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Horticulture in Mountain Agro-Ecosystems of Uganda: Environmental and Socio-Economic Threats and Opportunities

Bob Roga Nakileza

Department of Environmental Management,

Makerere University, Uganda

Corresponding author: nakilezabob@gmail.com

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Abstract: Horticultural crops have gained importance over the recent years as a strategy for addressing livelihood improvement particularly amongst both the rural and urban poor in high- and low- mountain areas. Mountain ecosystems in Uganda, however, are under pressure driven by increasing population, urbanisation and globalization. This has resulted into widely reported environmental degradation. Environmental and social concerns are a reality that needs to be underpinned if sustainable use of these ecosystems is to be achieved. This paper examined the socio-ecological problems, challenges posed by increased shift to horticultural farming and opportunities in mountain ecosystems of Uganda, using a case study of Mt Elgon. Data collection was obtained largely through household surveys, focus group discussions and field observations. Results revealed that household economic gain and unsustainable traditional crop production systems were the main drivers for the recent shift to intensive horticultural system. These changes have caused environmental and social concerns particularly accelerated erosion, health risks associated with increased use of chemical inputs, and conflict largely attributed to encroachment on conservation areas for farming and staking materials. The study recommends for pro-active measures (e.g. increased investment in horticultural value chain) in mitigating environmental and social problems if future sustainability of the mountain ecosystems are to be attained.

Keywords: Agro- ecosystems, Environmental, Horticulture, Mountain, Socio-ecological, Threats, Uganda

INTRODUCTION

Horticultural crops, which include vegetables, fruits, flowers and spices, have become an important produce supporting numerous smallholder livelihoods and through exports the national economies. A significant share of the total volume and value of horticultural crops at a global scale is contributed by Potato (*Solanum tuberosum),* sweet potato (*Ipomoea batatas*), and minor roots and tubers. These commodities are particularly important as a source of food, employment, and income in developing countries where the bulk of the world's producers, processors, and consumers reside (Zandstra and Scoot, 2007; Sati et al., 2015). According to Prain et al. (2007) global fruit and vegetable production increased by 50% during the 1990s, from 0.81 to 1.2 billion MTs. Meanwhile, per capita availability grew by 25%. Krishina et al. (2008) in Nepal found that adoption of vegetable farming improved the socio-economic condition of the upland farmers, particularly the poor, women and disadvantaged groups, in terms of their food security, farm income, resource accessibility, employment opportunity and social status.

Horticultural crop growing, however, is affected by complex environmental conditions. The consequences of such rapid change for instance global warming, change of seasonal pattern, excessive rain, melting of ice cap, flood, rising sea level and drought lead to extremity of all kinds. As observed by Datta (2013), decrease in potential yields is likely to be caused by shortening of the growing period, decrease in water availability and poor vernalization). In Kenya, Kiteme (2013) observed threats to horticultural production caused by decline or fluctuations in water flows from Mt Kenya.

In Uganda quite a number of horticultural crops are mainly grown in the mountain and highland areas. The liberalization policy, un-favourable prices for traditional crops and the need for short term benefits have been the key drivers for the shift to high value crops. Most of the horticultural crops are considered of high value and therefore grown to supplement household revenue. Although Kenya is still the leading grower of

horticultural produce in Africa, Uganda is on the rise due to the ideal climate and light intensity, water, fertile soils and labour (Ngamau, 2013). Horticultural crops have gained importance in Uganda over the last one and half decade since 1990 (Figure 1). This is partly explained by the growing urban market in the country, foreign demand and also the government diversification policy. The other factor is the favourable environmental conditions particularly in the mountain and highland areas. For instance, the vertical variations in climate conditions including topography and soils favour the growth of different horticultural crops. This was similarly noted in the Himalaya Mountains by Sati (2005), who explained that the farming system depends upon the three variable factors, the composition of the soil, the position of the field (elevation), slope aspects and the presence or absence of irrigation.

Despite the growing interest in horticultural crops and in particular its contribution to the economy of Uganda, there is still dearth of knowledge in social and ecological problems resulting from their increased adoption in fragile mountain ecosystems. This study aimed at investigating the socio-ecological problems and challenges posed by increased shift to horticultural farming in mountain ecosystems of Uganda, using a case study of Mt Elgon. It further examined the opportunities provided to farmers and other actors engaged in horticultural crops. Information generated is essential in developing a framework to guide research monitoring, resource managers and decision makers in planning sustainable land use in such fragile environments.

