Measuring demand and network effects for a new technology to improve food safety among smallholder farmers in Sub-Saharan Africa

Yurani Arias-Granada, Department of Agricultural Economics, Purdue University, yariasr@purdue.edu

Jonathan Bauchet, Department of Hospitality and Tourism and the Department of Agricultural Economics, Purdue University, jbauchet@purdue.edu

Jacob Ricker-Gilbert, Department of Agricultural Economics, Purdue University, jrickerg@purdue.edu

Selected Paper prepared for presentation at the 2021 Agricultural & Applied Economics Association Annual Meeting, Austin, TX, August 1 – August 3

Measuring demand and network effects for a new technology to improve food safety among smallholder farmers in Sub-Saharan Africa*

Yurani Arias-Granada † Jonathan Bauchet ‡ Jacob Ricker-Gilbert §

Abstract

This paper studies demand and peer effects for the technology Aflasafe that solves an unobservable quality problem (carcinogenic compounds) affecting staple and cash crops in tropical regions. We use an auction and a field experiment to measure demand for the technology and estimate the impact of social networks on demand. We found that smallholder farmers understood the problems associated with eating contaminated crops and were keen to buy the product. Demand was high when farmers were exposed to the technology for the first time, with almost two-thirds valuing the technology at the market price or above. One year after the first demand elicitation, most participants continued valuing the technology at the market price or increased their valuations. In addition, having at least one agricultural connection who randomly obtained the technology at baseline positively affected the probability of increasing the valuation in period two and shifting from being no-adopter to adopter. These results confirm the necessity of providing information to smallholder farmers about the negative health consequences of food contamination and leveraging agriculture social networks to foster the adoption of food safety technologies that control unobservable risks.

JEL Classification: I15, I18, I31, Q16, Q18

Keywords: Technology adoption, social networks, food safety, Aflasafe, Sub-Saharan Africa, Senegal

---

*The authors would like to thank the farmers who participated in the study and Dr Ibrahima Sarr and Boubacar Balde from the Institut Sénégalais de Recherches Agricoles (ISRA) for their support with data collection. This study was funded by the United States Agency for International Development (USAID) Bureau for Food Security under Agreement No. AID-OAA-L-14-00003 as part of Feed the Future Innovation Lab for Food Processing and Post-harvest Handling. This study was also funded by the Feed the Future Innovation Lab for Food Safety under Cooperative Agreement No. 7200AA19LE00003 awarded to Purdue University, in partnership with Cornell University. Yurani Arias-Granada gratefully acknowledges funding from the Purdue Jim and Neta Hicks Small Grant program. Any opinions, findings, conclusions, or recommendations expressed here are those of the authors alone.

†PhD Candidate in the Department of Agricultural Economics at Purdue University (yari-asgr@purdue.edu).

‡Associate Professor in the Department of Hospitality and Tourism and the Department of Agricultural Economics at Purdue University (jbauchet@purdue.edu).

§Professor in the Department of Agricultural Economics at Purdue University (jrickerg@purdue.edu).

1 Introduction

Successfully developing and diffusing agricultural innovations are critical to improving farmers' livelihoods in developing countries. Although agricultural technologies (e.g., improved seed and fertilizer) are more widely available in the developing world today than at any time in the past, adoption remains low in many places (Gollin et al., 2005; Dabalen et al., 2017). To address this concern, the economic literature has identified diffusion of information through social networks as a promising pathway to accelerate technology adoption in the presence of market and coordination failures (Bardhan and Udry, 1999; Foster and Rosenzweig, 1995).[1] Most of the existing evidence suggests that farmers learn from others and share information of new technologies and farming practices (Bandiera and Rasul, 2006; Cai et al., 2015; Conley and Udry, 2010; Magnan et al., 2015).[2] Namely, farmers form and update their adoption decisions not only on expected profits of the new technology, but also on what they discuss and learn from their peers. The information that is diffused through social networks may allow farmers to make assessments about the returns, update their valuations, and learn how to utilize the technologies.

Researchers often measure demand for specific agricultural technologies that have a direct impact on agricultural productivity and profits. However, little is known about demand and adoption of agricultural innovations solving problems that are mostly unobservable such as food quality and safety. The latter characteristics affect household's welfare in the short and long term by reducing the economic and health burden of contracting foodborne illnesses.[3] Demand for these technologies is unknown, primarily because the welfare gains are hard to quantify and monetize, and households in developing countries make small or no investments in preventive health (Dupas, 2011). As such, identifying those factors that could foster adop-

[1]Market failures and barriers to adopting new technologies have been widely studied and include limited access to credit and information, unclear property rights over the land, limited supply of complementary inputs, limited access to markets, retailers, and input stores, among others. (Feder et al., 1985; Foster and Rosenzweig, 2010; Suri, 2011).

[2]Few studies have found negative or null impacts of networks on agricultural technology adoption. These studies include Kremer and Miguel (2007) who found negative peer effects for deworming pills, a technology with greater social benefits than private benefits, and Duflo et al. (2008) did not find significant peer effects on fertilizer adoption.

[3]These include chronic diseases, health shocks, out-of-pocket health expenditures, malnutrition, losses in productivity and workdays, and even death.

tion of these particular technologies is crucial for Sub-Saharan Africa (SSA), the region with the largest per capita burden of foodborne diseases worldwide (WHO, 2015).

In this paper, we study demand and network effects for technologies that solve unobservable quality problems, such as aflatoxins, carcinogens compounds affecting cereals and grains eaten regularly by African people.[4] Ex-ante, one might expect adoption of food safety-enhancing technologies to be limited because awareness of invisible food contaminants is low, price premiums for aflatoxins-free crops do not exist, and it is not easy to test and measure levels of aflatoxins in rural markets. Additionally, there is no evidence on how to leverage social networks to diffuse knowledge and information about these technologies and how learning from others may impact smallholder farmers' valuations and adoption decisions. As such, this article aims to estimate how social networks shape knowledge diffusion and affect the adoption and demand for a food safety technology by analyzing the case study for Aflasafe. This product eliminates aflatoxins-producing fungi on crops while they are in the field (Alaniz Zanon et al., 2013; Senghor et al., 2019). We also examine how different social networks – agriculture connections, friends/family, and neighbors – may have differentiated impacts on demand for Aflasafe.

