



FARMERS' KNOWLEDGE, ATTITUDES AND PRACTICES IN THE PRODUCTION, PRESERVATION AND UTILIZATION OF AFRICAN LEAFY VEGETABLES IN WESTERN KENYA

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ABSTRACT: *A large diversity of African Leafy Vegetables (ALV) are consumed in the western Kenya. These vegetables have been neglected leading to persistent high cases of malnutrition and micronutrient deficiencies. To boost the promotion of these vegetables, which has been ongoing by various organizations, a study was conducted with the objective of determining the farmers' knowledge, attitudes and practices in the production, preservation and utilization of ALV in Kakamega and Vihiga Counties, Kenya. Twelve gender-disaggregated Focus Group Discussions were held. Visiting institutions, family and friends were the leading sources of knowledge. 'How to grow ALV' was the most favourite topic delivered. Nineteen different ALV species are consumed in Western Kenya. Vegetables for the market are harvested when there is no direct sunlight. Most vegetables are mixed when cooked. Duration and methods of cooking vary. Vegetables which have been domesticated for long are sold as much as they are home consumed, while the wild and those domesticated recently are not sold. Preservation for long periods was rare. Thirteen ALV are encouraged for specific individuals for health benefits. Twelve ALV are discouraged for specific individuals because of myths. The farmers have reasonable knowledge regarding ALV. Attitudes and practices are influenced by culture.*

KEYWORDS: Knowledge, Attitudes, Practices, African Leafy Vegetables, Production, Preservation, Utilization



INTRODUCTION

African Leafy Vegetables (ALV) have been consumed for many years locally. The vegetables used to be collected from the wild or grew as weeds on farms. They had been edged out by the coming of the exotic breeds of vegetables, despite being more nutritious. Actually, at the national level, their recognition is still very low. During the 2019 Kenya Population and Housing Census, no data was collected on ALV yet data was collected on a number of exotic breeds of vegetables like kales, cabbages, and tomatoes. In the recent past however, consumption has resumed and a number of the vegetables have been domesticated. Promotion of the ALV is also being undertaken by various organizations especially in Western Kenya. To encourage the promotion of these vegetables, a study was conducted with the objective of determining the farmers' knowledge, attitudes and practices in the production, preservation and utilization of African Leafy Vegetables in western Kenya. The research questions guiding this study were:

- i. What knowledge do farmers have in regard to production, preservation and utilization of the African leafy vegetables?
- ii. What attitudes do farmers have in regard to utilization of the African leafy vegetables?
- iii. What practices are undertaken by farmers in the production, preservation and utilization of the African leafy vegetables?

Importance of African Leafy Vegetables

There is more awareness of the health-enhancing properties of non-nutrient bioactive compounds found in fruits and vegetables. This awareness has directed immense attention to vegetables as vital components of daily diets. The focus on vegetables as critical dietary components is significant, as leafy vegetables have long been indispensable ingredients in traditional sauces that accompany carbohydrate staples for sub-Saharan African Populations (Smith and Eyzaguirre, 2007). They represent quality nutrition for large segments of the population and supply most of the required vitamins, especially A, B, and C, along with essential minerals, fiber, carbohydrates, and proteins (Mnzava, 1997; Muchoki, 2007). African leafy vegetables are accessible to low-income communities in rural and urban areas. This accessibility offers an opportunity of improving the nutritional status of many low-income families whose health and nutrition are at risk (Chweya and Eyzaguirre, 1999; Muchoki, 2007). Unlike previously, ALV have been attracting research attention recently for their nutrition quality and also for the healing power of some of them (Kimiye *et al.*, 2007), yet much is yet to be achieved. It is crucial to pay more attention to the preservation of these vegetables to ensure year-round supply even as their utilization is being promoted.

Western Kenya has arable land that supports a variety of crops and is endowed with abundant agricultural biodiversity. That includes ALV such as spider plant, African nightshade, pumpkin leaves, cowpea leaves, amaranths, jute mallow, slender leaf, and African kale. Yet, cases of malnutrition and micronutrient deficiencies remain high due to widespread poverty, poor feeding habits, and over-reliance on starchy foods. Women and children are at the center of nutritional deprivation owing to their increased physiological demands compounded by their often-disadvantaged social status in the society (Oniangó *et al.*, 2003). Studies show that dietary diversification is positively correlated with improved nutrition. Western Kenya has been described as highly rich in agro-biodiversity; however, cultural and social dimensions



cannot be overlooked in accurately capturing or addressing food insecurity. Home-based production of diverse and nutritious food is among the most direct and effective ways to address food and nutrition security for resource-poor families. Still, training and knowledge dissemination plays a significant role in changing cultural attitudes. (Walingo and Ekesa, 2013; Noack and Pouw, 2015).

STUDY AREA AND DATA COLLECTION

This was a cross sectional study conducted in Kakamega and Vihiga Counties (Figure 1). The counties were chosen because a large diversity of ALV are grown and consumed in western region of Kenya. The study was part of the ‘Nutrition Sensitive Promotion of Vegetables – Project’ whose objective was to measure and compare the impact of two different nutrition messages and two different message delivery channels on the diversity of vegetable production and consumption in smallholder household; which was conducted in Kakamega County. For this particular study, Vihiga County was added to increase the study area to improve the quality of data. The two counties cover the great Kakamega, since Vihiga was curved out of Kakamega in 1990 (Kenya District Boundary Map, 1989).

Kakamega has a population of 1,867,579 and a population density of 618 persons per square kilometre (Kenya National Bureau of Statistics, 2019). Rainfall is uniformly distributed throughout the year with March and July receiving highest whereas December and February the least. The county has annual rainfall that range from 1280.1mm to 2214.1 mm per year. Agriculture is the backbone of the county, producing over 65% of the total earnings. The area under agriculture is 219,776 ha. There are two main categories of crops. Food crops and industrial crops. Food crops include maize, sorghum, finger millet, rice, beans, peas, grams, cassava, sweetpotato, and arrow roots. Industrial crops are basically horticulture (Kenya National Bureau of Statistics, 2017). Total number of farming households are 335, 269.

