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African Leafy Vegetables and Household Wellbeing in Kenya: A Disaggregation by Gender

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Abstract: The aim of this study was to analyze the contribution of African Leafy Vegetables (ALVs) to household wellbeing by gender. The study was conducted in Kiambu District using multistage sampling technique. Primary data was collected from a sample of 166 small-scale farmers using a structured questionnaire. The findings of the study showed that ALVs is an important contributor to household income. Income, primary occupation of the farmer, distance to market, access to extension services, access to technical support and distance to piped water source, were found to be important factors influencing production of ALVs by smallholder farmers. The factors determining gross margins of ALVs, for women, included; education, land size, distance to piped water source and technical support for ALVs farming while the determinants of ALVs gross margins for men included; age of the household head, experience in farming, access to credit, group membership and access to technical support. On the policy front the study recommends the empowerment of the smallholder household, especially the female headed households and the youth, with productive resources such as extension services, technical support and an alternative land tenure system so as to improve their livelihoods.

Keywords: African indigenous vegetables, ordinary least squares, probit

INTRODUCTION

Agriculture remains the mainstay of most countries in SSA, Kenya included. Majority of Kenya's people (an estimated 80%) depend on agriculture for their livelihoods and employment. Agriculture makes a contribution, estimated at over 25%, to Kenya's Gross Domestic Product (GDP) (Muriuki *et al*., 2001). In Kenya, horticulture production (especially vegetables) is an important source of income for smallholder farmers, who often account for more than 70% of the output (McCulloch and Ota, 2002). This is because horticulture has higher returns than most cash crops and is suitable for production on small and marginal farms in varying climatic conditions (Minot and Ngigi, 2004).

The main vegetable crops grown by smallholder farmers for both subsistence and commercial purposes in Kenya include cabbages, tomatoes, kales (*sukuma wiki*), onions and indigenous vegetables commonly referred to as African Leafy Vegetables (ALVs) such as *amaranth* (Omiti *et al*., 2004).

ALVs have increasingly become important commercially in Kenya over the last 15 years where they have increasingly featured in both formal and informal markets in Nairobi and its neighbouring areas. Before 2000, ALVs were to be found only in the back-streets and in a few open-air markets. However since then ALVs have become a common occurrence in most supermarkets, where they are sold in increasing quantities. The city and its peri-urban areas are also dotted with grocery shops in the main shopping areas, as well as retail kiosks that also stock various types of the ALVs. The priority species marketed include African nightshades (*Solanum scabrum*), leafy amaranth (*Amaranthus* spp.), spider plant (*Cleome gynandra*), cowpeas (*Vigna unguiculata*), Ethiopian kale (*Brassica carinata*), *mitoo* (*Crotalaria ochroleuca* and *C. brevidens*)), *kahuhura* (*Cucurbita ficifolia*), jute plant (*Corchorus olitorius*) and pumpkin leaves (*Cucurbita maxima* and *C. moschata*) (Irungu *et al*., 2007; Otieno *et al*., 2009; Maundu *et al*., 1999).

Among the key peri-urban production areas in Kenya is Kiambu district. Sales of ALVs in Kiambu district rose from less than 31 tonnes per month in 2003, to more than 600 tonnes per month in 2006. It is estimated that approximately 9000 tonnes of ALVs have been sold to formal and informal markets in the period between 2008 and 2010 in central Kenya (AVRDC, 2010).

ALVs have gained commercial importance over the past 15 years as a result of the enormous growth in marketing (Irungu *et al*., 2007). This growth is attributed to increased consumer demand for ALVs. The increased demand has resulted to ALVs entering

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the supermarket chains and other lucrative markets which result to better incomes. To respond to this increase in demand for ALVs, there has been a tremendous increase in the production ALVs in Kiambu district. In spite of this increase in ALVs production and marketing, the contribution of ALVs to household income and more specifically to Female Headed Households (FHH), (which according to Omwoha (2007) and FAO (2012), are classified as a vulnerable and low-resource group, due to limited access to production resources and higher concentration among the poorer strata of the society), in comparison to Male Headed Households (MHH) is little known. This is despite the fact that ALVs can provide an opportunity for women empowerment because of the significant role they play in both subsistence production and income generation among rural and urban poor groups in Africa (Chadha, 2003).

The general objective of this study was therefore to analyze the contribution of ALVs on household wellbeing in Kenya by disaggregation of findings by gender of household head. The specific objectives of the study included; to analyze the socio-economic characteristics of ALVs farmers, to compute the share of income from ALVs to total household income for different socioeconomic groups, to analyze the socioeconomic characteristics influencing the decision to grow ALVs and to analyze factors that determine the Gross Margins of ALVs for men and women farmers.

ALV production has its advantages because of the uniqueness of ALVs such as short production cycles, requirement of a few purchased inputs, thrives in poor soil, are resistant to pests and diseases and are quite acceptable to local tastes (Ekesa *et al*., 2009). In addition ALVs are well suited to the small plots and limited resources of village families and produce high yields with strong nutritional value (NRC, 2006). ALVs besides being economical to produce have the added advantage of possessing other desirable traits nutritionally such as high vitamin content (vitamin A and C), fibre and minerals. ALVs can therefore support rural, peri-urban and urban populations in terms of subsistence and income generation, without requiring huge capital investments (DFID and R4D, 2010). This is especially so for the resource poor women and men farmers with low capital investments.

