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Maize Consumption Patterns and Consumer Preferences in Zambia

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1. INTRODUCTION

Maize is the major food crop in most of eastern and southern Africa. It covers 23 percent of the primary cropping area in eastern Africa and 24 percent in southern Africa, and it accounts for 22 percent and 21 percent of the calorie supply, and 30 percent and 27 percent of the protein supply, respectively. As a result of its importance, a large share of food crop research in Africa is devoted to maize. However, while the production and food supply statistics have been collected for 50 years, little is known about the consumption side.

As with other eastern and southern African countries, there are several datasets and studies on maize production and maize seed systems in Zambia (Howard and Mungoma, 1997; Kassie et al., 2012; Kumar, 1994a). However, nationally representative data and studies on maize consumption patterns are limited. Some consumer studies were conducted in Lusaka (Diskin and Kipola, 1994; Mason and Jayne, 2009) and in some specific rural areas (Hotz et al., 2011), but so far, no countrywide rural consumer studies have been conducted in Zambia to shed light on how maize is stored, consumed, and prepared, or even how people like their maize products and preparations.

In Zambia, HarvestPlus and its partners are working to develop and disseminate vitamin A-enriched orange maize varieties in order to help tackle vitamin A deficiency among rural populations. There is some encouraging evidence on rural consumers' acceptance of orange maize varieties (Meenakshi et al., 2012), as well as on the orange maize varieties' ability to retain vitamin A when stored and processed (Li et al., 2007; Mugode et al., 2014), and the human body's absorption of the vitamin A in orange maize (Li et al., 2010; Muzhingi et al., 2011). However, information on the maize storage and preparation processes and habits across Zambia is limited. This type of information is important for orange maize breeding and delivery efforts to be successful, since storage and processing can change the vitamin A content of the orange maize varieties. Moreover, awareness and information campaigns are key to orange maize varieties' being widely accepted, adopted, and consumed (Meenakshi et al., 2012). For such campaigns to be designed and implemented effectively, information is needed on the rural population's major and trusted sources of information and on their knowledge of vitamin A. The aim of this paper is to shed light onto these issues with information from major maize-producing areas of Zambia.

2. DATA SOURCE

Zambia is divided into three agro-ecological zones, with rainfall as the dominant distinguishing climatic factor (Figure 1) (Aregheore, 2009; CEEPA, 2006). Zone I lies in the western and southern parts of the country and accounts for about 15 percent of the land area. It used to be

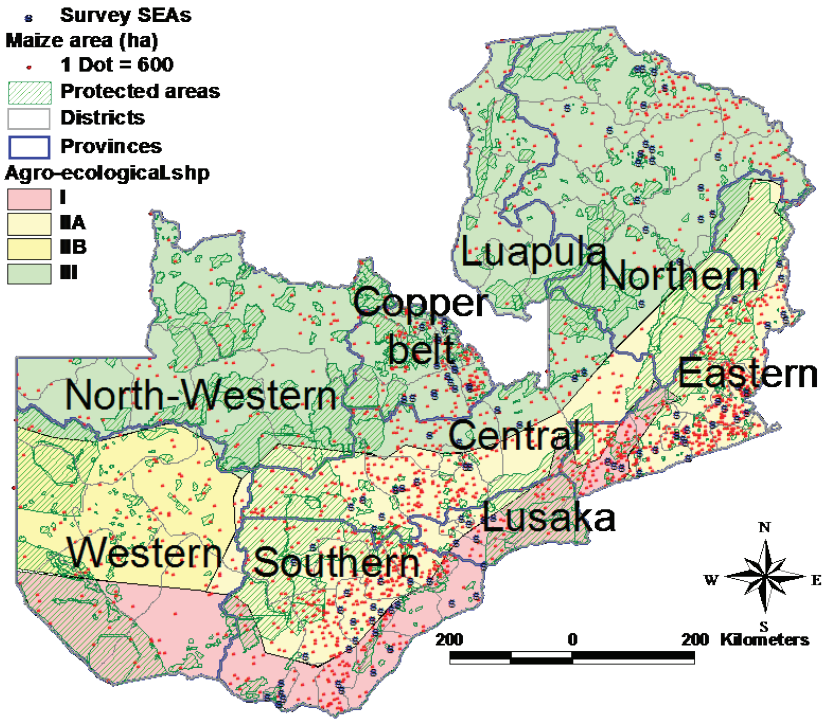

Figure 1: Agro-ecological Zones (AEZs) and Provinces of Zambia, with Population Density

considered the breadbasket of the nation, but for the last 20 years it has been experiencing low, unpredictable and poorly distributed rainfall. It currently receives less than 800 millimeters (mm) of rain annually.

Zone II covers the central part of the country, and receives 800–1,000 mm of rainfall annually, which is evenly distributed over the single cropping season. Zone II is divided into two subzones. Subzone IIA, in the east, is the most populous zone, with relatively fertile soils and the highest agricultural potential. Subzone IIB, in the west, is distinguished by low fertility, coarse sand, and alluvial soils.

Zone III spans the northern part of the country. It receives more than 1,000 mm of rainfall annually, but has poor soils and relatively low population density.

Rural households in the major maize-growing areas of Zambia comprise the population that is the focus of this study. After mapping the district-level maize production data, three agro-ecological zones (AEZs) (I, IIA, and III) and six provinces covering most of these AEZs were retained (Copperbelt, Central, Eastern, Lusaka, Northern, and Southern provinces). The selected areas covered most of the maize-growing areas and most of the population.

Rural households were selected in a stratified, two-stage sampling design using the three AEZs and standard enumeration areas (SEAs). Both the head of the household, usually a man, and the wife or oldest female were interviewed.

The survey consisted of a range of modules covering maize production; food consumption; awareness and knowledge of vitamin A and its sources; sources of information on agriculture, nutrition, and health; and use of various media sources (De Groote et al., 2011).

The survey was conducted from June to August of 2011. In total, 1,128 households were visited, and 633 men and 467 women were interviewed as primary respondents in 35 districts of the six retained provinces.

3. RESULTS

3.1 Seasonal pattern of maize production, sales, storage, and purchase

During 2010, the year before the survey, households harvested maize from April through July. However, the harvest is clearly concentrated in the two peak months of May and June (Figure 2), with some variation by AEZ and time of planting. Most households remove their maize from the fields, and store it on the cob as the harvest season progresses. The cobs are mostly stored in traditional open structures where they can dry. The shelling of the cobs takes place over a longer period, with a less pronounced peak in July and August.

