HarvestPlus
ResearchforAction
No. 3
August 2014

Smallholder Farming and Crop Variety Choice: Maize Variety Choice in Zambia

Hugo De Groote
Zachary Gitonga
Melinda Smale
Dorene Asare-Marfo
Earnest Kasuta
Ekin Birol
Kai Sonder

HarvestPlus
Better Crops • Better Nutrition

HarvestPlus leads a global effort to improve nutrition and public health by developing and disseminating staple food crops that are rich in vitamins and minerals. We work with public and private sector partners in more than 40 countries. HarvestPlus is part of the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH). CGIAR is a global agriculture research partnership for a food secure future. Its science is carried out by its 15 research centers in collaboration with hundreds of partner organizations. The HarvestPlus program is coordinated by two of these centers, the International Center for Tropical Agriculture (CIAT) and the International Food Policy Research Institute (IFPRI).

The **HarvestPlus Research For Action** series provides literature reviews, descriptive analyses, and other findings generated from HarvestPlus research and delivery activities. The information presented in this series is less technical and more applied in nature. It is intended for use by researchers, practitioners and policymakers interested in the many aspects of biofortification and ag-nutrition linkages.

Smallholder Farming and Crop Variety Choice: Maize Variety Choice in Zambia

Hugo De Groote[1], Zachary Gitonga[1], Melinda Smale [2],Dorene Asare-Marfo[3]
Earnest Kasuta[4], Ekin Birol[3], and Kai Sonder [1]

This brief is a summary of the 2011 HarvestPlus varietal adoption background study report titled "Adoption and Diversification of Modern Maize Varieties in Zambia in 2011: A Baseline Report Prepared for HarvestPlus", by Hugo De Groote, Zachary Gitonga, Melinda Smale, Dorene Asare-Marfo, Earnest Kasuta, Ekin Birol, and Kai Sonder. The authors would like to thank Emily McNulty for her support in developing this brief from the main report. The report is available from HarvestPlus upon request.

[1] International Maize and Wheat Improvement Center (CIMMYT), Nairobi, Kenya
[2] Michigan State University, East Lansing, MI
[3] HarvestPlus, International Food Policy Research Institute (IFPRI), Washington, DC
[4] University of Zambia, Department of Social and Development Studies, Lusaka, Zambia

Updated February 2015

Contents

I. INTRODUCTION

Micronutrient deficiency, especially vitamin A deficiency, is a major problem in developing countries (Aguayo and Baker 2005; Black et al. 2008; Kennedy et al. 2003). Various strategies have been developed to combat vitamin A deficiency, including vitamin A supplementation (in the form of capsules), food fortification, and the promotion of household vegetable gardens. In Zambia, where more than half of preschool children are at risk for vitamin A deficiency (Micronutrient Initiative 2009), biannual capsules are provided to children in combination with vaccinations, and sugar is fortified with retinol, the pure form of vitamin A (Fiedler et al. 2013). Unfortunately, rural households are harder to reach with supplementation, and they do not consume many of the fortified processed foods.

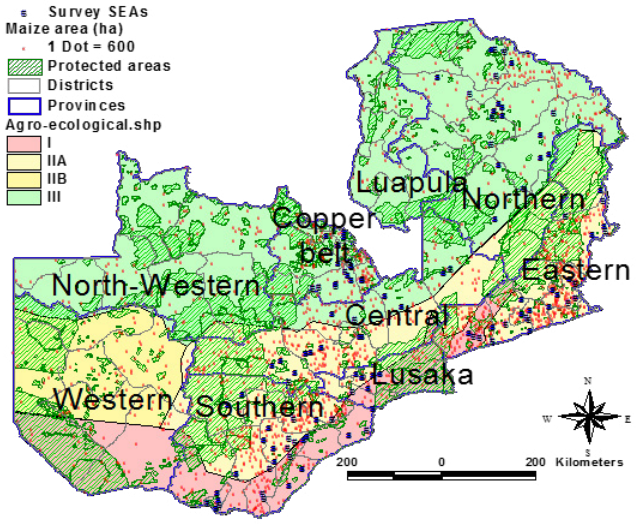
HarvestPlus and its partners are using conventional breeding methods to develop maize varieties that are enriched with vitamin A. Three vitamin A-rich maize varieties were officially released in 2012. These first wave varieties have 50 percent of the target level of vitamin A. Varieties with target levels are expected to be released in 2014 and will provide approximately 60 percent of the estimated average requirement for vulnerable populations (HarvestPlus 2013). All of these varieties are hybrids that are adapted to Zambia's agroecologies and exhibit desirable traits such as high yields and disease resistance. The delivery and marketing activities for the first-wave varieties commenced in the 2013 planting season. Zambia's agricultural research program has been successful in releasing a range of hybrids and open-pollinated varieties, and the liberalization of the seed market has further contributed to the diffusion of a wide mix of supplied and planted varieties by numerous seed companies. Zambian smallholders have a long history of growing improved maize varieties (the national maize research program and seed companies have released a wide array of maize hybrids since the 1970s). It is important for HarvestPlus to understand the current picture of maize varietal adoption among Zambian farmers in order to position itself strategically for effective and targeted delivery of vitamin A biofortified maize. HarvestPlus and its partners therefore conducted a survey of maize variety use in the major maize-growing areas of Zambia in 2011.

This paper summarizes the key findings of that study and makes recommendations for the delivery and marketing of vitamin A-rich maize varieties, as well as the development of future varieties, to achieve maximum adoption and consumption impact.

