fragmentation, climate variability among others. In order to curb further loss of biodiversity, efforts should particularly focus on food crops and livelihood diversification and adoption of farming technologies such as agroforestry.**

**Key words:** Biodiversity, farming, indigenous crops, monoculture, Western Kenya.

## INTRODUCTION

Biodiversity refers to all species of plants, animals and micro organisms existing and interacting within an ecosystem (Upreti and Ghale, 2002; Vandermeer and Perfecto, 1995; Pimentel et al., 1992). Biodiversity performs key ecosystem services including provision of food, shelter, oxygen and soil enrichment. Apart from boosting ecosystem productivity, biodiversity contributes to ecosystem resilience and stability. Agrobiodiversity, a subset of biodiversity, includes all crops and livestock, their wild relatives and all interacting species of pollinators, symbionts, pests, parasites, predators and competitors (Boef, 2000). In agricultural systems biodiversity performs ecosystem services beyond production of food, fiber, fuel and income. Biodiversity is necessary in the recycling of nutrients, control of local microclimate, regulating of local hydrological process, regulation of abundance of undesirable organisms and detoxification of noxious chemicals (Altieri, 1994).

Sugarcane can be considered as the single most important cash crop extensively grown in the Lake Victoria basin of Kenya and Uganda. In Kenya sugarcane is commercially grown in Western and Nyanza provinces, primarily by small scale farmers followed by large-scale farmers and company/factory nucleus estates (Gok, 2002). While setting up infrastructure for sugarcane farming and processing, minimal input is considered in terms of their impact on biodiversity. Land availability for

*Corresponding author. E-mail: godfreynetondo@yahoo.co.uk. Tel: +254-57351622 Ext. 3224. Fax: +254-573515221.

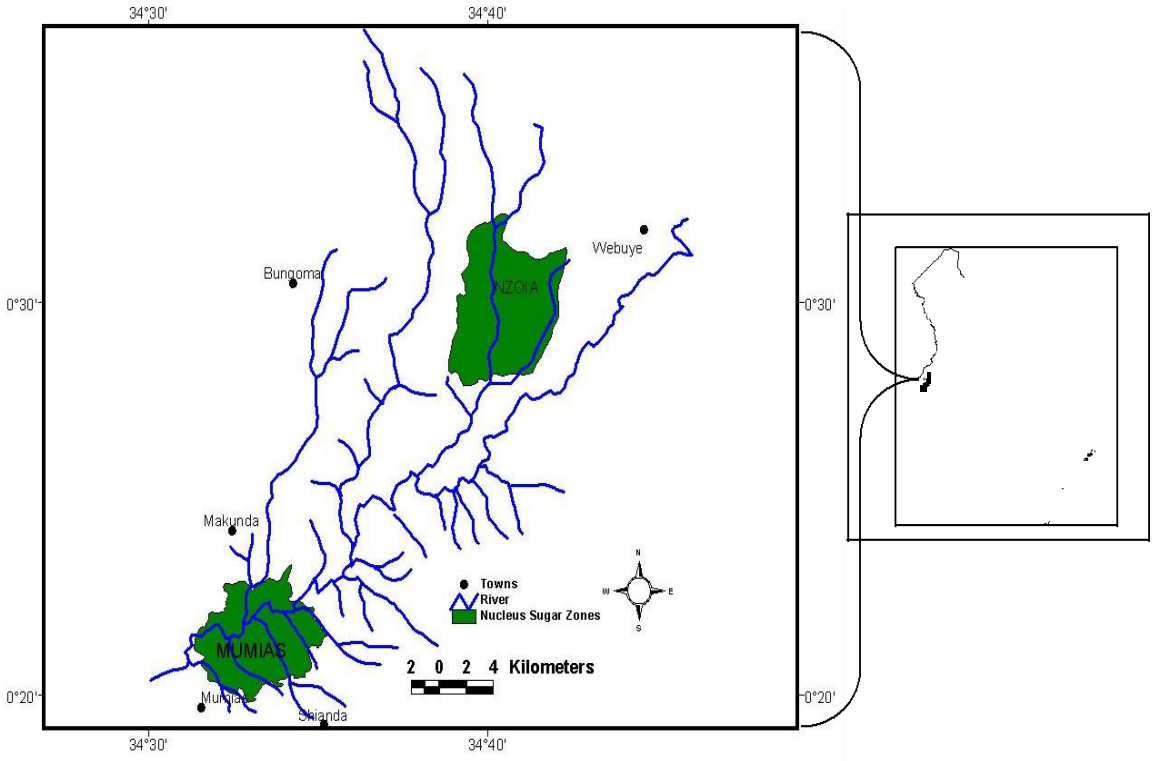


**Figure 1.** Location of Mumias and Nzoia Sugarbelts in Western Kenya. The shaded colour represents the nucleus estate of the sugar companies while out grower farmers occupy the surrounding areas of each nucleus estate. The sugar factories are within the nucleus estates.

subsistence farming and agricultural diversification as well as biodiversity conservation is not considered (Mallawaarachchi et al., 2001). For instance, sugarcane farming led to the reduction of Melaleuca ssp and the eucalyptus tree species in Australia (Johnson, 2000). Saving the remaining world's biodiversity has become an important public policy issue in the international, regional, and national level.