According to the NRC (2006), increased support from the scientific establishment and promotion in public policy circles, could allow ALVs to make large socioeconomic contributions to many African nations and help tackle problems of hunger and malnutrition through attainment of the Millennium Development Goals (MDGs) one and three; ending poverty and hunger and gender equality

Several studies have analyzed the consumption, nutritional content and marketing of ALVs (Habwe *et al*., 2008; Kimiywe *et al*., 2006; Ndungu *et al*., 2005; Imungi, 2002; Imungi and Porters, 1983; Maundu, 1995; Ekesa *et al*., 2009; Onyango and Imungi, 2007; Irungu *et al*., 2007; Maundu *et al*., 1999; Gotor and Irungu, 2010a, b). There is however no study that has focused on the contribution of ALVs to household wellbeing, through the disaggregation of findings by gender of the household head.

MATERIALS AND METHODS

The study area is Kiambu district, Kenya. The area was purposively selected because it has been used for the pilot projects of commercial ALVS production in Kenya. It was also selected mainly because of its proximity to the capital city, that is, Nairobi, where there is a potentially huge lucrative urban market for maize, dairy and horticultural products, amongst other consumer items (Otieno *et al*., 2009).

Kiambu district is a peri-urban area in Kenya in the outskirts of Nairobi city. The District is divided into 7 divisions namely Kiambaa, Limuru, Ndeiya, Githunguri, Kikuyu, Lari and Kiambu Municipality, thirty-seven locations and one hundred and twelve sub-locations (Kiambu District Strategic Plan 2005-2010).

Kiambu district covers an area of 1458.3 km^2, 97% of which is arable. About 90% of the arable land is under smallholdings (less than 2 ha) while the rest is under large farms. The district has reddish brown volcanic soils and natural water supply from a few springs. Altitude ranges from 1500 to 2591 m above sea level, while the average temperature is 26°C (Republic of Kenya, 2001a). The average annual rainfall is 1239.6 mm occurring in a bimodal pattern; long rains in April-May and short rains from October to November. The average population density was estimated at 526 persons per km^2 in 1999 (KNBS, 2003).

Generally, food production systems in Kiambu are relatively more commercialized; considering its comparative advantage in most physical infrastructure (roads, water, electricity, etc.) compared to other parts of the country (Otieno *et al*., 2009).

Sampling method: Multi-stage sampling method was used. In the first stage, Kiambu district was purposively selected. In the second stage, purposive sampling was used to select two divisions out of the seven divisions. That is Githunguri and Kiambaa divisions. A listing of ALVs farmer groups in these divisions was done, where all the groups nearest to the central place (Githunguri and Kiambaa towns) were sampled, a total of six groups were sampled (four in Githunguri and two in Kiambaa). A list of group members for each group was compiled then simple random sampling technique by use of random numbers was employed to obtain a sample of small-scale ALVs farmers. To obtain the required sample size, where the groups could not meet the requisite sample size, snowballing sampling technique

was used to identify the ALV farmers not belonging to any group and more so to obtain a more representative sample of FHHs. Then a structured questionnaire was administered to the small-scale farmers by trained enumerators. Focus group discussions were conducted to elicit collective views from the farmers who were organized into groups.

Analytical methods: Objective one was answered through descriptive statistics, such as frequency distributions, mean and standard deviation. To answer objective two, a Gross Margin (GM) analysis was done for all farmers. Then a ration of the GM as a proportion of the total household income was calculated for the different socioeconomic groups such as the educated, the youth and women:

$$GM = TR-TVC$$

The gross margin is defined as gross income net off direct variable cost:

$$GM_i = R_i - VC_i - wL_i \quad (1)$$

where,
R_i = Revenue from the i^{th} activity
VC_i = Variable cost from the i^{th} activity
wL_i = Cost of hiring labour and work parties from the i^{th} activity

To answer objective three the study has used a probit model to analyze socio-economic characteristics influencing the decision (or not) to grow ALVs by smallholder farmers:

$$\text{Prob}(Z_i = 1 | X = \int_{-\infty}^{X'\beta} \varphi(t)dt = \varphi(X'\beta)$$

where,
Z_i = An indicator variable equal to 1 if a household is growing ALVs and zero otherwise
$\varphi(\cdot)$ = The standard normal distribution function
βs = The parameters to be estimated
Xs = The determinants of the dependent variable, in this case the decision to grow ALVs by smallholder farmers in Kiambu district

The model can be specified as:

$$Z(0,1) = \log\left(\frac{p}{1-p}\right) = \gamma_{0j} + \propto_{ij} X_{ij} + \beta_{ij} W_{ij} + \delta_{ij} V_{ij} + \theta_{ij} U_{ij} + \varepsilon_i$$

where, Z is the probability of household growing ALVs, $\propto_{ij}$, β_{ij}, δ_{ij} and θ_{ij} are vectors of parameters to be estimated. p is the probability of the event (growing ALVs) occurring while (1-p) is the probability of the event (growing ALVs) not occurring. X_{ij} is a vector of household socioeconomic characteristics which include, age, gender, household size, education level and primary occupation of head. W_{ij} is a matrix of farm characteristics such asfarm size and form of ownership. V_{ij} is a vector of institutional factors including access to credit, extension services, technical support and social capital (group membership and participation), U_{ij} is a vector of market characteristics such as distance to the market and ε_i is the error term. $\varepsilon_i \sim N(0,1)$.

