Information and the trade-off between food safety and food security in rural grain markets: Experimental evidence from Malawi

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Abstract

To date there is little to no research on how food availability and food price seasonality in rural markets of developing countries affects both food security and food safety concerns. We implemented a clustered randomized control trial (RCT) with 1,098 rural households in central Malawi to evaluate whether providing information about food safety increased demand for safe groundnut, and whether the demand for quality (safe food) varied depending on food scarcity across the year. We used Becker-Degroot-Marshack auctions in both harvest and lean seasons to elicit consumers' willingness to pay for three quality grades of groundnut: (1) unsorted – damaged kernels not removed – and with no food safety label; (2) sorted and with no food safety label; and (3) sorted and with a label guaranteeing food safety. We found that, in the absence of information, typical consumers valued observable quality (grades 1 vs. 2), but not unobservable quality (grades 2 vs. 3). Information also increased consumers' premium for observable quality and created a premium for unobservable quality. Food scarcity strongly impacted these results. At harvest, both informed and uninformed consumers placed statistically equal premiums on unobservable quality. However, in the lean season, uninformed consumers' premium for unobservable quality disapperared, while informed consumers' premium for unobservable quality increased. These results highlight the role of providing food safety information, in combination with food quality labeling to promote food safety in the face of food security challenges often faced by rural households.

Keywords: randomized controlled trial, experimental auction, product quality, aflatoxins, groundnut, sub-Saharan Africa.

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Introduction

Many rural food markets of the developing world are characterized by informality (defined by a lack of enforceable quality grades and standards), along with pronounced seasonality. Seasonality takes the form of one (or at most two) harvests per calendar year, making it necessary to maintain food quantity and quality until the next harvest. Food availability and quality are highest at harvest while prices are lowest. Conversely, later in the year -- during the "lean" season – quantity and quality of food are low and prices are high. However, many smallholder farmers fail to take advantage of this clear arbitrage opportunity, a phenomenon labeled "sell low and buy high" (Burke et al., 2019). The phenomenon is partially due to storage issues creating physical losses to stored grain (Aggarwal et al., 2018; Kadjo et al., 2016; Omotilewa et al., 2018), cash and liquidity constraints (Basu & Wong, 2015; Burke et al., 2019; Channa et al., 2021; Dillon, 2020; Kadjo et al., 2018; Stephens & Barrett, 2011; Sun et al., 2013), and behavioral and social challenges including commitment issues, impatience, self-control and social pressure to share (Ashraf et al., 2006; Baland et al., 2011; Basu, 2014; Brune et al., 2011).

To date the literature on household behavior under seasonality has not considered how it affects demand for food quality in times of plenty (at harvest) and times of scarcity (during the lean season). Understanding the tradeoff between food security and food safety is essential because functioning markets depend on a consistent supply of quality grain (Hodges et al., 2011), and because households' grain sale and purchase behaviors are affected by both dimensions. It is also unclear whether and how interventions to improve food safety impact the tradeoff between quality and quantity that limited resource households inevitable have to make to endure the lean season.

It is difficult to maintain food quality in informal markets throughout the year. First, many markets are dominated by numerous small-scale producers and traders who typically operate without formal business registration. This makes enforcement and monitoring of quality standards in these markets difficult and expensive (Grace et al., 2015; Hoffmann et al., 2019; Roesel & Grace, 2015). This lack of regulation and coordination can have important negative consequences on human health (WHO, 2015). Given the unobservability of many food quality attributes (for example, presence of chemical and biological contaminants), producers and traders in these informal markets have little or no incentive to invest in grain quality, giving rise to a "lemons markets" in which low quality products dominate (Akerlof, 1970).

We implemented a clustered randomized control trial (RCT) with 1,098 rural households in central Malawi to evaluate whether randomly providing information about food safety increased consumers' demand for safe groundnuts. We used Becker-Degroot-Marshack auctions to elicit consumers' willingness to pay (WTP) for three quality grades of groundnuts: (i) "unsorted grade," for which broken or damaged nuts were not sorted out, and without a food safety information label, as would be commonly sold in rural markets; (ii) "sorted grade," which included visibly sorted groundnut with only undamaged nuts, and without a food safety information label; and (iii) "labeled grade," constituted of visibly sorted groundnut with only undamaged kernels, and with a food safety label. The auctions for groundnut of the three different levels of quality were conducted in both the harvest and lean seasons with the same households.[3] This allowed us to estimate the extent to which information affects the relative

[3] We only provided food safety information to treated households at harvest and did not repeat the information in the lean season. We did this to make the intervention more realistic of a true mass-extension campaign that would likely only train the same households once. Though some members of

importance that the same consumers place on food safety (quality) vs. food security (availability) during times of plenty and during times of scarcity.

Our main research objective is to estimate the trade-off between food safety and food security among rural consumers. In addition, we evaluate whether information on food safety, along with labels that make food safety attributes observable, increase consumers' demand for higher-quality/safe grain across the year. We also calculate whether the food safety label creates a separating equilibrium among consumers, by which demand for safe food exceeds the cost of testing and labeling it as such.

The food safety threat we tested and provided information about in this study were aflatoxins, which are poisons produced by fungi present in the soil that affect staple and cash crops such as maize, rice, sorghum, cassava, groundnut and millet. They thrive in the field, and in storage if grains are not dried and stored properly. These toxins pose a serious health risk globally, including liver and esophagus cancers, stunting, malnutrition and immunodeficiency (Khlangwiset et al., 2011). Furthermore, aflatoxins are unobservable to consumers in rural markets, because they are tasteless, colorless, and odorless (NTP (National Toxicology Program), 2016, 2019), and testing does not exist in these markets. Therefore, if consumers learn about and value the unobservable attribute then providing information about aflatoxin food safety could make the issue more salient and create an incentive for producers and consumers to transact higher-quality grain at a premium price.

the treatment group may have forgotten about the information after six months, our estimates can be viewed as a lower-bound impact from providing food safety information to this population.

This paper contributes to the literature in four main ways. First, to our knowledge we are the first to empirically estimate the extent of the trade-off between food security and food safety that many rural consumers make at harvest and lean season. In doing so we contribute to the literature on consumption and income seasonality among limited resource households. Previous studies found that access to credit in the lean season led to increased income and reduced consumption gaps (Basu & Wong, 2015), and increased on-farm work and higher agricultural labor wages (Fink et al., 2020). Other studies have found that offering farmers credit at harvest, which allowed them to borrow against their grain to store until prices rose later in the year, led to increased grain inventories and incomes (Burke et al., 2019). Similar positive impacts have been found for offering households formal savings accounts (Flory, 2018). In addition, offering farmers improved storage technology that enabled them to store more grain of higher quality into the lean season led to increased incomes and prices for maize (Aggarwal et al., 2018; Chegere et al., 2021; Nindi et al., 2021) and induced smallholders to invest more in improved seeds the following year (Omotilewa et al., 2018). We add to this important literature by incorporating the food quality and safety dimension to household consumption and income decisions across seasons. To our knowledge the only study to consider demand for food quality in rural markets at harvest and lean seasons focused on observable attributes such as insect damage and mold (Kadjo et al., 2016). Our paper provides empirical evidence of the effect of scarcity on consumers' demand for safe food – a largely unobservable problem – and provides valuable information on the quantity vs. quality tradeoff that consumers make.

Second, to our knowledge we are the first study to experimentally disentangle observable and unobservable premiums in consumers' willingness to pay for food safety. Most previous studies of consumers' WTP for grain quality have measured demand for observable or unobservable quality, but not both. For example, studies have focused on WTP for observable attributes such as grain color and insect damage (De Groote & Kimenju, 2008; Kadjo et al., 2016), or have estimated demand for unobservable attributes in grain like moisture content (Prieto et al., 2021) and on-farm production practices, which are unobservable to buyers in markets (Hoffmann & Gatobu, 2014). In a correlational analysis of maize samples from Kenyan mills, Hoffmann, Mutiga, et al. (2021) found that only observable quality was priced at a premium, but that unobservable quality (safety from aflatoxins contamination) was not. The closest work to ours is De Groote et al. (2016), which compared maize of three quality grades: visibly moldy, visibly clean but unlabeled, and visibly clean and labeled "aflatoxin-safe." Our study adds to De Groote et al. (2016) in that we identify an observable quality premium between "normal" unsorted grains that are commonly found in rural markets (unlike De Groote et al.'s study, which offered participants moldy maize) and sorted grains.

Third, we estimate the causal impact of providing information on aflatoxins and their dangers on farmers' valuation of various quality grades, using a randomized controlled trial. Providing information on aflatoxins has been shown to increase demand for maize flour in Kenya (Hoffmann, Moser, et al., 2021), particularly when an aflatoxins-free certification is provided (Kariuki & Hoffmann, 2019). De Groote et al. (2016) also analyzed the impact of providing information about aflatoxins on rural consumers' willingness to pay for maize of different quality grades. They found that providing aflatoxins information increased WTP for all quality grades of maize, but did not differentially influence WTP for higher or lower quality grades. Our study adds to De Groote et al. (2016) by offering a rigorous randomization of participants into the information or no information groups, as opposed to their “every other participant” approach. Our paper, therefore, estimates the causal impacts of providing food safety information, highlighting the importance of increasing awareness about food safety issues to address market failure within rural grain markets.

Last, we focus on groundnut rather than maize. Groundnut is both a cash and staple crop for many smallholder farmers in Malawi and elsewhere in SSA. Smallholder farmers’ sale of groundnut can be limited by their inability to meet stringent aflatoxins restrictions on international markets. In turn, these constraints could influence their demand for groundnut quality and their response to information in different ways from a staple crop like maize.

Overall, our results indicate that the food safety information treatment helped to increase consumers’ demand for both observable and unobservable grain quality attributes, but in different seasons. Overall, consumers’ willingness to pay for observable quality was higher than for unobservable quality, and only consumers who had been trained on aflatoxin contamination were willing to pay for unobservable quality (a premium of about 13 percent of market price). Receiving information about aflatoxins increased consumers’ demand for observable quality in the harvest season by 22 percent of market price; and for unobservable quality in the lean season (by 16 percent of market price), when food was scarce.

These results suggest that providing information may incentivize consumers to increase the relative importance they place on food safety during the lean season, compared to those without information who may be inclined to prioritize food security (availability) during times of scarcity. This suggests that government investment in aflatoxin awareness and training campaigns could facilitate sustainable supply of higher-quality safe groundnut in rural markets in Malawi.

Study Setting, Sample, Experimental Design and Auction Procedures

Background on groundnut production, consumption and food safety issues in Malawi.

