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# CAN AFRICAN INDIGENOUS VEGETABLES CONTRIBUTE TO NUTRITION SECURITY? A POLICY PERSPECTIVE

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**Abstract**

*Kenya is classified as a food-deficit country. Approximately 20 percent of the population does not attain the minimum dietary requirements to sustain a healthy and productive life, according to the National Bureau of Statistics. African Indigenous Vegetables (AIVs) contain beneficial micro-nutrients and are critical for achieving nutrition security. This study used cross-sectional household survey data to test the plausibility of enhancing food access in the context of nutrition security, on the one hand, and the contribution of the AIVs to nutrition security, on the other hand.*

*The results show that, the consumption of AIVs is not widely acknowledged or documented. Hhouseholds spend up to 15 times less money on AIVs when compared with exotic vegetables this is partly attributed to the perceptions that shape their tastes and preference. At a macro-level, the lack of consistent data makes the promotion of the importance of these vegetables to the policy makers a mundane task since it is difficult to demonstrate and authenticate the nutritional benefits that have been accrued by the consumption of these vegetables.*

**Keywords**: *African Indigenous Vegetables; Food security; Nutrition security; Plausibility Analysis*
**JEL Codes:** *Q18, Q01, P25, 055*

## 1. Introduction

Nutrition security is a multidimensional phenomenon; it implies access by all people at all times to the adequate utilization and absorption of nutrients in food, in order for them to live healthy and active lives (FAO, 2012; Ministry of Health, 2012). Undernourishment is usually a consequence of malnutrition: this can take several forms, including hunger, under-nutrition, obesity, and micro-nutrient deficiencies (Fanzo, 2012; Nene, 2012; Webb et al., 2014; Zhou et al., 2016). This is a worldwide problem: "an estimated 821 million people (one out of every nine people in the world) are undernourished" (p.2). Africa has highest proportion of undernourished population. This is estimated at 21 percent (256 million people) i.e. a third of the world's population (FAO-FAD-UNICEF-WFP and WHO, 2018). This means that with

only 12 years left to achieve the Sustainable Development Goals, the second target – zero hunger – requires concerted, urgent action if it is to be achieved.

Nutrition insecurity is not a new phenomenon in Kenya, according to the KNBS (2018); close to one in every three Kenyans (14.5 million) suffer from chronic food insecurity and poor nutrition annually. About 30 percent of children countrywide are stunted, 13 percent are moderately wasted, and 7 percent are moderately underweight. Twenty percent of the population does not attain the minimum dietary requirements to sustain a healthy and productive life. Micro-nutrient deficiencies in specific minerals and vitamins are high, even et al., 2014; FAO, 2015; FAO-FAD-UNICEF-WFP and WHO, 2018). Micro-nutrient deficiency is also referred to as "hidden hunger". In Kenya, it is estimated that 84 percent of children under five are deficient in vitamin A, 73.4 percent in iron, and 51 percent in zinc. Further, 60 percent of pregnant women are deficient of iron and 39 percent in vitamin A. An estimated 16 percent of adult males suffer from iron deficiency (anemia) (Government of Kenya, 2011; Ministry of Health, 2012).

Policy makers in Kenya continue to battle with the complexity that hidden hunger presents. Two policy documents provide guiding statements. In the first of these, The National Food and Nutrition Security Policy (2011), it states: "the Government will ensure achievement of adequate nutrition for optimum health of all Kenyans. Enhancing food access, supporting all Kenyans to adopt effective nutrition interventions, creating awareness to ensure all Kenyans have equitable access to nutritious diets and promoting healthy lifestyles throughout the life cycle" (Government of Kenya, 2011 p'.25'). In the second, The National Nutrition Action Plan (2012–2017), the third strategic objective is "to reduce the prevalence of micro-nutrient deficiencies in the population" (Ministry of Health, 2012 p.'13'). According to the Action Plan, the causes of the micro-nutrient deficiencies include poor dietary diversification, infections such as malaria, and food insecurity.

This study seeks to test the plausibility of the policy statements in regard to optimum nutrition for all Kenyans in The National Food and Nutrition Security Policy (2011), specifically in terms of enhancing food access. Several studies have been carried out to promote nutrition sensitive agriculture; it is well recognised that nutrition specific interventions alone cannot contribute to achieving the country's nutritional outcomes (Ministry of Health, 2012). It is the concerted efforts and engagement of a variety of stakeholders from different sectors targeting specific areas that are critical for achieving the desired nutritional outcomes (Ruel et al., 2018).

