Scaling up sweetpotato through agriculture and nutrition

In-depth study on household production, nutrition and consumption in Beira, Mozambique

APRIL 2019

Julius Okello, Carl Johan Lagerkvist, Norman Kwikiriza, Roland Brouwer, Abdul Naico, Simon Heck and Gordon Prain

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SUSTAIN Scaling up Sweetpotato through Agriculture and Nutrition

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SUSTAIN is a six-year partnership (2013–18), led by CIP, to scale up the nutrition benefits of biofortified orange-fleshed sweetpotato (OFSP). The goal is to reach 1.2 million households with children under-5 years of age in Bangladesh, Kenya, Malawi, Mozambique and Rwanda. SUSTAIN supports integrated interventions in agriculture, nutrition, utilization and marketing to strengthen production and consumption of OFSP.

Beira, where this study was conducted, witnessed a very devastating intense cyclone (*Idai*) in March 2019 that claimed more than one thousand lives and destroyed property, businesses, farmlands and people's general livelihoods. The situation and findings reported in in-depth report have therefore drastically changed by cyclone.

Contents

1. Background

1.1 Research background and study area

This section describes the study area and context in which the Mozambique study was conducted. It provides the context that is essential for understanding the study's sampling design. This study was carried out in Beira in central Mozambique. Contrary to the baseline study for the Scaling up Sweetpotato through Agriculture and Nutrition (SUSTAIN) project in Kenya, this study examined predominantly urban and peri-urban areas. It appeared, however, that although they were urban residents, many respondents comprised households with strong links to the countryside. Some participate in agriculture by farming plots within or outside the city boundaries. Moreover, some of the areas covered have a rural character.

Beira is the third largest city in Mozambique after Maputo and Nampula. It is the capital of Sofala province and an important harbor for the hinterland that uses the Beira corridor for imports and exports. Beira is connected to Zimbabwe, Malawi and Zambia by a main highway, and to Zimbabwe by a railroad and pipeline. The city lies on the coast. Most residences are on the slightly higher river and coastal dunes. These are separated by lower lying marshlands. These areas flood during the rainy season and are used for rice farming.

The city is divided in five administrative posts. Each post is subdivided into neighborhoods and each neighborhood into blocks. In general, the city can be categorized in three zones: urban, peri-urban and rural. The urban area consists of villas and apartment buildings, the peri-urban areas comprise informal settlements, while most dwellings/houses in the rural areas are made from traditional building materials. Wealth is concentrated in the urban areas, whereas the residents of the peri-urban and rural areas are generally poorer.

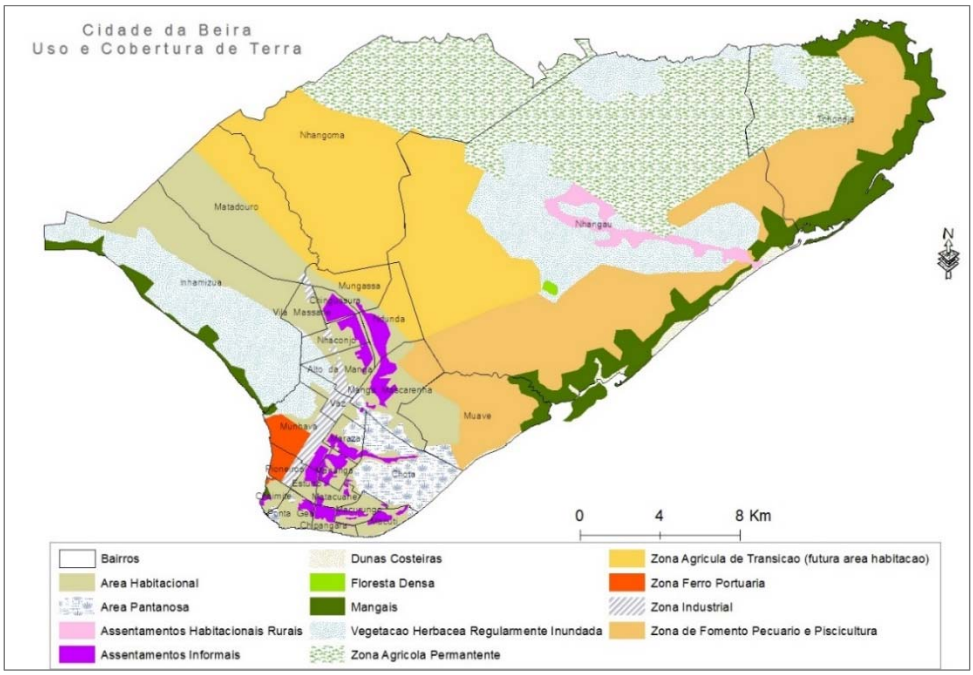


Figure 1: Land-use map of Beira (source: CIG-UCM).

Figure **1** presents the map of Beira city showing the neighborhoods and the land use patterns. It indicates the urban areas in the south and west along the Púnguè river estuary, and the agricultural areas, wetlands and mangrove woodlands (dark green) in the north and east. Nhangoma, Nhangau and Tchondja are

the most rural neighborhoods (in brown and blue), whereas areas in the south such as Ponta Gêa, Chipangara, and Macuti (in grey) are typical urban areas.

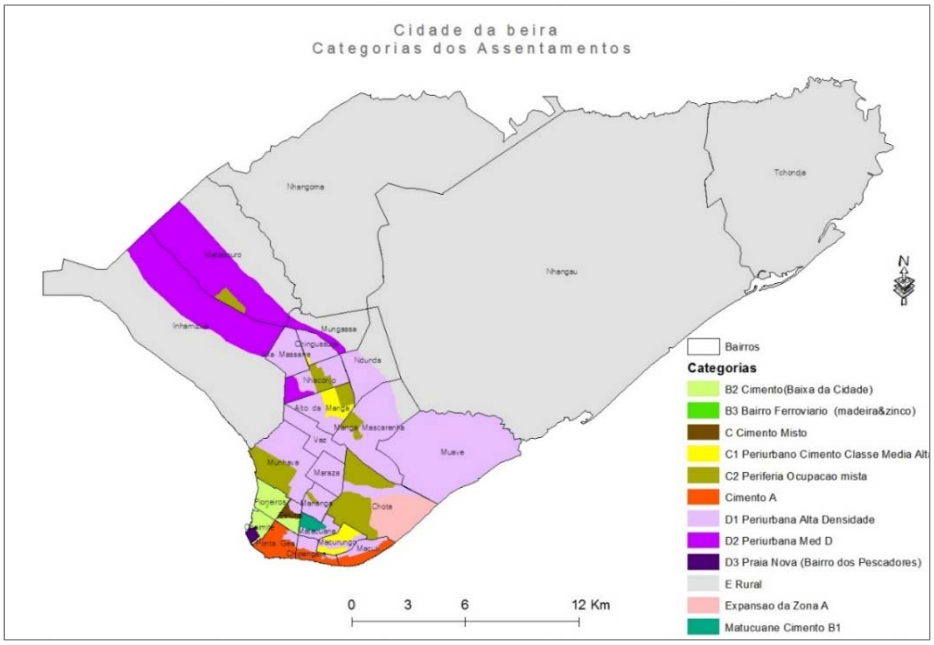


Figure 2: Map of Beira city with the various neighborhoods and the kind of settlements (source CIG-UCM)

Figure 2 is a map of the city and its neighborhoods classified in terms of building types. The dark red band (A) in Ponta Gêa, Chipangara and Macuti marks the original city center with villas and apartment blocks. The area in light green (B2, the Pioneiros and Chamite neighborhoods) is also an area with cement buildings, but a large part is occupied by businesses. The light (D1) and dark purple (D2) areas are mainly covered by single dwellings as part of the peri-urban fringe that surrounds the city center. The grey area to the north marks the rural outskirts of the city (E).

Table 1 provides a summary of the distribution of the population over the five administrative posts and 26 neighborhoods. It suggests that the eight neighborhoods comprising administrative post 1 – the old city center – are home to little less than one-third of the population. Administrative post 3 (Urbano 3) is also home to about one third of the population. The administrative post 5 (Urbano 5) is the least populated area, and has only about 2% of all residents.

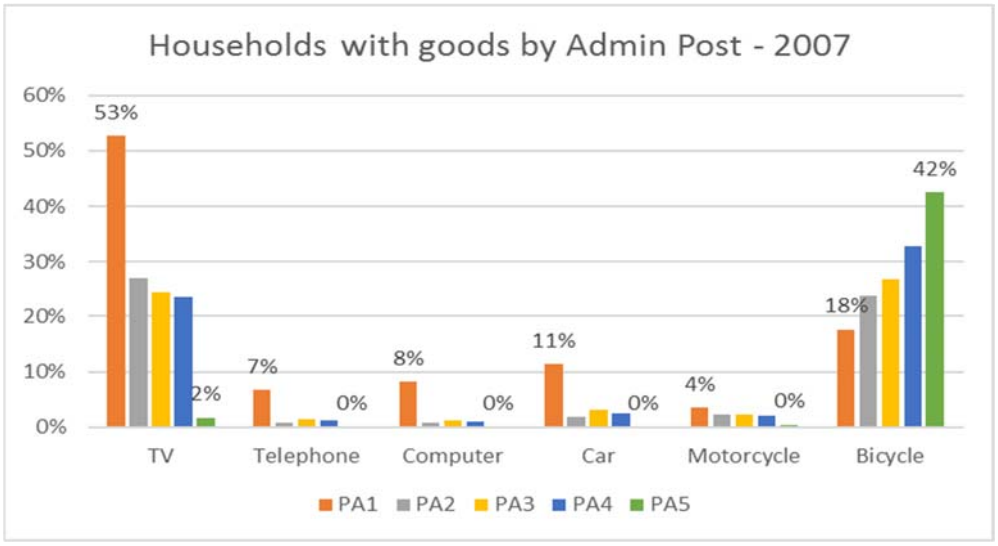
Data on detailed socioeconomic stratification of Beira is scarce. Only two sources of data exist on Beira, namely, the National Population and Housing Surveys of 1997 and 2007 and the data compiled by the Centro de Informação Geográfica (CIG) of the Catholic University of Mozambique (UCM). The former collects data on household size, type and composition, access to specific utilities, services and goods, and quality of housing. The 2007 Census provides data by administrative posts, and on ownership of, consumer goods[1] and information and communication technology (ICT) tools (Figure 3), but it does not provide a statistical breakdown on the quality of housing and access to utilities—such as power, water and sanitation—by administrative post

[1] This refers to the goods which are frequently purchased and used by the participant households.

Table 1: Population of Beira in 2007 by administrative post and neighborhood

Administrative post	Neighborhood	Number of households	Population		
			Male	Female	Total
TOTAL BEIRA		103,040	220,802	215,259	436,061
URBANO 1	CHAIMITE	3,795	7,798	6,849	14,647
URBANO 1	CHIPANGARA	6,055	13,004	12,288	25,292
URBANO 1	ESTURRO	5,021	12,105	11,615	23,720
URBANO 1	MACURUNGO	4,350	10,647	10,341	20,988
URBANO 1	MACUTI	3,129	8,015	7,496	15,511
URBANO 1	MATACUANE	7,873	17,837	17,453	35,290
URBANO 1	PIONEIROS	1,483	3,378	3,196	6,574
URBANO 1	PONTA GEA	4,834	11,394	10,750	22,144
SUB-TOTAL URBANO 1		36,540	84,178	79,988	164,166
URBANA 2	MUNHAVA CENTRAL	7,081	15,289	15,166	30,455
URBANA 2	CHOTA	1,113	2,529	2,490	5,019
URBANA 2	MANANGA	5,223	11,586	11,519	23,105
URBANA 2	MARAZA	4,622	10,143	9,942	20,085
URBANA 2	VAZ	1,847	4,166	4,186	8,352
SUB-TOTAL URBANO 2		19,886	43,713	43,303	87,016
URBANO 3	INHAMIZUA	3,557	8,604	8,950	17,554
URBANO 3	ALTO DA MANGA	3,999	9,879	9,765	19,644
URBANO 3	CHINGUSSURA	5,300	12,434	12,546	24,980
URBANO 3	INHACONJO	6,088	14,515	14,509	29,024
URBANO 3	MATADOURO	2,649	6,172	6,006	12,178
URBANO 3	VILA MASSANE	11,687	11,687	11,513	23,200
SUB-TOTAL URBANO 3		33,280	63,291	63,289	126,580
URBANO 4	MANGA MASCARENHAS	6,006	13,937	13,475	27,412
URBANO 4	MUAVE	2,043	4,417	4,450	8,867
URBANO 4	MUNGASSA	840	1,859	1,865	3,724
URBANO 4	NDUNGA	2,091	4,768	4,803	9,571
SUB-TOTAL URBANO 4		10,980	24,981	24,593	49,574
URBANO 5	NHAGAU	1,360	2,646	2,243	4,889
URBANO 5	NHANGOMA	405	798	745	1,543
URBANO 5	TCHONJA	589	1,195	1,098	2,293
SUB-TOTAL URBANO 5		2,354	4,639	4,086	8,725

The graphs in Figure 3 show clearly the difference in access to facilities between administrative Post 1 – the city center – and the rest of the city. For example, 53% of the households in administrative post 1 had a TV, whereas in administrative posts 2, 3, and 4, TV ownership was between 23 and 27% and just 2% in administrative post 5 – the most rural area.



a) Ownership consumer goods by households in the study Administrative Post (Admin Post)

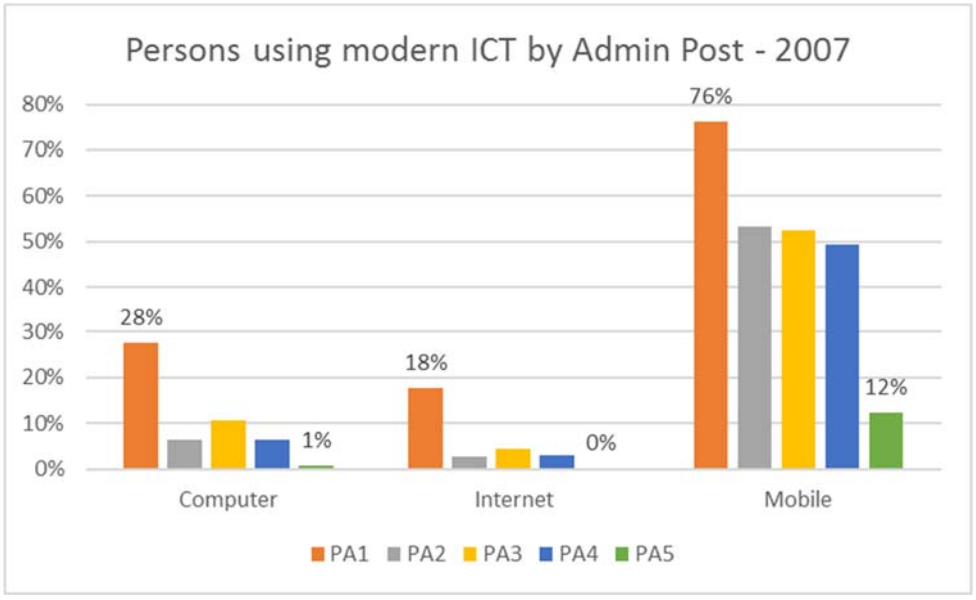


Figure 3: Access to facilities by Beira inhabitants (2007)

2. Study methodology

2.1 Sampling strategy

The sampling strategy used in this research was designed to generate a sample that is as representative as possible of the populations living in urban and peri-urban areas of Beira city, while at the same time reducing the survey cost and easing the logistics of implementing the survey. The study used stratified random sampling technique. The sampling proceeded as follows (See Appendix 1 for further details):

a. The five administrative posts covering all the urban and peri-urban Beira were purposively selected for study.
b. In each administrative post, a number of neighborhoods were randomly sampled using probability proportional to size (PPS) sampling technique. The proportions were based on the number of inhabitants.
c. Within each neighborhood, blocks were again randomly selected using PPS technique with proportions based on the estimated average number of inhabitants in each block of the neighborhood.
d. Lastly, within the block, households were sampled using systematic random sampling method. Specifically, every third household in a block was selected for interviews until the quota for the day was attained.

Once sampled, the household was randomly assigned to one of the three treatment groups: i) Control – this group of households received general information about orange-fleshed sweetpotato (OFSP) and its benefits, ii) Treatment 1 – this group received positive information about biofortification highlighting the benefits of OFSP, iii) Treatment 2 – this treatment group received information about the negative effects of biofortification of OFSP.

The study had two components namely: i) household interview with the household head or, if the head was absent, the spouse, and ii) consumer interview targeting the caregiver of a child under the age of 5 years if present, or pregnant woman. For the consumer interviews, households were exposed to sweetpotato roots, OFSP-based biscuits or OFSP-based juice. In total 795 households were interviewed but 40 interviews were rejected either because some were outside the sampled area or because the interview was incomplete.

In 277 of the households, it was not possible to administer the consumer module because of lack of sweetpotato roots, biscuits and/or OFSP-based juice that formed part of the experiment. The lack of sweetpotato roots and OFSP-based products affected Esturro D (53), Chipangara A (58), Maraza B (55), Alto da Manga A (58) Nhaconjo A (53). In Maraza D; Ndunda B, E; Chipangara C, F; Chota A E; and Nhaconjo C the second tool was only applied using roots because the juice fermented[2] by the time it reached the field and could not be consumed. A complete distribution of survey respondent in each of the administrative post is presented in Table 2a) below.

[2] The interviews were conducted in December when it was very hot. The high temperatures made the juice ferment much faster than had been anticipated during planning of the study. In some cases, the logistical delays and poor handling during shipment by the airline also contributed this problem.

Table 2: Distribution of survey respondents by administrative posts, neighborhoods and blocks

Administrative post	Neighborhood	Block	Number of interviews
		A	58
Chiveve (PA1)	Chipangara	C	45
		F	54
	Esturro	B	50
		D	53
Munhava (PA2)	Maraza	B	55
		D	48
	Chota	A	46
Inhamizua (PA3)	Alto da Manga	A	58
		B	53
	Nhaconjo	A	53
		C	59
Manga Loforte (PA4)	Ndunda	B	38
		E	48
Nhangau (PA5)	Tchonja	D	18
		F	19
Total			755

2.2 Research tools and study implementation

The study tool had two sets of modules that were borrowed and adapted from the SUSTAIN baseline study in Kenya. One set of modules covered the households' socio-economic status, the role of sweetpotato and in particular OFSP, and the nutrition status of the household in general and the youngest child between 6 month and 5 years old. This set of modules targeted the household head or the spouse, if the head was absent. The second set of modules addressed the perceptions and acceptance about OFSP and OFSP-based products. It was administered to caregiver of a child under 5 years of age or pregnant member of the household. The modules were translated from English into Portuguese for the interviews, and later back-translated into English for data analysis.

The data used in this study was collected by a team of 15 enumerators recruited locally. The enumerators would be able to speak the national language Portuguese, and the two local languages, Sena and Ndau. Before the start of the survey went through seven days of training between November 23 and November 30, 2015. During this training the questionnaires were revised and their translation into Portuguese adjusted. The training also ensured that the enumerators were fully proficient with the tools and that they would ask the questions correctly in the local languages, if needed.

In addition to the classroom training, two pilot/pre-test sessions of one day each were organized in the Nhangau, one of the neighborhoods in the most rural administrative post (Urbano 5). This area was selected because being it a rural community that has agricultural activities its inhabitants were expected to be able to answer questions in all sections of the questionnaire, hence provide the research team with good feedback on the clarity and appropriateness of all the questions.

The pre-test sessions were followed by actual survey conducted between December 01, 2015 and December 22, 2015. Interviews were conducted on Monday to Saturday of each week, with a break on Sundays. This study was conducted according to the guidelines laid down in Declaration of Helsinki: ethical principles for medical research involving human subjects (WMA 2013), and was approved by the government of Mozambique.

2.3 Producer study

This module of the study was conducted with the household head or spouse as the respondent. Data collected included demographic characteristics of the respondent and household members, knowledge and use of OFSP

and non-OFSP varieties, sweetpotato production and utilization, consumption and varietal preferences, perceptions about sweetpotato in general and OFSP in particular, sweetpotato marketing outlets, household dietary habits, consumption of Vitamin A rich foods and other foods, and the monthly trends in production and consumption of sweetpotato. Discussions on the empirical methods used in the administration of this module are in the respective sections of Chapter 3.

2.4 Consumer study

This module of the study focused on the caregiver of a young child, lactating mother or expectant woman. It was conducted once the interview with the household was completed and on the same day as the module 1 interview. It involved a field experiment encompassing cooking and tasting OFSP roots and one other OFSP-based product. Below is a detailed description of this study component.

2.4.1 The field experiment

A field experiment involving actual preparation and tasting was set up to examine the effect on consumer sensory expectations, experiences and emotions related to vitamin A-biofortified OFSP (roots and products derived from OSFP). A field experiment allows for a more real-world setting but gives the researcher less control over the environment (Rousu et al. 2005). Previous studies have found that context in which the study is implemented may influence sensory and emotional profiling (Edwards et al. 2003; Köster 2003; Desmet and Schifferstein 2008). Our experiment was, therefore, conducted in the home environment of the participants, because this is the context where food preparation and eating take place. Since the experiment also required participants to boil the sweetpotato roots and prepare them for tasting, our design allowed the participants to use their own cooking facilities and, therefore, this component of the study was not difficult for them. If they had been required to use an unfamiliar set of facilities, that could have introduced uncertainty and distracted their focus.