Groundnut is an important crop in Malawi, accounting for about 10 percent of the average total cultivated area between 2007 and 2017 (FAOSTAT, 2020). The crop is particularly important to smallholder farmers, who account for about 90 percent of its total production (Derlagen & Phiri, 2019). In the past 10 years, Malawi has been amongst the top 14 producers of groundnut in Africa (ranked number 2 in Southern and Eastern Africa), producing an average of about 334,000 tons of unshelled groundnut per year (FAOSTAT, 2019). Groundnut also contributes over 20 percent of smallholder farmers' agricultural income (Beghin et al., 2004). The crop is also valuable to farmers because of its nitrogen fixing properties, which helps to improve soil fertility over time.

For Malawi, about 60 percent of the total production of groundnut is sold and consumed domestically (Derlagen & Phiri, 2019). This means that the crop is also an important source of dietary protein, fats and vitamins for the farmers who grow them and for other rural households. A study by (Gelli et al., 2020) found that legumes including groundnut contributed about 8 percent of the average equivalent daily food consumption per adult in Malawi. (Gama et al., 2018) also highlighted the importance of groundnut in the Malawian diet, reporting that about 70 percent of farm households in Malawi consume groundnut and groundnut products at least three time a week.

Although exports continue to be important target markets for Malawi's groundnut sector (i.e., 40 percent of the groundnut produced in Malawi is exported), the export quantities for Malawi have significantly declined compared to 20 to 50 year ago (FAOSTAT, 2019). This is due in part to the introduction of aflatoxins regulations in several potential export countries (Njoroge, 2018). This includes the European Union, which has a maximum aflatoxin requirement of 4µg/kg for groundnut (European Commission, 2006). As such, domestic markets especially the under-regulated informal grain markets have become important targets for groundnut that fails to meet the export markets food safety requirements (Edelman & Aberman, 2015). Therefore, informal markets are likely to be characterized by the undersupply of aflatoxins-safe grain.

Results from several studies that tested samples of groundnut and groundnut products collected from various markets show that aflatoxins contamination remains a major problem in Malawi and most of SSA (Matumba et al., 2014; Matumba et al., 2015; Njoroge et al., 2016; Njoroge et al., 2017; Seetha et al., 2018; Soko et al., 2014). Considering the ineffective aflatoxins regulatory systems and low market demand for aflatoxins-safe grain due to the information gap, producers and traders are likely to have no incentives to bear the cost of controlling it. However, it is important to understand factors that may influence consumers' demand for grain quality, because it is likely to be an important factor that incentivizes producers and traders to invest in quality.

In Malawi, the supply of most agricultural commodities including groundnuts is dependent on rain-fed production. Increases in commodity supply during the harvest seasons often put downward pressure on prices such that grain prices tend to reach their lowest levels at harvest. However, due to scarcity prices tend to recover in the lean season often reaching their highest levels at the peak of the season which is typically between 6 to 8 months after harvest. This creates large seasonal variations in prices (Gilbert et al., 2017; Kaminski & Christiaensen, 2014). Grain quality also varies across seasons. This is due to post-harvest losses incurred during storage and these increase the longer the grain is stored (Affognon et al., 2015; Kadjo et al., 2016; Kaminski & Christiaensen, 2014). Seasonality in commodity supply, therefore, affects both the quality of groundnuts as well as prices.

Sampling and experimental design

Our sample included 1,098 farmers from Mchinji district in central Malawi, the major groundnut-producing area in the country (see Study area in Figure 1). Farmers were randomly selected from a list of members of the National Smallholder Farmers' Association of Malawi (NASFAM), a farmer-based organization that has over 43 associations across the country. Each NASFAM association had sub-units at the community level, called Group Action Centers (GACs). GACs are typically about 10 to 35 kilometers apart. A single NASFAM association counts 21 GACs (or communities) on average, with each GAC having an average of about 15 farmer clubs. A club was made of 10 farmers who reside within the same village; village are typically 1-5 kilometers apart from each other. We targeted two associations for the study, and we randomly selected 16 GACs from each association to form the study sample. Within each of the

32 GACs, we randomly selected 25 farmers, subject to the condition that at least 2 (and at most 5) farmers were selected in each club. The resulting initial sample included 830 farmers, who participated in auctions twice: in the harvest and lean seasons. To these we added 268 randomly-sampled new farmers in the lean season auction, to control for and test possible learning effects arising from the bulk of our sample bidding in the same auction twice.

[Insert Figure 1 here]

The random assignment for our RCT into treatment (received information about aflatoxins) or control (did not receive information about aflatoxins) groups was done at the GAC level. We assigned treatment at the GAC level to avoid potential information spillover across clubs (or villages) within the same GAC. This arrangement also ensured cost-effective administration of the study activities (aflatoxins training and auction). Although GACs are far enough apart to limit possible information contamination, GACs that fall within the same association are generally similar in terms of member demographics.

The information provided to treatment group participants included facts about aflatoxins, the crops they affect and the way they affect crops (in the field and during harvest, drying and storage), the health and economic effects of aflatoxins, and how to avoid or reduce aflatoxins contamination (practices available and appropriate for smallholder farmers). The information script is provided in Appendix A. In the second round of auction, participants in the treatment group were not given the aflatoxin information again. However, new participants assigned to the treatment group in the second round (as described below) were given the same information as the original treatment group received at harvest. Participants in the control group were provided with the information at the end of the study (ie: after completing the auctions in the lean season).

Auction procedures

We elicit farmers' WTP for grain quality with incentive-compatible, revealed preference auctions using the Becker-Degroot-Marschak (BDM) mechanism (Becker et al., 1964). The BDM is commonly applied in field experiments in developing countries (Channa et al., 2019; De Groote et al., 2011; De Groote et al., 2016; Prieto et al., 2021). BDM auctions provide revealed preferences estimates based on bidding real money and actually purchasing the item at the bid price. In our setting, because participants bid on three quality grades of groundnut, one of their three bids was randomly selected as a binding bid.

Participants were first oriented about the BDM goals and procedures, then went through two practice rounds with sweets to ensure they understood the process as well as understood that strategic behavior was not beneficial. Once this was done, participants completed the real auction. All the three groundnut grades were auctioned in one-kilogram units, and participants were allowed to inspect the groundnut before bidding. They then bid on the three grades of groundnut that were presented in random order. Once they bid for all the grades, the enumerator rolled a die in the presence of the participant to determine which of the three grades of groundnut was the binding bid. The participants then drew a paper from a bag that had uniformly distributed numbers around the median market price in each village, as reported by NASFAM farmers. These were used as "offer prices" at which the binding bid was determined. The participant bought the kilogram of groundnut of the selected grade if their bid was higher than the randomly drawn "offer price" from the bag, and they paid the "offer price" rather than the price they bid. Conversely, they did not buy the groundnut if their bid was below the "offer price." In all analyses, we use the amount that participants bid as our measure of WTP. Participants were given a fixed participation fee to eliminate liquidity constraints that would limit participation and bias their WTP.

The auction was implemented twice, first during the harvest season (June 2019) when farmers had abundant stocks of grains, and then again targeting the same participants during the lean season (January 2020). In the lean season we recruited an additional sample of 268 farmers (155 in the control group and 113 in the treatment group) during the second auction to tease out possible learning effects among the farmers in the original sample from the repeated auctions.[4]

We purchased all groundnut from a single trader during the 2019 harvest in order to reduce heterogeneity in other grain attributes. The grain was then used to simulate the different grain quality grades prevalent in local markets (i.e., sorted and unsorted grain) for both auctions. Appendix B shows pictures of the three quality grades. For the auction implemented in the lean season, we used the same grain that was purchased during the harvest season and stored in hermetic bags to ensure minimal variation in grain quality (Baributsa et al., 2017). Aflatoxins testing of groundnut was done by a laboratory in Malawi's capital, Lilongwe (Appendix C). The aflatoxins-safe certificate was shown to participants when they were presented with the 1-kg sample of aflatoxins-safe groundnut on which they bid. All groundnut

[4] For the treatment(informed) and control (uninformed) individuals in the added sample, a minimum of 10 farmers in 10 clusters of each study group with at least 10 farmers per cluster would ensure a minimum detectable effect (MDE) of 0.32 standard deviations.

used in the auctions came from the same sample, in which the aflatoxins level was 2.1 ppb (below the 15 ppb limit in Malawi and the 4 ppb limit in the European Union); the aflatoxins level was not mentioned when presenting participants with the samples of unsorted and sorted grades

Power calculations

Since our outcome variable is WTP for groundnut, we use baseline data from another study involving the same households, implemented in 2018, to get an estimate of mean and standard deviation of groundnut purchase prices for the harvest and lean season. These data indicated an intra-cluster correlation coefficient within GAC of 0.02. Power calculations used 80 percent power and 95 percent confidence intervals. Calculations suggested that 32 total clusters (GACs) including 23 farmers per cluster would ensure a minimum detectable effect (MDE) of 0.32 standard deviations between treated and control households. This is generally considered a small-to-medium effect size (Cohen, 1988; Duflo et al., 2008). Our sample included 830 participants in the harvest season auction, and 1,013 participants in the lean season auction (745 repeated study participants + 268 new participants in the lean season). In total 85 households who were surveyed at harvest could not be found in the lean season (discussed in detail in the attrition sub-section below).

