HORTINLEA BASELINE SURVEY REPORT 2014

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- Team leaders, supervisors and enumerators who participated in the survey
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Abstract

This report summarizes major findings from the HORTINLEA survey conducted in 2014 under the framework of HORTINLEA project. The HORTINLEA project is an inter-disciplinary research project addressing food security in East Africa, particularly in Kenya. The project targets to improve the livelihood and nutritional situation of the rural and urban poor. To achieve this, it focuses on production and consumption of horticultural crops, especially of African indigenous vegetables (AIVs). The HORTINLEA survey, conducted in rural, peri-urban and urban areas of Kenya focused on AIV actors along the value chain namely: producers, traders and consumers. The survey was carried out in September and October, 2014 where data was collected at the household, plot and community levels. It was administered using structured questionnaire with Geo-codes where more than 1500 actors were interviewed along the AIV value chain. Various topics were covered in the survey including household composition, education, health, assets, expenditure, credit and saving, agricultural and AIV production, agricultural and AIV marketing, nutrition, shocks and coping strategies.

The most widely produced African Indigenous vegetable is African nightshade produced by about 72% of respondents followed by cowpeas produced by about 48% of respondents. AIVs are traditionally considered as “women’s crop” where almost 60% of the producers stated that women are responsible for producing AIVs and in about 57% of the sample women are also responsible for marketing of AIVs. Most of the sampled households sell their AIV produce where African nightshade is the most marketed one. However, most producers do not have contract with the buyer, but rather sell their produce directly to consumers. Most AIV producers sell their produce either at the farm gate or at a stand on weekly markets while less than two percent of respondents sell their AIVs via supermarkets.

Even though the AIV value chain has many challenges, it has as well opportunities to improve. First, the link between producers to retailers and consumers could be expanded and formalized so that producers could benefit from marketing of these products. Second, post-harvest handling and transportation system of AIVs should be improved to ensure good quality and timely delivery of AIVs to consumers. Third, processing and value-addition activities could be introduced, which on the one hand improve the quality of the AIV product, while on the other hand create employment opportunity at different segments of the value chain.

Keywords: African indigenous vegetables (AIV); household characteristics; household welfare; AIV production; AIV marketing; Kenya

JEL classification: Q12; Q13; R20

Zusammenfassung

Dieser Bericht fasst die wichtigsten Ergebnisse der HORTINLEA-Umfrage zusammen, die 2014 im Rahmen des Projekts HORTINLEA durchgeführt wurde. Das HORTINLEA-Projekt ist ein interdisziplinäres Forschungsprojekt zur Ernährungssicherheit in Ostafrika, insbesondere in Kenia. Das Projekt zielt darauf ab, die Lebensgrundlage und die Ernährungssituation der armen ländlichen und städtischen Bevölkerung zu verbessern. Um dies zu erreichen, konzentriert sie sich auf die Produktion und den Konsum von Gartenbaukulturen, insbesondere von einheimischem afrikanischem Gemüse (AIVs). Die HORTINLEA-Umfrage, die in ländlichen, peri-urbanen und städtischen Gebieten Kenias durchgeführt wurde, konzentrierte sich auf AIV-Akteure entlang der Wertschöpfungskette: Produzenten, Händler und Verbraucher. Die Umfrage wurde im September und Oktober 2014 durchgeführt, wobei Daten auf Haushalts-, Grundstücks- und Gemeindeebene erhoben wurden. Es wurde mit Hilfe eines strukturierten Fragebogens mit Geo-Codes durchgeführt, bei dem mehr als 1500 Akteure entlang der AIV-Wertschöpfungskette befragt wurden. Verschiedene Themen wurden in der Umfrage behandelt, darunter Haushaltszusammensetzung, Bildung, Gesundheit, Vermögen, Ausgaben, Kredite und Ersparnisse, landwirtschaftliche und AIV-Produktion, landwirtschaftliches und AIV-Marketing, Ernährung, Schocks und Bewältigungsstrategien.

Das am weitesten verbreitete afrikanische einheimische Gemüse ist African nightshade, der von etwa 72% der Befragten produziert wird, gefolgt von cowpeas, die von etwa 48% der Befragten produziert werden. AIVs werden traditionell als "Frauenkultur" betrachtet: Fast 60% der Produzenten gaben an, dass Frauen für die Herstellung von AIVs verantwortlich sind und in etwa 57% der Fälle sind Frauen auch für die Vermarktung von AIVs verantwortlich. Die meisten der untersuchten Haushalte verkaufen ihre AIVs, wobei African nightshade das am meisten vermarktete AIV ist. Die meisten Produzenten haben jedoch keinen Vertrag mit dem Käufer, sondern verkaufen ihre Produkte direkt an die Verbraucher. Weniger als zwei Prozent der Befragten ihre AIVs in Supermärkten verkaufen.

Auch wenn die AIV-Wertschöpfungskette viele Herausforderungen hat, hat sie doch auch Chancen zur Verbesserung. Erstens könnte die Verbindung zwischen Produzenten und Einzelhändlern und Verbrauchern ausgebaut und formalisiert werden, damit die Produzenten von der Vermarktung dieser Produkte profitieren können. Zweitens sollte das Handhabungs- und Transportsystem für AIVs nach der Ernte verbessert werden, um eine gute Qualität und rechtzeitige Lieferung von AIVs an die Verbraucher zu gewährleisten. Drittens könnten Verarbeitungs- und Wertschöpfungsaktivitäten eingeführt werden, die einerseits die Qualität des AIV-Produkts verbessern und andererseits Beschäftigungsmöglichkeiten in verschiedenen Segmenten der Wertschöpfungskette schaffen.

1. Background information

1.1. HORTINLEA in Perspective

The HORTINLEA project is an inter-disciplinary research project addressing food security in East Africa, particularly in Kenya. The project targets to improve the livelihood and nutritional situation of the rural and urban poor. To achieve this, it focuses on production and consumption of horticultural crops, especially of indigenous vegetables. Indigenous vegetables provide essential nutrients such as Vitamins A and C, Iron, Calcium, Magnesium, Proteins and anti-oxidants that are suitable for normal growth and health (Abukutsa-Onyango, 2008; Schippers, 2000). In addition, the labor-intensive horticultural production systems as well as the associated logistic and processing activities provide employment and income opportunities. With its focus on indigenous vegetables, HORTINLEA seeks to meet the pressing challenges of malnutrition, poverty and sustainability. It aims to tackle these problems by adopting an integrated approach, which combines issues of poverty, environmental and gender concerns.

Incidence of poverty in Kenya is estimated to be 46% in 2005/06 (KNBS, 2007), and about 60% of the population lack the physical and economic access to adequate calories and therefore face starvation (Okeno et al., 2003). Strengthening the horticultural sector in general and indigenous vegetables in particular, thus has the potential to foster improvement in nutritional status and increase incomes among vulnerable people in Kenya.

1.2. HORTINLEA survey background

The HORTINLEA household survey is conducted within the framework of the HORTINLEA project as one of the central inputs providing household-level information about various socio-economic characteristics of actors involved in indigenous vegetables production, marketing and consumption along the value-chain. The household survey provides a comprehensive and high quality database that would allow a variety of socio-economic analyses of households' food security, poverty, livelihoods and agricultural decisions. The first round of survey was carried out in September – October, 2014. The survey is multi-level where data was collected at the household, plot and community levels. It was administered using structured questionnaire with Geo-codes. Multiple topics were covered in the survey including household roster, education, health, assets, expenditure, credit and saving, agricultural production, agricultural marketing, nutrition, shocks and coping mechanisms.

2. Methodology

2.1. Survey areas

The survey was conducted in three locations in Kenya namely, rural, peri-urban and urban locations. These three locations were chosen to capture the entire value chain of indigenous vegetable production, marketing and consumption. The selection of the specific survey sites was done through expert consultation and statistics from the Ministry of agriculture in terms of where most indigenous vegetables are produced both for home consumption and market purpose. The rural sites include two counties in the Western part of Kenya namely Kisii and Kakamega. The peri-urban sites include three counties namely Kiambu, Nakuru and Kajiado. The Urban site has one County namely Nairobi.

2.2. Survey design and logistics

In order to cover the whole value chain from production, marketing and consumption, the HORTINLEA household survey targeted three types of respondents, namely indigenous vegetable producers, traders and consumers. The AIV producers are found in rural and peri-urban areas while the traders and consumers are in urban locations namely Nairobi (see table 1 for details of survey sites and number of households). Even though traders of AIVs were identified both in rural and peri-urban areas, the survey only focused on traders in Nairobi due to shortage of funding. However, given that Nairobi is the capital of Kenya, it serves as the hub of markets not only for AIVs but also for all other commodities. Hence, the traders in Nairobi can be representative to trace the value chain of AIVs.

To determine the total number of sample respondents for the HORTINLEA survey, the following formula by Anderson *et al*. (2007) was used.

$$n = \frac{Z^2 pq}{e^2} \dots\dots\dots\dots\dots (1)$$

Where; n = Optimum sample size,

Z= Normal variant associated with levels of significant.

e = Probability of error

p= The estimated proportion of households that engage in indigenous vegetable value chain and q is 1-p

In the study confidence interval was 95% therefore, $Z_{\alpha/2}$=1.96, e = 5% (at 95% confidence level).

The most important variable in using the above formula is finding the proportion of households that engage in indigenous vegetable value chain. This information is not readily available in secondary documents. Therefore, we needed to rely on expert consultations and take into account the available budget to undertake the survey. Consequently, about 40% of households are assumed to be engaged in indigenous vegetable production and marketing in rural and peri-urban areas. In urban areas, about 10% of households are assumed to be engaged in the consumption and marketing of indigenous vegetables.

Following this approach, we arrived at 400 respondents (including contingency for non-responses) for each of the rural sites Kisii and Kakamega, which give a total of 800 respondents in rural sites. For peri-urban sites, we divided 400 respondents to three of the sites namely, Nakuru, Kiambu and Kajiado. Here we allocated 150 each for Nakuru and Kiambu and 100 for Kajiado. For urban consumers and traders, we arrived at 150 respondents (including contingency for non-responses) for each consumers and traders in Nairobi. The breakdown of the sampling frame is as shown in Table 1.

Table 1. HORTINLEA survey sites and number of respondents

Area description	County	Number of households Planned to be interviewed	Number of households actually interviewed	Type of respondents
Rural	Kisii	400	401	AIV Producer
	Kakamega	400	405	AIV Producer
Peri-urban	Nakuru	150	223	AIV Producer
	Kiambu	150	183	AIV Producer
	Kajiado	100	20	AIV Producer
	Kiambu	0	12	AIV Consumers
Urban	Nairobi	150	142	AIV Consumers
	Nairobi	150	157	AIV Traders
Total		1500	1543	

Once, we identified the total number of respondents within each of the sites, we used different targeting approach for each of the respondent types namely, producers, traders and consumers. For AIV producers, households in the sample were selected using Multi-stage sampling approach. Purposive sampling technique was used to select the five counties within the rural and peri-urban sites. It was purposive in that the respondents within these counties are involved in the production, marketing or consumption of Indigenous vegetables. Selection of the sub-counties and divisions was based on information from the respective district agricultural offices. From each division selected, locations/ward were randomly selected and households within locations were in turn randomly selected.

For AIV traders, purposive sampling technique was used, where those traders of Indigenous vegetables were identified in different market outlets of Nairobi County. These comprised traders in open markets, green groceries, kiosks and supermarkets. Once these outlets were identified in different parts of Nairobi, the number of traders that were interviewed in each of these outlets was determined after taking into

account the distribution of outlets within the County. As much as possible, the number of traders interviewed was made proportional to cover the different outlets of AIV markets throughout Nairobi County. Selection of traders within each market outlets was done randomly.

For consumers of indigenous vegetables, it was challenging to identify them, as it was not possible to knock on household's door and ask whether they consume AIVs or not. Finding them in the market outlets at the point of purchase would have been an option, however, given the length of the questionnaire, which takes at least more than one hour, this was not a viable solution. The alternative workable solution was to ask the traders that were interviewed to provide a telephone number of regular customers of AIVs, however, this worked only on 5% of traders, as most of them did not know their telephone number and some did not feel right about privacy issues of the customers. Hence, this method was also abandoned. The last method we resort to is using guides from the open markets and green groceries to identify AIV consumers living nearby these markets. The respondents were located near these markets and as much as possible random selection of respondents was applied.

It is important to note that the HORTINLEA household survey is not representative at the national level. However, the data gives a comprehensive overview of actors of Indigenous Vegetables across the value chain. Results of analysis done on the survey data can be generalized to be representative for Indigenous vegetable producers in rural and peri-urban areas; Indigenous vegetable traders in urban areas; and Indigenous vegetable consumers in urban areas. Even though relatively large samples are drawn within each County, with only 6 Counties covered in the survey, interpretation of results has to be done with care.

2.2.1. Data collection procedure and sampling methods

Before the main survey fieldwork, the questionnaire was pre-tested using trained enumerators in end of March, 2014. Two sub-countries were selected for the pre-test namely, *Lanet* and *Rongai* with in the Nakuru County. In addition to testing the questionnaire, consultation with experts and farmers were undertaken to acquire additional information about AIV value chain. The questionnaire was revised incorporating comments from expert consultations and following fieldwork interview experiences. Prior to the main survey, preliminary visit was held to consult with extension workers in all survey sites and notify selected farmers in advance about the objectives of the survey and to solicit their cooperation with enumerators.

The main household survey was undertaken from September- October, 2014. The survey team included a total of 37 members, with 27 enumerators; 8 supervisors, and 2 team leaders. Dr. Sindu W. Kebede was the main coordinator as a German Partner from Humboldt University of Berlin and Dr. Arnold Opiyo was

the main coordinator of the survey as a Kenyan partner from Egerton University. About six of the supervisors were Doctoral students within the HORTINLEA project.

Prior to the survey, extensive training was provided to enumerators both in classroom (including role-plays) and on the field in terms of administering the questionnaire and survey procedures. One full day was allocated for enumerators to practice administering the questionnaire with farmers near Egerton University. During the training, enumerators were divided into two groups those going to the Western rural sites of Kisii and Kakamega and the Eastern sites going to Nakuru, Kiambu, Kajiado and Nairobi. This way, the quality of training was high as few enumerators were in one group and questions were clarified accordingly. At the end of the training, HORTINLEA survey manuals were provided to every enumerator and supervisor to refer to for clarification during the survey.

In all locations, the survey was carried out through direct interviews with farmers engaged in indigenous vegetable farming and marketing; with traders of indigenous vegetables, and with urban consumers of indigenous vegetables along the value chain. During the survey, incentive was provided to respondents by a payment of KShs 500 per respondent/household for participation. Enumerators gave the incentive to respondents as they see fit in terms of the timing (beginning of interview, middle of interview or end of interview). In the ideal scenario, enumerators introduced the availability of incentive to the respondents in the beginning but gave it out at the end of the interview.

2.2.2. Survey Logistics

The HORTINLEA household survey combined both quantitative and qualitative data collection tools. The quantitative tools include structured questionnaires for AIV producer households in rural and peri-urban areas; structured questionnaire for AIV consumers in urban areas; and structured questionnaire for AIV traders in urban areas. Each of these questionnaires are comprehensive in terms of covering household socio-economic characteristics, agricultural production, saving and credit behaviors, food security, shocks faced by households and their respective coping strategies. The qualitative aspect includes Focus group discussion on food security and coping strategies. This was held with a mix of men, women, young and older members in 15 locations of the survey.

