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AFRICAN INDIGENOUS AND TRADITIONAL VEGETABLES IN TANZANIA: PRODUCTION, POST-HARVEST MANAGEMENT AND MARKETING

D.W. LOTTER, M.I. MARSHALL[1], S. WELLER[2] and A. MUGISHA[3]
Institute of Development Studies, St John's University of Tanzania, Dodoma, Tanzania
[1]Department of Agricultural Economics, Purdue University, West Lafayette, IN, USA
[2]Department of Horticulture and Landscape Architecture, Purdue University, West Lafayette, IN, USA
[3]Institute of Development Studies, St John's University of Tanzania, Dodoma, Tanzania
Corresponding author: don@donlotter.net

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ABSTRACT

Indigenous and traditional African vegetables (AITVs) are important sources of nutrition for sub-Saharan Africans (SSA), especially the low-income and food insecure. The U.S. Agency for International Development directed Horticulture Collaborative Research Support Program, now named the Horticulture Innovation Lab, builds international partnerships for fruit and vegetable research to improve livelihoods in developing countries. For this Programme a study was carried out to provide baseline information on AITVs in Tanzania and to determine research needs. A questionnaire-based survey was conducted in four regions of Tanzania with a total of 160 sellers and producers of AITVs, with attention to post-harvest management. Key concerns were demographics, i.e. who is growing, transporting, and selling AITVs, AITV identities and quantities, production, harvest, transport, wholesale and retail patterns, processing, and surplus. Common AITVs are greens of amaranths, nightshade, cowpea, cucurbits, *Ipomea*, cassava tree, spider flower and Ethiopian mustard; plus African eggplant and okra fruits. Ninety six percent of sellers and 71% of producers were female. Most AITVs are sold in roofed open markets, secondarily on streets by mobile or semi-mobile sellers. Amaranth was the number one seller for 83% of sellers. Issues covered were: (i) cultural practices, AITV plot size, seed sources, irrigation and pesticide use; (ii) post-harvest: harvest to market storage and transport times and modes, grading, packaging and bundling, and washing; and (iii) marketing: retail markup, price variation by season, year and region, average daily sales; cell phone use, retail space size and cost, retailer storage, remainders, processing and less common AITVs. OLS regression was done to elucidate factors affecting sales volume and regional differences. Post-harvest losses of AITVs do not appear to be significant as the value chain participants demonstrate an acute knowledge of consumer demand and daily market dynamics.

Key Words: Amaranth, cassava, horticulture, *Ipomea*, nightshade, post-harvest

RÉSUMÉ

Les légumes indigènes et traditionnelles africaines (AITVs) constituent une source importante de nutrition pour l'Afrique sub-saharienne, spécialement à bas revenus et à insécurité alimentaire. Le programme de soutien à la recherche collaborative de l'agence internationale américaine pour le développement, aussi appelé 'Horticulture Innovation Lab' institue des partenariats internationaux pour la recherche sur les fruits et les légumes pour améliorer les conditions de vie dans les pays en voie de développement. Une étude était conduite afin d'établir une information de base sur AITVs en Tanzanie et déterminer les besoins en recherche. Une enquête était conduite dans quatre régions de la Tanzanie avec un total de 160 vendeurs et producteurs de AITVs, avec attention à la gestion post-récolte. La question la plus importante concernait la démographie, par exemple, qui croît, transporte et vend AITV, identités et quantités de l'AITV, production, récolte, transport, grossistes et détaillants, transformation et surplus. Les AITVs usuels sont des amarantes, morelles, pois cajan, cucurbites, *Ipomea,*