II. METHODOLOGY

Rural maize-growing households in the major maize-growing areas of Zambia were the target population in this study. The population is mostly covered by five provinces (Northern, Central, Eastern, Copperbelt, Lusaka, and Southern), which also cover three agroecological zones (AEZ) (I, IIA, and III). Figure 1 shows the results of the mapping of the district-level maize production data.

Figure 1: Agroecological Zones & Provinces in Zambia with Population Density



A stratified two-stage sampling design was used. The three agroecological zones were used as the strata; from them, the sample was selected proportionate to each zone's population and maize production. Twenty percent of the sample lived in AEZ I, and 40 percent lived in each IIA and III. Standard enumeration areas (SEAs) are the first-stage sampling units. Using GIS analysis, the appropriate number of SEAs per agroecological zone were selected: 23 in AEZ I, 46 in AEZ IIA, and 44 in AEZ III. The second-stage sampling units were the farm households living in the selected SEAs. Ten households were randomly selected from household lists in each SEA.

The questionnaire was developed based on qualitative interviews with agricultural extension officers, focus group discussions with farmers, previous survey instruments, and a review of literature on maize varietal adoption and maize production in Zambia.

The questionnaire consisted of 13 modules, some of which were gender disaggregated: household identification, household composition, land ownership and production of HarvestPlus target crops, general maize production and

use of previous maize harvest, maize decisionmaking and labor costs, cultivated maize varieties, preferred maize traits, a choice experiment, food consumption frequency, awareness of vitamin A and biofortified crops, media use, household expenditures, and household assets and housing conditions.

Three teams, each consisting of five enumerators and one supervisor, collected the data from June to August 2011. In total, 1,128 households were visited in 35 districts of the 5 selected provinces.

III. RESULTS

A. Household Characteristics

The average household in the survey had seven members. Almost 20 percent of recognized or acting heads of household were women. Most household heads attended school for seven to eight years. The average age of the household head was similar across agroecological zones (48–50 years). More than 90 percent of heads of household were farmers, although in AEZ III 84 percent were farmers and 7 percent were self-employed in non-agricultural activities or were civil servants. Further socio-demographic characteristics of household heads are shown in Table 1. Characteristics of respondents who were not identified as household heads were compared to those of the identified household heads, and in most cases, they were found to be similar.

The size of respondents' land holdings varied greatly across agroecological zones. In AEZ III, farming households owned an average of 14.5 hectares (ha), while households in AEZ IIA owned 6.5 ha and 5.2 ha in AEZ I. The average area cultivated was similar across zones (6.35 ha in AEZ III, 4.0 ha in AEZ IIA, and 3.9 ha in AEZ I). Maize is the main crop grown in all AEZs, taking up the largest share of cultivated area during the main, rainy season. Figure 2 shows the average land area dedicated to maize and other HarvestPlus target crops for Zambia (i.e., iron-rich beans, vitamin A-rich cassava and sweet potatoes). Interpretation of the results related to these other crops should be done cautiously as the sampling frame consisted of major maize areas in Zambia and is not necessarily representative of cultivation of other crops.

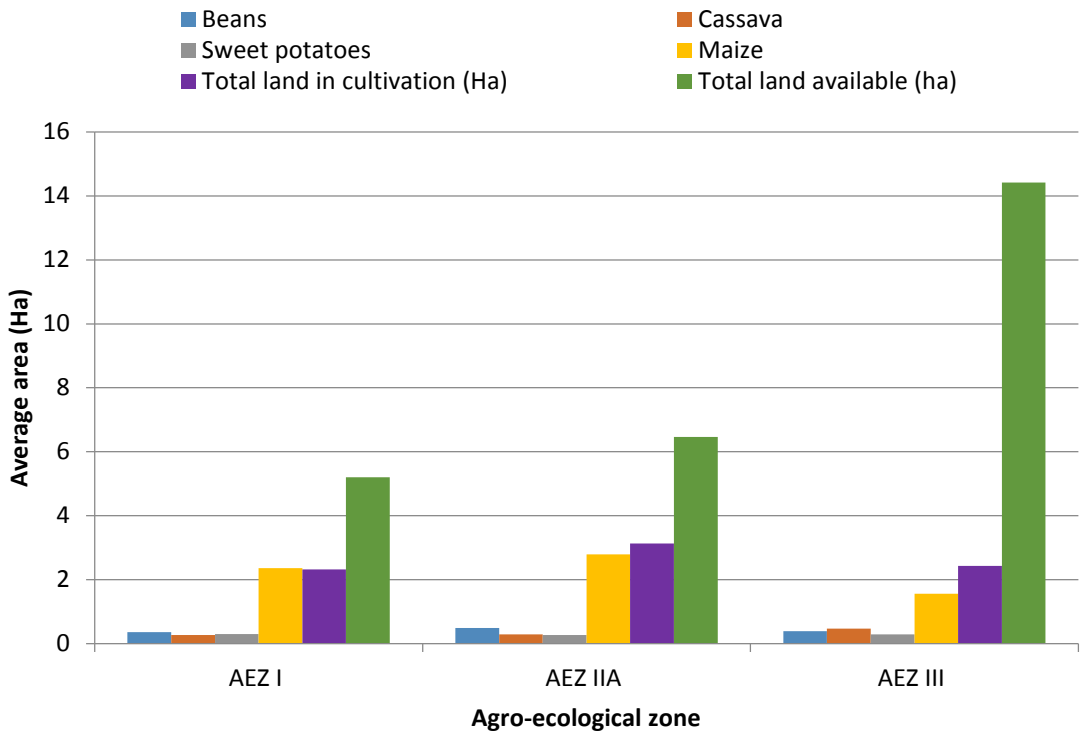
Household assets, as indicators of wealth, were analyzed, and it was found that 87 percent of the farmers owned their land, two-thirds owned traditional granaries, about half owned structures for keeping livestock, and one-third owned a plough. About three-quarters of farmers owned a radio, 69 percent had a mobile phone, and about one-third owned a television. Around 75 percent owned a bicycle. In terms of livestock, almost all households owned poultry, almost half owned goats, and about one-third owned cows.