AIVs contain several essential micro-nutrients, such as iron, zinc, and vitamin A, and contain non-nutrient substances called phytochemicals. They, therefore, have the potential to combat hidden hunger (Mwaura et al., 2013; Ekesa et al., 2009; Onim and Mwaniki, 2008; Oniang'o et al., 2007). Most of these vegetables are available even to resource-poor households and are part of their everyday diet (Weinberger and Swai, 2006). Several studies conducted on AIVs have suggested that they have higher levels of various nutrients than the conventionally cultivated species. Besides the nutritional benefits, these vegetables represent significant savings of cash in the household (Mwema and Crewett, 2019; Shackleton, 2003).

## 2. Importance of AIVs

In Kenya, the most popular varieties of AIVs produced include: amaranths (Amaranthus spp), spider plant (Cleome gynandra), African nightshade (Solanum spp), cowpeas (Vigna unguiculata), mitoo (Crotalaria brevidens), jute mallow plant (Corchorus olitorius), pumpkin leaves, (Cucurbita maxima), and African eggplant (Solanum aethiopicum) (Abukutsa-Onyango, 2007; Onim and Mwaniki, 2008; Abukutsa-Onyango, 2016; Kebede and Bokelmann, 2017).

These vegetables are known for their high nutritional value, and for their high levels of minerals, especially calcium, iron, magnesium, phosphorus, potassium and zinc, and several other components such as fibre (Mwema and Crewett, 2019; Weinberger and Swai, 2006; Abukusta-Onyango, 2016). According to the International Plant Genetic Resource Institute (IPGRI, 2003), AIVs have 13 times more iron and 57 times more vitamins than exotic vegetables in the brassica family (cabbage); however, a study carried out by FAO and the Government of Kenya shows that, on average, the AIVs contribute up to six times more calcium, magnesium, and potassium (depending on the cooking method and the vegetable type). As such, they have been documented to be the best at curbing malnutrition/micro-nutrient deficiencies among resource-poor households (Weinberger and Swai, 2006). In addition, they have been reported to have antioxidant, antiviral, antibacterial, anti-inflammatory, and anti-mutagenic properties (Yang and Keding, 2009). The nutritional content in milligrams (mg) of various AIVs as compared to exotic varieties is presented in Table 1.

The nutrient content of these AIVs could, however, be affected by factors, such as stage of growth, storage, cooking, and processing (FAO/Government of Kenya, 2018). Apart from their nutritional content, AIVs also have additional medicinal values. For example, spider plant has been recorded to aid in ameliorating constipation problems, while the African nightshade can help to alleviate stomach ache (FAO/Government of Kenya, 2018).

The importance of the micro-nutrients cannot be over-emphasized. Kenyans are increasingly faced with diet-related non-communicable diseases, especially in urban areas. These are caused by excessive energy intake associated with purchased meals and processed foods and decreasing levels of physical activity in urban settings (Carletto, et al., 2017; Ministry of Health, 2015; Mwenda et al., 2018). Additionally, millions of children and adults suffer from the ill-health effects of food-borne diseases (Marquez and Farrington, 2013).

## 3. Materials and Methods

The approach used is a plausibility analysis (Dunn, 2004), whereby the evaluation of the premises of the argument is used to determine if the argument is true or plausible. This involves a systemic review of the policy statements and seeks to determine how AIVs contribute to the government commitments on nutrition security. The premise is that for one to say that a policy statement has achieved the desired results, it would require systemic review of pertinent and relevant aspects that relate to the policy statement. This can be a laborious and challenging because many times policy outcomes are implied, and it is difficult to attribute success to a few factors. An argument that a policy can work may include retrospective proof from other contexts. Thus, plausibility analysis allows for consideration of theory, or empirical studies (Rigterink and Schomerus, 2016). In this case, plausibility analysis is applied to review one expected policy outcome in the Kenya Food and Nutrition Security Policy (KFNSP) (2011) – nutrition improvement /nutrition security the policy statement is that 'the Government will ensure achievement of adequate nutrition for optimum health of all Kenyans'(p.'25'). Through four objectives (i) Enhancing food access, (ii) supporting all Kenyans to adopt effective nutrition interventions, (iii) creating awareness to ensure all Kenyans have equitable access to nutritious diets and (iv) promoting healthy lifestyles throughout the life cycle.