manioc, cléome et moutarde éthiopienne. A ceci s'ajoute les aubergines africaines et les fruits d'Okra. Quatre vingt seize pour cent des vendeurs et 71% des producteurs étaient des femmes. La plupart d'AITVs sont vendus dans des marchés tôlés ouverts sur les rues par des vendeurs mobiles ou semi-mobiles. Les amarantes étaient les plus vendues (83%). Les problèmes rencontrés étaient: (i) pratiques culturales, la taille des parcelles sous AITV, sources des semences, utilisation des pesticides et de l'irrigation; (ii) post-récolte: de la récolte au magasin du marché et temps et mode de transport, catégorisation, emballage et empaquetage, et le lavage, et (iii) promotion sur le marché: fixation des prix des détails, variation des prix par saison, année et région, ventes moyennes journalières, utilisation des téléphone cellulaires, la taille et le coût de l'espace pour vente des produits, le magasin des petits vendeurs, les produits restants après vente, la transformation et les AITVs les moins communs. La régression d'OLS était faite après vente pour élucider les facteurs qui affectent le volume des ventes et les différences régionales. Des pertes post-récoltes d'AITVs ne paraissent pas être significatives étant donné que les participants dans la chaine des valeurs font montre d'une connaissance suffisante sur la demande du consommateur et les dynamiques quotidiennes du marché.

Mots Clés: Amarante, manioc, horticulture, *Ipomea*, morelle, post-récolte

INTRODUCTION

African indigenous and traditional vegetables (AITVs) hold excellent potential to improve nutrition and increase dietary diversity in Tanzania, where malnutrition remains a problem with stunting affecting 42% of under-five-year old children; anemia affecting 53% of pregnant women, 60% of under-five children and 81% of 9-11 month-old infants. In addition, vitamin A deficiency affects 33% of children and 37% of all women (World Bank, 2010).

At least 275 plant species have been identified in Africa that are used as vegetables, 75% are indigenous and 16% introduced long ago and widely adapted (Grubben and Denton, 2004). Neglect of AITVs by urban consumers in SSA, the global region with the fastest growing urban populations in the world, reduces the potential benefits of AITVs (Yang and Keding, 2012).

In Tanzania, as well as in other SSA countries, there has been a shift toward non-indigenous foods by urban dwellers, driven by the perception that indigenous foods are poor people's food (for *wanakijiji*, Swahili for bush dwellers), AITVs are something to be left behind when one "modernises" (Yang and Keding, 2012). According to Ambrose-Oji (2012) this reduced status of AITVs has led to a reduction in their share (from 20 to 11%) as a proportion of the total value of food in the Tanzanian diet.

Modern supermarkets in major SSA cities have fresh produce sections much like those of supermarkets in Europe and North America, but often omit indigenous vegetables. African consumers, who may visit these modern spectacles only once can be permanently influenced by the exclusive display of exotic vegetables and paucity of AITVs; the message being that "modern" people consume non-indigenous vegetables and leave AITVs in the villages.

AITVs are important sources of nutrients in the African diet, being excellent sources of vitamins A, B complex, C and E; as well as iron and calcium. Compared with cabbage, amaranth greens have been shown to contain 57 times more vitamin A precursor, 13 times more iron and 8 times more calcium (Yang and Keding, 2012). This nutritional quality is important for the poor, as it has been shown in a study in Tanzania that people in the lowest quintile ate less than half (154 g day^{-1}) of the vegetables compared to those in the highest quintile (317 g day^{-1}).

The terms "indigenous" and "traditional" are both used in this paper, as the term indigenous alone can be limiting. Ambrose-Oji (2012) discusses this issue and concludes that use of both terms in the context of African vegetables is appropriate, and to "define African indigenous vegetables or traditional African vegetables as names that refer to those plants which originate on the continent, or those which have such a long history of cultivation and domestication to African conditions". Additionally, there are ambiguities in the nature of the term "indigenous", i.e. when there are species within a genus of AITV that are exotic and others of the same genus that are indigenous, but all are identified by the same local name.

This is the case with the amaranths and cucurbits. The genus *Amaranth*, clearly the favourite AITV of Tanzanians, consists of over 60 species worldwide. Both introduced (10 species) and native species (8 species) (Brennan, 1981; Glen, 2002) exist in SSA, with species in both categories being eaten as vegetables. The most common commercially cultivated amaranth is the introduced species, *Amaranthus cruentus* [synonym *A. hybridus* subsp. *cruentus* (L.)] (Yang and Keding, 2012). A similar situation exists for the cucurbits, with introduced squashes [*Cucurbita. pepo* (L.), *C. maxima (*Duschesne) and *C. moschata* (Duschesne)] being cultivated and used for fruit and greens, and native species such as the bur gherkin [*Cucumis anguria* (L)]. whose leaves are eaten as a green.