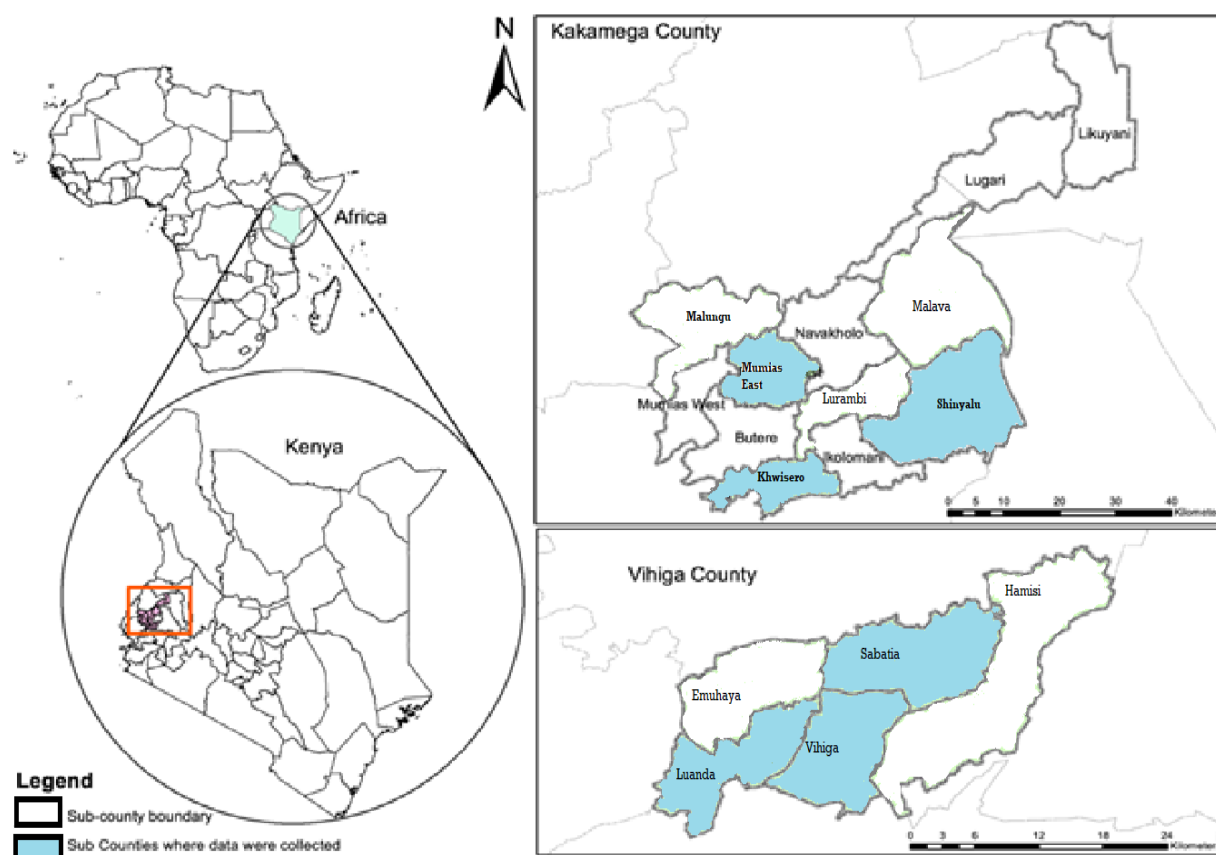


Figure 1: Map of Kakamega and Vihiga Counties in western Kenya

Source: [Kanyenji *et al.*, 2020] with modification.

Vihiga county has a population of 590, 013 and a population density is 1047 persons per square kilometre (Kenya National Bureau of Statistics, 2019). The area enjoys reasonably fertile soils and a good climate. It is sub-humid, receiving on average between 1,800 and 2,000 mm of rain distributed in two rainy periods, the long (March–July) and short (August – November) rains, which allow two cropping seasons per year (Marenja *et al.*, 2003; Valbuena *et al.*, 2015). Agriculture, dominated by small scale farmers, constitutes 70% of the economic activities. Crop farming contributes 64% of the county's income. The area under agriculture is 50,521 ha. Maize and beans are the main subsistence crops while tea and coffee are the main cash crops. Other crops are sorghum, millet, cassava, sweet potatoes and bananas (VihigaCounty, 2013). Total number of farming households are 113, 753. Eighty five percent of the population living in the county have their livelihood mainly from agricultural activities (Kakamega County, 2018).

Focus group discussions methodology and document analyses were used to collect data. The data collected was analyzed using descriptive and inferential statistics. A Focus Group Discussion (FGD) is commonly defined as a method of collecting research data through moderated group discussion based on the participants' perceptions, ideas, opinions, thoughts and experience of a topic decided by the researcher (Krueger and Casey, 2009; Powell and



Single, 1996; Morgan, 1997; Kitzinger, 1995; Bender and Ewbank, 1994). Qualitative researchers often rely on focus groups to collect data from multiple purposely selected individuals simultaneously, rather than from a statistically representative sample of a broader population. Focus groups are less threatening to many research participants, and this environment is helpful for participants (Nyumba *et al.*, 2017; Carlsen and Glenton, 2011; Pearson and Vossler, 2016). The method is frequently used as a qualitative approach to gain an in-depth understanding and exploration of social issues. Focus groups often provide much data, often more quickly than would a survey. Focus group data can be used alone or in conjunction with quantitative data (Basch, 1987; Wiggins, 2004). There is lack of clear, evidence-based guidance about deciding on sample size when using focus group methodology in research, though most focus group researchers use the group as the unit of analysis (Morgan, 1997; Carlsen and Glenton, 2011).

The sample size for this study was 12 FGDs. For this study, it was observed that six groups per county, three of each gender, were sufficient to remove bias and allow the researcher to examine themes common across the groups. Literature has suggested that three to six different focus groups are adequate to reach data saturation or theoretical saturation with each group meeting once or multiple times (Krueger and Casey 2009; Morgan, 1997; Carlsen and Glenton, 2011). A structured questionnaire was used to guide the discussions and collect data on knowledge, production, post-harvest handling, preservation and utilization of ALV.

Three farmer groups were randomly selected each from a different sub-county from the seven sub-counties participating in the larger study in Kakamega County. The list of the farmer groups in the various sub-counties had been supplied by the County Agricultural Office. For the Vihiga County, three farmer groups were randomly selected each from a different sub-county from the list of farmer groups supplied by the County Agricultural Office. For each farmer group, all the members were invited to join the FGDs, but not all were able to attend. No payments were given for attending the discussions. However, each participant was given KES. 200 (2USD) as transport refund after the discussions. A pilot FGD was conducted in one of the sub-counties which had not been selected in Kakamega to test the schedule and check whether there were errors that needed to be rectified before its deployment.