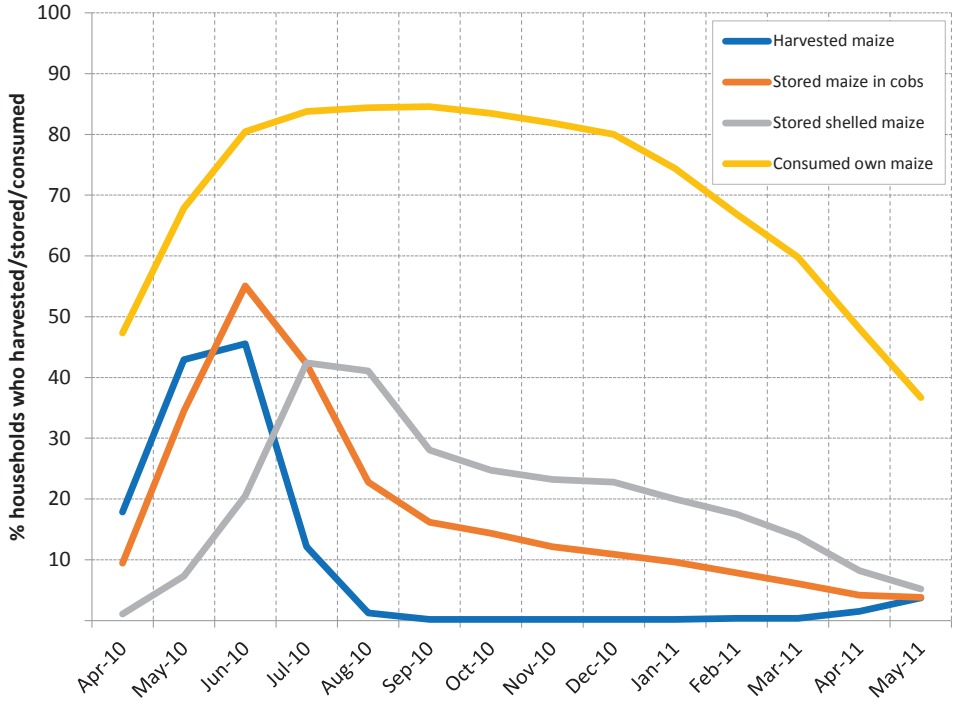

Figure 2: Harvest, Storage, Consumption, and Purchase Patterns

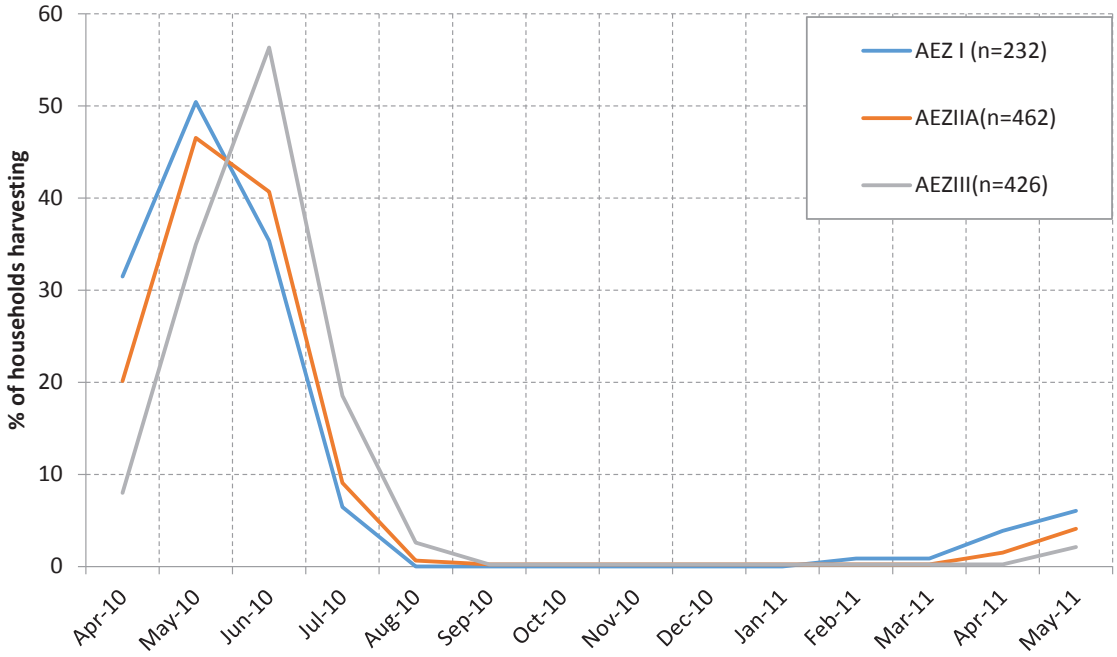

Figure 3: Maize Harvesting Patterns in the Different Agro-ecological Zones
(in % of households harvesting that month, with multiple months possible)

In April 2010, just before the harvest, half of the households were still consuming maize from their own stores harvested in the preceding season (2009). The proportion of households consuming their own stocks increased to more than 80 percent just after the harvest, remaining near that level for seven months until December 2010, when it began to gradually decline to 50 percent in April 2011. Few households bought maize grain during 2011. The highest proportion of households purchasing maize grain was under one in five in February and March. Even fewer households had purchased maize meal (fewer than one in ten at peak purchase time in May).

Some differences are observed among the zones in maize harvesting and storage. Farmers in Zone I harvest earliest (Figure 3): 50 percent harvested in May, and another 35 percent harvested in June. Farmers in Zone IIA have a similar pattern, although their harvests are spread more evenly between months: 37 percent in May and 41 percent in June. In contrast, most farmers in Zone III harvest about one month later: only 35 percent harvested in May and 56 percent harvested in June.

The patterns of maize storage are similar for the different zones. First, farmers store the maize cobs, with a clear peak for all zones in June (Figure 4). A higher percentage of households store maize cobs in June in Zones I and IIA (60 percent), compared with Zone III (44 percent). The pattern is also more spread out in Zones I and IIA, indicating that farmers there take longer to put their cobs in storage, especially in Zone IIA. For storing grain, the pattern differs in Zone III, where maize is stored mostly in July (51 percent) and August (36 percent). In the other two zones, the peak month for storage is August, although many households also store grain in July and it continues through March. The pattern of shelling is similar in all zones: the peak month for shelling is July for all zones, but the concentration in July is higher in Zone III (50 percent of respondents shelling) than in the other zones (30 percent).

Most households were self-sufficient in maize throughout the year, except in Zone I, where up to 35 percent of households purchased maize grain in the peak month, and about 20 percent of households purchased maize grain for a period of four months (Figure 5). In any given month in Zones IIA and III, at most 20 percent and 11 percent of households, respectively, purchased grain.