Of New World origin are two of the commonly sold AITVs; cassava leaf [*Manihot spp.*] and Ipomea leaf [*Ipomea batata* (L)]. Leaves of cassava are usually harvested for consumption from the "cassava tree" *Manihot glaziovii*, which is commonly grown in home compounds and field borders, although the leaves of the root-bearing *M. esculenta* are also used for pot herb, but are generally not the preferred of the two in Tanzania. Cowpea is primarily grown for the pulse; the leaves being a secondary harvest for vegetable. Ipomea leaf is often referred to as sweet potato leaf; however, the *I. batatas* taxa for leaf consumption are distinct cultivars that are not grown for root consumption (Katinka and Msuya), thus here we use the term *Ipomea* leaf. The AVRDC World Vegetable Center's Africa regional center in Tanzania has improvement or seed distribution programs for most of the AITVs in the first section of Table 1.

Edible nightshade leaf is unknown to most Westerners (European and others) and may cause confusion because of its nomenclatural and taxonomic association with the toxic black nightshade (*Atropa belladonna*) of temperate Eurasian origin, which has many phenotypic similarities with some of the edible tropical nightshades. Nightshade leaf has been eaten for centuries by indigenous peoples in Mexico, Central America and Africa, and is an important food in those regions.

This research is part of a larger effort that addresses AITV production and market-chain development for improved health, nutrition and income generation by small-holder farmers in Kenya, Tanzania and Zambia. This study had an emphasis on post-harvest management, therefore, both sellers and producers were interviewed, since post-harvest handling is split between the two.

MATERIALS AND METHODS

In the urban centres of four regions of Tanzania, a survey of AITV sellers and producers was carried out. AITV sellers are part of the "informal sector" of the Tanzanian economy, which accounts for approximately 50% of GDP (Weinberger and Msuya, 2004). Given that 78% of rural dwellers and only one third of urban dwellers cultivate AITVs in their home gardens at some time during the year (Weinberger and Msuya, 2004), the survey focused on urban centres, where most trade in AITVs takes place.

The survey was conducted during June and July of 2012 by interviewing a total of 160 AITV sellers and producers by sequentially visiting the cities of Dodoma, Arusha, Morogoro, and Iringa. A questionnaire of 160 questions was developed first in English and subsequently translated into Swahili. Subjects covered in the questionnaire were demographics, vegetable types and quantities, financials, sales environment, post-harvest management, production (asked of sellers who partnered with or are producers), processing, and uncommon and locally unique AITVs. Approximately half of the questions were quantitative, i.e. "Post-harvest pre-transport storage, number of minutes." The remainder were semi-qualitative, i.e. answered from a list of choices, for example "Pre-transport storage environment: (a) shade or night time, (b) sun, (c) structure/house, (d) naturally cooled enclosed storage, and (e) refrigerated storage." The questionnaire was tested twice on multiple local sellers in Dodoma, and adjusted accordingly.

In each city, 45 interviewees were selected to represent the general picture of AITV marketing in and around the city. Generally, three different sites in different parts of the city were visited for interviews of 15 sellers. The sellers ranged from mobile (produce basket carried on head), sidewalk-based (seated on the sidewalk, but

TABLE 1. African indigenous and traditional vegetables (AITVs) commonly sold in the public markets of Tanzania in the approximate order of popularity