On a particular day, two gender-disaggregated FGDs were held from one farmer group. It is believed that men and women talk more openly when in separate groups, and there is a possibility that their views are varied (Kanui, 2015). The meetings for women were held in the morning, and for men were held in the afternoon. The local contact persons advised on a central venue where the FGDs were held. The setting for each discussion was usually in a central community meeting place such as a church, market ground, or in a community leader's home. Discussions were held in Kiswahili, which is a common language in Western Kenya. The Focus group schedule/guide was administered by the researcher and a research assistant. The researcher was responsible for facilitating the discussion, prompting members to speak, requesting overly talkative members to let others talk, and encouraging all the members to participate. The research assistant responsibilities included recording the session by audiotape, taking notes, creating an environment that was conducive for group discussion (For example; dealt with latecomers, being sure everyone had a seat) and verified the data (Krueger and Casey, 2009; Onwuegbuzie *et al.*, 2009). Every evening, the facilitator and the note-taker discussed the events of the day, listened to the audiotapes and perused through the notes to re-check whether important points had been captured.



National Commission for Science, Technology and Innovation, Nairobi, Kenya granted the Research authorization. Jaramogi Oginga Odinga University of Science and Technology Institutional Ethics Review Committee provided the ethics approval. Oral informed consent to participate in the FDG was obtained from each participant by the researcher before conducting the discussions. To maintain confidentiality of study participants, names of participants and/or associated identifiable data were not collected. The anonymity of participants was adhered to when compiling the data collected.

Farmers' knowledge

Knowledge dissemination

The participants were asked to give information on where they obtained the knowledge from regarding appropriate production, preservation and utilization of ALV.

Trainings on vegetables

The group participants were asked whether they had ever participated in any trainings/demonstrations or teachings on ALV production, preservation and utilization. They were asked to indicate who had organized the trainings and, what was taught and the mode of teaching.

Challenges faced due to lack of information

Another question was on their current knowledge and challenges on appropriate ALV cultivation, preservation and utilization.

Production, Preservation and Utilization

Production

The participants were requested to list all the vegetables which they cultivated on their farms or collected in the wild and the different varieties.

Post-harvest handling and preservation

In this section, the participants were requested to provide information on post-harvest handling of the vegetables they produced, before taking them to the market, and also for home consumption. They were also to provide information on how they typically processed and preserved the vegetables.

Utilization

The participants were asked to name the different plant parts utilized and indicate whether the vegetables were for home consumption or for selling. Another question was on information of the members' family who consumed which vegetables and the reasons behind that. More information was required on members of the family who did NOT consume (avoided) certain vegetables and the reasons for that.



DATA ANALYSIS

Manual coding procedure was used to analyze the focus group transcripts. This consisted of generating a list of key ideas, words and phrases; using ideas to formulate categories and placing ideas and quotes in appropriate categories; examining the contents of each category for subtopics; and selecting the most frequent for the various categories (Burke *et al.*, 1999; McLaughlin *et al.*, 2002). The quality of the coding scheme was checked using the author and the research assistant. The two analyzed and coded the transcripts separately. They later met to compare the initial analysis and to reread relevant portions of the transcripts when there were any discrepancies. Identification of themes and categories was reached through consensus (Saulnier and Wheeler, 2000). The data was presented using tables, figures and through discussions and narratives.

RESULTS AND DISCUSSION

The results given in this paper were only for ALV. Any data collected for exotic breeds of vegetables or non-leafy vegetables is not reported.

The number of participants per group varied from 11 to 19 (14 being the median). The average time taken for each FGD was 2 hrs and 33 min in Kakamega, while in Vihiga, it was 2 hrs and 18 min, and other topics not related to the research questions of this paper were covered in the discussion. Of the participants in Kakamega, 47% were farmers, six percent were traders, and 47% were farmers and also traders. In Vihiga, 35% were farmers, two percent were traders, and 63% were farmers and also traders. The data above shows that only a small percentage of locals are full-time traders. There was a higher percentage of those who are full-time farmers. However, the highest percentage was for those who are farmers and also traders. This agrees with the findings of other researchers, which showed that most locals in Western Kenya are subsistence farmers who use agricultural products mainly for home consumption and income generation (Rao *et al.*, 2015; Abukutsa-Onyango, 2007).

Farmers' knowledge

Knowledge Dissemination

The participants gave their sources of knowledge regarding appropriate ALV production, preservation and utilization attitudes and practices as shown in Table 1.

From the information given in the above section, it shows that there are diverse sources of knowledge. All groups mentioned having received knowledge from neighbours/friends /relatives/ family category and from visiting institutions. However, other sources were not mentioned by all the groups. This information agrees with other researchers who reported that, locals make use of traditional knowledge together with new and diverse technologies regarding their attitudes and practices in vegetable production, preservation and utilization (Oniagó *et al.*, 2003; Rao *et al.*, 2015).



Table 1: Sources of knowledge for the farmers and Percent of groups that mentioned a particular source

Sources of knowledge	% of groups
1. Institutions. Such as Training institutions, Ministries, NGOs	100
2. Neighbours /friends / relatives/ family	100
3. Radios, television, internet, social media.	50
4. Agricultural fairs.	50
5. Magazines, newspapers, books, literature.	33
6. Groups: Farmer - men- or women- groups	33
7. Village administration. Such as Barazas, meetings.	33
8. Social functions. Such as church functions, funerals	33
9. Personal creativity.	8