To answer objective four, the study employed the Ordinary Least Squares (OLS) regression to analyze the determinants of the gross margins of women and men farmers. The sample of ALVs farmers was divided into two according to the gender of household head. An OLS regression was ran to find the determinants of gross margins.
In general the linear OLS function can be written as:

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 .. + b_nx_n + U \quad (2)$$

where,
Y = The i^{th} respondent's gross margin on the function
$x_1 \ldots, x_n$ = The value of the explanatory variables
$b_1 \ldots, b_n$ = The estimated regression coefficient for the variable X_i
U = Stochastic error term

The model can be specified as:

$$GMA_f = b_1 \text{ Age} + b_2 \text{ Hhsize} + b_3 \text{ LandSize} + b_4 \text{ Ext} + b_5 \text{ Credt} + b_6 \text{ Education} + b_7 \text{ Martstus} + b_8 \text{ Expfarm} + b_9 \text{ Procc} + b_{10} \text{ PipedH2o} + b_{11} \text{ LandT} + b_{12} \text{ Tarmackm} + b_{13} \text{ waterkm} + b_{14} \text{ marketkm} + b_{15} \text{ keydecmaker} + b_{16} \text{ technical support} + U \quad (3)$$

RESULTS AND DISCUSSION

The socio-economic characteristics of ALVs farmers: In answering objective one, the following descriptive statistics were used as shown in Table 1. Out of these 83 farmers growing ALVs, MHHs accounted for 66.3%, while FHHs account for 33.7%. These results showed that the working sample of the study contained a higher proportion of MHHs. This may be explained by the fact that majority households in the District are headed by males (about 83%), (District strategic plan 2005-2010). The other reason could be that more FHHs have limited land and labor resources that do not allow them to produce surplus produce to earn them sufficient income and participate in commercial activities (Kherallah *et al*., 2000). Smale and Heisey (1993) indicated that FHHs are also more likely to be cash-and credit-constrained, thereby affecting their ability to produce.

Table 1: Socio-economic characteristics of ALVs farmers

	MHHs		FHHs	
Characteristic	Frequency	%	Frequency	%
Gender				
Men	55	66.3	-	-
Women	-	-	28	33.7
Age				
15-30	4	7.3	1	3.6
30-45	14	25.5	14	50.0
45-60	24	43.6	8	28.6
Above 60	13	23.6	5	17.8
Education				
None	4	7.3	5	17.9
Primary	17	30	14	50
Secondary	22	40	7	25
Tertiary	12	21.7	2	7.1
Marital status				
Single	4	7.3	8	28.6
Monogamous	48	87.3	9	32.1
Polygamous	0	0	0	0
Divorced/separated	0	0	6	21.4
Widowed	3	5.5	5	17.9
Primary occupation				
Farming	46	83.6	24	85.7
Otherwise	9	16.4	4	14.3
Land size				
Less than 1 acre	14	25.5	15	53.6
1-2 acres	22	40	11	39.3
2-4 acres	14	25.5	2	7.1
Above 4 acres	5	9.1	0	0
Access to credit				
Yes	16	29.1	8	28.6
No	39	71.9	20	71.4
Access to extension services				
Yes	33	60	18	64.3
No	22	40	10	35.7
Group membership				
Yes	50	90.9	24	85.7
No	5	9.1	4	14.3

Survey data

The age structure showed that most men farmers were between 45- 60 years, while most women farmers were between 30-45 years. Age is one of the factors that affect the efficiency of carrying out farm activities. Age is also associated with farmer experience in farming practices as farmers gain experience over time.

About 72.2% of ALVs farmers have attained education to the secondary level while about 10.8% are uneducated. This agrees with Irungu (2007) that ALVs farmers are more educated than the other categories of traders, implying that the production of ALVs is a field for those endowed with human capital. This might be because one has to acquire knowledge on several aspects of ALVs, e.g., their nutritive value, marketing strategies, etc., before embarking on their production. Disaggregating the analysis by the gender of household head, men are more literate than women. About 61.7% of men farmers have obtained secondary education and above as compared to 32.1% of women farmers. Men with up to primary education account for about 37.3% as compared to about 67.9% of women. This agrees with Omwoha (2007), that there is a higher illiteracy rate among rural women than among their male counterparts, despite the policy of equal education for all children of school age. In other words, women are discriminated upon. Another reason could also be the inherent skewed resource endowments (e.g., ownership of land, capital), access to information, membership to development associations and benefit sharing schemes, that often favour men at the disadvantage of women irrespective of the latter's level of effort and multiple roles (Omiti*et al*., 2004).

About 83% of MHHs and 85.7% of FHHs rely on farming as their primary occupation. This implies that ALVs farmers perceive farming as an income generating activity. Breaking down the analysis further shows that, a very minor proportion of FHHs participated in off-farm activities as their primary occupation (14.3%). This may be attributed to the education discrimination of women. This shows that ALVs production is a good opportunity for both MHHs and FHHs, which lack other off-farm occupations. Also the high participation by MHHs in ALVs farming could be an indicator that ALVs farming offers an attractive investment. This is in line with Omiti *et al*. (2004), that greater percentage of high-value farm output is sold in MHHs compared to FHHs.

The mean landholding for ALV farmers is 1.70 acres with a standard deviation of 1.55. Disaggregating by gender, the mean acreage of land for FHHs is 0.97 acres with a standard deviation of 0.7 while that of MHHs is 2.07 acres with a standard deviation of 1.74 acres. About 65.5% of men farmers own land between 1-4 acres while 53.6% of women own less than one acre of land. This implies that farmers with smaller land holdings are more likely to produce ALVs as compared to those with large land holdings. This can be attributed to intensive land use, in order to maximize returns on land considering that ALVs are quick growing and yield immediate returns to the farmers. Table 2 shows a Chi square test ($\chi^2 = 9.973$, $p = 0.041$). This test shows that there is a significant difference between the MHHs and FHHs with respect to land size at five% level of confidence. This agrees with (Kosura and Karugia, 2004) that traditional land tenure systems discriminate against women in the control, acquisition and ownership of land.