Common name	Scientific name	Swahili name	Family
Amaranth leaf	*Amaranthus* spp.	*mchicha*	Amaranthaceae
Nightshade leaf	*Solanum scabrum* (Mill.) *S. villosum* (Mill.) *S. americanum* (Mill.)	*mnavu*	Solanaceae
Cowpea leaf	*Vigna unguiculata* (L.) Walp)	*kunde*	Papilionaceae
Squash leaf	*Cucurbita pepo* (L.)	*maboga*	Cucurbitaceae
Ipomea leaf	*Ipomea batata* (L.)	*matembele*	Convolvulaceae
Cassava leaf	*Manihot esculenta* (Crantz);*M. glaziovii* (Mull. Arg.)	*kisamvu*	Euphorbiaceae
African eggplant	*Solanum aethiopicum* (L.);*S. macrocarpon* (L.)	*nyanya chungu, ngogwe*	Solanaceae
Spiderflower leaf	*Cleome gynandra,*(L.)	*mgagani*	Cleomaceae
Okra	*Abelmoschus esculentus* (L.) Moench.	*bamia*	Malvaceae
Ethiopian mustard leaf	*Brassica carinata* (A. Braun)	*sukuma wiki*	Brassicaceae
Less common AITVs			
Mlenda A** - Jute mallow	*Corchorus olitorius* (L.)	*mlenda*	Tiliaceae
Mlenda B – False sesame	*Ceratotheca sesamoides* (Endl.)	*mlenda wa sege*	Pedaliaceae
Mlenda C – Wild simsim	*Sesamum angustifolium* (Oliv.) Engl.	*mlenda mwitu*	Pedaliaceae
Bur gherkin leaf	*Cucumis anguria* (L.)	*mlenda matango*	Cucurbitaceae
Bitter lettuce	*Sonchus exauriculatus* (Oliv. & Hiern) O. Hoffm. *Launaea cornuta* (Oliv. & Hiern) O. Jeffrey	*mchunga*	Asteraceae

** Mlenda is the name for several plants whose leaves make a mucilaginous or thickened dish when boiled

often mobile as well), market table-space seller, and seller with a booth on a suburban street or walkway. Additionally, four production site interviews of AITV producers were done in each region.

A digital scale was used to weigh bundles of AITVs to determine price per unit weight. The data were entered into spreadsheet and analysed using (SPSS) and STATA software.

RESULTS AND DISCUSSION

Table 1 shows AITVs commonly sold in Tanzanian markets. Amaranth was the clear favourite AITV being the number one seller in Tanzania by value for 83% of sellers. One 6% of sellers said that another AITV, nightshade leaf, was their top seller. The other AITVs were important for fewer than 5% of sellers. When asked to give the main reason for amaranth being the main AITV, 64% said profitability and 36% said market demand. Nightshade leaf and other AITVs were a distant second to the Amaranths in sales volume (Table 2).

Retail sellers of AITVs in Tanzania were overwhelmingly female (96% of sellers). Females made up the majority of AITV producers as well (71%), with that proportion increasing to 83% when male/female partnerships were included.

Sixty two percent of the sellers had cell phones. This recent technology reaching the grassroots holds excellent potential for outreach programmes in all sectors of development.

Average daily sales per retailer were US$10.12, with AITVs making up 69%, or $6.75 (Table 3). The main non-indigenous vegetables sold were Chinese cabbage (*Brassica rapa* ssp. *pekinensis*), Swiss chard (*Beta vulgaris* ssp. *cicla*), and head cabbage (*Brassica oleracea*). All of the sellers revealed selling throughout the year on a daily basis. The mean start-end times were 7 am to 6 pm. Average daily weight (seller's estimate) of AITVs sold during the rainy season was 13.7 kg, and during the dry season was 10.7 kg, with a seasonal fluctuation of 34%.

According to the respondents' recall of the 2008 price for a bundle of amaranth, the increase in price of AITVs since then was 50.5%, an average annual increase of 12.6% (Table 3). The majority of sellers reported no change in price during the year. To determine the change in price for the main AITV, the price for the main AITV for each quarter of the past year was asked of each seller. The average fluctuation in retailer AITV

TABLE 2. The most common African indigenous and traditional vegetables (AITVs), the number of sellers stocking them that day, plus unit weights and prices in US dollars