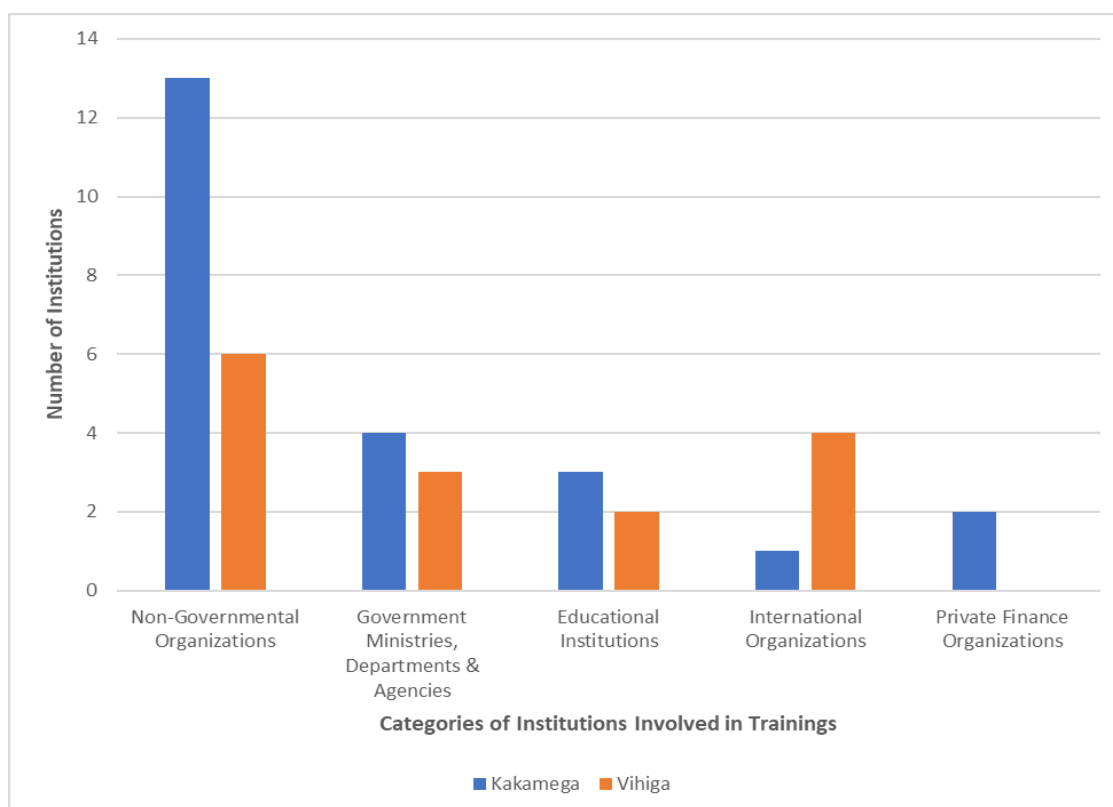


Figure 2: Categories and numbers of institutions involved in trainings



Trainings regarding ALV

Many organizations were involved in offering trainings/demonstrations in various topics using different media to the local farmers and traders. The organizations were in various categories as given in Figure 2. The non-governmental organizations category had the highest number offering trainings in both counties, while private finance organizations, specifically banks had the lowest number. These results concur with findings from other researchers who reported that, non-governmental organizations which are dedicated to a particular course, act as strategic-bridge-builders and are able to negotiate between multiple social worlds (For example, foreign donors, farmers, agricultural researchers, and the Kenyan state) and knowledge domains (For example, formal agricultural science and local knowledge), and ensure they succeed (Goldberger, 2008). The topics that had been taught by the above organizations were varied and included agronomic practices, production of vegetables and marketing of vegetables, as shown in Table 2. ‘How to grow indigenous vegetables’ was the most favourite topic taught by the institutions, because it was mentioned by 91.7% of the groups (11 out of the 12). The mode of training included seminars, barazas, field visits, technical support, extension services, demonstrations and /or provision of inputs/equipment/implements/literature to ensure the farmers could implement what they were taught.

Table 2: Topics taught to the Groups and Percent of groups that had received a particular training

Broad area	Specific teachings	% of groups
Agronomic practices	• Pest control (How to make pesticides from local herbs for vegetables)	8.3
	• Weather training, timing of land preparation, planting, harvesting, sensitization on rainy seasons.	50
	• Soil conservation and rehabilitation, making water channels, double digging	25
	• Composting, preparation of organic manure, how to use fertilizer, animal manure for maximum benefits.	58
	• Mixed farming	8.3
	• Mandela gardens, French gardens, Portable gardens, vertical gardens, sack vegetable beds	25
	• Rainwater harvesting and use of run-off, irrigation	25
Production of vegetables	• How to grow indigenous vegetables (i.e. <i>kunde, miroo, litsutsa, seveve, mrenda</i>)	91.7
	• Seed harvesting, seed bed preparation	33.3
	• Utilization of vegetables	33.3
	• Preservation using solar drier, value addition	41.7
	• Growing vegetables using a little amount of water	16.7
Financial management	• Record keeping, workplan	16.7
	• How to get capital to start a business (Table banking, Management of loans)	33.3



- | | |
|---|-----|
| • Writing business plan and proposal | 8.3 |
| • Opening a business, expanding the business (Vegetable production as an income generating activity, Marketing of vegetables) | 50 |

Areas which the participants needed more knowledge

The group members outlined their current knowledge challenges in regard to appropriate vegetable production, preservation and utilization. However, most of the areas which they mentioned, probably only needed reinforcing, because from the data, there was high probability that they had already been offered previously, though not to all the groups. To echo Dweba and Mearns, there is need for concerted effort to transfer the associated indigenous knowledge to assure potential future use of traditional vegetables (Dweba and Mearns, 2011).

Production, Preservation and Utilization

Production

Group participants gave different ALV that are produced in Western Kenya. Nineteen ALV species (cultivated and wild) were identified as shown in Table 3. Different groups identified different varieties for the same vegetable species (identified either by their morphology or taste) and the plant parts utilized. In 2015, another researcher gave a list of 11 ALV as she categorised food plant species (sorted by food use groups) available in Western Kenya (Kanui, 2015). The smaller number, in comparison with the findings in this study, could be attributed to the fact that, she did not include those from plants whose main use may not be as a leafy vegetable. For example, sweetpotato leaves and bean leaves.

Table 3: Diversity of African leafy vegetables cultivated and consumed in Western Kenya

Vegetable species			Sub-species/ cultivar	Plant parts used
English name	Local names	Scientific name		
1. Cowpea leaves	<ul style="list-style-type: none"> • <i>Likhubi</i> • <i>Kunde</i> 	<i>Vigna unguiculata</i>	<ul style="list-style-type: none"> • <i>Lihanda</i>- Drought resistant (Climbing variety) • <i>Enzeku</i> (Bush /standing variety) • <i>Likhubaika</i> • Wide-leafed • Narrow leafed 	<ul style="list-style-type: none"> • Leaves • Seeds
2. African nightshade	<ul style="list-style-type: none"> • <i>Lisutsa</i> • <i>Managu</i> 	<ul style="list-style-type: none"> • <i>Solanum villosum</i>, <i>Solanum americanum</i>, <i>Solanum scabrum</i> 	<ul style="list-style-type: none"> • The bitter variety • Non-bitter variety 	<ul style="list-style-type: none"> • Leaves