To prevent the possibility of respondents discussing the experiment with neighbors, the study sampling was designed such that all the interviews were conducted in one neighborhood on the same day. Because the respondents were selected randomly from each neighborhood, most did not live near or know one another. Furthermore, the neighborhoods were randomly sampled and, where adjacent, typically interviewed on the same day. Hence, we do not expect information diffusion to have occurred.

2.4.2 Information

The experiment had a total of three information treatments, each differing in the information the participants received. Participants were randomly allocated to these three information treatment groups. One group (Control) received only general information on the agronomic properties of the biofortified (orange-fleshed) sweetpotato variety, whereas in addition to the agronomic information, the other groups received either detailed information on benefits of vitamin A (treatment 1: Nutrition), or on negative product sensory aspects of OFSP compared to the white-fleshed and yellow-fleshed varieties (treatment 2: Drawbacks). Description of agronomic properties as control information was deemed relevant since the participants were expected to have personal but varied experience of growing sweetpotato. This meant that the interest in the potential of OFSP could be considered as a base from which the contrast to nutrition or drawback characteristics could be examined.

Together with the verbal information, participants in each treatment were presented with a set of images specific to each treatment. The descriptions and images used in the information experiment are provided in

Appendix B. The images used in each treatment were selected to be aligned with the meaning of the verbal information and conveyed aspects related to production and product properties, food availability and emotions. Experiences from photo-elicitation interviewing show that images enable stimulation of deeper meanings such as emotions and abstract ideas (Clark 1999; Clark-Ibáñez 2004), which cannot be obtained in traditional face-to-face interviews (Clark-Ibanez 2004).

The information on agronomic properties included details about growing period, disease resistance and yield. The detailed information on vitamin A fortification mentioned private and public health issues and nutritional and food security aspects. The information on negative product sensory differences described the trade-off between nutritional and sensory characteristics with reference to the white- and yellow-fleshed sweetpotato varieties.

2.4.3 Product

The field experiment included three products with the aim to analyze how the acceptability of OSFP, given the presented information, was influenced by the extent to which the product was processed. The product dimension is relevant since it is the product which serves as the conveyor of vitamin A. The acceptance among consumers of biofortification can be assumed to be product specific because different products serve different end-use purposes. For this reason, three products were included in the study, namely OSFP roots, a biscuit prepared from OFSP and a bottle of juice from OSFP.

At the time of the research, no roots of biofortified varieties were available in central Mozambique and roots were shipped to the study area from Maputo. The variety of sweetpotato used during the study for boiling and tasting was Irene. The biscuits and juice used during the study were made from Tio Joe variety. The two varieties have very similar sensory characteristics. The biscuits and juice were made at the International Potato Center (CIP) facility of in Maputo.

Specifically, the juice extracted during the grinding was mixed with sugar, ascorbic acid and xantham gum, then pasteurized and bottled. The bottles were labeled with stickers bearing the name and trademark of the private sector firm contracted by CIP to develop commercial juice and biscuits from OFSP namely, Sumavit. The firm was, at the time, setting up a soy yoghurt and OFSP juice production facility in Maputo.

The biscuits were made from the by-products of OFSP juice and soy yoghurt production. They contained OFSP pulp, soybean cake and some wheat flour. They were not packed nor labeled.

2.4.4 Steps in the experiment

In step 1, upon recruitment, participants were first asked for their informed consent. They were then assigned to one of the information treatment groups. Across the information treatment groups all participants received two OSFP roots of the variety Irene and one of the two other OFSP products (juice or biscuit). The assignment of the second product was random. Once given the products, the respondents were asked to wash the OFSP roots using potable water and cook the roots with their own fuel until ready (about 25 minutes) according to instructions provided by the enumerator. To compensate respondents for fuel usage for boiling the roots, each was given MZN 100 (about USD 3). Respondents who did not have cooking fuel at hand could use the money to buy the fuel type they typically used for cooking (i.e. charcoal or firewood). Depending on the area, the water used was tap water, water from boreholes or from dug wells. The respondents were further instructed to keep the second product safely nearby while waiting for the root to cook. While the OFSP roots were being boiled, a questionnaire with general questions on the respondent, household characteristics, food security

status and other household level variables was administered. Step 1 ended with the administration of this general questionnaire.

In step 2, after the enumerators had verified that the roots were boiled by piercing them using a sharp knife to ensure that the flesh was not exposed, the general (agronomic) information (Appendix B) was read aloud to participants and they were asked about their product involvement.

In step 3, the enumerator cut one of the two roots in half to reveal the inside. Participants were then asked to rate their expected sensory evaluation of the OFSP roots in comparison with their usual choice of fresh sweetpotato roots (i.e. white- and/or yellow-fleshed varieties). Following this evaluation of expected sensory effects, in order to generate a distraction before the actual tasting, a short break was introduced. During this, participants were provided with a glass of water to rinse their mouths and, in order to introduce a distraction with content unrelated to the OSFP product, the enumerator initiated a discussion about the need to drink water regularly and why water is good for the body.

In step 4, participants were instructed to taste the cut OFSP root and to rate their actual sensory experience. The consumption requirement in step 4 was expected to increase attentiveness and to enhance cognitive processing of the stimulus leading into the subsequent evaluation task. In steps 3 and 4, efforts were made to ensure that sensory testing was performed while the roots were still warm, as eating the cooled product would have affected the sensory properties. In step 5, participants described their moods and feelings about the product they had just tasted.

The experiment concluded with step 6, where participants were told that they were allowed to keep the uncut root as compensation for their time devoted to the experiment. This, together with the delay that the cooking took, was done to reduce the risk of in-kind endowment effects, which could have distorted the expected and/or actual liking.

2.4.5 Participants

Participants were selected focusing on the populations most vulnerable to vitamin A deficiency (VAD), as recommended by Birol et al. (2015). The study, therefore, targeted caregivers of children under five years of age or pregnant women in each of the study households because evidence suggests that, if caregivers find a food acceptable, they are more likely to feed it to their children and hence improve nutritional outcomes (Skinner et al. 2000). Moreover, these household members are usually the target population of the initiatives aimed at increasing the consumption of vitamin A, because of their vulnerability to its deficiency. Following the study, CIP initiated an intervention focusing on reducing the prevalence of VAD in the Beira area in 2016.

The sampling of the households which participated in the experiment was done as described above. That is, all 754 households took part in the experiment. All participants were drawn from regular consumers of sweetpotato, hence were familiar with the crop—especially the non-OFSP varieties. White-fleshed sweetpotato was the most preferred variety (67%) among the study participants, with on 14% and 13% of the respondents ranking yellow-fleshed and orange-fleshed sweetpotato varieties as the most preferred.

The socio-demographic profile of the participants is shown in Table 3. The mean age was 36 years (min 15, max 77; standard deviation (SD)=14). The 9-item household food insecurity access scale (HFIAS) developed by Coates, Swindale and Bilinsky (2007) was adopted to measure the degree of food insecurity (access) in the previous four weeks (30 days). The results from the HFIAS scale indicated that the participants had rarely experienced extreme physical consequences of food inadequacy in the household.

Table 3: Demographic characteristics of participants recruited for the study (n=264).

Relation to head of household:	Proportion (%)	Household income[a]	
Household (HH) head	22.0	Min	0
Spouse	68.9	Max	174,156
Son/daughter	2.7	Mean	36,738
Parent of HH head living with son/daughter	3.8	Standard dev.	48,461
Missing data	2.7		
Marital status:		HFIAS[b]	
Single	9.1	Min	0
Married	16.7	Max	27
Co-habiting	56.8	Median	4
Separated	4.5	1st quartile	0
Widowed	12.9	3rd quartile	10
		Mean	6.2
Salary work during 2014:		Standard dev.	6.5
No	70.8		
Yes	29.2		
Experience (years) of growing sweetpotato:			
0-5	69.5		
6-10	11.3		
11-20	10.0		
21-50	9.2		

Note: [a] Sum of crop, livestock and other income during 2014 (MZN). [b] Household Food Insecurity Access Scale score (9-items; minimum score is zero (the household responded "0" to all occurrence questions, maximum score is 27 (corresponds to "3" (often)).

2.4.6 Measures

Product involvement was assessed with the intention of measuring the perceived treatment-specific relevance of the OFSP, independent of the behavior that may be triggered by the relevance, using the 20-item (range 1-140) scale devised by Zaichkowsky (1985).

The expected and actual appropriateness of six sensory attributes/characteristics namely: sweetness; smell; color; texture/softness; taste; and ease of handling were scored on a 5-item nominal just-about- right (JAR) scale ranging from 'much too little' to 'much too much'. JAR scales are typically used for product optimization or to inform the direction of product development with ultimate aim of increasing consumer acceptability (e.g. Lawless and Heyman 1998; Gere, Sipos and Héberger 2015). The use of JAR scales based on pre- and post-tasting was expected to reveal how the level of a sensory attributes, relative to the assessor's ideal level, was affected by the information treatment.

The sensory attributes were selected based on results presented by van Oirschot, Rees and Aked (2003) and Tomlins et al. (2004; 2007). Van Oirschot et al. (2003) reported that the softness and moistness of OFSP varieties are linked to very short storage times under tropical conditions. Taste (liking) was included as a sensory attribute in the present study because information about the product technology may influence evaluations of the taste itself (Caporale and Monteleone 2004).

Nutrition and liking were evaluated on a 7-item ordinal scale. Before tasting, nutrition was on the range -3=I do not expect it to be nutritious at all, to +3=I expect it to be very nutritious. After tasting, the range was from -3=It is not nutritious at all, to +3=It is very nutritious. Similarly, liking before tasting was evaluated on a scale ranging from -3=I think that I would not like it at all, to +3=I think that I would like it very much. After tasting, the range was from -3=I do not like it at all, to +3=I like it very much.

An *EmoSemio* profile (Spinelli et al. 2014) was used to measure and compare the emotional profile of each treatment group after the actual testing. Items were measured on a 5-point scale from “not at all” to “extremely”. This measure reveals emotional responses that are not captured when only appropriateness of the product is measured. The profile uses full sentences instead of the single adjectives employed in the well-established *EsSense* profile (King and Meiselman 2010) and, therefore, provides a clearer and more contextual way to express emotions. The *EmoSemio* profile is also shorter (23 instead of 39 items), reducing the cognitive burden on respondents. Both of these aspects were relevant to the purposes of this study because of the additional difficulty to translate words with an emotional meaning from English via Portuguese to Ndau and Sema.

2.4.7 Statistical analysis

The JAR data for expected and actual appropriateness were both analyzed in two steps. First, to test the omnibus effect of the information provision between treatments, an independent-sample Kruskal-Wallis test was performed. It specifically tested whether the samples originated from the same distribution. Second, a series of Mann-Whitney tests were used to examine whether pair-wise samples originated from the same distribution. Finally, a series of related-samples Friedman tests was employed within treatments to test whether expected and actual likings originated from the same distribution.

Cumulative link models were used to determine the effect of information on the evaluation of the response variables *nutrition* and *liking* because data were ordered categorical. The estimations used the complementary log-log link as the distributions of nutrition and liking were heavily right-skewed (Agresti 2002). The adaptive Gauss-Hermite quadratic method with 20 nodes was used to obtain a more accurate approximation for the maximum likelihood estimate of the model parameters (Christense 2015). Model comparisons were performed between the cumulative link mixed model and the standard cumulative link model using likelihood ratio tests (Christense 2015). A two-level mixed model approach was used to analyze the repeatedly measured (i.e. before and after tasting) response for nutrition and liking, respectively because observations were nested within individuals. Observations are indexed by treatment i=1,2,3 and products k=1,2,3. Observation ik is the unit of observation. A random intercept approach was applied. This was to determine whether or not to account for individual heterogeneity in scale usage and response behavior. The models were estimated with unstructured thresholds for the ordinal response variable in the Ordinal package for R version 2015.6-28 (R Development Team 2015).

For each treatment, mean emotional responses with the *EmoSemio* questionnaires were summarized. An independent-sample Kruskal-Wallis test was performed to examine whether there was treatment-specific discrimination between emotions. A series of Mann-Whitney tests was then performed to assess whether pair-wise differences between the samples were supported.

3.Results of household and nutrition study

3.1 Characteristics of study households

3.1.1 Demographic characteristics and access to amenities

Table 4 provides the characteristics of the households who participated in this study. It shows that the mean age of the household heads in sample is 45 years with households that are headed by males having younger heads than those headed by female counterparts. This finding was expected because most of female heads tend to be widowed. Indeed, the results of this study indicate that 52% of the female-heads are widows, as compared to only 2% of the male-heads counterparts. Further, the results indicate that the difference in age between male and female household heads is statistically significant at less than 5% level of significance. Results also show significant differences between male- and female-headed households in terms of education and participation in paid jobs. Male heads had, on average, 7 years of education as compared to about 4.5 years for their female counterparts. The table also presents the differences in age and education of the household heads by location of household: urban versus peri-urban. The results show that urban household heads are significantly different from their peri-urban counterparts in age but not in terms of years of schooling.

Table 4: Demographic characteristics of the heads of the study households

Farmer/household specific variables	Overall sample (N=754)	Gender of the head			Area of study		
		Male (n=572)	Female (n=181)	p-value	Urban (n=256)	Peri-urban[1] (n=498)	p-value
Age (years)	42.34 (15.09)	41.57 (14.96)	44.77 (15.29)	0.013	45.89 (16.90)	40.51 (13.73)	0.000
Education (years)	6.40 (3.77)	7.00 (3.77)	4.50 (3.95)	0.000	6.27 (4.06)	6.47 (3.91)	0.526
Proportion (%) that undertook salaried work	72.51	79.20	51.38	0.000	75.00	71.23	0.273

[1] Peri-urban and rural are taken together

Table 5 presents the results of analysis of the eligibility of the study households to receive OFSP vines during a dissemination. It shows that 58% of the respondents in the overall sample had children less than 5 years of age making them eligible to receive vines if there were vine distribution at the time of the study. It also shows that of the 572 and 181 male and female-headed households, 59% and 54%, respectively, had children under 5 years of age. There was no statistically significant difference between the male- and female-headed households in terms of the proportion with children under 5 years of age.

Table 5: Eligibility of study households OFSP vine intervention

	Overall sample (N=754)	Gender of the head			Area of study		
		Male (n=572)	Female (n=181)	p-value	Urban (n=256)	Peri-urban[1] (n=498)	p-value
Child < 5 years	57.56	58.81	53.59	0.216	53.51	59.64	0.108
Lactating mother	23.47	25.48	17.13	0.021	21.88	24.30	0.458
Pregnant woman	10.08	9.95	10.50	0.831	6.64	11.85	0.026

[1] Peri-urban and rural are taken together

Table 6 characterizes the study households in terms of access to facilities and services. It shows that the study respondents do not differ by gender of the head of the household in their access to the key amenities and services. However, they differ significantly when compared by location (i.e. urban, peri-urban and rural). Specifically, the results show that respondents in the rural areas were located much further away from markets, health facilities and all-weather roads than their counterparts in the urban and peri-urban areas. These findings are in line with a priori expectations given the fact that urban areas usually have better-developed infrastructure compared to rural areas.

Table 6: Household access to facilities and services (expressed as means)[1]

Access variable	Overall	Gender of the household head			Area of study			
		Male-headed (n=572)	Female-headed (n=181)	p-value	Urban (n=256)	Peri-urban (n=461)	Rural (n=37)	p-value
Distance to the nearest market (minutes)	15.67 (12.85)	15.80 (12.98)	15.27 (12.45)	0.626	10.85^{a} (9.13)	17.19^{b} (12.46)	30.50^{c} (21.47)	0.000
Distance to the nearest weather road (minutes)	8.10 (7.58)	8.28 (7.67)	7.51 (7.27)	0.229	7.46^{a} (6.15)	7.51^{a} (7.26)	19.74^{b} (10.59)	0.000
Distance to the nearest public health center (minutes)	30.23 (24.46)	30.81 (24.95)	28.36 (22.79)	0.241	23.22^{a} (21.88)	30.41^{b} (20.25)	75.70^{c} (37.45)	0.000

[1] Numbers in parentheses are standard deviations; superscripts denote results of Bonferroni multiple tests of differences in means

Figure 4 presents the main occupations of the study respondents. As shown, most of the respondents were engaged in non-farm activities, largely because they were drawn from urban and peri-urban areas where there are opportunities for non-farm employment (Hitayezu et al. 2010; 2014). The figure, however, shows marked differences in the employment activities undertaken by male- and female-household heads. Whereas the former is mainly employed in non-farm activities, the latter are involved in a diversified portfolio of activities including farm and off-farm, where they work on their own farms or other peoples' farms.

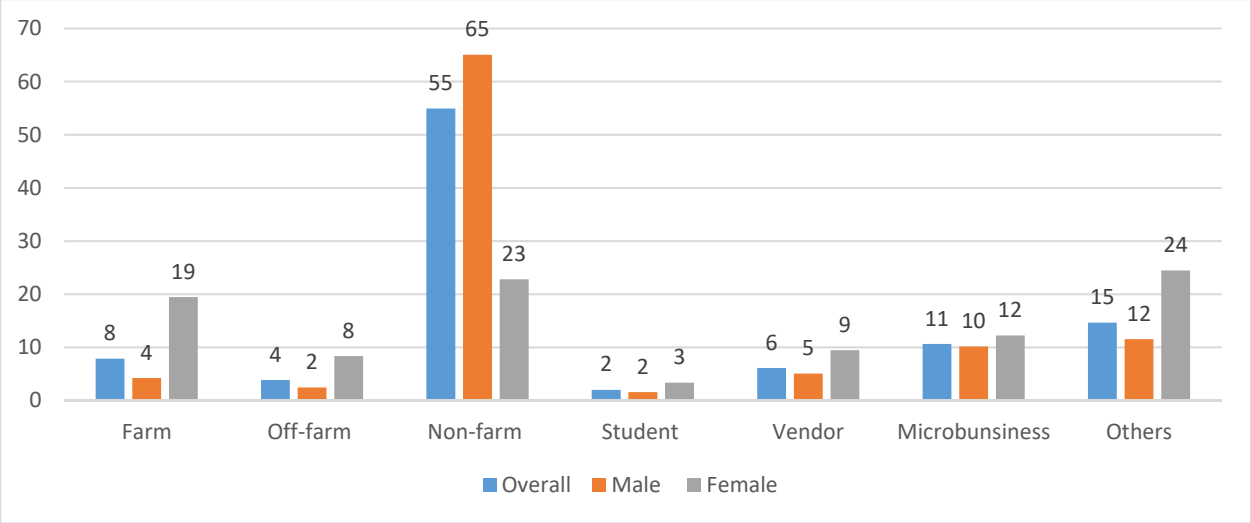


Figure 4: Major employment opportunities undertaken by household heads, % by gender

The respondents were also asked about their experiences in terms of years of growing sweetpotato. Table 7 presents the results. It shows that most of the study respondents had no experience growing sweetpotato. Indeed, more than 74% of the respondents in the overall sample had not grown sweetpotato in the past. The rest of the respondents had varying years of experience in growing sweetpotato, ranging from 1 year to more than 10 years. This finding is not surprising, given that Beira is a cosmopolitan, multiethnic city with many inhabitants that engage on non-farm employment, and are likely to have no agricultural or sweetpotato farming experience. Most surprising is that almost 18% of the respondents from the urban study areas had some sweetpotato farming experience.

Table 7: Years of experience in growing sweetpotato, % by gender of household head and study area

Years of sweetpotato farming	Overall sample	Gender		Study area			p-value
		Male (n=572)	Female (n=181)	Urban (n=256)	Peri-urban (n=461)	Rural (n=37)	
None	74.87	82.31	51.38	82.75	73.04	43.24	
1-5	8.24	6.84	12.71	7.06	8.40	13.51	
6 -10	4.79	3.34	9.39	3.14	5.03	13.51	0.000
11-20	5.45	3.16	12.71	3.14	6.52	8.10	
More than 20	6.65	4.35	13.81	3.91	7.01	21.64	

3.1.2 Asset endowments

Households typically own a wide range of assets that can be used for agriculture and other activities. These assets can be broadly categorized into livestock, physical and land. The value of livestock and physical assets owned by the study households is reported in Table 8 below, by the gender of the household head and the area of study. The table also presents the t-tests of differences in mean value of livestock and physical assets between male- and female-headed households and by urban, peri-urban and rural households. As shown, there is no statistical difference in the value of livestock assets owned by male and female heads. However, the results show, that male-headed households had a significantly higher value of physical assets than their female counterparts.

The results also show that the value of livestock assets owned by respondents in rural areas was significantly (more than double) higher than that of their counterparts in peri-urban areas, and three times what respondents in urban areas owned. Households in the urban and peri-urban areas had a higher value of

physical assets than their counterparts in the rural areas. This is likely due to the former having access to both wage and self-employment opportunities than the latter. Some of the most widely owned physical assets included radio/radio cassette (60%, N=754), mobile phone (87%, N=754), TV set (77%, N=754). Among physical assets commonly used in agriculture, the hand hoe (66%) and machete (48%) were the most widely owned.