METHODS

Study area

The study focused on the western slopes of Mt Elgon in Uganda (Figure 2), an area ranging between 1500m to <2500m a.s.l. The area belongs to the montane agro-ecosystem

characterized by relatively high rainfall (1200-1800mm per annum), cool temperate conditions (15 ^{o} to 25^{o} C). The soils are relatively fertile; nitisols and andosols are dominant. The dense drainage system (rivers, streams, and creek) from the mountain provides water sources for various uses including growth of horticultural crops. The varied environmental conditions (climate, slope, aspect, soils) support the growth of various horticultural crops such as fruits and vegetables. Horticultural crops such as carrots, onions, peas, cabbages, climbing beans, passion fruits and Irish potatoes are more favourable at higher altitude; oranges, mangoes, papaya perform relatively better at lower altitudes. Tomatoes do relatively well across the different altitudes depending on the land and moisture availability. The population pressure is high owing to high growth rate (averaging 3%); population density in some areas exceeds 1000 persons per km^2. Agriculture forms the main economic activity with intensive cultivation of coffee, banana and horticulture. The area constitutes part of an important catchment system supplying water in the low- and high-land areas for domestic and agricultural use among others. Environmental degradation, however, is an increasing problem caused by intensive cultivation on marginal lands coupled with inadequate conservation measures (NEMA, 1998, 2001). Three catchment areas of Wanale in Mbale district, Atari in Kapchorwa district and Upper Simu river catchment in Bulambuli district were selected for detailed study, mainly because they are major producers of horticultural crops in Mt Elgon.

Research design and data collection

The study adopted use of qualitative and quantitative approach. Therefore both quantitative and qualitative data were collected from 2013 to 2015. Data collection was done through interviews, group discussions, field observations and review of secondary literature. A total of 120 farmers were randomly sampled from purposively selected three catchments dominating in growing horticultural crops. The respondents were

interviewed using a structured questionnaire to obtain data on their socio-demographic characteristics, types, varieties and yield of horticultural crops grown, benefits and problems associated with growing horticultural crops. Nine group discussions (three per catchment), each composed of carefully selected male and female respondents involved in horticultural farming, were administered. The discussions mainly centred on perceived problems and strategies to addressing risks related to horticultural farming. Field observations included crop combinations, evidence of degradation, and conservation practices on farmlands. Literature sources reviewed included government reports and published journal papers. Quantitative data from household survey was captured and analysed using standard statistical software (SPSS) to generate descriptive and inferential statistics. Data from interviews and discussions was analysed qualitatively based on themes and subthemes.

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents

A summary of the respondents' socio-demographic characteristics in the study area is presented in Table 1. The majority of the respondents (33%) were aged between 26 to 35 years implying the predominance of the young farmers in horticultural farming. In terms of education a large percentage of the respondents (63%) had attained primary education. This means quiet a substantial number had low literacy level. Those that had tertiary education were the least (3%). This has implications on farmers' adoption decisions. Nhemachena and Hassan (2007) observed that education is likely to enhance the farmers' ability to receive, decipher and comprehend information relevant to making innovative decisions in their farms. Most of the respondents (73%) owned plots barely exceeding 1 acre thus the study engaged mainly small scale farming communities in the area. Majority

of the respondents (49%) are low income earners with barely more than a total of US $ 7.8 (UGX 25,000) income per month. This has implications on level of investment in farming and thus constrains agricultural development.

Horticultural crop production in the study area

As summarized in Table 2 and Figure 3, various types of horticultural crops are grown in the area. However, dominant horticultural crops grown are vegetables including beans (21%), onions (20%), cowpeas (16%) and carrots (13%).

Carrots are dominantly grown in Kigezi village in Wanale sub county. Fruit trees such as mangoes, oranges and pawpaw were rarely found growing at high altitude areas in the villages of Sukut and Bunabude. The Avocado fruit trees were dominantly grown in all the villages studied

Based on the above information on fruit and vegetables grown, it is generalized that horticulture is a major preoccupation in Mt Elgon and in most particular in the higher altitude sub counties of Wanale in Mbale district, and Kapchesombe in Kapchorwa district. Interviews held with the extension staff revealed that there were over 2500 families engaged in horticultural farming in Wanale Sub County alone. Generally landholdings (Table 2) are small averaging one acre per household. Thus the land is intensively farmed every year. Unit production is still low (Table 3) due to low adoption of improved farming practices.

