Do preferences for maize quality lead to self-provisioning? Preferences and behavior of farm households in Western Kenya

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1. Introduction

Maize is the primary staple crop in Kenya and much of east and southern Africa, and is cultivated by the vast majority of smallholder farmers in these regions, even in areas with low maize potential. High transaction costs and price risk are the main factors thought to drive self-provisioning of maize. However, even as market access has improved over the past decade, area under maize has remained constant in less favored areas, suggesting that there may be other reasons farmers grow their own maize. The contamination of maize and other crops with aflatoxin is a serious problem in many tropical countries including Kenya. Ingestion of this substance increases the risk of liver cancer, suppresses immune system function, and negatively affects child growth (Strosnider et al., 2006).

This paper explores consumer preferences over maize quality and safety as an additional explanation for reliance on self-provisioning among Kenyan smallholders through a second-price sealed-bid auction. Consumers are willing to pay an average of 26% more than the market price for grain they grew themselves. Sorting purchased grain reduces the price gap, as does testing for contamination with aflatoxin. Data on aflatoxin content of maize collected from hammer mills across the Western region of Kenya shows that consumer perceptions of quality are correct: purchased maize contains higher levels of aflatoxin on average compared to own-produced maize. Even more contaminated is maize that was received as a gift.

Survey data collected from the farmers a five-month period after harvest provides additional information on maize processing, storage, and marketing behavior. These data reveal that farmers themselves do not treat maize for own consumption differently from maize they plan to market. Adverse selection of maize into the market appears to occur primarily from the point at which it is sold to traders.

The remainder of the paper is organized as follows. The following section describes maize production in Kenya, and hypothesized reasons for the self-provisioning. Section 3 describes data collection and auction procedures. Section 4 describes results from these

components of the research, and summarizes data from a complementary study in which maize samples were collected from 26 hammer mills across Nyanza, Western, and Rift Valley provinces. Section 5 concludes.

2. Maize in Kenya

Maize is the primary staple crop in Kenya and much of east and southern Africa. A panel survey of farming households in collected by the Tegemeo Institute, Egerton University in three sites representing low, medium and high-potential agricultural from 1997 to 2007 shows that almost 100 percent of sample households grew maize (Brooks et al, 2009). The proportion of cultivated area under maize was approximately equal across study sites (Table 2, ibid), despite large differences in maize productivity across sites (Table 3, ibid).

Table 2 from Brooks et al. (2009: 6): Proportion of cultivated area under maize

District	1997	2000	2004	2007
Makueni	57.2	52.8	55.8	63.2
Kakamega	48	46.3	48.9	51.7
Nakuru	62.9	65.2	63.8	64.5

Table 3 from Brooks et al. (2009: 6): Maize productivity (kg/acre) by study district

District	1997	2000	2004	2007	Average
Makueni	297	379	298	506	370
Kakamega	514	740	1,014	1,179	862
Nakuru	936	388	1,305	798	857

Commonly hypothesized reasons behind self-provisioning of maize include high transaction costs (Omano, 1998) and price risk (Brooks et al., 2009). Maize price variation was fairly constant from 1997-2004 (Jayne et al. 2008), however, access to roads and maize markets decreased by 40% and 50% respectively in the Tegemeo study villages from 1997 to 2007 (Chamberlin and Jayne, 2009).[1] If transaction costs are indeed a major factor behind self-provisioning of maize, this begs the question of what else is inhibiting market integration and specialization among smallholder farmers. One possibility is maize quality. Information on Kenyan consumer perceptions and preferences over maize quality is scarce. The present study

[1] This includes all eight Tegemeo study areas.

aims to fill this gap in the literature by eliciting consumer perceptions and preferences over own-produced maize versus maize procured through the market, and to investigate the value to consumers of visually observable and unobservable quality standards.

3. Data

Household Survey

Six villages around Bungoma Town in Western Kenya were selected based on ease of access and expected time of maize harvest. In August 2009, a census of maize-growing farmers was conducted in each of these villages, and a sample of 30 farmers per village growing at least one of the three main hybrid maize varieties or a "local" open-pollinated variety, and who expected to finish harvesting their maize by mid-September, were recruited into the study.