Community questionnaire was also administered with the community leaders in most of the survey villages. In addition, price questionnaire was administered to collect price data for items included in the household survey. This was done from the local market near the village where respondents of the survey normally buy/sell their products.

During the survey, every enumerator was closely supervised and guidance was provided from the supervisor, team leader and extension staff at the ground level. Translation into Kiswahili and when needed to the specific local language was done concurrently by enumerators. This was made relatively easy because enumerators were assigned as much as possible to the sites where they spoke the local language. A consensus on a common Kiswahili word was reached on some specific words during the training among enumerators and supervisors especially on the AIV names and other agro-based products that seemed common in the study sites.

2.3. Data Capture techniques and Validation

In the HORTINLEA survey, the tracing rule is based on the definition of panel households, where a household that is interviewed in the 2014 survey will be re-interviewed in 2015. Hence, the survey tracks the same households during the subsequent rounds. This tracking is facilitated by GEO codes where in 2014, GEO codes of all households were captured and the same will be used to trace households using these codes in 2015. This minimizes attrition rates in the panel. If a household head had left or died in a household, that household will be retained in the survey. If the whole household has changed location, the household will be traced as long as it is within the same County. In cases that households cannot be located or traced, an exact proportion of new households will be randomly selected. The selection of the new households will be done from a list of newly formed or arrived households where these are broadly similar (in terms of demographic and wealth) to those which could not be tracked.

While the above tracing strategy works well for producer and consumer households, we need to use a different strategy for traders. For traders, the survey will attempt to trace individuals, not households. Even though GEO codes were recorded for traders, it is highly likely that traders might move from one market to another for various reasons. As much as possible, market guides and close neighbors will be requested for information about the whereabouts of these traders to minimize attrition rates. This problem is only related to open market traders while it will not be a problem with supermarkets and green groceries unless they have closed.

3. Household socio-demographic characteristics

To understand the farming systems better, we evaluate the socioeconomic profile of the targeted farming communities. These socioeconomic profiles included both demographic and other productive assets that those households owned. An understanding of these important benchmark variables would assist scientists to design better targeted technologies for greater impacts with regards to African Indigenous Vegetable (AIV) production and marketing.

3.1. Gender

Majority (80.6 %) of the surveyed households were male headed, while 19.4% were female headed households (Table 1). The average age of the household head was about 49.7 years.

Table 2. Number of male and female headed households in the sample

County	Male headed	Female headed	Total
Kisii	320	81	401
Kakamega	347	60	407
Nakuru	167	54	221
Kiambu	142	41	183
Kajiado	17	3	20
Total	993	239	1232

Demographically, the average household size was about 5 persons and the variation across the counties were statistically significant at 1% (s. Figure 1).

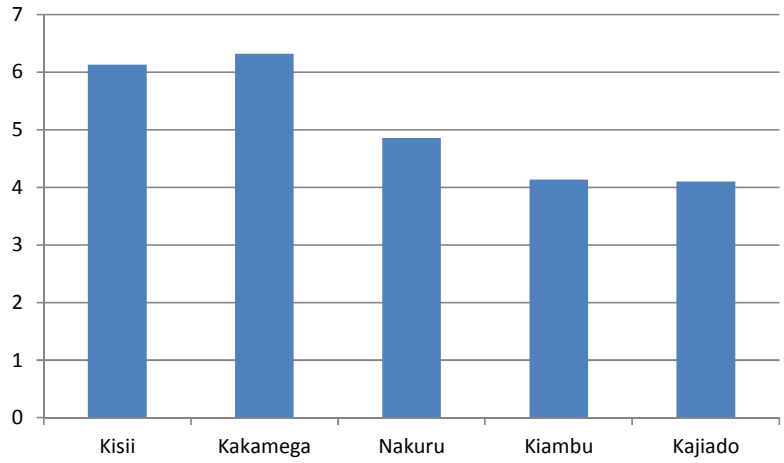


Figure 1. Average Number of household Members

Drawing from the results presented in Figure 1, it was worth noting that two counties had more persons per household than the other three counties. Kisii and Kakamega counties had an average of 6 persons per household while Nakuru had 5 persons per household. The other two counties (Kiambu and Kajiado) had an equal number of household members (4 persons). The demographic characteristics of the counties are likely to have an implication on availability of natural resources like land.

3.2. Marital Status

Majority of the household heads in the surveyed sample were monogamously married and living with their spouses (72.9%) followed by 12.5% who reported that they were either widows or widowers (Table 3). Another striking observation is the distribution of the household heads across the five counties who were separated and those who were widows or widowers. The results showed that Kajiado and Kiambu Counties had a relatively high proportion of household heads that were separated compared to Kakamega and Kisii counties. On the other hand, Kisii County reported the highest proportion of households that were widowed. This could perhaps be attributed to the rampant HIV/AIDS pandemic that is reported in the county by the Ministry of Health (Kilonzo et al., 2014).

Table 3. Present Marital Status of Household Head (% Households)

Marital status	Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
Never married/Single	2.8	2.2	9.1	8.7	10	4.6
Monogamously married	75.1	69.7	72.6	74.9	70	72.9
Polygamous married	4.8	17.4	2.3	1.6	5	8
Separated	0.5	0.2	1.4	2.2	5	0.9
Divorced	0.8	0.2	2.3	0.5	0	0.8
Widowed	15.8	9.9	11.5	12	10	12.5
Others	0.3	0.2	0.9	0	0	0.1

3.3. Fertility

Significantly higher proportion of women in Nakuru County reported to be currently pregnant (0.9%) as compared to those in Kiambu and Kajiado with reported percentage of 0.5% as indicated in Figure 2. However, the women in Kisii reported the least cases of expected births.

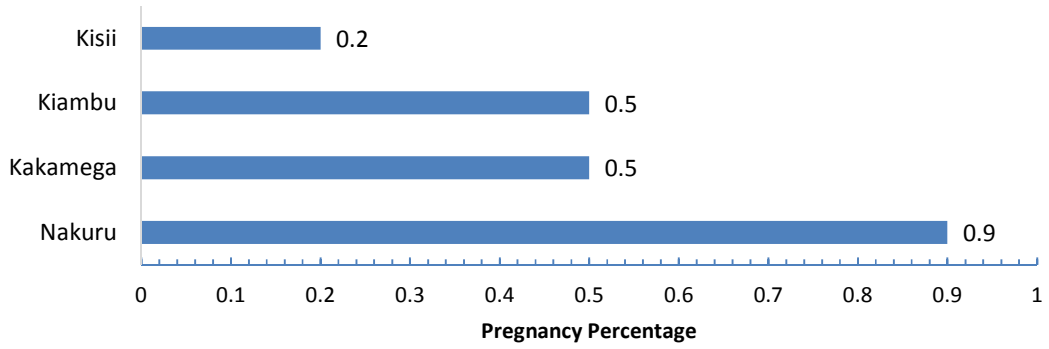


Figure 2. Share of pregnant women in the sample

4. Household socioeconomic characteristics and assets

4.1. Income and transfers

For this baseline and the follow up survey, we calculate the income aggregate according to the definitions and procedures suggested by Johnson et al. (1990). The income calculation is based on the following components: Remittances received; income from rents of land and assets; income from agriculture; income from natural resource use; income from employment; income from self-employment; interest from savings and other capital assets; and pensions. Income has been calculated in purchasing power parity adjusted US Dollars of the year 2015 (PPP$2015) with a conversion rate of 0.024028875 KShs in 2014 to PPP$2015 (PPP conversion factors from World Bank (2018), consumer price indices from KNBS (2018)).

Remittances received: Those remittances from non-household members to the household are fully considered as household income. Transfer income (monetary value) from absent household members to members in the nucleus sense is calculated. In addition, transfer income (money, gifts, remittances) received by the household between October 2013 and November 2014 from other persons (friends/relatives) are included.

Income from rents: The income from renting land paid in cash or in kind, is calculated individually and in total. In kind payments had to be valued in KShs by the farmer. In case farmers were not able to give an estimate, the mean of the farm gate prices given for the commodity by at least five households from the village, ward or district level was used.

Income from agriculture: A separate income estimate was calculated for crops and livestock, taking into account the total value of output, including home consumption. Net income has been calculated for each crop/livestock through subtracting total costs from revenue.

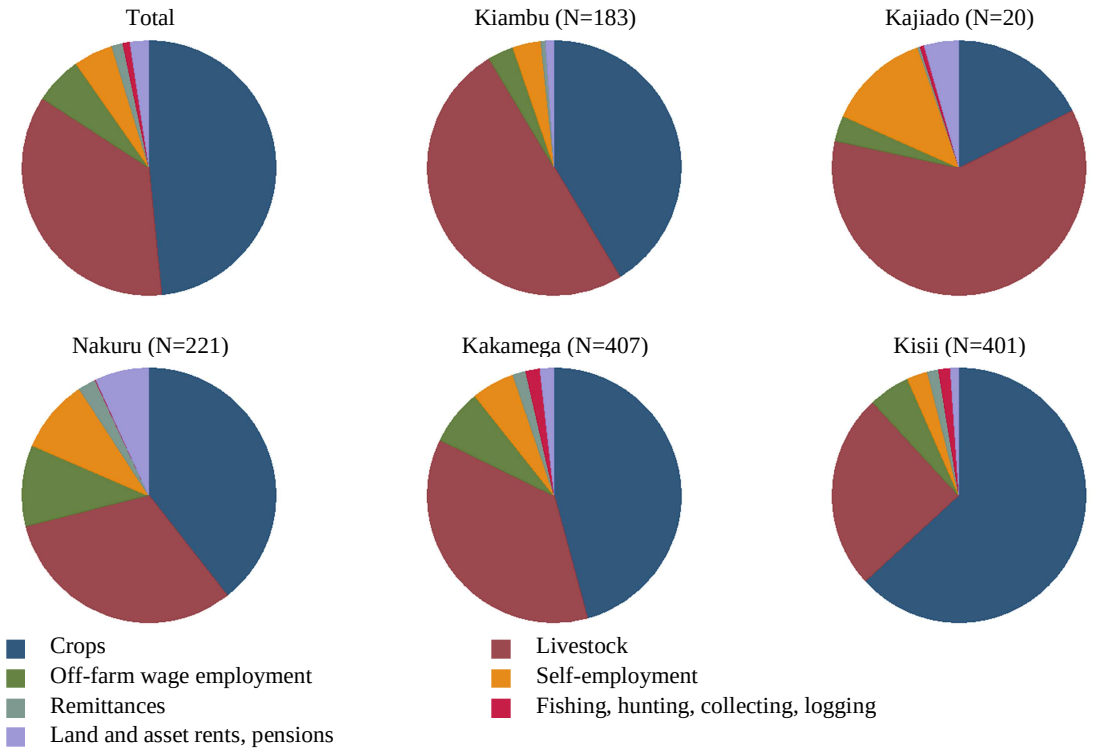
The calculation is based on the nucleus household definition: incomes accruing to household members in their function as head of business, as an employee or government transfer payments are accounted for as income. Total household and per capita income is highest in Kiambu and Kajiado County and lowest in Kakamega (s. Table 4).

Table 4. Distribution of income in the different counties, standard deviation in brackets

Region		Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
N		401	407	221	183	20	1232
_x10100	Total annual household income	6,450	3,611	6,747	10,362	11,858	6,234
		18,282	(5,427)	(10,617)	(15,413)	(9,889)	(13,435)
_x10101	Total annual household income per nucleus member	1,315	812	1,753	3,641	3,582	1,610
		(2,582)	(1,641)	(2,920)	(9,633)	(3,533)	(4,406)
_x10112	Per capita income per month	110	68	146	303	299	134
		(215)	(137)	(243)	(803)	(294)	(367)

The distribution of income sources varies as well significantly between the different counties. While in Kisii and Kakamega the main part of income is generated by crops, other income sources play a bigger role in the peri-urban counties Kiambu, Kajiado and Nakuru (s. Figure 3). Income from livestock is more important than crop income in Kiambu and Kajiado because of the high prevalence of dairy farming in the investigated areas. While crop and livestock income are of almost equal importance in Nakuru, respondents in this county had the highest share of income from off-farm and self-employment.

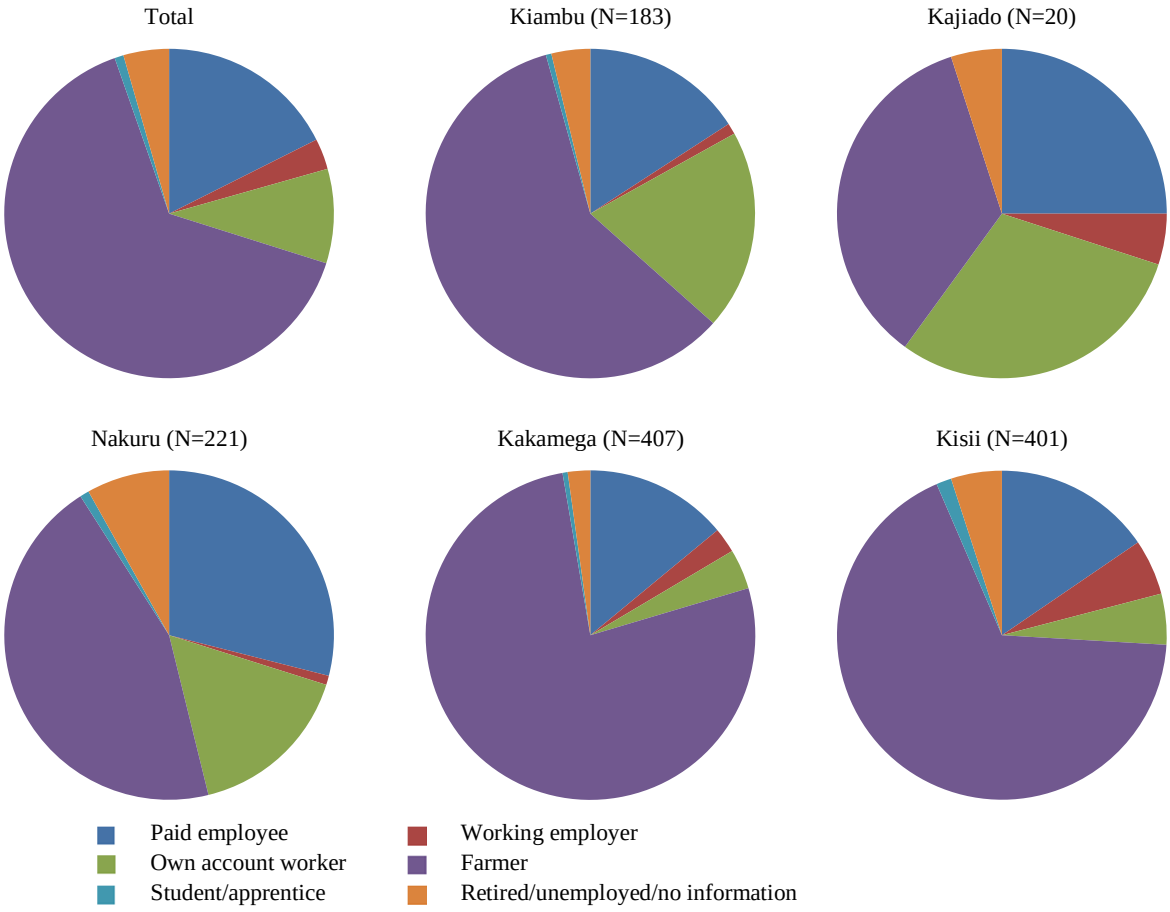
Figure 3. Distribution of income sources in the different counties



4.2. Occupation

As would be expected by the distribution of income sources, the vast majority of respondents are farmers (s. Figure 4). In Kisii and Kakamega more than 2/3 and ¾ of household heads stated this as their main occupation. Own account worker are more prevalent in the peri-urban counties and Nakuru has the highest share of paid employees with about 30 %.

