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Demystifying the Contribution of African Indigenous Vegetables to Nutrition-Sensitive Value Chains in Kenya

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Abstract

African Indigenous Vegetables (AIVs) are widely consumed in Kenya as part of everyday meals. They provide the much-needed micro-nutrients which are critical for combating micronutrient deficiencies ("hidden hunger"). The study describes the socio-economic characterizes of households in rural and peri-urban areas in Kenya and appraises the contribution of AIVs to household food access. The results show that there are spatial variations in the consumption of AIVs. Households living in rural areas have a wider variety of vegetables and consume their own production for an estimated ten months in a year; at the same time, purchase vegetables for between 6-7 months. Their peri-urban counterparts have less variety, consume their own produce for 11 months in the year and purchase for 8-9 months. Household income plays a critical role in enabling participation in food markets, Households living in rural areas earn significantly less on average from their land, their annual salary and net profits compared to their peri-urban colleagues. At least 40 per cent of households living in rural areas compared to an estimated 20 per cent in peri-urban areas grade their vegetables. In contrast, 50 per cent of all households wash their vegetables before consumption. In conclusion, households' living in rural areas are net buyers of food, indicating that interventions to ensure increased consumption of AIVs must be accompanied by broad-based livelihood improvements to ensure that benefits accrue. Also, there is a need to underscore the importance of extension services as knowledge brokers.

Keywords: household vegetable consumption, African Indigenous Vegetables, hidden hunger, nutrition security

1. Introduction

AIVs are widely consumed in Kenya as part of everyday meals, usually as an accompaniment to a starch. These indigenous vegetables are a source of micro-nutrients, specifically vitamins A and C, iron, calcium, magnesium, proteins and antioxidants, which are critical for nutrition security (Abukutsa-Onyango, 2010; Gido, Ayuya, Owuor, & Bokelmann, 2017a, 2017b; Kebede & Bokelmann, 2017; Muhanji, Roothaert, Webo, & Stanley, 2011). According to the UNSCN 6th Report on the World Nutrition Situation (UNSCN, 2010), nutrition security exists when food security is combined with education, a sanitary environment, adequate health services and proper care and feeding practices to ensure a healthy life for all household members. Globally, the importance of nutrition has been recognized and supported by the United Nations 2030 Agenda for Sustainable Development.

Several studies following the agriculture nutrition projects (Hawkes & Johnston, 2012; Turner et al., 2013) have been carried out and conceptual frameworks developed in attempts to map and measure the pathways by which agriculture contributes to nutritional outcomes (Herforth & Ballard, 2016; Herforth et al., 2012). In essence, these studies have identified the common themes that have the potential to affect nutritional outcomes. These are access to adequate food (food security), care practices, health services, and proper health environments (FAO, 2016; Herforth & Ballard, 2016).

Food access can be realized through self-production or trade; this implies that households can access nutritious food from their farms or buy it from the market at affordable prices. The household income can and will be directed towards the purchase of nutritious food if it is available and affordable, and if the supply is stable. Care practices include several activities geared towards behavioural and attitudinal change and the consumption of

nutritious food; this involves the decision-making power of women at the household level on income, time, and labour. Health environments are critical, considering the variability of weather patterns and the need to conserve natural resources (FAO, 2016; Herforth & Ballard, 2016).

Figure 1 provides a simplification of the pathways from AIVs to nutrition. We cannot over-emphasize the benefits of these vegetables in the provision of the much-needed micro-nutrients, which are critical for combating hidden hunger. They are grown by many households in rural areas and are part of the daily diet. The production system for AIVs in is not capital-intensive and has intermittent labour-intensive requirements during the growing season. This makes it easy for most households to participate in production (Chagomoka et al., 2014; Ruel et al., 2005; Shackleton et al., 2010).