It is widely recognized that if the remaining biodiversity is allowed to disappear as a result of socio-economic activities such as sugarcane cultivation, people's livelihoods will be at stake (Alcamo et al., 2003) . This biodiversity, especially biological resources form a basis for global as well as national economic and ecological security. So far no tangible research has focused on the impact of sugarcane farming on agrobiodiversity in Kenya. This explains the focus of this paper on the effects of sugarcane farming on agro-biodiversity in Mumias and Nzoia sugarbelts in western Kenya, particularly the long term effect of sugarcane farming on indigenous food crops and vegetables.

## METHODOLOGY

The study was carried out in 2007 in Matungu, East Wanga, and Mumias in the Mumias sugarbelt and Kanduyi, Webuye and Sitikho divisions in the Nzoia sugarbelt, of Western Kenya (Figure 1).

Purposive and stratified random sampling techniques were used to select the respondents who included both small scale and large scale farmers. Primary data were collected using researcher administered questionnaires (188 and 178 respondents for Mumias and Nzoia, respectively), and Focus Group Discussions (FGD) involving thirty individuals who were selected with the assistance of local authorities. Both gender and age factors were put into consideration. Trend on changes in crop species were assessed by partitioning periods into five year intervals. Transect walks were used to augment the data collected. Data were analyzed using descriptive statistics focusing on frequency distribution, regression and Pearson's chi-square tests. Chi- square analysis was performed to compare the effect of sugarcane on growing of food crops and indigenous vegetables. In all cases the SPSS statistical package was used.

## RESULTS AND DISCUSSION

### Crops grown before sugarcane introduction

Before sugarcane farming was introduced in Nzoia sugarbelt, maize and cassava were the most cultivated crop according to the respondents at 84.5% and 84.4%, respectively (Figure 2a). This was followed by sorghum (76.3%), sweet potatoes (72.8%), and bananas (53.2%). In Mumias, Cassava, Finger millet, Millet (sorghum), bambara groundnuts among others were grown by farmers (Figure 2b).