We measured demand for the food safety technology among smallholder farmers in Senegal's peanut basin. The technology Aflasafe was unknown to 97 percent of farmers in our study area at baseline, despite an increasing number of organizations in Senegal promoting the product. We use an experimental, revealed-preference auction method named the Becker-De Groote-Marshak (BDM) auction mechanism and two variants with multiple price list formats (MPL) to elicit demand for Aflasafe. The BDM mechanism has been widely used in Africa because the methodology incentivizes participants to reveal their true willingness to pay (WTP) and is easy to implement in a rural setting (Groote et al., 2016). We elicited actual demand for the technology as opposed to hypothetical demand because households bid real money to purchase Aflasafe. Additionally, the variants to the standard BDM allow us to control for framing effects in the elicitation question and the fact that Aflasafe was unknown to most participants – i.e., they had no previous reference on how much the product

[4] Affected products include maize, groundnuts, tree nuts, figs, cottonseeds, milk, cheese and most common animal feed (Gong et al., 2004).

would cost.

During the baseline survey, participants received information about the aflatoxins problem, the negative health effects of eating contaminated crops, the benefits of Aflasafe to control aflatoxins in the field, and when and how it should be applied. We also inquired about their connections with other study participants in their village. After farmers familiarized themselves with the technology, they bid for Aflasafe using either the BDM or the two variants, which were randomly determined. If the bid was successful, i.e., if the bid was higher than the randomly drawn auction price, participants then entered a lottery to determine who was able to actually purchase the product. This step provides the identification strategy to measure how participants' social networks could have affected their valuations for the food safety technology. We carried out the second auction one year after the first one and elicited again participants' WTP. We also asked about experience with the product, if they applied it, and whether they had discussions about Aflasafe with their social networks.

The random distribution of the technology allows us to overcome the reflection problem, a simultaneity problem in which individuals affect the behavior of their peers and they are also influenced by their peers' behavior (Manski, 1993). The lottery randomly allocates the technology among auction winners in each village. Therefore, each participant has a random number of social connections who obtained the technology at baseline. Since the allocation is random, a participant can have zero or a positive number of lottery winners – i.e., connections who obtained Aflasafe – in his social network. We exploit this exogenous exposure to the technology to measure the impact of having at least one adopter within a participants' social network on his valuation and adoption decision for Aflasafe in period 2. Previous studies also utilize lotteries to solve the reflection problem and take advantage of random variation in the information provided or technology allocation to estimate the impacts of social networks on different technologies and settings (Cai et al., 2015; Magnan et al., 2015).

This study contributes to the social networks, technology adoption and food safety literature in two ways. First, we identify to what extent a participant's social networks may influence her adoption and demand for Aflasafe. Because food safety-enhancing technologies have not been widely studied, it is not clear how to promote their adoption and how social networks could be used to leverage them. These technologies solve an unobservable quality problem and have social benefits larger than private benefits. In the case of Aflasafe, if aflatoxins are controlled, rural and urban consumers of key staple and cash crops in SSA will accrue economic and health benefits in the short and long term.[5] Farmers could also access lucrative exports when complying with international aflatoxins regulations. This setting differs from traditional technologies such as fertilizer, improved seed, or cost-saving technologies, which focus on farmers' profitability rather than food safety, and with tangible benefits easy to quantify.

Furthermore, a number of studies have found positive and significant peer effects on the decision to adopt a new technology, although in most cases the products were given for free or highly subsidized and benefits were easy to measure (Bandiera and Rasul, 2006; Cai et al., 2015; Oster and Thornton, 2012). We contribute to this literature by causally estimating network effects in an experiment mimicking a market rather than giving out the technology for free or utilizing subsidies for a technology with unobservable benefits. Although initially subsidizing technologies may increase adoption and learning over time, it is possible that farmers may anchor their valuations and become reluctant to purchase at full price (Dupas, 2014). Additionally, only three percent of participants were aware of the technology at baseline, which helps in avoiding price anchoring effects that may affect valuations.

Second, we provide new evidence on the demand for a new technology solving an unobservable quality problem. We are the first to measure demand for this product by using a revealed preference method as opposed to a stated preference method. In addition, we measure the impact of having at least one adopter within a participant's social network on his demand for the product in period two – i.e., whether his valuation increased, decreased, or whether he shifted from not paying the market price to paying this price or above. In SSA, smallholder farmers participate in markets plagued by asymmetric information on food quality and safety, weak safety regulations, lack of food surveillance systems, and economic incentives to improve food safety. As a result, discerning food safety attributes is hard, particularly in the case of invisible attributes such as aflatoxins. This creates a lemons market

[5]Households could avoid medical expenditures, productivity losses, and premature death. Consuming large amounts of aflatoxins-contaminated crops causes aflatoxicosis, an acute necrosis of the liver. Aflatoxicosis caused 125 deaths in Kenya in 2004 and 20 in Tanzania in 2016 (Azziz-Baumgartner et al., 2005; Kamala et al., 2018). Chronic consumption of aflatoxins causes liver cancer and immune system suppression.

problem akin to Akerlof (1970), in which producers do not invest in quality and only poor quality, potentially unsafe food is sold in informal markets (Hoffmann and Gatobu, 2014; Kadjo et al., 2020). Demand for agricultural technologies solving this market failure and enhancing food safety is scarce. The few exceptions have found that farmers were willing to pay more than traders for a moisture meter to measure moisture content in crops, and more risk averse participants were also willing to pay more for these moisture devices (Channa et al., 2019; Shimamoto et al., 2017).[6] Only one study has estimated WTP for Aflasafe, but the authors used a stated preference contingent valuation method. They found that on average, 82.5% of farmers were willing to pay 10 USD for a 10 kg bag or above that value in Nigeria (Ayedun et al., 2017).

Our results indicate that demand for the technology Aflasafe was high when a revealed preference method was implemented. The first demand elicitation showed that approximately two-thirds of participants valued a completely new food safety technology at the market price or above. The average WTP at baseline was 1,099 CFA/kg (2 USD/kg) which is slightly above the market price of 1,000 CFA/kg (1.85 USD/kg). One year after the first auction, valuations were still high, but more participants shifted to pay the market price and less the maximum value (1600 CFA/kg), as more information about the market price was diffused. The average WTP in period two was 1,150 CFA/kg, slightly higher than the WTP at baseline. Results from the follow-up survey also suggest that farmers were interested in buying small quantities of the product – between one and four kgs.