There is no study that looks at the potential of the AIVs to contribute to nutrition using the pathways indicated in Figure 1. This study describes the socio-economic characterizes of households in rural and peri-urban areas in Kenya and appraises the contribution of AIVs to household food access and care practices leading to dietary changes that contribute to the improved health of the household and thus their nutritional status.

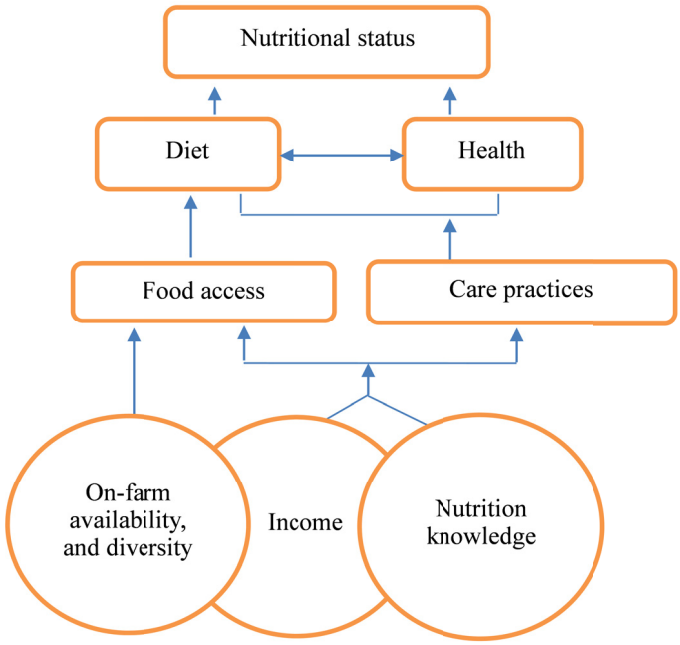

Figure 1. Simplified pathways for the contribution of AIVs to nutrition

Source: Adapted from Herforth and Ballard (2016).

2. Methods

2.1 Description of Study Area

This study uses a cross-sectional data set from a household survey conducted in 2016 by the Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa (HORTINLEA) project. The household survey covered four counties in Kenya: Kisii, Kakamega, Kiambu, and Nakuru. In these counties, the rural areas of Kakamega and Kisii counties were mapped out, while the peri-urban areas (Note 1) of Kiambu and Nakuru counties were mapped out for the household survey.

Kisii county is located 0.6667°S, and 34.75°E and covers an area of 1,317.5 km^2; it has a population of 1,152,282, of which 51 per cent live below the poverty line (the national poverty index is at 43.8 per cent). The county has nine sub-counties (KNBS, 2010). The county exhibits a highland equatorial climate, resulting in a bimodal rainfall pattern with an average annual rainfall of 1,500 mm. The long rains are between March and June, while the short rains are between September and November, with January and July being relatively dry. The maximum temperatures in the county range between 21 °C and 30 °C, while the minimum temperatures range between 15 °C and 20 °C (Kisii County Government, 2013).

Kakamega county coordinates are 0.2833°N, 34.750°E; the area has an altitude of 1,535 metres above sea level. The county covers an area of approximately 3,050.3 km2, with a population of 1,660, 651, of which 49 per cent live below the poverty line. The county has nine sub-counties (KNBS, 2010). The annual rainfall in the county ranges from 1280.1 mm to 2214.1 mm per year. The rainfall pattern is evenly distributed all year round, with March and July receiving heavy rains, while December and February receive light showers. The temperatures range from 18 ^{o}C to 29 ^{o}C. January, February, and March are the hottest months, with other months having relatively similar temperatures, except for July and August, which have relatively cold spells (Kakamega County Government, 2013). The agro-ecological conditions in Kisii and Kakamega counties favour AIV production, which takes place almost throughout the year. The production is mainly rainfed and thus follows the bimodal rainfall pattern. Most of the vegetables are sold at the farm gate or spot markets; however, there is evidence that AIV farmers in Kisii county have established informal contracts/networks and sell their vegetable as far away as Nairobi county.

