



Characterization and Documentation of Factors Contributing to Production and Consumption of African Leafy Vegetables (ALVs) in Kiambu and Kirinyaga Counties in Kenya

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Authors' contributions

This work was carried out in collaboration between all authors. Authors MR and PGOJ designed the study and protocol. Author MR wrote the first draft of the manuscript. Author PGOJ read all the drafts. Author KN performed the statistical analysis. Author CE read the first draft. All authors read and approved the final manuscript.

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ABSTRACT

The aim of the study was to evaluate popular ALVs in two counties; i.e. Kiambu and Kirinyaga counties in Kenya. Focus group discussion (FGD) and a field survey were employed. The study was carried out in the two counties in Central Kenya between January and February, 2015. Purposive sampling method was used where 67 respondents (37 and 30) Kiambu and Kirinyaga counties respectively; were interviewed. One FGD was carried out in each county. The findings indicated that; about seven ALVs were cultivated and consumed in the two counties. Vegetable amaranth and nightshade were the most dominant indigenous vegetables in both counties (83.8% and 81.1%) in Kiambu and (93.3% and 83.3%) in Kirinyaga respectively. These were followed by, spider plants, pumpkin leaves, cow peas leaves and jute mallow at 54.1%, 35.1% 32.4% and 21.6%

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respectively in Kiambu and 30%, 56.7%, 30% and 6.7% in Kirinyaga respectively. Furthermore, large number of farmers (59% and 66.7%) in Kiambu and Kirinyaga respectively grew ALVs for nutrition or health benefit in both counties. The finding also revealed that over 50% of the respondents in both counties cultivated ALVs both for domestic and commercial purposes.

Conclusion: Two ALVs species (*Amaranthus* and *Solanum spp*) were most popular in the studied region. However a large diversity of cultivated and consumed ALVs seems to exist in Central Kenya. Production and utilization of the vegetables for nutrition and health benefit was major incentive to continual cultivation of ALVs.

Keywords: ALVs; cultivation; consumer preference; vegetable diversity; Kiambu; Kirinyaga.

1. INTRODUCTION

African leafy vegetables (ALVs) are grown and consumed as leafy vegetable crops in Kenya and various parts of Africa [1,2,3]. ALVs have increasingly become important commercially in Kenya over the last two decades where they have increasingly featured in both formal and informal markets in Nairobi and its environs. These vegetables contain high levels of vitamins, iron, calcium and proteins [4]. Their nutritional and bioactive phytochemical properties [5] have been reported to be of health protecting benefit and medicinal value [6,7,8].

Previous report by Ngugi [9] observed that about 200 species of indigenous vegetables in Kenya are a part of traditional diets that mainly accompany starchy staples but unfortunately they have not been fully utilized. Western and coastal communities of Kenya display an extraordinarily large number of ALVs, an indication of food production systems that evolved with emphasis on vegetable cooking. Survey by Abukutsa-Onyango [10] reported about ten ALVs produced and consumed in western Kenya, with about above six of them being produced and consumed by the respondents in Luhya and Luo communities. In Siaya county for instance; the most common traditional vegetables were: Cowpea (*Vigna unguiculata*), Spiderplant (*Cleome gynandra*) Crotalaria (*Crotalaria spp.*), African nightshade (*Solanum nigrum*) and rarely Amaranthus (*Amaranthus sp*); and to a limited extent "Atipa" (*Asystasia mysorensis*) [2]. The ALVs consumed in the urban and peri-urban areas of Nairobi city revealed a diversity of fourteen ALVs, with about eight of them having prominence [10]. Production of ALVs was basically aimed for home consumption [8] on small portions of land – kitchen garden or grown as intercrop, mostly produced by resource-poor women farmers [10]. Intervention studies in the area have changed

the perception of ALV seasonal planting methods to not only promote nutrition reasons but also for high income and demand-driven production to meet market requirement [11].