Table 1: Characteristics of Household Heads

	AEZ I n = 150	AEZ IIA n = 320	AEZ III n = 281	All n = 751	
Education (years)	6.5 (3.57)	6.8 (3.56)	7.9 (3.58)	7.1 (3.61)	
Age (years)	50 (16.25)	48 (15.19)	49 (14.36)	49 (15.11)	
Headed by males (%)	71	82	80	79	***
Cannot read or write (%)	23	20	13	18	
Read only (%)	9	5	1	4	**
Read and write (%)	68	75	86	77	

Source: Authors, based on 2011 HarvestPlus baseline survey
Standard deviations in parentheses
Significant different across zones based on chi-square tests (***) = 1%; (**) = 5%; (*) = 10%. *** p < 0.01, ** p < 0.05, * p < 0.1

Figure 2: Land Holdings and Use by AEZ and Crop



Source: Authors, based on 2011 HarvestPlus baseline survey

Table 2: Land Holdings and Area Share of Maize and HarvestPlus Target Crops

	AEZ1I n = 232		AEZ2IIA n = 462		AEZ3III n = 426		All n = 1120		
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Pr > F*
Total land owned (ha)	5.2	7.2	6.5	38.2	14.5	63.0	9.27	46.3	0.004
Area cultivated rain season (ha)	3.6	5.5	3.9	4.6	5.96	9.6	4.62	7.17	0.000
Area cultivated dry season (ha)	0.2	0.97	0.14	0.69	0.39	1.5	0.25	1.10	0.000
Area under maize main season (ha)	2.1	3.2	2.38	2.49	1.68	2.2	2.06	2.56	0.012
Area under beans (ha)	0.1	0.2	0.09	0.38	0.16	0.40	0.11	0.36	0.000
Area under cassava (ha)	0.02	0.08	0.02	0.11	0.18	0.39	0.08	0.26	0.000
Area under sweet potatoes (ha)	0.05	0.14	0.07	0.18	0.14	0.25	0.09	0.21	0.000
Total cultivated land (ha)	3.86	5.55	4.01	4.78	6.35	9.74	4.87	7.29	0.000

*Note: one-way ANOVA (F-test) testing whether at least one of the means in a zone is significantly different from other zones
Source: Authors, based on 2011 HarvestPlus baseline survey

B. Maize Production

Almost all households (99.6 percent) grew maize in the main season of 2011, while very few (5 percent) grew it in the short season. Improved varieties were cultivated on most of the maize area (80 percent), ranging from 90 percent in AEZ II to 74 percent in AEZ IIA. The rest of the maize area was either planted with local varieties (16 percent) or varieties that the farmers were unable to identify (4 percent). Local varieties constituted less than 10 percent of maize varieties produced.

As expected, yields increased with rainfall levels. Yields for improved varieties ranged from 1.2 tons/ha in AEZ I to over 1.5 tons/ha in AEZ IIA and 2.3 tons/ha in AEZ III. Yields of local varieties were generally about half (53 percent) of those of improved varieties, although they did relatively better (0.58 t/ha) in AEZ IIA. The season covered by this survey (2010–2011) was an exceptionally productive year overall.

C. Variety Choice

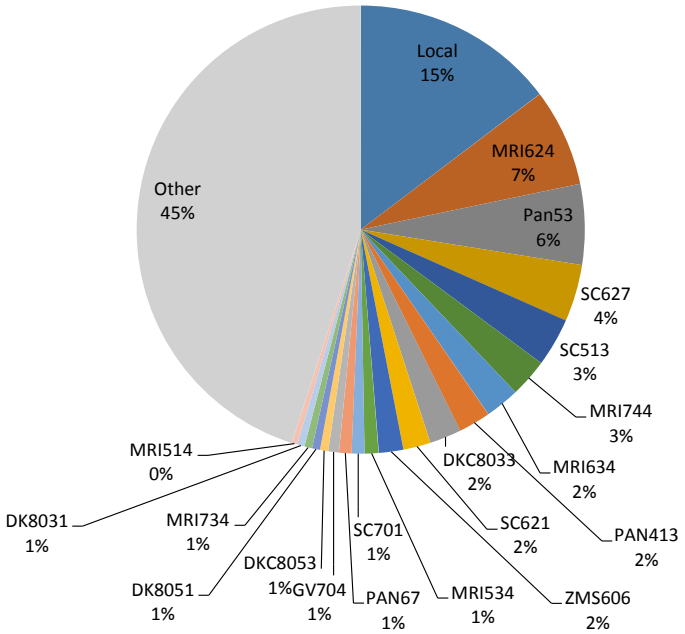
An array of improved maize varieties and maize hybrids adapted to local conditions have been released by the national maize research program and sold by the national seed company since the 1970s (Howard and Mungoma 1996). After the Zambian seed sector was liberalized in the 1990s, the number of released maize varieties proliferated, and seed companies have diversified. By the end of 2010, 203 improved maize varieties had been released. Of these, the surveyed farmers grew 106, as well as numerous local varieties and recycled hybrids. More than half of farmers planted more than one variety during the main rainy season, but few (less than 10 percent) grew more than two varieties, and the maximum number of varieties grown during that season was five. No one variety stands out as more popular; no single variety covers more than 10 percent of cultivated maize area, and the 20 most popular varieties together covered less than half of the maize area. About 16 percent of the maize area was taken up by local maize varieties. Figure 3 shows the area shares and market shares of Zambia's major maize varieties.