Men are solely responsible for growing and selling of the majority of horticultural harvest. However, women are generally in charge of beans. Horticultural crops like carrots fetch fairly substantial amount of money (US % >1 per kg) and this could explain why men have taken full control. This confirms the existence of strong patriarchal control in the rural areas of this mountain region.

Almost all the produce is sold out to markets in Mbale, Soroti, Tororo and other numerous urban areas as far as Kampala city. Part of the produce is also exported to Southern Sudan by local traders. Interviews with the NAADS coordinator revealed that on average the Wanale sub county in Mbale district ferries out 24 M tons per week of assorted farm produce of carrots, potatoes and climbing/field beans. Cultivation of horticultural crops especially have socio-ecological implications as underpinned in the next section.

Ecological problems associated with horticultural crop production

Numerous ecological problems experienced as a result of growing horticultural crops are summarized in Table 4. A large percentage of the responses (266.7%) indicated major problems of soil erosion, low soil fertility and pests. Other problems reported were poor crop yield and low rainfall. Low and erratic rainfall was linked to inadequate soil moisture especially during off-season in December to February. Datta (2013) observed that climatic variations such as erratic rainfall and high temperatures severely stress horticultural crop yields.

Table 5provides a summary on the analysis of the relationship between respondents' characteristics and ecological problems.

Analysis revealed significant association between respondents' socio-demographic characteristics and ecological problems experienced at 10% confidence level. Most respondents with small size of land parcel perceived soil erosion, low fertility and crop yield to be main problems hindering horticultural crop production. One of the prominent ecological problems reported in horticultural crop growing areas was accelerated soil erosion, which is induced by clean weeding, cultivation on steep slopes, and lack of use of appropriate conservation measures. This is in conformity with Yadaz et al. (2015) and Krishna et al. (2008) observations that horticultural crops grown on the hill slopes without

proper soil and water conservation result in soil erosion. They noted that soil erosion varied with the extent of disturbances caused to the soil surface. Loss of soil undermines soil nutrient levels leading to decline in crop yield. It was reported that most commonly the decline in crop yield prompted farmers to apply fertilizers (e.g. NPK, Urea) though it is expensive, and there are negative consequences on the environment where improperly applied as pointed out below.

Some horticultural crops such as carrots and onions reportedly need specific requirements such as open space in order to ensure good production. Consequently tree cover is dramatically reduced or totally eliminated on farmlands where such crops are grown (Figure 4a). This type of practice exposes the soil surface to erosive agents hence accelerated loss of soil and nutrients (Figure 4b). This is in agreement with Rasul (2009) who indicated that financial benefits associated with annual cash crops are off-set by high environmental costs, specifically in terms of soil erosion, carbon emission and biodiversity loss, which in the long term negatively affect agricultural sustainability.

Interviews and discussions with the extension workers and farmers revealed that chemical inputs frequently applied include herbicides, pesticides and artificial fertilizers. However, use of these chemicals is associated with environmental consequences. Krishna et al. (2008) noted that the increasing use of chemical fertilizers and decreasing use of farmyard manure (FYM) in vegetable-based CP indicates a low level of sustainability in upland farming systems. Chemical pollution presents a major problem particularly to water quality and soil biodiversity conservation. Herbicides (e.g. Sencor 7 EC) are commonly used to control weeds; for zero tillage purposes. Application of such chemicals, however, poses serious risks to health and aquatic life. Sencor 7 may have adverse effects on aquatic organisms and some beneficial insects, in particular where pest management is applied to foliage dwelling predators. Lewis et al. (2006) in UK observed serious potential risks to human health due to wide application of pesticides and other chemicals in fruit and field vegetables. Similar environmental and health concerns regarding use of

agricultural chemicals were also noted by Nonga et al. (2011) in Tanzania. As revealed in Table 6 numerous respondents applied fertilizers (e.g. 34 % for the NPK and 32% for the Urea) regularly for boosting production whenever they perceived low soil fertility on their gardens. For instance, farmers in the study area such as Wanale, a dominant horticultural crop growing area in Mbale district, do not practice regular crop rotation. Under such conditions the soils rarely regain their natural fertility status and therefore use of fertilizers is inevitable. Fertilisers are commonly used to double yields in horticultural crops; for instance NPK is applied in the ratio of 25:5:5 at a rate of 100 kgs per acre.