Nakuru county lies within the Great Rift Valley, it covers an area of 7,495.1 km^2 and is located 0.3031°S and 36.08°E. The county has a population of 1,756,950, with 34 per cent living below the poverty line. The county has 11 sub-counties (KNBS, 2010). The county has a bimodal rainfall pattern. The short rains fall between October and December, while the long rains fall between March and May. Temperatures in the county range from a high of 29.3 °C between the months of December to part of early March to low temperatures of up to 12°C during June and July (Nakuru County Government, 2013).

Kiambu county is located in the central region of the country and covers a total area of 2,543.5 km^2, with 476.3 km^2 under forest cover. The county is divided into 12 sub-counties and has a population of 1.7 million people, with 21.75 per cent living below the poverty line. The county lies between 1.1748°S, 36.8304°E. The county experiences a bimodal type of rainfall. The long rains fall between mid-March and May; this is followed by a cold season, usually with drizzle and frost from June to August and the short rains between mid-October and November. The annual rainfall varies with altitude, with higher areas receiving as high as 2,000 mm and lower areas receiving as little as 600 mm. The average rainfall received by the county is 1,200 mm. The mean temperature in the county is 26 °C with temperatures ranging from 7 °C in the upper highlands' areas to 34 °C in the lower midland zone. July and August are the months during which the lowest temperatures are experienced, whereas January, February, and March are the hottest months (Kiambu County Government, 2013). The agro-ecological conditions in Nakuru and Kiambu favour the production of AIVs all year round; in these counties' farmers practise both rainfed and irrigated production of these vegetables and have commercialized their production due to the readily available markets in the peri-urban and urban areas within the county and the neighbouring counties.

2.2 Data Collection

Households for the survey were selected using a multi-stage sampling approach. First, a purposive sampling technique was applied to choose four agricultural counties. In these counties, the rural areas of Kakamega and Kisii counties were mapped out, while the peri-urban regions in Kiambu and Nakuru counties were mapped out for the household survey. After which, at the village level, households were randomly selected. These households were involved in the production, marketing, or consumption of at least one AIVs. Face-to-face interviews were conducted using a structured questionnaire. Data was collected for five types of AIVs: African nightshade (*Solanum scabrum*), spider plant (*Cleome gynandra*), amaranth (*Amaranthus* spp.), cowpea (*Vigna unguiculata*), and Ethiopian kale (*Brassica carinata*). A total of 685 households were interviewed. Descriptive statistics were used to summarize and organize the data by measuring the central tendency and measures of variability.

3. Results and Discussion

3.1 Socio-economic Characteristics of the Households

The distribution age among of the respondents showed the average age was above 50 years, implying that farmers in the country are ageing. The peri-urban areas had older farmers (Kiambu: 54.6 years) compared to the rural areas (Kisii: 51.8). Most of these households are smallholder farmers with parcels of land ranging from 0.8 ha in Kisii to 1.3 ha in Nakuru. The average household size is significantly different between the rural areas (6 persons) and the peri-urban areas (5 persons) (Table 1). The population density of these counties' and the level of poverty is varied with the rural areas being more densely populated and having higher poverty rate compare to peri-urban areas. A study carried out on the consumption intensity of AIVs showed that having a large-sized household, increased the probability to purchase vegetables to supplement own production (Gido et al., 2017a).

Table 1. Distribution of the respondents and means comparison ttest results

Variables	Rural				Peri-urban				Rural	Peri-urban	Combined	Difference	Pr (T.t)
	Kisii		Kakamega		Nakuru		Kiambu						
	Mean	SD	Mean	SD	Mean	SD	Mean	SD					
Age household head	51.8	12.6	55.2	13.0	53.3	12.1	54.6	12.5	51.39	51.96	51.63	(0.57)	0.41
Household size	6	2	6	2	5	2	4	2	6	5	5	1.42	0.00***
Total land size in ha	0.8	0.9	1.1	1.2	1.3	2.1	0.6	0.8	1.04	0.93	0.99	0.11	0.15

Note. *** p < 0.01, ** p < 0.05, * p < 0.1.