Information about Aflasafe was rapidly diffused among participants from villages in rural Senegal. Farmers understood the negative health consequences of eating contaminated groundnuts and they shared this information with their networks. An average participant knew almost all the other participants in his village and had on average five agricultural connections. Of these, approximately two were auction and lottery winners – i.e., adopters at baseline. Results indicate that having at least one adopter in the agriculture social network had a positive impact on WTP in period two, but the effect is small – 30 CFA/kg (5 cents/kg) – and insignificant. Nevertheless, estimation results for compliers (LATE estimates) reveal

[6] When crops are not dried properly and moisture levels are above the recommended levels, aflatoxins proliferate and contaminate crops during storage.

that those participants with at least one adopter in their agriculture social network were 33 percentage points more likely to increase their WTP in period two, and 17 percentage points more likely to adopt the technology in period two – i.e., willing to pay the market price or above. We did not find impacts of other social networks such as friends/family or neighbors on demand for Aflasafe. Only adopters in agricultural social networks affected the likelihood of increasing valuations and adopting Aflasafe in period two.

2 Background

2.1 The problem of contaminated and unsafe food

Contaminated food imposes a large health and economic toll to people living in developing countries. These costs in the short and long-term include costs to health systems, productivity losses, premature deaths, out of pocket expenses, and costs to comply with food safety regulations. These costs are particularly high in SSA, the region with the largest per capita burden of foodborne diseases (WHO, 2015). This can be explained because food systems in Africa are mainly informal and unregulated, food safety attributes are hidden traits to most producers and consumers, surveillance is limited, and testing for different contaminants is expensive relative to farmers' profitability. Additionally, farmers, aggregators, processors, and retailers may need economic incentives to make crop production both safe and profitable.

Common chemical contaminants of staple and cash crops in tropical and subtropical regions are aflatoxins, compounds produced by A. flavus and A. parasiticus fungi present in the soil. The B1 type is the most poisonous and prevalent and has been classified as a type 1 carcinogen[7] by the International Agency for Research on Cancer (Bandyopadhyay et al., 2016). Different studies have shown associations between high incidence of liver cancer, immune system suppression, and chronic intake of food contaminated with aflatoxins, with higher risk for people infected with hepatitis B and C (Turner et al., 2005; Liu and Wu, 2010). Aflatoxins cannot be destroyed by traditional cooking methods – e.g., heating, boiling, and roasting – and contaminate crops during all stages of production and storage.

[7]This means there is sufficient evidence in humans.

Aflatoxins limits have been established in several African countries, although the enforcement of these regulations is a common challenge.[8] In Senegal, where this study was conducted, the government does not have limits for any crop. Hence, other interventions and strategies to face the problem should be undertaken. These alternatives include increasing awareness among all actors of value chains and adoption of food safety-enhancing technologies. Unlike East African countries where acute aflatoxins outbreaks have led to higher level of awareness, this number is still low in West Africa. Bauchet et al. (2021) found that only 28% of Senegalese farmers in their study were aware of aflatoxins' toxicity and health impacts at baseline.[9] Low awareness may also inhibit the adoption of available technologies to control aflatoxins' proliferation. In this paper we examine whether farmers in Senegal's peanut basin are interested in adopting Aflasafe, a biocontrol product derived from atoxigenic strains of the A. flavus family that controls aflatoxins in the field.

Aflasafe is one of the most prominent solutions to control aflatoxins, but it has no impact on yields. Given this particularity, it is unclear whether farmers in SSA are willing to adopt it. One might expect adoption of Aflasafe to be limited because aflatoxins are invisible, odorless and tasteless, people have limited awareness of them, and rural markets have no way to easily test and identify levels of aflatoxins. By contrast, once Aflasafe becomes widely available and markets in SSA pay premiums for crops with aflatoxins levels below the safety thresholds,[10] smallholder farmers could cover its cost and monetize its benefits. Farmers in affected areas may be also keen to use Aflasafe to control aflatoxins in their crops and improve household members' health and welfare. Recent evidence suggests that farmers in SSA value more self-produced crops because they know the quality levels and whether these are safe for self-consumption (Hoffmann and Gatobu, 2014).

[8] In Malawi the limit for groundnuts is 3 parts per billion (ppb) (PACA, 2018). The East African community adopted a 10-ppb limit for the most common crops produced in this region (IITA, 2015).

[9] Their sample consists of approximately 2000 smallholder farmers.

[10] Safety thresholds vary by country and crop. The US safety threshold for groundnuts is 15 parts per billion (ppb) and for maize is 20 ppb. The European Union safety threshold for groundnuts is 4 ppb and for maize is 10 ppb.

2.2 The Technology: Aflasafe

Biological control products have been widely used by farmers in the US to control and reduce aflatoxins. Some strains of the Aspergillus family are atoxigenic, namely they do not produce toxins and compete and control in the field the toxigenic strains. The atoxigenic strains are identified by taking samples from the countries or regions where the biocontrol product is under development. The strains are selected when they have defects in the genes that produce aflatoxins, are able to survive and proliferate in soils and crops, and are able to reduce aflatoxins by more than 90% (Grace, 2015).

This paper focuses on the biocontrol Aflasafe SN01, which is mostly sorghum (99.7%) killed by heating to avoid germination and once applied to the field gradually displaces the poisonous fungi. Farmers must apply 10 kg per hectare by tossing the product over the field surface; farmers need to ensure that all the pre-planting practices have been done to avoid burying Aflasafe in the soil because the product must always stay above the ground. The application depends upon the type of crop, for groundnuts 30 to 35 days before harvesting or 2-3 weeks before flowering, for maize 2–3 weeks before tassels appear (IITA, 2020). The product must be spread out uniformly and needs to be applied after rain, when is expected to rain, when the soil is wet, or the field should be irrigated after applying.