Analytical Approach

Empirical models

Our analyses proceed in four steps. We first estimate observable and unobservable quality premiums in the general population absent information on food safety by analyzing WTPs for the three quality grades of groundnut among uninformed participants (control group) only, using the following regression equation:

$$WTP_{ijt} = \beta_0 + \beta_1 S_{ijt} + \beta_2 L_{ijt} + \beta_3 T_{it} + \beta_4 X_i + \varepsilon_{ijt} \qquad (1)$$

In equation (1), *i* indexes individual participants, *j* indexes groundnut quality grades, and *t* indexes the time when the bid was placed (harvest or lean season). WTP is the bid value in Malawi Kwacha per kilogram of groundnut (MK/kg). S_{it}, L_{it} are binary variables equal to one if the grade of groundnut on which individual *i* bid was sorted (S_{it}), or sorted and labeled as aflatoxin safe (L_{it}), and zero otherwise. The unsorted groundnut grade is the omitted quality grade. Coefficient $\widehat{\beta_1}$ measures the observable quality premium, and the difference $(\widehat{\beta_2} - \widehat{\beta_1})$ measures the unobservable quality premium. Variable T_{it} is a binary variable equal to one if the bid was recorded in the lean season, and equal to zero if the bid was recorded in the harvest season. Due to seasonality, we would expect average bids to be higher in the lean season than at harvest *ceteris paribus*. Vector X_i is a vector of baseline participants characteristics, including the participants' baseline aflatoxins knowledge score (mean: 3.1, range: 0-10) and the number of years that the participant's household has been a member in NASFAM (mean: 4.1, range: 0-30). The former is included because the randomization is imbalanced with respect to baseline knowledge (p=0.030; Appendix D, described below), and the latter is included because it was correlated with the likelihood of attrition between the harvest and lean seasons (p=0.002;

Appendix E, described below). We present all analyses with and without vector X_i; results are nearly identical. Last, ε_{ijt} is the error term. Standard errors were clustered at the GAC level, which is the level of randomization of the information treatment; results are similar when clustering at the household level (Appendix F).[5]

Next, to estimate the impact of providing information on the two quality premiums, we implement the following regression on our full sample:

$$WTP_{ijt} = \alpha_0 + \alpha_1 S_{ijt} + \alpha_2 L_{ijt} + \alpha_3 I_{it} + \alpha_4 I_{it} * S_{ijt} + \alpha_5 I_{it} * L_{ijt} + \alpha_6 T_{it} + \alpha_7 X_i + \mu_{ijt} \quad (2)$$

where the subscripts, and variables WTP, S, L, T, X, and standard errors are as described for equation (1). I is a binary variable equal to one if the participant was provided information about aflatoxins and their dangers before bidding (treatment group), and equal to zero if the participant was not informed (control group). The error term is μ_{ijt}. The observable quality premium for uninformed participants is estimated by $\widehat{\alpha_1}$, and the unobservable quality premium for uninformed participants is $(\widehat{\alpha_2} - \widehat{\alpha_1})$. The observable quality premium for informed participants is $(\widehat{\alpha_1} + \widehat{\alpha_4})$, and the unobservable quality premium for informed participants is estimated by the expression $(\widehat{\alpha_2} + \widehat{\alpha_5} - \widehat{\alpha_1} - \widehat{\alpha_4})$.

Third, to estimate the impact of food scarcity on the quality premiums we estimate a modified versions of equation (2) in which I_{it} is omitted and replaced by T_{it}, including its interaction with the two grade variables. This model is estimated for uninformed participants only.

[5] We do not use the fixed effects estimator because it would drop some variables of interest including information treatment and quality grades dummy variables. In addition, the study was implemented across a 6 months period, so most of household characteristics (i.e. age, education landholding, etc) did not change such that correlated random effects estimator is also not applicable.

Last, to measure the impact of information on observable and unobservable quality premiums in each season, we estimate equation (2) without variable T_{it} but separately for bids in the harvest season and in the lean season. This model is estimated using the full sample.

Randomization balance checks

To estimate the balance of randomization, we used a probit estimator to model whether household characteristics were balanced across the treatment and control groups. Appendix D presents the results. The Chi-squared test of joint significance of all the independent variables in the model suggests that the treatment assignment was not perfectly balanced (χ^2=31.8, p=0.046). However, only one variable showed a statistically significant imbalance: participants who had a higher previous knowledge of aflatoxins were 1.8 percentage points more likely to have been assigned to the treatment group (p=0.030). To control for the possible effect of this imbalance, we present all results with and without this covariate included in regressions models (in vector X_i); results are unaffected.

Attrition

Willingness to pay for the three grades of groundnut quality for each participant was measured twice. In June 2019, during harvest, we surveyed and conducted the auction with 830 farmers. In January 2020, at the height of the lean season, we conducted a follow-up survey and a second auction with the same farmers. Of the 830 farmers surveyed at harvest, we could not locate 253 participants for the lean season survey and auctions (124 in the treatment group and 129 in the control group). In such cases, we aimed to survey another member of the household, and measured the new member's willingness to pay for the three groundnut quality grades. This effort was successful for 168 households, from whom we were able to collect lean season data. As a result, 85 households truly attrited from harvest to lean seasons; 50 of them were in the treatment group and 35 in the control group.

In order to estimate the possibility of bias from attrition being correlated with the treatment assignment, we regressed a binary indicator of an individual or household being an attriter (1=could not be found for the lean season survey; 0=completed the lean season survey) on the information treatment indicator and the set of baseline household characteristics included in the summary statistics table and the randomization balance test. Coefficient estimates show that neither individual-level nor household-level attrition were correlated with the random assignment (Appendices E and G). This suggests that our subsequent results remain consistent due to attrition although the missing households reduce the statistical power and perhaps the external validity of our results (Özler, 2017). At the individual level, years of schooling, gender, landholding, years as a NASFAM member, and members of the Chioshya NASFAM association were statistically significantly associated with the likelihood that a specific individual was not available to answer the survey and bid in the lean season. However, only one household characteristic was statistically significantly correlated with household attrition: years as a NASFAM member (p=0.002).

We addressed attrition in three ways. First, we present all regressions with and without a control variable for years as a NASFAM member, the variable consistently associated with household-level attrition. All results are robust to the inclusion of this variable. Second, we re-estimate our main table with years of schooling, gender, landholding, and members of the

Chioshya NASFAM Association included in the regression (Appendix H). Again, results are nearly identical to our main results. Last, we re-estimate our main table on the sub-sample of individuals who were included in both the harvest and lean seasons (Appendix I). Coefficient magnitudes and levels of statistical significance are similar to those in the main table. In summary, attrition – at the individual and household levels – did not impact our estimates.

Learning effects

Because most farmers in our sample were surveyed twice and bid twice on the same quality grades of groundnuts, learning may have occurred between harvest and lean seasons activities – about both aflatoxins and auction procedures – and may bias our measures of impacts and our comparisons across seasons. We tested for possible learning effects by re-estimating our main model with a binary variable equal to one if the household who bid in the harvest season also bid in the lean season, and zero if the household attrited between waves or was added to the lean season survey. Appendix J shows that coefficient signs, magnitudes, and statistical significance are the same as in the main estimates. Results (not shown) are similar if we define the variable based on a farmer (rather than any household member) having participated in both waves.

Summary statistics

Table 1 presents mean values of WTP for various quality grades, in Malawi Kwacha per kg (MK/kg; US$1=MK750 at the time of the study). At baseline (harvest season), the average WTP was MK233/kg for unsorted groundnuts, MK313/kg for sorted groundnuts, and MK334/kg for labeled groundnut grades. For all quality grades, the average WTP in the lean season was about 40 percent higher than that in the harvest season.

[Insert Table 1 here]

Table 2 shows characteristics of participants and their household. Before any aflatoxins information was shared with participants, participants knew the correct answer to 3.1 out of 10 questions about aflatoxins, on average. Only 39 percent of participants knew the answer to 5 or more questions. The aflatoxins awareness score was constructed based on participants' response to 10 key awareness questions, such as indicators that aflatoxins are present, crops affected, practices that proliferate aflatoxins in grain, aflatoxins' health effects and prevention (the list is provided in Appendix K).

On average, research participants were middle-aged (39 years), equally divided between men and women (46 percent men), had received a primary school education (5.8 years of schooling), and owned 3.5 acres of land. Participant were food insecure for 1.5 months in the previous 12 months; 75 percent of households reported being food insecure for at least one month (not shown).

[Insert Table 2 here]

Results

WTP for observable and unobservable quality attributes

Table 3 presents our base model, described in equation (1), for the sub-sample of uninformed consumers. Results represent demand for quality (aggregated across seasons) in a "normal" setting in rural markets, absent any information about the dangers of aflatoxins. They indicate that, on average, typical consumers value observable quality, but not unobservable quality.

Auction participants were willing to pay MK82/kg more for the sorted grade of groundnut (19 percent of market price), on average, than for the unsorted grade ($p<0.001$). Additionally, we found that auction participants were not willing to pay more for the labeled grade, on average, than for the sorted grade (coefficients indicate an unobservable quality premium of MK7, or 1.6 percent of market price; $p=0.109$).

[Insert Table 3 here]

Impact of information on quality premiums

Figure 2 shows three key impacts of information on the quality premiums (Table 4 presents the coefficients from equation (2) upon which Figure 2 is built). First, information increased consumers' quality premiums, for both observable and unobservable quality. The observable quality premium was MK34/kg higher for informed participants than uninformed participants (MK116 and MK82, respectively); the difference is statistically significant ($F=182$, $p<0.001$). The unobservable quality premium was MK55/kg higher for informed participants than uninformed participants (MK62 and MK7, respectively); the difference is statistically significant ($F=51$, $p<0.001$).

[Insert Figure 2 here]

[Insert Table 4 here]

Second, the higher observable quality premium for informed participants stems from their discounting of low-quality (unsorted) groundnut rather than placing a premium on sorted groundnut. WTP for sorted groundnut was statistically equal for informed and uninformed groups, but WTP for unsorted groundnut was MK26/kg lower for informed participants ($p<0.001$). Finally, uninformed participants were not willing to pay a premium for unobservable quality. Regression coefficients estimate a MK7/kg premium for unobservable quality among uninformed participants, but this estimate is not statistically significant (p=0.093).

Food safety and food security trade-off

To evaluate the presence of a trade-off between food safety and food security, we estimate the effect of food scarcity on (uninformed) consumers' observable and unobservable quality premiums. We do so by interacting the two grade variables in equation (2) with variable T_{it}, a binary variable equal to one for bids made in the lean season and zero for bids made in the harvest season, on the sub-sample of uninformed participants only. We narrow the sample to uninformed participants only in order to estimate the food safety and food security trade-off in a "normal" setting, absent our intervention. Results, shown in Table 5, shows that these participants placed a premium on observable quality in both harvest and lean seasons (MK50/kg and MK107/kg, p<0.001 and p<0.001). The value of this premium was much higher in the lean season, when quantities are scarcer, than in the harvest season, even when measured in percentage of the unsorted groundnut grade to account for generally higher prices in the lean season: the observable quality premium was about 20 percent of the lower-quality grade in the harvest season, and 32 percent in the lean season.

At harvest, uninformed participants were willing to pay a premium for unobservable quality of about MK12/kg, on average, or about 5 percent of the market price of groundnut, and this was marginally statistically significant (p=0.061). During the lean season auction, however, this marginally statistically significant premium disappeared: the estimated average unobservable quality premium was MK2/kg, equivalent to 0.6% of the market price of groundnut in the lean season (p=0.507).

[Insert Table 5 here]

Impact of information on quality premiums, by level of food scarcity

The level of food abundance or scarcity could influence the impact of providing aflatoxins information on willingness to pay for grain quality, both observable and unobservable. We address this question by estimating equation (2) separately for the harvest and the lean seasons.[6] Figure 3 and column 1-2 of Table 6 show the impact of information on willingness to pay and quality premiums at harvest.