Table 8: Value (MZN) of livestock and physical assets owned by respondents

Asset value	Overall sample (n=754)	Gender of household head			Area of study			
		Male (n=573)	Female (n=181)	P-value	Urban (n= 256)	Peri-urban (n=498)	Rural (n =37)	P-value
Livestock (n=754)	134.07 (233.90)	134.29 (233.68)	133.37 (235.23)	0.963	109.26[a] (218.71)	132.45[b] (231.49)	325.89[c] (280.20)	0.000
Physical (n=754)	7004.09 (7170.42)	7422.78 (7418.57)	5678.63 (6153.97)	0.004	8206.86[a] (7913.95)	6647.87[b] (6722.67)	3120.55[c] (5186.30)	0.000

Numbers in parentheses denote standard deviation; superscripts denote results of Bonferroni multiple tests of differences in means

Table 9 presents the ownership of land assets by gender of the study households and study area. It shows that overall, most of the households own very small parcels of land. As expected, households in the rural areas owned more land, on average, than their counterparts in the urban areas. The table further shows that the area cultivated and uncultivated were equally small. In terms of gender and land ownership, the results indicate that there are no differences between male- and female-headed households in the area cultivated, and also in the possession of land close to wetlands. However, urban and rural households differ significantly in the total amount of land owned as well as the size of land cultivated.

Table 9: Land ownership among study respondents, by gender and study area

Land ownership (Hectares)	Overall (n=754)	Gender of household head			Study rea			
		Male (n=573)	Female (n=181)	P-value	Urban (n= 256)	Peri-urban (n=498)	Rural (n=37)	P-value
Total owned	0.43 (0.66)	0.44 (0.66)	0.40 (0.64)	0.408	0.32[a] (0.49)	0.45[b] (0.67)	1.05[c] (0.75)	0.000
Total cultivated	0.33 (0.56)	0.35 (0.57)	0.29 (0.54)	0.290	0.22[a] (0.48)	0.35[b] (0.57)	0.87[c] (0.63)	0.000
Total uncultivated	0.05 (0.06)	0.05 (0.06)	0.05 (0.06)	0.901	0.04[a] (0.06)	0.05[a] (0.06)	0.10[b] (0.08)	0.000
Near water source	0.008 (0.081)	0.009 (0.083)	0.006 (0.074)	0.597	0.008[a] (0.088)	0.007[a] (0.076	0.02[b] (0.10)	0.002

Numbers in parentheses denote standard deviation; superscripts denote results of Bonferroni multiple tests of differences in means

3.2 Sweetpotato production and utilization

The 10 most frequently mentioned varieties are presented in Table 10. It shows that the three most widely known sweetpotato varieties are the Branca[3] (i.e., "white" fleshed), Alaranjada ("orange" fleshed), and Dente de Guebuza ("Guebuza's tooth" – Guebuza is the name of the former head of state). Clearly, the table show that the respondents had difficulty identifying varieties by name, but instead use descriptors of the flesh.

[3] Bianca and Alaranjada are, respectively, Portuguese words for white and orange.

Table 10: Sweetpotato varieties known to the study respondents

Variety	Frequency of mention	% within sample (n=754)
Polpa Branca ("White fleshed")	285	37.8
Polpa Alaranjada ("Orange fleshed")	233	30.9
Dente de Guebuza ("Guebuza's tooth")	163	21.6
Ndzipaeca	145	19.2
Cenoura ("Carrot")	142	18.8
Amarela ("Yellow")	120	15.9
Tumanze	58	7.7
Roxa ("Purple")	51	6.8
Batata doce de polpa amarela ("Yellow fleshed sweetpotato")	46	6.1
Branca ("White")	42	5.6

Farmers who planted sweetpotato obtained vines from various sources (Table 11). More than one-half of the 228 sweetpotato farming respondents obtained vines from own sources, with slightly more female-headed households relying on this source of vines compared to the male-headed households. Among those who relied on external sources of vines, the main sources used were female farmers within or outside the village. Very few respondents obtained the vines they planted from vine multipliers, mostly because there were none at the time of this study. Thus, the 1.3% of the respondents who mentioned that they obtained vines from such sources may have been referring to large-scale sweetpotato growers.

Table 11: Sources of vines planted by households who grow sweetpotato, % by head of household

	Overall (N=228)	Male-headed households (n=171)	Female-headed households (n=57)
Own farm	51.97	52.66	57.69
Female in the village	26.64	27.81	26.92
Female outside the village	6.11	7.10	3.85
Male outside the village	2.18	2.37	1.92
Male in the village	1.75	2.37	0.00
Vine multiplier	1.31	1.18	1.92
Other sources	10.04	10.51	7.70

Production of sweetpotato involves both labor and non-labor expenses. The non-labor expenses are incurred in obtaining the inputs such as vines, buying fertilizers and irrigation equipment. The analysis presented here is based only on the 244 respondents who planted sweetpotato. Overall, 33% of the male-headed households and 31% of the female-headed households had sweetpotato plots. Of the farmers who planted sweetpotato, 94 (i.e. 38%) were based in the urban areas while 150 farmers in peri-urban and rural areas.

Sweetpotato is grown in the study areas mainly as a monocrop. Findings indicate that only 16% of 244 sweetpotato farming respondents who intercropped sweetpotato with other crops. Comparison of sweetpotato cropping routine by gender of the household head does not show significant differences, but a slightly higher percentage (18%) of urban respondents intercropped sweetpotato compared to the respondents in the peri-urban and rural areas. Additionally, a small percentage of farmers (26%) bought vines, with purchase of vines being relatively higher among the male-headed households and among the peri-urban farmers.

The use of other inputs in sweetpotato production among respondents was quite low (Table 12). For example, only 2% of the respondents irrigated the sweetpotato plots in 2014. The low use of irrigation is probably because sweetpotato is typically planted after rice, and therefore when the soils are still humid. Use of

fertilizers and manure was even lower, with less than 1% of the respondents reporting that they applied these inputs in the sweetpotato plots. None of the respondents in the female-headed households irrigated their plots or applied fertilizers and manure directly on sweetpotato. Observed differences between the categories is statistically significant.

Table 12: Cropping and non-labor input use in sweetpotato production in 2014 (% of responses)

	Overall (n=244)	Gender of the head		Area of study	
		Male (n=188)	Female (n=56)	Urban (n= 94)	Peri-urban[1] (n= 151)
Proportion that intercropped sweetpotato	15.92	15.51	17.24	18.09	14.57
Proportion of farmers that bought the vines	25.91	27.23	21.43	15.96	32.03
Proportion that applied fertilizers in the sweetpotato crop	0.42	0.55	0.00	1.10	0.68
Proportion that applied manure in the sweetpotato crop	0.83	1.09	0.00	2.17	0
Proportion that irrigated the sweetpotato plot	2.51	3.28	0.00	1.10	3.38

[1] Includes rural

Table 13 shows that the average farm size committed to sweetpotato was 0.5 hectares. This figure is higher than expected, but could be attributed to errors in self-reported data since majority of farmers have difficulty estimating land areas correctly. Results further indicate that the size of the land committed to sweetpotato did not vary with either the gender of the household head or the area of study.

The labor used for sweetpotato production was predominantly family labor. Indeed, the results show that all the respondents who planted sweetpotato relied exclusively on family labor. The main sweetpotato activities undertaken by this family labor were land clearing and ploughing, mounding/ridging or planting bed preparation, planting, weeding and hilling and harvesting. Approximately 53% and 46% of the respondents also did sorting and bagging, respectively, of sweetpotato as part of the production and sale activities.

Table 13: Land and labor use in sweetpotato production among study households

Production levels	Overall (n=244)	Gender of the head			Area of study		
		Male (n=188)	Female (n=56)	P-value	Urban (n= 94)	Peri-urban (n= 151)	p-value
Average area (ha) under sweetpotato	0.50 (0.72)	0.52 (0.72)	0.45 (0.71)	0.518	0.43 (0.69)	0.54 (0.73)	0.244

Numbers in parentheses denote standard deviation

3.3 Varietal preferences

The respondent's ranking of the characteristics of varieties they prefer to grow is presented in Table 14. The respondents were specifically asked to rank the important traits they consider when deciding which variety of sweetpotato to grow on a Likert scale ranging from 1=unimportant to 5=very important. The table therefore presents the median scores, with higher score indicating that the attribute is more important, and vice versa. The results show that female-headed households ranked hardness (i.e. high dry matter content), good taste and ease of cooking much higher than their male counterparts. Notably, these are mainly cooking and sensory attributes, suggesting, as expected, that cooking and sensory attributes appeal more to female-headed households than their male-headed counterparts.

Table 14: Main attributes of sweetpotato varieties planted by study respondents (median score)

Attribute	Overall (N=244)	Male-headed households (n=188)	Female-headed households (n=56)
Early maturing	3.81	3.77	3.96
Resists disease	3.84	3.79	4.00
High yielding	3.83	3.80	3.95
Easy to establish with scarce rain	3.70	3.66	3.80
Does not dry up when rains are short	3.58	3.53	3.75
Easy to conserve its vines	3.38	3.30	3.64
Easy to store in the ground	3.23	3.20	3.38
Cooks quickly	3.90	3.86	4.02
Roots taste good	4.21	4.23	4.14
Leaves taste good	3.81	3.81	3.80
Very sugary/ sweet	3.74	3.72	3.79
Not watery (not soft)	4.17	4.14	4.25

3.4 Utilization of sweetpotato

3.4.1 Non-sale utilization of sweetpotato

The study households that produced sweetpotato used it in various ways, with consumption and giving away as gifts and donations as the main utilization forms. Overall, approximately 67% of the respondents gave out sweetpotato roots in one of these three utilization forms. Results also show that only 15% of the respondents in the overall sample sold sweetpotato roots. In terms of sales by sex of the head of the household, about 15% and 17% of the male-headed and female-headed respondents, respectively, sold some sweetpotato. Results further indicate that most of the sales occurred in the peri-urban areas, accounting for approximately 20% of the sales, as compared to urban areas (with just 5% of the sales). This suggests that most of the respondents in urban areas operated “kitchen gardens” and planted sweetpotato mostly for household consumption.

Figure 5 presents the various forms in which sweetpotato is consumed and the share of respondents who consume them in those forms. As in other countries, a large majority (76%) of households in the overall sample consume sweetpotato in boiled form. However, unlike Kenya, for instance, (see Muoki et al. 2015), a relatively large number of study households also consumed sweetpotato in fried and roasted forms. Thus, sweetpotato is consumed in more diversified forms in the study district is the case in Kenya, likely due to the fact that the respondents in Kenya were drawn from rural communities where sweetpotato is traditionally consumed in boiled form.

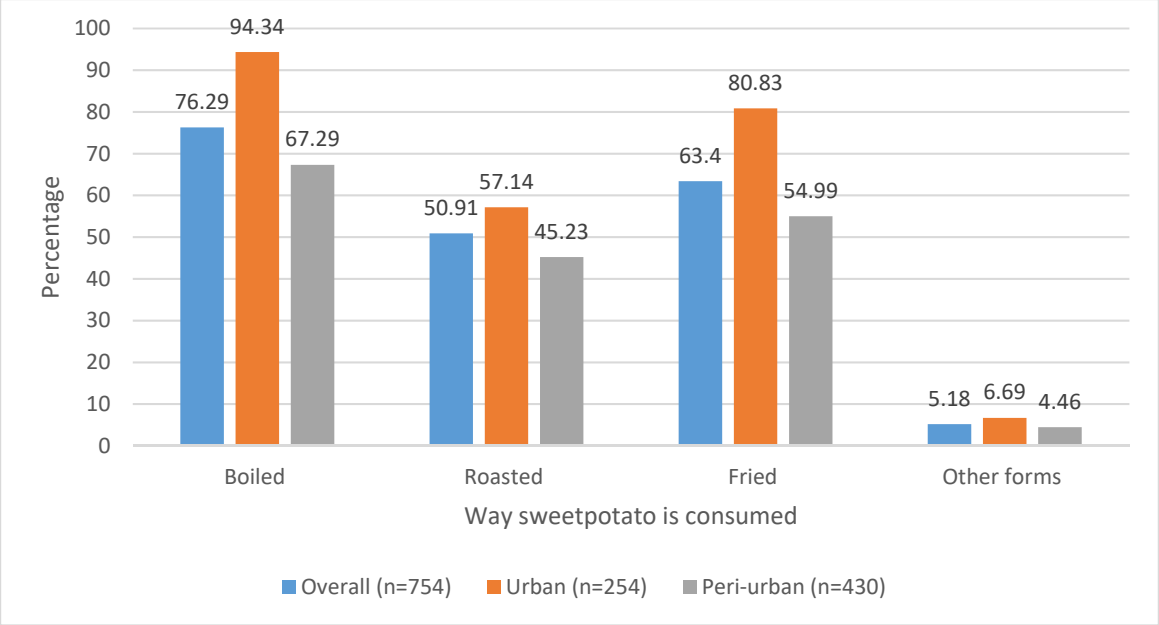


Figure 5: Forms in which sweetpotato is consumed by study households, % by study area

Some 171 respondents in the male-headed households responded to the question about the member in the household responsible for deciding the form in which sweetpotato is utilized. Results (Figure 6) indicate that more 80% of these respondents attributed the decision on sweetpotato utilization to a female member of the household.

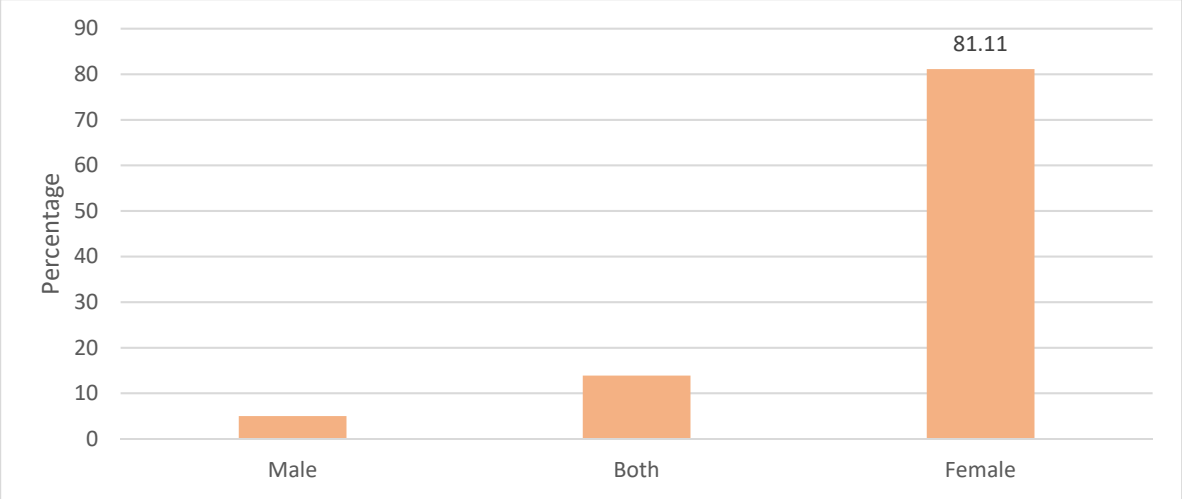


Figure 6: Decision-maker on how sweetpotato is utilized in male-headed households (% of responses, N=179

Respondents also provided information on the attributes of sweetpotato roots they most preferred to consume. Table 15 summarizes these characteristics for study respondents.

Table 15: Most preferred attributes of sweetpotato roots, % of responses

	Sweetpotato characteristic	Overall	Urban	Peri-urban
Most preferred skin color (N=677)	Purplish	5.32	6.11	4.82
	Cream	16.84	14.89	18.07
	White	18.17	17.18	18.80
	Red	23.04	25.19	21.69
	Brownish	36.63	36.64	36.63
Most preferred flesh color (N=654)				
	Purple flesh	5.05	4.67	5.29
	Orange flesh	13.46	12.45	14.11
	Yellow flesh	14.07	13.62	14.36
	White flesh	67.43	69.26	66.25
Size of sweetpotato preferred (N=644)				
	Small	8.85	8.59	9.02
	Large	22.83	25.00	21.39
	Medium	68.32	66.41	69.59

The results show that most of the respondents prefer brown and red-skinned roots, white-fleshed sweetpotato and medium-sized roots. However, compared to the skin color, the proportion of respondents who prefer white-fleshed sweetpotato and medium size is much higher (i.e. more than 50%). This finding was consistent across the study areas (i.e. urban and peri-urban). Preference for orange-fleshed roots came third after white and yellow. Notably, a lower proportion of the respondents in both areas of study have a greater preference for red-skinned and yellow-fleshed roots compared, for instance, to the case in Kenya and Uganda where red-skinned and yellow-fleshed roots are preferred by a greater number of people (Okello 2015). Findings of a similar survey conducted in Kenya, for instance, showed that 70% (N=600) of the respondents preferred red-skinned varieties to the white-skinned (13%). The study further showed that 51% (N=600) of the respondents preferred yellow-fleshed roots to white-fleshed (42%, N=600).

3.4.2 Sweetpotato sale and outlets

Table 16 presents the information about main buyers of sweetpotato and the point of sale. Overall, only 79 (N=754) respondents indicated that they sold some of the roots, indicating low levels of root market participation among sampled households. Among these, most sold their roots to neighbors (64%) and consumers in the local market (41%). The table further shows that most of the respondents who participate in the market for sweetpotato roots sold their roots at the farm gate (36%) and the local market (34%).

Table 16: Sale of sweetpotato: buyers and sale outlets, % of responses

		Overall (n=79)	Male-headed households (n=58)	Female-headed households (n=21)
Main buyers	Neighbor	64.56	65.52	61.90
	Local market	40.51	41.38	38.10
	Urban trader	31.65	34.48	38.10
	Rural trader/broker	30.38	29.31	19.05
	Other buyers	13.93	12.06	19.04
Main point of sale				
	Distant market	8.75	10.17	4.76
	Local market	33.75	33.90	33.33
	Farm gate	36.25	33.90	42.86
	Others	21.25	22.03	19.05

Results also show that, on average, the respondents who sold some of their roots outside the farm travelled, on average, about 55 minutes to reach the sales point (market), with male household heads travelling for longer (an average of 61 minutes) than the female household heads (40 minutes).

Figure 7 below presents the findings of the analysis of the gender of the person responsible for the decision to sell roots, if any, and the control of proceeds from such sales. Despite the small sample sizes involved, the results show that female household heads were responsible for the sale decisions as well as control the proceeds from sales. More of the male heads (14%; n=59) were involved in the decision about how proceeds from sweetpotato sales are used than in the decision to sell the roots.

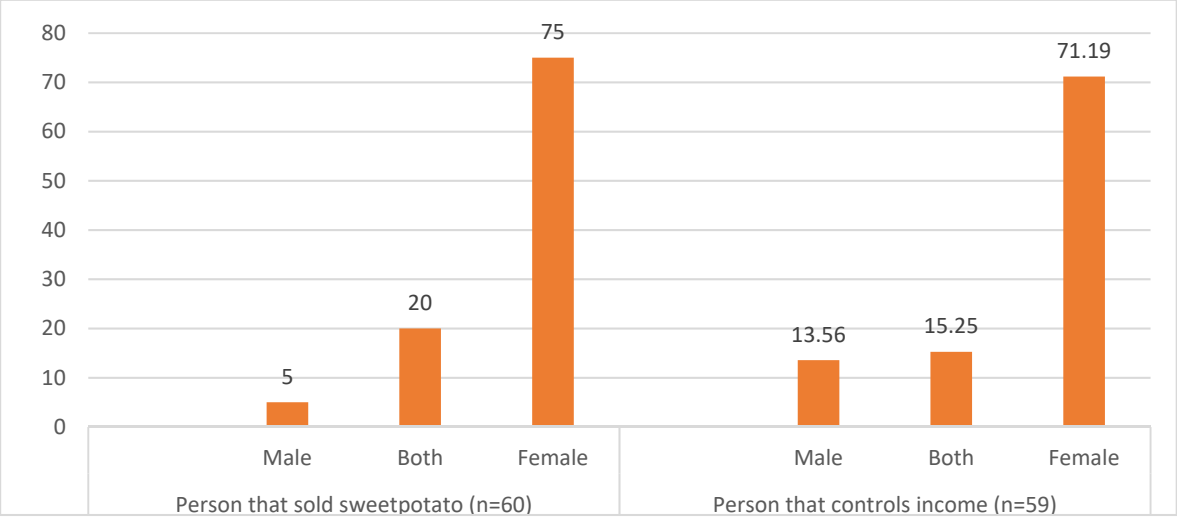


Table 7: Decision making and control from sweetpotato proceeds (for male-headed households, expressed in %)

3.5 Vine dissemination

Farmers often rely on vines from sources within their social networks for planting. In most communities, vine sharing among neighbors is a very common practice. In the study area, however, there was much lower vine sharing. The proportion of the study households who shared vines with others in their social network is presented in Figure 8. Only 13% indicated that they gave out vines to other farmers.