Previous research has documented the effectiveness of Aflasafe to control aflatoxins during the planting season. These include tests of Afla-guard and AF 36 in Texas and Mississippi in the US (Dorner, 2010; Isakeit, 2015; Weaver et al., 2015). Field trials in Senegal carried out between 2010 and 2014 resulted in lower aflatoxin levels for fields treated with Aflasafe SN01, and more samples from those fields having aflatoxins levels below 4 parts per billion (ppb) during harvest and storage (Senghor et al., 2019).

Despite the proven benefits in field trials, it is not clear yet whether smallholder farmers in SSA will be willing to use Aflasafe and what could incentivize them to be early adopters. There is still a lack of evidence on how much farmers would pay for the product, how far their valuations are from the current market price, and whether there could be a mismatch between the supply and demand of this technology. Currently in Senegal, Bamtaare-Sodefitex, a private-owned company is leading Aflasafe production and is selling 10 kg bags for 10,000

CFA (17 USD). To date, there is no evidence on whether smallholder farmers can afford the market price. Given this context, we aim to close this gap by providing new evidence on farmers' valuation for the technology and what factors could incentivize its adoption.

3 Experimental design and data

3.1 Study site and sample

The Groundnut sector in Senegal plays a significant economic and social role due to the number of smallholder farmers involved in this agricultural activity, with almost two-thirds of the rural population and half of the crop area dedicated to growing this crop (Niane Ndoye et al., 2015). In fact, groundnuts are grown by 52% of households in extreme poverty and aflatoxins hamper these producers to take advantage of lucrative exports and growing markets in Europe and Asia (Bank, 2017). This study focuses on Senegal's peanut basin, which is mainly rain-fed agriculture and has on average lower yields compared to other areas in the country with access to irrigation and higher input use.

We interviewed 250 households from 25 villages in Senegal's peanut basin. We collected data from four department with different microclimates, proximity to the town of Kaloack,[11] and purposely selected these departments based on the importance in groundnut production.[12] The sampling strategy followed a two-stage procedure. First, all rural communities from the four departments were listed and the exact number of villages randomly selected in each community was proportional to population size.[13] Second, extension agents from the Agence Nationale de Conseil Agricole et Rural (ANCAR) listed all households living in each selected village. Finally, ten groundnut-producing households were randomly selected to participate in the study. Before starting the data collection, participants were asked for their consent to participate. Upon obtaining their approval, participants answered demographic, groundnut production questions, their connections with other participants in the

[11]Kaolack is one of the most important market towns of Senegal and the main groundnut production and processing center.

[12]The 4 departments are Foundiougne, Gossas, Malem hodar, and Nioro du Rip departments.

[13]Population shares for each rural community were computed using data from the National Statistical Office of Senegal (ANSD, 2015).

study and bid for the technology Aflasafe.

The data collection was divided into two parts. The first survey was carried out in March 2020, and the follow-up in May 2021 (See figure 1 for a detailed explanation of the study timeline). The planting season in that part of Senegal runs from June to August. During the first survey, participants were oriented about the negative effects of aflatoxins, how to use Aflasafe, the related benefits to control aflatoxins in the field and during the planting season, when and how the product should be applied, and participated in the first auction. Data on groundnut production practices, aflatoxins awareness, demographic and socioeconomic variables, and a sample of participants' network within the village was also collected.

Each participant received a fee for his voluntary participation and to buy groundnut samples used in a different study. They could spend this money on two practice items (cookies and pen) and the Aflasafe, depending on their valuations for those items. If they were not interested in buying any product, they could keep all the money. The payment was done to avoid liquidity constraints that may hamper the purchase of Aflasafe. During the follow-up survey, farmers participated in the second auction, answered questions on perceptions about the use of Aflasafe and the diffusion of information about this new product.

3.2 Auction structure

The auctions in the two rounds of data collection followed the same structure. During the first auction, participants learned about the benefits of Aflasafe and how it should be applied during the planting season. The training information comes from the official dissemination material produced by The International Institute of Tropical Agriculture (IITA) available on the Aflasafe web page.[14] Respondents were randomly assigned to three groups, a standard BDM auction which directly asked how much they were willing to pay for the product, and two variants using Multiple Price Lists (MPL), one variation increasing and one decreasing in prices. The BDM is a standard procedure to measure valuations and elicit participants' WTP and it has been widely used in the African context given the facility to be implemented (Groote et al., 2016). Although in theory the BDM is an incentive compatible mechanism, it needs to be very well understood to reveal the real participants' valuations. When partici-

[14] https://aflasafe.com/aflasafe/how-to-use-aflasafe/

pants are not clear on how the mechanism works, they might misreport their true valuations leading to biased results (Andersen et al., 2006; Cason and Plott, 2014), especially for unknown technologies for which farmers do not have any price reference. To overcome this issue, participants familiarized with the auction mechanism by practicing with two items different to the bag of Aflasafe. The Practice sections ensured participants fully understood the activity by the time they were asked for their WTP for Aflasafe. Second, we used the increasing and decreasing MPL, which are easier to understand and allow to control for differences in the WTP elicitation methods.

For the standard BDM auction, individuals answered the question "how much would you be willing to pay for 1 kg bag of Aflasafe?" For the MPL mechanism, participants answered a list of questions with prices increasing (decreasing) as they moved to a new question and replied "Yes" or "No" to each price (See figure 2). When the price list is increasing, the WTP is the switching point at which farmers would not be willing to buy the product. When the price list is decreasing, the WTP is the switching point at which farmers would be willing to buy the product. Prices for Aflasafe come from a uniform distribution centered at the market price (1000 CFA), ranging from 400 CFA (0.74 USD) to 1600 CFA (2.97 USD) and increasing (decreasing) by 200 CFA (0.37 USD). The MPL variations low-high (increasing) and high-low (decreasing) allow to control for possible framework effects – whether starting from the lowest possible price or the highest price affect respondents' WTP.

Before the real auction started, farmers made an offer for two practice items (a cookie and a pen). They were told their best strategy was to determine the maximum they would be willing to pay for each item and offer that amount and it would not be an advantage to offer more than their maximum willingness to pay or offer less. After making their bids, participants drew a price from an envelope with prices ranging from 25 CFA (0.042 USD) to 175 CFA (0.29 USD) with changes of 25 CFA. If their bids were higher or equal to the random price selected from the envelope, they had the opportunity to participate in two lotteries to obtain each of the practice items. The tablet used to collect the data randomly selected whether the participant won the lotteries for the cookie and the pen.