Slightly more than half of the households sold maize, and they sold it during the month of harvest and two months thereafter (June–August). By far, the largest purchaser of maize grain from farmers was the Food Research Agency (72 percent of farmers), followed, by a significant margin, by direct sales to consumers (15 percent). Only 6 percent of farmers sold grain to traders, and very few sold grain to other buyers, such as retailers and processors. Most grain was sold on the local market.

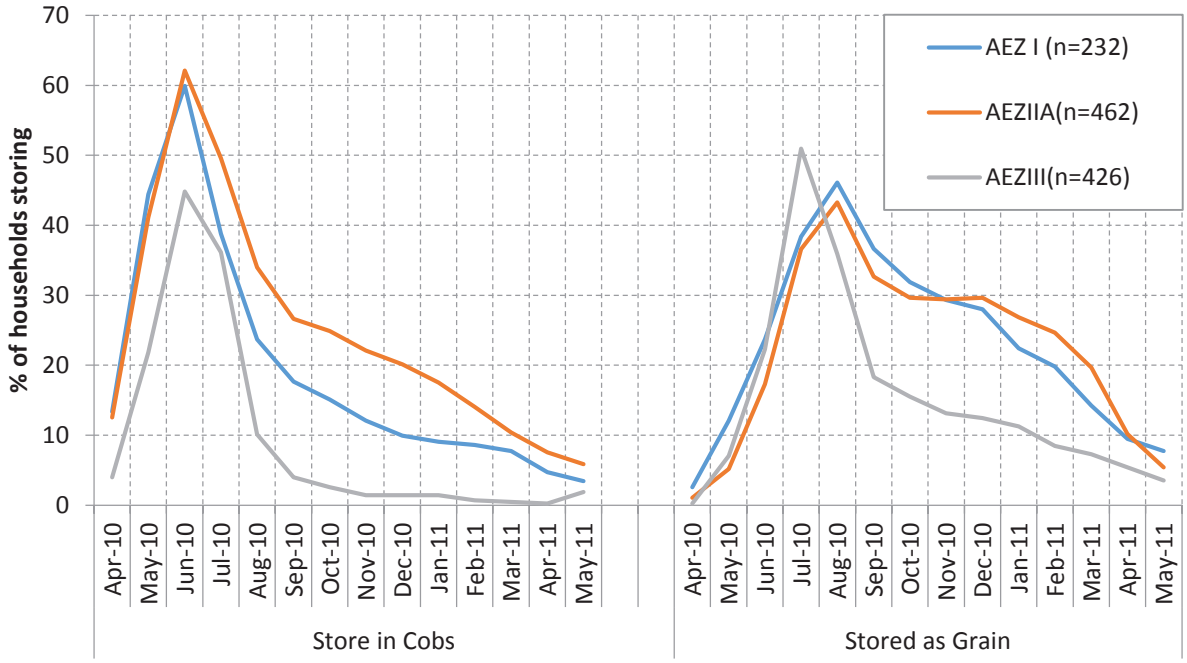

Figure 4: Maize Storage Patterns in the Different Agro-ecological Zones

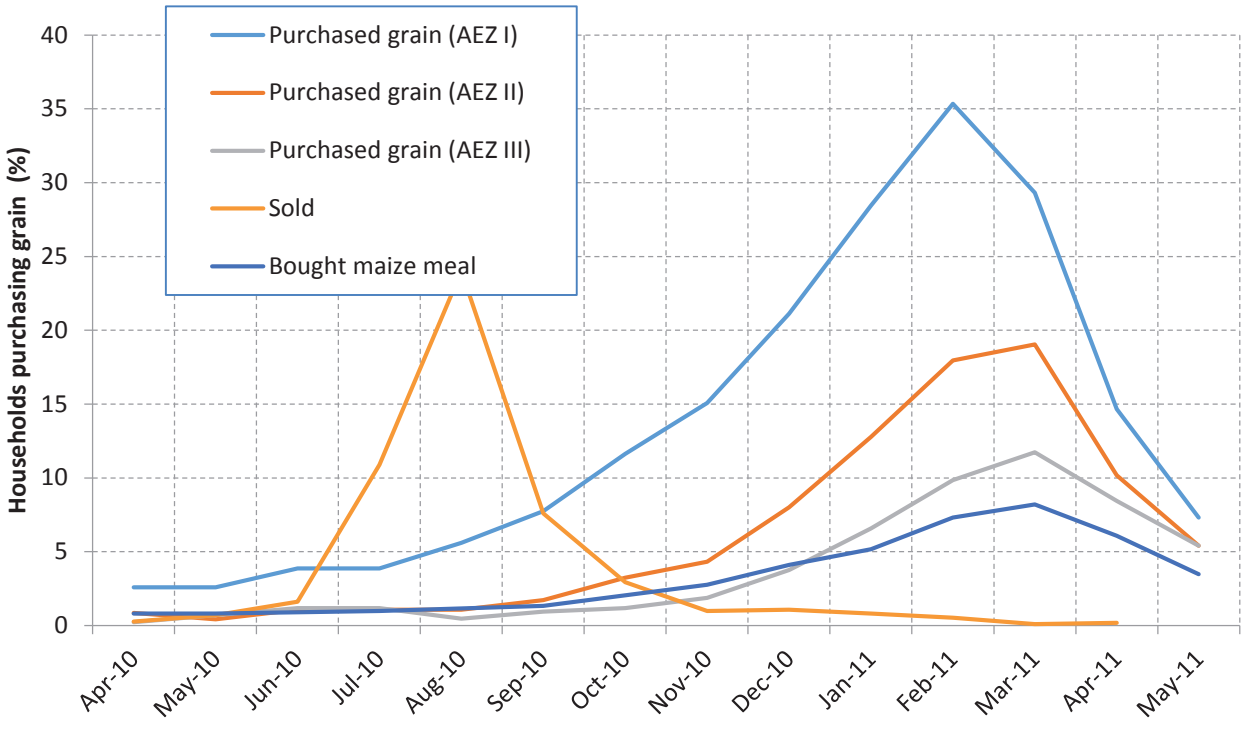

Figure 5. Distribution of Percentage of Households that Sold and Purchased Maize Grain
(by month and by zone)

3.2 Maize Production & Food Consumption

The survey results indicate that rural households cultivate large areas of maize: on average 2 hectares (ha), with slightly more in Zone IIA (2.3 ha) and less in Zone III (1.7 ha) (Table 3). On average, households produce more than 3 tons of maize, although this is substantially less in Zone I (2.3 tons). A slight majority of the households (52 percent) sell maize, although again substantially less in Zone I (42 percent) than in the other zones (more than 60 percent).