Farmers were interviewed within two weeks of storing their maize (mid to late September), again in November, and once more in January. Surveys covered varietal choice; maize cultivation, sorting, and drying practices; storage conditions, market transactions, basic consumption information, and awareness of health risks from consuming visibly moldy maize. During each survey round, the moisture content of farmers' stored maize was tested, and samples of stored maize were purchased from farmers, to be analyzed for aflatoxin contamination.[2]

Maize Auction

After the household survey was complete, approximately twenty farmers in each of five original survey villages, plus twenty additional farmers in each of two new villages, were visited and asked to sell one or two kilograms of maize. The amount purchased and purchase price were varied randomly across farmers to test whether reluctance to sell a small amount of maize might be driven by non-economic factors such as fear that the maize samples could be used for witchcraft.[3] There was no significant difference in the selling price (elicited through the Becker-deGroot-Marschak mechanism) of one versus two kg of maize. Indeed, the point estimate of the sales price for two kg is higher than that for one kg, suggesting, if anything, that scarcity of

[2] The impact of farm practices on the aflatoxin content of these samples will be the subject of a separate paper.

[3] We thank Ethan Ligon for this suggestion.

maize in store was behind reluctance to sell. Of the 150 farmers approached, 100 were willing to sell their maize.

Farmers (including those who refused to sell at the price offered) were then invited to a meeting during which they had the opportunity to purchase various types of maize, including that obtained by researchers from their own stores if they had sold it, maize that had been purchased from local traders, and maize purchased from another farmer in one of the study villages. Maize purchased from traders was differentiated into four types: direct from the market, sorted (discolored kernels and debris removed), certified below the legal limit for aflatoxin contamination, and both sorted and tested for aflatoxin.[4] In addition, some of the maize that had been sorted was ground and cooked into porridge, the typical staple food in this region. Participants were given the opportunity to taste this porridge before entering their bids.

In total, seven different types of maize were offered to participants, however to avoid decision overload, only four types were offered in each meeting. After two public practice rounds for other items (soap and cookies), the first type of maize on offer was passed around, so that each participant had an opportunity to carefully inspect it. Participants then entered bids for the maize in a sealed envelope. The second sample was then passed around, and so on. After all bids for the last type of maize were entered, one of the types of maize was randomly selected, and the highest bidder for that variety was sold the maize, at the price quoted by the second-highest bidder. Numbers of bids obtained for each type of maize in the 14 meetings (two meetings in each of the seven villages) are given in Table 1.

4. Results

Maize Auction

Of all the maize types offered, willingness to pay for own-produced maize was highest. Table 2 presents estimates for the premium consumers are willing to pay for their own maize, compared to each of the other categories. Maize purchased on the market and offered directly for sale was valued the lowest among all categories. This maize was judged to be of poorer

[4] The purchased maize all came from the same batch, and was all below the allowable limit for aflatoxin contamination, but participants were not told this.

quality than that typically available on the market, and the average bid, at 17% below the average market price given by participants, reflects this. Testing this maize for aflatoxin content increases willingness to pay but the maize is still valued below the market price. Removing damaged kernels and other debris pushes willingness to pay over the market price, and doing both increases valuation by participants further still.

Are consumers' preferences for own-produced maize based on observable characteristics? Between the time maize was purchased from farmers and when it was offered back to them for sale, rotten or discolored kernels, broken kernels, and other debris were removed and weighed as an objective measure of quality.[5] Compared with the sorted grain, which farmers rated as higher-quality than what is normally available on the market (Figure 1), farmers' own grain had more broken kernels and debris, and approximately the same proportion of rotten or discolored kernels.[6]

If the visible features of own-produced maize are not superior to those the sorted maize for which participants bid less, what about invisible quality attributes? When participants had the opportunity to taste the purchased maize, the gap in WTP comes closest to closing, though it remains statistically significant. Other farmers' maize is the next highest in value, higher than traded maize that was both sorted and tested for aflatoxin content. Farmers appear to trust their own maize handling and storage practices, and those of their neighbors, over the practices of commercial traders.