According to the Wanale National Agricultural Advisory Services [NAADS] coordinator some farmers apply over and above this rate of chemical fertilizers expectedly for higher yields. Frequent use of fertilizers has been alleged to result in soil structural degradation; loose soil structure. Similar observations have been made by other authors (e.g. Maskey, et al. 2003; Newly & Treverrow, 2006) regarding excessive use of fertilisers and soil degradation. Stringer (1998) also indicated that intensive fertiliser use in fruit and vegetable production cause environmental problems. Thus in this study area, as argued by Reetz et al. (2015) there is need for nutrient stewardship, which is the efficient and effective use of plant nutrients to achieve economic, social and environmental benefits with the engagement of farmers and other stakeholders.

Use of organic fertilizers (e.g. organic manure) would be more appropriate but these are rarely applied due to associated limitations of labour for transporting bulky inputs to fields commonly located far away from homesteads. Water analyses at Manafwa water works have recorded slightly higher levels above WHO standards for some chemicals such as nitrates and phosphates (John Oluka, personal communication, 2014). Though it is hard to underpin the exact source in the watersheds, it is most probable that frequent application on horticultural farmlands upstream provide strong evidence.

Consumers of horticultural produce are at risk of exposure to pollutants in plant tissues or root tubers consumed; for instance related chemical pollution was noted in the vegetable materials in Kampala city (Prain, et al. 2007). Spraying is commonly done to cope with the economic or market demand; there is high demand for fresh horticultural produce in urbanizing areas in the region. Thus, there is no doubt that use of pesticides is necessary to contain the pests. However, poor pesticide management practices such as frequent application and poor handling of the toxic chemicals by farmers may threaten the environment or health conditions including the lives of consumers.

Field observations showed that farmers widely cultivated close to or up to the edge of rivers/streams both upstream and downstream. This contributed to the surface water pollution. This observation is in agreement with what Muriithi and Yu (2015) noted in Kenya, that intensive farming along river banks reduces the natural riparian buffer, creating the easy movement of eroded materials into surface waters. Such anthropogenic disturbances introduce suspended materials into river system, thereby augmenting the amount of dissolved materials, EC, and salinity of surface waters within small scale intensive horticulture land use.

Social problems associated with horticultural crop production

Interviews and discussions with various respondents revealed the prevalence of numerous social and related economic problems faced by farmers in horticultural crop production in Mt Elgon (Table 7). The main problems included low price (39%) and lack of market (26%) for the produce. Others reported on theft of crops and inadequate cultivation land, inadequate supply of stakes for the crops and conflict in water use.

Shortage of staking materials especially for climbing beans and tomatoes was reported to be a major constraint that usually translated into social related problems. Forest encroachment by farmers bordering the park for staking materials is common and often

caused conflict. Some respondents interviewed reported harassment by the national park authorities and in particular by the park rangers; they are often chased and/or even beaten up. Thus, there is tension reported amongst some communities bordering the park. Unfortunately such tension and conflict often undermine collaborative management efforts long hard worked for by the Mt. Elgon park authorities and other stakeholders including the local communities. This is in line with findings by other researchers in the area (e.g. Scot 1998)

Conflict between upstream farmers and downstream water users was also reported in both Kapchorwa and Mbale districts. Interviews with a manager of the National Water and Sewerage Cooperation (NWSC) at the Mbale water works revealed that recently spikes in water flows had been experienced and also high treatment costs incurred. It was reported that this is largely attributed to pollution by farmers upstream. During the dry season, uncontrolled water withdrawals for horticultural farms reduce downstream flow. Besides it also accentuated water supply shortages in the urbanizing areas around Mbale. Theft of crop harvest was reportedly a common practice driven by the desire for quick income; therefore attributed to poverty. The fresh crop harvest is often stolen and sold to buyers from outside the local area. Limited land for cultivation was another problem constraining production in the areas studied. Shortage of cultivable land is linked to high population in the area. In most cases households have less than 1 acre for cultivation to meet the demand for domestic food consumption and also for earning cash. A cross tabulation (Table 8) showed the two variables of sex and education were significantly ($P<0.05$) associated with the socio-economic problems faced in producing horticultural crops. This is explained by the fact that educated respondents have greater access to market information and therefore comprehend issues relating to price fluctuations. The association between income and socio-economic problem was only significant at 10%. Respondents who have higher income were likely to be more sensitive to price offered for crops than other socio-economic issues. This is consistent with the argument by Ali

(2008) who indicated that poor small-scale farmers generally fail to benefit from the emerging market opportunities because they do not have the resources, information, or skills to meet the integrated market standards and they are relatively less integrated with markets.