Estimated maize losses during storage are substantial: 15 percent loss during storage in cobs, and 12 percent during storage in grain. These losses are much higher in the hotter Zones I and IIA, and substantially lower in the cooler Zone III (3 percent and 5 percent, respectively). About a third of households do not produce enough maize to cover their needs for the whole year, and need to purchase grain on the market, on average during one month of the year. The situation is worse in Zone I, where 45 percent of households buy maize for an average period of two months. According to households' own estimates, the average maize consumption per adult equivalent (AE) is about 100 kilograms (kg) per year, although consumption is higher in Zone III (113 kg/AE/year) and lower in Zone I (81 kg).

This survey did not collect detailed information on the quantity of maize consumed by household members. A detailed, albeit outdated, food consumption study conducted in the Eastern Province in 1986 estimated maize consumption to be 483 grams (g)/person/day (Kumar, 1994b), or 176 kg/person/day. According to the FAO food balance sheets, the total maize supply decreased from a peak of 450 g/capita/day in 1980 to 300 g/capita/day in 2009. In 2009, maize accounted for 49 percent of the energy supply, 51 percent of the protein, and 26 percent of the fat supply in the national food supply (FAOSTAT, 2010). A more recent study by Hotz et al. (2011) in Mkushi and Nyimba provinces of Zambia found that an average woman of child-bearing age consumed 287 g/day of maize (or 105 kg/year), whereas children 2–5 years of age consumed about 172 g/day.

This survey implemented a food frequency module for key food groups. Results indicate that the most common food consumed in the 24 hours preceding the survey was vegetables—green leafy vegetables and others—consumed by more than 80 percent of the households (Figure 4). Maize came third, consumed by 80 percent of households, while other cereals were consumed by only 16 percent of households. Besides being the most frequently consumed cereal, maize was the most frequently consumed staple food. Other popular food items were sugar (which is fortified with vitamin A in Zambia) (68 percent); nuts (60 percent, mostly peanuts); and oils (59 percent). Root crops and legumes were less popular, each eaten by less than half of the households, followed by fish, eaten by a third of the households. Fruits were eaten by less than a quarter of the households, and so were animal products other than fish. Orange-fleshed sweet potatoes, rich in vitamin A, were eaten by only 12 percent of the households, and Blue Band margarine (also fortified with vitamin A) was consumed by a minor percentage of the households surveyed.

Table 1. Maize Production and Consumption

	AEZ I		AEZ IIA		AEZ III		All	
Variable	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Maize area (ha)	2.0	3.2	2.3	2.4	1.7	2.2	1.96	2.53
Maize production (kg/HH)	2291	4109	3526	5773	3719	7015	3344	6017
Sales (% households)	42		61		63		52	
Stored, shelled maize (months)	3.2	3.7	3.1	3.7	2.1	2.7	2.8	3.4
Stored, unshelled maize (months)	2.9	3.8	3.9	4.5	1.3	1.7	2.7	3.7
Loss (% loss estimate cobs)	19.8	22.9	23.6	24.1	2.7	7.0	15.3	18.0
Loss (% loss estimate grain)	14.6	22.8	17.4	24.5	5.3	12.8	12.4	20.1
Purchase (% households)	45		34		19		31	
Purchase (months)	1.9	3.0	0.9	1.7	0.5	1.5	1.0	2.0
HH size	7.1		7.2		6.5		6.9	3.2
Adult equivalent	6.5	3.0	6.6	3.0	5.9	2.6	6.3	2.9
Maize consumption (kg) per AE	81.2	64.1	100.5	72.8	112.5	88.6	100.4	78.6
N	232		462		426		1120	

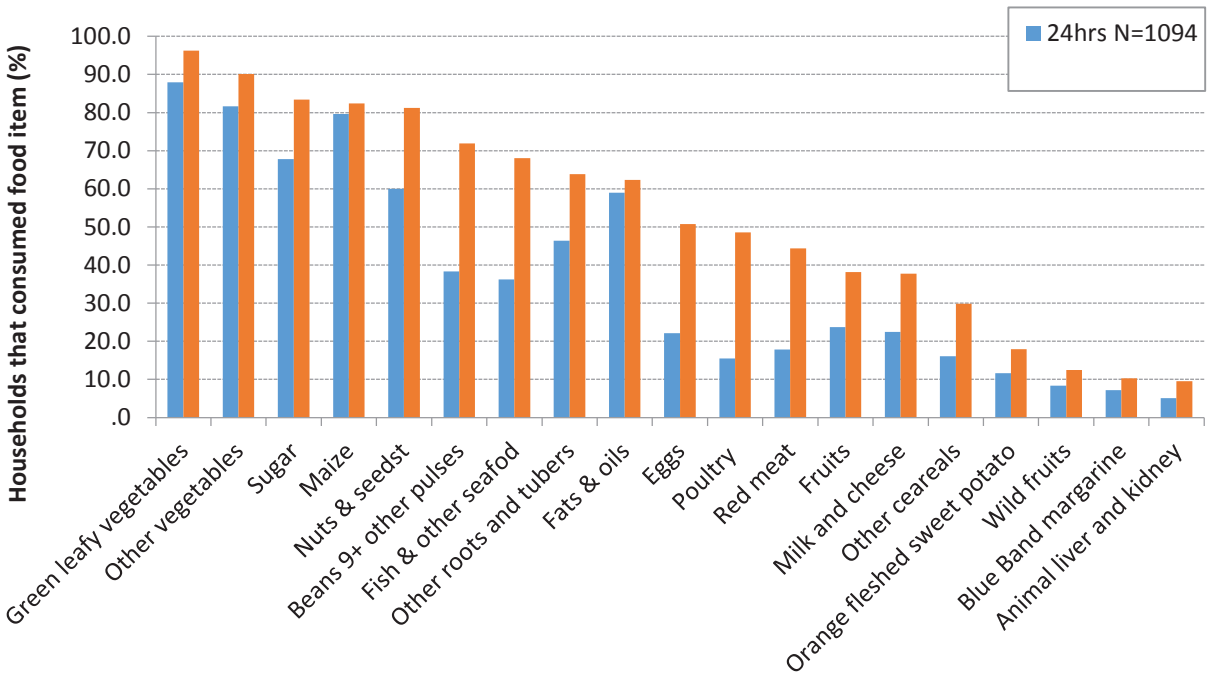

Figure 6: Frequency of Household Food Consumption for the Last 24 Hours and the Last 7 Days (N=1094)

Comparing the three zones' frequency of household food consumption in both 24 hours and seven days shows a similar picture of importance of food items. Vegetables and maize are the most important items in all zones, although sugar moves ahead of maize when reported over the seven days, while fats and oils move down. However, there are some substantial differences across zones (Figure 7). Zone III is clearly better off: for almost all food categories, more respondents from Zone III reported having consumed the food product when compared to Zone I or Zone IIA.