This study focus on the Food and Nutrition Security Policy (2011) statement, 'enhancing food access' (p. '25'), and assesses the policy statement against the six elements of a 'policy argument' -*Information, Claim, Warrant, Backing, Rebuttal and Qualifier* -(Dunn, 2004; Connell and Keane, 2006) with a bias to AIVs and their contribution to nutrition security. In addition, the study uses relevant prior knowledge and analysis of household data collected in 2016, to make the necessary inferences and assess if the scenario is a good match to what has been experienced in the past (either directly or indirectly).

**Table 1. Nutritional Content (mg) of Selected AIVs and Exotic Vegetables.**

| | Vegetable Name | Method of preparation | Ca (mg) | Fe (mg) | Mg (mg) | P (mg) | K (mg) | Zn (mg) |
|---|---|---|---|---|---|---|---|---|
| **Indigenous Vegetables** | | | | | | | | |
| 1 | Amaranth leaves, | picked, raw | 280 | 6.8 | 122 | 89 | 597 | 0.92 |
| | Amaranth leaves, | picked, boiled, drained (without salt) | 280 | 5.3 | 77 | 84 | 314 | 0.73 |
| | Amaranth, leaves | picked, stewed (without salt) | 346 | 8.3 | 151 | 110 | 737 | 1.14 |
| 2 | Black (African) nightshade, indigenous, leaves | picked, boiled, drained (without salt) | 91 | 6.2 | 24 | 58 | 200 | 0.46 |
| | Black (African) nightshade, indigenous, leaves | picked, raw | 100 | 8.6 | 41 | 68 | 421 | 0.65 |
| 3 | Jute mallow | picked leaves, raw | 207 | 6.3 | 30 | 88 | 283 | 0.58 |
| | Jute mallow | picked leaves, boiled, drained (without salt) | 207 | 5.0 | 19 | 84 | 149 | 0.46 |
| | Jute mallow | picked leaves, stewed (without salt) | 255 | 7.8 | 37 | 109 | 349 | 0.72 |
| 4 | Kale, Ethiopian (kanzera) leaves | raw | 117 | 5.7 | 54 | 51 | 639 | 0.7 |
| | Kale, Ethiopian (kanzera), leaves | boiled, drained (without salt) | 105 | 4.0 | 31 | 43 | 304 | 0.48 |
| | Kale, Ethiopian (kanzera), leaves, | steamed (without salt) | 96 | 3.9 | 42 | 42 | 472 | 0.52 |
| 5 | Pumpkin, leaves | raw | 383 | 5.6 | 142 | 119 | 423 | 0.9 |
| | Pumpkin, leaves | boiled, drained (without salt) | 347 | 4.0 | 81 | 102 | 201 | 0.64 |
| | Pumpkin, leaves | steamed (without salt) | 316 | 3.9 | 111 | 98 | 313 | 0.70 |
| 6 | Stinging nettle, leaves | raw | 668 | 7.2 | 133 | 122 | 524 | 1 |
| | Stinging nettle, leaves | boiled, drained (without salt) | 604 | 5.2 | 76 | 105 | 250 | 0.49 |
| | Stinging nettle, leaves | steamed (without salt) | 552 | 5.0 | 104 | 101 | 387 | 0.54 |
| **Exotic Vegetables** | | | | | | | | |
| 1 | Broccoli | tops and stems, boiled, drained (without salt) | 56 | 0.6 | 11 | 61 | 151 | 0.41 |
| | Broccoli | tops and stems, steamed (without salt) | 60 | 0.6 | 18 | 69 | 275 | 0.52 |
| 2 | Cabbage, leaf head | white, raw | 47 | 0.5 | 9 | 40 | 313 | 0.2 |
| | Cabbage, leaf head, | white, boiled, drained (without salt) | 45 | 0.4 | 6 | 36 | 159 | 0.18 |
| | Cabbage, leaf head | white, stewed (without salt) | 50 | 0.5 | 10 | 43 | 336 | 0.25 |
| 3 | Kale (*sukuma wiki*) | raw | 402 | 2.8 | 41 | 67 | 238 | 0.5 |
| | Kale (*sukuma wiki*), | boiled, drained (without salt) | 364 | 2.0 | 23 | 57 | 113 | 0.34 |
| | Kale (*sukuma wiki),* | steamed (without salt) | 332 | 2.0 | 32 | 55 | 176 | 0.37 |
| 4 | Spinach, leaves | raw | 131 | 1.7 | 72 | 28 | 570 | 1 |
| | Spinach, leaves, | boiled, drained (without salt) | 131 | 1.4 | 45 | 27 | 300 | 0.47 |
| | Spinach, leaves | stewed (without salt) | 161 | 2.1 | 89 | 35 | 704 | 0.74 |
| 5 | Spinach, Swiss chard, leaves | raw | 117 | 4.4 | 78 | 50 | 348 | 0.73 |
| | Spinach, Swiss chard, leaves | boiled, drained (without salt) | 117 | 3.5 | 49 | 47 | 183 | 0.58 |
| | Spinach, Swiss chard, leaves | stewed (without salt) | 144 | 5.4 | 96 | 62 | 430 | 0.90 |