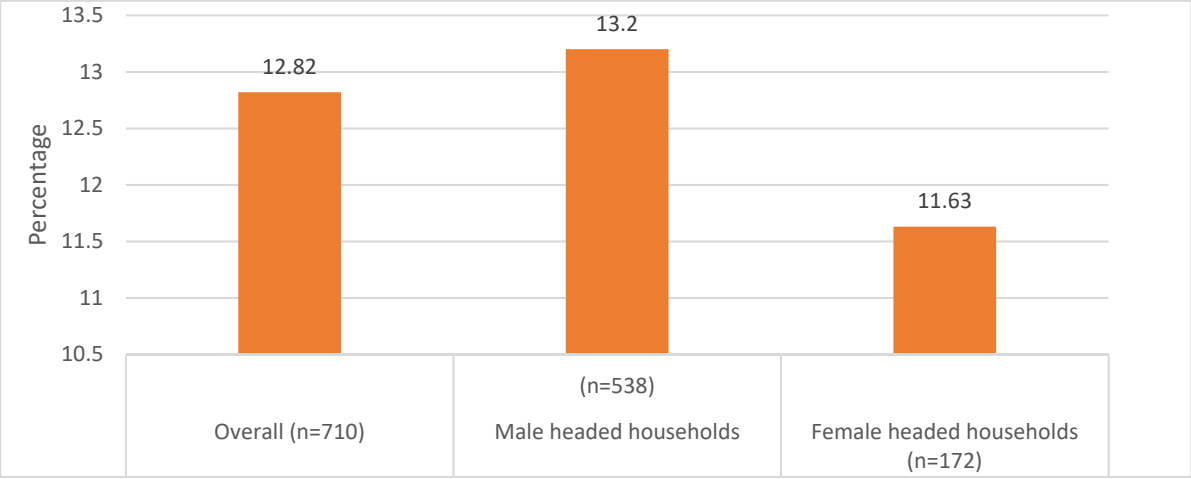


Figure 8: Proportion of farmers who gave out sweetpotato vines to others (n=710)

The results further indicate that approximately 60% of the study respondents have never acquired sweetpotato vines from other (external sources). This finding suggests that most sweetpotato growers in the sample depended on their own sources for sweetpotato planting materials.

The farmers who used external sources for planting materials did so due to a variety of reasons. The major reasons for relying on external sources for the planting materials included lack of own vines and trying out a new variety of sweetpotato (Table 17). The results further show that approximately 30% of the respondents who sought vines from external sources did so to test a new variety.

Table 17: Reasons for acquiring vines outside the farm (n=217)

Reason	Overall (n=217)	Male-headed households (n=168)	Female-headed households (n=49)
To test a new variety	30.88	30.36	32.65
No vines to plant	65.90	64.48	67.35
Given as part of the program farmer participated in	0.46	0.60	0.00
Other reasons	2.76	3.57	0.00

3.6 Sources of information about sweetpotato production

The results indicate that only 1.4% (N=723) of the study respondents had ever received training of any kind in sweetpotato production, mostly coming from non-governmental organizations. Thus overall, most of the respondents had no formal training on how to grow sweetpotato. The respondents were also asked what other sources of information they used to learn how to grow sweetpotato. Table 18 below summarizes the findings. As with the training, the table shows that majority of the respondents do not use any of the available sources of information on sweetpotato production. It specifically shows that only about 2% of the respondents obtained information from government field extension staff. This finding applies to both male and female heads of the households.

Table 18: Important sources of information on best practices in sweetpotato production, % of responses

Source of information	Overall (n=742)	Male-headed households (n=562)	Female-headed households (n=180)
None	95.15	95.20	95.00
Radio/ TV program	3.23	2.85	4.44
Other sources	2.43	2.49	3.33
Government extension agent -SDAE	2.16	2.31	1.67
Other NGOs	1.21	0.53	3.33
Catholic diocese	0.81	1.07	0.00
Relative	0.54	0.71	0.00
ADEM	0.40	0.53	0.00

3.7 Production of other crops

Apart from sweetpotato, this study investigated the other types of crops the respondents planted and their importance to the households. Table 19 presents the major food crops grown by the study respondents. Clearly, rice, maize and cassava are the three major food crops grown. Indeed, more than 90% of the respondents who farm ranked these crops as the most important foods crops grown in their households. Sweetpotato, included in the table for comparison purposes, had a very low overall ranking, indicating that the majority of the respondents did not consider it a major food crop. In general, the respondents planted a wide range of foods as well as cash crops. Figure 9 presents the proportion of households that planted some of the major food crops. It also presents the proportion of respondents who sold these crops. As shown, maize and rice tend to be grown mainly for food, while cassava and sorghum are grown for sale in addition to consumption. Study households also planted groundnuts, millet, soybean, and watermelon (as food crops) and wide range of cash crops including bananas, sunflower, sugarcane, papaya, tobacco, pineapples, coffee and mangoes. As expected, most of the food crops play the dual role of earning cash incomes. Indeed, farmers ranked rice and maize as the first and second cash crops, respectively.

Table 19: Ranking of major food crops grown by study households, % of response

Crop	Rank 1 (n=240)	Rank 2 (n=170)	Rank 3 (n=170)
Maize	25.42	14.12	14.12
Rice	61.25	19.41	19.41
Sorghum	1.25	2.35	2.35
Cassava	5.83	19.41	19.41
Beans	2.08	9.41	9.41
Sweetpotato	0.83	5.88	5.88

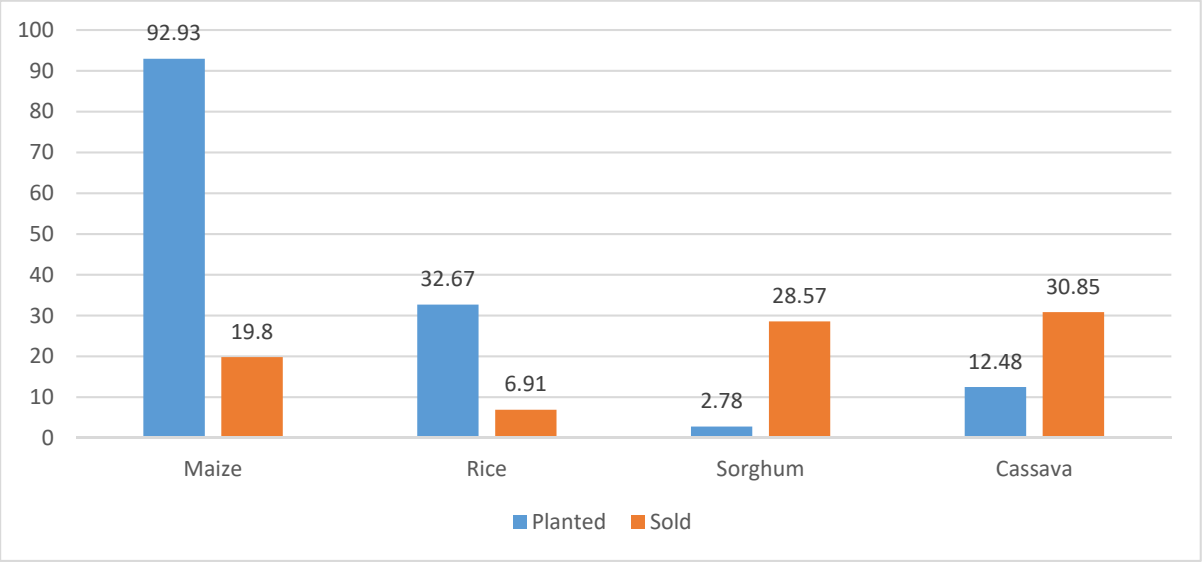


Figure 9: Production and sale of other food crops produced by study respondents, % of responses

3.8 Nutrition – Food security

3.8.1 Household food security

This study investigated the food insecurity situation of the study households using the household food insecurity access scale, developed by Coates et al. (2007). Under this method, four indicators of household food insecurity are usually computed and used to assess the food insecurity status of the household. These are: household food insecurity access-related conditions, household food insecurity access-related domains, household food insecurity access scale score, and household food insecurity access prevalence. The indicators are based on a standard set of nine simple questions.

i) Food insecurity access related conditions

The responses to the nine individual HFIAS questions used to measure the food insecurity access related conditions are presented in Table 20. Results show that 49% of the households were worried about not having enough food, while a higher proportion (62%) did not eat preferred types of food due to lack of resources. Some 51% of the respondents consumed/ate a limited number of foods due to lack of means to buy the food. Results further show that less than 38% of the households ate some foods they did not like due to shortage of food and resources, and 41% of the households had a member that ate fewer meals in a day because of lack of food. The table also shows that about one-third (i.e. 31%) of the study households had no food of any kind because of lack of resources. Some households (25%) had a member who went to bed hungry because there was not enough food, while 15% had a member in the household who went without food, both day and night. These findings generally suggest that a sizeable share of the study households were struggling with access to physical and quality food at the time of the study.

As expected, Table 20a) shows that the female-headed households were worse off than their male-headed counterparts in all the food insecurity access related conditions. Further analysis by area of study shows that households in peri-urban areas were also worse-off compared to households in the urban areas, in all aspects of the food insecurity access condition.

Table 20: Proportion (%) of households experiencing different conditions of food insecurity

a) Male versus female

Food insecurity access condition	Overall (n=574)	Male-headed households (n=573)	Female-headed households (n=181)
Households worried on not having enough food	48.54	47.12	53.04
Households did not eat preferred food due to lack of resources	62.07	60.03	68.51
Households member eat a limited number of food due to lack of means to buy food	50.60	48.25	58.10
Households with a member that ate some food they never liked because of lack of resources	38.15	36.44	43.58
Households which ate a small meal because of lack of enough food	38.55	36.80	44.13
Households with at least a member that ate fewer meals in a day because of lack of enough food	40.70	39.44	44.69
Households that had no food to eat of any kind because of lack of resources	30.60	28.98	35.75
Households with a member who went to sleep hungry because there wasn't enough food	25.30	23.28	31.67
Households with a member who went without food, both day and night	15.44	13.81	20.56

b) Urban versus peri-urban

Food insecurity access condition	Urban (n=256)	Peri-urban (n=37)
Households worried on not having enough food	41.80	52.01
Households did not eat preferred food due to lack of resources	55.08	65.66
Households member eat a limited number of food due to lack of means to buy food	43.75	54.16
Households with a member that ate some food they never liked because of lack of resources	32.03	41.34
Households which ate a small meal because of lack of enough food	32.03	41.96
Households with at least a member that ate fewer meals in a day because of lack of enough food	31.64	45.42
Households that had no food to eat of any kind because of lack of resources	22.27	34.97
Households with a member who went to sleep hungry because there wasn't enough food	16.02	30.14
Households with a member who went without food, both day and night	11.33	17.59

ii) Household food insecurity access-related domains

The results of the analysis food insecurity using access-related domains are presented in Table 21. They show that about 50% of the households were anxious about household food supply, and had insufficient food intake, thus experiencing the physical consequences of inadequate access to food at the time of the study. A much larger percentage (67%) of the households did not have sufficient quality of food. The results also show that female-headed households and households in peri-urban areas experienced more food insecurity problems than their counterparts. These results therefore corroborate those of *access conditions* and show that the incidence of food insecurity among the study households was relatively high.

Table 21: Other household food security measures (n=754)

Access related domain (Expressed in percentages)	Overall	Gender of head		Area of study	
		Male (n=573)	Female (n=181)	Urban (n=256)	Peri-urban
Anxious and uncertainty about food supply	48.54	47.12	53.04	41.80	52.01
Insufficient quality of food	67.34	65.49	73.18	62.11	70.06
Insufficient food intake and the resulting physical consequences	49.87	47.96	55.87	39.06	55.53

iii) Household food insecurity access prevalence (HFIAP)

The HFIAP indicator categorizes households into four categories following Coates et al. (2007), namely, the: a) food secure, b) mildly food insecure, c) moderately food insecure and, d) severely food insecure. Based on this categorization, households are increasingly food insecure as they respond affirmatively to more questions capturing the physical consequence of inadequate food access and when such consequences of poor food access are more frequent.

The results of the HFIAP analysis (Figure 10) indicates that 38% of the household were severely food insecure. These households had reduced meal sizes or ate fewer meals in some of the days during the reference period[4]. It also means that a member went to bed hungry or did not have anything to eat the whole day or night without food. About 16% and 17% of the households were moderately and mildly food insecure, respectively. Overall, only 29% of the households were completely food secure. These results further indicate that the households who participated in this study had serious food security problems. The results further show that

[4] HFIAS analysis is usually based on 30 days from the time of the interviews.

more female-headed households were moderately and highly food secure than their female counterparts indicating that male-headed households were worse of in terms of food security. Analysis by area of study also showed that households in peri-urban areas were more insecure than the urban households. These findings may be due to the fact that the study was conducted in December which is a dry lean season.

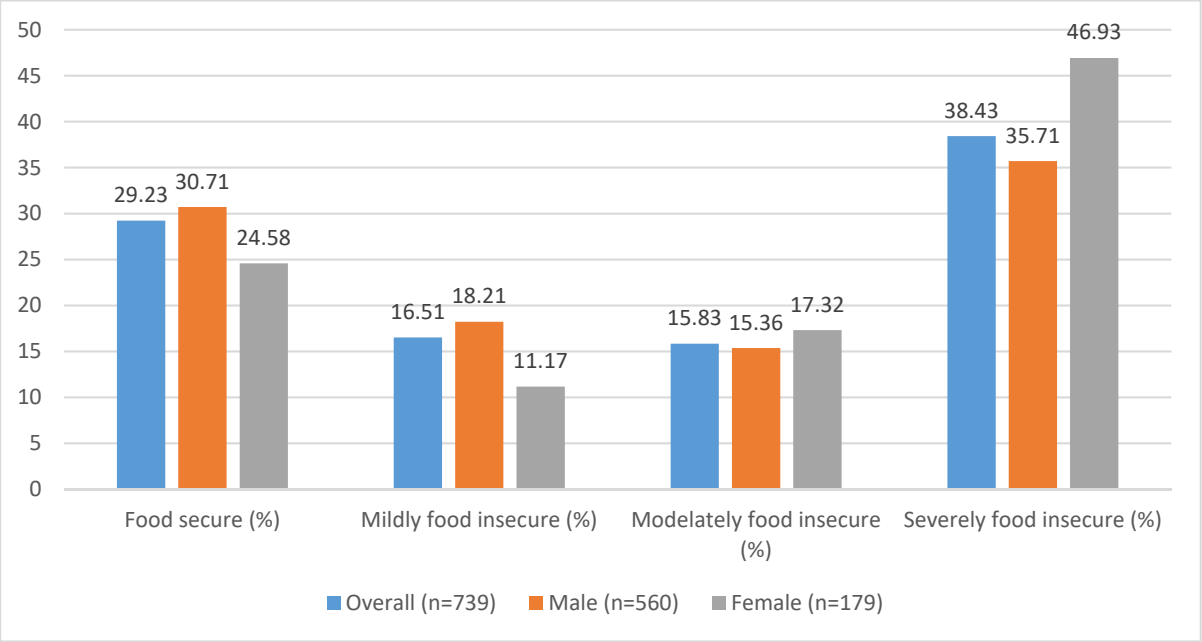


Figure 10: Food insecurity categories of households in Mozambique, by gender

We also analyzed the food insecurity situation using the HFIAS score. This score is a continuous measure of the degree of food insecurity (access). The score is constructed by summing the responses for each frequency-of-occurrence questions. The HFIAS score ranges from 0-27, and the higher the score, the more food insecure the household is. Figure 11 shows that male-headed and urban-based households are more food secure in terms of the HFIAS score than their female-headed and urban-based counterparts. These findings therefore corroborate those of other measures of food insecurity discussed above.

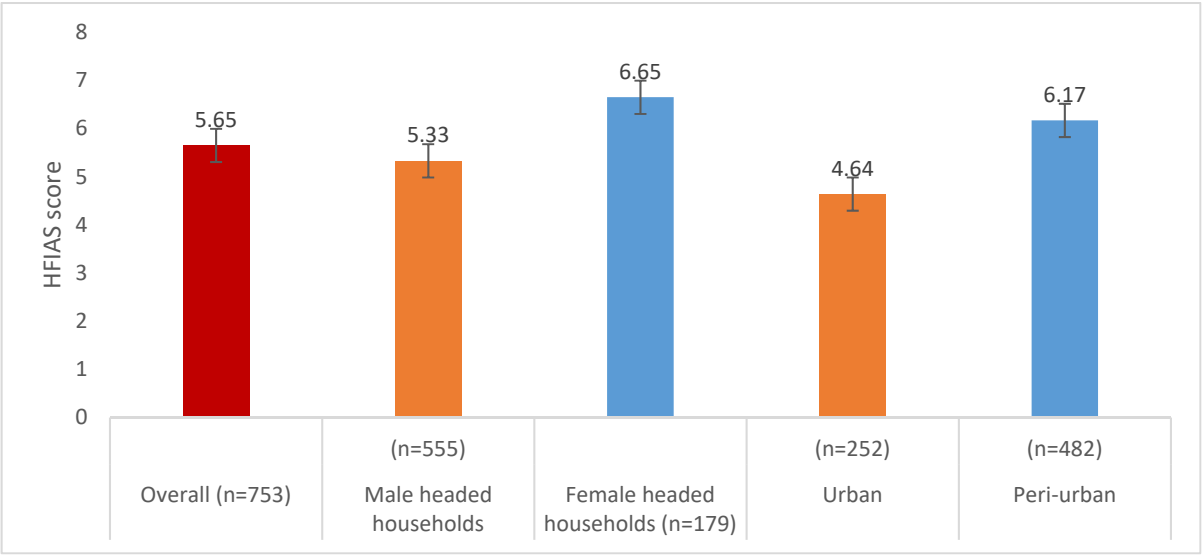


Figure 11: Extent of household food insecurity – the HFIAP score

3.8.2 Food availability and consumption over a calendar year

The HFIAS is a static measure of food insecurity that only captures the food supply situation in the household within 30 days of the interview. This study therefore assessed the months, in 2014, when households were likely to have had food supply problems. It also examined the months when sweetpotato was consumed at least twice a week as a way of plugging the food supply gap[5] and also the months the households received relief food or food from external sources as a way of coping with food shortages.

Results (Figure 12) from the study show, generally, that there was little sweetpotato consumption by the study households. Apart from October and November, sweetpotato was consumed, at least twice a week, by less than 25% of the households. Sweetpotato was least consumed between the months of March and July, where less than 10% of the households consumed it twice a week.

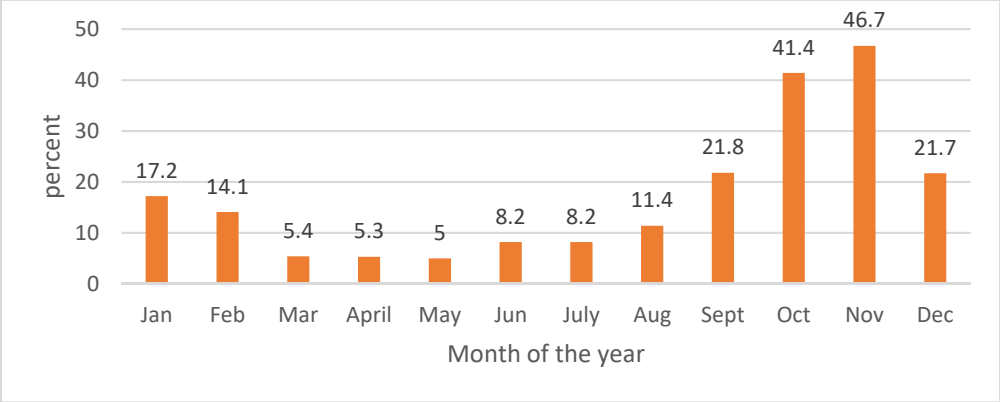


Figure 12: Proportion (%) of households who consumed sweetpotato at least twice in a week (n=754)

Figure 13 shows that food shortages were most acute between October and February. The results also show that these, generally, were the months when external sources of food, i.e. food aid, were used by some of the households facing shortages to obtain food.

Thus, as expected, the months when relatively more sweetpotato was consumed and relief food sought coincided with months of acute food shortage. The findings indicate that sweetpotato is an important crop in times of scarcity of other food.

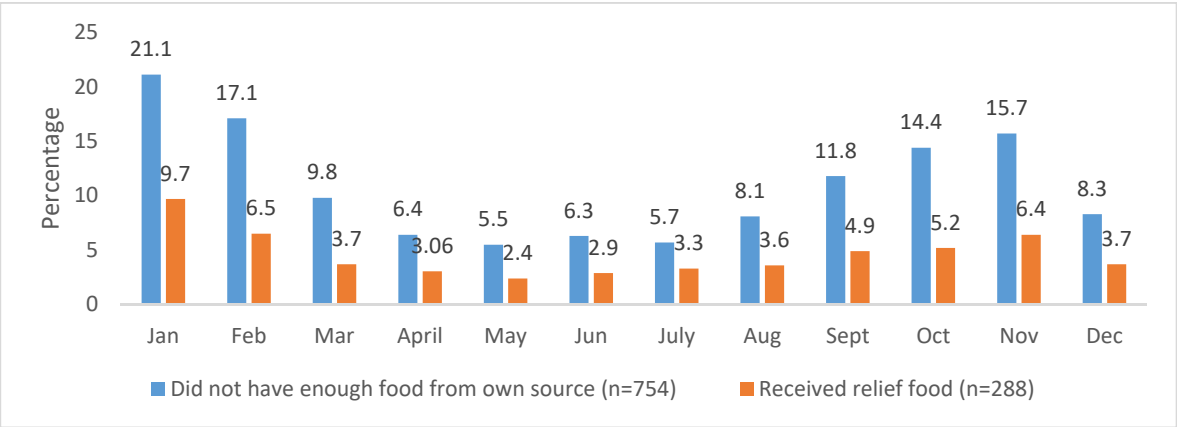


Figure 13: Households with inadequate food from own sources, and that received relief food

[5] Past studies in other countries have demonstrated that sweetpotato is often used to fill the hunger gap. See for instance Masumba et al. (2004), Namanda et al. (2011) and Saghir et al. (2012).