At harvest, results mirrored the estimates of the impacts of information on the observable quality premium: larger premium for informed participants than uninformed participants (i.e. MK116/kg versus MK50/kg). We also observe that both informed and uninformed participants placed a premium on unobservable quality. However, the amounts of these premiums were not statistically different from each other. That is, informed participants were willing to pay MK29/kg more for unobservable quality, compared to MK12/kg for uninformed participants. However, the MK17/kg difference was not statistically significant (F=2.5, p=0.127).

[Insert Figure 3 here]

[6] A regression in which a binary variable indicating the lean season is interacted with quality grades and information (grade * information * lean), and the associated comparisons of WTPs across harvest and lean seasons, show that differences across seasons are all statistically significant (Appendix L). We present estimates for each season separately for clarity.

[Insert Table 6 here]

In the lean season, the impact of information on participants' willingness to pay and quality premiums differed noticeably from the harvest season (see Figure 4 and columns 3-4 of Table 6 which show the impact of information on willingness to pay and quality premiums in lean season). First, although both the informed and uninformed participants placed large premiums for observable quality, their observable quality premiums were not significantly differences from each other (MK116/kg for the informed versus MK107/kg for the uninformed; F=1.5, p=0.228). Estimates of the quality premium in percentage of the average willingness to pay for unsorted quality grade in each season, which adjust for the mean difference in WTP across seasons, tell the same story (MK116/kg and MK107/kg represent 35 percent and 32 percent of the average willingness to pay for unsorted quality grade in each season).

[Insert Figure 4 here]

Second, unlike the harvest season where the unobservable quality premium was not statistically significantly different for informed and uninformed participants (difference in premiums=MK17/kg, p=0.127), in the lean season, the impact of informing participants was large and statistically significant. This is because uninformed participants exhibited no premium for unobservable quality (MK=2/kg or 0.6 percent of the unsorted WTP in the lean season, p=0.494). However, informed participants were willing to pay a premium of MK90/kg (27 percent of the unsorted WTP I the lean season, p<0.001) for groundnut of guaranteed unobservable quality. The difference was strongly statistically significant (p<0.001).

A simple cost-effectiveness calculation

We compare the amounts of unobservable quality premiums to the costs of testing and labeling crops as aflatoxins-free. The amount of the unobservable quality premium (from labeling), on average across the harvest and lean seasons, was MK62/kg for informed consumers and MK7/kg for uninformed consumers (Table 4). Assuming one aflatoxins test can be conducted per 100 kg bag, the increased price that producers would receive is MK6,200 per bag sold to informed consumers, and MK700 per bag sold to uninformed consumers. We estimated the cost of providing information about aflatoxins to be MK2,400 per household trained, based on the costs we incurred in the project. This cost could be reduced by using cheaper deliver mechanisms (e.g. radio), by including information on more than one topic per session, and/or considering that the benefits of information last more than one season. In our study, the information about aflatoxins was not repeated to participants in the lean season, about six months after the harvest season auction, yet we found large impacts of information on the unobservable quality premium in the lean season.

Testing groundnut for aflatoxins is therefore not cost-effective unless consumers are informed about the dangers of aflatoxins. For those consumers, the cost-effectiveness of testing groundnut for aflatoxins before sale hinges on the cost of aflatoxins testing. Given the benefits and costs reported above, testing crops for aflatoxins would provide a positive return if aflatoxins costs were limited to about MK3,800 per bag, or about US$5 per bag. Several types of tests exist; current costs of the material used in this project are about US$7 per test; including transportation and laboratory expenses, the total cost of an aflatoxins test can reach up to US$20.

We also conduct a comparison of the observable (sorting) quality premiums to the costs of sorting – including time or labor costs and quantity loss due to sorting or removal of broken and damaged grain. Assuming 10 percent quantity loss from sorting, the 10 kg lost per 100 kg bag would be valued at MK4,300 (average market price over harvest and lean seasons was MK430/kg). Based on the labor costs incurred in the project, we estimate the cost of sorting a 100 kg bag to be MK1,500. This implies an estimated total sorting cost of MK5,800. Given the estimates of observable quality premium for uninformed consumers (MK82/kg) and informed consumers (MK116/kg) reported in Table 4, sorting provides positive returns of MK2,400 to MK5,800 per bag (US$3.20 to US$7.75) on average. Given these meaningful positive returns, understanding why farmers do not sort grain and how their constraints can be lifted should be a concern to researchers and practitioners.

Discussion and Conclusion

This paper contributes to the literature on seasonality, information, product quality and market development in sub-Saharan Africa by evaluating how food safety information and food availability influence consumers' demand for observable and unobservable grain quality attributes at harvest season when grain quantity and quality are high, while price is low, and during the lean season when the opposite is true. Aflatoxin levels in groundnuts was our unobservable quality attribute, used to evaluate rural consumers' demand for food quality and food safety. Specifically, we (*i*) disentangled demand for observable quality (sorting of broken nuts, debris) and unobservable quality (aflatoxins-free labeling), (*ii*) measured consumers' willingness to pay a premium for each type of quality in different seasons with different levels of food security (abundance/scarcity), and (*iii*) estimated the impact of providing information about food safety (aflatoxins contamination) on each type of quality in each season.

Overall, consumers in our study were willing to pay for observable quality, a finding consistent with Kadjo et al. (2016) who also found that consumers were willing to pay more for maize with higher observable quality during the harvest season. In addition, information increased demand for observable quality: providing information about an unobservable source of contamination – aflatoxins – increased demand for observable quality, by about MK34/kg which is equivalent to about 8 percent of the market price for the crop on average. Possible spillover effects of food safety information about unobservable contaminants on demand for observable quality may be an additional benefit of such information and should be taken into consideration by future research on food safety programming. Finally, information also created demand for unobservable quality: it increased consumers' willingness to pay for unobservable quality by about MK55/kg which is equivalent to about 13 percent of the average market price, on average, while uninformed consumers exhibited no unobservable quality premium. The result confirms that aflatoxins contamination is unobservable to rural consumers in practice (Hoffmann & Gatobu, 2014; Hoffmann, Mutiga, et al., 2021).

In addition, food scarcity and seasonality, played an important role is consumers' demand for food safety. At harvest, information increased demand for observable quality (by 22 percent of market price) but not unobservable quality; during the lean season, information did not increase demand for observable quality, but increased demand for unobservable quality (by 16 percent of market price).

These results suggest that informed consumers who had been trained about aflatoxins did not believe the risk of aflatoxins contamination to be high at harvest. This could be due to them not fully understanding the information provided (which described how aflatoxins can contaminate crops during cultivate), and/or them having knowledge of the conditions in which crops are grown, harvested, and stored. Given that we find positive impacts of the training on willingness to pay for quality six months after the training was conducted (harvest to lean seasons), the latter reason is likely to be key.

Taken together, the findings highlight three important messages for future research and for food safety programming. First, we show that households trade-off food quantity and quality in the lean season when overall quality and quantity are both low. In this way our study adds important new information to the existing literature that has demonstrated the benefits of credit, savings and technology interventions that increase income and consumption in the lean season (Aggarwal et al., 2018; Basu & Wong, 2015; Burke et al., 2019; Channa et al., 2021; Chegere et al., 2021; Flory, 2018; Nindi et al., 2021; Omotilewa et al., 2018). However, our results suggest that simply increasing the quantity of food sold and consumed in the lean season may not be sufficient to increase food safety and security. There is need to identify and support initiatives or policy interventions that pursue both objectives simultaneously. The result is consistent with the idea that consumers know that crop quality (observable and unobservable) decreases over time in storage (Kadjo et al., 2016), so that solving food quality problem requires solving storage and food security issues as well. This also suggest that the "sell low and buy high" phenomenon, by which many farmers sell their crops at harvest at a low price and purchase the same food in the lean season at a high price (Burke et al., 2019), is compounded by a quality problem: sell high quality at a low price and buy low quality at a high price.

Second, improving the quality and safety of foods that consumers buy in rural informal markets requires both informing consumers about sources of contamination *and* labeling of safe foods. Absent information, consumers were willing to pay a very small price premium for unobservable quality (labeled groundnut) at harvest, and no premium at all in the lean season when food was scarce. This result is consistent with Hoffmann, Moser, et al. (2021), and complements that study with evidence from rural markets and groundnuts. The rigorous randomized design employed in the present study could explain the difference from De Groote et al. (2016), who found that information did not influence demand for observable and unobservable quality differently.

Third, the results indicate a need for policies that (1) increase the monitoring and enforcement of quality standards in rural markets, particularly during the lean season when food is scarce and consumers have priors about its average quality, and (2) promote low-cost testing of crops for contaminants. Consumer's high willingness to pay for quality in the lean season suggest a possible arbitrage opportunity for farmers that can maintain crop quality from harvest to the lean season, conditional on information reaching consumers and labeling of safe food (and absent general equilibrium effects). Testing and labeling remain prohibitive for a market for high-quality food to emerge on its own. But policy action that initially subsidizes the cost of aflatoxin testing could complement and spur market mechanisms, for the economic and health benefits of smallholder farmers, their family, and a large number of consumers. This sort of preventative food safety investment is likely to be more cost-effective than the paying for the longer-term health consequences of consuming unsafe food.

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Figure 1: Study area.