For the real auction participants bid for 1 kg bag of Aflasafe. Their bids were compared with the random price drawn from a second envelope, with prices ranging from 400 CFA to

1600 CFA with changes of 200 CFA. If their bids were higher or equal to the random price, they got the opportunity to participate in the lottery and win the Aflasafe. This lottery creates a random allocation of the technology among auction winners in the first round, allowing us to measure the network effects. It is important to note that lottery winners were oversampled. Namely, once a participant won the first auction, she had a 0.66 probability of obtaining the product via the lottery. This was done on purpose because beforehand we did not know the interest in the technology. In the hypothetical scenario in which few farmers would have won the auction because demand was very low, then few would have obtained the technology.[15]

During the second auction, the lottery was not implemented, and all auction winners obtained the product Aflasafe. Notably, most studies have given the technologies for free or at highly subsidized prices (Bandiera and Rasul, 2006; Cai et al., 2015; Oster and Thornton, 2012). In our experimental design farmers do not get the technology for free or receive any subsidy. They participated in an experimental auction and if the won the auction, they participated in a lottery to obtain the technology. Price anchoring can also be ruled out because only three percent of participants heard about the technology before participating in this study.

3.3 Measurement of social networks

The literature on social networks utilizes different approaches to define and construct social connections. These methods include taking a detail census of villages and connections among individuals (Banerjee et al., 2013; Beaman and Dillon, 2018; Cai et al., 2015), asking to name up a predetermined number of friends, relatives or social contacts (Kremer and Miguel, 2007; Oster and Thornton, 2012), and using certain characteristics or variables – e.g. religion, race, caste – to infer the number of links between subjects and his possible connections rather than listing all the links (Breza et al., 2019). However, most of the empirical literature relies on sampled network data due to the elevated costs of conducting a complete census of villages. In this approach a subset of the population in each location is randomly selected and the

[15] All the steps involved in the auctions and the lottery were clearly explained to participants before they bid for the practice items and the bag of Aflasafe.

subjects in that sample reveal their connections with the other nodes in the sample (Conley and Udry, 2010; Magnan et al., 2015). When the main goal is to measure direct spillovers from a treated individual onto an untreated one, sample network data can preserve the characteristics under analysis (Breza, 2016; Kremer and Miguel, 2007; Oster and Thornton, 2012).

In this study, we use sampled network data and define a network or graph at the village level as a set of connections (edges) between the smallholder farmers (nodes) who participated in the study. We collected network data in the first survey by asking each participant whether they knew any of the other participants interviewed in their villages, what type of social connection they had – friend, relative, neighbor, agricultural group/ agricultural cooperative, church/ religious group, or savings or credit group/ cooperative, and whether they previously discussed agriculture with any of their connections. We collected data from a sample of ten farmers or nodes and asked each farmer about their social connections with the other nine nodes in their villages. Links are undirected, that is farmer A is connected to farmer B if either any of the two reported knowing each other. We use three definitions of social networks to estimate the impact of different types of connections on demand for Aflasafe. First, if participant A and B previously discussed about agriculture (e.g., agricultural practices, inputs, pest problems, seeds, or new agricultural technologies). Second, when participants A and B reported being friends or family. Finally, when participants A and B reported being neighbors.

Measuring network effects posits some challenges. There is a simultaneity bias problem because individuals affect the behavior of their peers and they are also influenced by their peers' behavior. This is commonly known as the reflection problem (Manski, 1993). The empirical literature on technology adoption has overcome this problem by creating exogenous variations and randomly assigning information on new technologies or the technology itself (Cai et al., 2015; Magnan et al., 2015; Oster and Thornton, 2012). We follow these studies and use a lottery to randomly allocate the technology Aflasafe, which in turn creates exogenous variation in the number of social connections who got the technology within a participants' network. This information is key to identify the impact of networks on demand for the technology Aflasafe.

We follow Magnan et al. (2015) who used the auction and lottery to define three groups: 1) Those who did not win the auction; 2) Those who won the auction and lost the lottery; and 3) Those who won the auction and won the lottery. The latter group is denominated adopters because they are the only ones who obtained the technology after participating in the lottery. Auction winners and losers (group 2 and 3) are denominated qualifying farmers because both participated in the lottery to obtain the technology. Our main empirical specification utilizes the definition of these groups to measure the impact of social networks on demand and adoption for Aflasafe. We estimate the impact of having at least one social connection in the group of adopters and control for the number of qualifying farmers in a participant's social network.

4 Empirical strategy

4.1 Dependent variables

We utilize the valuations for the technology Aflasafe in two different periods of time and estimate whether different social networks (agriculture connections, friends/family, or neighbors) impacted the valuation in period two. The first variable of interest is WTP in period two. Second, we want to assess whether participants increased or decreased their valuations in period two and if having at least one adopter in a participant's social network at baseline could have led to changes in valuations. As such, we define the dependent variable *WTP increased* equal to one if a participant increased his valuation in period two with respect to period one, and zero otherwise. We also defined the variable *WTP decreased* equal to one if a participant decreased his valuation in period two, and zero otherwise. Lastly, we are interested in the variable *Switched*, which is equal to one if a participant valued the technology below the market price at baseline and then shifted to pay the market price or above in period two.

Moreover, we explore some possible mechanisms through which farmers may have changed their valuations and adoption decisions in period two. The first mechanism is the variable *Discussed*, equal to one if the participant discussed about Aflasafe with at least one adopter at baseline who belonged to the corresponding social network. Second, the variable *Heard/saw* equal to one if the participant heard that an adopter in his social network applied Aflasafe or saw him applying the product. Finally, we explore if participants shared information about aflatoxins and whether having adopters of Aflasafe at baseline increased their knowledge about this contamination problem. We define the variable *Discussed* equal to one if a participant had conversations about aflatoxins with any of the adopters in his networks, and zero otherwise. Lastly, we define the variable *Heard/saw* equal to one if the participant heard or saw any adopter in his social network taking measures to control aflatoxins.