To check whether these results are robust to the level of aflatoxin awareness, which may have been elevated among farmers who were also respondents in the household survey, we run the same estimates using only the new villages (Table 3). These estimates tell broadly the same story, except that willingness to pay for aflatoxin-tested maize is even higher than WTP for own maize. WTP for tested and sorted maize, however, is lower. An additional robustness check is presented in Table 4. Here, we limit the sample to those sessions in which own maize was offered before aflatoxin was mentioned. Again, results are similar, with a marked premium for own maize compared to the market price.

[5] These were reintroduced before the maize was presented to farmers for resale

[6] The point estimate for rotten or discolored kernels was higher for farmers' maize than for the sorted sample.

Posho mill survey

To further explore the differences between own and traded maize, we use data from a survey of maize collected at hammer mills in 26 market centers clustered around four major towns in Western, Nyanza, and Rift Valley Provinces. Maize samples were procured from 605 clients of small hammer or "posho" mills. Farmers typically bring their own maize or maize kernels they have purchased to these mills once or twice a week to have it ground into a flour which is then cooked into the regional staple, maize porridge. Enumerators spent at least two days at each of these posho mills interviewing clients and collecting samples of their maize.

These samples were tested for aflatoxin content at the Biosciences east and central Africa (BecA) Hub, at the International Livestock Research Institute (ILRI) headquarters in Nairobi using a Helica test. The proportion of samples above the maximum allowable aflatoxin limit set by the Kenya Bureau of Standards of 10 ppb was 9.6% overall, 5.2% among own-produced maize, and 10.4% among purchased maize. The highest level of contamination by far (29%) was found among samples of maize that had been received as a gift. Table 6 presents regression results of a binary variable indicating that a sample exceeds 10 ppb aflatoxin. The difference between own-produced and purchased maize is significant at the 95% confidence level under a simple OLS regression, but becomes statistically insignificant when errors are clustered at the village level, or when fixed effects are introduced. The higher contamination level of gifted maize remains significant across specifications.

Household Survey

The question arises, at what point in the value chain does the quality differential between marketed and maize produced for own consumption arise? During the household survey, farmers were asked to describe their post-harvest handling of maize in detail. In particular, they were asked whether they sort harvested maize into one or more groups, for different purposes. Of 180 farmers, 68 reported sorting their maize cobs into separate groups, and just five reported sorting the maize kernels into groups after shelling. At both stages, the main distinction was between "clean" or "good" maize for own consumption and sale, versus low-quality, damaged or rotten maize for livestock feed, sale to brewers, and giving away. Only one respondent described the maize intended for sale as "damaged" and "rotten". The sample is too small to detect

significant differences, but if anything, maize destined for sale was dried slightly longer, and more likely to be treated with preservative, than maize intended for own consumption.

Interviews with 17 maize traders suggest that the sorting of low-quality maize occurs at the farm gate and beyond. Standards for moisture content exist in the formal maize market in Kenya, but maize traded through informal channels is not subject to these regulations. Traders operating in the formal maize market therefore use electronic moisture meters, and may either refuse to buy maize that has not been adequately dried, or dry it themselves. If a formal-sector wholesaler rejects a trader's shipment of maize, the trader will often sell that maize in the informal sector. This results in a sorting equilibrium of high and low-quality maize in the formal and informal markets.

5. Conclusions

This research characterizes Kenyan smallholder farmers' preferences over maize that is own-produced, traded, and grown by other farmers. The predominance of self-provisioning maize, which is the staple grain in Kenya, has previously been attributed the high transaction costs of marketing for small-holder farmers and price risk. Concerns over quality of maize may be an additional factor inhibiting the market integration of smallholder farmers.

Lower income consumers generally purchase maize from the low-quality, informal market. Maize available on the formal market is almost always processed and packaged prior to sale, making it expensive relative to the unpackaged maize kernels sold on the informal market. However, our finding that relatively poor, rural consumers are willing to pay substantial premiums for higher quality maize, and in particular for visibly unobservable characteristics, suggests a potential for branding and standards in the unprocessed maize market. In addition to expanding consumer choice, the introduction of such standards could be opportunity for combating chronic human exposure to aflatoxin in Kenya, and could help encourage diversification of smallholder farmers away from maize.