**Source:** (FAO/Government of Kenya, 2018)

The indicators measured include; diversity of the food supply, depth of food deficit (cal/capita/day), household food expenditure (AIVs vs. exotic vegetables expenditure). These indicators were collected from food balance sheets and the expenditure share computed from household survey data

### 3.1 Consumption Intensity

Daily consumption of AIVs is recommended if the benefits are to be accrued, count data was used for number of days in one week i.e. minimum =0 maximum =7, The standard Poisson regression was used (Greene 2002; Gujarati 2004).

$$f(Y_i = y_i|X_i)= \frac{\mu_i^{Y_i} e^{-\mu}}{Y_i^!} \qquad Y_i= 0,1,2, \ldots\ldots; \lambda > 0 \tag{1}$$

Where $f(.)$ is the probability that $Y_i$ value takes non-negative integer, $y_i$ is the consumption outcome made by the household $i$, $X_i$ is a vector of explanatory variables, $\mu_i$ is a parameter of Poisson distribution associated with $X_i$ the $Y$ factorial means $Y_i^!$= Y∗ (Y-1) ∗ (Y-2) ∗2 ∗1

### 3.3 Data

Cross-sectional data from a household survey conducted in 2016 under the Horticultural Innovation and Learning for Improved Nutrition and Livelihood in East Africa (HORTINLEA) project was used. The project focused on five types of AIVs: African nightshade (Solanum scabrum), spider plant (Cleome gynandra), amaranth (Amaranthus spp), cowpea (Vigna unguiculata) and Ethiopian kale (Brassica carinata). The data was collected from two peri-urban area (Nakuru and Kiambu) and two rural areas (Kisii and Kakamega) in Kenya. The focus was on summarizing empirical evidence on issues of AIVs, and on questions of food and non-food consumption expenditure, consumption, and perceptions.

**Table 2. Summary Statistics of Selected Variables**

| | **Rural** | | | | **Peri-Urban** | | | |
|---|---|---|---|---|---|---|---|---|
| | **Kisii** | | **Kakamega** | | **Nakuru** | | **Kiambu** | |
| **Variables** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** | **Mean** | **SD** |
| Age Household Head | 52 | 13 | 55 | 13 | 53 | 12 | 55 | 12 |
| Age Wife/Husband | 45 | 11 | 46 | 12 | 46 | 11 | 49 | 13 |
| Total annual HH salary $ | 4,497 | 9,905 | 2,146 | 6,036 | 6,145 | 9,518 | 7,000 | 12,962 |
| Total monthly food expenditure of household [PPP$(2005)] | 84 | 65 | 78 | 60 | 116 | 86 | 111 | 68 |
| Total annual expenses all HH members [PPP$(2015)]- Imputed values | 2,831 | 2,518 | 1,749 | 1,482 | 3,867 | 2,988 | 3,413 | 2,843 |

Households for the survey were selected using a multi-stage sampling approach. First, a purposive sampling technique was applied to select four counties namely 2 rural and 2 peri-urban. After randomly selection the division, was carried out by locations/wards in each

county. The households were then selected purposive, those that were involved in production, marketing or consumption of at least one of the AIVs. In all the wards, face to face interviews were conducted using a structured questionnaire. A total of 685 household were interviewed; a description of the data is shown in Table 2.

## 4. Results

The study attempts to assess the "enhancing food access" policy statement in regard to nutrition security. The conclusion "access to nutritious food should be maintained" is arrived at by the supporting policy-relevant information, which represents the beginning of the argument. The warrant is the justification, or reason, for arriving at the conclusion, after the statements have been qualified or rebutted to distinguish between grounds and warrants as types of premise. Thus, there is a need for empirical analysis to provide a basis to assess the policy statement.