4.2 Econometric model

We start by estimating the impact of three different types of social networks – agriculture connections, friends/family, and neighbors – on the dependent variables described in the previous section. In period one, we have 82 participants (32.8%) who lost the auction, 63 (25.2%) who won the auction but lost the lottery, and 105 (42%) who won the auction and lottery. Participants in the latter group are denominated adopters at baseline because they obtained the technology after winning the first auction. All auction winners regardless of the lottery results are denominated qualifying farmers.

In period two, we asked participants whether they bought Aflasafe between March 2020 and May 2021, after most of them heard about the product and its benefits for the first time. We found that only 24 participants procured small quantities of Aflasafe – one, two, or four kgs – mainly from weekly markets (96%) and 4 participants bought from NGOs, cooperatives, or extension agents. Of these, 11 were adopters (won auction and lottery) and 13 were non-adopters at baseline. Most participants reported not buying Aflasafe because they did not know where to buy it. Supply of the product is increasing, but distribution and commercialization started very recently, approximately three years ago.

Not all participants in the group of adopters at baseline applied the product to their fields. We found that 78% of adopters applied the product and the remaining reported not applying it because at the time of application (June-August 2020) they did not remember how to do it. Only one adopter reported no applying Aflasafe because he believed the product was not effective to control aflatoxins and another participant did not think it was important to apply it. Given the imperfect compliance to treatment, we focus on the impacts of social networks on compliers. We estimate the treatment-on-the-Treated (TOT) impact of social networks on demand for Aflasafe. In our main specification, we instrument the variable having at least one social connection who applied Aflasafe during the planting season in 2020 with the variable having at least one social connection who won the lottery and obtained Aflasafe in the first auction.[16] We run the following first-stage regression:

$$T_i = \alpha_i + \beta_1 Adopter_i + \beta_2 Q\prime_i + \beta_3 Networksize_i + \beta_4 X_i' + U_i \tag{1}$$

Where T_i is equal to one if participant i has at least one social connection who applied Aflasafe in the 2020 planting season, and zero otherwise. The instrument variable is $Adopter_i$ and indicates whether or not participant i has at least one social connection in the corresponding social network – agriculture, friends/family, and neighbors – who won the lottery at baseline. The predicted values of T_i are used to estimate the following second-stage regressions:

$$WTP2_i = \alpha_i + \beta_1 T_i + \beta_2 Q\prime_i + \beta_3 Networksize_i + \beta_4 WTP1_i + \beta_5 X_i' + \varepsilon_i \tag{2}$$

$$y_i = \alpha_i + \beta_1 T_i + \beta_2 Q\prime_i + \beta_3 Networksize_i + \beta_4 X_i' + \varepsilon_i \tag{3}$$

$$M_i = \alpha_i + \beta_1 T_i + \beta_2 Q\prime_i + \beta_3 Networksize_i + \beta_4 X_i' + \varepsilon_i \tag{4}$$

Where $WTP2_i$ is participant i willingness to pay in period two, y_i are the other dependent variables previously described – *WTP increased, WTP decreased, and Switched*, and M_i are the possible mechanisms through which social networks may have impacted demand for Aflasafe. The vector $Q\prime_i$ indicates three dummy variables to control for the number of farmers who won the auction at baseline in participant i social networks. The first dummy variable is equal to one if participant i has one qualifying connection in his network, and zero otherwise. The second dummy variable indicates whether or not participant i has two

[16]The two variables have a positive correlation of 0.82.

qualifying connections in his network. Lastly, the third dummy variable is equal to one if participant i has more than two qualifying connections in his network, and zero otherwise.

We control for the total number of connections participant i has in each social network – agriculture, friends/family, or neighbors – by including the variable $Networksize_i$. The vector X_i' denotes other control variables, including one dummy variable equal to 1 if the low-high auction method (multiple price list format with increasing prices) was randomly assigned to respondent i, and zero otherwise. Similarly, another dummy variable equal to 1 if the high-low auction method (multiple price list format with increasing prices) was randomly assigned to respondent i, and zero otherwise. The omitted category is the standard BDM approach, consisting of asking participants directly for their bid.

We show later that the sample is well balanced between lottery winners and losers, but participants who knew about Aflasafe at baseline (3.2%) were more likely to bid more. We include this variable as a control in all the regressions as well as if the participant himself was an adopter at baseline – won the auction and lottery. Only equation 2 includes as a control the WTP in period one, following an ANCOVA specification that controls for the outcome at baseline. Lastly, ε_i denotes the error term specific to each participant.

5 Results

5.1 Summary statistics

Summary statistics on demographics, aflatoxins, and Aflasafe awareness are presented in table 1, panel A. We have data for 250 groundnut producers in Senegal's peanut basin. Almost a quarter of participants were female, and on average they are 45 years old. Only 14% of participants completed primary education and the household has on average 6.5 hectares of land. Most households have at least one durable asset – radio, tv, bicycle, motorcycle, or vehicle. We found that only 20% of participants had prior knowledge of aflatoxins, and only 3.2% of participants were aware of Aflasafe – 8 out of 250. Of these, only one farmer previously received training on how the product should be applied and none of them knew the proper timing to applying Aflasafe. Consequently, for most farmers the information we provided at baseline about aflatoxins and Aflasafe was their first input to form their valuations for the product.

5.2 Demand for the technology Aflasafe

Participants were randomly allocated to three auction variations to measure demand. The randomization is confirmed in table 1, panel B. Approximately 33% of smallholder farmers participated in the BDM auction, 32% in the multiple price list increasing in prices, and 34% in the list decreasing in prices. Although most farmers in the study area did not know the product Aflasafe at baseline, valuations after receiving information were high. Notably, during the first auction, 66% valued the technology at the current market price or above (1,000 CFA per 1 kg or approximately 1.85 USD). Figure 3 shows the distribution of valuations for period one and two. The average WTP in period one was 1,099 CFA per kg, slightly higher than the market price, and the median is exactly the market price for 1 kg. The elicited valuations also show that only two percent of participants reported a zero valuation for 1 kg of Aflasafe in period one. That is, they would only adopt the product if it were given for free. This means that nearly the entire sample placed a positive value on the technology at baseline.