The agronomic advantages of ALVs include; rapid growing, environmental tolerance with ability to produce seeds under tropical conditions; minimum management and reduced input. All these provide suitable reason for ALVs as alternative source to improve food security and reduce micronutrient malnutrition in developing countries [12,13,14]. Despite the many advantages, ALVs production and consumption have been neglected for a long time in some parts of Central Kenya, yet micronutrient malnutrition is high, especially among resource-poor families [15,16,17]. This is brought about by the stiff competition ALVs cultivation face from exotic vegetables like spinach, sukuma wiki and cabbage [18]. Moreover; other limitations of ALVs cultivation include poor quality seed, lack of important technical knowledge on production and utilization of ALVs and poor understanding of marketing dynamics among others [7,19,20]. Some studies [19,20] have shown that ALVs can support rural, peri-urban and urban populations in terms of subsistence and income generation, with little capital investments [9]. This is worthwhile investment especially, for the resource-poor women and men engaged in formal and informal farming with low capital. However; cultivation and utilization of ALVs is yet to reach its full potential in central Kenya, which would greatly contribute to tackling problems of hunger and malnutrition through attainment of the Millennium Development Goals (MDGs) leading to eradicating poverty and hunger and gender inequality [21]; hence food, nutrition and economic security. It's therefore important to understand the diversity of ALVs and particularly taking cognizance of the most preferred among the various ALVs in the region.

2. METHODOLOGY

2.1 Description of Study Site

The study was conducted between February and March, 2015; in two counties of Kiambu and Kirinyaga, representing one community in Central Kenya. The study area included Kiambu and Kirinyaga counties: Kiambu selected on the basis of its proximity to the city- Nairobi (which offers a big market) while Kirinyaga is more interior thus a better representation of a rural setup. The altitude for Kiambu County ranges from 1500 to 2590 m above sea level with annual average rainfall of 1200 mm p.a [20,22]. Kirinyaga lies between altitudes of 1158 to 5180 m above sea level with average rainfall of 1250 mm [23]. Both counties enjoy two rainy seasons, with annual temperature range between 12°C to 30°C [19,22,23].

2.2 Sampling Description

The respondents were purposively sampled on the basis of the counties and on the basis of whether the farmers were growing ALVs or not. After identifying all those growing the ALVS, the respondents were randomly sampled. A structured questionnaire was administered to 67 respondents; 37 and 30 respondents in Kiambu and Kirinyaga respectively. One FGD was held in each county. The sample number of farmers interviewed was calculated using the formula adopted from Fischer et al. [24].

$$N = \frac{z^2 pq}{d^2} = \frac{0.82^2 0.5(1-0.5)}{0.05^2} = 67 \quad (\text{Eq. 1})$$

Where:

N is the required sample size;

z is normal deviation (0.82) which corresponds to 95% confidence interval;

p is proportion in the population growing ALVs estimated at 50% since it is not known.
q is 1-p

d is degree of accuracy (0.05)

The information captured on the questionnaire included; preferred ALVs cultivated by respondents, reasons and motivations for cultivation of ALVs, the percentage of land allocated to ALVs, use of organic and inorganic fertilizers and the major constraints in the

production of ALVs. The FGDs and key informants who included agricultural officers, hoteliers, ALVs famers and traders, were used to reconfirm what was indicated in the structured questionnaires. Data collected from the study was analyzed by both qualitative and quantitative methods. The qualitative approach was used to discuss data from FGDs and key informants. Descriptive statistics was used to explain the quantitative part where percentages of the various responses were used and presented in form of graphs and tables.

3. RESULTS AND DISCUSSION

3.1 The Socio-economic Characteristics of Sampled of Farmer Engaged in ALVs Production

Regarding the gender of the respondents; the findings revealed that the interviewed sample was more or less the same. In Kirinyaga women constituted the majority of the sample (64%) while in Kiambu it was male farmers (56.8%) dominated the production of ALVs. This could be explained by the fact that Kiambu is in the outskirts of major city where ALVs is demand is high and more than 90% of the supply to these outlets is from farms that are within the environs thus men may have discovered the opportunity of high income. Once an enterprise picks up, males tend to take over from the female [19].