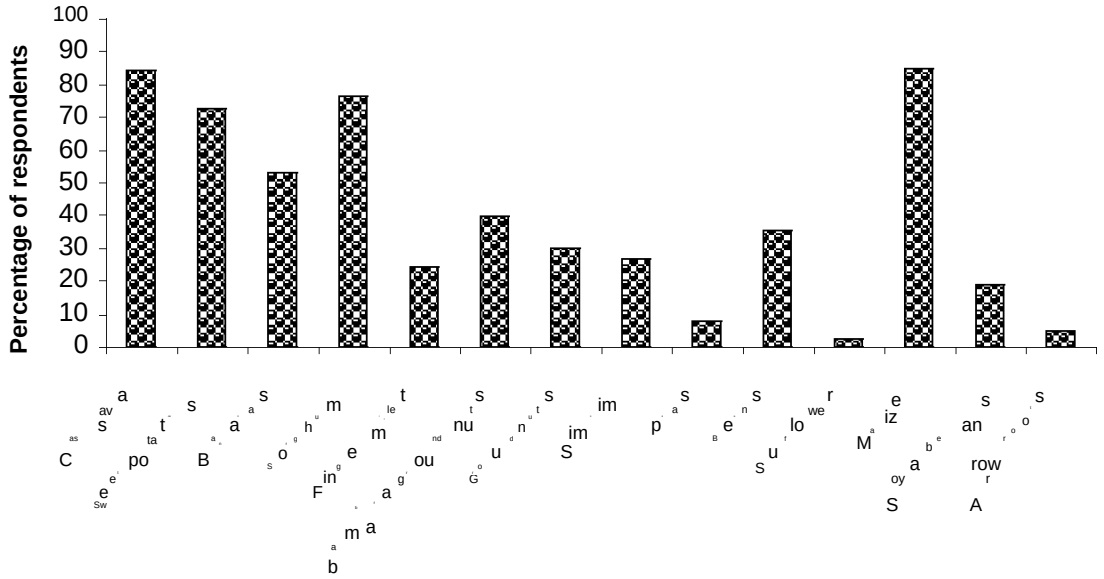


**Figure 2a.** Crops grown in Nzoia sugarbelt before sugarcane were introduced.

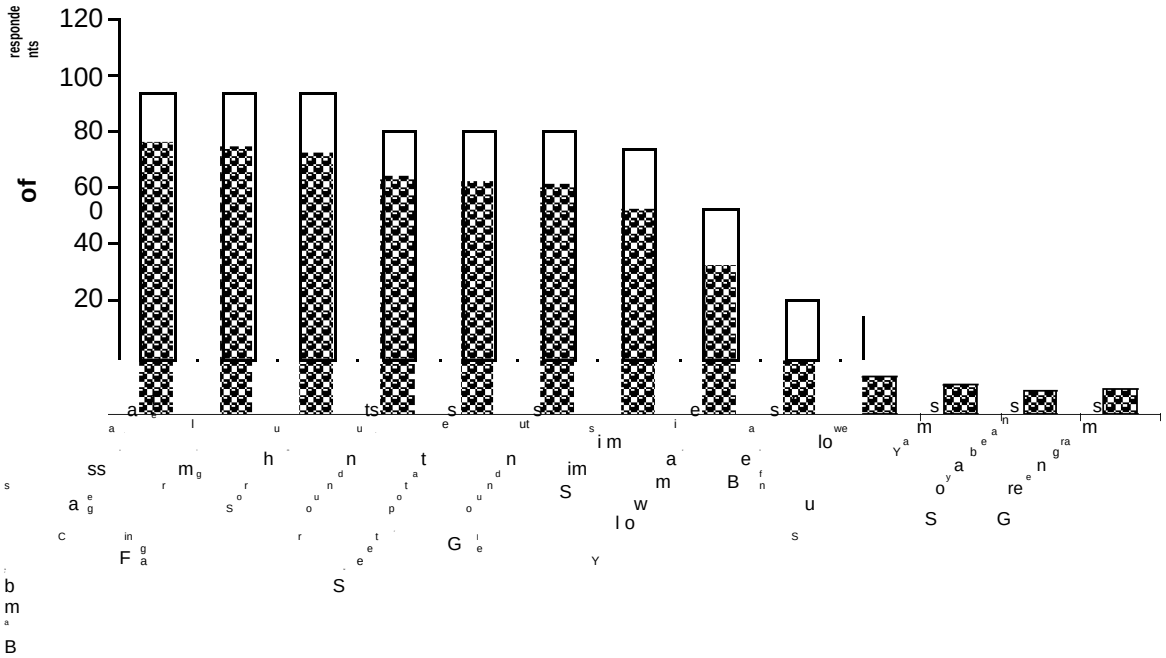


**Figure 2b.** Crops grown in Mumias sugarbelt before introduction of sugarcane.

Our data, in agreement with Nekesa and Meso (1997) indicate that traditional food crops were abundant in the area before sugarcane was introduced. Crops such as cassava, finger millet, sorghum, sweet potatoes, bambara groundnuts and simsim are ecologically adapted to the region. These crops were relied upon for food security because they are highly nutritious, and can withstand environmental stressors such as drought and inadequate soil nutrients. They also offered variety unlike the current status where maize is a staple food crop, but whose productivity is highly dependent on adequate rainfall.

**Effect of sugarcane farming on land size under indigenous crops**

The mean size of land in Mumias sugarbelt under all indigenous crops per farmer has been decreasing since 1960s from about 9.8 acres to about 4.6 acres in 2000s which is a two fold decline of the total land under indigenous crops (Figure 3a). The average acreage per farmer under sugarcane increased from 1970s and 1980s when sugarcane was introduced but has tended to decline in the 1990s and 2000s. Regression of size of land under sugarcane and indigenous crops was highly

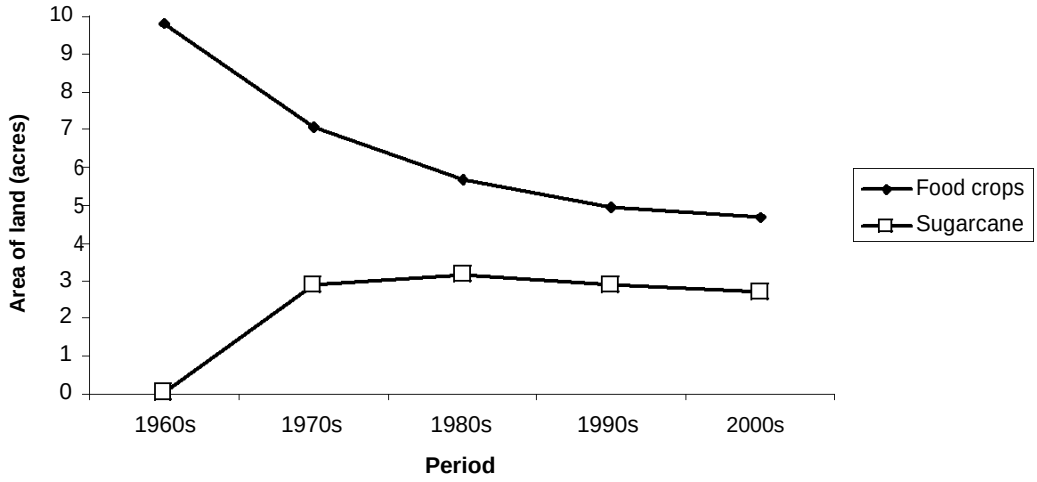


**Figure 3a.** Mean size of land under sugarcane and indigenous crops (combined) in Mumias sugarbelt from 1960s to 2000s.

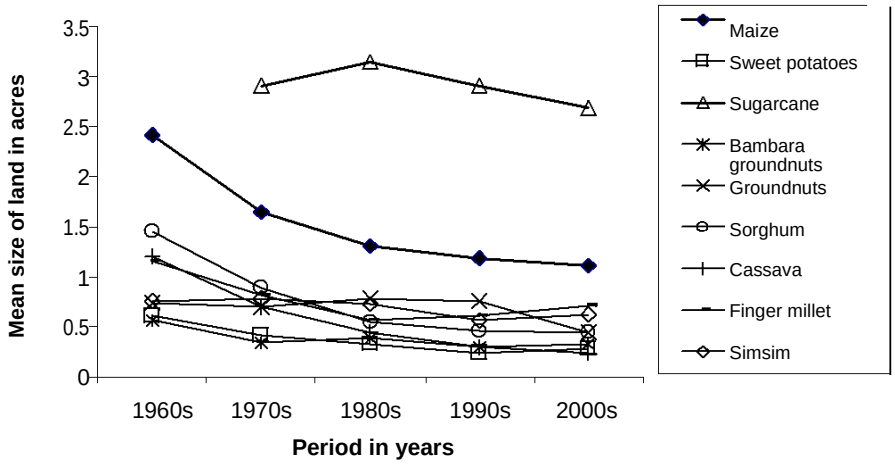


**Figure 3b.** Mean size of land per farmer under sugarcane and traditional crops in Mumias sugarbelt between 1960s to 2000s.