3.9 Dietary diversity

Dietary diversity is used to measure the micronutrient adequacy of the diet consumed by individuals. It is mostly measured in young children as child dietary diversity (CDD) score and women of reproductive as minimum dietary diversity for women (MDD-W). CDD is computed based on eight food groups namely; grains, roots and tubers; eggs; milk (dairy products); biofortified foods; pulses and nuts; flesh meats and fish; vitamin A plant sources; and other fruits and vegetables. A large dietary diversity score is associated with improved food security and nutrient intake. Specifically, a CDD score of 4 is considered adequate. That is, children consuming four or more of the food groups are considered to have adequate diets.

The MDD-W is normally computed following the guidelines from FAO (FAO 2014) and is based on 10 food groups namely: all starchy staples; beans and peas; nuts and seeds; dairy products; flesh foods; eggs; vitamin A-rich dark green leafy vegetables; other vitamin A-rich vegetable and fruits; other vegetables; and, other fruits. A MDD-W of 5, implying that individuals consumed foods from five different groups, is considered adequate. Both CDDS and MDD-W were based on 24-hour recall.

Overall, the results of our analysis indicate that the average CDD score over the two study areas was 4.45 (Table 22a), which implies that young children in the study households were just meeting the dietary diversity requirement. It more specifically implies that children in the study households received micronutrients from the diverse foods eaten. The CDD score was not significantly different by gender of the household heads but the score was significantly higher for the urban households than the peri-urban households.

The CDD-W was below the required threshold of 5 (Table 22b). Results also show that the MDD-W is significantly different urban and peri-urban based household but not between female households and male-headed households. This difference in the MDD-W between respondents from urban areas and their counterparts in peri-urban areas is in line with *a priori* expectations. It may reflect the differences in purchasing power between the two categories of households. The finding may however also be due to the greater diversity of foods sold in urban markets.

Table 22a): Dietary diversity score for children under 5 years in the sample

	Gender of the head			Area of study		
Overall (n=428)	Male (n=329)	Female (n=99)	p-value	Urban (n=256)	Rural (n=498)	p-value
4.45 (1.76)	4.45 (1.77)	4.46 (1.72)	0.942	4.68 (1.75)	4.35 (1.76)	0.069

Table 22b): Minimum Dietary Diversity for Women (MDD-W) of reproductive age in the sample

	Gender of the head			Area of study		
Overall (n=468)	Male (n=359)	Female (n=109)	p-value	Urban (n=256)	Peri-urban (n=498)	p-value
4.25 (1.65)	4.27 (1.64)	4.20 (1.68)	0.705	4.56 (1.73)	4.11 (1.59)	0.006

Numbers in parentheses denote standard deviation

3.10 Food consumption score

The Food Consumption Score (FCS) is another indicator of the household food security. It is based on weighted consumption frequency of eight food groups over a 7-day period, hence uses 7-day recall. FCS captures both quantities (number of days per week a food is consumed) and the quality of food (frequency of different food

groups consumed) (Swindale and Bilinsky 2006; Kennedy et al. 2007). The FCS can range between 0 and 112. FAO has three thresholds of FCS: i) poor – if FCS is less than 21; ii) moderate/borderline if FCS is between 21.5 and 35 and iii) acceptable if FCS is above 35. In this study, the FCS were computed using the method described by Hagenimana et al. (2001) and Rosen et al. (1993). The results of these computations are presented in Tables 23a) and Table 23b). They show that the mean FCS for children under of the age of 5 years in the sample was 43.81 out of the maximum 112, while the FCS for the caregivers was 41.99 out of the maximum 112. The scores were not significantly different between gender of the household head and the area of study. This study, therefore, found that both the children and the caregivers had acceptable food consumption scores.

Table 23: Food consumption score for young children and woman in study households

(a) Mean food consumption score for children

	Gender of the household head			Area of study		
Overall (n=500)	Male (n=387)	Female (n=113)	P-values	Urban (n=180)	Peri-urban (n=364)	p-value
44.60 (33.09)	43.81 (31.81)	47.27 (37.19)	0.328	42.06 (36.68)	45.92 (31.02)	0.215

(b) Mean food consumption score for women

	Gender of the household head			Area of study		
Overall (n=544)	Male (n=421)	Female (n=123)	P-values	Urban (n=180)	Peri-urban (n=364)	p-value
41.99 (23.42)	41.67 (25.35)	43.09 (25.75)	0.585	41.47 (26.67)	42.25 (24.82)	0.738

Numbers in parentheses denote standard deviation

Figure 14 provides the proportion of study children and caregivers that fell into the different FCS groups. It shows that 60% of the children and 61% of the reference women (caregivers) had FCS above 35.

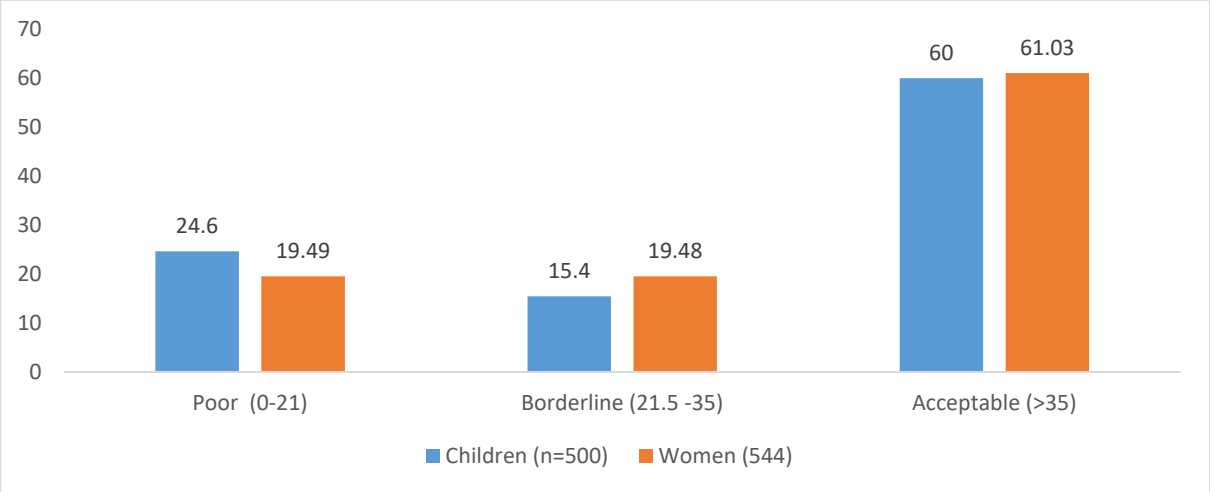


Figure 14: Proportion of children and woman in each food consumption groups (FCG), % of responses

3.11 Vitamin A consumption score

Vitamin A consumption scores (VSC) were estimated using the Helen Keller International (HKI) (Coates 2007) methodology. This method uses a simple count of the number of days in a week (7 days) foods rich in vitamin A were consumed. Two categories of vitamin A rich foods are examined namely: i) animal sources and ii) plant

sources. Fat, oil, protein foods are included because absorption and utilization of vitamin A require these foods. Whether or not the food foods eaten the duration of one week have adequate amounts of vitamin is determined by the following thresholds:

a. ≤4 days per week for mean frequency of consumption of animal sources of vitamin A and foods that have been fortified with retinol (vitamin A).
b. ≤6 days per week for mean frequency of total consumption of animal and plant sources of vitamin A (weighted by source).

The results (Table 24) of this study show that the mean VCS from all the animal sources was 3.39, while vitamin A score from all sources (plant and animal sources) was 4.06. These values suggest that study households consumed vitamin reach foods from animal (only) and animal and plant sources in only three and four days of the week, respectively.

Table 24: Mean frequency of vitamin A consumption (days of consumption relative to one week)

Score variable		Gender of the head			Area of study		
	Overall (n=500)	Male (n=387)	Female (n=113)	P-values	Urban	Peri-urban	p-value
Mean frequency of consumption (animal score)	3.39 (2.91)	3.39 (2.91)	3.41 (2.90)	0.950	3.47 (3.00)	3.35 (2.86)	0.637
% of children with mean frequency of Vitamin A consumption (animal score) less or equal to 4	60.60	60.98	59.29		55.81	63.11	
Mean frequency of consumption (plant + animal score)	4.06 (3.17)	4.05 (3.17)	4.11 (3.18)	0.866	4.09 (3.30)	4.06 (3.11)	0.923
% children with mean frequency of Vitamin A consumption (Total score) less or equal to 6	63.00	63.31	61.95		61.63	63.72	

Numbers in parentheses denote standard deviation

These values are less than the recommended thresholds of 4 (from animal sources only) and 6 (from plant and animal sources). The results, therefore, indicate that children did not meet the vitamin A consumption requirements. Further analysis shows that over 60% of the households never met the vitamin A needs of the children. The scores were not significantly different by either gender of the household head or the area of study.

3.12 Knowledge, attitude and perceptions

3.12.1 Knowledge of vitamin A

The respondents were asked if they have ever heard of vitamin A. Results indicate that about 90% of the respondents had heard about vitamin A. Figure 15 below shows that a greater number of caregivers from male-headed households know about vitamin A than their female-headed counterparts. Indeed, there is a significant difference in knowledge of vitamin A between the two groups of respondents. Results, however, show that there is no significant difference in knowledge of vitamin A between urban and peri-urban respondents. About 50% of those who knew of vitamin A had known about it for more than 2 years, while some 31% had known about for less than one year (Table 25).

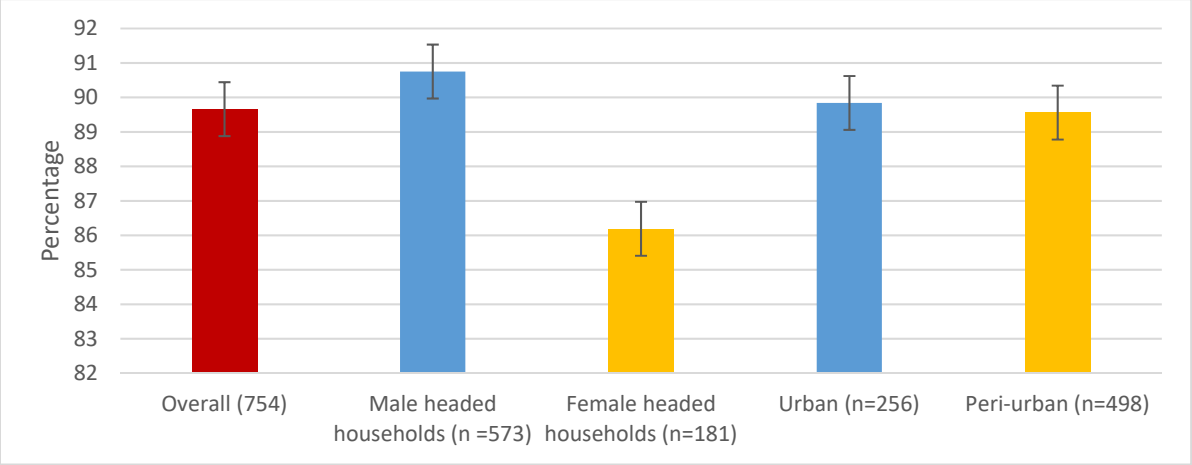


Figure 15: Proportion of caregivers in Mozambique that had ever had heard of vitamin A (%)

Table 25: Period vitamin A had been heard (% of responses)

Period	Overall (n=672)	Gender of the head		Area of study	
		Male (n=516)	Female (n=156)	Urban (n=516)	Peri-urban (n=156)
Recently	10.86	10.85	10.90	9.17	11.74
1-3 months	11.90	12.60	9.62	12.66	11.51
4-6 moths	4.02	4.65	1.92	3.93	4.06
6-12 months	4.91	5.43	3.21	3.93	5.42
1-2 years	5.65	5.81	5.13	6.11	5.42
> 2 years	50.30	48.84	55.13	51.09	49.89
Don't know	12.35	11.82	14.10	13.10	11.96

Most respondents learned about vitamin A from health clinics (Table 26). Specifically, more than 79% of the caregivers got information about vitamin A from health clinics, with significantly higher proportion (82%) of urban caregivers in the sample obtaining knowledge from the clinics than the peri-urban ones (74%). There is, however, no statistical difference between male- and female-headed households in obtaining vitamin A-related information from this source. Results also show that about 32% and 30% of the study respondents obtained vitamin A information from national radio and the school, respectively, with no significant differences by gender and area of study. Results further show that about one-quarter (25%) of the study respondents across gender and area of study learned about vitamin A from friends and relatives. Other sources of information about vitamin A included the television, print media and health promoters.

Table 26: Sources vitamin A information was obtained from, % of responses

Source	Overall (n=672)	Gender of the head		Area of study	
		Male (n=506)	Female (n=155)	Urban (n=224)	Peri-urban (n=437)
Health clinic	79.27	78.85	80.65	74.11	81.92
National radio	31.77	32.61	29.03	39.29	27.92
School	29.50	29.84	28.93	33.04	27.69
Friend/relative	25.26	25.49	24.52	28.57	23.57
Vernacular radio	16.64	16.40	17.42	16.07	16.93
Health promoter	13.01	12.85	13.55	15.18	11.90
Other sources	2.12	2.17	1.94	2.23	2.06
Print media	2.12	2.17	1.94	1.79	2.06

The respondents were also asked about the role of vitamin A in the human body. The main response was "prevents diseases" (54%) and "good for eye sight" (35%) (Table 27). About one-half of the respondents (over 43%) did not know the function of vitamin A in the body. Others (18%, overall) even attributed vitamin A to the manufacture of blood by the body. Thus, while a large proportion of caregivers had heard about vitamin A, a sizeable proportion did not know its usefulness to the body.

Table 27: Importance of vitamin A to human body, % of responses

Role of vitamin A	Overall (n=672)	Male (n=517)	Female (n=155)
Prevents diseases	53.57	52.22	58.06
Good for eye sight	34.67	35.01	33.55
Produces blood	18.45	18.38	18.71
Keeps skin healthy	9.82	6.18	9.68
Don't know	42.71	44.10	38.08
Other reasons	0.09	0.00	0.65

To test the respondents' knowledge of sources of vitamin A, they were asked to name any three foods that are rich in vitamin A. Figure 16 summarizes the responses. As expected, most respondents named the locally available foods namely mango (59%), carrot and papaya. Only a small percentage mentioned eggs (12%) and pumpkins (11%). The data further shows that a high percentage of caregivers (91%) indicated that it is healthier to eat sweetpotato for breakfast than bread.

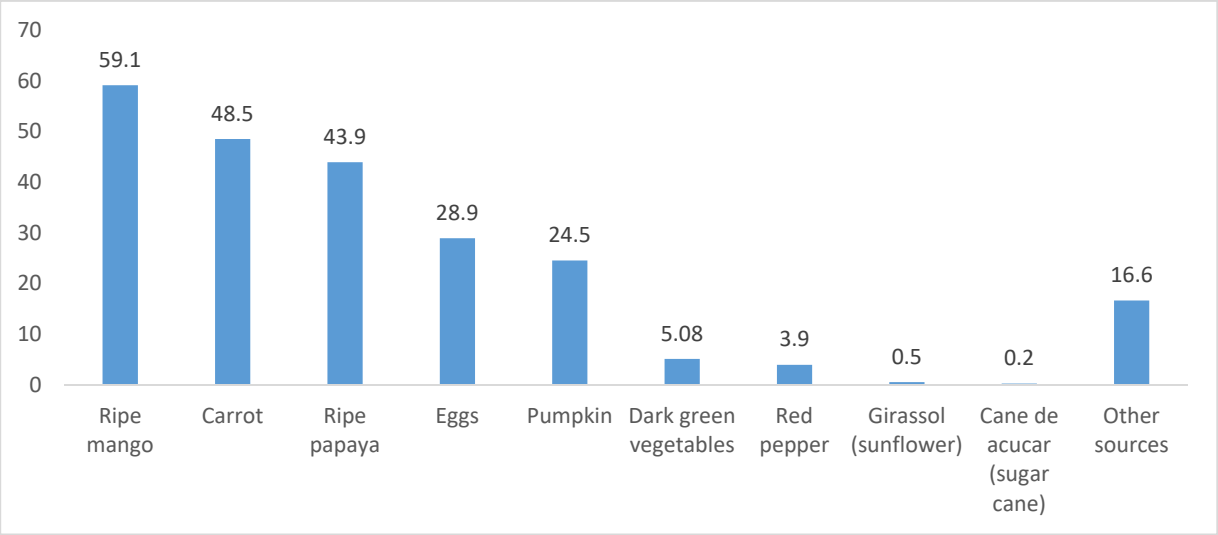


Figure 16: Proportion (%) of caregivers who mention sources of vitamin A

Figure 17 presents the proportion of caregivers who had participated in vitamin A supplementation campaigns. Overall, only 33% had participated in vitamin A supplementation using capsule. A significantly higher proportion of male-headed households received vitamin A supplementation than their female counterparts. There was, however, no significant difference between urban and peri-urban caregivers in the use of vitamin A supplements. Results show that 29% of the urban caregivers participated in supplementation as compared to 32% from peri-urban.

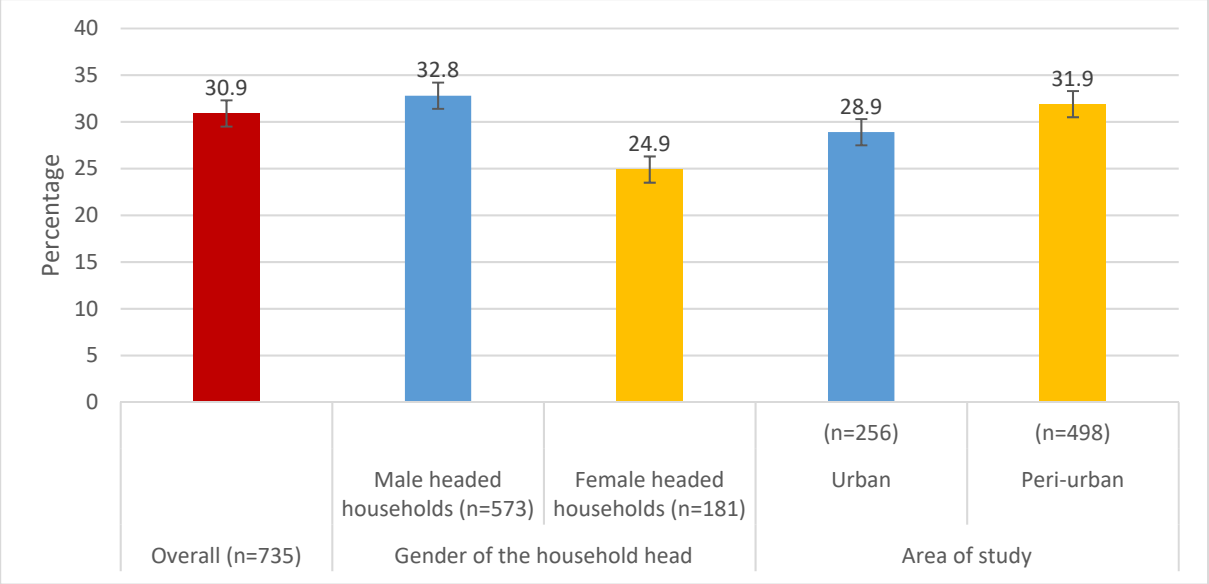


Figure 17: Participation in vitamin A capsule supplementation

3.12.2 Attitude toward sweetpotato production and consumption

Table 28 presents the results of analysis of respondents' attitude toward sweetpotato production and consumption. The results are based on a 5-point Likert scale rating of perceptions about production and consumption of sweetpotato, with 1=strongly agree and 5=strongly disagree.

Overall, the results suggest that the respondents had a positive attitude toward sweetpotato production. For instance, respondents disagreed or strongly disagreed with the statement that "you can't grow sweetpotato and be considered a man" and "sweetpotato is a woman's crop", as shown by the high average rating of 4 and above while they agreed with that sweetpotato should be promoted as an important crop by the relevant government/country. Results further indicate that there were little and insignificant differences in the perception of these attributes between urban and peri-urban respondents.

Scores on attitude toward consumption indicate that respondents generally favored sweetpotato consumption. They generally agreed or strongly agreed that "sweetpotato leaves are good to consume", and that "OFSP varieties are healthier to eat than non-OFSP varieties", as shown by the low average rating of less than 2. Relating to the role sweetpotato can play in household food security, both urban and peri-urban respondents generally agreed that sweetpotato is one of the crops a community can rely upon in times of food shortage.

Results further indicate that respondents generally disagreed with negative perceptions about sweetpotato, in general, and OFSP. Both the urban and peri-urban respondents either disagreed or strongly disagreed with the statement that "sweetpotato is not good for children", "too much sweetpotato causes stomach problems", "sweetpotato cause stomach problems", "there is no market for sweetpotato", and "sweetpotato is not good for lactating women".