Furthermore, more households in Zone III reported consuming maize, but also other cereals. In the more important categories other than maize, households in Zone I are clearly worse off, with fewer reporting consumption of food from these categories. Households in Zone IIA are mostly in between their counterparts in Zones I and III, except for maize: only 65 percent reported eating maize in the last seven days, as compared with 86 percent in Zone I and almost all households in Zone III.

This food frequency survey allows calculation of the household dietary diversity score (HDDS) (Swindale and Bilinsky, 2006). Of the 19 categories listed in Figures 6 and 7, rural households consumed on average about six categories in the last 24 hours, and eight categories in the last seven days. Households in Zone III clearly have more diversity in their diet, with substantially higher scores (6.8 for the 24 hours and 8.4 for the seven days recall) than households in Zone I and IIA.

Figure 8 shows that almost all households ate nshima (stiff maize porridge) for lunch (99 percent) and for dinner (98 percent), and most households also ate it for breakfast (78 percent). The second most popular dish is Samp, which is most frequently consumed for breakfast (80 percent), but also for lunch (65 percent) and dinner (61 percent). Boiled maize is generally the third most popular maize product, and is eaten for breakfast (62 percent) and lunch (57 percent). Porridge was only eaten for breakfast (72 percent), and roasted maize and popcorn were eaten only as snacks, both by 66 percent of households.

Only minor differences were observed in the frequency of consuming maize preparations among zones. With the exception of nshima, there were substantial differences in consumption of foods made from maize among the three major language groups (Figure 9). The importance of nshima for lunch and dinner was similar, with almost all households having eaten it in the last week, regardless of ethnic group. The other maize preparations were generally eaten more frequently by the Tonga speakers, less by the

Nyanja speakers, with Bemba speakers in the middle. The Tonga ate more frequently maize nshima or porridge for breakfast than the other groups, and more Samp and boiled maize (at any time). The Nyanja, on the other hand, ate maize less frequently than the other groups, in particular as Samp and as boiled maize. In Zone I, two-thirds of respondents were Tonga speakers, and most of the rest spoke Nyanja, while in Zone IIA two-thirds were Nyanja speakers and the rest were Tonga speakers, while almost all respondents in Zone III were Bemba speakers.

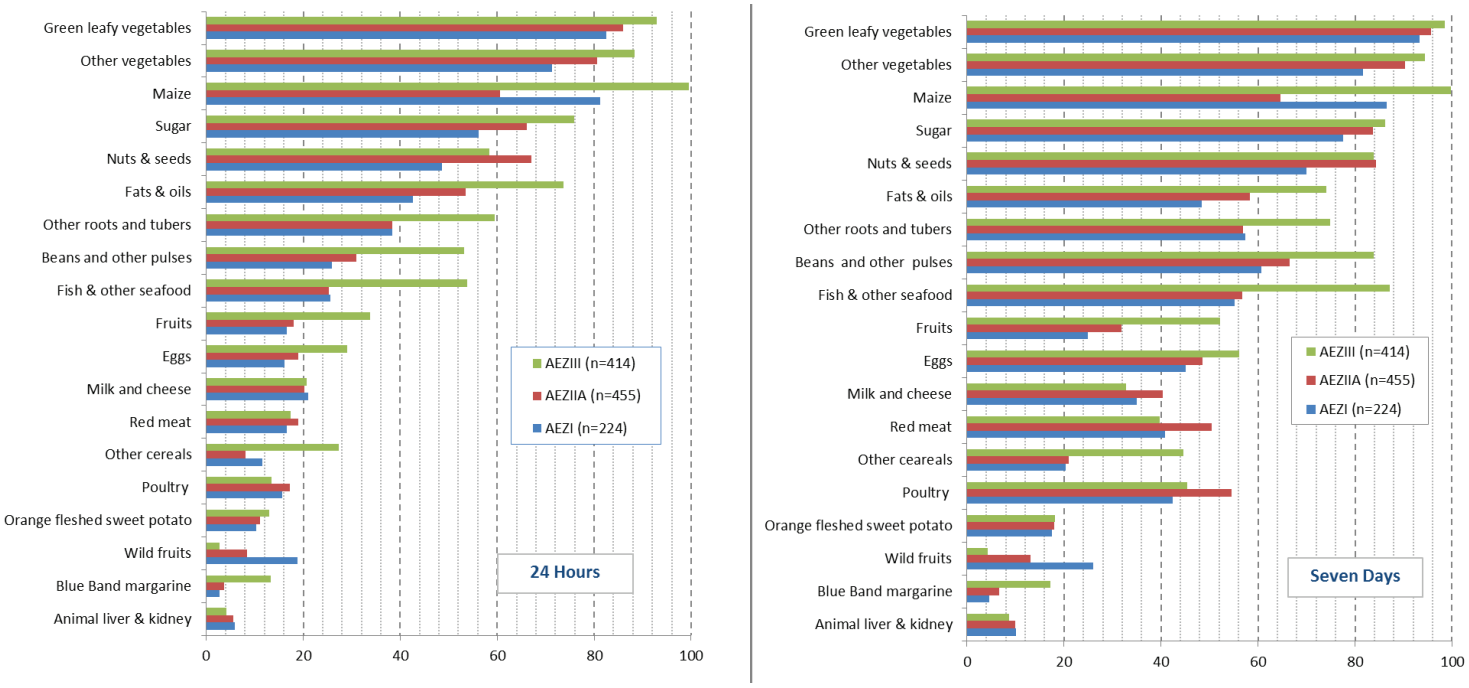

Figure 7: Frequency of Household Food Consumption for the Last 24 Hours and the 7 Days, by Agro-ecological Zone