significant ($P<0.001$) . In this case the land under sugarcane continued to rise as that under indigenous crops decreased. Similarly chi-square test between area under sugarcane and indigenous crops was also highly significant ($p<0.000$). This shows that there is a strong relationship between sugarcane farming and the reduction in indigenous crops. Further, land under sugarcane increased inversely with the size of land under individual indigenous crops such as simsim, finger millet, bambara groundnuts, sorghum, cassava and sweat potatoes (Figure 3b). Similar trends were observed for Nzoia sugarbelt (data not shown). The acreage under sugarcane increased due to the introduction and promotion of monocultural sugarcane farming concomitant with the construction of Nzoia and Mumias sugar factories in the 1970s. However, in the 1980s the sizes began to reduce due to many factors such as land sub-division while sharing out between sons and selling of part of the land.

The key determinant underlying this trend is population pressure leading to fragmentation of land. Some farmers may also have started realising that sugarcane farming is not as lucrative as before and hence abandoned the growing of the crop. Other factors such as late harvesting and payment after harvesting may also have discouraged farmers from expanding acreage of sugarcane. On the other hand, land under indigenous food crops reduced in the 1970s and 1980s. However, in the 1990s and 2000s the decline in area under individual food crops eased. The farmers on realizing that sugarcane farming is not as profitable may have turned to growing some of the food crops; particularly maize which is a staple food crop.

Although acreage of traditional food crops such as sorghum and millet and vegetables have been shrinking