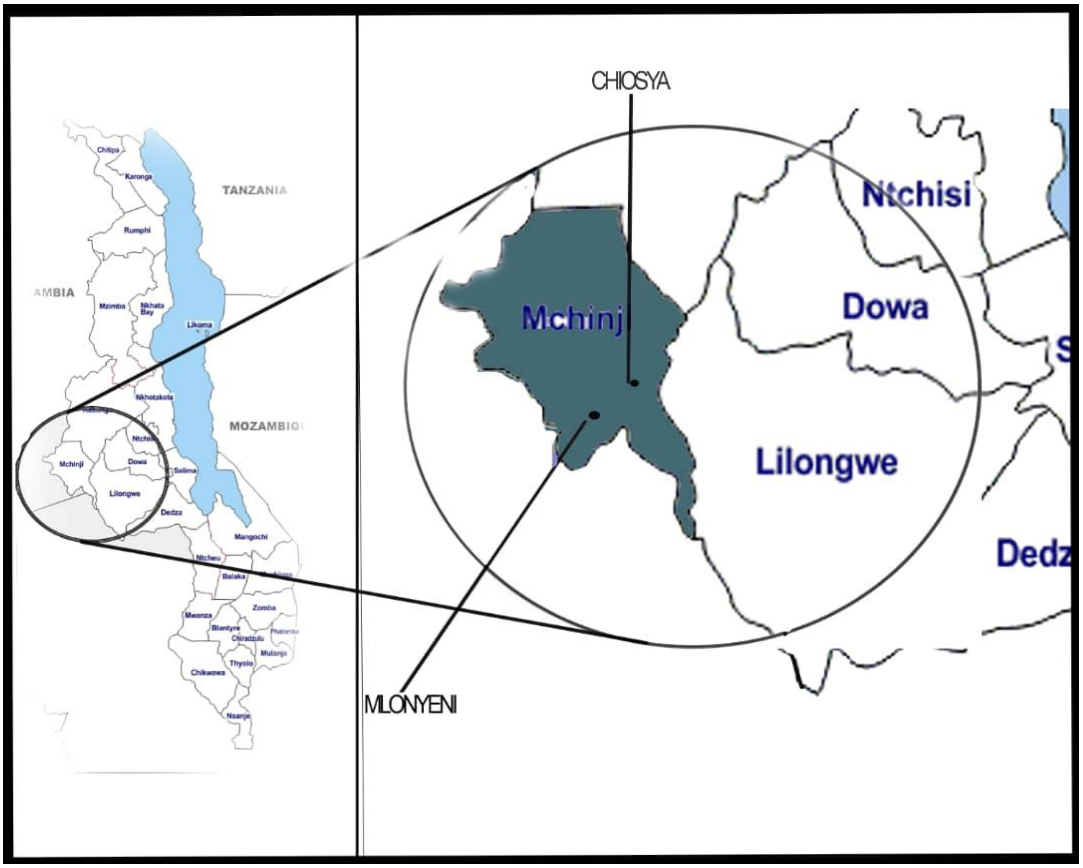
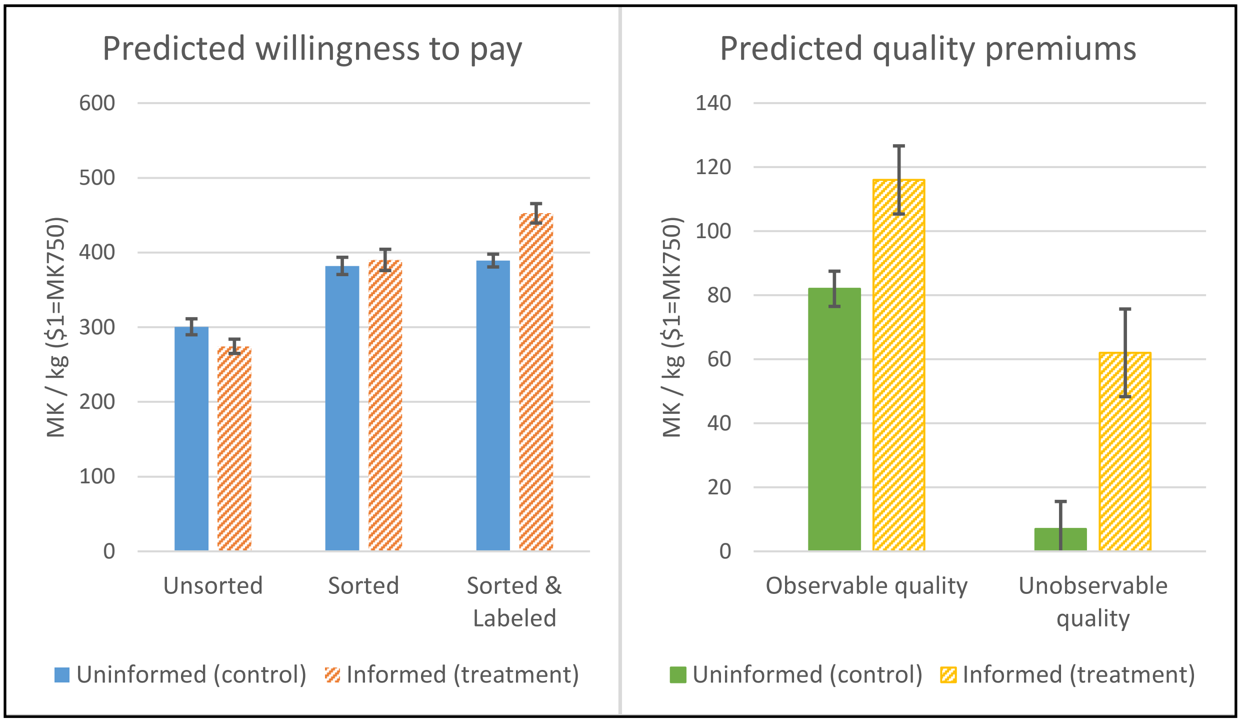
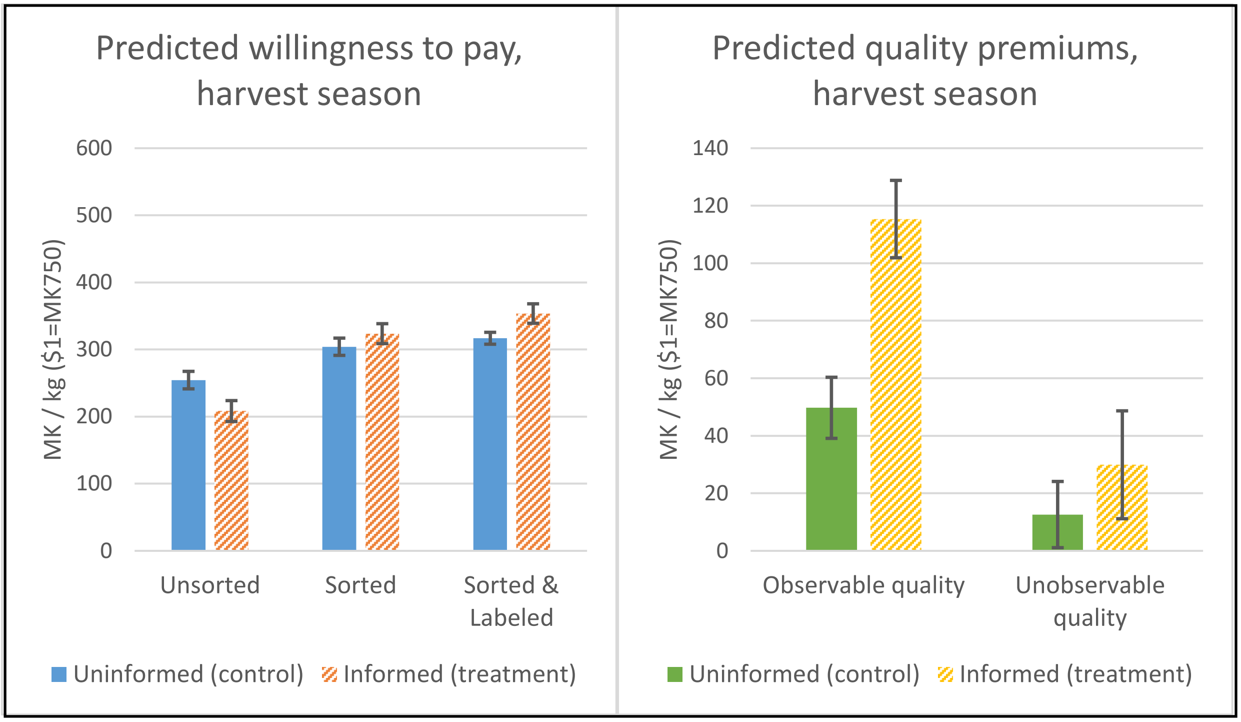


Figure 2. Impact of information on willingness to pay and quality premiums.



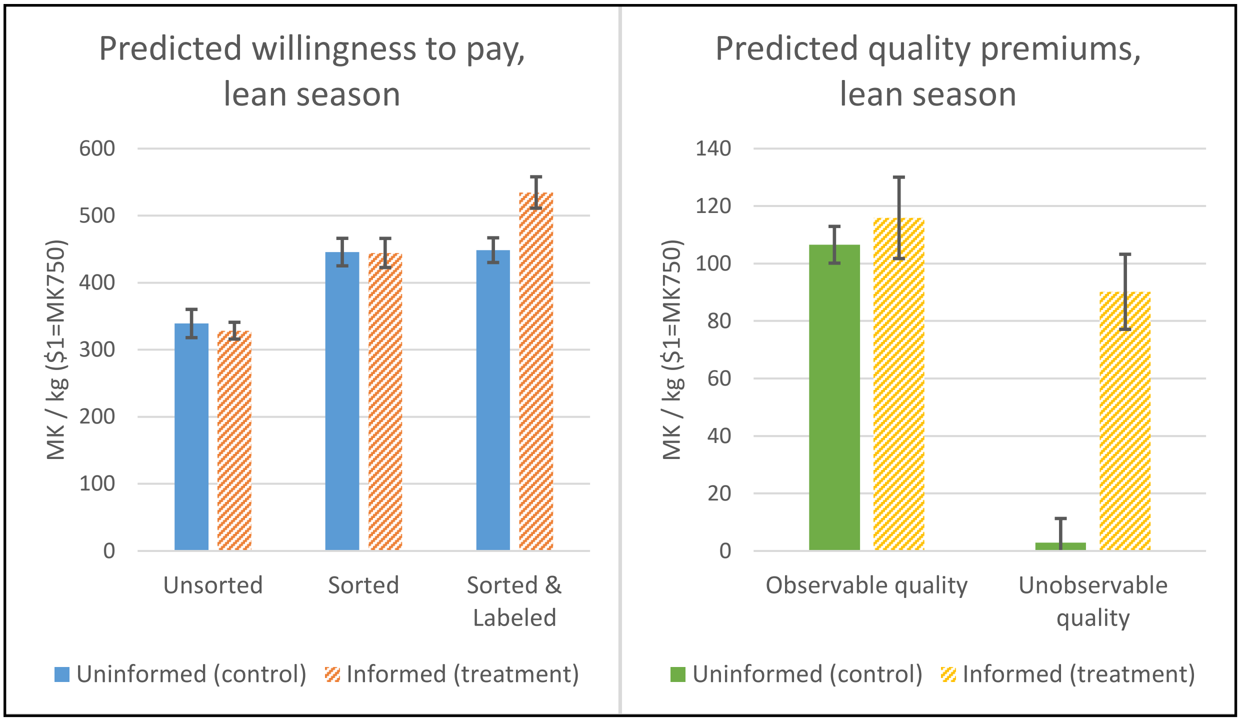
Error bars represent 95% confidence intervals. Average market price of groundnut (over harvest and lean seasons)=MK430/kg.