Amaranth	
Percent of sellers selling on interview day†: (%)	75
Average weight sold per day (estimate by seller)(kg)	7.3
Average weight of 3 bundles (weighed on scale) (kg)	0.227
Average price of 3 bundles (US$)	0.08
Price per kg (US$)	0.42
Nightshade	
Percent of sellers selling on interview day (%)	46
Average weight per day (kg)	8.1
Average weight of 3 bundles (kg)	0.381
Average price of 3 bundles (US$)	0.13
Price per kg (US$)	0.50
Squash leaf	
Percent of sellers selling on interview day (%)	41
Average weight per day (kg)	6.3
Average weight of 3 bundles (kg)	0.326
Average price of 3 bundles (US$)	0.10
Price per kg (US$)	0.35
Cassava leaf	
Percent of sellers selling on interview day (%)	27
Average weight per day (kg)	6.1
Average weight of 3 bundles (kg)	0.312
Average price of 3 bundles (US$)	0.11
Price per kg (US$)	0.40
Ipomea leaf	
Percent of sellers selling on interview day (%)	33
Average weight per day (kg)	6.8
Average weight of 3 bundles (kg)	0.218
Average price of 3 bundles (US$)	0.08
Price per kg (US$)	0.42
Cowpea leaf	
Percent of sellers selling on interview day (%)	24
Average weight per day (kg)	5.6
Average weight of 3 bundles (kg)	0.353
Average price of 3 bundles (US$)	0.12
Price per kg (US$)	0.39

† This ratio is less than 83%, which is the percent of sellers who said that amaranth is their #1 AITV, because some amaranth sellers did not have it on hand that day

TABLE 3. African indigenous and traditional vegetables (AITVs) production and marketing, selected statistics by region in Tanzania

#1 AITV for interviewed seller	Arusha	Dodoma	Iringa	Morogoro	Average
#2 AITV	Amaranth	Amaranth	Amaranth	Amaranth	-
#3 AITV	Nightshade	Ipomea leaf	Nshade/Squash lf	Squash leaf	-
	Squash leaf	Night shade	Squash/Nightshade	Af. eggplant	-
AITV seed source					
% of producers commercial packaged seed	73	60	100	39	75
Local market	27	0	0	23	12
Saved	0	30	0	39	12
Post-harvest washing, % of producers					
No wash	60	39	45	76	55
Tap water	32	53	0	12	24
Stream, drinkable	3	8	2	12	6
Stream, not drinkable	5	0	50	0	14
Miscellaneous					
Avg weight, 3 bundles Amaranth, kg	0.252	0.199	0.143	0.531	0.281
Price per kg Amaranth, US$	0.3	0.59	0.49	0.36	0.44
Avg revenue/day rainy season, US$	11.36	6.73	7.38	8.6	8.53
AITV as % of all vegetable sales	72	66	77	60	69
Avg seller estimate of % increase in wholesale price since 2008	50	39	54	60	50.5
Avg % change in weight of AITV sales from rainy to dry season	-38	-42	-25	-37	-35
Amount seller would pay to cold store 5 kg produce 1 day, US$	0	0.3	0.18	0.24	0.18
% of sellers who know of certified organic production	12	26	5	0	11
Size of vegetable plot, dry season, hectares	0.73	0.61	0.49	0.03	0.46

bundle prices through the year was 3.5%. This stability of bundle price (not price per unit weight) may be the norm because only basic accounting is done by both producers and sellers. Generally, price markup is done by buying three bundles of AITV, usually for 100 Tanzanian shillings (US$0.06), and selling two of the bundles for the same price, a markup of 33%. Sellers reported that whenever the price increased they decreased the size of the bundle and sold it for the same price. The evidence for this was that the unit price of AITVs rose by 50% since 2008, despite the majority of sellers reporting no change in bundle price during the year.

The average seller of AITVs in Tanzania, as a composite, sold daily 6.1 kg amaranth leaf, 3.7 kg nightshade, 2.6 kg squash or cucurbit leaf, 2.3 kg Ipomea leaf, 1.6. kg cassava leaf and 1.3 kg cowpea leaf.