Labour shortage was mentioned during formal discussions with some farmers as a significant factor during critical times of horticultural crop production However, this was not explicitly reported in household survey. . Kuyvenhoven et al. (2001) also noted that labour scarcity during critical demand time negatively impacts on crop yield. They thus argued that labour demand should be considered when using technologies such as physical SWC practices; for instance by undertaking such labour demanding activities during off-season.

Opportunities for farmers and other actors engaged in horticultural crop production

There is existing local and regional market for the various horticultural crops grown in the study area. The wide market is supported by the rapid urbanization process and a shift to the horticulture crops in the food system. Upsurge of population migrating from rural to urban areas will continue and so are the challenges of providing them with employment and nutrition. Involvement in growing short cycle but high-value crops such as horticultural crops thus provides a solution. This is in agreement with what was observed by Abegunde (2012) in Lagos in Nigeria. Rural areas in the highlands are at an advantage in terms of providing more organic vegetables as opposed to those grown in urban areas. However, for greater benefit there is need for appropriate technological support so that the small scale farmers at the grassroots are able to grow the right variety of horticultural crops on demand, sort the harvest and improve on the packaging. This will also ensure delivery of safe food to whichever existing local, national or regional horticultural market niche.

Urban and peri-urban areas in the mountains and surrounding areas generate a lot of plant material wastes, which are often burnt, dumped or buried. Such wastes if properly harnessed to avoid health risks can stimulate horticultural crop production other than over-depending on expensive inorganic fertilizers. This observation is corroborated with findings by Rosen et al. (1993) which reported that use of municipal solid waste [MSW] composts will depend on whether quality of the product can meet the standards of the industry and whether the cost is competitive with that of other organic materials currently used. A few farmers around urban areas such as Mbale town have adopted application of urban waste but on a small scale. Obviously research will be important in establishing constraints to adoption of such organic fertilizers by farmers in order to guide the extension service.

Mt Elgon area has got a comparative advantage over lowlands due to favourable climate, fertile volcanic soils and low disease incidence among others. This ensures continued production for supplying the ever growing local, national and regional demand. Besides the new approaches being advocated for increasing ecosystem resilience to climate change and variation, and carbon sequestration favours the growth of fruit trees. Growing of horticultural crops such as fruit trees and shrubs can also improve the farmers' incomes hence their resilience to climate change risks. This is in agreement with Sati (2005) who observed that the geographical and climatic conditions in Himalaya in India are very suitable for the production of fruits for economic development and environmental restoration. Twaha et al. (2012) found that farmers' perception on improved income was a key factor influencing tree adoption by small scale farmers in Mt Elgon.

Availability of labour for various activities in horticultural crop production and value chain is another great opportunity. In particular the prevailing high population of youth and women (>50%) offers high labour potential. Women have special traditional skills in weeding, transplanting, harvest and marketing, which strategically well positions them

in the horticultural farming sector.The youth constitute an important energetic force that can be empowered for effective performance.

CONCLUSION AND RECOMMENDATIONS

Horticultural crops have a great potential for livelihood improvement particularly in the rural-urban continuum in the mountain areas. Therefore, the production trends for these crops as evidenced in this study are likely to increase due to available market demand at local, national and regional levels. However, as demonstrated by this study landscape sustainability in Mt Elgon is at stake; it is being threatened due to accelerated soil erosion, loss of soil nutrients, shortage of staking materials and frequent but less controlled application of chemicals by farmers. Social related problems such as inadequate land and resource use conflicts were also prevalent. It is important for the extension workers and other resource managers/practitioners to encourage use of sound practices for soil conservation, weed and pest control. Innovations in growing crop varieties that are high-yielding, requiring no staking or where farmers make use of other crop stems/stalks for support such as old stalks of maize will be crucial to reduce the demand on forest resources. It is also no longer sustainable for farmers to depend on the dwindling forest resources particularly for supply of staking materials. The new interventions for poverty alleviation through programmes initiated for instance by the National Agricultural Advisory Service (NAADS), Mount Elgon Regional Conservation and Environment Programme (MERCEP), United Nations Programme (UNDP) and International Union for Conservation of Nature (IUCN) should target investment in high-value horticultural crops while also addressing farmers' lack of adequate knowledge on soil and pest management.