Figure 3. Impact of information on willingness to pay and quality premiums, harvest season.



Error bars represent 95% confidence intervals. Average market price of groundnut in the harvest season=MK300/kg.

Figure 4. Impact of information on willingness to pay and quality premiums, lean season.



Error bars represent 95% confidence intervals. Average market price of groundnut in the lean season=MK535/kg.

Table 1: Outcome descriptive statistics

	Count	Mean	Std. Dev.	Min	Max
Panel A: Overall					
WTP for unsorted groundnut (MK/kg)	1,843	289	134	0	830
WTP for sorted groundnut (MK/kg)	1,843	386	142	50	1,060
WTP for labeled groundnut (MK/kg)	1,843	418	152	70	1,210
Panel B: Harvest season					
WTP for unsorted groundnut (MK/kg)	830	233	104	0	760
WTP for sorted groundnut (MK/kg)	830	313	104	50	870
WTP for labeled groundnut (MK/kg)	830	334	103	70	740
Panel C: Lean season					
WTP for unsorted groundnut (MK/kg)	1,013	334	139	90	830
WTP for sorted groundnut (MK/kg)	1,013	445	140	60	1,060
WTP for labeled groundnut (MK/kg)	1,013	487	152	70	1,210

Data are in Malawi Kwachas (MK) per kilogram; US$1=MK750.

Table 2: Household descriptive statistics

	Count	Mean	Std. Dev.	Min	Max
Baseline aflatoxins knowledge score (0-10)	1,098	3.1	3.4	0	10
=1 if baseline aflatoxins awareness score > 5	1,098	0.39	0.5	0	1
Age of respondent (years)	1,081	39	12	17	76
Respondent's schooling (years)	1,098	5.8	3.7	0	38
=1 if respondent is male	1,098	0.46	0.5	0	1
Household size	1,098	5.3	1.8	1	12
Landholding (acres)	1,098	3.5	1.4	0.4	10
Number of years in NASFAM	1,098	4.1	3.3	0	30
Number of school goers in household	1,068	2.4	1.6	0	9
Number of females in household	1,068	2.7	1.3	0	9
Number of adults (age>18 years) in household	1,068	2.5	1.1	0	9
Distance from home to closest market (km)	1,098	12	15	0	300
Number of extension officer visits per year	1,098	5.6	10.2	0	90
=1 if household owns radio set	1,098	0.46	0.5	0	1
=1 had cash savings at the beginning harvest	1,068	0.25	0.4	0	1
Storage expenditure (MK)	1,068	2,015	5,051	0	91,000
Number of months food insecure (0 to 12)	1,098	1.5	1.5	0	10
=1 if respondent too ill to farm for >2 months in past 2 years	1,068	0.19	0.4	0	1
=1 if association is Chioshya	1,098	0.52	0.5	0	1

US$1=MK750 (Malawi Kwacha). The baseline aflatoxins knowledge score (0 to 10) is constructed based on participants' response to 10 aflatoxins awareness questions.

Table 3: Observable and unobservable quality premiums, uninformed participants only.

	(1)	(2)
Dependent variable:	Willingness to pay (MK/kg)	
=1 if sorted grade (β_1)	82***	82***
	(3)	(3)
=1 if labeled grade (β_2)	89***	89***
	(5)	(5)
=1 if lean season	119***	122***
	(13)	(13)
Baseline aflatoxins knowledge score (0 to 10)		2*
		(1)
Number of years in NASFAM		1
		(1)
Constant	235***	225***
	(6)	(7)
Observations	3,030	3,030
R-squared	0.25	0.25
Number of unique bidders	600	600
Observable quality premium (β_1)	82***	82***
Unobservable quality premium ($\beta_2 - \beta_1$)	7	7
F-test: Obs. quality premium = unobs. quality premium	F=176***	F=176***

The sample is limited to uninformed participants. Coefficient names refer to equation (1). Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include the baseline aflatoxins knowledge score and the number years that the household has been a member of NASFAM. Average market price of groundnut (over harvest and lean seasons)=MK430/kg.

Table 4: Impact of information on observable and unobservable quality premiums.

	(1)	(2)
Dependent variable:	Willingness to pay (MK/kg)	
=1 if sorted grade (α_1)	82***	82***
	(3)	(3)
=1 if labeled grade (α_2)	89***	89***
	(5)	(5)
=1 if household informed about aflatoxins (α_3)	-26***	-26***
	(7)	(7)
Sorted grade * Information (α_4)	34***	34***
	(6)	(6)
Labeled grade * Information (α_5)	89***	89***
	(7)	(7)
=1 if lean season (α_6)	129***	129***
	(9)	(9)
Constant	230***	227***
	(5)	(7)
Observations	5,529	5,529
R-squared	0.32	0.32
Number of unique bidders	1,098	1,098
Baseline control variables included	No	Yes
Uninformed participants (Control group):		
Observable quality premium (α_1)	82***	82***
Unobservable quality premium ($\alpha_2 - \alpha_1$)	7*	7*
Informed participants (Treatment group):		
Observable quality premium ($\alpha_1 + \alpha_4$)	116***	116***
Unobservable quality premium ($\alpha_2 + \alpha_5 - \alpha_1 - \alpha_4$)	62***	62***
F-test: Obs quality premium, uninformed = obs. quality premium, informed	F=31***	F=31***
F-test: Unobs quality premium, uninformed = unobs. quality premium, informed	F=51***	F=51***

Coefficient names refer to equation (2). Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include the baseline aflatoxins knowledge score and the number years that the household has been a member of NASFAM. Average market price of groundnut (over harvest and lean seasons)=MK430/kg.

Table 5: Impact of seasonality on observable and unobservable quality premiums, uninformed participants only.

	(1)	(2)
Dependent variable:	Willingness to pay (MK/kg)	
=1 if sorted grade (α_1)	50***	50***
	(5)	(5)
=1 if labeled grade (α_2)	62***	62***
	(6)	(6)
=1 if lean season (α_6)	85***	87***
	(15)	(15)
Sorted grade * Lean season (α_4)	57***	57***
	(6)	(6)
Labeled grade * Lean season (α_5)	47***	47***
	(6)	(6)
Constant	254***	244***
	(7)	(7)
Observations	3,030	3,030
R-squared	0.31	0.31
Number of unique bidders	600	600
Baseline control variables included	No	Yes
Harvest season:		
Observable quality premium (α_1)	50***	50***
(In % of unsorted grade at harvest)	*19.7%*	*20.5%*
Unobservable quality premium ($\alpha_2 - \alpha_1$)	12*	12*
(In % of unsorted grade at harvest)	*4.7%*	*4.9%*
Lean season:		
Observable quality premium ($\alpha_1 + \alpha_4$)	107***	107***
(In % of unsorted grade in lean season)	*31.6%*	*32.3%*
Unobservable quality premium ($\alpha_2 + \alpha_5 - \alpha_1 - \alpha_4$)	2	2
(In % of unsorted grade in lean season)	*0.6%*	*0.6%*
F-test: Obs quality premium, harvest season = obs. quality premium, lean season	F=95***	F=95***
F-test: Unobs quality premium, harvest season = unobs. quality premium, lean season	F=2.6	F=2.6

Coefficient names refer to equation (2). Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include the baseline aflatoxins knowledge score and the number years that the household has been a member of NASFAM. Average market price of groundnut= MK300/kg (harvest) and MK535/kg (lean season).

Table 6: Impact of information on observable and unobservable quality premiums, in harvest and lean seasons.

	(1)	(2)	(3)	(4)
Dependent variable:	Willingness to pay (MK/kg)			
Season:	Harvest		Lean	
=1 if sorted grade (α_1)	50***	50***	107***	107***
	(5)	(5)	(3)	(3)
=1 if labeled grade (α_2)	62***	62***	109***	109***
	(6)	(6)	(5)	(5)
=1 if household informed about aflatoxins (α_3)	-46***	-45***	-11	-12
	(10)	(10)	(12)	(12)
Sorted grade * Information (α_4)	66***	66***	9	9
	(8)	(8)	(8)	(8)
Labeled grade * Information (α_5)	83***	83***	97***	97***
	(9)	(9)	(10)	(10)
Constant	254***	259***	339***	334***
	(6)	(7)	(10)	(13)
Observations	2,490	2,490	3,039	3,039
R-squared	0.18	0.18	0.19	0.19
Number of unique bidders	830	830	1,013	1,013
Baseline control variables included	No	Yes	No	Yes
Uninformed participants (Control group):				
Observable quality premium (α_1)	50***	50***	107***	107***
(In % of unsorted grade)	*19.7%*	*19.3%*	*31.6%*	*32.0%*
Unobservable quality premium ($\alpha_2 - \alpha_1$)	12**	12**	2	2
(In % of unsorted grade)	*4.7%*	*4.6%*	*0.6%*	*0.6%*
Informed participants (Treatment group):				
Observable quality premium ($\alpha_1 + \alpha_4$)	116***	116***	116***	116***
(In % of unsorted grade)	*55.8%*	*54.2%*	*35.4%*	*36.0%*
Unobs. quality premium ($\alpha_2 + \alpha_5 - \alpha_1 - \alpha_4$)	29***	29***	90***	90***
(In % of unsorted grade)	*13.9%*	*13.6%*	*27.4%*	*28.0%*
F-test: Obs quality premium, uninformed = obs. quality premium, informed	F=61***	F=61***	F=1.5	F=1.5
F-test: Unobs quality premium, uninformed = unobs. quality premium, informed	F=2.5	F=2.5	F=131***	F=131***

Coefficient names refer to equation (2). Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include the baseline aflatoxins knowledge score and the number years that the household has been a member of NASFAM. Average market price of groundnut= MK300/kg (harvest) and MK535/kg (lean season).

Appendix A. Aflatoxins information script for the Malawi food quality and safety study

We will now take you through a training session to inform you about Aflatoxins prevalence, its health effects as well as how to control or prevent contamination.

1. ***What are aflatoxins?***

Aflatoxins are carcinogenic poisons produced by molds or fungus such as *Aspergillus flavus* and *Aspergillus parasiticus* which are usually found in improperly stored food. These toxins are invisible and tasteless such that it is hard for a consumer to detect them in their food without use of some lab equipment.

2. ***Which crops and foods are affected by Aflatoxins?***

As pointed out earlier aflatoxins are found in improperly stored food including maize, rice, sorghum, cassava, groundnut and millet amongst other staple foods. Molds are a key indicator of aflatoxins and these can also grow in flour or spices that are not stored properly and contaminate them with aflatoxins. Feeding animals grain contaminated with molds can also affect the products we get from them such as milk as these toxins can be carried over and are difficult to neutralize. Aflatoxins cannot be neutralized by cooking or processing. Some traditional food processing procedures especially those that increase moisture content can also increase aflatoxins infestation in food.