Figure 4. Occupation of household heads in the different counties



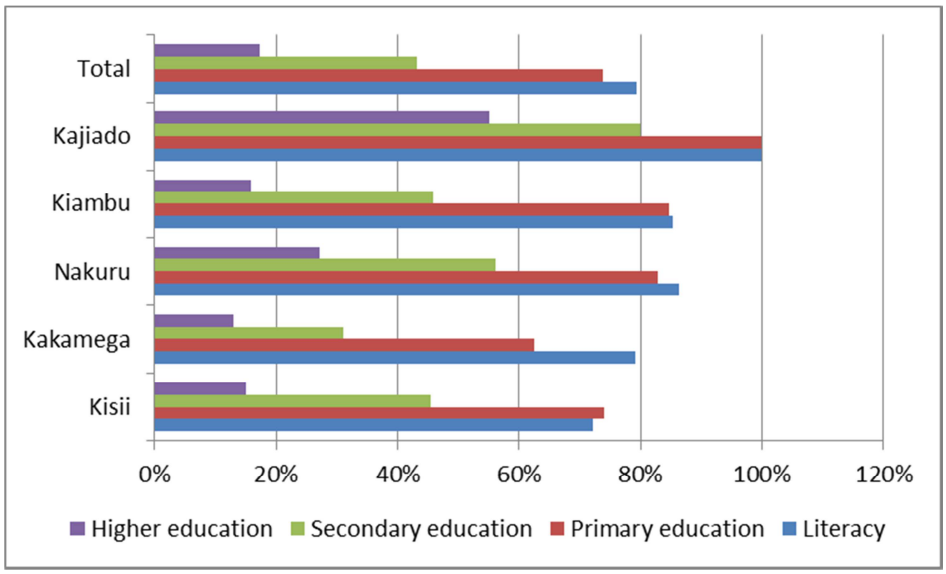
Regarding the distribution of occupation forms according to sectors (s. Figure 5), most paid employees are found in education, transport and communication and public administration. Own account workers are mainly found in small businesses, the construction sector and electricity and water supply.

Figure 5. Number of household heads over the different sectors

4.3. Education

In the sample, primary education which conveys basic knowledge of reading and writing is most prevalent (s. Figure 6). More than 70 % of the interviewed households had a household head that completed primary education and about 79 % stated that they can read and write without difficulties. Completion of further schooling, however, is already much less prevalent with 43 % of all household heads holding a second education degree and only 17 % a degree of higher education. The samples of the two rural areas in Kakamega and Kisii have lower shares of degree holders throughout all three education levels compared to the peri-urban samples. The only exception is higher education degrees, which are almost the same levels in Kiambu and Kisii. The high rates of degree holders in Kajiado are probably because of the very low rate of response in this county, making the sample not representative.

Figure 6. Education of household heads (share of household heads that reached the respective level)



Despite relatively lower education rates of household heads, the annual school costs per household are highest in Kisii (s. Table 5), if Kajiado is not taken into consideration. Nakuru households spend about the same amount of money on education, while Kiambu and Kakamega spend only 2/3 and half of this amount, respectively. One reason for the high rates in Kisii could be the higher rates of fertility especially compared to Kiambu County.

Table 5. Mean of school costs in the different counties

County	School costs [PPP$2015]		N
Kisii	1,513	(2,293)	401
Kakamega	838	(1,297)	407
Nakuru	1,511	(2,292)	221
Kiambu	1,026	(1,633)	183
Kajiado	1,863	(1,928)	20
Total	1,223	(1,938)	1232

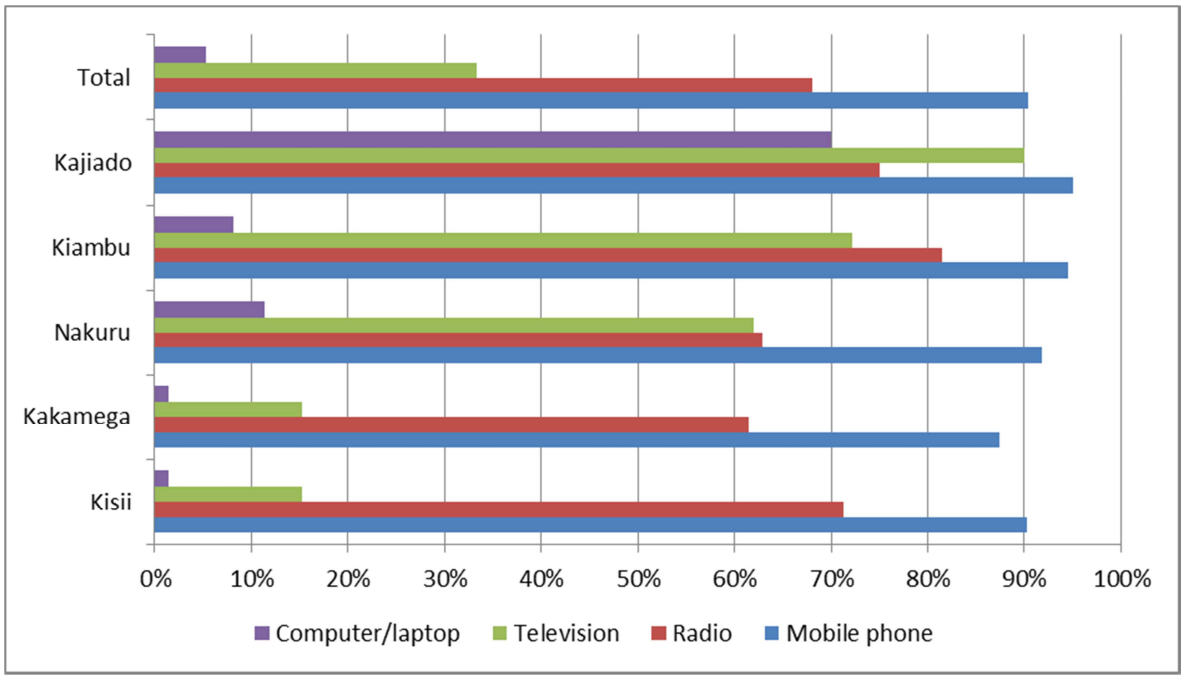
Notes: Standard errors in brackets

4.4. Assets

While almost every household has at least one mobile phone, prevalence of other assets for communication and information varies between the different counties (s. Figure 7). The second most used item is the radio with about 70 % of households of the sample owning one. The highest concentration of

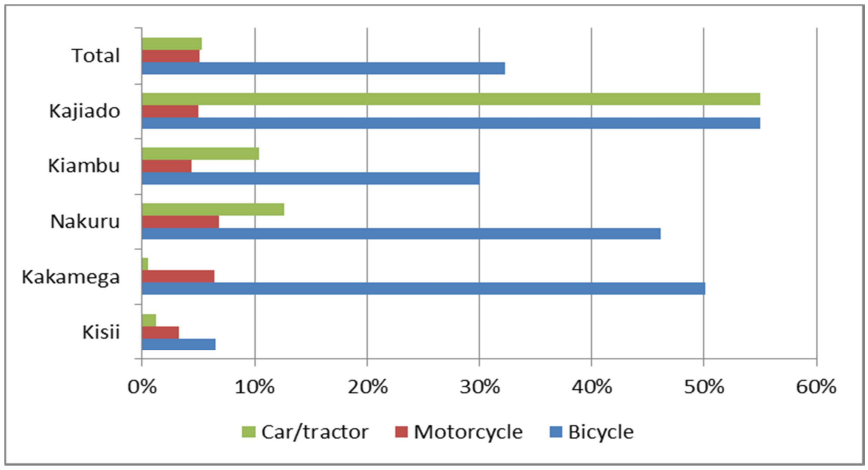
radios is found in Kiambu and Kisii, while televisions reach almost the same levels in Kiambu and Nakuru. Ownership of pcs and laptops are much less common, ranging from 11 and 8 % of households in Nakuru and Kiambu to as low as 1 % in Kakamega and Kisii.

Figure 7. Prevalence of assets for communication and information (share of households that have at least one of these assets)



About a third of all interviewed households own at least one bicycle, with highest rates in Kakamega and Nakuru (s. Figure 8).

Figure 8. Prevalence of assets for transport (share of households that have at least one of these assets)



Only in Kisii the share of households lies below 10 %. One reason for this could be the very bad road conditions in the study area not allowing for effective use of bicycles. Motorcycles are owned by 3 to 7 % of all households. While the amount of households owning motorcycles and the ones owning cars are almost the same in the overall sample, the share of cars is significantly higher in the peri-urban study areas of Nakuru and Kiambu, suggestion higher household wealth compared to the rural sample sites in Kakamega and Kisii.

5. Household Farm characteristics, utilization and activities

5.1. Land ownership, sizes and acquisition methods

Access to land for faming can either be owned, rented in, communal or borrowed land. Some households also hold land in different plots under the management of different or the same household members. Those cultivated plots are either irrigated fully, partially or completely dependent on rain-fed agriculture.

Land use by status of operation is as shown in Table 5.1. The most significant status of operation among the households who were interviewed was access to land for own use with a mean of 1.65 acres per household. About 1.7 acres was operated by each household in form of share cropping while 1.06 acres was operated as rented in for a fixed term (Table 6). The least reported form of operation was renting in from relatives (no rent paid) with a mean of 0.49 acres per household.

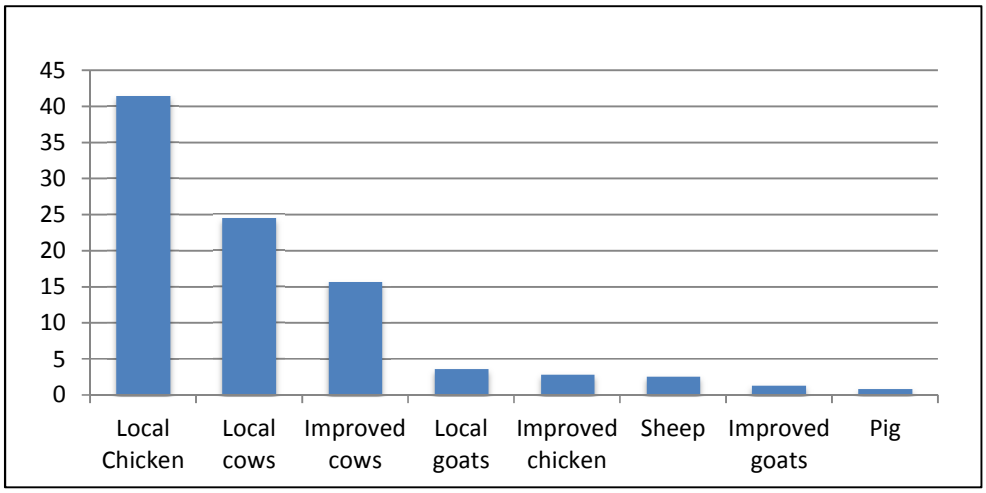
Table 6. Land ownership, sizes and acquisition methods

Status of operation	N	Minimum	Maximum	Mean	SD
Own use	1398	0.00	105	1.659	4.493
Communal	10	0.25	2	0.775	0.520
Rented from non-relatives	16	0.25	2	0.816	0.633
Rented from relatives (No rent paid)	12	0.01	2	0.486	0.559
Rented for fixed in-kind (Sharecropping)	6	0.25	5	1.708	0.901
Rented for fixed term	130	0.10	17	1.064	1.959

Notes: SD = standard deviation

Livestock ownership is widely regarded as an important asset that enables vulnerable farming households to cope with various shocks and crises (Ellis, 2000). In the event of crop failure, smaller animals such as goats or chicken can be sold off to obtain needed cash with which farmers can purchase food, seed, and other needs. The surveyed households owned chicken, goats, cows, sheep and pigs among others. Most of these livestock types were either local or improved species. Majority of the surveyed households (41.4 %) owned local chicken. Local cows were the second most widely owned livestock types among the households surveyed (24.5 %) as shown in Figure 9. From Table 8, it was noted that improved cows also featured prominently among the most important livestock types in terms of ownership (owned by about 15.7 % of the households). However, the least reported livestock enterprise was pigs at 0.86 %.

Figure 9. Livestock enterprises and ownership [% of households (N = 1232)]



Among the households owning local chicken, the average number per household was about 32 birds while improved chicken was 96 with a per unit value of PPP$ 9.42 and 6.13, respectively. On the other hand, the average number of local cows and improved cows owned was 7 and 6 respectively with each animal being valued at an average cost of PPP$ 184 and 434 respectively (Table 7).

Table 7. Size of Stock and Expenditure on livestock

Livestock type	Average size of current stock	Average value/unit	Average expenditure/unit/week [PPP$2015]		
			Feed	Veterinary	Hired labour
Local chicken	32	9.42	2.26	0.24	0.00
Improved chicken	96	6.13	18.82	0.39	0.37
Local cows	7	183.58	11.89	4.10	1.39
Improved cows	6	433.75	135.66	14.88	7.99
Local goats	6	33.64	4.18	1.38	0.00
Improved goats	4	85.76	66.08	3.55	0.50
Sheep	7	35.54	3.18	1.97	0.03
Pig	3	130.96	114.41	4.57	0.80

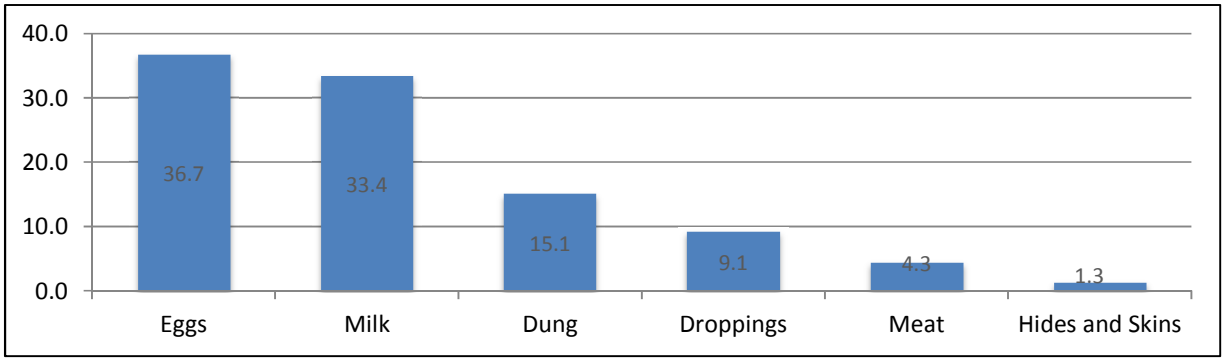
The average number of local goats and improved goats was 6 and 4 respectively while the average number of sheep per household was 7. The average value of each local goat and improved goat was indicated as PPP$ 34 and 86 respectively while the sheep were valued at PPP$ 36. The pigs recorded the least average at 3 per household with a per unit value of PPP$ 131. The results from the analysis also showed the three main categories of expenditure for various livestock types. The highest expenditure was

on feeds for improved cows at an average of PPP$ 136 per week. This high cost could be attributed to the body mass requirement and their level of productivity.

5.2. Main Livestock Product

In terms of livestock products, the household generally had a higher production of eggs (36.7%) compared to the other products (Figure 10). This could well coincide with the high number of chicken owned by each household as previously indicated in Table 8. The second most dominant product which was produced by the household was milk followed by dung at 33.4 and 15.1 per cent, respectively. Hides and skins were the least reported products among the households who were interviewed at 1.3 per cent.