References:

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Table 1. Bids per session

Village ID	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	total
Own maize	5	1	6			5		6		7	14	11			119
Traded maize	8	6					9	6		7	14		6	8	123
Traded maize, sorted	8	6		7	9	5	9			7				8	115
Traded maize, tested for aflatoxin		6	7	7		5	9		8				6	8	125
Traded maize, sorted and tested for aflatoxin				7	9	5	9		8		14	11	6		131
Others' maize	8		7	7	9			6	8			11	6		132
Traded maize, sorted, can taste before bidding			7		9			6	8	7	14	11		8	177
Market price	7	6	7	8	9	5	9	6	7	6	14	11	6	6	107

Table 2. Premium for own maize

	Unsorted purchased	Unsorted aflatoxin tested	Sorted	Sorted aflatoxin tested	Other farmers'	Tasted	Market price
Own maize premium	27.743***	18.989***	13.497**	10.967**	10.094**	7.722*	16.979***
	(2.96)	(3.8)	(4.46)	(3.66)	(3.74)	(3.61)	(3.12)
Constant	54.094***	62.847***	68.339***	70.870***	71.742***	74.114***	64.857***
	(1.42)	(2.91)	(3.17)	(2.2)	(2.66)	(2.31)	(0.50)
Bids	119	114	111	124	117	125	167
Participants	86	96	99	94	89	81	113

*p<.05; **p<.01; ; ***p<.001

Table 3. Premium for own maize; new villages only

	Unsorted purchased	Unsorted aflatoxin tested	Sorted	Sorted aflatoxin tested	Other farmers'	Tasted	Market price
Own maize premium	24.065***	-5.989	10.922	14.930*	17.989**	7.426	16.028**
	(5.63)	(10.07)	(6.01)	(6.85)	(6.23)	(5.48)	(4.64)
Constant	55.571***	85.625***	68.714***	64.706***	61.647***	72.211***	63.609***
	(3.73)	(7.66)	(3.99)	(4.29)	(3.9)	(3.32)	(0. 96)
Bids	25	19	25	28	28	30	34
Participants	25	19	25	17	17	19	23

*p<.05; **p<.01; ***p<.001

Table 4. Premium for own maize; sessions where own maize offered before aflatoxin mentioned

	Unsorted purchased	Unsorted aflatoxin tested	Sorted	Sorted aflatoxin tested	Other farmers'	Tasted	Market price
Own maize premium	29.974**	25.699**	25.379**	15.545	11.688	7.622	18.345**
	(8.57)	(9.33)	(8.89)	(13.65)	(7.32)	(9.71)	(6.12)
Constant	54.571***	58.846***	59.167***	69.000***	72.857***	76.923***	66.2***
	(6.7)	(7.39)	(7.15)	(12.32)	(5.23)	(7.7)	(4.19)
Bids	36	35	34	27	43	35	47
Participants	25	19	23	22	26	23	25

*p<.05; **p<.01; ***p<.001

Table 5: Proportion of posho mill samples above the legal limit (10 ppb), by source

	Mean	N
Own-produced	0.05	209
Purchased	0.10	365
Received as gift	0.29	31

Table 6: Likelihood that aflatoxin exceeds legal limit (10 ppb), relative to own-produced maize

	OLS	Clustered Standard Errors	Fixed Effects
Purchased	0.0515*	0.0515	0.0136
	(0.024)	(0.050)	(0.0187)
Gift	0.2377***	0.2377*	0.1290*
	(0.051)	(0.053)	(0.0525)
Constant	0.0526**	0.0526**	.0780***
	(0.019)	(0.019	(0.014)
Observations	574	574	574
Villages	26	26	26