D. Decision-Makers

The majority of decisions regarding maize activities were made by the household head, as shown in Figure 4. Table 3 shows that whether they were household heads or not, women were also heavily involved in decisionmaking around maize activities.

Figure 3: Area and Market Share of the 20 Most Popular Maize Varieties in Zambia

Area share of major maize varieties in Zambia



Market share of major maize varieties in Zambia

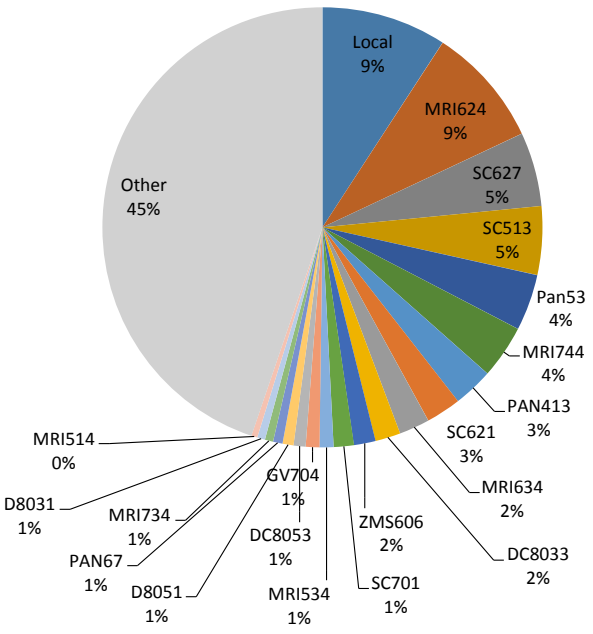


Figure 4: Primary Decision-makers on Maize Activities (% of households)

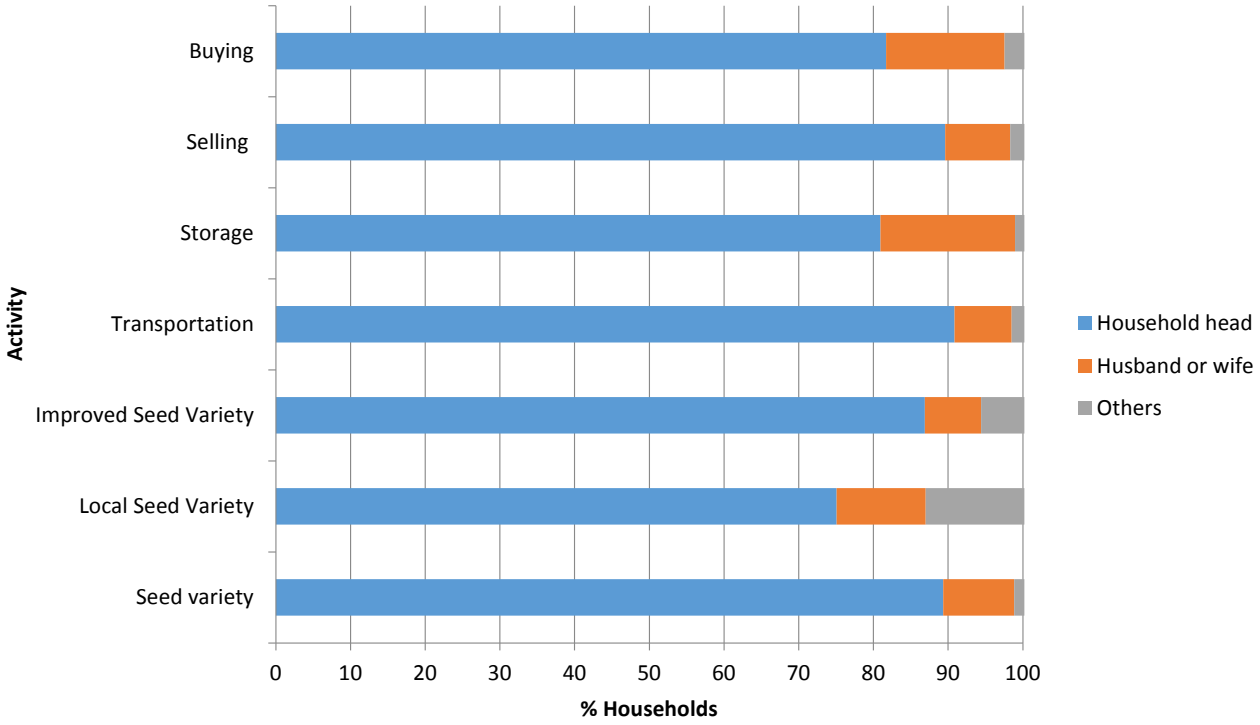


Table 3: Female Involvement in Decisions around Maize Activities - Proportion of Households in which Females Make Decisions (%)