### 4.1 Food Availability

The country's level of production for the main food crops are not sufficient to meet consumption levels, between 20 and 25 per cent of the population is food insecure at different times of the year, especially in periods just before major harvest seasons (KNBS, 2016). Despite considerable development of improved technologies (such as seed varieties and innovations by various research institutes), the farming community continue to exhibit low levels of uptake of improved technology due to several challenges including; variability of weather patterns, limited technical knowhow in aspects of production and socio-economic concerns (Rötter, *et al.*, 2016). Close to 50 per cent of overall household income is allocated to food purchases, a clear indication of vulnerability due to volatility in food prices occasioned by variability in weather patterns. Table 3 shows that households purchase 38 per cent of their staple requires compared to 83 per cent of their animal protein requirements and only 10 per cent of their vegetable requirement implying that most of the interviewed household were involved in vegetable production and consumed what they produced.

**Table 3. Food Availability Patterns**

| Region | County | Staples | | Vegetables | | Animal Protein (Fish and Meat) | |
|---|---|---|---|---|---|---|---|
| | | Own production | Purchase | Own production | Purchase | Own production | Purchase |
| **Rural** | Kisii | 68.50 | 32.69 | 89.92 | 47.60 | 19.00 | 77.08 |
| | Kakamega | 70.13 | 31.52 | 87.16 | 38.20 | 26.23 | 79.70 |
| **Peri-urban** | Nakuru | 59.46 | 41.24 | 89.41 | 62.86 | 22.80 | 88.18 |
| | Kiambu | 44.68 | 58.36 | 95.02 | 57.01 | 24.10 | 93.41 |

**Note**: * Frequencies showing source of food

In order to understand further the 10 per cent of vegetables that are purchased household weekly expenditure was computed, for AIVs compared to exotic vegetables. Households consume AIVs at least twice a week and spend up to 15 times more on exotic vegetables compared to AIVs (Table 4). This is because household consume the (seasonal) vegetables that they produce and thus purchase the short fall. Usually vegetables are consumed in addition to other food types such as protein and carbohydrates to constitute a balanced meal. Tastes and preferences of consumers also determine the choice of vegetable (Gido e*t al.*, 2016; Gido e*t al.*, 2017a).

**Table 4. Spending on African Indigenous Vegetables vs Exotic Vegetables**

| Region | County | 2016 n=685 | | | |
|---|---|---|---|---|---|
| | | AIVs | | Exotic | |
| | | Mean | SD | Mean | SD |
| Rural | Kisii | 0.51 | 1.31 | 5.58 | 17.33 |
| | Kakamega | 0.43 | 2.13 | 5.21 | 12.64 |
| Peri-Urban | Nakuru | 0.40 | 1.28 | 6.64 | 18.49 |
| | Kiambu | 0.13 | 0.52 | 6.88 | 10.98 |
| | **Pooled** | **0.38** | **1.49** | **5.97** | **15.18** |

Enhanced access for nutritious food means that household will be able to either produce enough food or afford to purchase all their food requirements. For AIVs to be recognised as part of the national food basket efforts need then to be made to create awareness on the benefits of AIVs and their contribution to good nutrition. More importantly, it will be important to purposively increase the production and commercialisation of indigenous vegetables (Muhanji, *et.al*, 2011) such that there are adequate quantities consistent available throughout the year. This will make it easy for their inclusion in the national food basket (Table 5). The vegetables that have data collected regularly are tomatoes and onions (KNBS, 2016).

**Table 5. Per Capita Supply of Some Major Food Items in Kenya in 2015**

| Commodity | Per year food | Per day | | |
|---|---|---|---|---|
| | Kilograms | Calories | Protein (grams) | Fats (grams) |
| Cereal (excl. beer) | 110 | 925 | 23 | 5 |
| Starchy roots | 80.3 | 201 | 2 | 0 |
| Pulses | 27.2 | 255 | 16 | 1 |
| Tree nuts | 0.5 | 4 | 0 | 0 |
| Vegetable oil | 5.4 | 130 | 0 | 15 |
| Vegetables | 44.6 | 27 | 1 | 0 |
| Tomatoes | 10.5 | 6 | 0 | 0 |
| Onions | 0.6 | 1 | 0 | 0 |
| Vegetables, Other | 33.4 | 20 | 1 | 0 |
| Fruits | 70.3 | 113 | 1 | 1 |
| Meat | 12.3 | 64 | 5 | 5 |
| Milk | 98.2 | 173 | 9 | 9 |
| Eggs | 1.3 | 4 | 0 | 0 |
| Fish and Sea food | 4.5 | 8 | 1 | 0 |

**Source**: KNBS (2017)

### 4.2 Consumption Intensities

To assess whether households would be willing to adopt nutrition interventions such as consuming AIVs frequently, the study aimed to evaluate why households would spend money on purchasing AIVs. The results show that households that had higher income and older household heads spent more money purchasing AIVs compared to the others; this can be attributed in part to the indigenous knowledge that the older household heads had (which informed their preference). The results were also significant for the households that produced AIVs, household size, and those that considered themselves food-secure (Table 6).