Access to credit is a very important to the success of farming. About 28.9% of ALV farmers have access to credit, while about 71.1% do not have access to credit. Disaggregating by the gender of household head, MHHs have a marginally higher access to credit of about 29.1%, as compared to FHHs who have a lower access to credit of 28.6%. This low access may be attributed to the lack of security. According to Duggleby (1995), Women face specific gender barriers in accessing financial services, including lack of collateral (usually land), low levels of numeracy, education and the fact that they have less time and cash to undertake the journey to a credit institution.

About 39.8% of the ALV farmers have access to extension service, while 60.2% lack access to extension services. Findings from the study show that a high proportion of women farmers access extension services, about 64.3% as compared to 60% of men. This difference in access to extension service may be

Table 2: Land size household head cross-tabulation

			Household head		
			Male	Female	Total
Land size	less than 1 acre	Frequency	14	15	29
		%	25.5%	53.6%	34.9%
	1-2 acres	Frequency	22	11	33
		%	40.0%	39.3%	39.8%
	2-4 acres	Frequency	14	2	16
		%	25.5%	7.1%	19.3%
	4-6 acres	Frequency	3	0	3
		%	5.5%	0.0%	3.6%
	4-5 acres	Frequency	1	0	1
		%	1.8%	0.0%	1.2%
	8-10 acres	Frequency	1	0	1
		%	1.8%	0.0%	1.2%
Total		Frequency	55	28	83
		%	100.0%	100.0%	100.0%

(χ^2 = 9.973, p = 0.041)

explained by the increased recognition of women in agricultural transformation as a result of the considerable effort that has been made throughout the world to provide women farmers and women on the farm with efficient, effective and appropriate technology, training and information (FAO, 1997). The provision of extension services remains one of the major interventions crucial in the agricultural sector for rural development, food security, poverty alleviation and income generation. The role of the extension and advisory services can never be understated, in their contribution to the agricultural sector, given the current challenges in the industry. Extension services can positively contribute to the transformation of farming.

About 89.2% of ALV farmers are members to a producer group, while about 10.8% are not. Disaggregating by the gender of household head, about 90.4% of MHHs belong to a group as compared to 85.7% of FHHs that belong to a group. According to FAO (1995), the advantages that rural producers gain through organized efforts include; greater leverage for enterprise success, better prospects for sustainable development and more equitable sharing of benefits from common property resources. According to Ngugi and Kariuki (2008) the benefits of collective organization that members can expect include but are not limited to, improved access to credit and extension services, greater bargaining power to leverage for more competitive prices and advocate for more conducive policies. Farmer-groups are likely to reduce transaction costs and to redistribute rights in favour of farmers (Staatz, 1986).

Household size and experience in farming: The average household size for ALV farmers is 4.22 with a standard deviation of 1.71 persons per household, this finding concurs with the findings of Gotor and Irungu (2010a, b) where they found they found the average household size of ALVs farmers to be 4.96 persons with a standard deviation of 2. The average household size for MHHs is 4.61 persons per household with a standard deviation of 1.52, while for FHHs the average household size is 4.32 with a standard deviation of 2.07. These household sizes fall below the national average of 5.1 for Kenya (KNBS, 2007). According to Edriss and Simtowe (2002), the average household size has a bearing on availability of labor, especially considering that most smallholder farmers depend on family labor. The more the number of people in a household, the more the family labor supply is, all other things held constant. This implicitly affects the amount of hired labor that a farmer uses on his farm to undertake farming activities. On the other hand, large households have more mouths to feed, which may in turn result to committing less money to buy farm inputs (Modise, 2008).

The mean number of years of experience for ALVs farmersis17.08 with a standard deviation of 13.28 years. Men farmers have more farming experience as compared to women. Men have an average farming experience of 18.37 years with a standard deviation of 13.5 years while, women farmers have an average farming experience of 14.53 years with a standard deviation of 12.70 years. Gotor and Irungu (2010a, b) found out that many older households reported that they have grown ALVs for a long time of more than twenty years. However, the younger generation had abandoned them for exotic vegetables and only started growing them in the last 10 years. This agrees with the findings by Vorster (2007), that ALV production is endowed with indigenous knowledge about the ALVs varieties, knowledge on what, how, where and when to consume ALVs as well as their preservation and conservation (Table 3).

Access to technical support for ALV farming: Technical support for ALV farming is the support provided to ALV farmers directed specifically to ALV production. This support includes, seed supply systems, value chain intervention, promotion and awareness campaigns carried out by community based organizations like IFPRI and Farm Concern International. Out of the 55 MHH, 67.3% had no access

Table 3: Household size and experience in farming

Variable	Average	S.D.
Household size MHHs	4.61	1.52
Household size FHHs	4.32	2.07
Experience in farming (years) MHHs	18.37	13.50
Experience in farming (years) FHHs	14.53	12.70

Table 4: Access to technical support services

Access to technical support	MHH (%)	FHH (%)
Yes	32.7	34.7
No	67.3	64.3

Table 5: Share of ALVs income and age of household head

Age	N	Mean share	S.D.
15-30	5	0.2343	0.0640
30-45	28	0.2757	0.1466
45-60	32	0.3155	0.1559
Above 60	18	0.2727	0.0586

Computer output

Table 6: Share of ALVs income and education level

Education	N	Mean share	S.D.
None	9	0.2687	0.0348
Primary	31	0.3445	0.3400
Secondary	29	0.4519	0.4067
Tertiary	14	0.2800	0.1833

to technical support for ALVs farming, while 32.7% had. And out of the 28 FHH, 64.3% had no access to technical support, while the remaining 34.7% had access to technical support (Table 4).