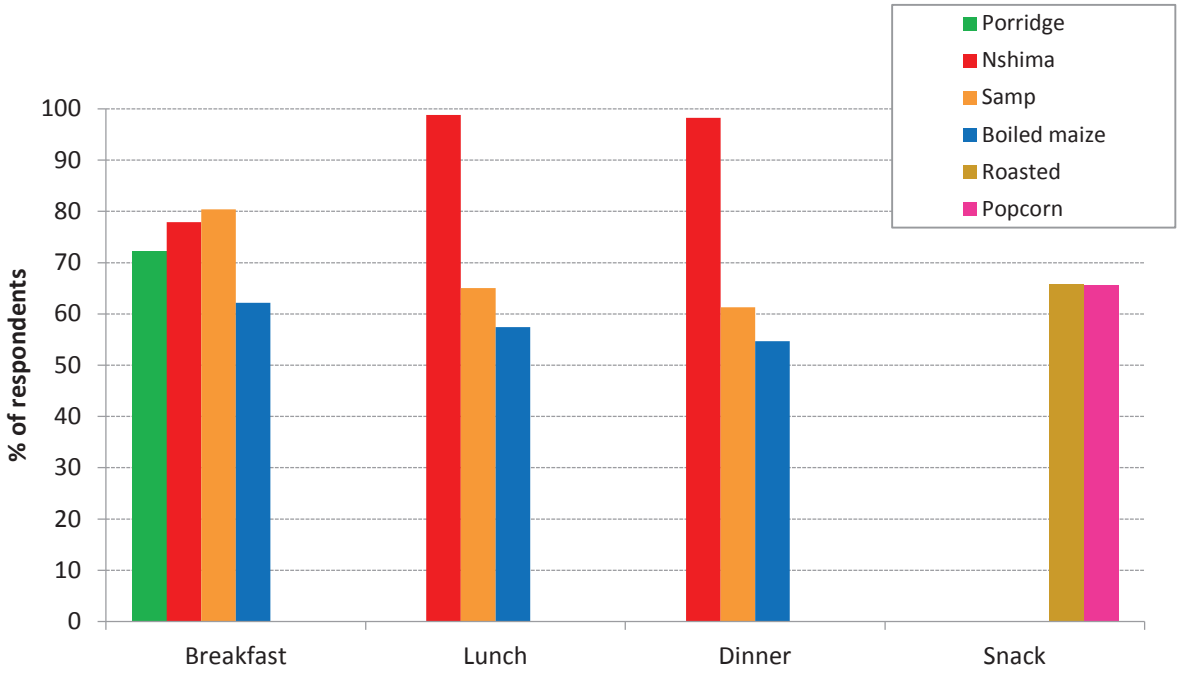

Figure 8: Percentage of Households that Consumed Maize in Different Preparations, at Different Times (at least once in the last seven days)

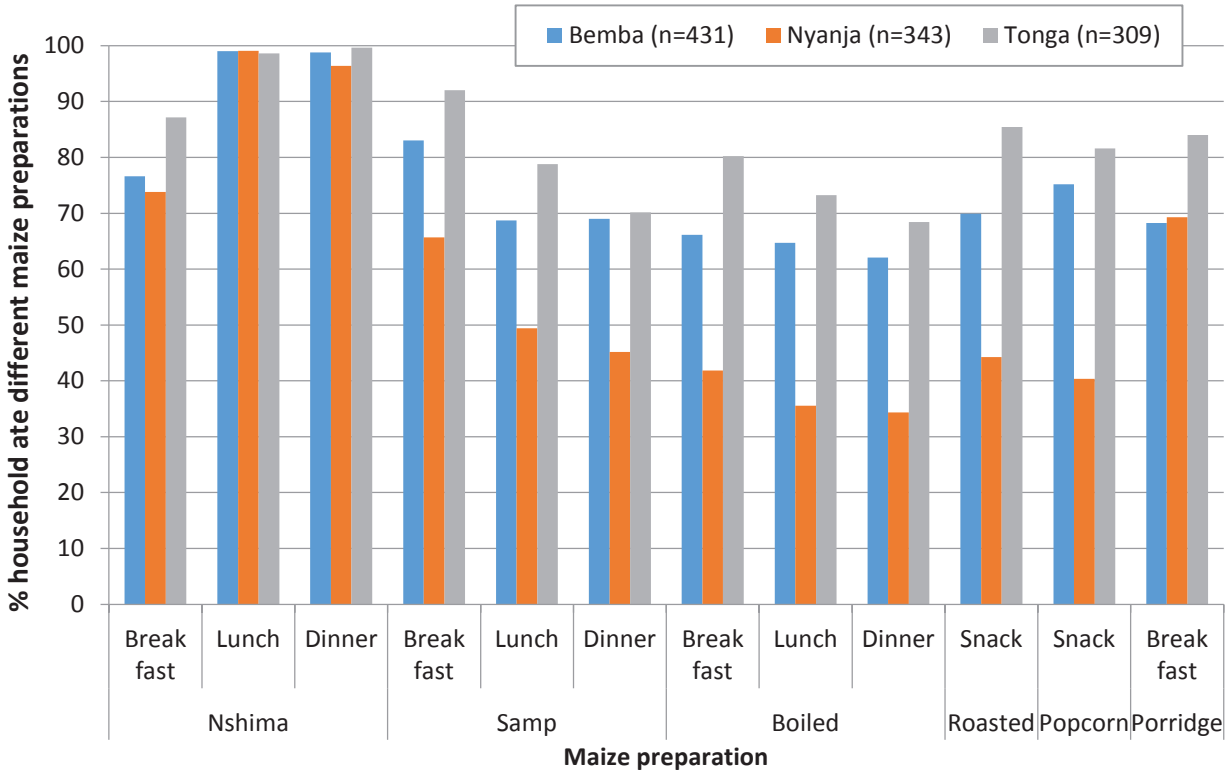

Figure 9: Popularity of Different Maize Preparations at Different Times of the Day, for the Major Ethnic Groups (in % of households having consumed the maize preparation at breakfast, lunch or dinner).

3.3 Sources of Information

The most important sources of information for rural households on agriculture, nutrition, and health issues are the radio (86 percent of households), agricultural extension agents (59 percent), health clinics (56 percent), registered farmers' groups (54 percent), and newspapers (30 percent) (Table 2). Social and other informal groups are minor sources of information. The radio is the most important source of information by number of households, as well as by the frequency of receiving information: most people listen to radio daily (60 percent) or weekly (19 percent). Other sources of information are usually accessed only monthly or occasionally. The radio is also well trusted, with more than half of listeners trusting it "completely" (54 percent) and one-third trusting it "a lot" (38 percent). However, trust in the source of information is actually higher for extension services and clinics. Trust in registered groups is similar to that of radio, but respondents trust newspapers less. Some differences among zones were observed. In general, fewer respondents from Zone I received information from the different sources listed in Table 2. The difference was small for radio (with 80 percent of respondents receiving information from this source, compared with 86 percent overall), but was substantial for other sources, in particular extension (44 percent vs. 75 percent) and newspapers (18 percent vs. 51 percent). In Zone III, on the other hand, more respondents had access to those sources than overall, in particular extension (75 percent), clinics (65 percent) and registered groups (68 percent). Radio, extension, registered groups, and clinics were "important" or "very important" in all zones, with more than 95 percent in each zone classifying them as such. In Zone I, however, fewer people (85 percent) found newspapers to be "important" or "very important", as compared with 93 percent in other zones. The radio was clearly more frequently listened to in Zone III (65 percent listened daily) than in Zones I (56 percent) and II (57 percent). Trust, in all sources of information, is clearly less in Zone I and higher in Zone III. For example, the number of respondents from Zone I who have "a lot" of trust in or "completely" trust radio or extension is 88 percent (compared with more than 92 percent in the other zones), and even less for clinics (74 percent) and newspapers (75 percent).