3. ***Health Effects and Economic Costs***

Consumption of aflatoxins in large quantities can cause aflatoxicosis. This condition involves abdominal pain, vomiting, fever, diarrhea and convulsions. There has been several publicized epidemics in other countries like Kenya and Tanzania, but it is likely that people in Malawi experience this but few reports it.

Chronic consumption of aflatoxins in small quantities which is more prevalent in Malawi is also dangerous. This is because it can suppress the immune system, cause stunting, malnutrition, especially in children. There extensive research evidence that suggest a strong correlation between chronic aflatoxins exposure and liver diseases and cancers. Besides, because maize is a staple food crop in Malawi, taking up to about 60 percent of the daily caloric intake, it is likely that Malawians may be at high risk of chronic exposure to aflatoxins. For children who are mostly feed grain-processed products like porridges and puddings (*"Phala")* as weaning foods*,* this may also be a serious health threat.

Aflatoxins contamination in grain can also pose economic threat by limiting farmers access to high value markets. For example, for export markets and local processing sectors, there are limitation in terms of aflatoxins contents for grain, as such farmers that have contaminated grain with aflatoxins level beyond the allowable levels can fail to access such markets and this can have significant effects on the economy as well as reduce incomes for farmers. There has been limited awareness about aflatoxins in Malawi with the few initiatives focused on groundnut mostly because of the need to deal with such barrier to markets. However, not much has been done to raise consumer awareness about aflatoxins prevalence in different food crops especially those sold/purchased from informal grain markets such as groundnut and maize. Our purpose is to raise awareness about aflatoxins prevalence and its health effects

4. How to Avoid Contaminations (Dealing with Practices that Proliferate aflatoxins)?

Aflatoxins contamination can be avoided in many ways in the different stages of production.

- ***During production***, farmers can use some bio pesticides like Afla-safe to control aflatoxins while the crops are still in the fields.

- ***During harvest***, farmers can avoid contamination by avoiding direct grain contact with soils i.e. not piling grain on the ground before and during harvesting.

- ***After harvest***, farmers can avoid aflatoxins contamination by ensuring that their grain is properly dried before packing as well as avoiding drying grain directly on the ground. This is because high moisture content promotes aflatoxins growth.

- ***During storage***, farmers can also further control aflatoxins by using effective storage technologies like hermetic bags (PICS bags) which have proven to be more effective at controlling molds.

Appendix B. Auction samples

Bag 4 shows the unsorted quality grade, bag 5 shows the sorted quality grade, bag 6 shows the sorted and labeled quality grade. Observable quality premium = WTP for bag 5 – WTP for bag 4. Unobservable quality premium = WTP for bag 6 – WTP for bag 5.

Appendix C. Aflatoxins-free certificate

VALID NUTRITION

Valid Nutrition, Box 202, Lilongwe, Malawi

+265 (0)1 712 488 malawi@validnutrition.org www.validnutrition.org

DATE: 15/05/2019

Sample type: Raw nut and Maize
Sample ID: Grade A & B
Test required: Total aflatoxin
Date analysis started: 15/05/2019

CERTIFICATE OF ANALYSIS

1. Mycotoxin test

SAMPLE	TEST	RESULT	UNITS	METHOD	LAB REFERENCE NUMBER
Maize (A)	Total aflatoxin	1.7	ppb	Fluorometry	CHE/19/AO/17
Maize (B)	Total aflatoxin	0.71	ppb	Fluorometry	CHE/19/AO/17
Raw nut (A)	Total aflatoxin	2.1	ppb	Fluorometry	CHE/19/AO/17
Raw nut (B)	Total aflatoxin	41	ppb	Fluorometry	CHE/19/AO/17

Declaration

The undersigned hereby certify that the data is true to the specification of the obtained results of tests

Emmanuel Mawanga
Quality Assurance and Control Supervisor

Chikondi Matiki
Quality Assurance Manager

Note: We used groundnut sample A for all auctions. The aflatoxins limits in groundnut are 4 parts per billion (ppb) in the European Union, and 15 ppb in Malawi and the United States.

Appendix D. Test of randomization balance

Dependent variable:	1 if household informed about aflatoxins (T), 0 if uninformed (C)
Baseline aflatoxins knowledge score (0 to 10)	0.018**
	(0.008)
Age of respondent (years)	0.002
	(0.002)
Respondent's schooling (years)	-0.002
	(0.005)
=1 if Respondent is male	-0.013
	(0.047)
Household size	-0.000
	(0.016)
Landholding (acres)	-0.019
	(0.039)
Number of years in NASFAM	-0.011
	(0.008)
Number of school goers in household	0.006
	(0.018)
Number of females in household	0.002
	(0.018)
Number of adults in household (age>18 years)	-0.018
	(0.015)
Distance from home to closest market (km)	-0.005
	(0.003)
No of extension officer visits per year	0.001
	(0.001)
=1 if household owns radio set	0.046
	(0.040)
=1 had cash savings at the beginning harvest	-0.043
	(0.041)
Storage expenditure (1000 MK)	-0.001
	(0.003)
Number of months food insecure (0 to 12)	-0.014
	(0.010)
=1 if member too ill to farm for >2 months in past 2 years	0.009
	(0.030)
Respondents' anchor price (1000 MK)	0.376
	(0.369)
=1 if repeated auction participant (learning effects)	0.026
	(0.083)
=1 if NASFAM association is Chioshya	0.084
	(0.202)
Observations	1,068
Chi^2-test of joint significance of all probit coefficients	$\chi^2 = 31.8$**

Coefficients are marginal effects after a probit regression. Standard errors clustered by group action center in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. 1 US$=750 Malawi Kwacha (MK). The baseline aflatoxins knowledge score (0 to 10) was constructed using participants' response to 10 aflatoxins awareness questions.

Appendix E. Test of attrition bias, household-level attrition

Dependent variable:	Dummy=1 if household attrited between harvest and lean seasons; =0 if not		
Level of analysis:	Household	Bid	Bid
Standard errors clustered by:	GAC	GAC	Household
=1 if household received information (T group)	0.039	0.039	0.039*
	(0.031)	(0.031)	(0.021)
Baseline aflatoxins knowledge score (0 to 10)	0.001	0.001	0.001
	(0.002)	(0.002)	(0.003)
Age of respondent (years)	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Years of schooling for respondent (years)	-0.001	-0.001	-0.001
	(0.003)	(0.003)	(0.003)
=1 if respondent is male	0.009	0.008	0.008
	(0.017)	(0.017)	(0.021)
Household size	0.011	0.011	0.011
	(0.008)	(0.008)	(0.010)
Landholding (acres)	-0.009	-0.009	-0.009
	(0.008)	(0.008)	(0.006)
Number of years in NASFAM	-0.015***	-0.015***	-0.015***
	(0.005)	(0.005)	(0.005)
Number of school goers in household	-0.004	-0.004	-0.004
	(0.010)	(0.010)	(0.010)
Number of females in household	-0.002	-0.001	-0.001
	(0.010)	(0.010)	(0.010)
Number of adults in household (age>18 years)	-0.009	-0.009	-0.009
	(0.011)	(0.011)	(0.011)
Distance from home to closest market (km)	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)
No of extension officer visits per year	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
=1 if household owns radio set	-0.020	-0.020	-0.020
	(0.018)	(0.018)	(0.021)
=1 had cash savings at the beginning harvest	-0.039	-0.039	-0.039
	(0.031)	(0.031)	(0.028)
Storage expenditure (1000 MK)	-0.001	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
Number of months food insecure (0 to 12)	-0.002	-0.002	-0.002
	(0.007)	(0.007)	(0.007)
=1 if member too ill to farm for >2 months in past 2 yrs.	-0.006	-0.006	-0.006
	(0.020)	(0.020)	(0.027)
Respondents' anchor price (1000 MK)	-0.109	-0.065	-0.065
	(0.238)	(0.247)	(0.295)
=1 if NASFAM association is Chioshya	0.023	0.022	0.022
	(0.036)	(0.036)	(0.022)
Willingness to pay for grain grade (1000 MK/kg)		0.013	0.013
		(0.060)	(0.052)
Observations	830	2,490	2,490
Chi^2-test of joint significance of all coefficients	χ^2 = 103***	χ^2 = 96***	χ^2 = 34**

Coefficients are marginal effects after probit regressions. Standard errors clustered as indicated in heading in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline aflatoxins knowledge score (0 to 10) is constructed based on participants' response to 10 aflatoxins awareness questions.

Appendix F: Main model, standard errors clustered by household.

	(1)	(2)	(3)	(4)
Dependent variable:	Willingness to pay (MK/kg)			
Season:	Harvest		Lean	
=1 if sorted grade (α_1)	50***	50***	107***	107***
	(6)	(6)	(5)	(5)
=1 if labeled grade (α_2)	62***	62***	109***	109***
	(6)	(6)	(5)	(5)
=1 if household informed about aflatoxins (α_3)	-46***	-45***	-11	-12
	(7)	(7)	(9)	(9)
Sorted grade * Information (α_4)	66***	66***	9	9
	(9)	(9)	(8)	(8)
Labeled grade * Information (α_5)	83***	83***	97***	97***
	(9)	(9)	(8)	(8)
Constant	254***	259***	339***	334***
	(5)	(6)	(6)	(8)
Observations	2,490	2,490	3,039	3,039
R-squared	0.18	0.18	0.19	0.19
Number of unique bidders	830	830	1,013	1,013
Baseline control variables included	No	Yes	No	Yes
Uninformed participants (Control group):				
Observable quality premium (α_1)	50***	50***	107***	107***
(In % of unsorted grade)	*19.7%*	*19.3%*	*31.6%*	*32.0%*
Unobservable quality premium ($\alpha_2 - \alpha_1$)	12**	12**	2	2
(In % of unsorted grade)	*4.7%*	*4.6%*	*0.6%*	*0.6%*
Informed participants (Treatment group):				
Observable quality premium ($\alpha_1 + \alpha_4$)	116***	116***	116***	116***
(In % of unsorted grade)	*55.8%*	*54.2%*	*35.4%*	*36.0%*
Unobs. quality premium ($\alpha_2 + \alpha_5 - \alpha_1 - \alpha_4$)	29***	29***	90***	90***
(In % of unsorted grade)	*13.9%*	*13.6%*	*27.4%*	*28.0%*
F-test: Obs quality premium, uninformed = obs. quality premium, informed	F=49***	F=49***	F=1.3	F=1.3
F-test: Unobs quality premium, uninformed = unobs. quality premium, informed	F=3.8*	F=3.8*	F=159***	F=159***

Coefficient names refer to equation (2). Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include the baseline aflatoxins knowledge score and the number years that the household has been a member of NASFAM. Average market price of groundnut= MK300/kg (harvest) and MK535/kg (lean season).