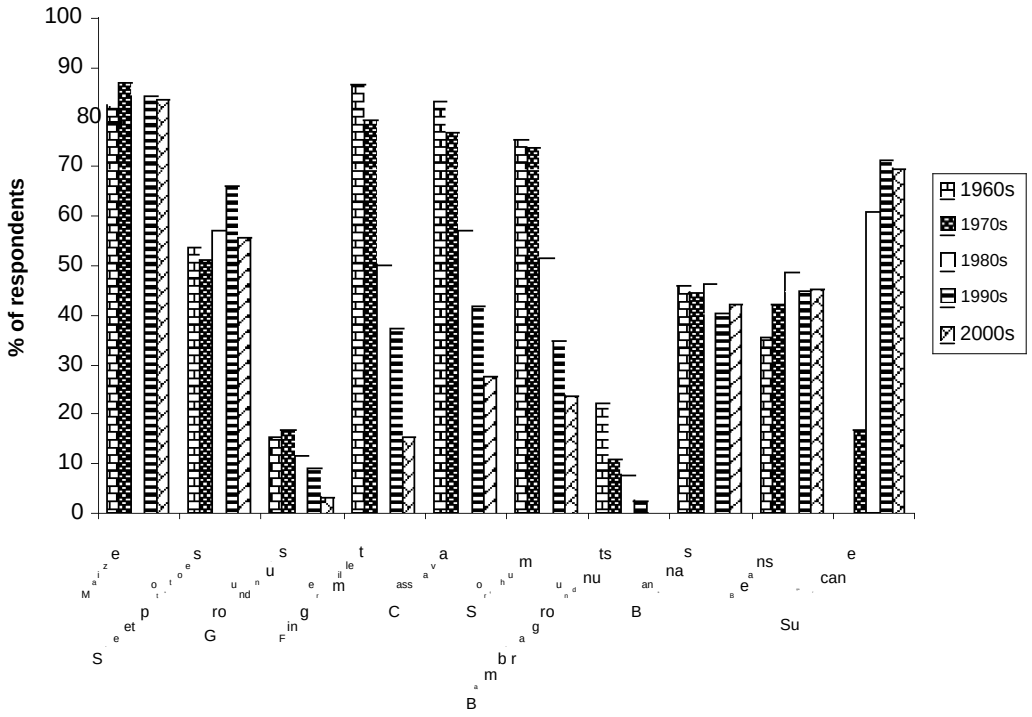


**Figure 4a.** Trends in major crops grown in the Nzoia sugarbelt since 1960s to 2000s.

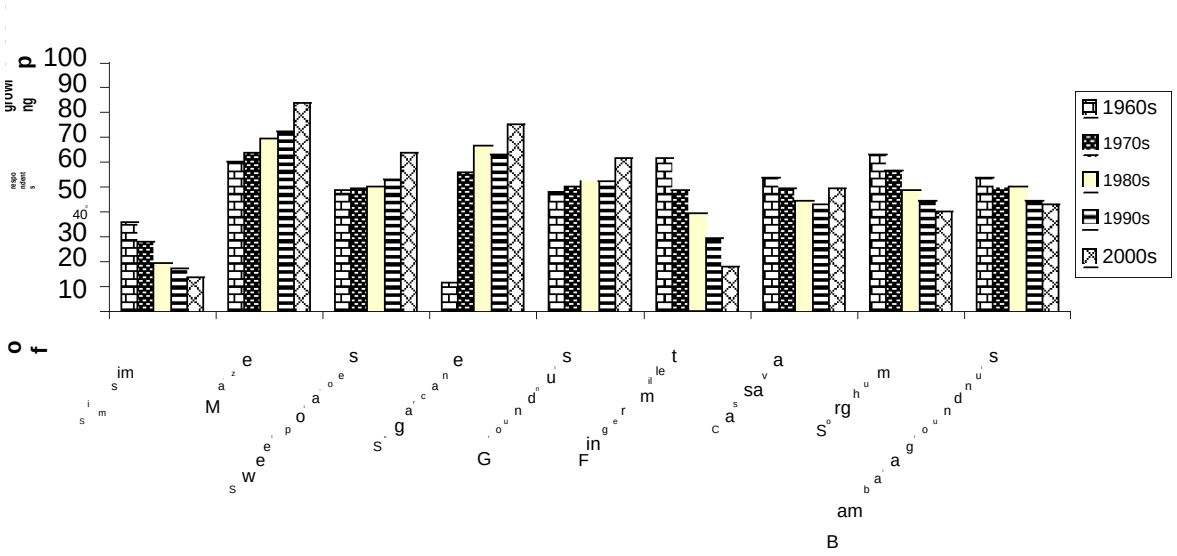


**Figure 4b.** Trends in major crops grown in the Mumias sugarbelt since 1960s to 2000s.

as a result of conversion of the land to sugarcane growing, some crops such as groundnuts and Bambara groundnuts are still being grown by some farmers because they are usually intercropped with sugarcane in the early stages of sugarcane growing up to about one (1) meter height. The intercropping may have contributed to the sustenance of the indigenous crops like bambara groundnuts in the study area (Nekesa and Meso 1997).

**Effects of sugarcane farming on the cultivation of indigenous food crop and vegetables**

While the cultivation of sugarcane increased over the period 1960s to 2000s that of the indigenous crops reduced (Figures 4a and 4b) . One of the most affected crops in Nzoia sugarbelt for the period is finger millet whose cultivation declined from about 60% to about 19%,