Source of technical support for ALVs farming: Majority of the farmers obtained technical support for ALVs farming from Family Concern International. Out of the 10 women that received technical support for ALVs farming, 70% obtained support from Family Concern International, 10% obtained support from government agencies and 20% obtained support for ALVs production from Kenya Agricultural Research Institute (KARI). Out of the 19 men that received technical support, 68.4% received support from Family Concern International, 26.3% received support from other government agencies and 5.3% received technical support from the World Vegetable Centre.

According to Muthoni *et al*. (2010), some of the stakeholders that have been promoting production and commercialization of AVLs include Rural Outreach Programme (ROP) (Oniangó *et al*., 2005), Biodiversity International (formerly International Plant Genetic Resources Institute, IPGRI) (Maundu, 1990), Farm Concern International, Asian Vegetable Research and Development Center (AVRDC World Vegetable Center, Regional Center for Africa), University of Nairobi and Maseno University among others (Mwangi and Mumbi, 2006).

According to Gotor and Irungu (2010a, b), the collaborating organisations ranged from CBOs to national research institutions in the provision of technical support for ALV production and marketing. Some of these include; international organizations such as the World Vegetable Center (AVRDC), the International Potato Center (CIP), the International Centre for Research in Agro-Forestry (ICRAF), Farm Africa, the International Development Research Centre (IDRC) and Plant Resources of Tropical Africa (PROTA). Local organizations included Kenya Industrial Research Development Institute (KIRDI), Sacred Africa and Kenya Seed Company.

The share of income from ALV's to total crops income for different socio-economic groups: In answering objective two, the share of ALVs income of various socioeconomic groups was computed. In general the mean share of ALVs income to the total income is 0.3629 with a standard deviation of 0.3307. This means that ALVs income contributed about 36.29%, on average of the total crop incomes for the 83 ALV farmers. This finding agrees with the finding by Ochieng (2010) that vegetable production is an important contribution to the incomes of the households in the study area.

Share of ALVs income and age of household head: The results in Table 5 show that ALVs farmers between 45-60 years have the largest share of income of about 31.55% of the total crops income. This means that older farmers benefit more from ALV farming as compared to the other groups of farmers. This could be attributed to the nutritional and medicinal properties of ALVs. According to Gotor and Irungu (2010a, b) many older households reported that they have grown ALVs for a long time while the younger generation had abandoned them for exotic vegetables and only started growing them only recently. Therefore this long experience benefits the older farmers as can be seen from the high incomes. According to Makhura (2001), the age of the head of the household is considered a crucial factor, since it determines whether the household benefits from the experience of an older person, or has to base its decisions on the risk-taking attitude of a younger farmer. As such, age has an influence on the farmer's attitude towards risk; this may explain why older farmers undertake to grow ALVs. This is because ALVs are low risk crops due to their; short production cycles, require few purchased inputs, thrive in poor soil, are resistant to pests and diseases and are quite acceptable to local tastes (Ekesa *et al*., 2009).

Share of ALVs income and education level: Farmers with secondary level of education had the largest share of crops income from ALVs (45.19%), followed by farmers who had attained primary school education (34.45%), tertiary education (28%) and finally farmers with no education (27%) as shown in Table 6. This means that the share of ALVs incomes to total crops incomes continues to rise with an increase with years of formal education, up to a point which it reaches a maximum (at secondary level) and then starts declining (at tertiary level). This can be explained by the fact that more educated farmers invest in high income

enterprises and off-farm enterprises. This agrees with findings by Okon and Enete (2009) that higher level of education enables farmers to acquire and process relevant information more effectively. It also equips them with better managerial skills which eventually lead to improved methods of production and hence higher level output. Further according to Reardon (1997) better-educated members of rural populations have better access to any non-farm employment on offer and are also more likely to establish their own non-farm businesses. Better educated individuals are more likely to migrate to take up employment opportunities in other areas, as they have greater chances of success than their less-educated or uneducated counterparts.

Share of ALVs income and gender of household head: The sample was divided into two groups of farmers, the male and female farmers. A t-test is run to compare the share of income from ALVs for the two groups as shown in Table 7. There is a significant difference in the share of ALVs income between women and men farmers (t = -0.949, p = 0.038). Women have a higher share of income as compared to men.

This can be explained on one hand by the fact that men have better opportunities for farm and non-farm enterprises due to the patriarchal nature of our society, which contribute much income than ALVs, as compared to women who face many significant constraints in production and grow ALVs as a primary source of income. This agrees with FAO (2007), that while men and women generally face the same external constraints, they have an unequal access to human-controlled factors. They have different endowments, such as land rights and education and different access to technologies, labour, capital, support services and credit. This disparity results in differentials in productivity to the detriment of women. However the results show that ALVs growing are a good opportunity for women to take up in order to become empowered.

Regression results of the socio-economic characteristics influencing the decision to grow ALVs by smallholder farmers: Probit regression model was used to identify the factors influencing the decision to grow ALVs by smallholder farmers. The results are presented in Table 8. The following explanatory variables are statistically significant; income, primary occupation of the farmer, distance to market, access to extension services, access to technical support and distance to piped water source. In the model specification, Total Household Assets was included as a variable, but was dropped at the analysis stage due to high multicolinearity with total household income.