Figure 1: Subjective quality assessment of auctioned maize

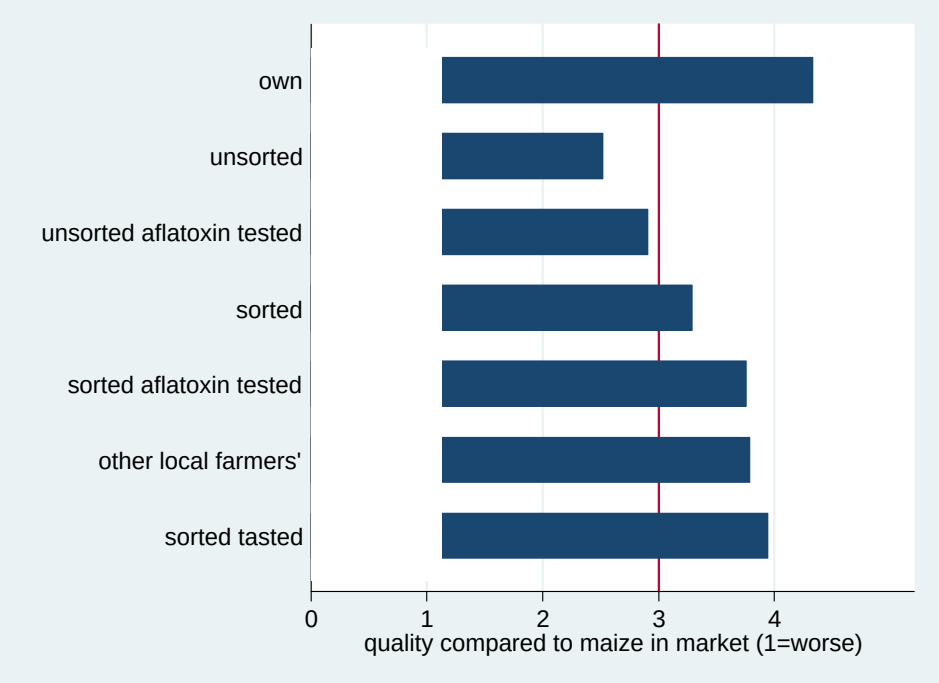
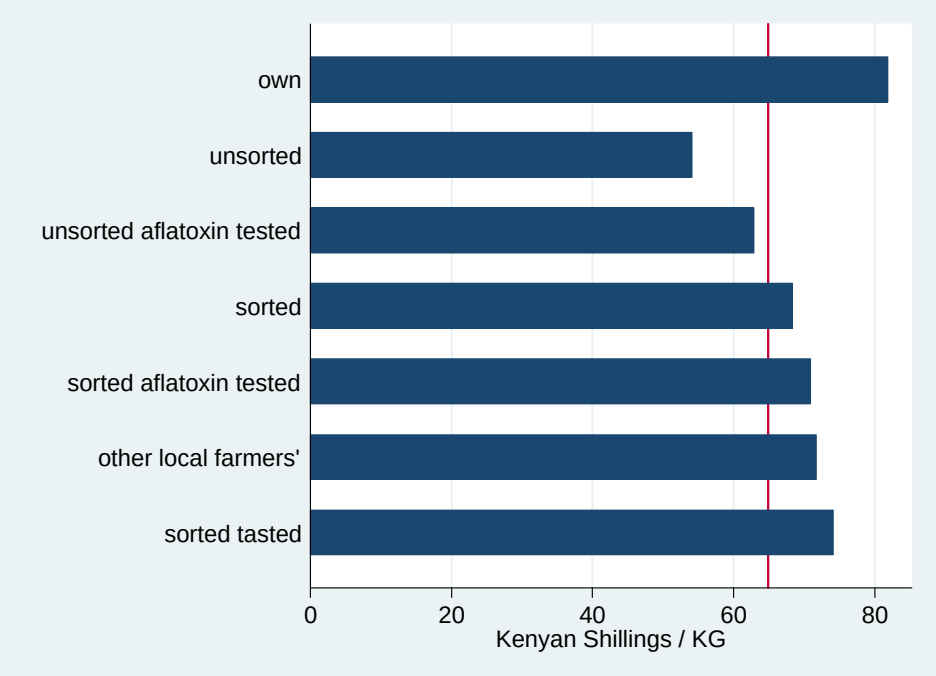


Figure 2: WTP for maize in second-price auction



Appendix A: Script for tested maize:

Maize can sometimes be contaminated with certain molds that produce toxins harmful to human health. If the maize has not been properly dried, this problem can become very bad. These toxins, called "aflatoxins" can cause cancer, harm the growth of children, and can even kill you. This is a big problem in Kenya. In our previous research, we found that one out of ten samples of maize we collected contained aflatoxin. We have tested this maize for aflatoxin and found that it is safe for human consumption.