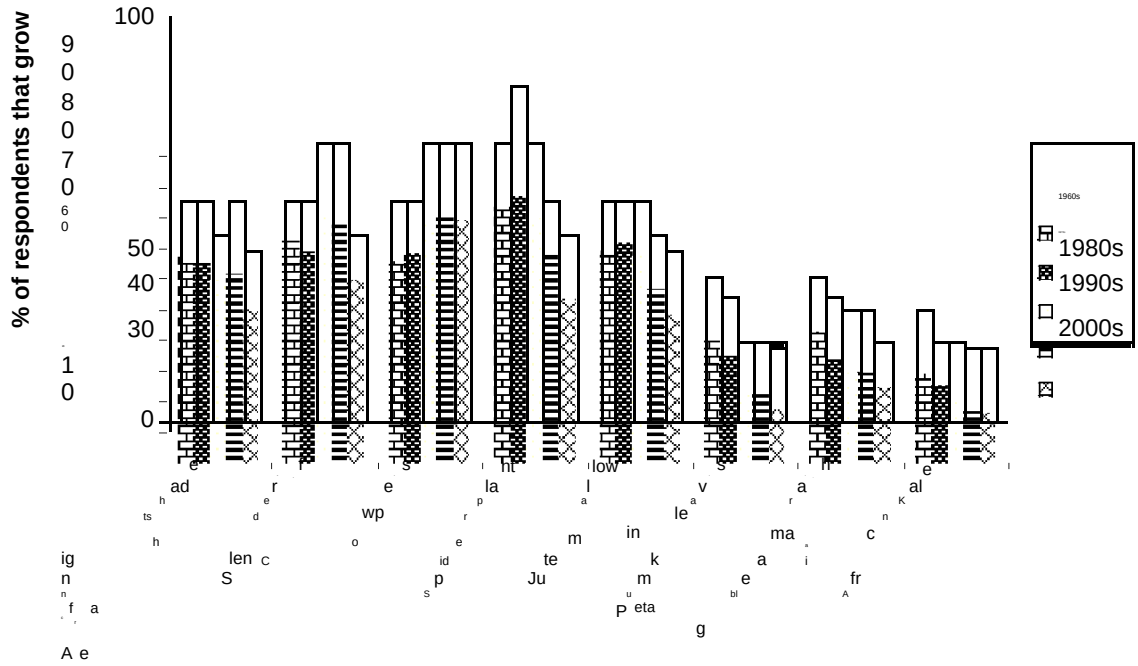


**Figure 5a.** Trends in the growing of indigenous African leafy vegetables in the Nzoia sugarbelt since 1960s to 2000s.

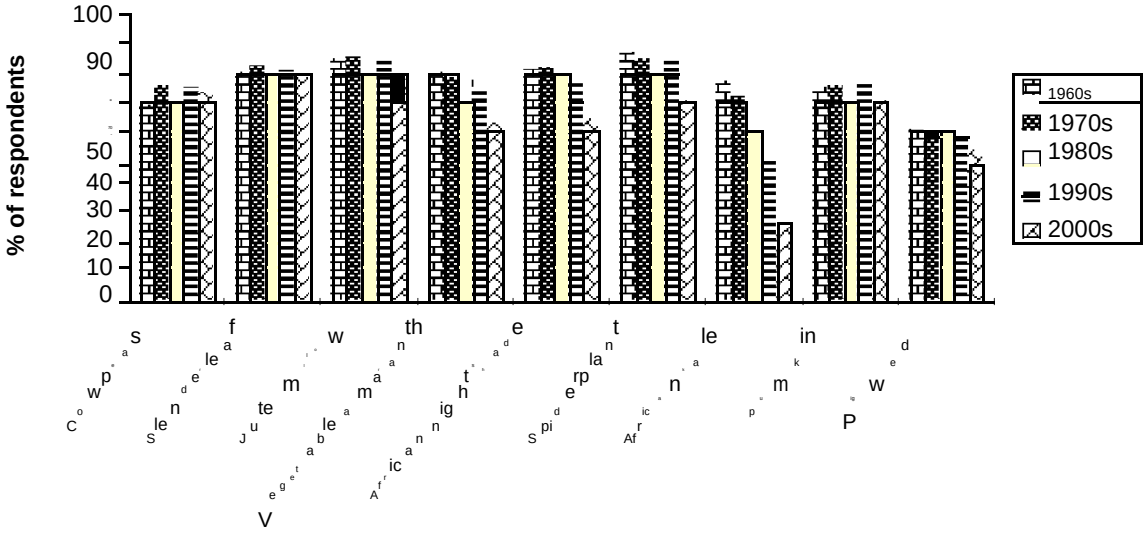


**Figure 5b.** Trends in the growing of indigenous African leafy vegetables in the Mumias sugarbelt since 1960s to 2000s.

translating to about 40% reduction. Others are cassava, sorghum and bambara groundnuts. In Mumias sugarbelt finger millet, sorghum and simsim were the most affected by sugarcane farming (Figure 4b)

In Nzoia some indigenous vegetables such as spiderplant, African nightshades, and vine spinach have been declining since 1960s (Figure 5a). Some vegetables like jute mallow increased from 1960s to 1990s before showing a slight decline in 200s.Vegetable amaranth does not show any clear pattern. Apparently more farmers have been growing cowpeas, as indicated by the steady increase since 1960s. In Mumias, remarkable declines occurred for African nightshades, vegetable amaranth and African kale (Figure 5b). Some reduction also occurred in jute mallow, spiderplant, pumpkin and pig weed.

The change in indigenous vegetables in relation to sugarcane were highly significant ($p<0.05$) indicating that sugarcane farming contributed to the decline of indigenous vegetables in Nzoia and Mumias. The decline in cultivation of the crops may have been due partly to the wrong perception that sugarcane farming is more profitable than the food crops (Waswa et al., 2009). The study indicates that expansion of sugarcane farming poses a high risk to the existence of varietal diversity of indigenous vegetables such as pumpkin, African night-shade, amaranths and food crops like sorghum, finger millet, cassava and sweet potatoes. This is exacerbated by farmers abandoning the growing of the crops. Most indigenous crops have many landraces with unique qualities.

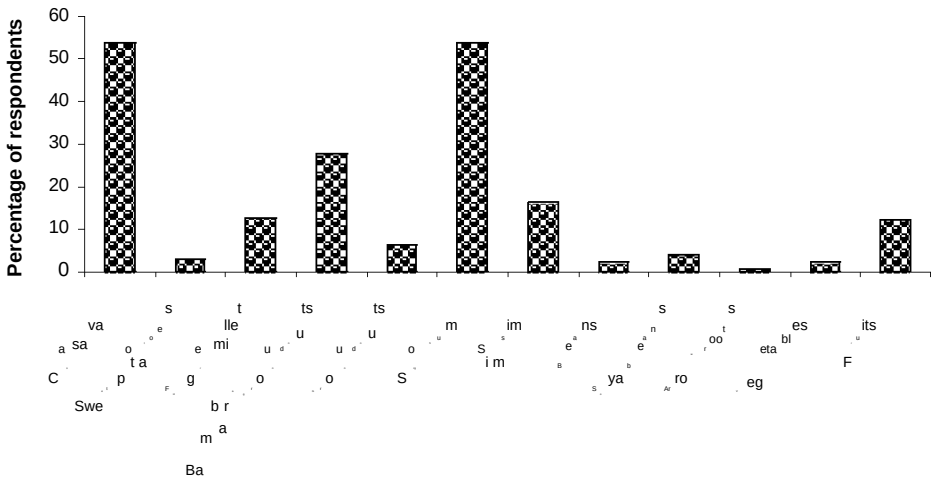


**Figure 6a.** Percentage of farmers who have abandoned cultivation of specific food crops in Nzoia sugarbelt.

The farmers also have personal networks through which they disseminate local varieties/landraces. Furthermore, they practice intercropping, fallow cropping and relay cropping. All these traditional practices contribute to maintenance of crop and vegetable diversity. However, contemporary forms of agriculture, particularly monoculture has contributed to accelerated agrobiodiversity erosion by replacing these traditional faming technologies, which mostly encourage crop diversification. As indicated by Upreti and Ghale (2002) and FAO (2004) that commercialization of agriculture is the main cause of food crop diversity loss, sugarcane farming in the study area is contributing significantly to the same. These indigenous crops and vegetables were grown mainly for local consumption and were also of medicinal value as well as festivals and making of alcohol. The inputs such as chemical fertilizers, pesticides and insecticides are minimal (Upreti and Ghale, 2002). The spatial distribution and exchange of local varieties through seeds and other propagation materials have been disrupted, further contributing to loss of variety