Income is found to be statistically significant at 5% level and negatively related to ALVs growing. This means that farmers with high incomes are not likely to grow ALVs. The marginal effects show that a 1% increase in household incomes will reduce the probability that a farmer participates in ALVs farming by 1.87%. This could be because; farmers with higher incomes would devote their time and resources to invest in more risky enterprises that will earn them higher returns than ALVs farming. This agrees with Ezedinma and Chukuezi (1999), that the choice to invest in commercial vegetable production in urban areas is influenced by the level of income.

Table 7: Share of ALVs income and gender of household head

Household head	N	Mean	S.D.	t	p
Female	28	0.4112	0.43397	-0.95**	0.038
Male	55	0.3383	0.26467		

Computer output

Table 8: Probit regression results for socio economic characteristics

ALV	Marginal effects	Robust S.E.	z	P>|z|
Household size	0.0260	0.0290	0.90	0.369
Age	0.0084	0.0187	0.45	0.655
Age squared	-0.0000	0.0002	-0.26	0.797
Income	-1.8708	8.3509	-2.22	0.026**
Gender	0.1344	0.1143	1.15	0.251
Education	0.0139	0.0150	0.93	0.352
Marital status	-0.0237	0.0420	-0.56	0.573
Experience farming	0.0014	0.0050	0.28	0.779
Primary occupation	0.2218	0.1001	2.15	0.032**
Land size	-0.0100	0.0322	-0.31	0.756
Credit	-3.1007	4.3607	-0.71	0.477
Group	0.0325	0.1312	0.25	0.804
Market	-0.0587	0.0307	-1.93	0.054**
Extension service	0.2221	0.0873	2.46	0.014***
Piped water source	-0.5187	0.2153	-2.40	0.016***
Technical support	0.5653	0552831	4.61	0.000***

***: Significant at1 percent level; **: Significant at 5% level and; *: Significant at 10% level; Observed p = 0.5; Predicted p = 0.5448; Log likelihood = -86.838739; Number of observations = 166; LR chi2 (17) = 57.86; Prob>chi2 = 0.0000; Pseudo R2 = 0.2453

The primary occupation is found to be significant at 5% level; meaning that farming households who depend primarily on farming were more likely to participate in ALVs farming. The marginal effects show that when the primary occupation of the household head is farming, the probability of growing ALVs increases 0.22%. This finding agrees with the findings by Gotor and Irungu (2010a, b) that the primary occupation of the household head is a major determinant of the likelihood to produce and market ALVs in peri-urban Nairobi. This agrees with Ezedinma and Chukuezi (1999), that the primary occupation of commercial vegetable producers is farming (about 80%).

The distance to market is significant at 5% level. This means that the closeness of a farmer to the market encourages them to participate in ALVs farming as compared to farmers far off from the market. The marginal effects indicate that, a 1% increase in the distance to market reduces the probability of growing ALVs by 0.0587%. This might be due to the fact that ALVs are vegetables and like other vegetables, they are highly perishable. This finding concurs with the findings by Omiti *et al*. (2004), that the distance from the farm to the point of sale, assumed in this study to be the market, is a major obstacle to market participation. Key *et al*. (2000) and Makhura (2001) found that

distance to the market negatively influences both the decision to participate in markets and the proportion of output sold. Thus, the variable transport costs per unit of distance increases with the potential marketable load size. For farmers in very remote rural areas, geographic isolation through distance creates a wedge between farm gate and market prices. This leads to a shift from production of profitable but highly perishable commodities such as fruits and vegetables to relatively storable low-value cereals (Stifel and Minten, 2008).

Access to extension services is significant at 1% level. This means that farmers who access extension services are more likely to grow ALVs. The marginal effects show that access to extension services increases the probability of growing ALVs by 0.22%. According to Muyanga and Jayne (2006) agricultural extension services provide farmers with important information, such as patterns in crop prices, new seed varieties, crop management and marketing. Exposure to such activities is intended to increase farmers' ability to optimize the use of their resources. At times even when technologies are available, smallholder farmers have no access to them (Fliegel, 1993). Awareness of existing technologies generates effective demand by providing a critical signal to input distribution systems (Davidson *et al*., 2001). Thus, extension systems and input distribution systems are mutually reinforcing-the contribution of extension to agricultural productivity growth depends on functioning input distribution systems and vice versa. In addition, ideal extension system provides feedback from farmers to research centres.

Distance to the nearest piped water supply is used as a proxy to access to water resource. The distance to piped water source is significant at 1%, meaning that farmers near to a water source are more likely to participate in ALVs farming. Marginal effects show that a 1% increase in the distance to piped water source reduces the probability of growing ALVs by 0.5187%. This may be because ALVs are vegetables, have to be irrigated during the dry season. This agrees with the findings of Hope *et al*. (2003), in a study in a rural community in South Africa, in which they found a positive association between the ability to involve in irrigation of vegetables and owning private water-supply. The finding also agrees with findings by Owuor (1998) that lack of proximity to water supply could be constraining domestic horticulture. And that the growing of more horticulture in Central highlands could partly be attributed to close proximity to water supply among other factors.