**Table 6. Determinants of Weekly Spending on AIVs**

| Variables | Coefficient |
|---|---|
| Land area under AIV | -0.0297** (0.0140) |
| Age of farmer (years) | -0.0033 (0.0021) |
| Household size | 0.0285** (0.0124) |
| Formal education of farmer (years completed) | -0.0143 (0.0372) |
| Household income | 0.0000** (0.0140) |
| Gender of farmer | 0.0185 (0.0722) |
| Food security status (1-Yes, 0-No) | -0.2102*** (0.0630) |
| Group membership (Vegetable group) | 0.0033 (0.0565) |
| Constant | 0.3699** (0.1835) |

**Notes**: R-squared =2%; F (9,1344) = 3.05; Prob > F=0.0013**.** Figures in parentheses are robust standard errors. *$p$ <10%, **$p$<5% and ***$p$<1%

The determinants for AIVs expenditure were then computed; the results show that household income and the age of the household head were significant (Table 7). Studies that have been carried out on AIVs supported these results with slight variations. Gido et al. (2017b) found that AIV consumption was higher among rural dwellers, where the age of the household played a role in increasing the intensity of consumption. In our case, household size reduced the intensity of vegetable consumption.

**Table 7. Determinants of number of days in the week that AIVS are consumed**

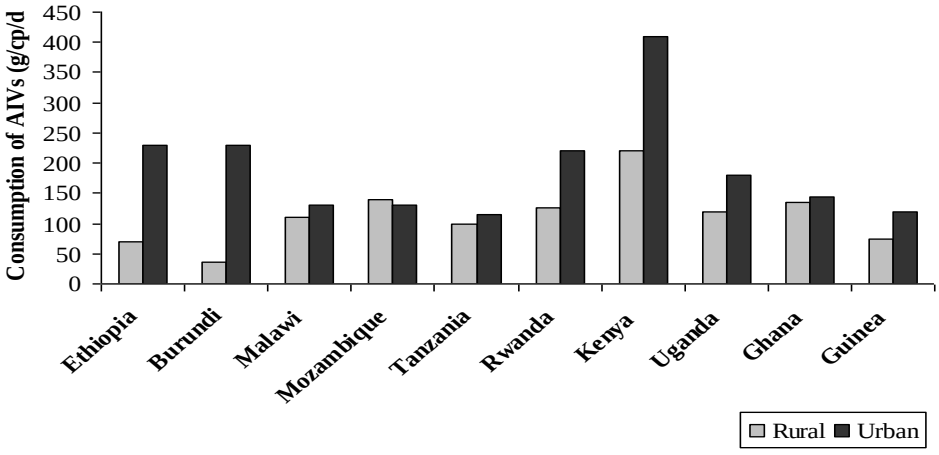
| Variables | Marginal effects (dy/dx) |
|---|---|
| Land area under AIV | 0.0318 (0.0343) |
| Gender of household head | -0.9354 (0.1795) |
| Household size | 0.0475 (0.0230) |
| Formal education of farmer (years completed) | 0.0067 (0.0913) |
| Household income | 0.0000** (0.0000) |
| Age of household head (years) | 0.0186*** (0.0054) |
| Constant | 5.7300*** (0.0649) |

**Notes:** Pseudo R-squared =0.35; Prob > $chi^2$=0. 0022.Figures in parentheses are robust standard errors. *$p$ <10%, **$p$<5% and ***$p$<1%

Empirical evidence shows that vegetable consumption in different African countries is higher in urban compared to rural areas, although the differences are small; the exceptions are Burundi and Kenya, where vegetable consumption in urban areas seems particularly high. Figure 1 depicts the difference in consumption between urban and rural areas of countries in Sub Saharan Africa (Ruel *et al.*, 2005; Weinberger and Swai, 2006; Shackleton *et al*., 2009).