Seed variety to cultivate	43
Acquiring seed (local and improved)	43
Transportation	42
Storage	42
Selling in the market	38
Buying from the market	41

Source: Authors

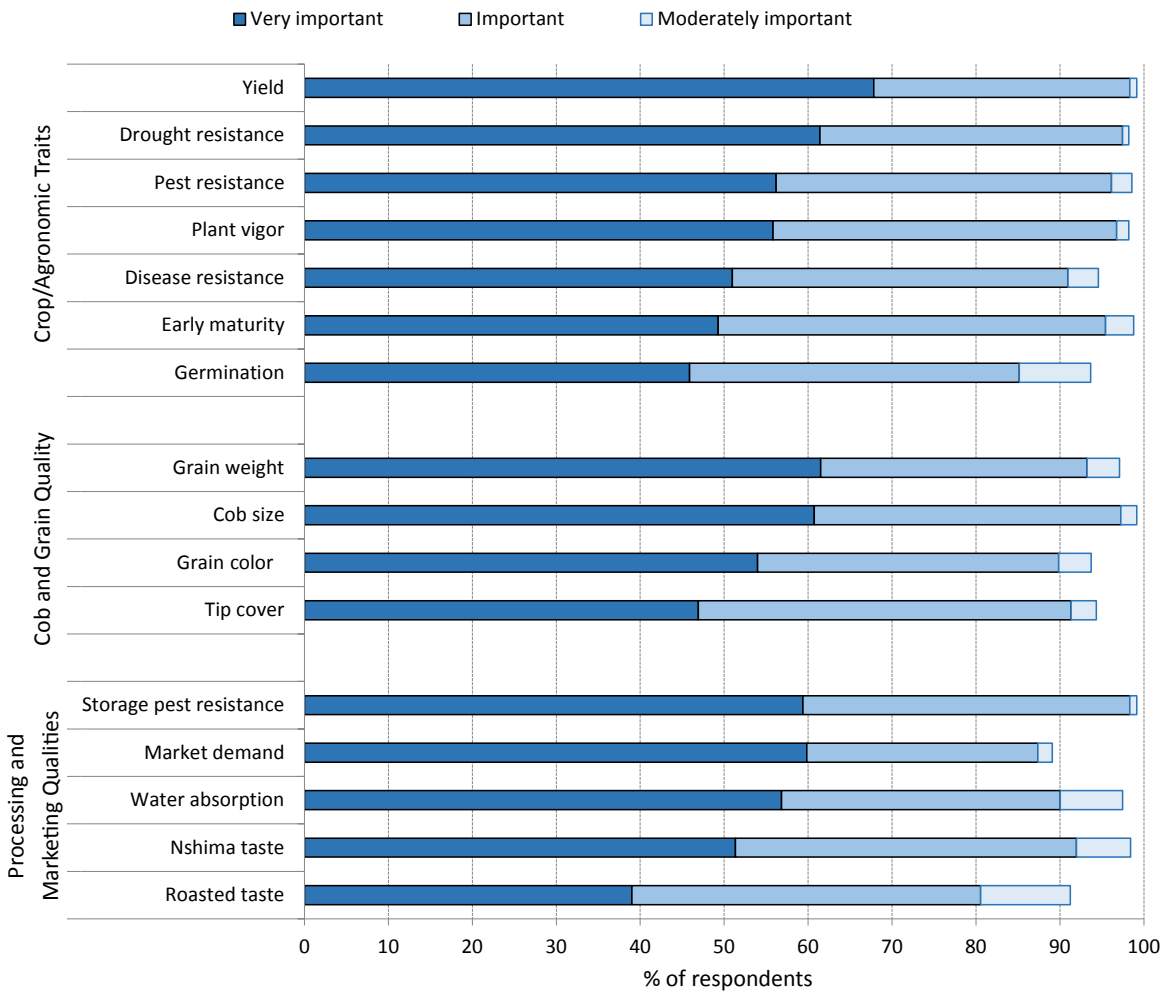
E. Traits

Maize with white grain was strongly preferred; it was grown by 95 percent of respondents. About 8 percent of farmers grew maize with cream-colored grain, and just a few grew varieties with yellow, red, or speckled grain. Most farmers grew medium- (58 percent) or late-maturing (49 percent) varieties, and only 16 percent grew early- or extra-early-varieties, but this was linked to the agroecological zones. Those who grew early-maturing varieties did so almost exclusively in AEZ I and II (the southern zones), and late-maturing varieties were much more popular (grown by 62 percent) in AEZ III (the northern zone). Although farmers grew the whole spectrum of texture options, from dent to flint[5], there is a clear preference for dent over flint varieties.

Figure 5 shows the importance of the various traits as evaluated by farmers. Agronomic characteristics are the most important criteria farmers use when selecting a variety. Yield, drought resistance, and field pest resistance were by far the most important attributes farmers consider (98, 97, and 96 percent, respectively). Other criteria often mentioned as important or very important were plant vigor, disease resistance, early maturity, and germination.

[5] Dent maize (*Zea mays indentata*) is a variety with a high soft starch content that results in a small indentation at the crown of each kernel of a ripe ear. Dent maize is popular for use in cornmeal flour. Flint maize (*Zea mays indurata*) has a hard outer layer (said to be as hard as flint) and contains less soft starch than dent maize. Flint maize is the preferred type for making hominy.