Figure 10. Main Livestock products [% of households (N = 1232)]



5.3. Crop farming enterprises

The surveyed households have their cultivated land divided into different parcels in each season.

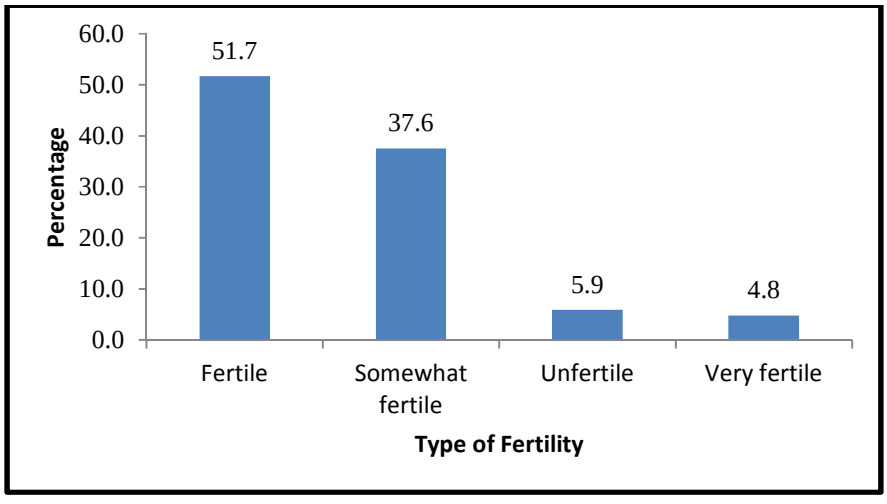
An analysis of main household members responsible for production of selected crops in these parcels showed that the main members responsible in the households were mainly spouses. Spouses were mainly responsible for production of major cereals such as beans, maize and millet at 36.5%, 35.5% and 33.7%, respectively (Table 8). Under the exotic types of crops, spouses were mainly involved in their management with the major exotic crop being onions and Irish potatoes. The same trend of the household members responsible for production of crops is realized for the production of indigenous vegetables. However, the percentages for the involvement of spouses are higher compared to the other crops. Therefore, these results showed that access to land as a production resource is skewed to the advantage of spouses in the surveyed farming communities.

Table 8. Main household member responsible for production of selected crops [%]

Crops	N	Head	Spouse	Head & spouse	Others
Cereals/Legumes					
Beans	696	32.0	36.5	28.2	3.3
Maize	833	34.7	35.5	26.8	3.0
Millet	86	25.6	33.7	33.7	7.0
Sorghum	146	36.3	24.0	36.3	3.4
Exotic vegetables					
Onions	156	25.5	56.9	13.1	4.6
Cabbage	70	35.7	47.1	12.9	4.3
Irish potatoes	60	36.7	48.3	10.0	5
Tomatoes	47	36.2	38.3	19.1	6.4
Spinach	172	37.2	46.5	11.6	4.7
Indigenous Vegetables					
Amaranth	529	28.7	45.6	21.6	4.2
Cowpeas	603	26.4	49.1	22.6	2
African nightshade	902	28.2	48.5	18.3	5
Spiderplant	552	26.8	48.3	18.8	6
Ethiopian kale	437	24.7	47.4	23.8	4.1

The natural qualities of the parcels operated to support farming were also assessed by eliciting farmer's perception of the parcel's soil fertility (s. Figure 11).

Figure 11. Farmers Perception of the parcel's soil fertility [% of households (N = 1232)]



While about 51.7% of the parcels operated by the surveyed households were reported to be fertile it is important to note that only 4.8% were indicated to be very fertile (Figure 11). Most household also

perceived the fertility of their parcels to be somewhat fertile (37.6% of the households) while another small percentage (5.9%) perceived their parcels to be unfertile.

5.4. Farm equipment and information technology

Ownership of farm production assets is very important in enabling farmers prepare their farms on time and thus likely to achieve higher yields. One of the most important production assets for smallholder farmers in rural Kenya is the ox-plough. However, only 3.2% of the surveyed households owned an ox plough (Table 9). Kajiado County had the highest proportion of the households owning ox-ploughs (10%). Kisii County followed with about 4.5% of the households reporting that they own ox-ploughs (Table 9). This ox-plough ownership was also significantly associated with the County where the respondent came from. Other important farm operation equipment owned by surveyed farmers was Jembes (93.8%), Panga (95.4%) and slasher (63.8%) among other assets as indicated in Table 11.

Table 9. Ownership of other assets [% of households]

	Kisii	**Kakamega**	**Nakuru**	**Kiambu**	**Kajiado**	**Total**
N	401	407	221	183	20	1232
Asset						
Ox-plough	4.5	1.2	0	0.6	10	3.26
Jembe	96.7	97.9	97.2	77.6	100	93.88
Panga	96.4	95.8	95.9	86.8	100	93.4
Slasher	62.8	70.8	67.1	38.6	80	63.86
Axe	77	69	63.8	65.6	70	69.08
Fork Jembe	20.1	13.6	43.7	67.5	90	46.98
Wheelbarrow	29.7	27.2	65.3	56.9	94.7	54.76
Spade/shovel	38.7	35.1	55.8	56.3	84.2	54.02
Mobile phone	91.6	93.2	92.1	95.1	100	94.4
Radio	73.6	65.3	65.7	83	85	74.52
Television	16.8	16.1	64.3	74.6	90	52.36
Bicycle	7.1	53.3	47	30.6	55	38.6

Empirical studies have shown that female headed households are disadvantaged in terms of their ability to access important farm equipment that could enable them to make timely and accurate decisions. Timely and accurate decisions are important in improving productivity and competitiveness. Therefore, additional analyses were carried out to assess ownership of these assets by gender of the households head. The results were as presented in Table 10. There were significant variations of asset ownership (mobile

phones, radio, and bicycle) by gender. A higher proportion of male headed households owned these assets than those households headed by females.

Table 10. Asset ownership by household head gender [% of households]

	Female	**Male**
N	239	993
Asset		
Ox-plough	1.4	2.3
Jembe	91.7	95.7
Panga	95.2	94.6
Slasher	56.3	64.9
Axe	67.1	71
Fork Jembe	30.4	30.1
Wheelbarrow	39.8	40.5
Spade/shovel	35.5	45.9
Mobile phone	90.7	93.4
Radio	62.4	73.3
Television	31.4	36.6
Bicycle	18.9	37.9

6. AIV production and marketing

6.1. Types of AIVs produced and distribution within survey area

The most widely produced Indigenous vegetable is African nightshade produced by about 72% of respondents followed by cowpeas produced by about 48% of respondents (Table 11). Out of the sampled counties, most of the AIV production is concentrated in rural areas of Kisii and Kakamega County. In particular, production of Amaranth (*Amaranthus spp.*), cowpea (*Vigna unguiculata*), spiderplant (*Cleome gynandra*) and Ethiopian kale (*Brassica carinata*) is entirely in rural counties of Kisii and Kakamega while it is African nightshade (*Solanum spp.*) that has a widespread production in peri-urban counties of Nakuru, Kiambu and Kajiado. We found that peri-urban counties capture about 10% of production for African nightshade. This finding is consistent with the fact that African nightshade is the most widely produced AIV among the sampled households.

The average area allocated to the production of these indigenous vegetables is more or less the same, the highest being 0, 21 Acres for spiderplant and the lowest, 0, 18 Acres for African nightshade. These indigenous vegetables have a long history of production in the different villages the survey took place. In some villages, AIVs were produced since as far back as 1950s while the highest percentage of respondents started production in the year 2000. This might have to do with the opening of supermarkets and the gradual development of marketing channels to sell to peri-urban and urban consumers at relatively higher prices. In addition, creation of awareness on the benefits of AIVs to health and nutrition has triggered the start in production of these vegetables by many.

Table 11. Indigenous vegetables and their production in rural and peri-urban Kenya [% of households]

	N	Amaranth	Cowpeas	African nightshade	Spiderplant	Ethiopian kale
Total sample	1232	42.2	48.5	72.7	44.8	35.5
By county						
Kisii	401	76.9	67.2	44.8	72.6	91.6
Kakamega	407	23.1	32.8	45.2	27.4	8.4
Nakuru	221	-	-	8.5	-	-
Kiambu	183	-	-	1.3	-	-
Kajiado	20	-	-	0.2	-	-
Average crop area in acres	1232	0.19	0.19	0.18	0.21	0.20

The survey results show that the trend in area planted remained the same for all the five focus indigenous vegetables compared to five years ago (Table 12). In contrast, the majority of respondents reported that

trends in yield increased for all AIVs except for Amaranth. The main reason for yield increase is due to good weather and improvements in soil fertility. This shows that favorable weather condition and preserving of soil fertility contribute to the increase in yield of indigenous vegetables. The increase in average yield while area planted remained the same could also imply that there is a practice of agricultural intensification on these AIVs. Analyzing deeper the notion of intensification on AIVs, we assessed the use of fertilizer and types of seeds.

Table 12. Trend in area planted and yield in AIV compared to five years ago [% of households]

	Stayed the same	**Increased**	**Decreased**
Trend in area planted under product compared to five years ago			
Amaranth	58.5	23.2	18.3
Cowpeas	51.0	27.8	21.2
African Nightshade	52.3	27.9	19.8
Spiderplant	53.2	26.0	20.8
Ethiopian kale	49.9	30.7	19.5
Trend in average yield compared to five years ago			
Amaranth	42.7	36.5	20.8
Cowpeas	33.9	42.0	24.1
African Nightshade	33.0	43.6	23.5
Spiderplant	32.0	44.0	24.1
Ethiopian kale	28.5	49.7	21.8

We found that most respondents apply fertilizer while growing AIVs. This ranges from 82% of respondents reporting to have used fertilizers for spiderplant and Ethiopian kale to about 73% of respondents using fertilizer for amaranth (Table 13). The majority of farmers however, apply fertilizer just once in every season and about 51% of them use organic fertilizers coming from on-farm to grow these vegetables. This is in line with the argument for sustainable agricultural practices whereby use of environmentally friendly fertilizers is promoted. Still about 29% of the producers use inorganic fertilizers while some producers use both organic and inorganic fertilizers for AIV production. The use of inorganic fertilizers could be a threat to sustainable agricultural production in that it increases nutrients and toxins leading to disruption of the ecosystem resulting in negative biological and environmental consequences (Tilman et al., 2002; Rigby et al., 2001; Matson et al., 1997). Nevertheless, the use of inorganic fertilizer might not be entirely due to AIV production alone. In Kenya, most AIVs are intercropped with other crops such as maize which implies that the inorganic fertilizer might have been applied to the intercropped product and not necessarily to AIVs exclusively.

Table 13. Fertilizer use and source [% of households]

	Amaranth	Cowpeas	African nightshade	Spiderplant	Ethiopian kale
Aplied fertilizer to grow this product	73.5	75.4	81.8	82.6	82.2
How often did household put fertilizer to grow this product?					
once in every season	50.1	61.7	55.8	61.7	55.1
twice per season	20.5	19.6	21.1	20.6	17.8
more than twice per season	27.3	17.0	21.1	14.9	25.7
others	0.0	1.8	2.0	2.8	1.3
Type of fertilizer used by the household					
inorganic	28.6	28.9	29.1	30.6	27.9
organic	49.4	55.8	48.5	49.5	51.8
both	22.0	15.3	22.4	19.9	20.3
Source of fertilizers					
on farm	45.1	51.1	44.4	46.1	47.4
outside farm	31.3	31.8	31.9	32.0	29.8
both	23.6	17.1	23.7	21.9	22.9

Most of the producers buy seeds to grow the AIVs and the majority buy usual/local seeds ranging between 47-67% of producers as shown in Table 14. While improved seeds are rarely used, certified improved seeds are used by more producers as compared to improved seeds. Most households buy these seeds from within the sub-village or within the village.

Table 14. Seed use and source [% of households]

	Amaranth	Cowpeas	African nightshade	Spiderplant	Ethiopian kale
Bought seeds to plant this product	55.0	69.4	61.0	61.3	64.6
Which types of seeds were planted?					
usual seeds/local seeds	47.1	67.2	56.8	58.6	49.6
improved seeds	13.9	10.1	11.1	9.7	12.5
certified improved seeds	20.9	12.0	17.3	15.4	23.9
recycled seeds	17.0	10.1	13.8	16.0	12.7
Others	1.1	0.5	1.0	0.4	1.3
Where was the source of these seeds?					
within the sub village	37.5	39.3	41.3	42.4	37.4
within the village	37.3	33.8	32.6	33.6	31.8
others	25.2	26.8	26.2	24.0	30.8

We find that most of the producers do not use irrigation for AIV production, only about 24% of respondents use irrigation for Amaranth, and about 20% of them use irrigation for African nightshade (Table 15). The majority of respondents reported that there is no need for use of irrigation to grow these vegetables. Some also mention that shortage of water and shortage of money as main reasons for not using irrigation.

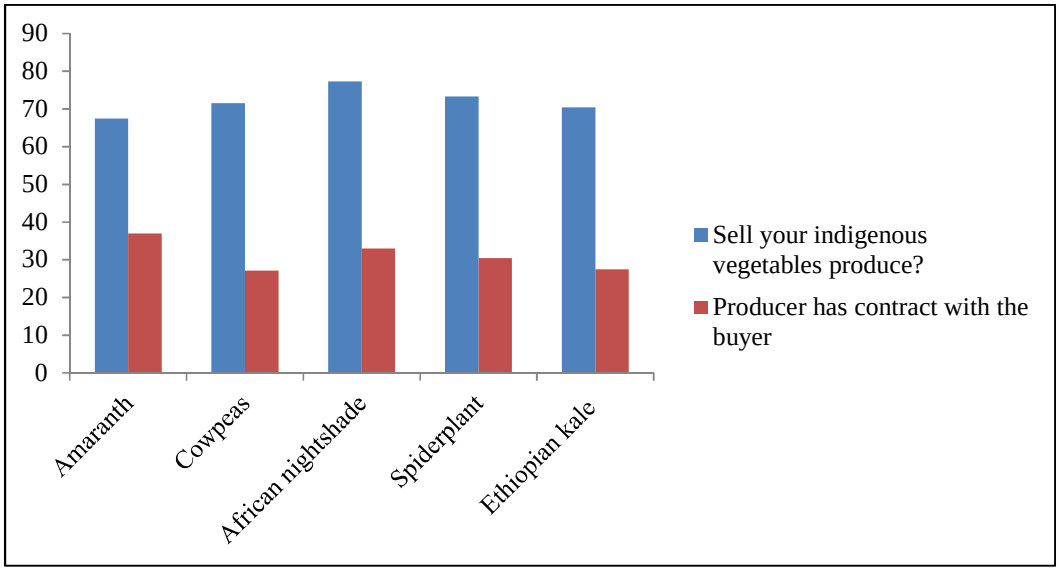
Table 15. Irrigation use [% of households]

	Amaranth	**Cowpeas**	**African nightshade**	**Spiderplant**	**Ethiopian kale**
Household use irrigation to grow this product	23.48	10.53	20.69	15.79	14.43
Reason for not using irrigation					
No need	76.76	72.03	67.8	63.1	74.92
Shortage of water	6.53	9.81	10.09	15.24	2.11
Shortage of money	0	11.9	10.24	12.62	14.5
Others	16.71	6.26	11.87	9.04	8.47

6.2. AIV marketing

It is found that most of the sampled households do sell their AIV produce. Among the AIVs, African nightshade is the most marketed one (Figure 12). This is expected as it takes the highest share of production as well. However, most producers do not have contract with the buyer.