Regional differences emerged when sellers were asked what their 2nd, 3rd, and 4th selling AITVs were (Table 3). Nightshade and squash leaf were 2nd and3rd in Arusha (north) and Iringa (south), Ipomea and nightshade in Dodoma (central) were 2nd and 3rd and squash leaf and African eggplant in Morogoro (east).

Production and post-harvest handling. The average size of AITV market garden plots was 0.66 ha in the rainy season, and 0.53 ha per grower during the dry season, with 100% of the production coming from plots with irrigation. Shortage of irrigation water during the dry season accounted for the lower AITV crop area during that season. The predominant seed source for AITVs was packaged commercial seed purchased from stores (75% of producers). This was unexpected because most producers cut costs to the bare minimum of inputs, which we expected to include saving seed and buying seed in local markets. For soil fertility, most of the producers used a combination of manure and synthetic fertilisers both at low application rates.

Insecticide use was difficult to determine accurately, as AITVs were often included in a spray regime for neighbouring beds of non-AITV crops that generally need more chemical pest control than AITVs. The majority (68%) of growers said they did not spray AITVs. When sprays were used, the most commonly cited insecticides were profenofos, abamectin, dimethoate, lambda-cyhalothrin, deltamethrin and endosulfan and metalaxyl/mencozeb mix as fungicide. When asked the number of days between the last spray and harvest, producers and their partners stated on the average 10.9 days. Herbicides were not mentioned and are rarely used in small-scale vegetable production. Labour was cheap at US$3-4 per day and hand weeding was, therefore, preferred. Only 17% of the producers knew what certified organic production is.

Harvest was done in the late afternoon to prepare the AITVs for early morning transport to market. On average, two people harvested and carried the produce to transport, with harvest taking an average of 1.8 hours. A total of 52% of growers do no washing of the produce, while 28% wash with tap or drinkable water, and 20% use non-drinkable flowing water from streams and irrigation canals. Culling with one sellable grade was done by only 31%, the remainder cull in the field by selective harvesting of desired plants. Eighty three percent of the sellers/producers bundled the AITVs with a fiber tie; the remainder sold loose. Packaging for transport generally was nylon reinforced plastic bags, approximately 1m x 0.5 m, with a small percentage using the same type of bag inside a basket. Pre-transport storage averaged 8.6 hours (overnight). Average distance to market was 11.5 km, taking one hour generally inside a passenger van (48%), hired truck with covered bed (29%), or bicycle (13%).

Producers generally sold AITVs to wholesalers by bed. A bed of one AITV was typically 1 to 1.5 m wide and 10 to 20 m long, and could have a widely varying price, depending on prevailing supply. When supply was high, growers had no choice but to sell each bed of approximately 40-50 kg of AITV for as low as 20,000 shillings (US$12.50); or even 10,000 shillings (US$6.25). At other times, when heavy rains disrupted production in the market gardens of the capital city Dar es Salaam, wholesalers offered up to 100,000 shillings (US$62.50) for the same size bed. The former scenario of surplus supply was the more common of the two, according to producers. None of the producers indicated involvement in or knowledge of any kind of cooperative for marketing.

Although cell-phones have permeated Tanzanian society, an organised system for small scale growers to obtain price information has not reached the average AITV grower. Kenya stands out in Africa for its development mobile phone applications, some for agriculture (Gatehouse, 2012). Tanzanian producers and sellers will likely benefit from this technology in the future. Clearly, cell-phones have allowed informal communications between rural growers and urban sellers, releasing growers from the old problem of isolation and near complete dependence on middlemen.

Computer and Internet use is very low in Tanzania (12% of the population in 2013) (World Bank, 2013) and is unlikely in the near future to provide a channel for price information for small scale growers and sellers. However, for growers needing information-rich and graphics-rich support such as for integrated pest management, mobile phones may not be sufficient and this may drive growth in computer and Internet use among growers.