Regarding gender, most of the respondents were male. Although this is a peculiar situation, generally women are considered more likely to be involved in vegetable farming at the household level because of the role they play in the family; however, it does not negate the findings of this study. Majority of the respondents had completed at least, up to year 12 of schooling, except Kakamega county that reported 42 per cent having completed school up to year 7. Nakuru county recorded that 26 per cent had tertiary (Note 2) level education (Table 2). Studies have shown that education plays a significant positive role in influencing the consumption of nutritious and healthy food. More educated people are more likely to enquire and seek out knowledge related to nutrition which influences their decisions on everyday diets (Mavengahama, McLachlan, & Clereq, 2013; Paddock, 2017; Shackleton et al., 2010).

Table 2. The proportion of the respondents by gender and education level (%)

Variables	Rural		Peri-urban	
	Kisii	Kakamega	Nakuru	Kiambu
Gender				
Female	21.5	10.9	19.6	22.6
Male	78.5	89.2	80.4	77.4
Highest level of education				
None	0.3	0.5	0.0	0.0
Pre-school	1.1	0.3	1.8	0.0
Standard 7 (year 7) and below	25.3	42.1	20.6	23.3
Standard 8 (year 8)	11.4	11.9	5.4	14.8
Form 3 (year 11) and below	13.6	11.1	11.2	10.6
Form 4 (year 12)	**36.2**	**20.1**	**33.9**	**38.5**
Tertiary education (> 13 years of school)	12.0	14.0	26.4	12.7
Post-graduate	0.5	0.0	0.7	0.0

3.2 Participation of Households in the Production and Consumption of Vegetables

Most vegetables have short production cycles, with low input requirements and short labour-intensive periods; they tend to be adaptable to most climatic conditions, making them attractive for many resource-poor farmers. At the same time, these vegetables can be grown as inter-crops, in kitchen gardens or backyards, and on small parcels of land (Kebede & Bokelmann, 2017; Mwaura et al., 2013; Nyambo et al., 2013). Table 3 shows that in rural areas, households consume their own production for an estimated ten months a year, and at the same time purchase vegetables for between six and seven months. Their peri-urban counterparts consume their own produce for 11 months a year and purchased for eight to nine months. Emphasizing the seasonality of indigenous vegetable production and at the same time points towards tastes and preferences—these prompt households to buy vegetables even when they are involved in vegetable production. According to Gido (2017a), distance to the market did not act as a deterrent for consumers, when sourcing particular vegetables. Besides, different vegetable complement each other; for instance, jute mallow complements slender leaf and amaranth complements spider plant, and thus households could be involved in purchasing their preferred vegetables.

Table 3. Source of vegetables consumed by households and means comparison ttest results

Variables	Rural				Peri-urban				Rural	Peri-urban	Combined	Difference	Pr (T.t)
	Kisii		Kakamega		Nakuru		Kiambu						
	Mean	SD	Mean	SD	Mean	SD	Mean	SD					
Total number of months of vegetable consumption in the last 12 months													
Own production	10.8	2.6	10.5	2.5	11.2	1.2	11.5	1.9	10.62	11.07	10.81	(0.44)	0.001***
Buy	7.4	5.5	6.0	5.2	8.8	5.1	9.3	4.9	5.15	7.19	6.02	(2.05)	0***

Note. *** p < 0.01, ** p < 0.05, * p < 0.1.

The amount, frequency, and type of vegetable consumed by households indicate the demand that these vegetables can potentially generate if production is upscaled, household size notwithstanding. Table 4 shows that on average in the rural areas, amaranth, cowpeas and African nightshade are consumed twice a week. While in peri-urban areas these vegetables are consumed on average three times a week. Implying that households in rural areas have more variety in terms of indigenous vegetables to choose from, compared to households in peri-urban areas, in addition to their tastes and preference (Nyambo et al., 2013; Ruel et al., 2005).