Figure 12. Marketing of AIVs [% of households (N = 1232)]



It is notable that whenever producers do have contract with buyer, the highest share is for Amaranth followed by African nightshade. Most producers directly sell their produce to consumers while some sell to retailers (Table 16). In the case of Amaranth, about 23% of respondents reported to have sold to middle men. Export of AIVs is quite rare among the sampled producers. Most producers rather sell their produce within the village. If they go outside of their village to sell their produce, they rarely go outside of their County.

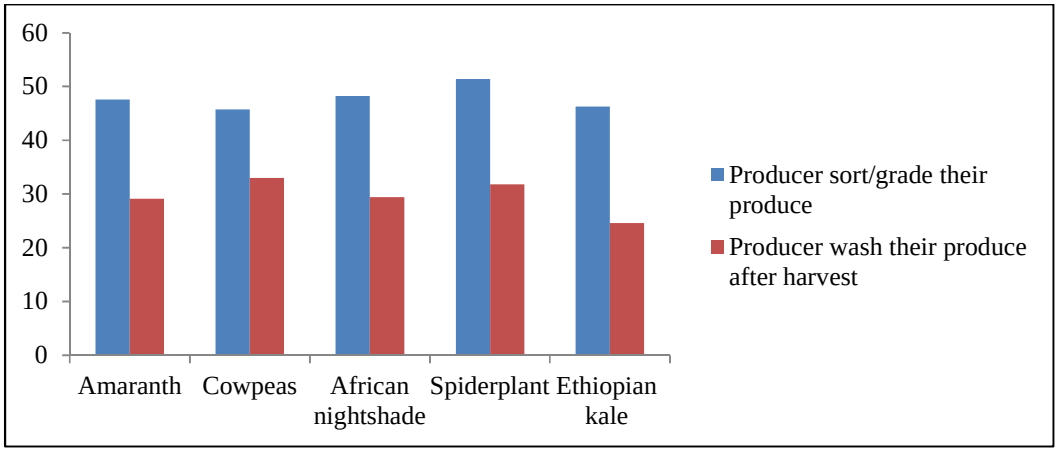
Most AIV producers sell their produce either at the farm gate or at a stand on weekly markets. Sell of AIVs to supermarkets is quite rare. Only less than two percent of respondents sell their AIVs at the supermarket, the highest being cowpeas followed by African nightshade and Ethiopian Kale. This shows that the value chain from producers to high-value markets such as supermarkets is not well developed for the AIVs. It could also be the case that the middle men or wholesalers are the ones who bridge the gap between the producers and supermarkets.

Table 16. Marketing of AIVs [% of households]

	Amaranth	**Cowpeas**	**African nightshade**	**Spiderplant**	**Ethiopian kale**
To whom do you sell your produce?					
Supermarkets	3,48	1,35	1,87	1,61	0,36
Wholesalers	6,95	3,81	5,52	5,53	1,42
Retailers	14,44	12,78	14,29	14,75	9,96
Consumer	51,34	66,59	58,84	59,45	73,67
Export	0	0,22	0,14	0,23	0,36
Middlemen	23,26	14,8	19,38	17,74	13,88
Processor/manufacturer	0,53	0,45	0	0,69	0,36
Where do you sell your produce?					
Within the village	55,88	62,11	61,81	64,98	60,85
Outside village but within county	37,43	35,2	33,66	31,34	34,52
Outside county but within Kenya	5,88	1,79	3,82	3,46	3,91
Outside Kenya	0,8	0,9	0,71	0,23	0,71
How is the product sold?					
Farm gate	43,85	43,95	43,56	47,7	33,81
Stand on weekly markets	40,64	43,5	44,7	41,01	57,65
Other shopkeeper	1,34	2,47	1,27	1,38	0,36
Middleman	12,83	8,3	9,05	8,53	6,76
Supermarket	1,34	1,79	1,41	1,38	1,42

Most of the AIV producers reported to sort or grade their produce (Figure 13). The sorting or grading is conducted according to size in all AIVs except for Ethiopian Kale for which color is the main sorting or grading criterion (Table 17). Other criteria include blemishes (for Amaranth, cowpeas and African nightshade) and weight (for African nightshade and spiderplant).

Figure 13. Grading and washing of AIVs [% of households (N = 1232)]



Most producers use bags to package their AIV products (s. Table 17). The majority of them use gunny bags or plastic bags. Some also reported to have used woven bags for packaging purposes.

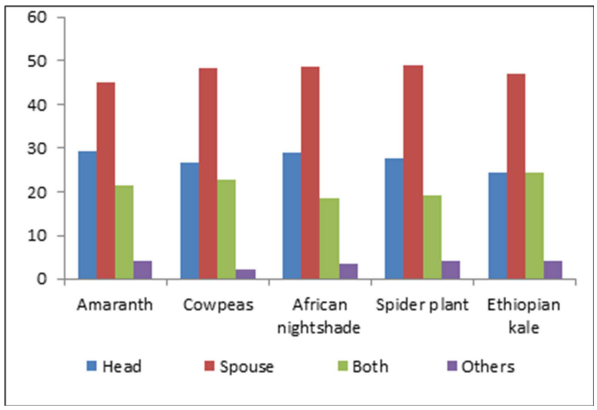
Table 17. Criterion for AIV Grading and reports on packaging by small holder farmers [% of households]

	Amaranth	**Cowpeas**	**African nightshade**	**Spiderplant**	**Ethiopian kale**
Producer sort/grade their produce	47,59	45,74	48,23	51,38	46,26
Criteria to grade the produce					
Size	35,39	26,96	29,33	26,46	19,23
Color	12,92	17,65	16,13	15,7	36,15
Maturity	12,36	10,78	15,54	13,45	12,31
Blemishes	24,72	23,04	17,3	17,04	17,69
Weight	11,24	16,67	17,3	25,11	13,08
Shape	3,37	4,9	4,4	2,24	1,54
Kind of Packaging used by producers					
Plastic crate	2,94	2,47	2,4	2,76	2,49
Woven bags	17,91	27,58	20,51	17,28	21,35
Wooden crate	0,27	0,67	0,42	0,46	0,36
Plastic bag	17,11	17,71	18,39	20,74	26,69
Gunny bags	22,46	24,44	24,05	23,73	25,62
None	39,3	27,13	34,23	35,02	23,49

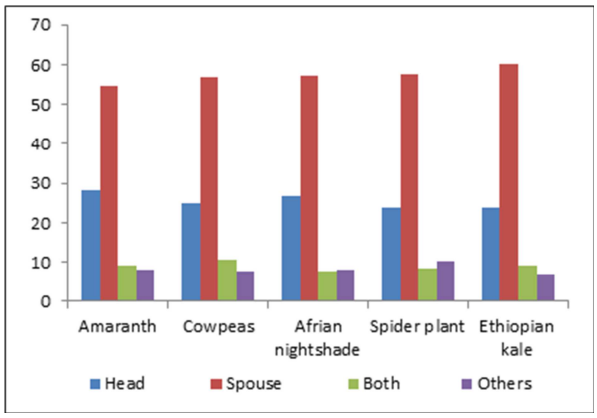
The effect of using this kind of packaging is now widely studied. Especially, given that AIVs are perishable products, care for post-harvest handling is important to ensure freshness, good quality as well as benefit from good prices.

Regarding the household member responsible for the production and marketing of AIVs, we find that mostly spouses (women in the context of Rural and peri-urban Kenya) play the major role. More than 45% of producers responded that women are responsible for production of AIVs while this figure even increases for marketing of AIVs (s. Figure 14). More than 55% of producers responded that women are responsible for marketing of AIVs. This supports the notion that AIVs are largely women dominated vegetables produced and marketed primarily by them. This plays a good role in terms of ensuring food security of the household. Since women are the main role players in preparation food in the household, they can feed their household from the produced AIVs, but also sell them in nearby markets to fill-in the food security gap in the household. Of course, it has to be explored whether the money obtained from the sale of the AIVs is entirely used by women or whether it is shared with the head for some other consumption items that work against ensuring food security of the household.

Figure 14. Household members responsible for AIV production and marketing [% of households (N = 1232)]



Household members responsible for AIV production



Household members responsible for AIV marketing

7. Food Security and Poverty

7.1. Food security status

To investigate the food security status of the sample, a range of indicators have been investigated, including Food Consumption Score (FCS), Household Dietary Diversity Score (HDDS), Month of Adequate Household Food Provisioning (MAHFP) and Coping Strategy Index (CSI).

The FCS is a diet diversity score, in which the frequency of consumption of different food groups by a household during the 7 days before the survey is weighted by certain factors (WFP, 2008). Steps of calculation:

1. Group all food items into specific food groups (s. Table 18).
2. Sum all consumption frequencies of food items of the same group, and recode the value of each group above 7 as 7.
3. Multiply the value obtained for each food group by its specific food group weight (s. Table 18)
4. Sum the obtained weighted food group scores to obtain the FCS.

Table 18. Food groups and weights for FCS (WFP, 2008)

	Examples of food items	**Food group**	**Weight**
1	Maize , maize porridge, rice, sorghum, millet pasta, bread and other cereals Cassava, potatoes and sweet potatoes, other tubers, plantains	Main staples	2
2	Beans, peas, groundnuts and cashew nuts	Pulses	3
3	Vegetables, leaves	Vegetables	1
4	Fruits	Fruit	1
5	Beef, goat, poultry, pork, eggs and fish	Meat and fish	4
6	Milk yogurt and other diary	Milk	4
7	Sugar and sugar products, honey	Sugar	0.5
8	Oils, fats and butter	Oil	0.5
9	spices, tea, coffee, salt, fish power, small amounts of milk for tea	Condiments	0

The MAHFP counts the months of last year in which the household stated to have had enough food available. It is a rather subjective indicator, because it is based on the respondents perceived food security status (Bilinsky & Swindale, 2010).

The HDDS is a diet diversity score based on the consumption of 12 food groups (Swindale & Bilinsky, 2006). Frequencies of food consumed of all household members in the last 7 days are grouped in the following groups and added together. The HDDS can thus take values between 0 and 12.

1. Cereals
2. Root and tubers
3. Vegetables
4. Fruits
5. Meat, poultry, offal
6. Eggs
7. Fish and seafood
8. Pulses/legumes/nuts
9. Milk and milk products
10. Oil/fats
11. Sugar/honey
12. Miscellaneous

The CSI is an index describing different levels of coping strategies households may pursue to cope with the effects of food shortages. Prior to the survey, coping strategies were determined in focus group discussions and weighted according to their perceived level of severity and frequency of occurrence (s. Maxwell & Caldwell, 2008 for a description of the procedure). Table 19 shows the different questions. During the survey, households were asked how many days in their worst week of the planting, pre-harvest and post-harvest season they had to fall back on these strategies.

Table 19. Questions and weights used to calculate the CSI

Question number	Please indicate how many days in the worst week of the season you…	Weight
q6_19	Were not able to eat the kinds of food you preferred	2.5
q6_22	Ate a smaller meal than you felt you needed	3.04
q6_23	Ate fewer meals in a day	2.98
q6_25	Went a whole day and night without eating	2.75
q6_27	Borrowed food or relied on help from a friend or relative	2.63
q6_28	Purchased food on credit	2.33
q6_31	Consumed seed stock held for the next season	3.13
q6_32	Sent household members to eat elsewhere	4
q6_33	Sent household members to beg	3
q6_34	Restricted consumption by adults in order for small children to eat	3

According to the indicators, the average food security status of the sample is good (s. Table 20). An adequate FCS starts at 42 points, so on average, the households in all sample sites are food secure. This is expected, because the sample was collected in one of the most food secure regions in Kenya (WFP, 2015). Relatively to the other counties, Kisii and Kakamega are less food secure throughout the food security indicators.

Table 20. Selected food security indicators in the different counties

County	N	HDDS		FCS		MAHFP		CSI	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Kisii	399	7.80	1.71	59.14	18.50	8.47	4.17	11.24	15.79
Kakamega	392	8.11	1.84	60.24	20.14	8.34	3.86	13.29	15.89
Nakuru	220	8.57	1.56	74.00	14.60	11.57	1.65	3.70	10.16
Kiambu	182	8.52	1.41	72.44	16.83	11.30	2.60	2.57	9.16
Kajiado	20	9.00	1.45	82.53	19.60	12.00	0.00	0.12	0.52
Total	1213	8.17	1.71	64.58	19.40	9.47	3.76	9.05	14.65

Notes: SD = standard deviation

7.2. Nutritional food security status

Information about the households' food consumption has been captured in a 7-days recall, preferable answered by the person mainly responsible for food preparation in the household. Listing the food groups as share of total quantity consumed it is visible that staples make the biggest share of the households' diet, followed by all vegetables (s. Figure 15). Staple consumption is higher in the rural sample sites Kisii and Kakamega. The highest share of AIVs on total food consumption can be found in Kakamega, while it is less important in the peri-urban counties Kakamega and Nakuru. Here, milk and milk products play a more important role.

Figure 15. Average share of food groups on total quantity of food consumed

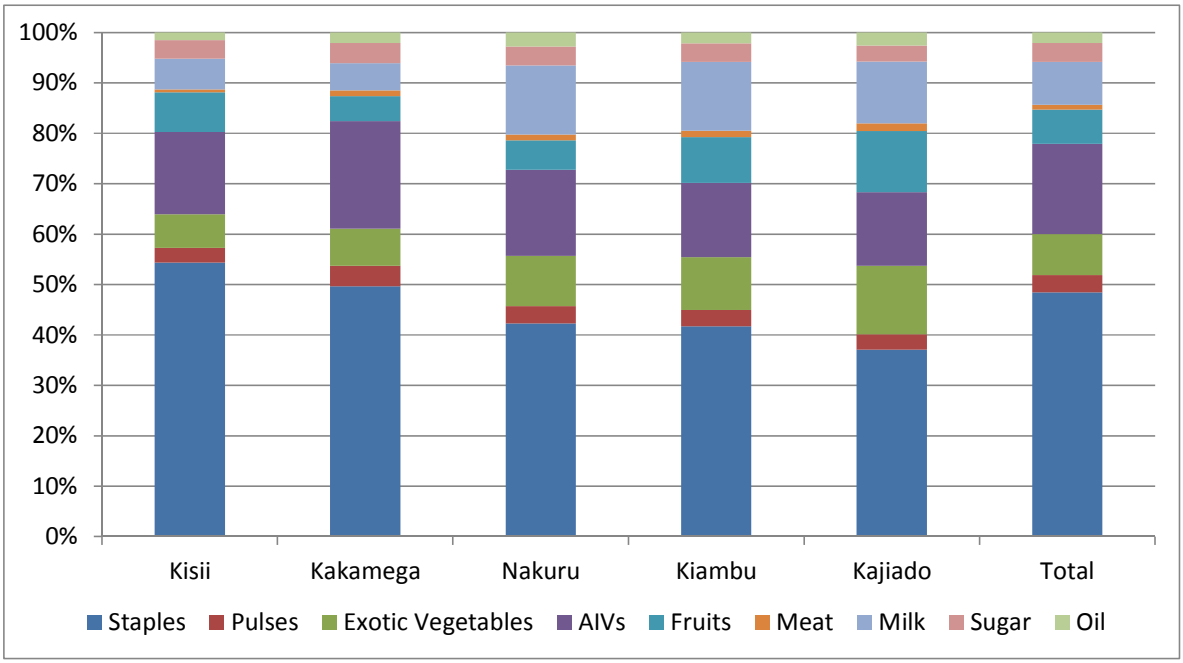


Table 21 shows that the average daily per capita calorie intake is in range of the needs for an average moderately active male (USDA & HHS, 2010). While there is few differences among the counties in average calorie intake, households in Kisii and Kakamega consumed less protein. Irrespectively, protein intake in all counties is in the range recommended daily intake for an average moderately active male (USDA & HHS, 2010).