The distributions for periods one and two are similar (See figure 3). Participants in period two continued to value the technology at the market price or above. However, in period two more participants wanted to pay the market price and less the maximum value (1,600 USD) as more information about the market price was diffused. The average WTP in period two was 1,150 CFA/kg, slightly higher than the valuation in period one. This could be explained by the fact that farmers learned about the market price for 1 kg of Aflasafe and updated their valuations for the technology. In the second period, their valuations were more concentrated around 1,000 CFA per kg (See figure 4).

In table 2 we present balance tests between auction losers and winners. Both groups are very similar in terms of demographics and socioeconomic characteristics. They only differ in the percentage of farmers who heard about Aflasafe before participating in this study. All the eight farmers who knew about Aflasafe won the auction. We included this variable as a control in all regressions. WTP in period one for auction winners is on average 620 CFA larger than WTP for auction losers. This is expected given that auction losers self-selected out of the lottery to participate for the technology Aflasafe. In table 3 we present balance tests among qualifying farmers – i.e., those who won the auction and participated in the lottery. Lottery losers and winners were balanced at baseline.

5.3 Network characteristics

Table 1, panel C presents mean and median values for networks variables. The results show that, on average, each participant knew approximately nine other participants out of ten in his village. However, they do not necessarily have specific relations with all of them. On average, participants reported having five agricultural connections among the ten participants in their villages, four friends or relatives, and six neighbors. The median for the different type of connections is close to the mean, except for the number of neighbors, which is slightly higher. Figures 5, 6, and 7 show the distributions of the three different social networks. The histograms indicate that smallholder farmers in Senegal are very well-connected in their villages, although there is an important heterogeneity with some having zero social connections and others having up to nine agriculture connections, friends/relatives, or Neighbors.

At baseline, valuations for Aflasafe were private because few participants knew about the product beforehand. Consequently, the number of adopting and qualifying farmers in each village is random. On average, a participant has two lottery winners in his agriculture social network, and 1.5 who actually applied Aflasafe during the planting season. That participant also has on average three qualifying farmers – auction winners – at baseline. The numbers are similar for the friends/family network, with an average participant having 1.5 lottery winners in this network, one who applied Aflasafe, and 2.5 qualifying farmers. Lastly, a participant has on average 2.7 neighbors who won the lottery and obtained the product, two who applied it, and 4.5 auction qualifying farmers at baseline. Moreover, there exists significant variation in the number of adopting and qualifying farmers that each participant has in the three types of social networks.

5.4 Impacts of agriculture social networks on demand for Aflasafe

We now turn to the impacts of different social networks on demand for the food safety technology Aflasafe. We start by analyzing agriculture social networks. Namely, those connections that participants knew beforehand and discussed agriculture with. Table 4 presents the TOT impacts of agriculture social networks on Demand for Aflasafe. We instrument the variable having at least on connection who applied Aflasafe in participant i agriculture social network with having at least one connection who won the lottery for the product in period 1. We estimate the impact on four dependent variables previously defined, WTP in period two, WTP increased, WTP decreased, and switched.

Results in column 1 suggest that having at least one adopter in the agriculture social network positively affected WTP in period two, although the effect is small (30 CFA, approximately 5 cents) and insignificant. However, results in column 2 show that having at least one adopter in the agriculture social network positively affected the probability of increasing WTP in period two with respect to period one, and this effect is significant at the five percent level. In column 3, the result indicates that having at least one adopter in the agriculture social network decreased the probability of reducing the valuation in period two, but this effect is not significant. We also test whether the presence of adopters in the agriculture social network led those participants who bid below the market price at baseline to increase their valuations and adopt the technology in period two – i.e., they decided to pay the market price or above. We find that having at least one adopter in the agriculture social network increased the probability of adopting the technology in period two by 17% for those who initially did not want to pay the market price.

The Intent to treat (ITT) impacts of Agriculture social networks on demand for Aflasafe are presented in table 11 in the appendix. Results are similar to the TOT, although slightly attenuated due to the imperfect compliance. We still see a positive and significant effect of having at least one adopter at baseline on the probability of increasing the valuation during the second auction. Table 12 in the appendix presents the results when the network variables are defined as a continuous variable. We instrument the variable number of farmers in the agriculture social network who applied Aflasafe with number of farmers in the network who won the lottery, and consequently, acquired the product in the first auction. We obtain similar results to table 1, but the impacts are smaller.

5.5 Analysis of mechanisms

To better understand how social networks impacted demand for Aflasafe, we explore different mechanisms. These include discussions about Aflasafe with adopters in the agriculture social network, and whether or not each participant heard or saw that an adopter in his agriculture social network applied Aflasafe to his field. Other possible pathways include acquiring more information about the problem of aflatoxins and measures to control them during all the stages of production. Consequently, we use two additional mechanisms, whether or not the participant discussed about aflatoxins with any of the adopters in his agriculture social network, and if he heard or saw any of these adopters taking measures to control aflatoxins after we provided information about this food safety problem. Table 5 shows the impact of agriculture social networks on the four mechanisms. Column 1 and 2 show that having at least one adopter in the agriculture social network increased the likelihood of discussing about Aflasafe or having heard or saw that a connection applied Aflasafe. In both cases the probability increased by almost 40% and the effect is significant at the 5% level.

Moreover, since Aflasafe is a technology that control aflatoxins, we would expect participants to discuss more about the problem after they received information about it and technologies to improve crops' quality and safety. Results in table 5, column 3 suggest that having at least one adopter in the agriculture social network increased the probability of having discussions about aflatoxins. Also, participants with adopters in their agriculture network were more likely to hear or see about measures to control these carcinogenic compounds.

5.6 Impact of other social networks on demand for Aflasafe

We examine what type of social connections – agriculture, friends/family, or neighbors – have the greatest impacts on demand for Aflasafe. Table 6 and 8 show that having at least one adopter in other social networks such as friends/family or neighbors did not have an impact on WTP in period two for the technology Aflasafe. Furthermore, these alternative social networks did not affect the probability of increasing WTP in period two or shifting to pay the market price or above in period two. Overall, these results reveal that only adopters in agricultural social networks impacted the probability of increasing valuations or adopting Aflasafe in period two. Although we do not find impacts on demand for the technology Aflasafe, results in table 7 reveal that participants with at least one adopter in their family/friends' social network were more likely to discuss about Aflasafe and aflatoxins or hear or see those adopters applying Aflasafe. Table 8 suggests that these discussions and interactions happened to a lesser extent among neighbors. The probabilities of having discussions about Aflasafe or aflatoxins with adopters who were neighbors are lower but significant. These results confirm that information about a technology that solves an unobservable quality problem was highly diffused in rural villages in Senegal, but only adopters in agriculture social networks positively impacted demand for the product.