Table 4. Consumption of specific vegetable types

Vegetable type	Frequency and quantity consumed	Rural				Peri-Urban			
		Kisii		Kakamega		Nakuru		Kiambu	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Amaranth (Lidodo, Chelwanda, Terere)	Days in a week	1.5	2.0	1.8	2.0	2.2	2.4	2.7	2.2
	Quantity of bunches* in a week	4.4	4.1	4.5	5.9	5.7	5.3	4.5	3.8
Cowpeas (Likhubi, Kunde)	Days in a week	1.1	1.4	2.1	1.4	0.7	1.5	0.4	1.3
	Quantity of bunches in a week	3.9	3.3	4.9	5.3	3.7	3.1	4.7	4.4
African nightshade (Lisutsa, Managu)	Days in a week	2.0	1.5	2.0	1.7	2.5	2.2	2.7	2.1
	Quantity of bunches in a week	5.0	4.1	5.5	5.5	6.0	5.2	4.6	4.1

Note. *Bunch is estimated at 0.5 kg.

3.3 Household Income

Household income plays a critical role in enabling participation in food markets. Households in rural areas earn significantly less on average from their land, annual salary, and net profits compared to their peri-urban colleagues (Table 5). There are variations across the different locations; however, these may imply that poverty is rife in the rural areas compared to the peri-urban ones due to the number of market opportunities available. The corresponding poverty line indicates that the households in Kisii (51%) and Kakamega (49%) counties live below the National poverty line which is 43.8 per cent compared to Nakuru (34%) and Kiambu (21.75%) counties household live above the National poverty line (Kansiime et al., 2018; Karanja et al., n.d.; Rajendrana et al., 2016; KNBS, 2010). Studies have shown that dietary diversity is usually higher in market-oriented production systems compared to subsistence ones because households generate income which can be used to purchase food (Sibhatu & Qaim, 2018).

Table 5. Household income means comparison ttest results

	Rural	Peri-urban	Combined	Difference	Pr (T.t)
Total Land ha	1.04	0.93	0.99	0.11	0.1548
Total income per ha ($)	4,608.50	8,049.22	6,072.85	(3,440.71)	0.0009***
Total annual household salary ($)	2,955.86	5,852.67	4,187.53	(2,896.82)	0.00***
Net profit from other sources of income average profit month [PPP$(2005)]	713.41	1,676.63	1,123.35	(963.23)	0.0009***

Note. *** p < 0.01, ** p < 0.05, * p < 0.1.

3.4 Knowledge About Nutritious Vegetables

Empirical evidence shows that nutrition knowledge, off-farm income, market access, and self-production influence dietary diversity (Sibhatu & Qaim, 2018). Vegetables accompanied by a staple are an integral component of most daily meals. Interestingly, households living in rural areas are net food buyers (Table 6) when compared with peri-urban households. Empirical studies have shown that a majority of the extreme poor live in rural areas and are engaged in agriculture, which is their primary source of livelihood (Croppenstedt et al., 2018; KNBS, 2018). Most of the production systems employed are rainfed, thus leaving the household vulnerable to weather variability (Ecker, 2018). Coupled by market failures which leave households with no choice other than to supplement their farm income with nonfarm employment, which helps to mitigate the consumption risk necessitated by reduced farm production diversity (Barrett et al., 2001; Dillon & Barrett, 2017; Ecker, 2018).