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Tables and Figures

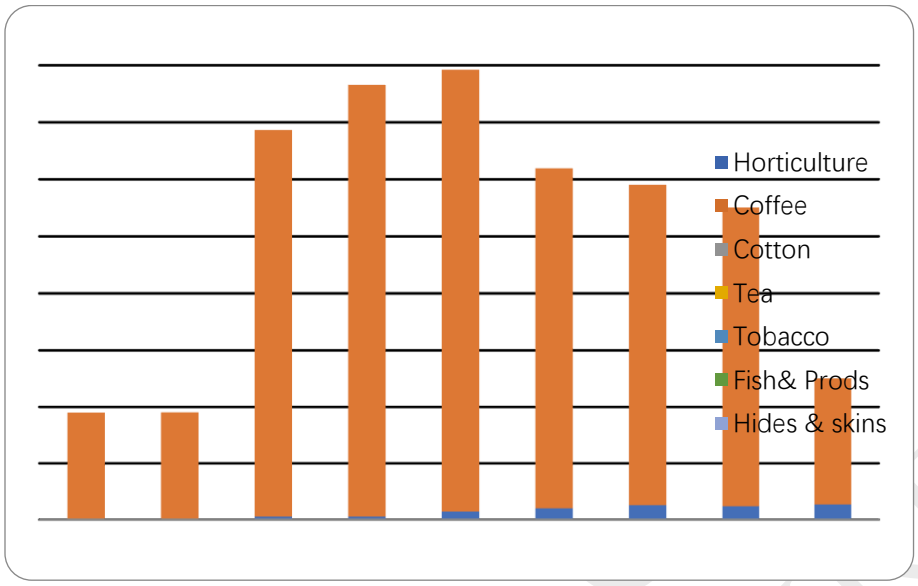

Figure 1. Comparison of horticultural crops with other major exports of Uganda (US $ million) 1992-2000

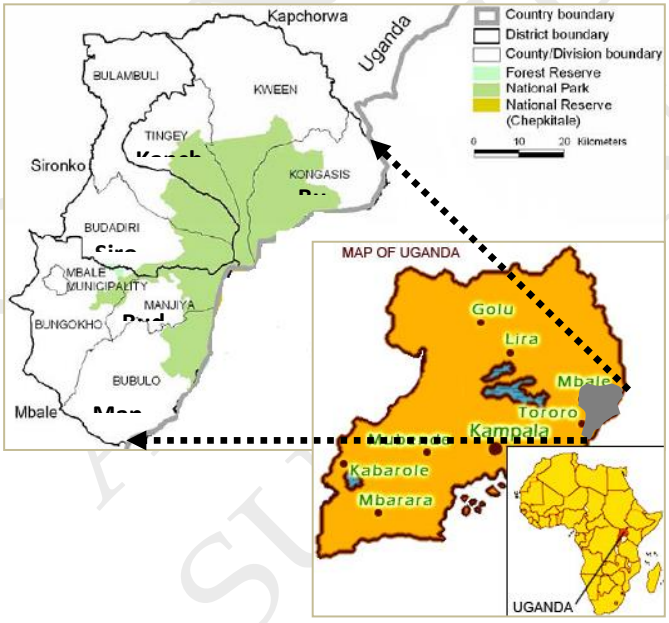

Figure 2. Location map of the study area in Mt Elgon, Uganda

Table 1. Background characteristics of respondents (N=120)

Items		**Frequency**	**Percentage**
Villages	Bushenyi	30	25.00
	Bunabudde	30	25.00
	Kigezi	30	25.00
	Sukut	30	25.00
	Total	**120**	**100.00**
Sex	Male	61	50.83
	Female	59	49.17
	Total	**120**	**100.00**
Age	15-25	26	21.57
	26-35	40	33.33
	36-45	28	23.33
	46-55	10	8.33
	55 and above	16	13.33
	Total	**120**	**100.00**
Educational level	Informal education	11	9.17
	Primary	75	62.50
	Secondary	30	25.00
	Tertiary	4	3.33
	Total	**120**	**100.00**
Marital status	Married	109	90.83
	Single	9	7.50
	Divorced	2	1.67
	Total	**120**	**100.00**
Household size	1-3	42	35.00
	4-6	49	40.83
	6-8	12	10.00
	>8	17	14.17
	Total	**120**	**100.00**
Land size	0.25-1.0	88	73.33
	1.5-5.0	32	26.67
	Total	**120**	**100.00**
Income	1000-10000/=	34	28.33
	10001-25000/=	26	21.67
	25001-50000/=	24	20.00
	>50000/=	36	30.00
	Total	**120**	**100.00**