Differences are apparent in the use of information by the gender of the household head. Households headed by women are much less likely to receive information from newspapers, radio, or extension agents. However, they are

more likely to receive information from registered farmer groups, which highlights the importance of including these groups in the promotion and extension of agricultural technologies.

Awareness of vitamin A was high: most respondents (87 percent) had heard about it. Awareness was higher in Zone III (93 percent) than in Zones I and IIA (84 percent in both). Most respondents had also heard of vitamin A maize (65 percent), and some had heard of orange maize (8 percent). About a quarter of the respondents could not correctly identify any source of vitamin A, while a third could correctly identify one, a quarter could identify two, and 4 percent could identify three sources. About a third of respondents correctly identified dark green leafy vegetables as a source of vitamin A (35 percent), and a quarter identified eggs and dairy products (both 26 percent), fruits (26 percent), and legumes (24 percent) (Figure 10). About a fifth mentioned sugar (22 percent), which is fortified in Zambia, and nuts (20 percent), whereas fish, maize, and other vegetables were each mentioned by about 10 percent.

The knowledge of sources of vitamin A was generally similar among zones, with some small differences. More respondents in Zone IIA knew about the fortification of sugar with vitamin A, and vegetables as a source when compared to respondents in Zones I and III. Substantially fewer respondents from Zone III knew about nuts and seeds as possible sources of vitamin A. More people in Zone I than other zones knew about fish, maize, orange flesh sweet potatoes, and red meat as a source of vitamin A.

Table 2: Sources of Information on Agriculture and Health

Group	Category	Radio	Extension	Health Clinic	Registered groups	Newspaper	Social group	Unregistered group
Receives information from this source (% respondents):	AEZ I	80	44	42	38	18	10	3
	AEZ IIA	88	60	61	46	21	9	5
	AEZ III	86	75	65	68	51	24	3
	All	86	59	56	54	30	16	4
Importance of source (% of receivers – across all zones)	Moderately Important	2	2	1	2	5		
	Important	33	31	31	36	32		
	Very important	64	67	68	62	61		
Frequency of receiving (% of receivers)	Daily	60	2	2	1	7		
	Weekly	19	8	4	15	18		
	Monthly	2	32	18	43	8		
	Occasionally	16	45	57	37	37		
	Rarely	3	14	19	6	29		
Trust in source (% of receivers)	A little	1	0	1	1	2		
	Somewhat	7	4	7	5	17		
	A lot	38	32	28	44	32		
	Completely	54	64	64	50	48		

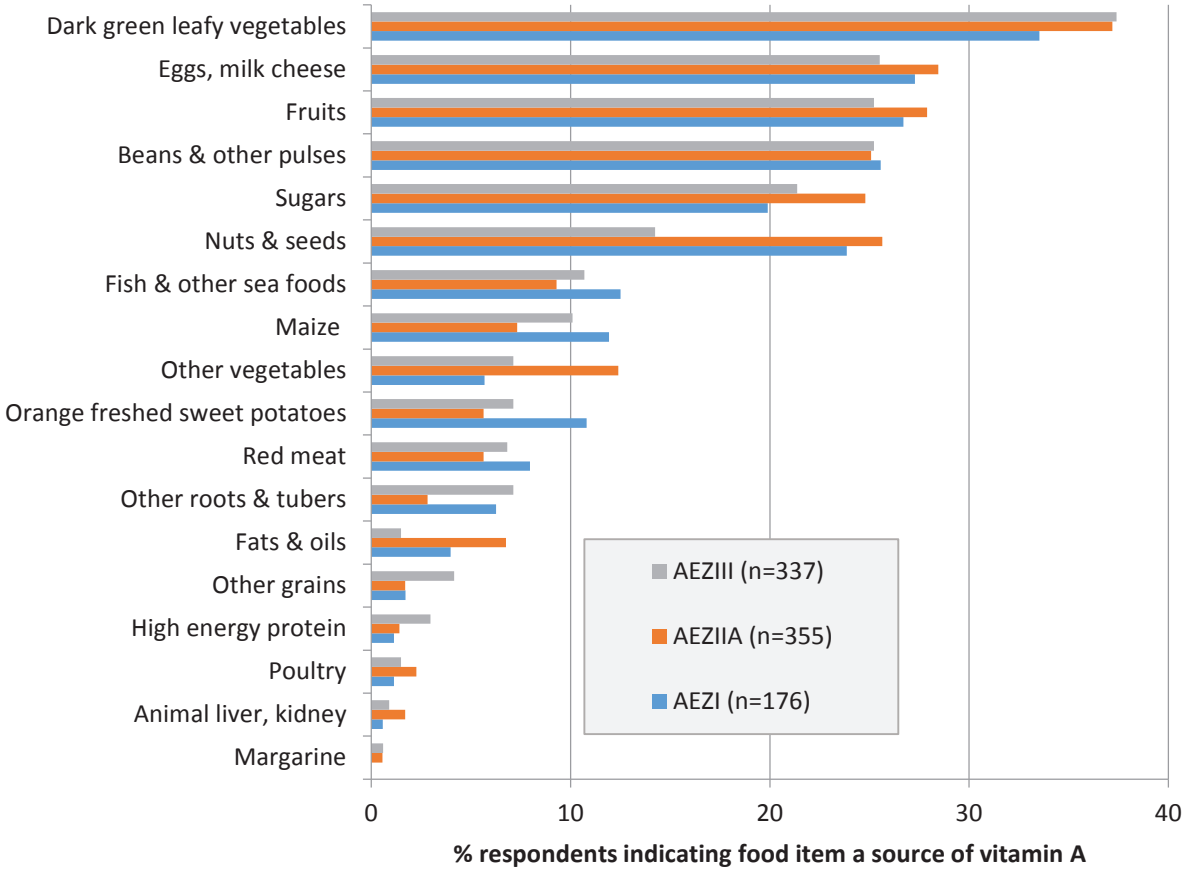

Figure 10. Food Items Perceived as Sources of Vitamin A by Respondents

3.4. Factors Affecting Awareness & Knowledge

The factors affecting awareness of vitamin A were analyzed by a logit model on the binary variable of "awareness" on individual and household characteristics, wealth indicators, institutional factors, and regional factors (Table 3). Knowledge levels on vitamin A were approximated by calculating the number of correct sources of vitamin A identified by the respondent. Since this variable contains count data, the effect of different factors on knowledge was analyzed with a Poisson regression model, using the same independent variables as for awareness. Results differed substantially between men and women; therefore, they were analyzed separately.