Table 6. Simplified weekly food diary means comparison ttest results

Food type	Rural	Peri-urban	Combined	Difference	Pr (T.t)
Carbohydrates					
Cereals	6.16	5.48	5.87	0.69	0***
Tubers	2.89	3.12	2.99	(0.23)	0.0437*
Plant proteins					
Legumes	2.01	2.19	2.09	(0.18)	0.06*
Vegetables					
Exotic vegetables	3.96	4.31	4.11	(0.34)	0.0081***
Indigenous vegetables	4.73	4.24	4.52	0.496	0***
Fruits					
Fruits	2.48	2.91	2.67	(0.42)	0.0011**
Animal Protein					
Meat, fish, eggs	1.39	1.74	1.54	(0.349)	0.0001***
Milk and dairy products	5.35	6.56	5.86	(1.21)	0***
Stimulants					
Sugar	6.25	6.65	6.42	(0.39)	0***
Fats and oils					
Cooking oil	6.36	6.85	6.57	(0.49)	0***

Note. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The other critical area regarding knowledge on nutrition is how the handling of vegetables; the evidence was sorted to established whether the households that consumed AIVs graded their vegetables at any level or used some sort of criteria to determine which vegetable was good. At least 40 per cent of households living in rural areas, compared to an estimated 20 per cent in peri-urban areas, graded their vegetables (Figure 2). Market outlet, to some extent, determines the degree of grading carried out. Studies have shown that households in rural areas prefer purchasing their AIVs in local open-air markets and farm gate outlets, this could partly account for the grading of vegetables because the market provides an opportunity to negotiate and choose the vegetables before purchase. Implying that most often than not, the consumers are purchasing the produce from the farmers directly. While their peri-urban counterparts preferred to buy their vegetables from green groceries, supermarkets and open-air markets, implying that the opportunity to interact with the farmer does not exist (Gido et al., 2016). Regarding care practices, the results show that at least 50 per cent of the households in Kakamega county wash their vegetables before eating, while the in the other three counties the households wash their vegetables fewer times. Access to information on AIVs is widely acknowledged among the household; this could be attributed to food consumption patterns.

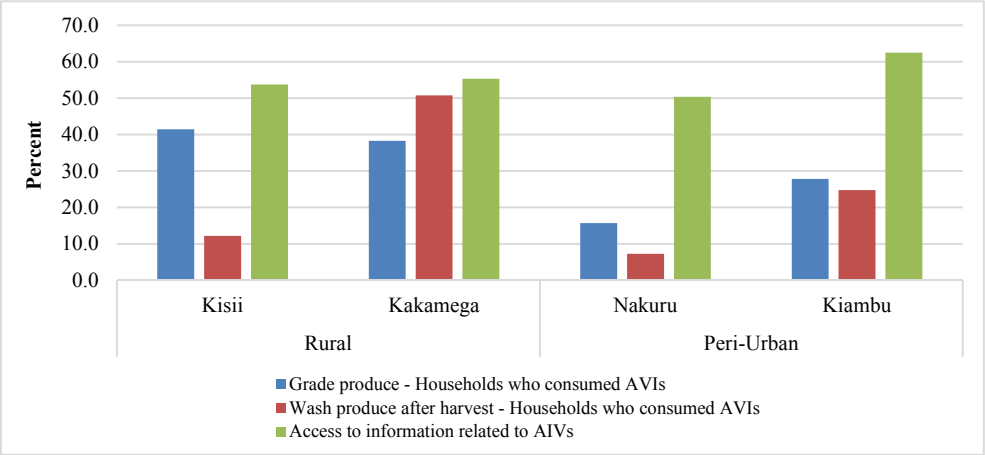

Figure 2. How households handle AIVs before consumption (%)

Table 7 indicates where households get information on the AIV production system. Results show that on average, extension officers are the primary source of information (45%), followed by membership in a farmers' group (8%), and neighbours (8%)—showing that the extension services are working because farmers are getting the right messages (Ekesa et al., 2009; Mwaura et al., 2013). Intuitively, the community at large participates in information sharing, and this can be exploited to share relevant information.