Table 2. Different types of horticultural crops in the study area

		Responses		Percent of Cases
Scientific name	English/local name	N	Percent	
Vigna unguiculata	cowpeas	32	16.3	27.6
Daucus carota subsp. sativus	Carrots	25	12.8	21.6
Passiflora edulis	passion	14	7.1	12.1
Phaseolus vulgaris	Beans	42	21.4	36.2
Brassica oleracea var. capitata	cabbages	9	4.6	7.8
Persea americana	Avocadoes	14	7.1	12.1
Artocarpus heterophyllus	Jerk Fruit	1	0.5	0.9
Allium cepa	onions	39	19.9	33.6
Solanum aethiopicum	Bitter Tomatoes	12	6.1	10.3
Brassica oleracea	Sukuma	8	4.1	6.9
Total		196	100	169

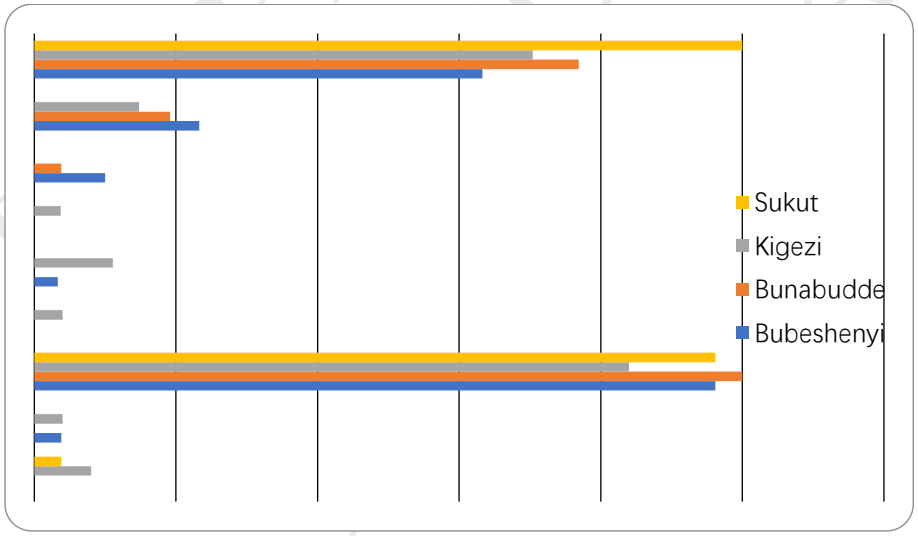

Figure 3. Horticulture crops in villages studied (Kigezi, Sukut, Bunabudde and Bubeshenyi) in Mt Elgon

Table 3. Priority ranking and estimated average unit production of selected horticultural crops in Wanale

Crop	Ranking in priority by farmers	Potential yield (bags/acre)	Realised yield (bags/acre)
Potatoes	1	80	40
Carrots	2	120	60
Cabbages	3	240	120
Passion fruits	4	125	55

Source: NAADS coordinator, Wanale sub county

Table 4. Percentage response on the major problems encountered by horticultural farmers

	Responses		Percent of Cases
	N	Percent	
Pests	117	34.3	100%
Erosion	99	29	84.6%
Low soil fertility	96	28.2	82.1%
Poor yields	24	7	20.5%
Low rainfall	5	1.5	4.3%
Total	341	100	291.5%

Table 5. Cross tabulation between the respondents' background characteristics and ecological problems