3. Slender leaf	<ul style="list-style-type: none"> • <i>Miroo</i> • <i>Mito</i> • <i>Emiro</i> • <i>Marejea</i> 	<ul style="list-style-type: none"> • <i>Crotalaria ochroleuca</i> 	<ul style="list-style-type: none"> • Bitter variety • The non-bitter variety (<i>Mibobo</i>) 	<ul style="list-style-type: none"> • Leaves
4. Jute mallow, Jew's mallow, bush okra, Egyptian spinach.	<ul style="list-style-type: none"> • <i>Mrenda</i> • <i>Murere</i> • <i>Omurere</i> 	<ul style="list-style-type: none"> • <i>Corchorus olitorius</i>, <i>Corchorus acutangulus</i>, <i>Corchorus olitorius</i>, <i>Corchorus trilocularis</i>, <i>Corchorus tridens</i> 	<ul style="list-style-type: none"> • Bitter variety • Indian variety • Big leafed • Small leafed • Tall stems 	<ul style="list-style-type: none"> • Leaves • Young seeds
5. Pumpkin leaves	<ul style="list-style-type: none"> • <i>Seveve</i> • <i>Malenge</i> • <i>Lisebebe</i> 	<ul style="list-style-type: none"> • <i>Cucurbita moschata</i>, <i>Cucurbita maxima</i> 	<ul style="list-style-type: none"> • The one with round-edged leaves • Rough/saw-edged leaves 	<ul style="list-style-type: none"> • Leaves • Fruits • Seeds
6. Spider plant	<ul style="list-style-type: none"> • <i>Saga</i> • <i>Tsisaka</i> • <i>Mgagani</i> 	<ul style="list-style-type: none"> • <i>Cleome gynandra</i>, <i>Cleome hirta</i> 	<ul style="list-style-type: none"> • Bitter • Non-bitter 	<ul style="list-style-type: none"> • Leaves
7. Pigweed, Leaf amaranth	<ul style="list-style-type: none"> • <i>Dodo</i> • <i>Mchicha</i> • <i>Zimboga</i> • <i>Tsimboka</i> • <i>Libokoyi</i> • <i>Chiboga</i> • <i>Livokoi</i> 	<ul style="list-style-type: none"> • <i>Amaranthus blitum</i>, <i>Amaranthus cruentus</i>, <i>Amaranthus retroflexus</i> 	<ul style="list-style-type: none"> • Small leaves • Big leaves • With thorns • Without thorns 	<ul style="list-style-type: none"> • Leaves • Seeds • Young stems
8. African kale, Ethiopian cabbage, Ethiopian kale	<ul style="list-style-type: none"> • <i>Kanzira</i> • <i>Ikanzira</i> 	<ul style="list-style-type: none"> • <i>Brassica carinata</i> 	<ul style="list-style-type: none"> • One cultivar 	<ul style="list-style-type: none"> • Leaves
9. Vine spinach, African spinach, Indian spinach	<ul style="list-style-type: none"> • <i>Nderema</i> • <i>Inderema</i> 	<ul style="list-style-type: none"> • <i>Basella alba</i> 	<ul style="list-style-type: none"> • Broad leaves • Small leaves 	<ul style="list-style-type: none"> • Leaves
10 Bean leaves	<ul style="list-style-type: none"> • <i>Makhalaba</i> 	<ul style="list-style-type: none"> • <i>Phaseolus vulgaris</i> 	<ul style="list-style-type: none"> • 10 varieties - Colour of seeds, maturity time growth type, shape of seeds 	<ul style="list-style-type: none"> • Leaves, • Seeds
11 -	<ul style="list-style-type: none"> • <i>Lirunde</i> • <i>Murunde</i> 		<ul style="list-style-type: none"> • One cultivar 	<ul style="list-style-type: none"> • Leaves
12 -	<ul style="list-style-type: none"> • <i>Imbetsa</i> 		<ul style="list-style-type: none"> • One cultivar 	<ul style="list-style-type: none"> • Leaves



13	Cassava leaves	<i>Mwuogo</i>	<i>Manihot esculenta</i>	<ul style="list-style-type: none"> • Reddish • Green 	<ul style="list-style-type: none"> • Leaves • Tubers
14	Sweet potato leaves	<ul style="list-style-type: none"> • <i>Milavi</i> • <i>Mabwoni</i> 	<i>Ipomoea batatas</i>	<ul style="list-style-type: none"> • With purple leaves • With green leaves • With white leaves • With yellow-fleshed tubers 	<ul style="list-style-type: none"> • Leaves • Tubers
15	Blackjack	• <i>Inguyesi</i>	<i>Bidens pilosa</i>	• One cultivar	• Leaves
16	Pepper leaves	• <i>Ipilipili</i>	<i>Capsicum annuum</i>	• One cultivar	<ul style="list-style-type: none"> • Fruit • Leaves
17	Moringa		<i>Moringa oleifera</i>	• One cultivar	<ul style="list-style-type: none"> • Seeds • Pods • Leaves
18	Wandering Jew, Dayflower	<ul style="list-style-type: none"> • <i>Linyolonyolo</i> • <i>Linyoronyoro</i> • <i>Lifwafwa</i> 	<i>Commelina benghalensis</i>	• One cultivar	<ul style="list-style-type: none"> • Leaves • Vines
19	-	<ul style="list-style-type: none"> • <i>Kitiezo</i> • <i>Shirietso</i> 	<i>Erythrococca bongensis</i>	• One cultivar	• Leaves

Post-Harvest Handling and Preservation

Table 4 shows how ALV for the market are handled after harvesting. The vegetables are harvested either early in the morning, in the evening or at night when there is no sun. Some farmers wash the vegetables, or the roots for those which are uprooted. The vegetables are put under a shade, bundled and packed in sacks ready for the market. Vegetables which remain unsold, are: thrown away, left at the market, given to neighbours for free, fed to domestic animals, used as manure, preserved (by spreading them outside overnight and sprinkling with water) to be taken to the market the following day or sun-dried for later use. These findings concur with reports regarding vegetable losses in four Counties in Kenya (Ndirangu *et al.*, 2017). The researchers reported that the unsold vegetables are used for livestock feed, home consumption, disposed or used as compost manure, though in this study there were more options given on how they deal with unsold vegetables. Similar findings were reported regarding indigenous vegetable traders in Kakamega, Nakuru and Kisii. It was reported that, they use unsold vegetables for family consumption, sell it the following day, feed livestock; or discard it (Gogo *et al.*, 2018).