Figure 5: Importance of Different Criteria in Farmers' Variety Selection



Grain weight, cob size, and grain color were cited as very important by more than half of the respondents, with slightly less than half of the respondents mentioning tip cover as very important. In the post-harvest category, storage pest resistance and marketing were the most important. In terms of processing, water absorption, taste of nshima, and taste of roasted maize were identified as the most important. Table 4 shows the importance of various traits to farmers by agroecological zone.

F. Information Sources and Social Capital

Rural households got their information about agriculture, nutrition, and health issues from the radio (86 percent of households), agricultural extension agents (59 percent), health clinics (56 percent), registered farmers' groups (54 percent), and newspapers (30 percent). Radio was the most frequent source of information and is well trusted by respondents. Extension agents and clinics were even more trusted, although they were mentioned less often as sources of information.

In terms of social capital, membership in registered farmers' groups was quite high (79 percent of households). Registered groups were a means of obtaining subsidies through the Farmer Input Support Programme (FISP) and were considered exclusive. Of those who indicated being members a farmers' group, 88 percent received subsidized seed, as compared to only 9 percent of households that did not belong to a farmers' group. Unregistered farmer groups and other social groups were not important sources of information.

Differences are apparent in use of information by gender of the household head. Female household heads were much less likely to use the newspaper or radio, possibly because they have time constraints, are less literate, or do not possess a radio. They were also less likely to receive information from extension agents—a bias that is often reported in the literature. However, they were more likely to receive information from registered farmers' groups, which supports current efforts to include them in such groups.

Table 4: Importance of Agronomic, Processing, and Marketing Qualities to Farmers in Agroecological Zone (Tukey's honest significance test)

	Attributes	Between AEZIIA and AEZI	Between AEZII and AEZI	Between AEZIII and AEZI
		Mean Difference (I-J)	Mean Difference (I-J)	Mean Difference (I-J)
Crop/Agronomic traits	Germination	0.19 ***	0.28 ***	0.09 *
	Early maturity	0.23 ***	0.05	-0.18 ***
	Disease resistance	-0.15	0.49 ***	0.64 ***
	Pest resistance	0.17 ***	0.38 ***	0.21
	Vigor	0.23 ***	0.34 ***	0.11 **
	Drought resistance	0.19 ***	0.19 ***	0 ***
	Yield	0.21 ***	0.31 ***	0.1 **
Cob and grain quality	Cob size	0.2 ***	0.33 ***	0.13 ***
	Grain weight	0.32 ***	0.58 ***	0.26 ***
	Good tip cover	0.06	0.27 ***	0.21 ***
	Grain color (whiteness)	0.53 ***	0.7 ***	0.17 **
Processing and marketing qualities	Taste as roasted	0.49 ***	0.72 ***	0.23 **
	Pounding ability	0.39 ***	0.57 ***	0.18 **
	Market demand	0.4 ***	0.72 ***	0.32 ***
	Taste of nshima	0.3 ***	0.48 ***	0.19 ***
	Water absorption	0.43 ***	0.44 ***	0.01
	Storage pest resistance	0.22 ***	0.25 ***	0.02

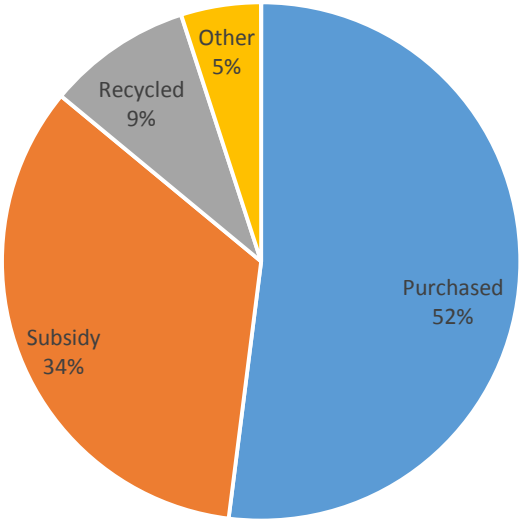
Significant (***) = 1%; (**)5%; (*)=10%. *** p<0.01, ** p<0.05, * p<0.1
Note: Tukey's test is essentially a t-test, except that it corrects for experiment-wise error rate that may occur when multiple comparisons are being made (in this case, zones are more than two).
Source: Authors

Given the findings, radio, extension officers, and health clinics are likely to be effective channels to use for informing the public about the health benefits of vitamin A maize.

G. Seed Sources

Agrodealers were the most important source of maize seed planted in the 2011 main cropping season. The second most important source was subsidized seed from FISP with 32 percent. More than half of households surveyed received subsidies for seed (65 percent) and fertilizer (66 percent), which were provided together as a package. Almost all subsidies (96 percent) came from FISP. Table 5 summarizes FISP subsidy received by agroecological zone and shows that receipt of FISP was more common among farmers who cultivated hybrid seed varieties. Subsidies are linked to group membership as most of the households that received subsidy belonged to a registered group (88 percent). Figure 6 shows seed sources by agroecological zone.