The decline of traditional varieties/landraces of food crops and vegetables is called genetic erosion (Picone and van Tassel, 2002) . This eventually leads to loss of genetic diversity which has the impact of loss of genes necessary for improvement of food crops against pests, diseases, environmental stresses like water deficit and salinity. By losing landraces through sugarcane farming we are undermining our ability to adapt crops to future conditions, including climate change (Picone and van Tassel, 2002).

## Abandonment of indigenous food crop cultivation

Some farmers reported to have abandoned growing indigenous crops. The key crops that have been significantly abandoned due to sugarcane farming in Nzoia sugarbelt are cassava and sorghum, despite their ecological suitability (Figure 6a). For Mumias most farmers have abandoned finger millet, simsism, sorghum and bambara groundnuts (Figure 6b). Reasons for deserting cultivation of food crops were varied. Whereas 89.4% respondents in Mumias cited sugar cane farming as the main cause, only 26.7% respondents gave the same reason for Nzoia (Table 1). However nearly equal number of respondents cited land fragmentation/limited land at 34.9 and 34.5% for Mumias and Nzoia, respectively. Soil infertility (27.5%) featured prominently as reason for abandoning the food crops in Mumias but was not cited in Nzoia. Other reasons include pests and diseases, change of taste and preference, low production, labour intensive, lack of seeds, lack of ready market, change of climate and low returns, most of which were cited by less than 10% of the respondents.

The abandonment of food crops and vegetable cultivation has contributed to their disappearance in Mumias and Nzoia sugarbelts and by extension all other sugarcane growing regions in the Lake Victoria region. The roles played by other factors cited by the farmers (Table 1) are equally important. In this study it was reported that cassava was affected by cassava mosaic virus forcing many farmers to abandon growing it. Generational preferences mainly involving youths indicate that they lack interest in some crops such as bambara groundnuts, sorghum, simsim and finger millet. The youths also dislike the foods prepared from these crops. According to Liwenga et al. (2008) sugarcane cultivation renders the soil infertile and hence cannot support crops like finger millet, thus contributing to their abandonment.

## Conclusions

There has been a decrease in land under indigenous crops and vegetables since the introduction of sugarcane

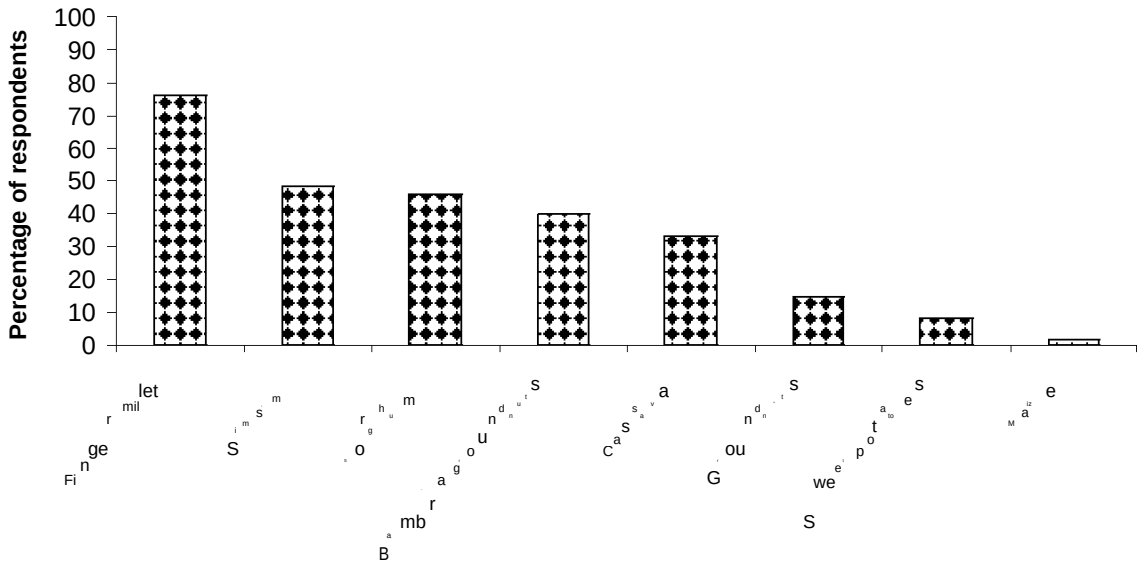


**Figure 6b.** Percentage of farmers who have abandoned cultivation of specific food crops in Mumias sugarbelt.

**Table 1.** Reasons for abandoning growing of some food crops in Nzoia and Mumias sugarbelts.

| Reason | Percentage of respondents | |
|---|---|---|
| | Nzoia | Mumias |
| Sugarcane farming | 26.7 | 89.4 |
| Land fragmentation/limited land | 34.5 | 34.9 |
| Soil infertility | - | 27.5 |
| Change of taste and preference | 10.5 | 16.4 |
| Introduction of exotic plants | - | 12.7 |
| Pests/moles/diseases | 7.5 | 10.1 |
| Climate variability | 1.0 | 6.9 |
| Lack of skills | - | 4.8 |
| Labour intensive | 4.8 | 4.8 |
| Expensive seeds | 1.9 | 1.1 |
| Poverty | - | 0.5 |
| Lack of ready market | 3.8 | - |
| High production costs | 9.5 | - |