**Table 4: Post-harvest Handling of Vegetables for the Market**

	<i>Vegetable species</i>	<i>Post-harvest handling when brought to the market</i>
1	Cowpea leaves, slender leaf	<ul style="list-style-type: none"> – It is harvested when there is no dew. – It is spread outside overnight. It is packed in sacks, ready for the market in the morning. – The roots are cut off before packing – Alternatively, it is harvested when there is no dew, spread under a shade while bundling (tying in bundles), packed in sacks, kept in the house (Farmer's house) awaiting transportation. – If they remain from the market, they spread the vegetables outside during the night so that they stay fresh – They give to neighbors for free. – If not sold for long, they throw away.
2	Thinnings for: Cowpea leaves, pigweed, slender leaf, Jute mallow, African kale	<ul style="list-style-type: none"> – Uproot the vegetables. Shake the soil, wash the roots, drain, sprinkle water on the leaves, tie into bundles, put in a basket, take to the market. – If all are not sold, sprinkle water on them and leave them out in the night, bring in during the day.
3	African nightshade, Jute mallow, cowpea leaves, pigweed, and spider plant	<ul style="list-style-type: none"> – Should be picked in the early morning hours before the sun rises and placed under the shade. – Bundle and put into a sack and cover with banana leaves – If vegetables remain, put under the shade in the cold. – The vegetables can stay for two days. – If vegetables remain, throw away, leave it at the market, or use it as manure. – The remains from the market should be taken back the following day or sold to neighbors at a lower price near home. – Otherwise, give the animals or make manure. Do not give away.

The group participants also outlined how vegetables for home consumption, are handled after harvesting and prepared, as shown in Table 5. Most of the vegetables for home consumption are washed, cut into small pieces: fried; boiled and then fried; boiled/fried and then added sour or fresh milk; boiled in *msherekha*, fried and added milk; boiled in *msherekha* and added milk; then the vegetables are served either hot or cold. Most of the indigenous vegetables are mixed with others and duration of cooking varies from vegetable to vegetable. These methods of preparation agree well with methods reported in a survey undertaken in South-Western Uganda, which indicated that although the methods of food preparation for home consumption, varied from one household to another, boiling, steaming and frying were very common and cross-cutting in almost all the households (Musinguzi *et al.*, 2006). Musotsi and his friends reported that most of the indigenous vegetables in western Kenya are boiled in unspecified amounts of water, or some form of wet heating. There was addition of bicarbonate of soda; and once the vegetables are simmered, there would be some additives



such as milk, cream, ghee, groundnut sauce or simsim sauce. It seems with time, the local communities are moving more towards frying the vegetables (Musotsi *et al.*, 2005). Similarly, findings were reported regarding preparation methods for traditional vegetables in Tanzania. They prepared the vegetables mostly by steaming, boiling or stir-frying in combination with other vegetables such as onions and tomatoes (Keller, 2004).

Table 5: Post-harvest Handling and Preparation of Vegetables for Direct Consumption

<i>Vegetable species</i>	<i>Processing for direct consumption</i>
1. Slender leaf	<ul style="list-style-type: none"> – Remove the twigs. Wash in plenty of water. Put in sufuria, add <i>msherekha</i> (ash decant: prepared from burnt dried bean stalks or banana fibres) and boil for about 15 min. Remove the remaining soup. Add milk and a little salt. Boil for about 10 min. Serve while hot with ugali. – Alternatively: Remove the twigs. Wash in plenty of water. Put in sufuria, add <i>msherekha</i>, and boil for about 15 min. Drain. Fry in oil, onion, and tomato for 2 mins.
2. African nightshade, African Kale, pigweed and spider plant	<ul style="list-style-type: none"> – Mix them. Boil for 30-40 mins. Drain the water. Fry in oil, onion, and tomato, add milk/cream, and cook for 7 mins.
3. African nightshade + spider plant + pigweed	<ul style="list-style-type: none"> – After plucking, wash in plenty of water. Put in a pot, add a little salt, and enough water. Boil for about 30 min. Add sour milk, serve hot with ugali. – Alternatively: After washing, use a pot for cooking. Put the vegetables inside the pot, sprinkle with a little salt, boil in a closed pot for about 30 min. Remove from the heat. Let them stay for 12 hrs. Put oil, onions, and spices in the vegetables, add sour milk. Boil for 5 min. Serve while hot with ugali. This meal can stay for three days.
4. Cowpea leaves	<ul style="list-style-type: none"> – Wash in plenty of water. Put in a pot and sprinkle salt. Cook for about 2 hrs in a covered pot. Serve while hot with cold ugali. – Alternatively: Boil in water with <i>musherekha</i> for 5 mins. Put oil, onion, and tomato on top and mix.
5. <i>Okulunga</i> – Cowpea leaves, pumpkin leaves, slender leaf, Jute mallow, vine spinach, mushroom	<ul style="list-style-type: none"> – Pick vegetables. Remove the twigs and wash. Boil water and add <i>musherekha</i> and salt. Add the vegetables. Cook for 10-20 min. Remove and drain. Fry. Add milk and serve
6. <i>Tsiamatsi</i> - African nightshade, spiderplant, amaranth, African kale, cowpea leaves	<ul style="list-style-type: none"> – Pick vegetables. Remove the twigs and wash. Fry onion and tomatoes. Add vegetables. Cook for 30 min – covering with banana leaves. Stir/turn. Boil for another 20 min. Add milk and serve.
7. Jute mallow	<ul style="list-style-type: none"> – Boil for 30-40 mins. Drain the water. Fry in oil, onion, and tomato, add milk/cream, and cook for 7 min.



- | | | |
|----|--------------|--|
| 8. | African Kale | – Wash and cut into small pieces. Fry in oil, onion, and tomatoes for 10 mins. |
| 9. | Vine spinach | – Mixed with other vegetables. Fry in oil, onion, and tomatoes for 5 mins. |

Though preservation for long periods was rare, a few participants outlined how they preserved some vegetables for long periods, as given in Table 6. There were only two methods used to preserve the vegetables. By boiling everyday or by drying in the sun. It was noted that most of the farmers were not preserving the vegetables for long periods. Reasons given were; they lacked preservation skills, the taste changes and they do not have periods in the year when they totally lack the fresh vegetables. Similar sentiments were reported regarding farmers in Kakamega, Kisii and Nakuru who were not satisfied with the current methods of indigenous vegetables preservation. This was attributed to the perception by farmers that available methods of postharvest treatment, such as sun drying, solar drying and blanching are ineffective, expensive, unsustainable, or farmers were not aware of how to appropriately use them (Gogo *et al.*, 2018).