Finally access to technical support for ALVs production is significant at 1%, meaning that access to technical support increases the likelihood of participating in ALV farming. The marginal effects show that access to technical support increases the probability of growing ALVs by 0.5653%. According to Hillocks (2011), agricultural approaches and technical support to enhance dietary intake of vitamins and minerals have the additional advantage in that they foster community self-reliance, are sustainable in the absence of external funding and offer the opportunity for enhanced income by marketing surplus production. ALVs production is one such initiative. Technical

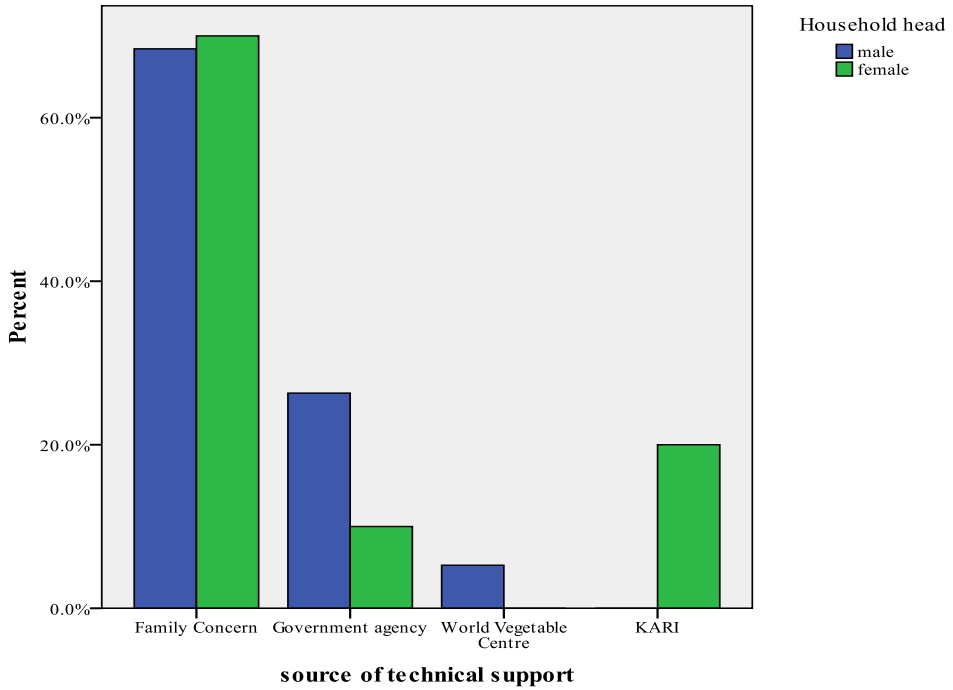

Fig. 1: Source of technical support

support for ALVs include; seed supply (Onim and Mwaniki 2008), nutritional awareness and promotional campaigns for increased use of ALVs as food citing their nutritional importance (Obel-Lawson, 2006), market linkages where contract farmers of ALVs have are linked to city supermarkets, informal markets and individual vendors and food processing and preparation for sustainable utilization of ALVs (Habwe *et al*., 2008) (Fig. 1).

Regression results of the factors determining the gross margins of ALVs for men and women farmers: Education has a significant but negative relationship with gross margins of women farmers at the 10% level, meaning that more learned women are not likely to have higher gross margins from ALVs. This may be attributed to the fact that educated women are most likely to pursue other farming enterprises or off-farm income earning activities. This can be explained by the findings of Ogunlela and Mukhtar (2009) that women embark on agricultural activities for a variety of reasons. Prominent among such reasons is that of being able to earn financial resources, as well as being a family tradition and personal interest. Further according (Vorster, 2007), ALVs production requires indigenous knowledge about the ALVs varieties, knowledge on what, how, where and when to consume ALVs as well as their preservation and conservation (Table 9).

Land size has a significant and positive relationship with gross margins for women farmers at 1%, meaning that, women with larger land sizes are more likely to obtain higher gross margins from ALVs farming. According to Ukoha *et al.* (2010) farm size has a positive and significant influence on the net return in vegetable production at 1% for women vegetable farmers implying that the larger the farm size is, the higher the net return in vegetable production. According to Kundu *et al*. (2010) farm size has a significant and positive relationship with the net returns of women vegetable farmers. Further according to FAO (1990) lack of access to land remains a major constraint for women farmers in Africa and land reform programmes have led almost exclusively to the transfer of land rights to male heads of households. Even in countries where ownership and inheritance laws have been reformed in favour of women, in practice women do not necessarily have more rights to land, as local customs and lack of information act as barriers. In the rare cases where women own land, they are still at a disadvantage in the sense that their land holdings tend to be smaller and less fertile than men's.

The distance to a piped water source has significant but negative relationship to the gross margins of women farmers at 1% meaning that women with a piped water source near them are more likely to have higher gross margins than those far off, this finding concurs with the findings by Kundu *et al*. (2010) that inadequate water supply constrained gross margins of women vegetable producers.

Age of household head, experience farming, access to credit, group membership, access to extension services and access to technical support are the significant determinants of gross margin for men ALVs farmers. The age of household head is significant at 10% level meaning that, older farmers are more likely to have higher gross margins than younger farmers. This finding concurs with the finding by Gotor and Irungu (2010a, b) that many older households reported that they have grown ALVs for a long time. However, the younger generation had abandoned them for exotic vegetables and only started growing them in the last ten years.