Age profile of the respondents in both counties was to some extent spread across the age gaps in both counties, however; a young population dominated the sample with about 72% of respondents being under age of 40 years. For instance, in Kirinyaga, over 70% of the sample was above the age of 40 years (Table 1). According to Ali [25], age is one of the factors that affect the efficiency of carrying out farm activities particularly in peri-urban region, where more effort is needed for maximum benefit. Nevertheless age is also associated with farmer's experience in farming practices as farmer's gains experience over time specifically for ALVs production and utilization. The reason for the more youthful population getting engaged in vegetables in Kiambu (near capital city) may be related to ready market [26] and easy availability of credit facility unlike in Kirinyaga where the business may not be so lucrative. This is in agreement with the results of Mwaura [20] who opined that access to credit is a very important to the success of farming.

In terms of education; the differences between the counties were less marked and almost a half of the respondents had attained primary school education while a third had gone up to secondary level. Less than 10% in both counties had not attained formal education, whilst 16.2% and 13.3% had received college level in Kiambu and Kirinyaga counties respectively. Education level for ALV production is significant because one has to acquire knowledge on several aspects of ALVs, e.g. their nutritive and medicinal value, marketing strategies, less investment and high returns, environmental tolerance among others, before embarking on their production [10,18].

3.2 Diversity of Cultivated and Consumed ALVs in Kiambu and Kirinyaga Counties

Results from the focus group discussions (FGD) indicated a great diversity of ALVs, which were cultivated and consumed in the studied counties in central Kenya. These were; African nightshade (*Solanum species*), Amaranths (*Amaranthus*), spiderplant (*Cleome gynandr*), pumpkin leaves (*Cucurbita moschata*), cowpeas leaves (*Vigna unguiculata*), and jute mellow (*Corchorus olitorius*). The finding agrees with the work of other workers [10,27]. The survey findings indicated preference of vegetable amaranths and nightshades among the cultivated ALVs; with over 80% farmers growing and consuming them [8] (Fig. 1). Nutritive/medical values, as well as tastes were among the reasons that led to consumption of the preferred ALVs. Other consumed ALVs in the counties include; stinging nettle (*Urticda dioica*), sweet potato (*Ipomea batatus*) leaves, arrowroot leaves, banana male bud and common comfrey, muhika na ihu (*Asystasia mysorensis*), and togotia (*Erucastrum*

arabicum), It appeared that most of them have been domesticated while few of them have been collected from the wild or considered as weeds [8]. Some of ALVs were said to be of special attributes like e. g *Asystasia mysorensis* which is cooked with mashed potatoes or banana [9]. In Kikuyu culture this vegetable was cooked for special visitors- the in-laws.

3.3 Motivations for Cultivation of ALVs in Kiambu and Kirinyaga Counties

When asked what motivated them to grow AIVs; several reasons such as high income return, consumer demand, drought resistance, nutrition and health benefit among others like taste, low maintenance cost and less use of chemicals such as pesticides on AIVs were mentioned (Table 2). Most of the farmers produced ALVs for nutrition and health benefits (59% and 66.7%) in Kiambu and Kirinyaga respectively. Most of ALVs are presumed to be very good source of vitamins, minerals and trace elements which are very important in human diet [28,29]. High value is placed on number of AIVs since they are perceived to contain valuable medicinal properties which are of great health benefit. For instance the bitter ones such as nightshades and spider plants are reported to heal stomach-related ailments and discomfort such as constipation [30]. During the discussion with the stakeholders, it was also revealed that local vegetables amaranth (*Amaranthus blitoides*) was very good and helpful in child bearing by improving both men and women fertility where increased consumption was related increase chances of conception. These ALVs have nutritional and medicinal properties for young children, pregnant and lactating mothers; where it is even recommended by doctors [31].