Table 6: Post-harvest Handling and Preservation for Long Periods

	<i>Vegetable Species</i>	<i>Procedure for preservation</i>
1.	Cowpea leaves, Slender leaf	– Dry. However, not common.
2.	African nightshade, Jute mallow, cowpea leaves, pigweed, and spider plant	– Cook by boiling. Then boil every day to preserve. – Alternatively: Put outside to let any insects crawl away. Dry in the sun for two days. Store in an open container somewhere in the kitchen. – Alternatively: Put in a paper bag and aerate (put holes).
3.	Slender leaf	– Boil vegetables and keep boiling and draining water every day. Do not add tomatoes, because it spoils it.
4.	African nightshade, African kale, amaranth and spider plant	– Dry in the sun and store in an open container.
5.	Jute mallow	– Boil until cooked and drain. Dry in the sun until very dry (powdery dry).
6.	Cowpea leaves	– Wash and drain. Dip vegetables in hot water with <i>msherekha</i> and dry in the sun.

Utilization

The participants were able to indicate how they use vegetables, whether for home consumption or for sale. This is shown in Figure 3. Some vegetables are sold and consumed in equal measure. These are the ALV which have been domesticated for a long time and are well known in the area. Only Moringa and African nightshade are sold more than consumed by the farmers, probably Moringa has become very commercial because of its health benefits while African nightshade has found commercial success in Kenya (Khalai, 2020). Only pumpkin leaves, among the cultivated species are consumed more by the farmers than sold. Most of the wild vegetables are not sold. Similarly, most of the ALV from plants which have multiple uses are not sold. One could only get them from their farms or by being given by a friend. There were no vegetables where the farmers sold everything. These results agree with findings from other researchers in the area. A market survey on ALV, found that in three markets in Western Kenya, vegetables included cowpea leaves, pigweed, African nightshades, jute mallow, spiderplant, slenderleaf, African kale, and pumpkin leaves (Abukutsa-Onyango *et al.*, 2003). Indeche found that over 50 percent of the women farmers grew African nightshade, cowpea leaves, slenderleaf, jute mallow and spider plant (Indeche, 2015). These were also the most common ALV in the markets. Another researcher reported that Amaranthus species, Solanum species and cowpea leaves were available in six markets (Abukutsa-Onyango, 2007). Most of the ALV are consumed by all the family members and most people in the community. However, several ALV are consumed by specific individuals and during particular times. There are varied reasons why some vegetables are encouraged or discouraged for specific individuals or group of individuals.

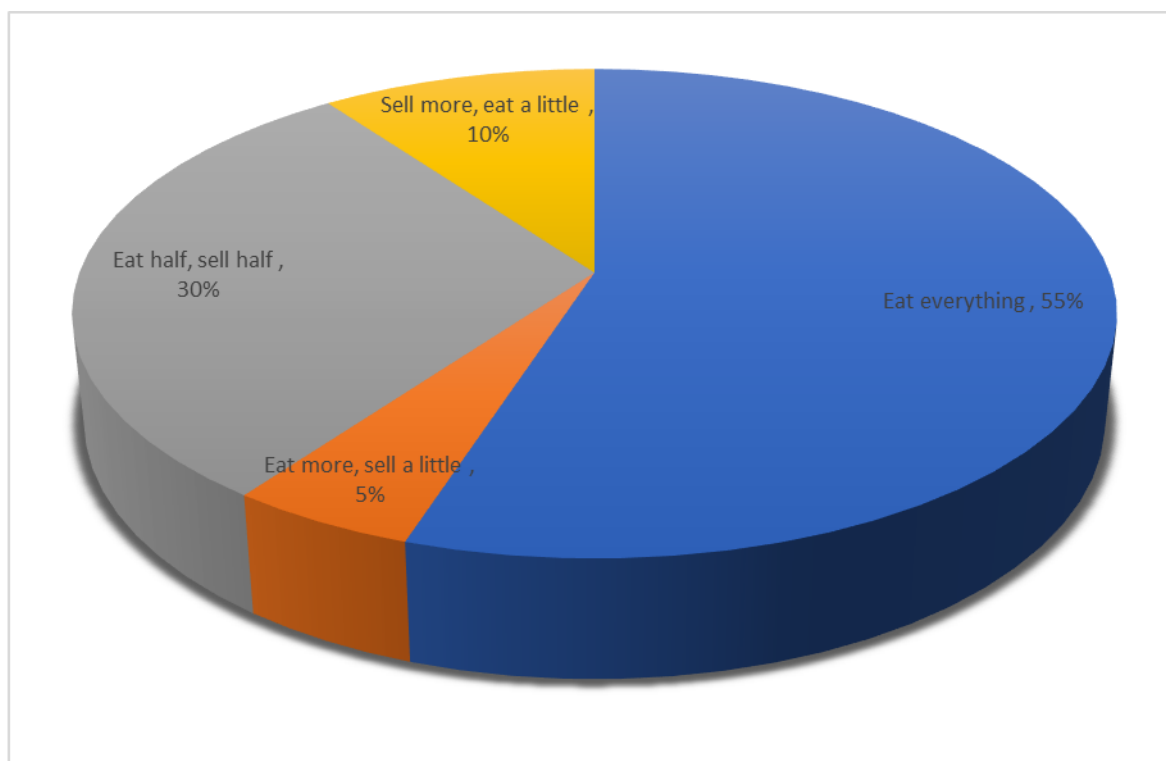


Figure 3: Utilization of ALV by either selling or home consumption



African Leafy Vegetables which are Encouraged for Specific Groups and the Reasons

Table 7 gives thirteen ALV which are encouraged for specific individuals and the reasons. It is evident from the table that apart from providing essential nutrients, these vegetables are believed to offer more health benefits. These benefits include: improving immunity, easing delivery, promoting blood production and stimulating milk production for lactating mothers. Similar findings have been reported by other researchers. Walingo reported that the perceived role of indigenous vegetables in health include: increasing blood, increasing milk production in lactating women, making body strong, preventing prostate cancer, treating hypertension and fever, providing energy and relieving constipation and stomach-ache (Walingo, 2005). Another group of researchers reported that, indigenous vegetables are believed to: treat diabetes, high blood pressure, backache, colds and coughs, stomach ache, cancer, asthma, TB, anemia, fainting, backache, malaria, chest pains, digestive problems, AIDs, diarrhea, skin rashes, typhoid, oedema; cleanses blood, improves eye sight, boosts appetite, and revitalizes the body (Kimiye *et al.*, 2007). Although different regions report variations in the kind of benefits offered and also differences in the particular vegetables providing these benefits, it is evident that these extra benefits greatly motivate those who consume the vegetables to continue utilizing them. Most of the benefits seem to be towards improving immunity, promoting blood production and stimulating milk production for lactating mothers. It would be important for future studies to verify these traditional beneficial claims.