Ethnicity, occupation, sex, income, and education levels are among the main factors affecting the consumption and utilization of these vegetables. Consumption is, however, highest when the vegetables were in season due to lower prices (Kimiywe et al. 2007). Familiarity among adults with these vegetables accounted for their popularity in consumption and utilization. For instance, Ekesa et al. (2009) observed that out of nine AIVs available in Western Kenya, cowpea and jute mallow were consumed by 85 percent and 63 percent of households, respectively. This popularity is attributed to the fact that it is common for the community in western Kenya to cook two or three varieties of AIVs together; a mixture of these two AIVs is very common. In contrast, a survey by the World Vegetable Centre (AVRDC, 2006) on consumers of AIVs at different income levels revealed that high-income households tended to associate these types of vegetables with poverty. Consumers in urban areas consumed less of the vegetables because of health concerns because most of them are

thought to be grown along sewer lines with untreated water. In some scenarios, the vegetables are associated with specific ethnic groups.




**Source:** Adapted from (Ruel et al. 2005)

**Figure 1 : Consumption of AIVs between Urban And Rural Areas of Countries in Sub Saharan Africa.**

Regarding the promotion of nutritious intervention through the consumption of AIVs, there is a geospatial challenge that is compounded by tastes and preferences. This can be overcome by scaling up nutrition education at the community levels, and by food-based approaches for the prevention of micro-nutrient deficiencies.

### 4.3 Perceptions on AIV Consumption

The promotion and utilization of the AIVs at household level need to be enhanced in order for these vegetables to become the preferred choice for households and for households to be willing to increase their expenditure. The perceptions of the household on the consumption of AIVs will strongly influence their ability to purchase more of the vegetables (table 8).

**Table 8. Correlation Between Months When They Have Enough Food and How Much They Spend on AIVs in Comparison to Exotic Vegetable**

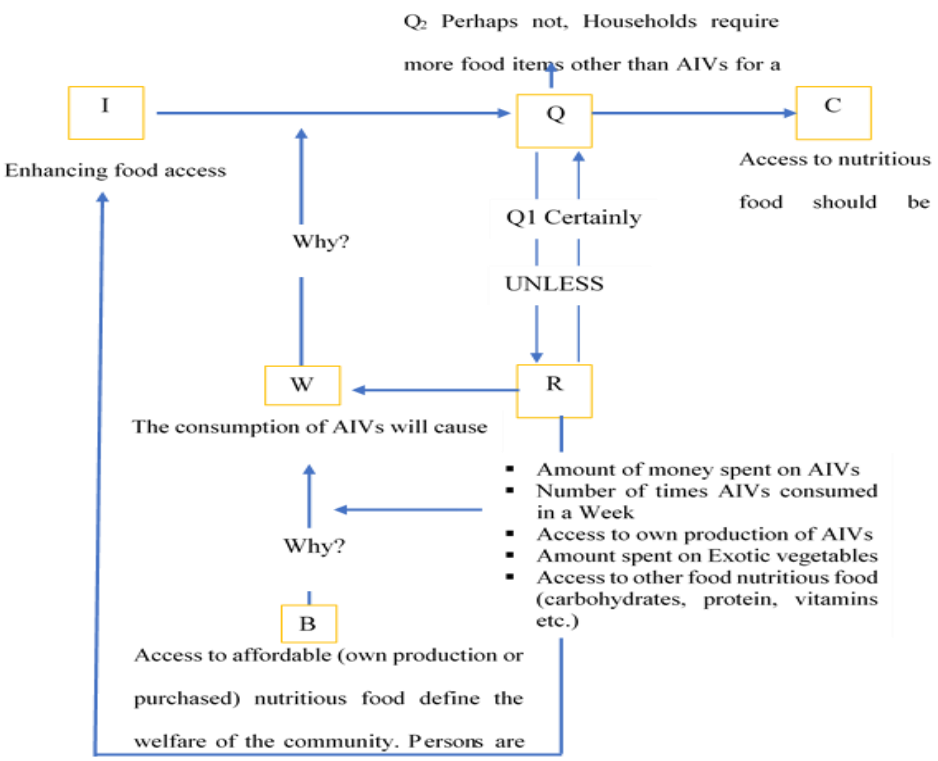
| County | Not enough food | | | | Enough food | | | | t-test | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AIVs | | Exotic | | AIVs | | Exotic | | AIVS Exotic | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | T stat | T stat |
| Kisii | 0.42 | 1.03 | 4.81 | 13.79 | 0.65 | 1.47 | 3.85 | 4.75 | -5.7*** | 2.2** |
| Kakamega | 0.28 | 1.02 | 4.81 | 10.90 | 0.62 | 2.84 | 4.22 | 5.29 | -6.1*** | 1.8* |
| Nakuru | 0.38 | 1.24 | 6.24 | 14.42 | 0.28 | 0.55 | 4.65 | 2.74 | 1.9* | 2.7*** |
| Kiambu | 0.06 | 0.35 | 6.15 | 9.30 | 0.11 | 0.46 | 5.45 | 3.44 | -3.1*** | 1.6 |