Figure 6: Source of Seed Planted



Source: Authors

Table 5: Seed Subsidy Receipt, by Agroecological Zone

		FISP Receipt	
		No	Yes
AEZ I			
Non-hybrid user (%)	34.1	75.6	24.4
Hybrid user (%)	65.9	33.1	66.9
AEZ II			
Non-hybrid user (%)	34.5	69.7	30.3
Hybrid user (%)	65.5	29.6	70.4
AEZ III			
Non-hybrid user (%)	27.1	47.4	52.6
Hybrid user (%)	72.9	19.5	80.5
Full Sample			
Non-hybrid user (%)	31.6	63.7	36.3
Hybrid user (%)	68.4	26.2	73.8

Source: Authors

H. Seasonality in Harvest, Post-harvest, Marketing, and Consumption of Maize

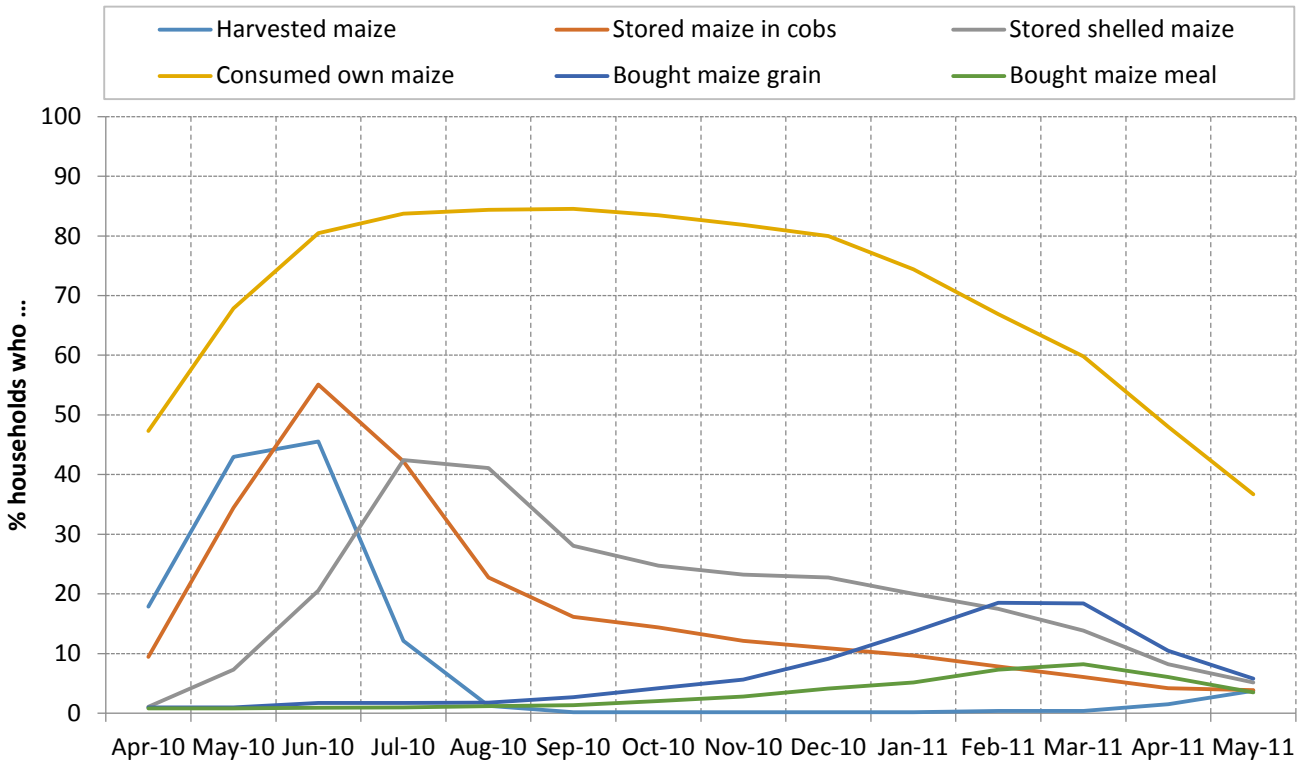
Depending on the agroecological zone and time of planting, maize was harvested between April and July. Figure 7 shows that 42 percent of households harvested maize in April and 45 percent harvested in May. Maize is stored on the cob until late in the harvest season when it is shelled. In April 2010, half of the households were still consuming maize from their previous season's storage. The season covered in the survey (2010–2011) was, however, a particularly good year for maize production. Figure 7 depicts harvest, storage, consumption, and purchase patterns of the households, and the lines represent the percentage of households performing a particular activity in the different months. Most households relied on their own maize storage all year, with the exception of AEZ I where up to 35 percent of households purchased grain during February and March 2011.

Just over half of the respondents reported selling maize from the preceding harvest. The largest purchaser of farmers' maize was the Food Research Agency (72 percent of farmers sold to them), followed by direct consumers (15 percent), traders (6 percent), wholesalers (2 percent), processors (2 percent), retailers (2 percent), and others (2 percent). Most sales took place at local and district markets, and just 10 percent of sales were farm gate sales.

I. Awareness of Vitamin A and Vitamin A Maize

Most respondents (87 percent) had heard of vitamin A; awareness was higher in AEZ III (93 percent) than in AEZ I and IIA (84 percent each). Two-thirds of respondents could identify at least one source of vitamin A; 32 percent correctly named one source, and 29 percent correctly named two or more sources. Most respondents had heard of vitamin A maize (65 percent), and some knew about orange maize (8 percent). This might suggest that relatively minimal work may be needed in educating Zambian maize farmers about the nutritional benefits of orange maize.