Table 21. Daily calorie and protein per capita intake

		Caloric intake (kcal)		Protein intake (g)	
County	**N**	**Mean**	**SD**	**Mean**	**SD**
Kisii	401	2,454	1,879	73.8	58.9
Kakamega	407	2,332	2,624	72.1	60.2
Nakuru	221	2,414	1,635	81.3	50.1
Kiambu	183	2,485	1,963	88.2	51.2
Kajiado	20	2,183	1,264	85.9	75.6
Total	1232	2,407	2,120	76.9	57.3

Notes: SD = standard deviation

7.3. Poverty analysis

The assessment of poverty among the sample households is based on consumption rather than income. There is a well-established literature on the preference of consumption instead of income for poverty (and hence welfare) measurement (Deaton and Zaidi, 2002; KNBS, 2007). The first reason is that consumption is not closely tied to short-term fluctuations in income and that consumption is smoother and less variable than income. Compared to income, consumption is a better indicator of long-term average well-being as it shows what is in fact consumed instead of ability to purchase as in the case of income (Fields, 1983; Ravallion, 1991; Bigsten et al. 2003). In addition, income data is typically harder to collect, especially in developing countries, as respondents have difficulty in reporting accurate information of income as compared to consumption.

Given the above justification, we use household consumption aggregate to assess the poverty (welfare) situation of sampled households in rural and peri-urban areas of Kenya. The consumption aggregate is constructed following the guidelines provided in Deaton and Zaidi (2002). The consumption aggregate consists of two broad components namely: food and non-food consumption. The food consumption component is calculated based on section five of the HORTINLEA questionnaire which collects recall information over a one week period on the quantities consumed of about 95 food items. The major groups of these food items include cereals; roots and tubers; pulses; meat; Other animal products; exotic vegetables; indigenous vegetables; fish; dairy products and eggs; fruits; beverage and drinking;

seasonings; and sugar and candy. The food consumption aggregate is constructed using four sources namely: a) food consumed from purchases; b) food consumed from gifts, free of charge; c) food consumed from own production; and d) food consumed from storage (own stock). In addition, the survey collected information on the unit prices for the purchase of food items in the past one week from the respondents. In addition to this, a price questionnaire was administered simultaneously with the household survey to capture per unit prices of all items included in the survey questionnaire from the nearby local market where the interviewed households would normally purchase these items.

There are two main issues related to food consumption aggregation: a) correctly converting the various unit references in which food items were reported into a metric unit; and b) accurately valuing food consumption from various sources. We tackled the first issue by using a table to convert the different measurement units into a standard metric units namely kilograms or liters. For the second challenge, we used a data set of median food item unit prices that are representative of those faced locally by each household.

The second main component of consumption aggregate is the non-food consumption expenditure. Section five collects household expenditure information on about 24 regular non-food items during the past one month. The section also allows respondents to report expenditures of items spent on a per year basis. These are latter converted into per month by dividing by 12. In addition, non-food items received as a gift or free of charge during the past 4 weeks are also captured. The non-food items included personal care, medical care, education costs, transport, communication, clothing, donations, and domestic utensils. Following previous practices in consumption aggregation in developing countries, we do not include health expenditures in the non-food consumption expenditures.[1]

We then added the food and non-food consumption expenditure valued in PPP$2015 to obtain the total consumption expenditure per household. In order to obtain a measure of individual well-being, we have two options to use namely, deflate the total consumption expenditure by household size or by equivalence scales. Even though, deflating it by household size is the simplest way, it will underestimate the welfare of people who live in households composed of a high fraction of children. This is because children, up to a certain age, consume less than adults (KNBS, 2007). The second option of using equivalence scales gives a better individual estimate as it weighs the different individual age groups differently. Following (KNBS, 2007; Anzagi and Bernard, 1977), we use the following equivalence scales: age groups 0-4 are weighted as 0.24; children aged 5-14 are weighted as 0.65; and all people aged 15 years and above are

[1] For details on arguments for not including health expenditures in the non-food consumption expenditure, see KNBS (2007); Deaton and Zaidi, 2002.

assigned a value of unity. In this report, we present both total consumption expenditure per capita as well as total consumption expenditure per adult equivalence.

We take the international poverty line of $1.25 a day in 2005 prices to identify the level of poverty among the sample households. Using the average exchange rate in from September-October 2014, we used PPP$ 80 per month as the poverty line to evaluate the status of poverty in 2014 among the sampled households. Consequently, about 47% of the sampled AIV producers are found to be under the $1.25 a day poverty line when using total consumption expenditure per capita (s. Table 22). When we use total consumption expenditure per adult equivalent the figure improves to about 37.9% of the sampled households falling under the poverty line. The poverty gap index, which shows the average percentage of shortfall in consumption for the population from the poverty line is 0.15 while the poverty severity index is 0.08 among the sampled households.

Table 22. Poverty rates by County

	Poverty head count (TC/capita [%])	**Poverty head count (TC/AE)**	**Poverty gap index (TC/AE)**	**Poverty severity index (TC/AE)**
Total	0.4764	0.3782	0.1508	0.0828
	(0.0142)	(0.0138)	(0.0069)	(0.0051)
Rural	0.6064	0.4876	0.1992	0.1116
	(0.0171)	(0.0175)	(0.0094)	(0.0072)
Peri-urban	0.2287	0.1698	0.0585	0.0279
	(0.0204)	(0.0182)	(0.0076)	(0.0047)
Kisii	0.5162	0.3715	0.1442	0.0764
	(0.0249)	(0.0241)	(0.0117)	(0.0081)
Kakamega	0.6953	0.6019	0.2536	0.1464
	(0.0228)	(0.0242)	(0.0142)	(0.0117)
Nakuru	0.2714	0.2171	0.0763	0.0378
	(0.0299)	(0.0277)	(0.0120)	(0.0079)
Kiambu	0.2021	0.1311	0.0434	0.0188
	(0.0297)	(0.0250)	(0.0096)	(0.0054)

Notes: standard deviation in brackets; TC = total consumption; AE = adult equivalent-

We find that poverty rates are higher among the rural households as compared to peri-urban households. This is in agreement with nationally representative statistical results of Kenya for instance, results from the Kenya Integrated Household Budget survey 2005/05 (KNBS, 2007). Comparison among the Counties shows that Kakamega County has the highest level of poverty with about 60% of the sampled household under the poverty line. Kisii County follows at a distance with about 37% of the households being poor. This trend follows consistently when we consider poverty gap and poverty severity indices as well. Among the peri-urban Counties, Nakuru has the highest level of poverty, with about 21% of the sampled households under the poverty line followed by Kiambu with 13% of households being poor. Our sample households in Kajiado was too small (only 20 households) to calculate a reasonably standard poverty ratio. Hence, we have left out this County from the calculation of poverty measure.

8. Institutions and access to services

8.1. Access to markets and information

Farming communities need to access important information and services for them to be competitive. One of the most important pieces of information needed is related to extension. The extension information needed by farmers to improve their productivity include food situation, market information, credit services among others. Farmers also need information on input and output markets. All this information can be sourced from different sources e.g. public or government extension, neighbors, friends, civil society organizations, traders, farmer etc.

The results showed that food situation related extension information was the most easily accessible with about 46.2% of the surveyed households reporting that they had accessed it. The other main type of information which was accessed by the surveyed households was information on seeds and fertilizer application at 43.2% and 41.8%, respectively (Table 23). Other important extension received by a large proportion of the surveyed households included information on market (38.4%), pest application (30.9%), livestock health (27%) and credit services (24.8%).

Table 23. Types of Information available for the household [% of households]

	Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
N	401	407	221	183	20	1232
Food situation	47.1	41.8	49.8	47.5	65.0	46.2
Market information	32.0	32.0	45.5	54.7	57.9	38.4
Irrigation	5.3	7.8	26.9	43.0	63.2	16.9
Pesticide application	23.2	18.8	46.4	52.5	52.6	30.9
Fertilizer application	37.0	33.0	54.5	52.2	68.4	41.8
Processing	2.7	6.2	16.4	19.9	36.8	9.6
Storage	8.5	9.6	27.3	22.5	47.4	15.1
Seeds	34.9	39.1	53.4	53.6	78.9	43.2
Credit services	18.8	10.4	39.5	45.8	63.2	24.8
Agroforestry	11.9	12.8	19.5	28.1	57.9	16.8
Livestock health	18.6	16.7	38.6	47.5	73.7	27.0
Aquaculture	3.2	5.0	14.1	16.3	36.8	8.4
Other agricultural problems	10.5	14.4	16.8	25.7	33.3	15.7

The results also showed that a higher proportion of households in Kajiado County reported that they had accessed food situation related information compared to the other counterparts. These differences in proportions of households accessing food situation related information across the surveyed counties were

statistically significant. Reasons for these differences could be associated with fact that food security issues could be of major concern in Kajiado County as this is a semi-arid county. The least sought after information across the five counties is on aquaculture and processing at 8.4% and 9.6% percent respectively (Table 25).

8.1.1. Access to markets and information centers

In the same breadth, the sources of the extension information were also analyzed and results presented in Table 24. The most important source of food situation information among the surveyed farmers was from extension service officers. About 45.3% of the surveyed farmers reported that they had received at least one of the food situation information from extension service officers, followed by about 25.7% who reported that they had received at least one of the food situation information from neighbors. Also, about 9.3% of the surveyed farmers reported that they had received at least one of the food situation information from neighbor farmer (Table 24). The same trend is observed among the other sources of information with extension service officers being the major agents of other types of information.

Table 24. Source of information [% of households (N = 1232)]

	Extension service officer	**Neighbors**	**Friends**	**Civil society organizations**	**Traders/ Middlemen**	**Farmer group member**
Food situation	45.3	25.7	9.3	0.6	5.1	13.8
Market information	34.4	18.9	16.9	1.9	15.0	12.8
Irrigation	60.1	15.0	17.6	3.9	0.7	2.6
Pesticide application	67.0	10.1	12.8	1.7	1.3	7.1
Fertilizer application	63.9	12.7	12.7	1.7	1.5	7.6
Processing	70.2	6.0	13.1	3.6	1.2	6.0
Storage	70.2	5.7	11.3	1.4	3.5	7.8
Seeds	57.5	15.5	13.6	1.4	1.2	10.8
Credit services	51.9	9.2	25.2	4.9	1.5	7.3
Agroforestry	77.0	4.7	8.8	2.7	0.7	6.1
Livestock health	68.2	12.2	12.5	1.2	0.8	5.1
Aquaculture	81.6	2.6	9.2	3.9	0.0	2.6
Other agricultural problems	80.7	7.4	3.0	1.5	1.5	5.9

8.1.2. Access to extension services

Further analyses were carried out to assess the proportion of surveyed households that accessed different information from different channels. Face to face or oral communication was the most important channel of information in accessing all the type of information with over 90% of all the surveyed households

reporting to have used it (Table 25). The least utilized channels of communication were internet with only a few of the surveyed households reporting to have used it in accessing only irrigation and marketing and food situation information.

Table 25. Channels of communication [% of households (N = 1232)]

Type of Information	Face to face/oral	Radio	Newspapers	Text message[1]	Telephone call	Television	Internet
Food situation	94.7	2.6	0.3	0.0	1.8	0.3	0.3
Market information	93.5	3.1	0.2	0.7	1.7	0.2	0.5
Irrigation	92.3	4.1	0.6	0.6	1.2	0.6	0.6
Pesticide application	95.4	1.5	0.3	0.9	0.9	0.9	0.0
Fertilizer application	96.2	1.4	0.5	0.9	0.7	0.5	0.0
Processing	95.8	2.1	1.1	0.0	0.0	1.1	0.0
Storage	94.5	2.1	0.7	1.4	0.7	0.7	0.0
Seeds	94.7	1.9	0.2	0.4	2.3	0.4	0.0
Credit services	90.8	3.8	0.4	0.8	3.8	0.4	0.0
Agroforestry	97.0	1.8	0.6	0.0	0.0	0.6	0.0
Livestock health	96.1	1.0	0.0	0.0	2.9	0.0	0.0
Aquaculture	95.4	2.3	1.1	0.0	0.0	1.1	
Other agricultural problems	94.8	1.3	0.6	0.0	1.9	1.3	0.0

[1]via mobile phones

8.2. Social capital and networks

8.2.1. Membership to a farmer group dealing with vegetables (% of households)

Memberships in farmers' groups or associations dealing with vegetables Kakamega county reported the highest proportion of farmers belonging to farmer groups (61.6%), followed by Kisii County with about 39.3% of the surveyed farmers (Figure 16). These differences in the proportions of farmers belonging to farmer groups were statistically different across the surveyed counties. Besides providing information, farmer groups can also be used as important input and output markets for rural farmers and for mobilizing savings and credit in rural areas where formal savings and credit institutions like banks might be lacking.

Further analysis on group composition revealed that the average number of members in group was 28 with the highest numbers being depicted in Kajiado County (61). The most popular gender in the groups was female with a mean composition of 19 females in a group (Table 26).

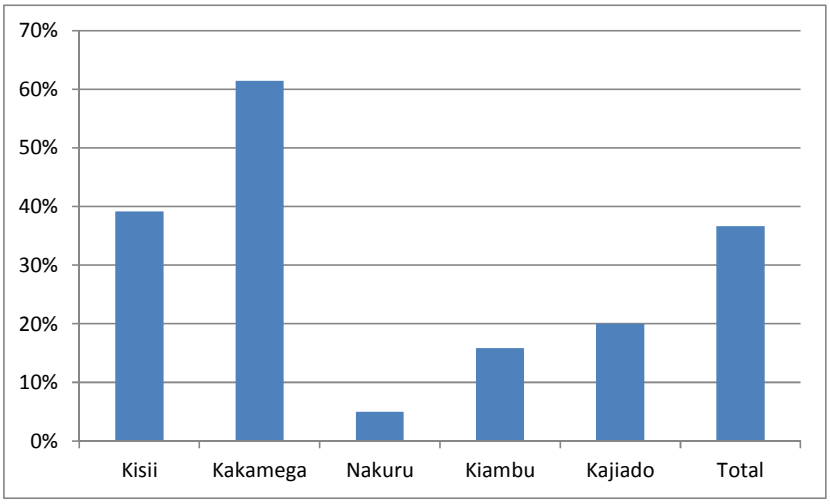


Figure 16. Membership to a farmer group dealing with vegetables [% of Households]

The high numbers of women belonging to groups could be an indication that there is a higher collective action among women than men. Kajiado County had the highest proportion of females belonging groups while Kakamega had the lowest (Table 26).

Table 26. Average membership compostitions of farmer groups

	Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
N	157	250	11	29	4	451
Members in the group	20.76	25.42	17.45	18.59	61.50	28.744
Males in the group	5.58	9.00	1.09	6.62	28.50	10.158
Females in the group	15.09	14.83	16.36	12.34	41.00	19.924

8.2.2. Social networks

Social capital is very important in rural farming settings where information asymmetry is very rampant. Most farmers rely on their social capital and other networks in their villages to access information and for help in difficult times. In this study, social capital was defined as membership to formal and informal groups while other networks was defined as the number of relatives and non-relatives living within and outside the village that the household can rely on in times of need.