According to the HORTINLEA survey, it was noted that 90 per cent of the respondents recognise that AIVs are an essential part of a meal, the vegetables are not considered toxic and

55 per cent disagree that they are part of a 'poor man's diet'. Seventy-two per cent of the respondents agree that AIVs are available in the market through the year, while 42 per cent believe that the participation of supermarkets will reduce the quantities of vegetables available in the traditional markets. In relation to eating habits, 73 per cent of the adult males and 71 per cent of the children consumed AIVs daily. In addition, the consumption and perception data gives the impression that, AIVs are widely available and are the preferred vegetables.

### 4.4 Policy Implication

Enhancing food access is possible through a concerted effort by all relevant stakeholders. This paper tests the plausibility of the "enhancing food access" policy statement (Figure 2). In addition, the policy statement is tested against seven types of rival claims in regard to the consumption of the AIVs. (i) Invalidity: It is assumed that enhanced food access includes nutritious food; this is not always the case as is evident in the composition of the food basket. Consumption of AIVs present an opportunity to achieve widespread nutritional benefits consumption can be enhanced. Most household grow their own vegetable, implying that deliberate efforts and awareness creation is needed such that even when there are shortages of food, AIVs are the preferred choice of vegetable. (ii) Exclusion: the expenditure of households that had higher income and older household heads was higher for AIVs because they already appreciated the benefits of consuming these vegetables. Consumer tastes and preference are important when it comes to these traditional vegetables; this is compounded by their availability, which is seasonal. (iii) Unresponsiveness: The assumption that these vegetables are readily available and are considered nutritious does not mean that is the only source of micro-nutrients. Households consume AIVs at least twice a week and spend up to 15 times more on purchase of exotic vegetables compared to AIVs. (iv) Feasibility: AIVs are a viable option as a source for micro-nutrients (v) Inequity: Ethnicity, occupation, sex, income, education levels and perceptions are among the major factors affecting consumption and utilization of these vegetables. Thus, continuous promotion of these vegetables is needed to encourage their consumption. (vi) Inappropriateness: It is possible to challenge the discourse the AIVs are viable source of micro-nutrients because the amount of micro-nutrients provided will depend on both where and how the crop was grown, in addition, to the methods used in the preparation and storage of the vegetables. Further research is required to provide more accurate information on actual micro-nutrient content. (vii) Mis-formulation: Policy recommendation are in some cases based on ethical premises and, in many cases, seek to achieve reforms through regulation, allocation and/or reallocation of resources. Thus, there is uncertainty and it is difficult to predict the future outcome of interventions, such as the promotion of AIVs due the fact there is still more research that needs to be carried out on these vegetables.




**Source:** Illustration adapted from Dunn (2004)
**KEY**: Information (*I*), Claim (*C*), Warrant (*W*), Backing (*B*), Rebuttal (*R*), Qualifier (*Q*).

**Figure 2. Plausibility of AIVs Contribution to Reduction of Hidden Hunger**

## 5. Conclusions

The AIVs have been shown to make a significant contribution to nutrition security because they contain large number of micro-nutrients. It therefore assumed that the nutritional benefits from the consumption of these vegetables will be obvious to most households. However, this is not the case since large number of households spend less money on AIVs when compared with exotic vegetables; this can be partly attributed to the perceptions that shape their tastes and preferences. At a macro-level, the production of these vegetables does not generate consistent sufficient data on the several types of AIVs to enable Kenya's National Bureau of Statistics to include them in the country's food basket.

The lack of consistent data makes the promotion of these vegetables to policy makers a difficult task since it is difficult to demonstrate and authenticate the nutritional benefits that accrue from the consumption of these vegetables.

The study proposes the following areas of intervention. First, concerted efforts are needed to increase the availability and supply of the AIVs products in the market; this will create a loyal consumer base and in the long run mean that more people are consuming these vegetables. Secondly, for policy makers to appreciate the importance of these vegetables in nutrition security, researchers should develop or recommend different AIV products for the different stages of growth to support people throughout their lives. These efforts will provide

the much-needed evidence to showcase the benefits of AIV consumption. Lastly, awareness creation campaigns should be intensified to promote the consumption of indigenous vegetables, with consistent clear messages on nutrition and the health benefits of eating AIVs. In the long run, consumer perceptions may change and more of them will be willing to spend a larger proportion of their income on AIVs.

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