Table 7: African leafy vegetables which some members of the family are encouraged to consume and the reasons

	<i>Vegetable species</i>	<i>Family members</i>	<i>Reason</i>
1.	Pumpkin leaves	Those with weak immunity	Promotes blood formation
2.	Jute mallow	Pregnant women Lactating mothers Women and children Men (In some clans) Members who have chest blockage issues	For ease of delivery Associated with increased milk production • It is cheap • It strengthens joints and bones Known to add sexual energy and general body energy Purifies the chest/good for asthma patients
3.	<i>Shirietso</i> , bean leaves, arrowroots leaves, cassava leaves	Old family members	They know how to prepare them
4.	Vine spinach	Lactating mothers Pregnant women Lactating mothers	• Boosts blood production • Stimulates milk production To help the placenta come out quickly Associated with increased milk production



5. Spider plant	Pregnant women Stressed family members Lactating women	To give them minerals To reduce stress • Stimulates milk production • Boosts blood production
6. African nightshade	Sick people	Used as medicine
7. Pepper leaves	Drinking men	Handles hangovers
8. Pumpkin leaves	Lactating women Those with low immunity	• Stimulates milk production • Boosts blood production Boosts immunity status
9. African kale, pigweed	Lactating women	• Stimulates milk production • Boosts blood production
10. Moringa	Those with low immunity	Boosts immunity status

African Leafy Vegetables which are Discouraged for Specific Groups (Avoided) and the Reasons

The ALV which are avoided/discouraged for specific members and the reasons are given in Table 8. Twelve ALV are not consumed by specific persons, either because of social beliefs, some of which have some truth in them but others are completely baseless. Or because of their bitter taste or the youth do not know how to prepare them. These results agree with the findings of a study conducted in Uganda by Hart and Mouton (2005). They reported that some of the indigenous vegetables have taboos associated with them, which are assumed to affect certain categories of people who come into contact with them. They are used as a means of local social control and explanations of misfortune. They also noted that due to taste preferences and experience, elderly residents had almost exclusive knowledge about a few specific traditional vegetables which were no longer consumed or generally used by the younger residents. This knowledge included food preparation and ritual practices.

Table 8: African leafy vegetables which some members of the Family do NOT Consume (Avoid) and the Reasons

<i>Vegetable species</i>	<i>Family members</i>	<i>Reason</i>
1. Vine spinach	Some clans All	• They swore and believed they could not eat. • They itch if they eat. • It is food for snakes People do not know it
2. Bean leaves	Some clans Men (especially those who drink)	They swore never to eat. It is cooked by boiling
3. Spider plant	Children Those with ulcers	They are bitter. They are acidic
4. African nightshade	Children	They are bitter.



5. Slender leaf	Some families Those with ulcers	They believe if eaten in plenty can cause kidney problems. They are acidic
6. <i>Shirietso</i>	Some clans Lactating mothers The young generation Some families	Believe if one eats, they go mad. Dries breastmilk They do not know how to prepare Associated with the low class in society.
7. <i>Murunde</i>	Men Some families	<ul style="list-style-type: none"> • They do not like it. • They dislike the slipperiness of the vegetable Associated with the low class in society.
8. Cowpea leaves	Lactating mothers Women who have delivered	Dries breastmilk. <ul style="list-style-type: none"> • Too much fiber • It is cooked with '<i>msherekha</i>.'
9. <i>Imbetsa</i> , <i>Wandering Jew</i>	Some families	Associated with the low class in society.
10. Bitter slender leaf, bitter African nightshade	The youth	They do not like the taste.
11. Jute mallow	Some clans, e.g., <i>Basoi</i> (Local herbalists) Men Those with ulcers Some individuals	They believe if eaten a curse will not get to its target/herbs will not heal <ul style="list-style-type: none"> • They do not like it. • They dislike the slipperiness of the vegetable • Leads to impotence and reduce their ability to engage in sex • Most people do not know how to cook Jute mallow well. They are acidic Makes people oversleep
12. Sweet potato leaves	Some members	They lack information on how to prepare them.



CONCLUSION

It is evident from the findings of this study that, the highest percentage of those who participated in the focus groups, were farmers and also traders. There are diverse sources of knowledge, both from the local community, visiting institutions and individual initiatives. Among the visiting organizations, non-governmental organizations category had the highest number offering trainings in both counties. While ‘*How to grow indigenous vegetables*’ was the most favourite topic taught by the visiting organizations. Despite the many trainings, a number of topics still needed reinforcing, as the farmers felt ill-equipped.

Nineteen different ALV consumed in western Kenya were identified. These included both domesticated and wild vegetables. Vegetables for the market are harvested either early in the morning, in the evening or at night when there is no sun. Vegetables which are not sold, are: thrown away, left at the market, given to neighbours for free, fed to domestic animals, used as manure, or preserved for later use. Most of the ALV for home consumption, are mixed with others and duration of cooking varies from vegetable to vegetable. They are washed, cut into small pieces: fried; boiled and then fried; boiled/fried and then added sour or fresh milk; boiled in *msherekha*, fried and added milk or boiled in *msherekha* and added milk; then served either hot or cold. Finally, most of the farmers were not preserving the vegetables for long periods because, they lack preservation skills, the taste changes for those who try to dry them, and they did not have periods in the year when they totally lacked fresh vegetables, as some people grew vegetables along the streams or watered the vegetables grown in the kitchen gardens.

The ALV which have been domesticated for a long time and are well known in the area are sold and home consumed in equal measure. These include; cowpea leaves, jute mallow, slender leaf, spider plant, pigweed and African kale. Only Moringa and African nightshade are sold more than consumed by the farmers. Only pumpkin leaves are consumed more by the farmers than sold. Most of the wild ALV and those from plants which have other parts which are utilized are not sold. There were no vegetables where the farmers sold everything. Apart from providing essential nutrients, several vegetables are believed to offer more health benefits, especially towards improving immunity, promoting blood production and stimulating milk production for lactating mothers. A number of ALV are not consumed by specific persons, either because of social beliefs, their taste or lack of knowledge on how to prepare them by the younger generation.

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