Table 7. Sources of African Indigenous vegetable information (%)

	Rural		Peri-urban	
	Kisii	**Kakamega**	**Nakuru**	**Kiambu**
Extension service officers	58.9	38.5	35.5	48.6
Membership in a farmers' group	8.4	19.3	1.9	2.8
Neighbours	6.5	9.2	9.3	8.4
Self	5.6	2.8	4.7	7.5
Relatives	4.7	6.4	5.6	3.7
Friends	3.7	2.8	3.7	7.5
Civil society organizations	2.8	11.9	0.9	0.9
Farmers' field school	1.9	3.7	0.9	0.0
Other household heads	1.9	1.8	0.0	0.0
Village development meetings	0.9	1.8	2.8	1.9
Individuals at market	0.9	1.8	0.9	1.9
Other	3.7	0.0	1.9	0.9

Most (over 70 per cent) of the households interviewed consumed these vegetables for their nutritional content (Ekesa et al., 2009; Sibhatu & Qaim, 2018); access to and the medicinal value of the vegetables ranked second and third (Table 8). Indigenous vegetables have regained their prominence in household diets despite being regarded as a "poor man's diet" for many years following the introduction of exotic vegetables during the colonial period. There is evidence now showing that these indigenous vegetables have superior nutritional properties (Abukutsa-Onyango, 2007, 2010; Gido et al., 2017a; Muhanji et al., 2011; Abukutsa-Onyango et al., n.d.; Sibhatu & Qaim, 2018).

Table 8. Why do households consume African Indigenous Vegetables?

Reason	Rural						Peri-urban					
	Kisii			Kakamega			Nakuru			Kiambu		
	RANK											
	1	2	3	1	2	3	1	2	3	1	2	3
Nutritional purposes	70.9	22.5	6.6	69.5	19.4	7.7	77.2	15.3	7.4	77.8	19.3	4.5
Easy to access everywhere	8.0	20.1	29.7	6.6	21.0	26.0	2.1	16.8	19.1	3.5	17.8	27.3
Medicinal	13.1	43.2	39.6	14.2	39.2	30.8	14.5	48.1	42.6	16.0	51.1	34.8
Cultural habits	3.0	8.9	13.2	4.1	7.5	20.2	3.4	13.7	11.8	0.0	5.9	18.2
Affordable price	2.5	3.6	6.6	2.0	6.5	3.8	1.4	2.3	5.9	0.7	4.4	6.1
No other vegetables available	1.0	0.0	1.1	0.0	0.5	1.0	0.0	0.0	1.5	0.0	0.7	0.0
Pregnancy	0.5	0.6	1.1	0.0	0.0	2.9	0.0	0.0	5.9	0.0	0.0	7.6
Others	1.0	1.2	2.2	3.6	5.9	7.7	1.4	3.8	5.9	2.1	0.7	1.5

4. Conclusion

This study attempts to describe the socio-economic characterizes of households in rural and peri-urban areas in Kenya and appraises the contribution of AIVs to household access to nutritious food. There may be variations within the spatial locations. However, it general it can be said that households widely consume the AIVs in both rural and peri-urban areas. Furthermore, households in rural areas are net buyers of food, indicating that interventions to ensure increased consumption of AIVs must be accompanied by broad-based livelihood improvements to ensure that benefits accrue. Lastly, there is a need to underscore the importance of extension service officers as knowledge brokers.

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Notes

Note 1. Peri-urban regions can be defined as 'superficial' rural areas that are within the orbit of immediate urban hubs. Urban and peri-urban agriculture (UPA) occurs within and surrounding the boundaries of cities throughout the world and includes products from crop and livestock agriculture, fisheries and forestry in the urban and peri-urban area. It also includes non-wood forest products, as well as ecological services provided by agriculture, fisheries and forestry. Often multiple farming and gardening systems exist in and near a single city (FAO, 2001).

Note 2. Tertiary education refers to the respondent that had completed a certificate, diploma, higher diploma and undergraduate studies.