Table 28: Perceptions about sweetpotato production and consumption (average scores)

	Overall	Urban	Peri-urban
Sweetpotato leaves are good for human beings to consume	1.57	1.59	1.55
Sweetpotato that are orange inside are healthier than ones that are white inside	1.96	1.93	1.98
Sweetpotato is the most reliable food crop for our family during times of food shortage	2.33	2.44	2.27
Even when we have lots of maize, cassava, or potato to eat, we still like to have sweetpotato in our diet	2.30	2.32	2.28
You can't grow sweetpotato and be considered a man	4.01	4.07	4.06
Sweetpotato is not good for children less than 2 years old	3.70	3.74	3.68
Sweetpotato is not good for pregnant women	3.87	3.88	3.86
I am proud to serve sweetpotato to my family	1.97	1.94	1.98
You can't eat too much sweetpotato because you will get stomach problems	2.94	3.02	2.91
It does not pay to increase the area growing sweetpotato, because there is no market to sell it	3.46	3.52	3.42
Sweetpotato should be promoted as an important crop by the relevant government of my county/country	1.92	1.91	1.93
Vitamin A is found in all types of sweetpotato	2.83	2.71	2.88
Sweetpotato is not good for lactating women	3.90	3.89	3.91
Sweetpotato is a woman's crop	4.10	4.15	4.06

3.13 Infant and young child nutrition and maternal/caregiver knowledge

3.13.1 Early breastfeeding and child feeding practices

The results of this study show that slightly more than 90% of the young children in the study households were breastfed, but only about 80% of them were put to the breast within one hour of birth (Table 29). Hence about 20% of the children who were breastfed did not receive colostrum. Further, approximately 33% and 53% of the children were introduced to semi-solid foods and liquids, respectively, before the recommended age of 6 months. Further, Figure 18 shows that most of the mothers stopped breastfeeding their children within 1.5 years of age, with more than one-third of the mothers terminating breastfeeding within one year.

Table 29: Early breastfeeding and child feeding practices among study respondents, % of responses

Feeding practice		Frequency
Proportion who mentioned that child ever breastfed (n=405)		90.26
Proportion of children who received colostrum (n=423)		80.6
Age child was introduced to semi-solid food (n=417)		
	< 6 months	32.61
	6 months	54.68
	> 6 months	12.71
Age child was introduced to water or other liquids (n=411)		
	< 6 months	53.28
	6 months	40.15
	> 6 months	7.57

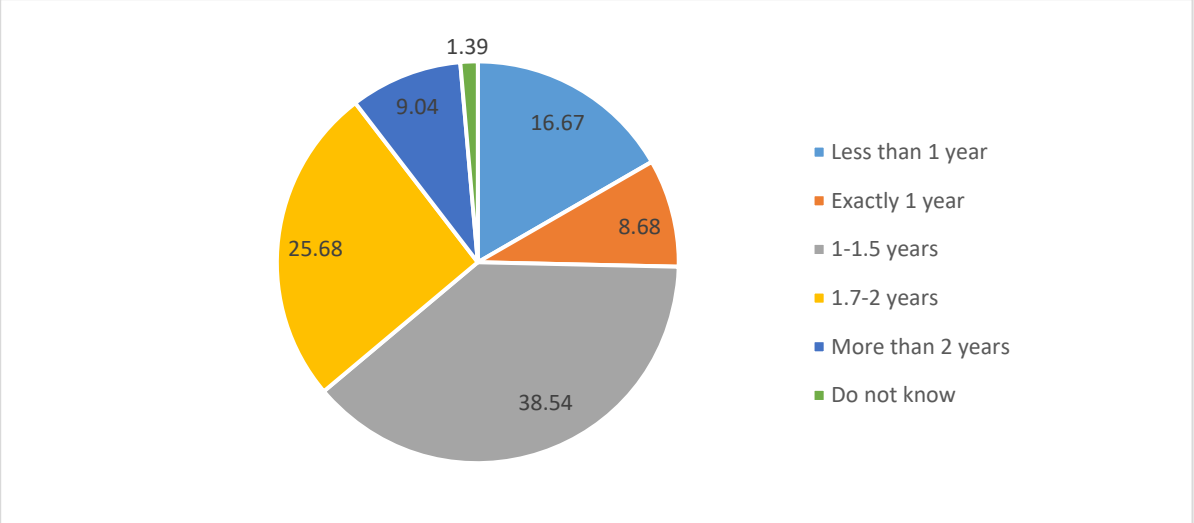


Figure 18: Continued breastfeeding of young children by study respondents, % of responses

Table 29: Period the child received dietary supplements, % of responses; n=411

Supplementation period	Vitamin A	Fortified lipid	Fortified porridge
Less than 1 month ago	31.47	7.54	11.95
1-3 months ago	35.90	2.92	3.17
4-6 months ago	6.99	0.97	1.46
6 -12 months ago	2.80	0.97	2.93
More than 1 year ago	5.59	1.46	1.22
Don't know	13.52	18.49	16.83

Results further indicate only 28% of the mothers with children under the age of 5 years were still breastfeeding their children at the time of the study and that approximately 21% were doing exclusive breastfeeding.

3.13.2 Vitamin A supplementation

Table 30 shows that more than 72% of infant and young children received vitamin A supplements within the first 6 months while a relatively smaller proportion of about 10% and 15% received fortified lipid supplements and the fortified porridge, respectively, within the same period. Overall, a very large majority (about 83%) of the infant and young children in the study sample had received vitamin A supplements. However, more than 10% of the caregivers did not know if their children had received any of these supplements.

3.13.3 Caregiver's knowledge of infant and young child feeding practices

Overall, 95% of the caregivers knew that it is good for the child to get colostrum (Table 30). Some 4% of the caregivers did not, however, know whether giving colostrum to the infant is good or bad. Table 30 also presents infants' feeding frequency mentioned by the study respondents. More than 49% mentioned that an infant should be fed more than 10 times in a day, indicating lack of knowledge of proper feeding regime for infant children.

Table 30: Knowledge on infant feeding practices among caregivers, % of responses

Knowledge		Response
It is good or bad to give the first breast milk (n=739)		
	Bad	1.49
	Good	94.86
	Don't know	3.65
Number of times a child < 6 months should be breastfed in a day (n=739)		
	1-2 times	1.22
	2-4 times	4.07
	4-6 times	9.77
	6-8 times	15.47
	8-10 times	18.72
	More than 10 times	49.39
	Don't know	1.36
Under normal circumstances, until what age should a mother breast- feed a child		
	< 1 year	6.93
	For 1 year	9.65
	Between 1 year and 1.5 years	24.18
	1.6 -2 years	54.89
	Over 2 years	2.72
	Don't know	1.63

Table 31 below presents results of analysis of questions relating to maternal knowledge of supplemental feeding practices. Results show that a sizeable proportion (27%) of respondents would introduce water earlier than 6 months, while 14% of the respondents indicate that porridge can be introduced before the child attains the age of 6 months. Further, the results indicate that most of respondents (more than 50%) would include sweetpotato in supplemental feeding of young children after 7 months.

The findings also indicate that there is very low knowledge of the various food groups (Table 32). Overall, only 15% of the caregivers could correctly identify the three basic food groups (that is, the energy giving foods (starch and fats), body building foods (proteins), and foods that protect the body (vitamins)). In terms of gender, more caregivers from female-headed households (22%) knew about the three food groups than their male-headed counterparts (13%). There was also a significant difference between urban and peri-urban caregivers in the knowledge of the three food groups. About 8% of caregivers from the urban areas correctly identified the three basic food groups compared to 14% from the peri-urban areas.

Table 31: Knowledge of supplemental feeding practices among caregivers (% of responses, n=746)

Practice	Response	
Age baby should be given water for the first time		
	< 6 months	26.64
	At 6 months	69.07
	> 6 months	2.29
	Don't know	2.0
Age baby should be given foods such as porridge for the first time		
	Less than 6 months	14.21
	At 6 months	79.62
	> 6 months	4.93
	Don't know	1.34
Age baby should be given fed to sweetpotato for the first time		
	< 6 months	3.50
	At 6 months	37.42
	7-11 months	19.92
	1 year	24.63
	Over 1 year	10.22
	Don't know	4.31

Table 32: Knowledge of the three basic foods

	Gender of the head			Area of study		
Overall (n=754)	Male (n=573)	Female (n=181)	P-value	Urban (n=256)	Peri-urban (n=495)	P-value
15.25	13.26	21.55	0.007	18.36	13.54	0.081

3.13.4 Source of information about young child nutrition

The respondents obtained information about infant and young child nutrition from various sources (Figure 19). Health centers were the most important source of information about infant and young child feeding with more that 60% of the respondents indicating that they obtained information from this source. The two other important sources of information on infant and young child feeding practices were mothers and other female relatives. Other common sources of information such as the radio, mother clubs/groups, churches/mosques and NGOs were not important sources of information among the study caregivers. For instance, only 13% of the respondents used radio as a source of information.

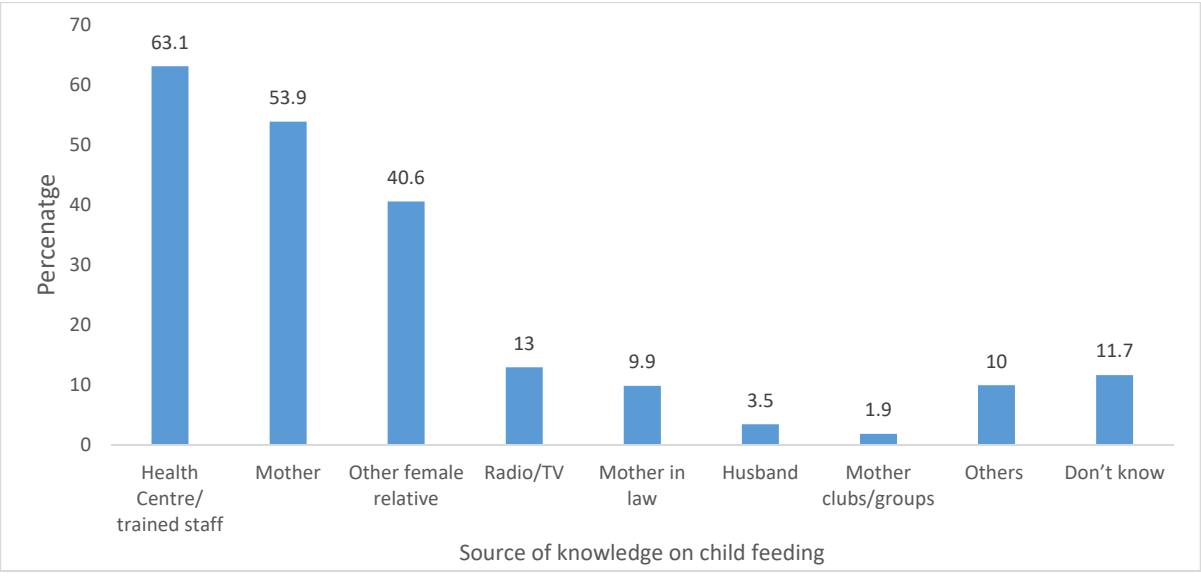


Figure 19: Source of information about child feeding among study caregivers, % who used a source

3.14 Minimum meal frequency

The frequency of feeding infant and young children has effect on their development. Children left under the care of others, especially siblings, may fail to reach at the required frequency. Results indicate that more than 50% of the study respondents left their young children (aged 6-23 years) under the care of another adult for more than one hour. At the same time, more than 40% of the respondents had left young children under the care of another child for more than one hour.

Results also indicate that almost all the children (94%) drank plain water during the day or night (Table 33). Other liquid foods consumed included milk, porridge and juice, although relatively fewer respondents fed their young children on these foods over the reference period. Among those that did, about 44% and 42% fed their children on porridge and juice, respectively.

Table 33: Minimum meal frequency for the children, % of responses

Meal frequency		Overall	Male-headed households	Female-headed households	P-value
Left the children under the care of another adult for more than 1 hour (n=200)		52.50	52.87	51.16	0.843
Left in the care of another child for more than 1 hour (n=199)		44.72	45.57	41.46	0.640
Drank plain water (n=193)		94.30	92.81	100	0.082
Drank infant formula (n=189)		25.93	28.00	17.95	0.204
Number of times child drank infant formula (n=49)					
	1-3 times	60.87			
	4-6 times	23.91			
	More than 6 times	15.22			
Proportion that drank milk, such as tinned, powdered, or fresh animal milk (n=40)		20.63			
Number of times child drank milk (n=49)	1-3 times	80.00			
	4-6 times	15.00			
	More than 6 times	5.00			

Table 34: Consumption of liquids by young children, % of responses

Liquid consumed		Gender of the head			Area of study		
	Overall (n=189)	Males (n=40	Female (n= 149)	P-value	Urban (n=42)	Peri-urban (n=147)	P-value
Milk based products	20.83	19.73	25.00	0.468	25.58	19.46	0.387
Juice or juice drinks	43.16	46.00	32.50	0.127	52.38	40.81	0.184
Vitamins/ mineral supplements/ medicines or juice drinks	13.02	13.16	12.50	0.913	16.28	12.08	0.474
Porridge	44.21	45.33	40.0	0.549	48.84	42.86	0.490

Results (Figure 20) also indicate that 59% of the children ate solid or soft mushy foods. Majority ate such foods during the breakfast and lunch. More than one-half ate mushy food during late morning, late afternoon and for dinner.

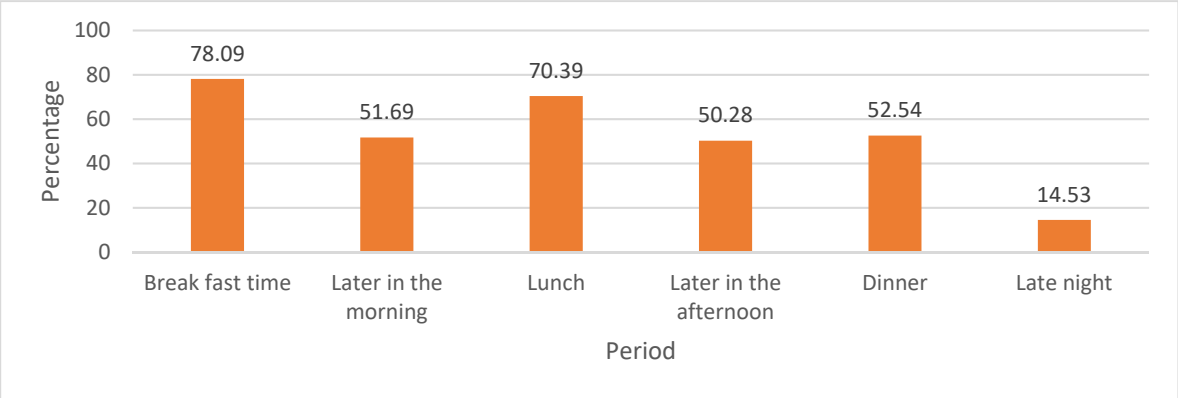


Figure 20: Times of the day child ate soft, marshy or solid foods; % of responses, n=179

3.15 Wash practices

Figure 21 shows that majority of the households drank water without boiling it. Water treatment practices, such as chlorination, filtering were also rare. The use of untreated water by the majority could expose young children to water-borne diseases.

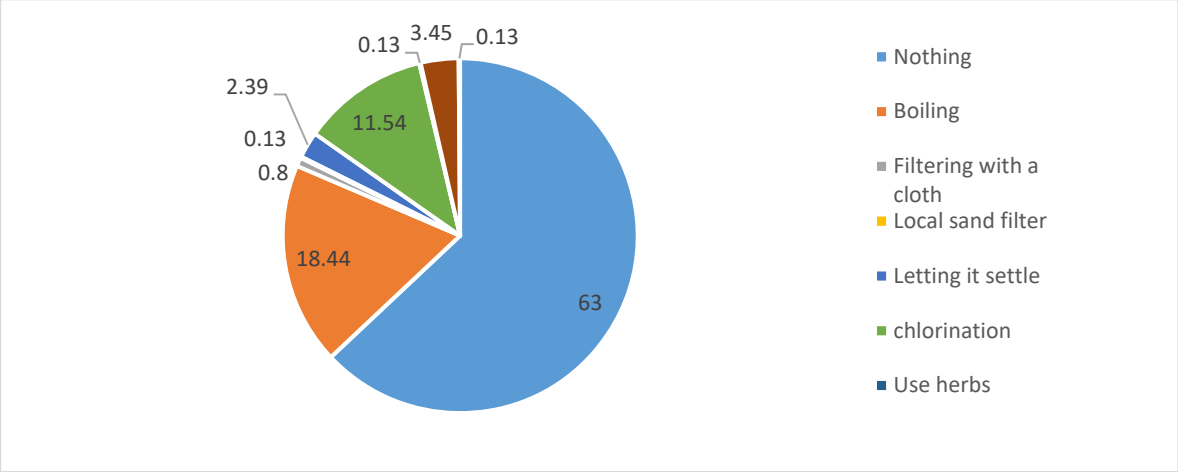


Figure 21: Treatment of drinking water before use among study respondents, % of responses

Overall, though, majority (more than 73%) of caregivers wash hands in instances that could expose young children to pathogens/infections (Table 35). More than 86% of the caregivers washed hands before handling food, before and after using the toilets.

Table 35: Washing of hands for various activities involved handling food (n=754)

Activity	Percentage
Proportion that washed hands before preparing food	90.05
Proportion that washed hands before serving food	86.07
Wash hands before eating	91.38
Wash hands before feeding children (n=697)	75.61
Proportion that wash hands after going to toilet/ defecation	86.47
Wash hands after cleaning children bottom (n=653)	73.05

Results (Table 36) also show that 72% of caregivers disposed of children's feces safely in a latrine while 15 % buried them. Only a small proportion of the households scattered feces around the compound or house, hence used a practice that can expose children to infection.

Table 36: What is done to children's feces (n=674)

What is done	Percentage
Thrown out with normal rubbish/trash	5.93
Deposited immediately in a latrine	72.26
Scattered around the compound/house	2.08
Buried	15.13
Thrown into the bush	1.63
Others	2.82
Thrown away with garbage	0.15

4. Results of consumer study

The survey showed that all 76% of the study respondents consume sweetpotato in boiled form. By comparison, only 51%, 63% of the respondents consume sweetpotato in roasted and fried form, respectively. Some 6% of the respondents consumed sweetpotato in other forms, the most common being porridge. Generally, a significantly higher proportion of the respondents in urban areas (81%) consumed sweetpotato in fried form than their counterparts in peri-urban (45%). Among the urban consumers, a significantly higher proportion consumed sweetpotato in fried form (81%) than in roasted form (57%).

4.1 Involvement

Descriptive statistics for the personal involvement scale revealed high internal reliability and high levels of mean involvement (Table 37). The results also indicated that product relevance was treatment-specific. In particular, the Treatment 2 sample showed a lower mean, a lower minimum value and greater variability. However, a series of independent-sample Kruskal-Wallis test was unable to reject equality of distributions of personal involvement across the treatment and control groups, as well as across products within each treatment group.

Table 37: Descriptive statistics for the personal involvement scale

	Mean	Std. deviation	Min	Max
Control (Agronomic information only)				
OSFP	110.5	17.5	73	140
Biscuit	104.7	21.7	54	133
Juice	105.8	19.2	77	140
Treatment 1(Nutrition)				
OSFP	104.8	19.4	47	140
Biscuit	102.0	21.9	48	140
Juice	106.0	18.2	71	140
Treatment 2 (Drawbacks)				
OSFP	103.7	21.1	47	140
Biscuit	97.9	21.1	56	140
Juice	102.3	20.0	61	140

4.2 Sensory expectations before tasting

Figure 22 shows the expected appropriateness of each sensory attribute for each product as assessed before tasting the products. There were differences in the taste attribute between information treatments only for juice (Kruskal-Wallis test statistic=12,738; df=2; p-value=0.002).