Table 1. Demographics of sampled ALVs respondents

		Kiambu	Kirinyaga
Gender	Male	56.8%	36%
	Female	43.2%	64%
Age	20-30	16.2%	10%
	31-40	36.6%	20%
	41-50	31.0%	34%
	51-60	10.8%	25%
	Above 60	5.4%	10%
Level of Education	Completed primary	43.2%	50%
	Completed secondary	32.4%	30%
	Completed tertiary	16.2%	13.3%
	None	8.1%	6.7%

The findings are similar to that of Mavengahama [32] who observed that although they may be consumed in small quantities, ALVs influence the intake of cereal staples, manage hunger and play a central role in household food security in the rural setups.

In the studied counties; ALVs were grown for both consumption and for sale, with over 50% respondents producing ALVs for commercial purposes in Kiambu while Kirinyaga had 26.7% (Table 2). A higher percentage (67.6%) cultivated ALVs for high income returns unlike Kirinyaga which produced less in relation to income (33.3%). The possible explanation for the difference could be because Kiambu is a peri-urban area with close proximity to the capital city, that is, Nairobi, where there is a potentially huge lucrative urban market; hence food production systems are relatively more commercialized; considering its comparative advantage in most physical infrastructure (roads, water, electricity) [26] compared to Kirinyaga which more interior. This is an indication that ALVs farming offers an attractive can be source of income for the wellbeing of the households [33].

3.4 Land Allocated to ALVs and Use of Organic and Inorganic Fertilizers

ALVs were apparently grown mainly in home gardens mostly within the homestead, with 57%

of respondents assigning growing of ALVs to small portions of less than an eighth of an acre in Kirinyaga while Kiambu had a lesser percentage of 29% (Table 3). In Kiambu, a good number of farmers (34%) grew ALVS between half and one acre as compared to Kirinyaga being 20%. The large number of farmers assigning production of vegetables on small portions in Kirinyaga; could be the fact that farmers in the area allocate other crops such as tomatoes, French beans [34] bigger portions unlike Kiambu where most farmers have smaller land holdings thus are more likely to produce ALVs as compared to those compared to Kirinyaga where most of them have large land holdings. This can be attributed to intensive land use, in order to maximize returns on land, this being that ALVs are quick growing and yield immediate returns to the farmers [19]. Above 50% of respondents in the two counties used both organic manure and inorganic fertilizer as a source of nutrients (Table 3). This reveals the changing trend for use of farmyard manure only in cultivation of ALVs [1] where the farmers are now using both organic and inorganic fertilizer. Use of inorganic fertilizer was a bit higher in Kiambu as compared to Kirinyaga and was more evident as one moved away towards rural areas [35]. Moreover, another report by Abukutsa-Onyango [36] showed that both organic and inorganic sources of fertilizer significantly increase yields of edible portions of ALVs.

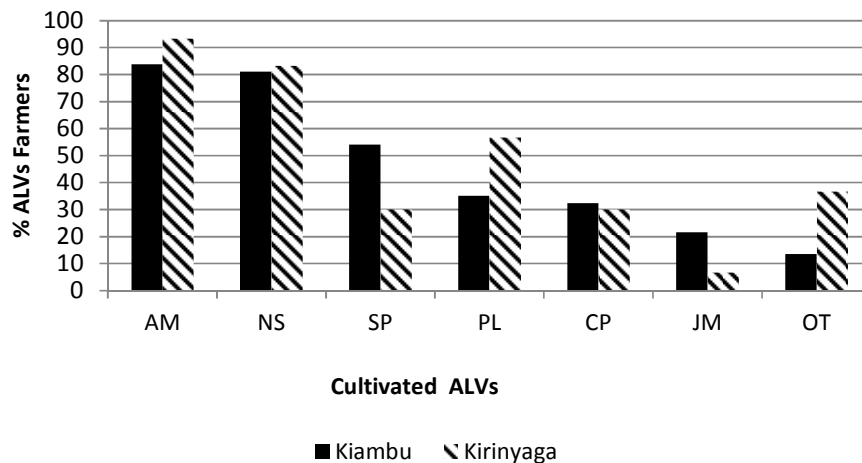


Fig. 1. Preferred ALVs in Kiambu and Kirinyaga Counties (y axis show % of farmers cultivating ALVs in the counties)