The number of relatives living within the village that the surveyed households had was about 26 compared to 232 people known by household living within their villages. In the same breadth, the surveyed households reported an average of about 41 non-relatives living within and outside their village

that they can rely on for critical support in times of need. Kajiado County reported the highest number of people within and outside the village which the household can rely on in times of need (85) while Kakamega reported the least (13). This could imply that households in Kakamega district seem to live an individualistic life compared to the other surveyed Counties i.e. there is very week social capital and rural networks in Kakamega County. Nakuru County reported the lowest number of relatives living within the village while Kakamega reported the highest (Table 27). It might be that in Kakamega, people rely on relatives for hard times.

Table 27. Social networks [% of households]

	Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
N	157	250	11	29	4	451
Number of relatives in this village	24.0	52.6	6.6	38.3	12.7	26.8
Number of people known by the household in this village	139.6	278.4	238.3	338.3	168.9	232.7
Number of people within and outside this village which the household can rely on in times of need	14.4	13.6	38.0	56.1	85.7	41.5

8.3. Access to credit

Out of those who accessed credit, an analysis was undertaken to know the sources of those credit that they had accessed and the average amount obtained from these sources. The results presented in Table 28 showed that the highest average amount obtained was from the banks (PPP$ 38,000), followed by the SACCOs (PPP$ 19,000), and then self-help groups (PPP$ 5,000). The high amount of credit being obtained through banks showed the importance of formal financial institutions in availing credit to smallholder farmers in the survey Counties.

Table 28. Average amount of credit obtained from various sources by households [PPP$ 2015]

Sources of Credit	N	Minimum	Maximum	Mean	SD
Bank	268	0	38,446	1,081	3,788
NGO/MFI	228	0	8,410	118	681
Employer	213	0	4,325	36	324
Individual	214	0	1,201	14	115
SACCO's	252	0	19,223	648	1,996
Self-help group	246	0	5,046	178	508

Notes: SD = standard deviation

8.4. Savings

The results from this particular survey showed that a high proportion of households surveyed had the household heads having the savings account (64.6%) compared to spouses members who had saving account (37%). Only 3.2% of the surveyed households had both head and spouse members having a savings account (Figure 17). This is a clear indication that there is need for a concerted effort to sensitize spouses who according to the analysis here are mainly female on saving using both formal and informal saving institutions found in rural areas.

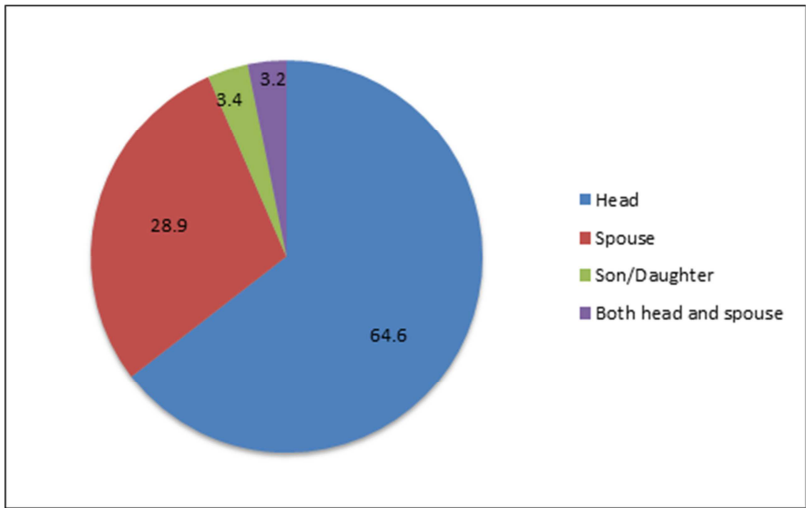


Figure 17. Percentage of household members with a savings account (N = 1232)

Further analysis was done to determine the purpose of opening a savings account among the surveyed households. The most important need for a savings account among the sampled farmers was for subsistence needs (ca. 35.2%) (Figure 18). This high proportion of farmers indicating that they have a savings account for subsistence needs could be attributed to needed savings for consumption reasons. Another important need for a savings account that was reported by a high proportion of sampled farmers was for the purpose of school fees (30.3%). About 20% of the sampled farmers needed a savings account for mitigating against unexpected shocks or events.

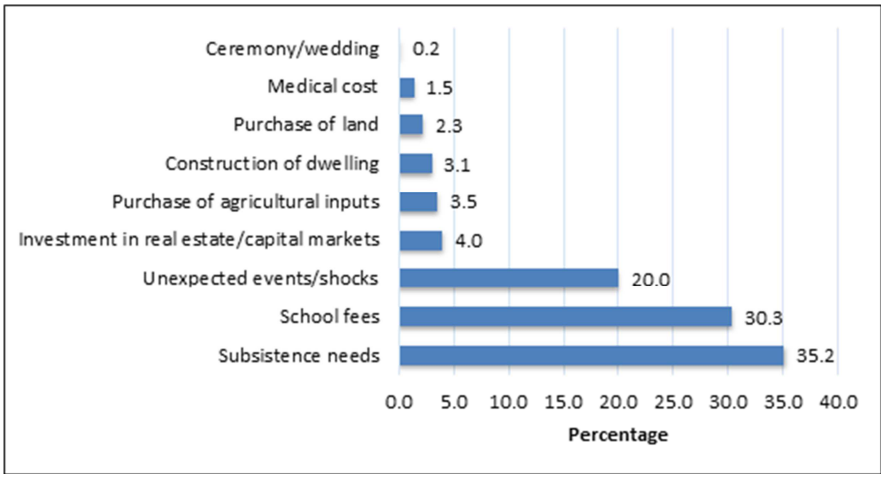


Figure 18. Purpose of Savings Accounts (N = 1232)

9. Household Shocks and Coping strategies

9.1. Shocks

African Leafy vegetable (ALV) producers were interviewed regarding their experiences of shocks in the past 12 months[2]; their consequences and types of responses to these shocks as coping strategies. The results show that ALV producers face various shocks. The most frequent shock is crop failure reported by about 26% of the interviewed households (Table 29), followed by unusually heavy rain and illness of household member reported by about 22% and 20% of respondents, respectively. The distribution of shocks vary when looking at the different Counties. For instance, in the rural Counties of Kisii and Kakamega, unusually heavy rain and crop diseases are the most reported types of shocks. Even from the rural countries, there are some location specific shocks. While shocks such as crop failure and crop diseases are dominant in Kisii County, unusually heavy rain is significantly dominant in Kakamega County. In contrast, in the peri-urban Counties, the type of most frequent shocks vary among the Counties. In Nakuru, about 28% of households reported drought as the most frequent shock followed by crop failure. Illness of household member is the most reported type of shock in Kiambu County while drought is the most reported shock in Kajiado.

The survey also inquired households to categorize the severity of the shocks into high, medium or low. We find that most shocks are reported to have a 'high' level of severity in particular, crop failure, unusually heavy rain and illness of household member. Crop disease is reported to have a medium and low level of severity (Table 29).

The survey also requested the negative effects of these shocks in terms of pushing households to reduce either food or non-food consumption. The results show various effects on consumption depending on the type of the shock. Table 30 shows that most households reported to have reduced consumption of non-food items due to crop disease (about 47%), crop failure (about 14%), and unusually heavy rain (11%). The same type of shocks also seems to have caused reduction of food consumption: crop disease (38%), crop failure (13%) and unusually heavy rain (12%). Illness of household member and drought are also found to have an effect on reduction of consumption for both food and non-food items.

[2] The Household survey was conducted in the month of September-October, 2014. The respondents were interviewed regarding shocks that occurred in the 12 months prior to the survey.

Table 29. Major shocks faced by households and their level of severity [% of households (N = 1232)]

	% of households Faced shock by location						Severity of shock		
	All	**Kisii**	**Kakamega**	**Nakuru**	**Kiambu**	**Kajiado**	**High**	**Medium**	**Low**
Drought	18.02	17.21	14.74	28.51	12.02	40	8.28	8.44	1.3
Unusually heavy rain	22	27.43	38.33	0	2.73	0	12.26	9.17	0.24
Crop failure	26.3	37.16	21.87	26.7	12.57	20	16.96	8.28	0.89
Livestock death	15.34	11.72	18.67	19.46	10.93	15	9.66	4.71	0.89
Livestock disease	10.96	8.98	13.76	9.05	12.02	5	4.95	5.11	0.89
Illness of household member	20.37	24.94	24.82	8.6	16.39	5	11.12	8.52	0.65
Crop disease	20.21	43.14	3.19	21.27	7.65	10	0.4	61.66	33.2

9.2. Coping strategies

The questionnaire also inquired households regarding the type of ex-post coping strategies they used in response to the various shocks they faced. Again, we report on the most frequent types of shocks here. The most common ex-post coping strategies against shocks are working more and diversifying agricultural portfolio (Table 30).

Table 30. Summary of major coping Strategies to most frequent shocks

	1st and 2nd coping strategy[1]		**% of HH that reduced consumption of non-food items due to shock**	**% of HH that reduced consumption of food items due to shock**	**Months needed to recover from shock[2]**
Drought	Did nothing (7.14%)	Worked more (4.79%)	9.25	9.09	2
Unusually heavy rain	Worked more (8.6%)	Did Nothing (5.84)	11.44	12.18	1
Crop failure	Worked more (9.17%)	Diversified agr. portfolio (6.33%)	14.37	13.47	1
Livestock death	Did nothing (6.09%)	Worked more (4.63%)	4.87	4.71	1
Livestock disease	Worked more (2.68%)	Diversified agr. portfolio (2.19%)	2.92	2.84	1
Illness of HH member	Worked more (5.93%)	Used saving(3.17%)	10.55	9.01	1
Crop disease	Worked more (28.06%)	Diversified agr. portfolio (25.69%)	47.04	37.94	3

Notes: [1]Percentage of households reported in bracket; [2]Mode reported; HH = household

For coping against illness of household member, households also reported to have used saving. An important note in the types of coping strategies is households not taking any active coping strategy (option of doing nothing) in response to a shock. This is recorded for especially climate related covariate

shocks such as drought and unusually heavy rain and to some extent for livestock death. This could be due to either the households are too poor/not able to do anything against the shock, or that households had an ex-ante coping strategy in place and hence the effect of the shock was minimal. In either of the cases, the percentage of households responding to have done nothing in response to a shock is not insignificant, hence more work is needed to find out the reason why households are not taking an active coping strategy in response to shocks. We also found that most households took about 1-3 months to recover from shocks (Table 30).

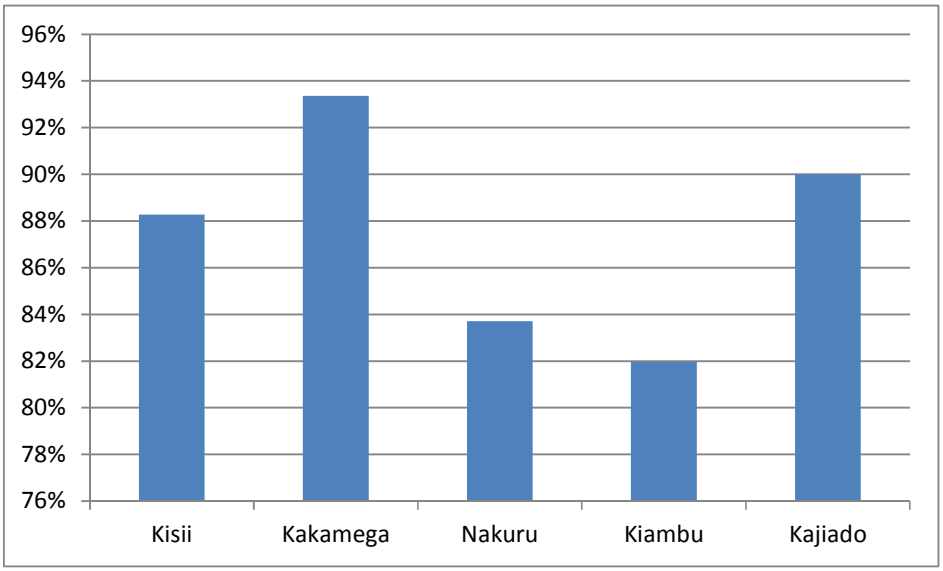
10.Climate and adaptation in relation to AIV production

Climate Change and associated disasters pose a threat to ecosystems, infrastructure and socio-economic systems and pose a major challenge to sustainable production of indigenous vegetables. Climate Change signals include the extremes in maximum and minimum temperatures, and reduced frequency and intensity of rainfall extremes (droughts, floods), and shrinking of the rivers.

10.1. Farmers perception of climate change

According to the survey findings, the level of perception on climate change and its impact on the environment was quite high across the five counties. However, the perception was high in Kakamega and Kajiado Counties (93.73% and 90%) as compared to the other counties (Figure 19). Climate change was least perceived in Kiambu County.

Figure 19. Percentage of households reporting to perceive climate change



Climate change affects the livelihood of households directly or indirectly. Farm households have different strategies of adapting to climate change. Consequently, 31.68% of the sample households reported growing of more varieties as a good strategy of climate change adaptation. This strategy was mainly advocated for in Kisii County as compared to the other counties (Table 31). Another dominant form of adaptation strategy mentioned was more investment in irrigation (8.74 %). This practice was mentioned

mainly in Kajiado County which is also the driest County as compared to the rest. The other adaptation strategies which were mentioned are doing away with some other varieties (6.5%), adding new crops to portfolio (7.32%) and saving money among others. Although most of adaptation strategies are essential for changing their livelihood of farming households in general, households face different difficulties for application in the reality of their perspectives. This is due to different difficulties in which farm families face due to resource base endowment and other intellectual base differences among households.

Table 31. Adaptation Strategies households adopt against climate change [%]

Adaptation Strategy	Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
Grow more varieties	56.8	48.9	27	20.4	5.3	31.68
No adjustment	0.3	10.9	44.6	44.9	42.1	28.56
Invest more in irrigation	0.8	1.4	2	13.2	26.3	8.74
Add new crops to portfolio	13.7	18.3	3.4	1.2	0	7.32
Stop growing some varieties	12.9	12	6.4	1.2	0	6.5
Save money	4.3	1.6	2.5	5.4	10.5	4.86
Invest in more secure homestead	0.3	0	0.5	1.2	5.3	1.46
Plant trees	0.3	3.3	2.9	0	0	1.3
Use more fertilizer	0.3	0.3	1.5	1.8	0	0.78
Spray more fertilizer	1.6	0.3	1	0.6	0	0.7
Ask for remittances	0.5	0.8	1		0	0.575
Start non-farm business	0	0	1	1.8	0	0.56
Build terraces	0.3	1.1	0	0	0	0.28
Take up non-farm employment	0	0	0.5	0.6	0	0.22
Invest in pond	0	0.3	0	0.6	0	0.18
Invest more in dams	0	0.3	0	0	0	0.06

11.Health, Water, Sanitation and Energy use

11.1. Health characteristics and access to health services

About 47 % of the households in the sample report at least one member that has been sick in the last four weeks (s. Table 32). Kiambu and Nakuru with 33 and 39 % have the lowest sickness rates among the different counties. The most prominent disease is malaria or fever symptoms which could be malaria with rates up to 56 % of all sick individuals in Kakamega. Even though malaria plays a smaller role in Kiambu and Nakuru, it is still the single most important disease.