Marketing. Two-thirds of the sellers rented table space in a market (67%), 20% sold from a piece of plastic laid on the ground, and the rest were mobile (basket on head alternating with sitting) verbally promoting sales. Individual selling space in markets averaged 2.6 m^2, rented at US$ 0.11 m^{-2} per day. None of the sellers were registered as a business, which is a generally unenforced legal requirement for retailers due to the liberal policy of the government towards the informal sector. A roofed structure was the environment for 56% of the sellers, full sun for 21%, and full shade for 20%.

Post-harvest losses appeared to be low in this tight system of small-scale entrepreneurs, who were in close daily touch with their value chain partners (i.e. producers in touch with their buyers, retailers in touch with their customers' needs). At the end of business day, sellers failed to sell on the average 1.5 kg of produce. Sixty-two percent of sellers stored unsold produce and sold it the next day. The average end of business day discount was 13%. Non-refrigerated storage is available for 92% of sellers. None of the sellers had access to refrigerated storage, which generally does not exist in Tanzania's public markets. When asked how much they would pay for each half-day (i.e. overnight) of refrigerated storage for 5 kg of produce, 70% of sellers could not answer or were not interested, 14% would pay $0.80, the remainder less. Of those who were interested, 63% and 33% wanted 1 and 2 days, respectively for 5 kg of produce.

In terms of value addition to AITVs, 40% of sellers said they did no processing, 30% processed squash leaf, 17% cowpea leaf, and

TABLE 4. Regression results for average African indigenous and traditional vegetables (AITVs) weight sold per day in Tanzania

Variable	Variable definition	Coefficient	Std Error
Producer-seller	1=Individual is a producer & seller; 0 =seller only	4.79***	0.80
Male	1= male, 0=female	3.24**	1.62
Amaranth not #1 AITV	1=amaranth is not #1 AITV; 0=otherwise	-0.81	0.98
Processing	1=processes AITVs; 0=otherwise	0.09	0.73
AITV Demand	1=reason sells AITVs is high demand; 0=otherwise	1.48*	0.83
Region:			
Arusha	1= Arusha; 0=otherwise	2.39**	1.12
Dodoma	1=Dodoma; 0=otherwise	5.45***	1.46
Iringa	1= Iringa; 0=otherwise	-0.22	1.33
Market Type:			
Regional Market	1=sells at regional market; 0=otherwise	0.99	1.37
District Market	1=sells at district market; 0=otherwise	2.79**	1.19
Ward Market	1=sells at ward market; 0=otherwise	2.02*	1.23
Constant		2.29	1.45

Note: N=179 observations. R^2=30.48. Reference variables are Morogoro (region) and selling from street stall (market type). ***, **,* refer to statistical significance of <0.01, <0.05, <0.10, respectively

10% Ipomea leaf. Slicing and sun-drying accounted for 84% of processing, boiling and sun-drying 13%, and crushing and sun-drying 3%.

Factors affecting sales volume. A simple OLS regression analysis was conducted in order to determine the influence of producer type, gender and location on the average volume of AITVs sold per day (Table 4). The results show that if the individual was a producer and seller of AITVs, he/she sold 5 kg more per day than if she was just a seller. Males sold 3 kg per day more than females, although the AITV market is heavily female dominated at 96% of sellers.

The area of the country and type of market where AITVs were sold also made a difference in the volume sold per day. For instance, sellers in Arusha and Dodoma sold on average 2 and 5 kg more than sellers in Morogoro, respectively. Sellers who sold at district and ward markets sold on average 2.8 and 2 kg more than sellers that sold only at a street stall. If the main reason for selling AITVs was because of high demand, sellers sold 1.5 kg more than those whose reason was profitability.

The regression results demonstrate that even though AITV production and marketing are heavily female dominated, males sold on average more volume than females. Interestingly, if the individual is a producer/seller, the sales volume sold per day was much higher than if the individual was limited to retailing only. It makes sense that a producer/seller would have an added incentive to sell all that s/he produces. Moreover, a seller is more likely to only purchase what s/he thinks they will be able to resell. The results also indicate that the level of urban market and type of market play a role in sales volume. It is intuitive that sellers at larger markets at the district and ward level would sell on average more AITVs than sellers in local street stalls.

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