Variable		**Ecological problems**					
		N	Pests	Soil Erosion	Low fertility	Poor yields	Low rainfall
Sex	Male	61	11.48	1.64	63.93	18.03	4.92
	Female	59	13.56	3.39	61.02		8.47
X^2= 1.4608 df =4 pr =0.834							
Age	15-25 Years old	26	15.38	0.00	57.69	15.38	11.54
	26-35 years old	40	17.50	2.50	62.50	12.50	5.00
	36-45 years old	28	10.71	3.57	67.86	14.29	3.57
	46-55 years old	10	10.00	0.00	50.00	20.00	20.00
	Above 55 years old	16	0.00	6.25	68.75	25.00	0.00
X^2= 12.1110 df= 16 pr= 0.736							
Marital Status	Married	108	11.11	2.78	63.89	14.81	7.41
	Single	10	30.00	0.00	40.00	30.00	0.00
	Divorced	2	0.00	0.00	100.00	0.00	0.00
X^2= 7.0372 df=8 pr=0.533							
Land size	.25-1.0 acres	87	11.49	2.30	62.07	16.09	8.05
	1.5-5.0 acres	31	9.68	3.23	67.74	16.13	3.23
X^2 = 1.0448 df= 4 Pr = 0.903							
Educational level	Informal Education	11	0.00	0.00	63.64	27.27	9.09
	Primary	75	6.67	1.33	68.00	17.33	6.67
	Secondary	30	30.00	6.67	46.67	10.00	6.67
	Tertiary	4	25.00	0.00	75.00	0.00	0.00
X^2= 18.4594 df=12 Pr = 0.102							
Household head Income	1000-10000/=	34	11.76	2.94	55.88	20.59	8.82
	10001-25000/=	26	7.69	0.00	76.92	15.38	0.00
	25001-50000/=	24	12.50	4.17	66.67	12.50	4.17
	Above 50000/=	36	16.67	2.78	55.56	13.89	11.11
X^2= 7.4032 df= 12 Pr = 0.830							

Figure 4 (a) Left: Steep slopes are cleared for growing horticultural crops (e.g. cabbages, carrots and onions) in Wanale, Mbale district. Exposed soils are prone to water erosion as evidenced by rills and sheet wash. (b) Right: Eroded young banana intercropped horticultural farmland as evidenced by soil deposition in the foreground on the lower slope in Tambajja village, Atari catchment in Kapchorwa district.

Table 6. Response on different type of Fertilizers applied in the area

Variable	N	Percent
Urea	102	33.6
NPK	98	32.2
DAP	67	0.22
Organic matter	37	0.122
Total	304	100

Table 7. Social–economic problems encountered by respondents in the area

Responses	N	Percent	Percent of Cases
Theft	6	0.094	0.214
Low price	25	0.391	0.893
Lack of market	17	0.266	0.607
inadequate land	11	0.172	0.393
Inadequate funds	4	0.062	0.143
Lack of equipment like pangs	1	0.016	0.036
Total	64	1	2.286

Table 8. Cross tabulation between the background characteristics of respondents and social-economic problems faced in horticultural farming

		N	Theft	Low Price	Lack of market	Inadequate Land
Sex	Male	61	3.28	31.15	52.46	13.11
	Female	59	1.69	38.98	25.42	33.90
X^2 = 11.9761	df= 3 Pr = 0.007					
Age	15-25 Years old	26	7.69	34.62	42.31	15.38
	26-35 years old	40	0.00	47.50	27.50	25.00
	36-45 years old	28	3.57	28.57	46.43	21.43
	46-55 years old	10	0.00	20.00	50.00	30.00
	Above 55 years old	16	0.00	25.00	43.75	31.25
X^2 =11.4333	df=12 Pr = 0.492					
Marital Status	Married	108	1.85	32.41	41.67	24.07
	Single	10	10.00	50.00	20.00	20.00
	Divorced	2	0.00	100.00	0.00	0.00
X^2= 8.1793	df=6 pr = 0.225					
Land size	.25-1.0 acres	87	2.30	35.63	34.48	27.59
	1.5-5.0 acres	31	0.00	32.26	54.84	12.90
X^2 =5.2419	df=3 Pr = 0.155					
Educational level	Informal Education	11	0.00	36.36	9.09	54.55
	Primary	75	2.67	36.00	34.67	26.67
	Secondary	30	3.33	30.00	60.00	6.67
	Tertiary	4	0.00	50.00	50.00	0.00
X^2=16.7924	df=9 Pr = 0.052					
Income of the household head	1000-10000/=	34	2.94	23.53	32.35	41.18
	10001-25000/=	26	3.85	38.46	30.77	26.92
	25001-50000/=	24	0.00	50.00	33.33	16.67
	Above 50000/=	36	2.78	33.33	55.56	8.33
X^2 =16.0245	df=9 pr=0.066					