Appendix G: Test of attrition bias, individual-level attrition

Dependent variable:	Dummy=1 if participant attrited between harvest and lean seasons; =0 if not		
Level of analysis:	Household	Bid	Bid
Standard errors clustered by:	GAC	GAC	Household
=1 if household received information (T group)	0.049	0.050	0.050
	(0.050)	(0.050)	(0.031)
Baseline aflatoxins knowledge score (0 to 10)	-0.006*	-0.006*	-0.006
	(0.003)	(0.003)	(0.005)
Age of respondent (years)	-0.002*	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)
Years of schooling for respondent (years)	-0.026***	-0.026***	-0.026***
	(0.007)	(0.007)	(0.005)
=1 if respondent is male	-0.052**	-0.052**	-0.052
	(0.025)	(0.025)	(0.033)
Household size	-0.002	-0.002	-0.002
	(0.015)	(0.015)	(0.015)
Landholding (acres)	-0.035**	-0.035**	-0.035***
	(0.014)	(0.014)	(0.010)
Number of years in NASFAM	-0.015***	-0.015***	-0.015***
	(0.005)	(0.005)	(0.005)
Number of school goers in household	-0.004	-0.005	-0.005
	(0.018)	(0.018)	(0.015)
Number of females in household	-0.028	-0.027	-0.027*
	(0.018)	(0.018)	(0.016)
Number of adults in household (age>18 years)	-0.015	-0.015	-0.015
	(0.013)	(0.013)	(0.017)
Distance from home to closest market (km)	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
No of extension officer visits per year	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.002)
=1 if household owns radio set	-0.044	-0.044	-0.044
	(0.027)	(0.027)	(0.032)
=1 had cash savings at the beginning harvest	0.029	0.029	0.029
	(0.040)	(0.040)	(0.038)
Storage expenditure (1000 MK)	0.004	0.004	0.004
	(0.003)	(0.003)	(0.003)
Number of months food insecure (0 to 12)	0.004	0.004	0.004
	(0.010)	(0.010)	(0.010)
=1 if member too ill to farm for >2 months in past 2 yrs.	0.002	0.002	0.002
	(0.029)	(0.029)	(0.039)
Respondents' anchor price (1000 MK)	-0.396	-0.292	-0.292
	(0.432)	(0.431)	(0.444)
=1 if NASFAM association is Chioshya	-0.198***	-0.198***	-0.198***
	(0.052)	(0.051)	(0.030)
Willingness to pay for grain grade (1000 MK/kg)		-0.041	-0.041
		(0.087)	(0.081)
Observations	830	2,490	2,490
Chi^2-test of joint significance of all coefficients	χ^2 = 300***	χ^2 = 366***	χ^2 = 108***

Coefficients are marginal effects after probit regressions. Standard errors clustered as indicated in heading in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline aflatoxins knowledge score (0 to 10) is constructed based on participants' response to 10 aflatoxins awareness questions.

Appendix H. Main model, with additional control variables for individual-level attrition.

	(1)	(2)
Dependent variable:	Willingness to pay (MK/kg)	
Season:	Harvest	Lean
=1 if sorted grade (α_1)	50***	107***
	(5)	(3)
=1 if labeled grade (α_2)	62***	109***
	(6)	(5)
=1 if household informed about aflatoxins (α_3)	-48***	-6
	(8)	(10)
Sorted grade * Information (α_4)	66***	9
	(8)	(8)
Labeled grade * Information (α_5)	83***	97***
	(9)	(10)
Constant	242***	335***
	(10)	(18)
Observations	2,490	3,039
R-squared	0.19	0.21
Number of unique bidders	830	1,013
Uninformed participants (Control group):		
Observable quality premium (α_1)	50***	50***
Unobservable quality premium ($\alpha_2 - \alpha_1$)	12**	12**
Informed participants (Treatment group):		
Observable quality premium ($\alpha_1 + \alpha_4$)	116***	116***
Unobs. quality premium ($\alpha_2 + \alpha_5 - \alpha_1 - \alpha_4$)	29***	29***
F-test: Obs quality premium, uninformed = obs. quality premium, informed	F=61***	F=1.5
F-test: Unobs quality premium, uninformed = unobs. quality premium, informed	F=2.5	F=131***

Coefficient names refer to Equation X. Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include baseline aflatoxins knowledge score, number years that the household has been a member of NASFAM, years of schooling, gender, landholding, years as a NASFAM member, and members of the Chioshya NASFAM association.

Appendix I. Main model, farmers included in harvest and lean seasons only.

	(1)	(2)	(3)	(4)
Dependent variable:	Willingness to pay (MK/kg)			
Season:	Harvest		Lean	
=1 if sorted grade (α_1)	55***	55***	111***	111***
	(6)	(6)	(5)	(5)
=1 if labeled grade (α_2)	67***	67***	116***	116***
	(7)	(7)	(7)	(7)
=1 if household informed about aflatoxins (α_3)	-42***	-42***	1	-1
	(13)	(13)	(16)	(17)
Sorted grade * Information (α_4)	60***	60***	-6	-6
	(12)	(12)	(9)	(9)
Labeled grade * Information (α_5)	79***	79***	85***	85***
	(11)	(11)	(11)	(11)
Constant	253***	253***	336***	329***
	(8)	(7)	(13)	(19)
Observations	1,731	1,731	1,731	1,731
R-squared	0.19	0.19	0.19	0.20
Number of unique bidders	577	577	577	577
Baseline control variables included	No	Yes	No	Yes
Uninformed participants (Control group):				
Observable quality premium (α_1)	50***	50***	111***	111***
Unobservable quality premium ($\alpha_2 - \alpha_1$)	17**	17**	5	5
Informed participants (Treatment group):				
Observable quality premium ($\alpha_1 + \alpha_4$)	115***	115***	105***	105***
Unobs. quality premium ($\alpha_2 + \alpha_5 - \alpha_1 - \alpha_4$)	31***	31***	96***	96***
F-test: Obs quality premium, uninformed = obs. quality premium, informed	F=27***	F=27***	F=0.4	F=0.4
F-test: Unobs quality premium, uninformed = unobs. quality premium, informed	F=1.9	F=1.9	F=61***	F=61***

Coefficient names refer to Equation X. Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include the baseline aflatoxins knowledge score and the number years that the household has been a member of NASFAM.

Appendix J. Main model, with binary variable for learning effects.

	(1)	(2)	(3)	(4)
Dependent variable:	Willingness to pay (MK/kg)			
Season:	Harvest		Lean	
=1 if sorted grade (α_1)	50***	50***	107***	107***
	(5)	(5)	(3)	(3)
=1 if labeled grade (α_2)	62***	62***	109***	109***
	(6)	(6)	(5)	(5)
=1 if household informed about aflatoxins (α_3)	-46***	-45***	-11	-12
	(10)	(10)	(12)	(12)
Sorted grade * Information (α_4)	66***	66***	9	9
	(8)	(8)	(8)	(8)
Labeled grade * Information (α_5)	83***	83***	97***	97***
	(9)	(9)	(10)	(10)
=1 if repeated auction participant household (learning effects)	-2	-3	7	-5
	(8)	(8)	(9)	(11)
Constant	257***	261***	334***	336***
	(9)	(10)	(12)	(13)
Observations	2,490	2,490	3,039	3,039
R-squared	0.18	0.18	0.19	0.19
Number of unique bidders	830	830	1,013	1,013
Baseline control variables included	No	Yes	No	Yes
Uninformed participants (Control group):				
Observable quality premium (α_1)	50***	50***	111***	111***
Unobservable quality premium ($\alpha_2 - \alpha_1$)	17**	17**	5	5
Informed participants (Treatment group):				
Observable quality premium ($\alpha_1 + \alpha_4$)	115***	115***	105***	105***
Unobs. quality premium ($\alpha_2 + \alpha_5 - \alpha_1 - \alpha_4$)	31***	31***	96***	96***
F-test: Obs quality premium, uninformed = obs. quality premium, informed	F=61***	F=61***	F=1.5	F=1.5
F-test: Unobs quality premium, uninformed = unobs. quality premium, informed	F=2.5	F=2.5	F=131***	F=131***

Coefficient names refer to Equation X. Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include the baseline aflatoxins knowledge score and the number years that the household has been a member of NASFAM.

Appendix K. Questions used in aflatoxins knowledge test.

1. Have you ever heard of aflatoxins?
2. Are molds key indicators of aflatoxins?
3. Which crops [maize] are most affected by aflatoxins?
4. Which crops [groundnuts] are most affected by aflatoxins?
5. Does moisture promote aflatoxin proliferation?
6. Does drying on the ground promote aflatoxin contamination?
7. Can hermetic storage control aflatoxin contamination?
8. Does piling (mkukwe) promote aflatoxin proliferation?
9. Can consumption of aflatoxins contaminated food cause diarrhea?
10. Can chronic consumption of aflatoxin-contaminated food cause liver cancer?

Appendix L. Main model, with triple interaction.

	(1)	(2)
Dependent variable:	Willingness to pay (MK/kg)	
=1 if sorted grade	50***	50***
	(5)	(5)
=1 if labeled grade	62***	62***
	(6)	(6)
=1 if household informed about aflatoxins	-46***	-46***
	(10)	(10)
Sorted grade * Information	66***	66***
	(8)	(8)
Labeled grade * Information	83***	83***
	(9)	(9)
=1 if lean season	85***	86***
	(14)	(14)
Sorted grade * Lean	57***	57***
	(6)	(6)
Labeled grade * Lean	47***	47***
	(6)	(6)
Information * Lean	35*	36**
	(17)	(17)
Sorted grade * Information * Lean	-56***	-56***
	(10)	(10)
Labeled grade * Information * Lean	14	14
	(12)	(12)
Constant	254***	252***
	(6)	(7)
Observations	5,529	5,529
R-squared	0.19	0.19
Number of unique bidders	1,098	1,098
Baseline control variables included	No	Yes

Standard errors clustered by GAC in parentheses. *** p<0.01, ** p<0.05, * p<0.1. US$1=MK750 (Malawi Kwacha). Group action centers (GAC) are community-level clusters; the assignment to treatment and control was done at the GAC level. Baseline control variables include the baseline aflatoxins knowledge score and the number years that the household has been a member of NASFAM.