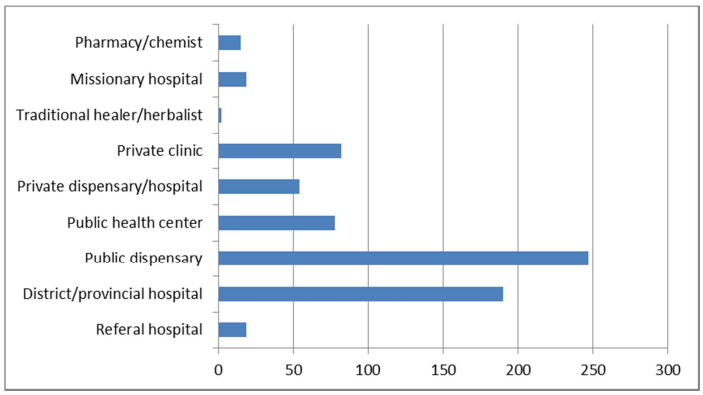
Table 32. Health status of household members

County	N of households	Any sick member in HH [%]	% of sick members with…			
			N of sick HH members	Malaria/ Fever	Diarrhea/ Thyphoid	Flu/Asthma/ RD
Kisii	401	49.6	284	45.4	23.2	19.7
Kakamega	407	55.5	358	57.0	17.9	15.4
Nakuru	221	38.5	100	34.0	11.0	21.0
Kiambu	183	32.8	77	26.0	22.1	24.7
Kajiado	20	45.0	17	17.6	29.4	29.4
Total	1232	47.0	836	46.7	19.5	18.7

Notes: HH = household; RD = respiratory diseases

Of all sick individuals in the sample, 83 % visited a health provider. Most prominent choices were public dispensaries, district or provincial hospitals and private clinics (s. Figure 20).

Figure 20. Number of individuals going to a health treatment facility



With about PPP$ 100, households in Nakuru spent the most on average for each sick household member, while average spending is much lower in Kakamega and Kisii County (s. Table 33). One of the reasons could be that households in Nakuru and Kiambu go more often to private clinics, which are substantially more expensive than public hospitals and dispensaries.

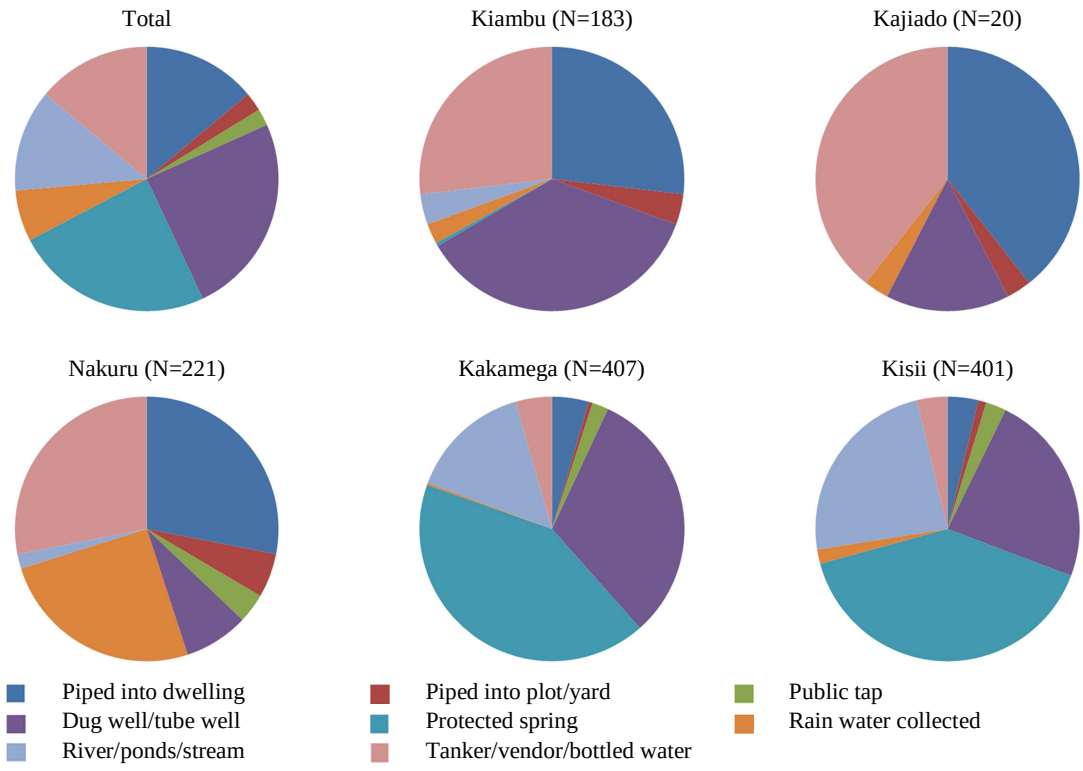
Table 33. Average spending per sick HH member [PPP$2015]

County	N of sick HH members	Mean	Standard deviation
Kisii	284	74.62	231.21
Kakamega	358	39.87	210.84
Nakuru	100	90.31	224.34
Kiambu	77	56.38	102.18
Kajiado	17	65.33	76.62
Total	836	59.75	210.98

11.2. Access to water and sanitation

The main sources of water supply vary significantly between the different counties.

Figure 21. Main water sources in the different counties



Households in Kisii and Kakamega access their water mainly through natural sources like springs, rivers or ponds, while these water sources are almost absent in the peri-urban samples (s. Figure 21). Here the water is mainly piped directly into the dwelling or is brought by tankers or vendors. Dug wells are common in both rural and peri-urban countries and are the single most important water supply form in Kiambu County. Nakuru County is the only sample site where rain water collection plays an important role as water supply.

More than 90 % of all households in the sample use their main water source as well as drinking water. Of these, about 60 % take measures to make the water safer to drink (s. Table 34). Boiling is the technique that is used most often in all counties except Kakamega, where chlorine is the dominant form of making water potable.

Table 34. Share of households practicing the following measures to make water safer to drink [%]

	Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
N	401	407	221	183	20	1232
Boil	40.1	9.8	47.1	39.3	50.0	31.4
Add chlorine	10.7	48.2	10.0	13.7	20.0	23.5
Strain through a cloth	1.0	3.7	0.0	0.0	0.0	1.5
Use water filter	2.2	7.6	0.0	0.0	0.0	3.2
Any measure	54.1	69.3	57.0	53.0	70.0	59.7

Pit latrines are by far the most common toilet facility throughout the whole sample, with covered pit latrines making the highest share (s.Table 35). Flush toilets and VIP latrines only play some role in the peri-urban sample sites.

Table 35. Types of toilet facilities used [% of households]

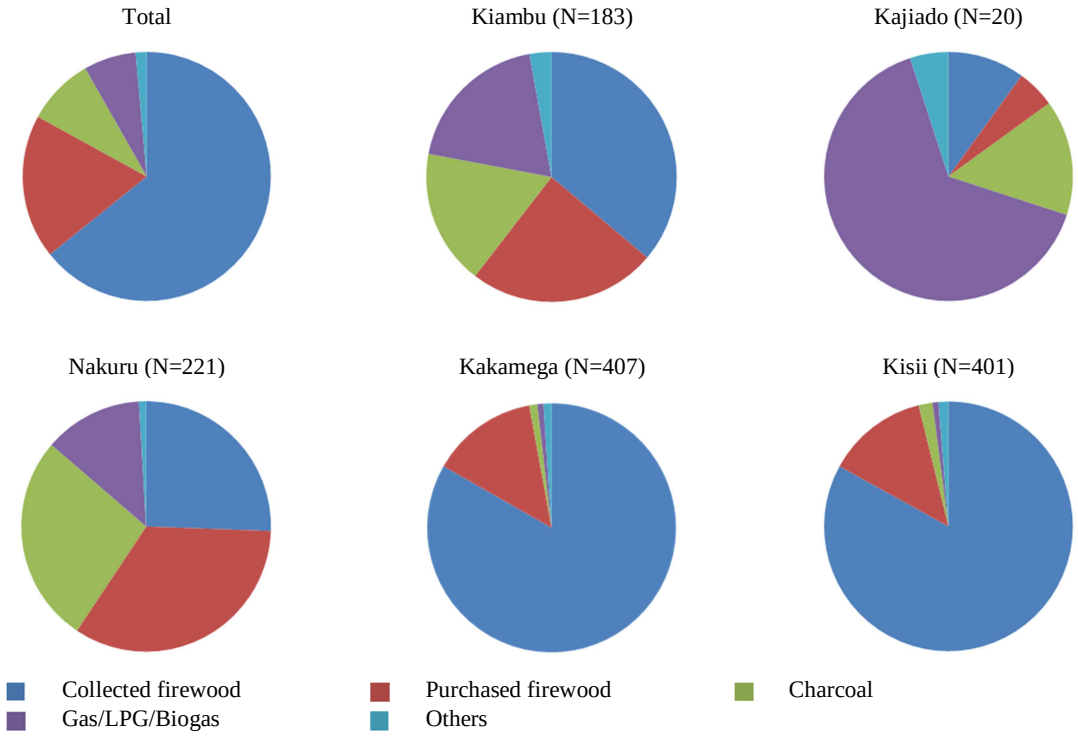
	Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
N	401	407	221	183	20	1232
Flush toilet	2.3	5.0	23.0	13.3	75.0	9.9
VIP laitrine	13.8	12.1	12.4	18.5	15.0	13.7
Uncovered pit latrine	22.7	17.1	3.7	0.6	0.0	13.7
Covered pit latrin	61.1	65.9	60.8	67.6	10.0	62.7

11.3. Energy use and agro forestry

11.3.1. Energy use

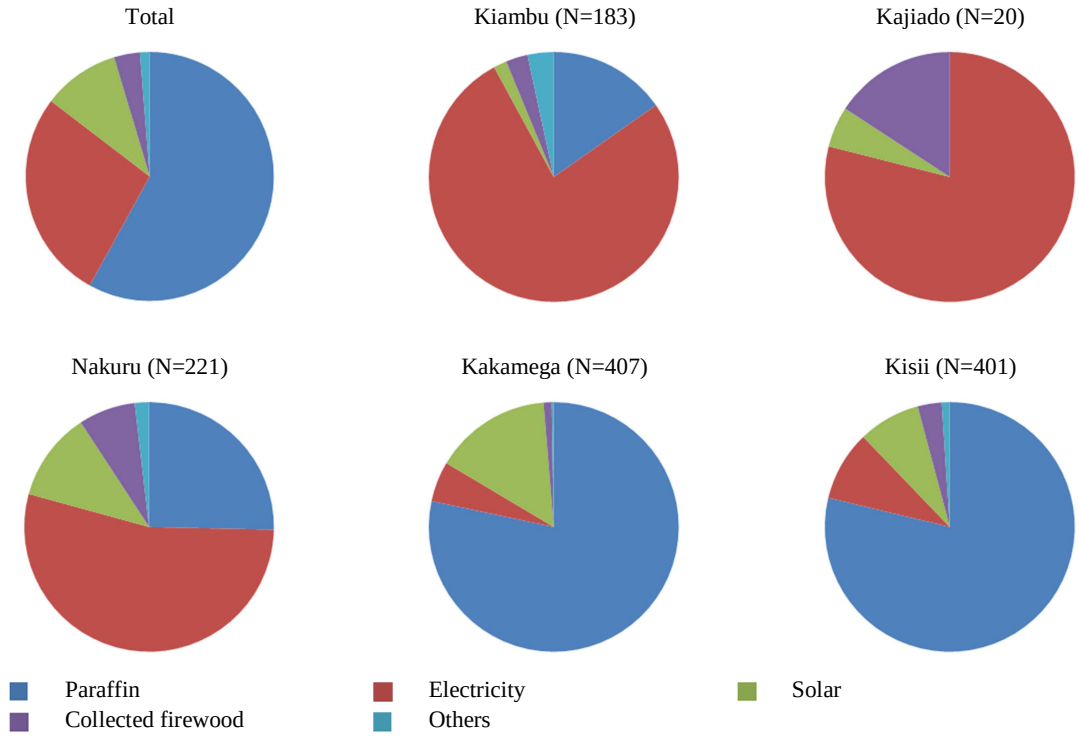
The main source of cooking fuel used is firewood in all sampling sites except Kajiado is firewood, which is used in Kakamega and Kisii by almost all households (s. Figure 22). The share of firewood that is bought instead of collected is higher in Kiambu and Nakuru. Charcoal and gas play a substantial role as cooking fuel only in the peri-urban areas.

Figure 22. Main cooking fuel used



The most important sources of lighting fuel are paraffin and electricity, but there is a significant difference between the peri-urban and rural sample sites (s. Figure 23). While in Kakamega and Kisii almost 80 % of households use paraffin as lighting fuel, the same rates are found for electricity in Kiambu and Kajiado. In Nakuru more than 50 % of households use electricity, about a quarter uses paraffin.

Figure 23. Main lighting fuel used



The widespread usage of paraffin in the rural areas is strongly correlated with a lack of access to an electricity grid. In Kisii and Kakamega County, less than 10 and 5 % of respondents, respectively, stated that they have access to electricity. Of the few that had, a much smaller percentage had access to the Kenya power grid and households instead depend on alternative electricity sources (s. Table 36).

Table 36. Main sources of electricity

	Kisii	Kakamega	Nakuru	Kiambu	Kajiado	Total
Total HH number	401	407	221	183	20	1,232
Access to electricity	9.7%	4.7%	61.5%	79.8%	95.0%	29.1%
HH with access to electricity	48	32	148	146	20	394
Kenya Power	75.0%	53.1%	89.9%	99.3%	95.0%	88.8%
Solar panels	18.8%	46.9%	7.4%	0.0%	5.0%	9.1%
Others	6.3%	0.0%	2.7%	0.7%	0.0%	2.0%

Notes: HH = household

11.3.2. Agroforestry

The average household has tree plots with 60 to 70 trees aged about 40 years with 1.6 tree species (s. Table 37). These numbers are relatively constant throughout all sample sizes with the exception of Kiambu and Kajiado, where the mean number of trees per household is much higher. However, the standard deviation is as well very high, so these means are influenced by a few household with relatively large forest plots. It is remarkable to note that all households in the sample own at least one tree.

Table 37. Characteristics of tree plantings on household level

		Number of trees per household		Average age of trees		Number of tree species per household	
County	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Kisii	401	63.69	66.56	35.83	41.54	1.61	0.82
Kakamega	407	63.62	60.79	42.59	49.51	1.76	0.92
Nakuru	221	70.46	78.50	44.53	43.94	1.33	0.66
Kiambu	183	106.18	256.58	46.41	42.95	1.41	0.84
Kajiado	20	147.91	257.82	40.70	43.12	1.50	1.10
Total	1232	72.56	121.79	41.28	45.07	1.58	0.85

Notes: SD = standard deviation

The main purpose for planting trees is for firewood production (s. Table 38). In Kisii and Kakamega food production for own consumption and selling comes second. While this purpose is important in Nakuru and Kiambu as well, shading and timber production play a more important role here.

Table 38. Main purpose of the trees [% of households]

County	**Kisii**	**Kakamega**	**Nakuru**	**Kiambu**	**Kajiado**	**Total**
N	401	407	221	183	20	1232
Firewood	88.0	85.5	51.6	38.3	45.0	72.6
Food (own consumption)	56.6	73.0	19.9	30.6	45.0	51.4
Food (selling/business)	29.7	22.1	5.9	16.9	20.0	20.9
Timber	47.1	53.3	35.3	37.2	40.0	45.5
Soil improvement/fertilizer	36.7	31.7	4.1	7.1	5.0	24.3
Shading (for crops or humans)	19.2	24.1	29.4	7.1	25.0	20.9
Medicine/Spices	2.5	0.7	4.5	0.0	0.0	1.9

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