Table 9: The factors determining the gross margins for men and women farmers

	Women		Men	
Variable	β coefficients	t-values	β coefficients	t-values
Constant	-36, 366.75	-1.47	-37, 557.35	-0.87
Household size	0.1025072	0.57	-0.1120322	-0.56
Age	0.3731412	1.26	0.500278	1.35*
Education	-0.3473794	-1.84*	0.0415568	0.22
Marital status	-0.1449924	-0.58	-0.0507037	-0.37
Experience farming	0.3391274	1.01	-0.423699	-1.35*
Primary occupation	0.0784817	0.29	0.1069967	0.93
Land size	0.7510784	2.83***	-0.1203758	-0.76
Credit	-0.0428843	-0.24	-0.2234422	-1.64*
Group	0.4036765	1.29	0.1790026	1.90**
Market	-0.0308897	0.10	0.0912903	0.62
Extension service	0.3230514	1.36	0.190153	1.16
Tarmac km	-0.0689488	0.24	-0.1665039	-0.80
Piped water source	-0.4245256	-2.80***	0.021985	0.15
Decision maker	0.3251565	1.58	-0.0765943	-0.78
Technical support	0.5004394	1.70*	0.3388459	1.89**
F	3.34***		0.733*	
R^2	0.6913		0.3274	
N	28		55	

***: Significant at 1% level; **: Significant at 5% level and ; *: Significant at 10% level

The years of farming experience are significant at 10%, meaning that farmers with more farming experience are more likely to obtain higher gross margins from ALVs farming. These findings imply that most of the respondents had been into farming for quite a long period of time. Long farming experience is an advantage for increase in farm productivity since it encourages rapid adoption of farm innovations (Obinne, 1991).

Group membership is significant at 5% meaning that those farmers with producer group membership are more likely to obtain higher gross margins. This can be explained by the low transaction costs involved when farmers market their produce collectively. Farmer-groups are likely to reduce transaction costs and to redistribute rights in favour of farmers (Staatz, 1986). Further, this collective action enables the farmers to negotiate high prices for delivered produce increasing the gross margins.

Finally access to technical support has a positive and significant relationship with the gross margins of both women and men farmers, at 10 and 5%, respectively. This means that women and men with access to technical support are likely to get higher gross margins from ALVs farming. This could be attributed to the fact that farmers with access to technical support are offered technical advice for ALVs production and marketing services for their produce to supermarkets and the main markets in Nairobi.

This finding agrees with the findings of Irungu *et al*. (2007) that the local NGOs and international organisations have played a part in promoting the marketing of ALVs. The promotion and subsequent linking of small-scale farmers to market chains has been instrumental in increasing the supply of these vegetables, not only in the supermarkets but also in other market outlets. Vertical integration has been achieved through institutional linkages between the producers and the supply outlets. The contractual arrangements between producers and supermarkets ensure continued supply, since it is already matched to demand. In addition, the risk of rapid price fluctuation is greatly reduced.

Thus, the promotion, support and linking up of the various market actors by some local NGOs and international organisations has led to increased supply as well as increased efficiency in the chains.

In conclusion comparing the determinants of gross margins for MHHs and FHHs, it is evident from the findings that the only common factor that matters to the gross margins of both groups is the access to technical support for ALVs production and marketing. The two groups differ in the other determinants of ALVs gross margins. For FHHs on top of technical support, Education, land size and distance to piped water source are the other determinants of gross margins. The other determinants of gross margins for MHHs with technical support include; age of household head, experience in farming, group membership and access to extension services. Therefore technical support is a necessary but not sufficient condition, if gains at improving ALVs gross margins for men and women farmers are to be realized, the specific determinants for each group have to be put in consideration.

CONCLUSION

This study has been carried out in Kiambu district to assess the contribution of ALVs to household wellbeing by disaggregating the findings by gender. The specific objectives of the study are; to analyze the socioeconomic characteristics of ALV farmers, to compute the share of income from ALVs to total household income for different socioeconomic groups, to determine the socioeconomic characteristics influencing the decision to grow ALVs by smallholder farmers and to analyze factors that determine the gross margins of ALVS for men and women farmers.

The findings of this study have provided an in-depth analysis of the contribution of ALVs to household wellbeing. The study has analyzed the contribution of ALVs to household incomes for different socioeconomic groups. The results show that ALVs make contributions to household incomes for different socioeconomic groups such as the different age groups of farmers, the different education categories of farmers and to men and women farmers. These contributions are very important considering that ALVs are of very high nutritional and biodiversity value.

Finally the determinants of gross margins for women and men ALVs growers are compared. In comparing the determinants of gross margins for MHHs and FHHs, it is evident from the findings that the only common factor that matters to the gross margins of both groups is the access to technical support for ALVs production and marketing. The two groups differ in the other determinants of ALVs gross margins. For FHHs on top of technical support, education, land size and distance to piped water source are the other determinants of gross margins. The other determinants of gross margins for MHHs with technical support include; age of household head, experience in farming, group membership and access to extension services. Therefore technical support is a necessary but not sufficient condition, if gains at improving ALVs gross margins for men and women farmers are to be realized, the specific determinants for each group have to be put in consideration.

RECOMMENDATIONS

The importance of technical support and access to extension services on the growing and marketing of ALVs has been clearly shown by the study findings. There is need therefore for more government involvement in dissemination of this precious

knowledge to the rest of the country. There is also need for more NGOs involvement to ensure that there is increased ALVs production by especially marginalized farmers such as women and youth in the advent of hard economic times characterized by high rates of inflation and unemployment. However for this to be effective, the role of the private sector cannot be overemphasized especially in marketing of ALVs and interventions in the value chain.

According to the study, the factors that really matter for women to be able to increase their gross margins from ALVs farming include; education, land size, piped water source and access to technical support. Therefore alternative land tenure should be assessed to ensure that women get access to more land and improved access to a water source in order to increase their gross margins from ALVs production.

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