Age mattered, but only for women: younger women were clearly more aware as well as more knowledgeable. For men, on the other hand, it was education that mattered: more years of formal education increased both awareness and knowledge for men, but not for women. Agro-ecological zones did not have an effect on awareness or knowledge in women, but they did in men, with awareness being clearly higher in Zone III. Household size also mattered, but the effect differed by gender: larger households (in adult equivalent) had higher awareness among women and higher knowledge among men. There were some differences among provinces: awareness among men was higher in Eastern Province, but lower among women. Women were more aware in Northern Province, but less in Southern Province.

Respondents who had adopted improved maize varieties tend to be more aware of vitamin A sources than those who did not, although the reasons for this link are not immediately clear. Finally, respondents who had received information from health clinics were more knowledgeable about vitamin A than others. Specifically, women who received information from health clinics were more aware than their counterparts who did not, but men who had received information from the health clinics were less aware.

Table 3. Factors that Drive Awareness and Knowledge of Vitamin A

(awareness is a binary variable, analyzed with logistic regression; knowledge is a count variable, number of correct sources of vitamin A recognized, analyzed with Poisson regression)

Binary dependent variables: Awareness (1=yes; 0=No) : Knowledge (1=Yes; 0=No)	Female respondent				Male respondent			
	Awareness		Knowledge		Awareness		Knowledge	
	Coef.	Std. Err.	dy/dx	Std. Err.	Coef.	Std. Err.	dy/dx	Std. Err.
Age of respondent	-0.018	0.006***	-0.014	0.005***	-0.003	0.005	-0.005	0.003
Education	-0.022	0.025	0.029	0.02	0.108	0.021***	0.08	0.016***
AEZ(I)								
IIA	-0.144	0.259	0.085	0.23	0.148	0.205	0.16	0.17
III	-0.796	0.538	0.402	0.45	1.206	0.420***	0.55	0.35
Adult equivalent	0.057	0.03*	-0.005	0.03	0.014	0.024	0.04	0.019**
Province (central)								
Copperbelt	0.634	0.427	-0.661	0.254***	-0.665	0.332*	-0.52	0.20
Eastern	-0.975	0.349**	0.165	0.32	1.658	0.278***	0.35	0.25
Lusaka	-0.094	0.484	0.390	0.48	0.507	0.379	-0.20	0.31
Northern	0.826	0.433*	-0.213	0.25	0.125	0.328	-0.01	0.21
Southern	-0.658	0.367*	-0.176	0.33	0.311	0.290	0.20	0.27
Total land owned (ha)	-0.001	0.002	0.001	0.00	0.003	0.003	0.00	0.00
Adoption of improved maize (1 = adopted)	0.483	0.258*	0.122	0.21	0.482	0.208**	0.04	0.17
Livestock asset holding (TLU)	-0.002	0.011	0.005	0.01	0.003	0.008	0.01	0.01
Getting information from clinic	3.050	0.180***	1.251	0.133***	-0.755	0.144***	0.58	0.105***
Distance to the market (km)	-0.002	0.003	-0.020	0.02	0.004	0.002	-0.01	0.01
Total annual expenditure (ZMK)	0.011	0.070	0.000	0.00	0.123	0.1*	0.00	0.00
Membership in registered group	0.143	0.201	0.166	0.17	-0.015	0.163	0.17	0.13
Membership in unregistered group	-0.688	0.501	-0.056	0.27	-0.297	0.362	-0.38	0.207*
Constant	1.138	1.255			-0.824	0.927		
Number of obs	1,100		-0.014	0.005***	1100.000		1100	
LR (chi^2 (18)	457.34		0.029	0.02	152.04		107.320	
prob>chi^2	0.000				0.000		0.000	
Pseudo R^2	0.3309		0.085	0.23	0.1008		0.04	
Log likelihood	-462.39		0.402	0.45	-678.012		-1283.35	

Source: Authors; Significance for two-tailed tests (***) .01%; (**) 1%; (*) 5%.

4. DISCUSSION & CONCLUSION

The results of this study confirm that maize is the most important crop and food staple in Zambia. Maize production and storage are highly seasonal, with harvest taking place mostly in one season, over a period of two months. Shelling and storing takes place in the months after harvest, and are a bit more spread out, while consumption of home-produced maize stretches over most of the year. Most households interviewed were self-sufficient in maize produced from the preceding season (2010), which was more productive than average. Only a few households purchased maize, and then mostly as grain, not as meal. More than half of the households, who did sell surplus maize, did so during the first three months after harvest. There are substantial regional differences, with households in the dryer Zone I producing less maize than those in the other zones, and households in the wetter Zone III benefiting from higher yields. The most important preparations are nshima, samp, and boiled maize for the three major meals, while porridge is only important as breakfast.

The importance of nshima for lunch and dinner was similar across zones, and almost all households had eaten maize nshima at least once in the last week. However, the other maize preparations, such as samp and boiled maize, are more popular with the Tonga speakers, and less with the Nyanja, with the Benga somewhere in the middle.

The frequency of food consumption differed substantially among zones. Households in Zone III are much better off as they consume food from almost all categories and do so frequently. As a result, they have a much better dietary diversity. Households in Zones IIA and III have similar food frequency and diversity patterns, except that substantially fewer respondents in Zone IIA report consumption of maize: only 61 percent consumed maize in the last 24 hours, as compared with 81 percent in Zone III.

Most people were aware of vitamin A, and two-thirds of respondents could name at least one source correctly. Radio, extension, clinics, formal groups, and newspapers were the most important sources of information, and were well trusted by the respondents in all zones. Only a small difference was observed for newspapers: fewer people (85 percent) in Zone I found newspapers important or very important, as compared with other zones (93 percent).

Most respondents listened daily to the radio, and mostly in local languages. The radio was more popular in Zone III (65 percent of respondents listened daily), followed by Zones I (56 percent) and IIA (57 percent). Factors that drive awareness of vitamin A differ between men and women: younger women and more educated men are more aware of vitamin A than their counterparts. Additionally, information from health clinics has large and positive effects on women's awareness, but surprisingly, has a negative effect on men's awareness.

Based on these findings, and also the findings of other studies (e.g., organoleptic tests by Meenakshi et al. (2012) and farmer field day evaluations by Chibwe et al.(2013), which showed rural consumers' acceptance of orange maize, this paper concludes that orange maize is likely to have a positive impact on the nutritional outcomes of rural households with high vitamin A deficiencies. While currently white maize varieties dominate farmers' fields, many are aware of the benefits of vitamin A and could be persuaded to switch to orange maize if given the appropriate information. Promotional campaigns should use popular media, especially local language radio, extension, clinics, and formal farmer groups.

Further research is needed to evaluate the orange maize varieties' characteristics that were not measured during the national performance trials. Since maize is produced in one season and stored and consumed over the year, resistance to storage pests needs to be evaluated. Sensory evaluations at different lengths of storage time, for the major preparations (nshima, samp, and boiled maize) also need to be conducted.

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