Figure 7: Maize Harvest, Storage, Consumption, and Purchase Patterns



Source: Authors

Younger respondents were more aware of vitamin A, although this was only significant for females. Education had a positive effect on awareness, but only for women. Women in larger families were more aware of vitamin A, while expenditures, an indication of income and wealth, had a positive effect on men's awareness. Other wealth indicators, however, did not have a significant effect. Women who obtained health information from a clinic were more aware of vitamin A, but the effect was opposite for men. There were also some zonal and provincial differences; men in AEZ III had higher vitamin A awareness, while awareness for women was greatest in the Northern province and lowest in the Southern province. Finally, there is a clear link between adoption of improved maize varieties and awareness of vitamin A, for both men and women, although the reasons for this link were not immediately clear.

J. Frequency of Food Consumption

Respondents were asked about the foods they had eaten in the past 7 days and also 24 hours before the survey. In the past 24 hours, maize was the third most common food (consumed by 80 percent of households), following green, leafy vegetables and other vegetables. The next most popular food items were sugar (fortified with vitamin A), nuts, and oils. Maize is the most frequently consumed cereal and the main staple for calories and protein; in the past 24 hours, other cereals were only consumed by 16 percent of households. In the seven days leading up to the survey, almost all households ate nshima for lunch (99 percent) and dinner (98 percent), and most also ate it for breakfast (78 percent). Nshima is a stiff porridge made from ground maize flour and is the major staple food of Zambia. Samp, another traditional dish made from dried maize kernels and dried beans, was also popular for all three meals (in the past week, 80, 65, and 61 percent of households had eaten it for breakfast, lunch, and dinner, respectively). Boiled maize had been eaten in the past week for breakfast by 62 percent of households and for lunch by 57 percent. Porridge was only eaten for breakfast (by 72 percent of households in the past week), while roasted maize and popcorn were eaten as snacks, both by two-thirds of households in the past week.

IV. CONCLUSIONS

Maize is the most important crop and food staple in Zambia, mostly consumed as nshima, samp, and boiled maize. Production, storage, sales, and purchase of maize are highly seasonal.

Almost all maize produced in Zambia is used for food consumption. Farmers have a slight preference for grains with dent texture and tend to grow early-maturing varieties in the drier AEZ I and late-maturing varieties in AEZ III. Otherwise, there are few geographic patterns. The survey data confirm that no single variety or company dominates the market. Varieties and market shares are, for the most part, evenly and equitably distributed, indicating a competitive maize seed market. For maximum adoption of vitamin A–rich orange maize varieties, it is recommended that several varieties be developed and then delivered through partnerships with private seed companies.

Findings from the survey show that most people are aware of vitamin A, and one-third can correctly identify vitamin A-rich food sources. Radio, extension services, clinics, formal groups, and newspapers are the most important and well-trusted sources of agricultural and health information. Most households listen to the radio daily in local languages.

Previous research on consumer acceptance of orange maize varieties (Meenakshi et al. 2012) and on farmer evaluation of these varieties (Chibwe et al. 2013) revealed that consumers and farmers like the consumption and production traits of orange maize varieties almost as much as, if not more than, those of white varieties. Meenakshi et al. (2012) further showed that information about the nutritional benefits of orange maize increased consumers' appreciation of these varieties, whether that information came from a radio or local leaders. Findings from this study on sources of information also suggest that radio messages could be as effective as face-to-face interactions in providing nutrition education. Since radio messaging is more cost-effective, promotional campaigns through local language radio are recommended.

Further, the survey data lead us to recommend that an effort be made to introduce orange maize seed through both agrodealers and the FISP in order to reach maximum adoption levels.

REFERENCES

Aguayo, V. M., and S. K. Baker. 2005. "Vitamin A Deficiency and Child Survival in sub-Saharan Africa: A Reappraisal of Challenges and Opportunities." Food and Nutrition Bulletin 26: 348–355.

Black, R. E., L. H. Allen, Z. A. Bhutta, L. E. Caulfield, M. de Onis, M. Ezzati, C. Mathers, and J. Rivera. 2008. "Maternal and Child Undernutrition: Global and Regional Exposures and Health Consequences." Lancet 371: 243–260.

Chibwe, E., H De Groote, Z. Gitonga, and E. Birol. 2013. "A Participatory Evaluation of Vitamin A Biofortified Maize in Zambia." Unpublished, HarvestPlus, Washington, DC.

Fiedler, J.L., K. Lividini, R. Zulu, G. Kabaghe, J. Tehinse, and O. I. Bermudez. 2013. "Identifying Zambia's Industrial Fortification Options: Toward Overcoming the Food and Nutrition Information Gap-induced Impasse." Food and Nutrition Bulletin 34 (4): 480–500.

HarvestPlus. 2013. HarvestPlus Crop Strategies Brochure.

Howard, J., and C. Mungoma. 1996. "Zambia's Stop-and-Go Revolution: The Impact of Policies and Organizations on the Development and Spread of Maize Technology." International Development Working Paper 61 East Lansing, MI, US: Michigan State University, Department of Agricultural Economics.

Kennedy, G., G. Nantel, and P. Shetty. 2003. "The Scourge of "Hidden Hunger": Global Dimensions of Micronutrient Deficiencies." Food, Nutrition and Agriculture 32: 8–16.

Meenakshi, J.V., A. Banerji, V. Manyong, K. Tomlins, N. Mittal, and P. Hamukwala. 2012. "Using a Discrete Choice Experiment to Elicit the Demand for a Nutritious Food: Willingness-to-Pay for Orange Maize in Rural Zambia." Journal of Health Economics 31 (1): 62–71.

Micronutrient Initiative. 2009. Investing in the Future: A United Call to Action on Vitamin and Mineral Deficiencies. Ottawa, Canada.