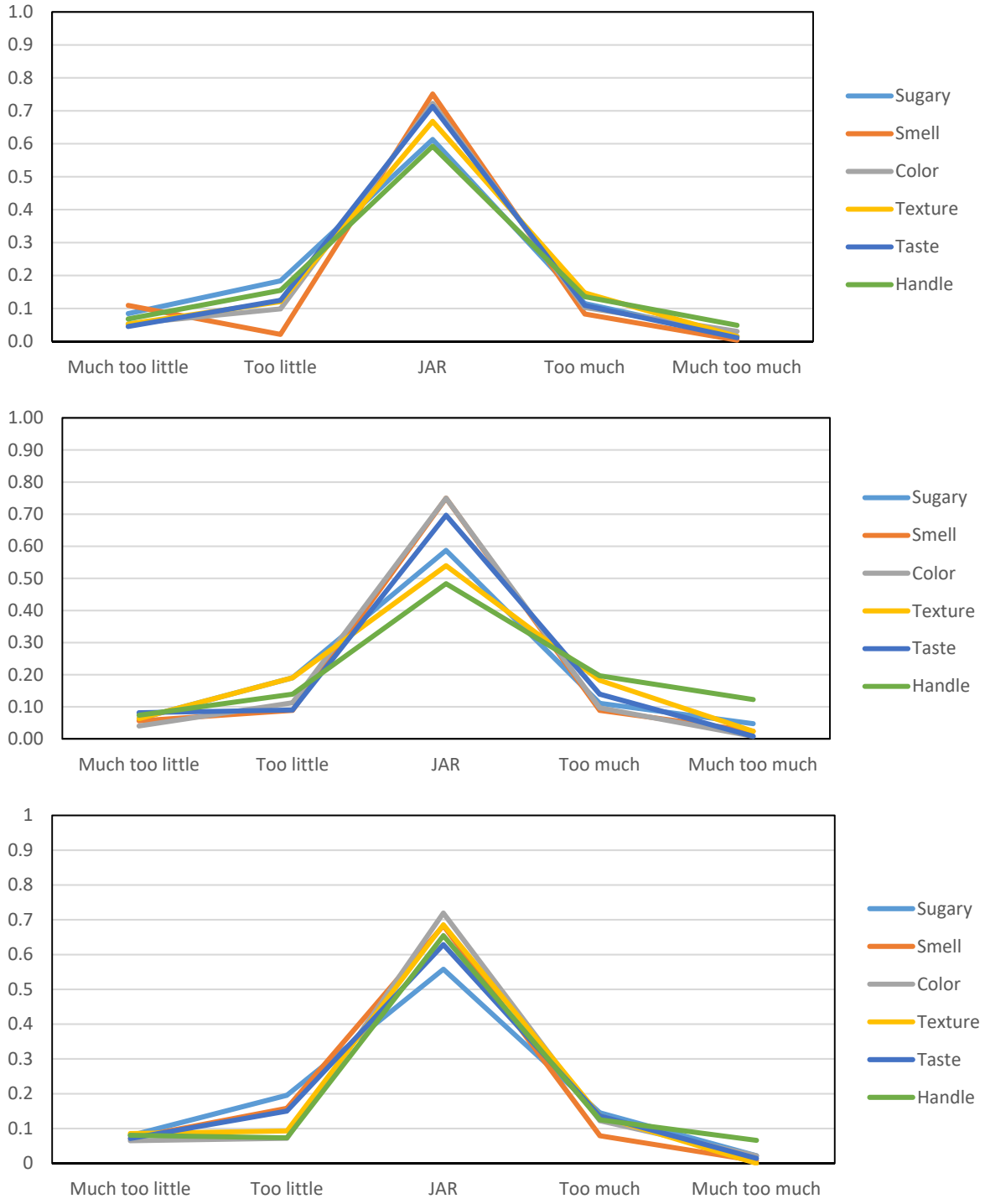


Figure 22: Appropriateness of sensory attributes before actual tasting for boiled OSFP root (top), biscuit (middle) and juice (bottom)

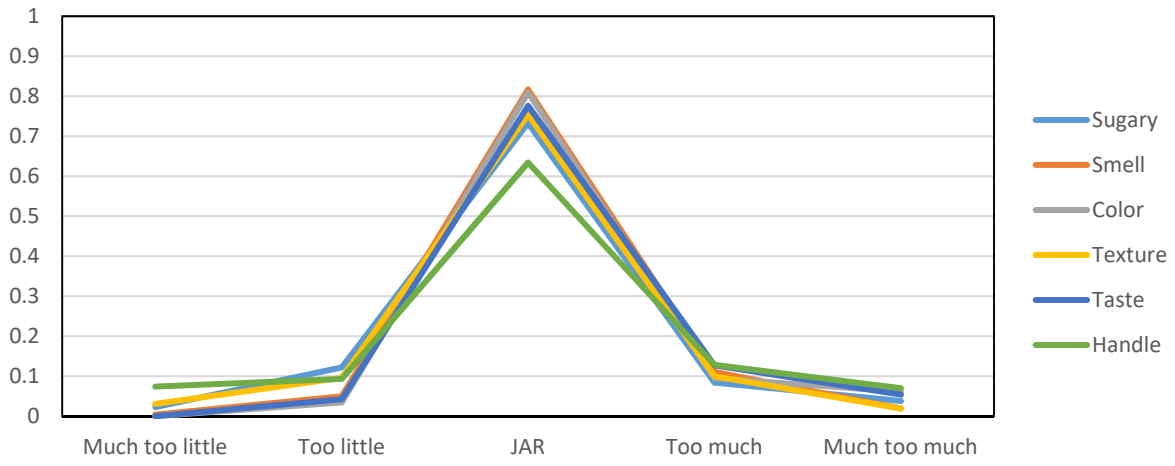
Before actual tasting, the respondents could only form sensory expectations based on the available treatment-specific information, prior beliefs and the visual appearance of the product as displayed. However, mental representation and processing of these stimuli is likely to have played a role in the formation of expected JAR scores (Carporale and Monteleone 2004). Results from the pair-wise tests showed that the information effect for taste was significant only between the Drawback and Control treatment groups (Mann-Whitney Z=-2.0; p-value=0.045). This means that information on VAD and biofortification influenced expectations on the taste of the product. Interestingly, for the Control group, a larger share of the participants considered the taste attribute to be in excess. The main effect of drawback information about biofortification for juice was therefore unexpectedly to decrease the product taste acceptability of the participants.

The relatively consistent JAR assessment of the sensory attributes across samples and products suggest that the product formulations was well-accepted. However, for the OSFP root there were a tendency for sweetness and handling (i.e. crumbliness) to be toward the range of too little. Similarly, for juice there were tendencies that sweetness, smell and taste were below the JAR-level. For the biscuit, there were, on the other hand, tendencies that the expected sweetness, handling and texture was slightly in excess.

4.2 Sensory assessment after actual tasting

For each product, Figure 23 shows the appropriateness of each sensory attribute as assessed after tasting the products. For each of the three products significant differences in the responses to the JAR scales across the three samples was revealed only for the biscuit. Here, differences in appropriateness were detected for smell (Kruskal-Wallis = 5.85; df=2; p-value=0.054), color (Kruskal -Wallis=13.13; df=2; p-value=0.001), and for taste (Kruskal-Wallis=5.83; df=2; p-value=0.054).

The results from the pair-wise tests on for the biscuit showed that the information effect was highly significantly different between the Drawback and Control treatment groups for smell (Mahn-Witney Z=-2.2, p-value= 0.027), color (Mahn-Witney Z=-3.56, p-value=<0.001) and taste (M-W=-2.2,p-value=0.26). There were also highly significant differences in appropriateness between the Nutrition and Control treatment groups for smell (Mann-Whitney=-2.09, p-value=0.037) and for color (Mann-Whitney=-2.64, p-value=0.008). No significant differences in appropriateness for smell, color and taste were revealed between the Nutrition and Drawback groups. These results suggest that the JAR ratings for smell, color, and taste in the Control group was more toward the “too much” level.



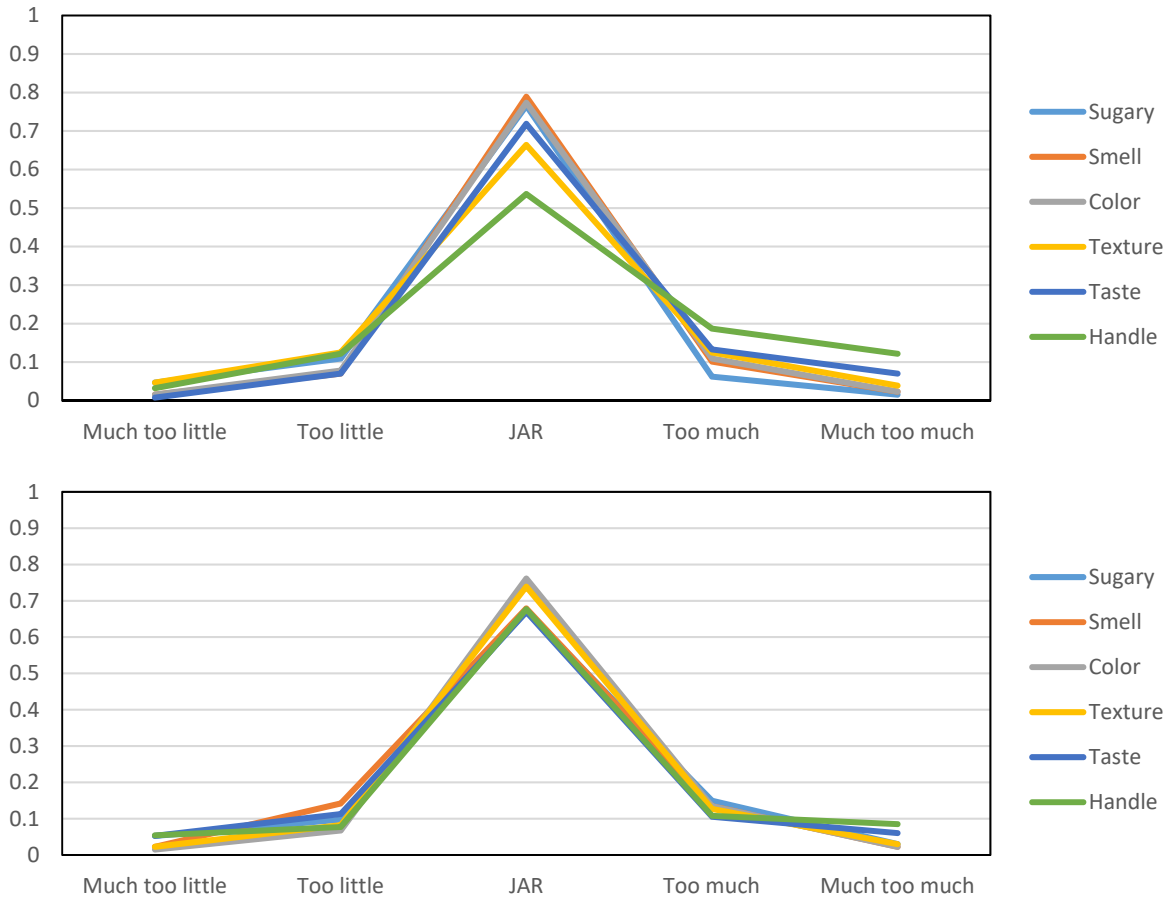
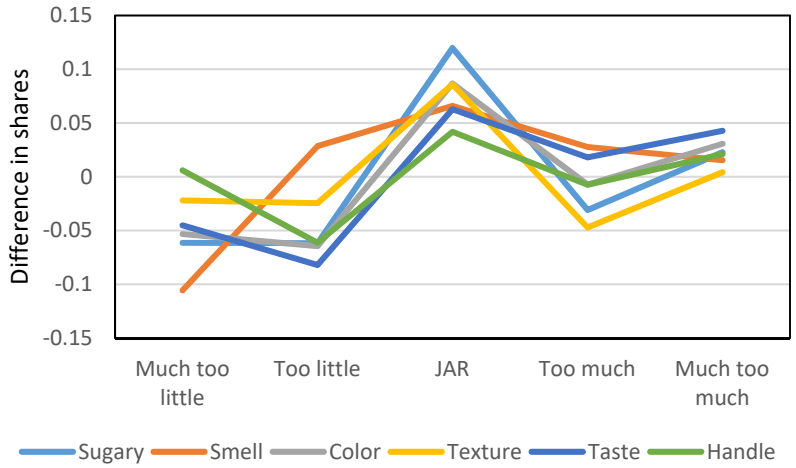
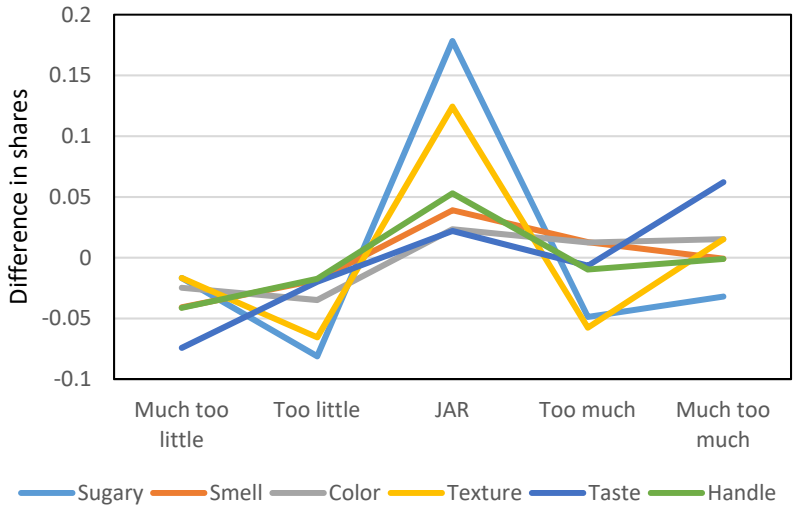


Figure 21: Appropriateness of sensory attributes after actual tasting for OSFP root (top), biscuit (middle) and juice (bottom).

With these relatively consistent assessments, it is relevant for product research and development purposes to consider how the sensory attributes can be summarized after tasting. Across the samples, the handling, texture and taste attributes for biscuits and the handling attribute for boiled OFSP root were considered to be above the ideal level. For the juice, the assessment of the sensory attributes was more unanimous toward the JAR.

Figure 24 shows the differences in JAR-responses after and before tasting for each product. Across products, the sweetness became more appropriate (more emphasis on JAR) after tasting. In addition, while there was an emphasis given to the JAR-level both before and after tasting, the tails of the JAR-scale distribution shifted from giving more weight to levels below JAR before tasting to instead giving more weight to levels above JAR after tasting. This suggests presence of lower anticipated sensory experiences before tasting and presence of sensory rejections after tasting. Both effects were, however, not substantial in levels. Across samples, for boiled OSFP root, the smell was more assessed toward 'too little' after tasting, whereas for biscuit, the JAR for sweetness and texture was given much more emphasis after tasting. For juice, the result after tasting suggests that the smell was increasingly considered as inappropriately too much. This finding may have been, in some instances, due to the changes taste caused by heat/high temperature when the product was exposed to sun during transportation to study area making it sour.





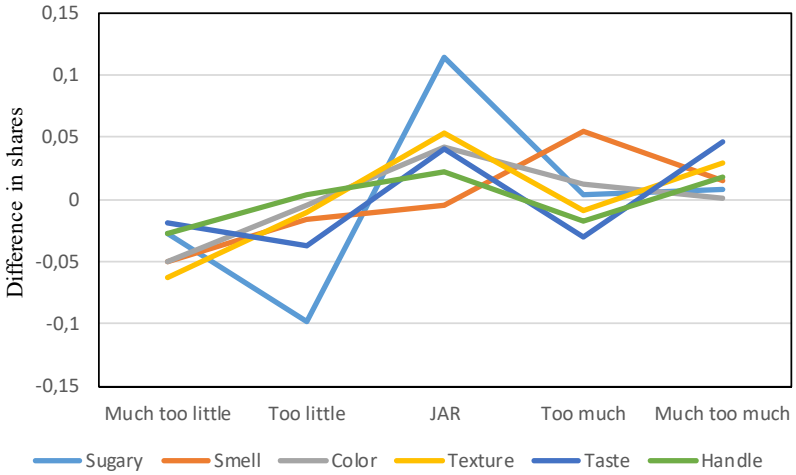


Figure 24: Differences in appropriateness of sensory attributes between after and before actual tasting for boiled OSFP root (top), biscuit (middle) and juice (bottom)

The results from the Friedman tests showed that there were treatment-specific differences between actual and expected sensory assessment (Table 38). The Control and Drawback groups showed more differences. The results for the Control group indicated that smell and color of boiled OSFP root and biscuit received higher ratings on the JAR-scale after tasting. The same effect was observed for texture and taste of OSFP root. For the Drawback group, the rating was higher on the JAR-scale for sweetness and smell for boiled OSFP root and juice, whereas the rating was higher on color and taste of OSFP. There were less significant differences in sensory assessment for the Nutrition group: however, the rating of smell increases for OSFP and juice and the taste attribute for boiled OSFP roots was rated higher on the JAR-scale.

Table 38: Tests of whether expected and actual sensory assessment originated from the same distribution.

	Control		Positive		Drawback	
	Friedman[a]	Sign.	Friedman[a]	Sign.	Friedman[a]	Sign.
Sugary						
OSFP					6.48	0.011
Biscuit						
Juice					5.45	0.20
Smell						
OSFP root	8.33	0.004	4.26	0.039	6.74	0.009
Biscuit	5.44	0.020				
Juice			5.33	0.021	3.24	0.072
Color						
OSFP root	6.54	0.011			3.60	0.058
Biscuit	8.00	0.005				
Juice						
Texture (dry matter)						
OSFP root	4.48	0.034				
Biscuit						
Juice						
Taste						
OSFP root	4.76	0.029	3.00	0.083	10.53	0.001
Biscuit						
Juice						
Handle (crumbliness)						
OSFP root	4.2	0.041				
Biscuit						
Juice						

Note: only significant results are presented.
[a] Related-samples test that the expected and actual appropriateness follow the same distribution.

4.3 Information effects on nutrition and liking

Table 39 shows the results for the cumulative link models for the response variables nutrition and liking, respectively. In addition to information treatment and product, the models included trial (i.e. before and after tasting) and the full set of two- and three-level interactions. The models for liking included the ordinal response on nutrition since the assessment of nutrition preceded the assessment of liking. For both the response variables the likelihood ratio statistic supported the mixed model estimation, which suggests that different participants had different intercepts.

As Table 39 shows, there was no significant main effect of information on nutrition. This result was unexpected. However, nutrition was rated high across treatments and products (median=2; mean=1.875; 1st quantile=1; 3rd quantile=3). This finding implies that neither the additional information on positive health benefits of vitamin-A biofortification nor the sensory drawbacks contributed to differentiation of the assessment of nutrition in relation to the assessment based on just agronomic properties. However, in Model 1 there was a main effect, suggesting that biscuit was considered lower in nutrition than boiled OSFP root, whereas in Model 2, juice was considered to be lower in nutrition. Furthermore, for both Models 1 and 2 there were no significant interactions between information and products.

Next, Table 39 shows significant effects of both information and products on liking for Model 3 but not for Model 1 and Model 4. The liking response variable was also highly rated across treatments and products ((median=2; mean=1.877; 1st quantile=1; 3rd quantile=3). The difference between the two models is interesting and suggest that the non-mixed model absorbs individual heterogeneity in liking while attributing this to treatment and products. Furthermore, the nutrition variable was highly significant in both Model 3 and Model 4. These findings suggest that the products being considered as highly nutritious was also more liked. In addition, in Model 4 there were two significant two-level interactions. For juice, the information about vitamin-A enrichment lowered liking. This result was consistent in that for juice, a higher rating of nutrition contributed to lower liking. For the three-level interactions, the results suggest that liking of juice increased with positive as well as negative information for respondents who considered the product more nutritious.

Table 39: Cumulative link models of treatment and product characteristics on nutrition and liking scoring

Response		Nutrition		Liking	
Cumulative link Models		Model 1	Model 2	Model 3	Model 4
Fixed effects	Treatment				
	dT1[a]	-0.107	-0.090	1.011***	0.093
	dT2[b]	-0.084	0.073	1.091***	0.308
	Product				
	dP1[c]	-0.331	-0.486**	1.213***	0.222
	dP2[d]	-0.376*	-0.228	0.064*	0.378
	Trial[e]	0.346***	0.470***	0.426***	0.312***
	Nutrition (*N*)	N.A.	N.A.	1.084***	0.935***
	Interactions				
	dT1× dP1	0.135	0.089	-1.611***	-0.245
	dT1× dP2	-0.004	-0.173	-0.477	-0.053
	dT2× dP1	-0.016	0.102	-2.470***	-0.915**
	dT2× dP2	0.151	-0.057	-0.912**	-0.348
	dT1×Nutrition			-0.419***	-0.053
	dP1×Nutrition			-0.652***	-0.259*
	dP2×Nutrition			-0.253	-0.166
	dT2×Nutrition			-0.545***	-0.192
	dT1× dP1×Nutrition			0.931***	0.403**
	dT1× dP2×Nutrition			0.186	0.129
	dT2× dP1×Nutrition			1.300***	0.531**
	dT2× dP2×Nutrition			0.384*	0.121
Random effects	Std. Dev Intercept	N.A.	1.005	N.A.	0.739
	Observations	1,046	1,046	1,046	1,046
	Clusters (participants)	N.A.	266	N.A.	266
Aikiake Information Criterion (AIC)		2989.9	2833.6		2323.2
logLik		-1479.9	-1400.8		-1136.6
LR.stat.[f]			158.3		96.1
Pr(>Chisq)			<0.001		<0.001

Note: ***, **, and * denote significance at <0.01, 0.05 and 0.1, respectively. Models 1 and 3 are cumulative link models (clm) whereas Models 2 and 4 are cumulative link mixed models (clmm)

[a] Dummy variable for treatment coded as; Drawback=1, Positive=0, Control=0.

[b] Dummy variable for treatment coded as; Positive=1, Drawback=0, Control=0.

[c] Dummy variable for product coded as; Juice=1, Biscuit=0, OFSP root=0.

[d] Dummy variable for product coded as; Biscuit=1, Juice=0, OFFP root=0.

[e] Dummy variable for time of observation coded as; After tasting=1, Before tasting=0.

F The likelihood statistic for the comparison of clm and clmm is LR=-2(l_{clm}-l_{clmm}) where l_{clm} is the log-likelihood of the clm model and l_{clmm} is the log-likelihood of the clmm model.

dPi is dummy variable for product i

dTi is the dummy for treatment i

4.4 Emotional responses to product information

The mean scores for the *EmoSemio* profile (Table40) revealed a dominance of positive emotions (i.e. items numbers 1-16) over negative emotions (i.e. item numbers 17-23) for all three products and across all treatments/groups. There were, however, little differentiation of emotions across products.

The relatively large number of non-discriminating emotions suggests that these emotions are less suitable for characterizing how the information treatment affected the actual sensory experience of the OFSP in this study context. However, as the levels of the emotions are well in line with those reported by Spinelli et al. (2014), the lack of discrimination seems less likely to reflect a lack of relevance, which is otherwise a well-established cause of non-discrimination (Delplanque et al. 2012).