in Nzoia and Mumias sugarbelts in western Kenya. The cultivation of both indigenous crops and vegetables has shown a declining trend. Some of the affected indigenous crop and vegetable species include sorghum, finger millet, bambara groundnuts and simsim, African kale, African nightshade, amaranths and spiderplant among others. Whereas sugarcane farming has significantly contributed to the decline of agrobiodiversity other factors have also contributed to decline in crop and vegetable diversity, including land fragmentation, soil infertility, changes in consumption tastes and preferences, pests and diseases, labour intensiveness of some crops like bambara groundnuts, poor adoption of new farming technologies and high costs of seeds. The decline or abandonment of the crops and vegetables leads to erosion of genetic resources and pose a high risk of loss of species diversity if precautionary conservation measures are not instituted in time.

From the foregoing it is recommended that enhancing biodiversity through various interventions is needed urgently. This may include revegetation of farm edges, introducing agroforestry practices such as integrating strips of land in farms to provide natural habitats and enhancing technical skills in crop diversification (Kindt et al., 2005). This will enhance and maintain agrobiodiversity of food crops and vegetables in the sugarbelts. Further, crop diversification should be promoted, particularly those that are early maturing, highly nutritious and adapted to the ecology of the sugarbelts. Farmers with small pieces of land should be discouraged from growing sugarcane

since it is not economical.


## ACKNOWLEDGEMENTS

The authors thank the Lake Victoria Research Initiative (ViCres) a programme of the Inter University Council of East Africa (IUCEA) for funding the research from which this paper is derived. Appreciation is also extended to the respondents for their cooperation.


### REFERENCES


Alcamo J, Ash NJ, Butler CD (2003). Ecosystem and Human Well-being. Millennium Ecosystem Assessment. A framework for assessment. Island press, Washington.

Altieri AM (1994). The ecological Role of Biodiversity in Agroecosystem. Elsevier Publishers.

Boef WS (2000). Learning about institutional frameworks that support farmer management of agro-biodiversity: Tales of the unpredictables. PhD. thesis, Wageningen University, Wageningen, the Netherlands pp. 281-300.

FAO (2004). What is agrobiodiversity? Food and Agricultural organization of the UN, Rome. http://www.oecd.org/dataoecd/44/18/40713249.pdf.Cited 15 February 2009.

GoK (2002). Butere- Mumias District Development Plan. Ministry of Planning, Government of Kenya. Government printers Nairobi, Kenya.

Johnson AK (2000). Land cover changes and its environmental significance in the Herbert River Catchment North East Queensland. Routledge publishers, Babinda, Queensland.

Kindt R, Niordin Q, Njui A, and Ruigu S (2005). Biodiversity conservation through agroforestry. Managing tree species within a network of community based non governmental, governmental and research organisation in Western Kenya. ICRAF working paper no. 2 Nairobi. World Agroforestry Centre.

Liwenga ET, Kangalawe RYM, Masao CA (2008). Agricultural Commercialisation and Biodiversity. Institute of resource Assessment, University of Dares Salaam Morogoro Tanzania.

Mallawaarachchi T, Blamey RK, Morrison MD, Johnson AKL, Bennett JW (2001). Community values for environmental protection in a cane farming catchment in Northern Australia: A Choice Modelling Study. J Environ. Manage., 62: 301-316.

Nekesa P, Meso B (1997). Traditional African vegetables in Kenya: production, marketing and utilization. Organic Matter Manage, Network, Nairobi, Kenya.

Picone C, Van Tassel D (2002). Agriculture and biodiversity loss, Industrial Agriculture. Published in Niles Eldredge (Ed) Life on earth: An Encyclopaedia of biodiversity, Ecology and Evolution, pp. 99-105, ABC- CLIO, Santa Barbara, California.

Pimentel D, Stachow U, Takacs DA, Brubaker HW, Dumas AR, Meaney JJ, O'neil JAS, Onsi, DE, Corzilius DB (1992). Conserving biological diversity in Agricultural/ Forestry System. BioScience, 42: 354-362.

Upreti RB, Ghale YU (2002). Factors leading to biodiversity loss in developing countries: The case of Nepal. Biodivers Conserv., 11: 1607-1621.

Vandermeer J, Perfecto I (1995). Breakfast of Biodiversity: The truth about Rainforest Destruction, Foodfast Books, Oakland, p. 185.

Waswa F, Netondo G, Maina L, Naisiko T, Wangamati J (2009). Potential of Corporate Social Responsibility for poverty alleviation among Contracted sugarcane farmers in the Nzoia sugarbelt, Western Kenya. J. Agric. Environ. Ethics, 22: 463-475. DOi 10.1007/s10806-009-9165-6.