AM-Amaranth Spp, NS-Night shades- Spider plants PL-Pumpkin leaves CP- Cowpeas, JM- Jute mallow, OT- others

Table 2. Reasons and motivation for planting Amaranths in Kiambu and Kirinyaga counties

		Kiambu	Kirinyaga
Reasons for growing AIVs	Domestic purposes	13.6%	30%
	Both domestic and commercial	35.4%	43.3%
	commercial	51%	26.7%
Motivation for growing AIVs	High income/returns	67.6%	33.3%
	Consumer demand	56.8%	33.3%
	Nutritive/health benefit	59%	66.7%
	Drought resistance	29%	23.3%
Others		24.5%	26.3%

Table 3. Land allocated to AIVs and organic and inorganic fertilizer use

		Kiambu	Kirinyaga
Land allocated to AIVs	1- ½ acre	34%	20%
	¼ - 1/8	37%	23%
	Less than- 1/8	29%	57%
Organic manure and inorganic fertilizers	Organic	24%	36%
	Organic and inorganic	56%	54%
	Inorganic	22%	10%

3.5 Constraints Facing Production of African Leafy Vegetables

The survey revealed major constraints facing ALVs production; poor seed quality, water shortage, pest and diseases, lack of technical knowledge on ALVs production. This is in agreement with previous findings [10]. About 50.8% and 80% of farmers in Kiambu and Kirinyaga respectively relied on self-saved seeds (Table 4). This informal production of seeds among the ALVs farmer may be the result of inferior seeds. The findings concurs with those of several authors that seed production at the farm level by farmers is still the most common source of seeds for ALV farmers and more often than not, seeds produced are of poor quality [37,38,39]. Drought was one factor that was found out to affect AIVs production especially during the dry season. However simple irrigation techniques e.g. use of bucket, simple water pans were popular. The distance to a water source (stream, river or piped) influenced ALV production and this may be because ALVs are vegetables which require irrigation during dry seasons [40]. Lack of proximity to constant water supply could be constraining domestic horticulture. Out of the interviewed farmers; 48% in Kiambu and 70% in Kirinyaga did not have access to technical advice (data not shown). Technical advice provides farmers with important information, such as patterns in crop prices, new seed varieties, crop management and marketing. Exposure to such activities is intended to

increase farmers' ability to optimize the use of their resources [20]. Lack of technical advice could have lead to deficiency in awareness of the pros of ALVs [14].

Table 4. Constraints facing production of African leafy vegetables

	Kiambu	Kirinyaga
Poor seed quality	35%	24%
Water shortage	23%	20%
Pest and diseases	14%	26%
Lack of technical advice	20%	20%
Others	8%	10%
Sources of seeds		
Home saved	53.8%	80.0%
Agrovets	25.6%	6.7%
Home saved + Agrovets	20.6%	13.3%

4. CONCLUSION

In the studied counties vegetable amaranth (*Amaranth spp.*) and nightshade (*Solanum spp.*) were the most popular ALVs regardless of the large number of leafy vegetables cultivated in the region. Production and utilization of the ALVs among the small scale farmers is a promising venture not only for nutrition and health benefit but also as a source of income, employment due to was major incentive to continual cultivation of ALVs among other motivations. However; ALVs for commercial purposes among the small scale

farmers seem to be a bit restricted venture especially in the outskirts of the bigger cities where it can be a good source of employment, meeting food, nutrition and economic security for livelihood improvement.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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