5. Summary conclusions and implications

This in-depth study was aimed at understanding the socioeconomic and consumer characteristics of communities living urban and peri-urban areas of Beira city in Sofala province of Mozambique. It specifically examined the acceptance of products made from OFSP, as well as boiled OFSP roots among and peri-urban consumers in Beira city. It also investigated the effect of providing consumers with information about the beneficial aspects of vitamin A and drawbacks of biofortification process, especially on the sensory attributes of the sweetpotato products.

The study targeted households as both producers and consumers of sweetpotato. The consumer component was conducted as a field experiment. Thus, each household was randomly placed into one of the three treatment groups upon being recruited. The groups were: i) Control – received general agronomic information about OFSP and its benefits, ii) Treatment 1 – received positive information about vitamin A highlighting the benefits of OFSP, iii) Treatment 2 – received information about the negative effects of biofortification on OFSP. In each treatment group, consumers provided the expected and actual evaluation of the products based on their sensory attributes (sweetness/sugariness, smell, color, taste, texture and crumbliness/handling).

Table 40. Mean emotion scores using EmoSemio

			OSFP			Biscuit			Juice		
			C	T1	T2	C	T1	T2	C	T1	T2
1	It is an anti-stress: it calms me, it soothes me, it reassures me	Anti-stress	2.80	2.94	3.10	2.89	2.98	3.06	2.39	2.85	3.00
2	It relaxes me and make me feel carefree	Relaxed	2.88	3.08	2.91	2.67	2.80	2.70	2.43	2.91	3.10**
3	I associate it with amusement and fun	Amused	2.69	2.97	2.85	2.69	2.96	2.91	2.61	2.74	2.98
4	It makes me feel full of energy and reinvigorated	Energetic	3.05	3.22	3.18	3.25	2.78	3.00	2.57	3.09	3.10
5	It makes me merry	Merry	3.07	3.47	3.18	3.33	2.91	3.15	2.61	2.83	3.18
6	It makes me happy	Happy	3.03	3.12	3.29	3.20	2.96	3.28	2.74	3.00	3.22
7	It satisfies me	Satisfied	3.19	3.45	3.28	3.31	3.28	3.43	2.7	2.8	3.16
8	It makes me feel tender and affectionate	Gratified	2.49	2.88**	2.55	2.36	2.65	2.48	2.26	2.67	2.49
9	It gratifies me, reward me	Tender	2.69	2.97	2.71	2.39	3.02*	2.64	2.45	2.61	2.73
10	It makes me feel cuddled and loved	Cuddled	2.42	2.45	2.38	2.31	2.29	2.32	2.09	2.67	2.43
11	It communicates sensuality, it charms me	Sensual	2.41	2.53	2.43	2.28	2.40	2.17	1.96	2.28	2.57
12	It communicates security	Secure	2.53	2.61	2.63	2.19	2.43	2.64	2.09	2.63**	2.58**
13	I associate it to happy memories of childhood	Happy memory	2.49	2.49	2.69	2.67	2.52	2.64	1.91	2.34	2.61
14	It makes me feel good and generous	Generous	2.39	2.76	2.56	2.39	2.76	2.76	2.22	2.74	2.61
15	It surprises me	Surprised	2.74	2.97	3.06	3.22	3.04	3.02	2.59	3.41**	3.29**

16	It makes me curious	Curious	2.73	2.82	2.82	2.97	3.29	3.28	2.14	3.11*	3.03*
17	It makes me feel indifferent	Indifferent	1.90	2.12	2.26	1.91	2.09	2.28	1.91	2.02	2.23
18	It bores me	Bored	1.39	1.41	1.69**	1.39	1.33	1.69**	1.57	1.85	1.43
19	It makes me feel neglected, without any care for me	Neglected	1.40	1.41	1.56	1.31	1.37	1.55	1.45	1.55	1.48
20	It makes me feel sad	Sad	1.32	1.40	1.44	1.22	1.43	1.57	1.39	1.64	1.52
21	It disappoints me	Disappointed	1.29	1.46	1.42	1.19	1.44	1.54	1.35	1.59	1.44
22	It makes me feel guilty	Guilty	1.19	1.49	1.42	1.11	1.24	1.60*	1.39	1.76	1.51
23	It annoys me, it makes me nervous	Annoyed	1.14	1.49*	1.46	1.11	1.30	1.48*	1.39	1.54	1.58

Note: Hypothesis: for a given product, the distribution of the emotion is the same across categories of treatment.

Note: C=control, T1=Positive, T2=Drawback. * and ** denote significance at 0.05 and 0.10, respectively.

Results of the producer component indicate that the majority of the respondents were in middle age (45 years) and had relatively low levels of education (means of 4 years for women and 7 years for men). About 58% of the households had children under the age of 5 years, while more than one-half of both male- and female-headed households were engaged in non-farm related activities. This latter finding was attributed to the fact that the still included a large portion of urban and peri-urban populations with occupations in non-farm sector.

Most of the of the respondents did not grow sweetpotato. Only about one-third of the respondents had sweetpotato potato plots. Moreover, most (more than 98%) of the respondents had no formal training on sweetpotato production and do not use any external inputs in production. Only 2% used irrigation and just 1% applied fertilizers on sweetpotato. These findings imply, in general, that the sample of respondents had poor capacity (in terms of knowledge and skills) to undertake good agriculture. Further, most of the respondents obtained vines from own and family sources, but much less from outside sources. The results further showed that the respondents had a generally positive attitude toward sweetpotato, indicating that incorporating OFSP into their cropping system is not likely to face resistance.

This study also found that most of the study households were moderately food secure, but results indicate that there were moderate to high levels of anxiety over food supply situation in the households. Analysis of diets of children under 5 years of age and women of reproductive age (i.e. caregivers of the young children) found that the former were borderline in terms of adequacy of the foods they consumed 24-hours prior to the study. On the other hand, the caregivers did not attain the recommended level of diverse diet (i.e. at least five food groups). The HKI-derived frequency of consumption of vitamin A-rich foods indicated that the study community (from where the sample was drawn) was borderline in terms of vitamin A deficiency problems. These findings, taken together with those on food security, present a picture of households that are borderline in many of the measures of food security and nutritional adequacy.

The results of the consumer study found a relatively consistent JAR assessment of the sensory attributes across samples and products before the actual tasting. This implies that the product formulations were well-accepted by respondents. However, the sweetness and crumbliness of OSFP root tended to be evaluated on the lower side of the JAR scale (i.e. too little). For juice, consumers' expected evaluation of sweetness, smell and taste was also on the lower side of JAR-level, while for the biscuit, the consumers' expected evaluation of sweetness, handling and texture was on the higher side of the JAR scale (i.e. slightly in excess). Further, results

from the pair-wise Mann-Whitney tests showed that the information effect for taste was significant only between the Drawback and Control treatment groups. This implies that information on VAD and biofortification influenced expectations on the taste of the products.

After actual tasting of the products, significant differences in the JAR scale emerged only for biscuits. In particular, Mann-Whitney pairwise tests indicated that there was significant difference in smell between the Control and Nutrition groups and also between the Control and Drawbacks groups. The results from the Friedman tests showed that there were treatment-specific differences between actual and expected sensory assessment, with the Control and Drawback groups showing more differences.

The results of the fixed-effects linked regression model fitted to test the effect of information on differential assessment of the OFSP products found no significant effect of information about the positive aspects of vitamin A and the drawbacks of biofortification. However, further analysis found evidence that the products considered to be highly nutritious by the respondents were also more liked. Overall, the results of the consumer component of this study showed consistent and favorable evaluation of the OFSP products based on their perceived attributes. This implies that consumers generally found the products acceptable.

Several conclusions arise from this study. First, most respondents did not grow sweetpotato, but about one-half were eligible for receiving OFSP interventions because they either had a child under five years of age or were pregnant. Second, there was, generally, a positive attitude toward sweetpotato production and consumption among the study households. Third, the study households were, overall, moderately food secure, and those in urban areas were better off than their peri-urban counterparts in terms household food security. Fourth, the quality of diets consumed by the children under 5 years and women of reproductive age was low. Fifth, providing information about benefits of vitamin A and drawbacks of biofortification on sweetpotato had no overall effect on the overall liking of OFSP-based products. However, there were significant discriminating differences on the JAR rating of the attributes of OFSP-based products before and after the actual tasting of the products. Sixth, consumer evaluation of the OFSP products indicated that most would find them acceptable.

Appendix 1: Detailed sampling procedure

The data used to determine the respective proportions are presented in Table A1. It shows that Beira has 25 neighborhoods. These neighborhoods are unequally distributed over the administrative posts: PA5 (Urbano 5) has 3 households and PA 1 (Urbano 1) has 7 households. To The city has about 433 thousand inhabitants living in 94,900 households with on the average 4.56 members. The number of households per administrative posts households is also not constant and ranges from 2300 households in PA5 to 35,800 households in PA1. It was determined that for practical reasons the first sampling stratum would consist of eight neighborhoods. These eight neighborhoods would represent about one-third of the city's households. To maintain a similar proportion for each administrative post the number of neighborhoods in the sample has to be proportional to the number of households. Thus, the total sample of 8 neighborhoods needs to be distributed as follows: 2 neighborhoods in the administrative posts 1, 3 and 3 and only 1 in the admin posts 4 and 5.

Table A1: Sampling structure.

Geographic units	# Residents (rounded)	# of neighborhoods		Households		Average # of households per neighborhood	% of households in sample
		All	Sampled	#	size		
City (sum)	433000	25	8	94900	4.56	3796	32%
PA1	164000	7	2	35800	4.58	5114	29%
PA2	87000	5	2	19500	4.46	3900	40%
PA3	127000	6	2	26500	4.79	4417	33%
PA4	50000	4	1	10800	4.63	2700	25%
PA5	9000	3	1	2300	3.91	767	33%

The sample of neighborhoods was at random, except for the sample in PA5 (Urbano 5). The enumerators did a two-days training in the Nhangau neighborhood which for that reason was excluded from the final sample.

Table A2: Sampled neighborhoods, blocks and expected number of interviews

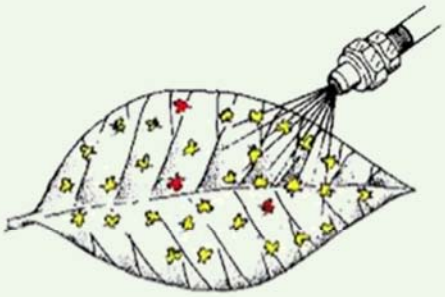
PA	Neighborhood	households	# blocks	households/ blocks	Sample size	Sampled blocks	Planned N°of interviews	N°. of households to jump
1	CHIPANGARA	6043	8	755	3	a,c,f	135	17
1	ESTURRO	5087	5	1017	2	b,d	90	22
2	CHOTA	1090	3	363	2	b,c	90	8
2	MARAZA	4530	6	755	2	b,d	90	8
3	ALTO DA MANGA	4037	5	807	2	b,c	90	9
3	INHACONJO	2708	6	451	2	a,c	90	5
4	NDUNGA	2100	7	300	2	b,e	90	3
5	TCHONJA	591	1	591	1	a	45	13
Sum		26186	41	639	16		720	14

Each neighborhood is subdivided in blocks. The eight selected neighborhoods have in total 41 blocks. Because there is no information about the number of households per block this was estimated as the quotient of the total number of households in the neighborhood and the number of blocks. As shown in the A1, this average varies from 300 in Ndunga to 1017 in Esturro. The subsample in the block stratum is again proportional to the number of blocks in each neighborhood. Thus it is 3 in Chipangara – the neighborhood with most blocks – and 1 in Tchonja, the least populous neighborhood with only one block. The team consisted of 15 enumerators and it was estimated that each enumerator would do three interviews per day. Each day would be dedicated to one block so that the total time for data collection would be 16 days. Sampling in each block was done using systematic random sampling technique.

Appendix 2: Product information given to each of treatment groups

B1. Control: General information (read to all)

Orange-fleshed sweetpotato as a crop grows quite fast and some varieties can even mature in 3-4 months, which give food to the farmer and potential to sell the product faster than the other types of sweetpotato, which mature in 6 months. In addition, the new varieties are resistant to some of the diseases and pest that often affect the white and yellow types of sweetpotato. This means that a farmer is able to harvest more from a given area of land.


B2. Treatment 1 information (in addition to general information):

Vitamin A is an essential nutrient crucial for maternal health and child survival. Vitamin A Deficiency leads to severe visual impairment and blindness, and significantly increases the risk of severe illness, and even death, from such common childhood infections as diarrhea disease and measles among children.

Plant source foods such as the orange flesh sweetpotato (OFSP) are an effective and sustainable strategy (or way) to address Vitamin A Deficiency among vulnerable populations in sub Saharan Africa. OFSP is a biofortified staple crop rich in provitamin A carotenoids, minerals such as iron and zinc and energy unlike vegetables. Biofortification is the idea of breeding crops to increase their nutritional value. OFSP has been developed through conventional selective breeding.

Vitamin A deficiency (VAD) remains a top public health problem in Mozambique and many other sub Saharan African countries. In Mozambique 69% of children under the age of five years are vitamin A deficient. One of the immediate causes of VAD is inadequate dietary intake of preformed vitamin A and food rich in provitamin A carotenoids such as the orange flesh sweetpotato (OFSP) by the vulnerable groups. Thousands of preschool children and pregnant women are currently at risk of VAD in Mozambique. Pregnant women are more vulnerable to VAD during the last trimester when demand by both the unborn child and the mother is highest

B3. Treatment 2 information (in addition to general information):

Orange Fleshed sweetpotato (OFSP) has been developed through a technology referred to as Biofortification. Biofortification is the idea of breeding crops to increase their nutritional value. In the process of improving the nutritional properties, some sensory attributes of OFSP are affected negatively.

For example, some consumers have felt that it becomes too soft when boiled and therefore does not feel like the white and yellow types they are used to. Others have felt that OFSP is not tasty as the WFSP and YFSP sweetpotato that you might be used to. Specifically, other consumers argue that OFSP is not as sweet (i.e. is less sugary) as the white and yellow types. There are also some consumers who say OFSP is only good for children due to its deep orange color, and not for grownups.

References

Agresti, A. 2002. Categorical data analysis. Second edition. Wiley. Hoboken: New Jersey.

Birol, E., Meenakshi, J.V., Oparinde, A., Perz, S. and Tomlins, K. 2015. Developing country consumers' acceptance of biofortified foods: a synthesis. *Food Security*, 7:555–568.

Caporale, G. and Monteleone, E. 2004. Influence of information about manufacturing process on beer acceptability. *Food Quality and Preference*, 15(3):271–278.

Cardello, A.V. 2003. Consumer concerns and expectations about novel food processing technologies: Effects on product liking. *Appetite*, 40(3):217–233.

Cardello, A.V., Meiselman, H.L., Schutz, H.G., Craig, C., Given, Z., Lesher, L.L. and Eicher, S. 2012. Measuring emotional responses to foods and food names using questionnaires. *Food Quality and Preference*, 24:243–250

Christensen, R.H.B. 2015. Analysis of ordinal data with cumulative link models – estimation with the R-package ordinal.

Clark, C.D. 1999. The autodriven interview: A photographic viewfinder into children's experience. *Visual Sociology*, *14:*39–50.

Clark-Ibáñez, M. 2004. Framing the social world with photo-elicitation interviews. *American Behavioral Scientist*, *46*:1507–1527.

Coates, J., Swindale, A. and Bilinsky, P. 2007. Household food insecurity access scale (HFIAS) for measurement of food access: Indicator guide. USAID and Academy for Educational Development, Washington DC, USA.

Desmet, P.M.A. and Schifferstein, H.N.J. 2008. Sources of positive and negative emotions in food experience. *Appetite*, 50:290–301.

Delplanque, S., Chrea, C., Grandjean, D., Ferdenzi, C., Cayeux, I., Porcherot, C. et al. 2012. How to map the affective semantic space of scents. *Cognition and Emotion*, 26(5):885–898.

Edwards, J.S.A., Meiselman, H.L., Edwards, A. and Lesher, L. 2003. The influence of eating location on the acceptability of identically prepared food. *Food Quality and Preference*, 14:647–652.

Gere, A., Sipos, L. and Héberger, K. 2015. Generalized pairwise correlation and method comparison: Impact assessment for JAR attributes on overall liking. *Food Quality and Preference*, 43:88–96.

Hagenimana, V., Low, J., Anyango, M., Kurz, K., Gichuki, S. T. and Kabira, J. 2001. Enhancing vitamin A intake in young children in western Kenya: Orange-fleshed sweet potatoes and women farmers can serve as key entry points. *Food and Nutrition Bulletin*, *22*(4):376–387.

Hitayezu, P., Okello, J. J. and Obel-Gor, C. 2014. Farm households' participation in rural non-farm employment in post-war Rwanda: Drivers and policy implications. *Development Southern Africa*, 31(3):452–474.

Kennedy, G. L., Pedro, M. R., Seghieri, C., Nantel, G. and Brouwer, I. 2007. Dietary diversity score is a useful indicator of micronutrient intake in non-breast-feeding Filipino children. *The Journal of nutrition*, *137*2:472–477.

King, S. and Meiselman, H.L. 2010. Development of a method to measure consumer associations associated with foods. *Food Quality and Preference*, 21:168–177.

Köster, E.P. 2003. The psychology of food choice: Some often encountered fallacies. *Food Quality and Preference*, 14:359–373.

Köster, E.P. and Mojet, J. 2015. From mood to food and from food to mood: A psychological perspective on the measurement of food-related emotions in consumer research. *Food Quality and Preference*, doi.org/10.1016/j.foodres.2015.04.006.

Lawless, H. T. and Heyman, H. 1998. *Sensory evaluation of food: principles and practices*. New York: Chapman & Hall.

Masumba, E. A., Kulembeka, H., Tollano, S. M. and Yongolo, M. 2004. Participatory evaluation of improved sweetpotato var ieties in Eastern Tanzania. *African Crop Science Journal*, *12*(3):259–265.

Namanda, S., Gibson, R. and Sindi, K. 2011. Sweetpotato seed systems in Uganda, Tanzania, and Rwanda. *Journal of Sustainable Agriculture*, *35*(8):870–884.

R Core Team. 2015. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienn a, Austria. URL https://www.R-project.org/.

Rousu, M.C., Monchuk, D.C., Shogren, J.F. and Kosa, K.M. 2005. Consumer willingness to pay for "second-generation" genetically engineered products and the role of marketing information. *Journal of Agricultural and Applied Economics*, 37(3):647–657.

Saghir, P., Njuki, J., Waithanji, E., Kariuki, J. and Sikira, A. 2012. *Integrating improved goat breeds with new varieties of sweetpotato and cassava in the agro-pastoral systems of Tanzania: a gendered analysis*. ILRI (aka ILCA and ILRAD).

Schifferstein, H.N.J. 2010. From salad to bowl: The role of sensory analysis in product experience research. *Food Quality and Preference*, 21:1059–1067.

Schouteten, J.J., De Steur, H., De Pelsmaeker, S., Lagast, S., De Bourdeaudhuij, I. and Gellynck, X. 2015. Impact of health labels on flavor perception and emotional profiling: A consumer study on cheese. *Nutrients*, 7:10251–10268.

Siegrist, M. 2008. Factors influencing public acceptance of innovative food technologies and products. *Trends in Food Science and Technology*, 19:603–608.

Skinner, J.D., Carruth, B.R., Wendy, B. and Ziegler, P.J. 2002. Study of the effects of snack-centered dietary education on first-grade elementary students and duration of these effects *Journal of the American Dietetic Association*, 102(11):1638–1647.

Spinelli, S., Masi, C., Dinella, C., Zabolini, G.P. and Monteleone, E. 2014. How does it make you feel? A new approach to measuring emotions in food product experience. *Food Quality and Preference*, 37:109–122.

Spinelli, S., Masi, C., Zoboli, G.P., Prescott, J., and Monteleone, E. 2015. Emotional responses to branded and unbranded foods. *Food Quality and Preference*, 42:1–11.

Swindale, A. and Bilinsky, P. 2006. Development of a universally applicable household food insecurity measurement tool: process, current status, and outstanding issues. *The Journal of nutrition*, *136*(5):1449S–1452S.

Tomlins, K., Rwiza, A., Nyango, A., Amour, R., Ngendello, T., Kapinga, R., Rees, D. and Jolliffe, F. 2004. The use of sensory evaluation and consumer preference for the selection of sweetpotato cultivars in East Africa. *Journal of the Science of Food and Agriculture* 84:791–799.

Tomlins, K., Ndunguru, G., Stambul, K., Joshua, N., Ngendello, T., Rwiza, E., Amour, R., Ramadhani, B., Kapande, A. and Westby, A. 2007. Sensory evaluation and consumer acceptability of pale-fleshed and orange-fleshed sweetpotato by school children and mothers with preschool children. *Journal of the Science of Food and Agriculture* 87:2436–2446.

Tomlins, K., Owori, C., Bechoff, A., Menya, G. and Westby, A. 2012. Relationship among the carotenoid content, dry matter content and sensory attributes of sweet potato. *Food Chemistry*, 131:14–21.

World Medical Association (WMA) 2013. Declaration of Helsinki: ethical principles for medical research involving human subjects. *Journal of the American Medical Association* 310(20):2191-4. doi: 10.1001/jama.2013.281053.

Van Oirschot, Q.E.A., Rees, D. and Aked, J. 2003. Sensory characteristics of five sweet potato cultivars and their changes during storage under tropical conditions. *Food Quality and Preference*, 14:673–680.

Zaichkowsky, L. 1985. Measuring the involvement construct. *Journal of Consumer Research*, 12(3):341–352.

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