6 Conclusions

Understanding how to accelerate the adoption and diffusion of food safety technologies is crucial to reducing the burden imposed by unsafe food. This is critical because a large share of the population in developing countries is negatively affected by unobservable food contaminants and awareness is still very low. However, it is not clear how farmers can learn and diffuse information about these technologies because they have no impact on profits and their health benefits in the short and long term are hard to monetize. To close this gap, in this paper we measured how different social networks impacted demand for the food safety technology Aflasafe. This product controls carcinogenic compounds affecting staple and cash crops during all stages of production.

We used auctions to elicit WTP for the technology in two different periods of time. Demand in both periods was high, with more than two-thirds of participants valuing the technology at the market price or above. One year after the first demand elicitation and information about the product was diffused in the villages, more farmers decided to pay the market price for one kg of Aflasafe (1,000 CFA), but an important share of participants still valued the technology above the market price.

Moreover, we found that participants, randomly selected from rural villages in Senegal, were very well connected. They knew almost all participants in their villages and had on average five agricultural connections and two Aflasafe adopters in their agriculture social networks. Results indicate that agricultural connections had the greatest impact on diffusion of information about Aflasafe and demand after participants became familiar with the technology. Participants also had discussions about Aflasafe and aflatoxins with adopters within their friends/family network and neighbors, but these two alternative social networks did not have an impact on demand for the technology.

The elevated interest in the food safety technology Aflasafe reveals that after smallholder farmers are aware of the aflatoxins problem, they are willing to pay the market price and procure small quantities of Aflasafe. These results confirm that it is essential to provide information on the negative consequences of food contamination and leverage agriculture social networks to foster the adoption of food safety technologies that increase food quality and control unobservable risks.

References

Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*, 84(3):488–500. Publisher: Oxford Academic.

Alaniz Zanon, M. S., Chiotta, M. L., Giaj-Merlera, G., Barros, G., and Chulze, S. (2013). Evaluation of potential biocontrol agent for aflatoxin in Argentinean peanuts. *International Journal of Food Microbiology*, 162(3):220–225.

Andersen, S., Harrison, G. W., Lau, M. I., and Rutström, E. E. (2006). Elicitation using multiple price list formats. *Experimental Economics*, 9(4):383–405.

ANSD (2015). Rapport Projection de la Population au Senegal. Technical report.

Ayedun, B., Okpachu, G., Manyong, V., Atehnkeng, J., Akinola, A., Abu, G. A., Bandyopadhyay, R., and Abdoulaye, T. (2017). An Assessment of Willingness To Pay by Maize and Groundnut Farmers for Aflatoxin Biocontrol Product in Northern Nigeria. *Journal of Food Protection*, 80(9):1451–1460.

Azziz-Baumgartner, E., Lindblade, K., Gieseker, K., Rogers, H. S., Kieszak, S., Njapau, H., Schleicher, R., McCoy, L. F., Misore, A., DeCock, K., Rubin, C., and Slutsker, L. (2005). Case–Control Study of an Acute Aflatoxicosis Outbreak, Kenya, 2004. *Environmental Health Perspectives*, 113(12):1779–1783.

Bandiera, O. and Rasul, I. (2006). Social Networks and Technology Adoption in Northern Mozambique. *The Economic Journal*, 116(514):869–902. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1468-0297.2006.01115.x.

Bandyopadhyay, R., Ortega-Beltran, A., Akande, A., Mutegi, C., Atehnkeng, J., Kaptoge, L., Senghor, A., Adhikari, B., and Cotty, P. (2016). Biological control of aflatoxins in Africa: current status and potential challenges in the face of climate change. *World Mycotoxin Journal*, 9(5):771–789. Publisher: Wageningen Academic Publishers.

Banerjee, A., Chandrasekhar, A. G., Duflo, E., and Jackson, M. O. (2013). The diffusion of microfinance. *Science (New York, N.Y.)*, 341(6144):1236498.

Bank, W. (2017). Groundnut Value Chain Competitiveness and Prospects for Development. Technical report. Washington DC.

Bardhan, J. and Udry, C. (1999). *Development Microeconomics*. OUP Oxford.

Bauchet, J., Prieto, S., and Ricker-Gilbert, J. (2021). Improved Drying and Storage Practices that Reduce Aflatoxins in Stored Maize: Experimental Evidence from Smallholders in Senegal. *American Journal of Agricultural Economics*, 103:296–316. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/ajae.12106.

Beaman, L. and Dillon, A. (2018). Diffusion of agricultural information within social networks: Evidence on gender inequalities from Mali. *Journal of Development Economics*, 133:147–161.

Breza, E. (2016). Field Experiments, Social Networks, and Development. In *The Oxford Handbook of the Economics of Networks*. ISBN: 9780199948277.

Breza, E., Chandrasekhar, A. G., McCormick, T. H., and Pan, M. (2019). Consistently estimating graph statistics using Aggregated Relational Data. *Cornell University*. arXiv: 1908.09881.

Cai, J., De Janvry, A., and Sadoulet, E. (2015). Social Networks and the Decision to Insure. *American Economic Journal: Applied Economics*, 7(2):81–108.

Cason, T. N. and Plott, C. R. (2014). Misconceptions and Game Form Recognition: Challenges to Theories of Revealed Preference and Framing. *Journal of Political Economy*, 122(6):1235–1270. Publisher: The University of Chicago Press.

Channa, H., Chen, A. Z., Pina, P., Ricker-Gilbert, J., and Stein, D. (2019). What drives smallholder farmers' willingness to pay for a new farm technology? Evidence from an experimental auction in Kenya. *Food Policy*, 85:64–71.

Conley, T. G. and Udry, C. R. (2010). Learning about a New Technology: Pineapple in Ghana. *American Economic Review*, 100(1):35–69.

Dabalen, A., Fuente, A. D. l., Aparajita, G., Karamba, W., Nguyen, N. T. V., and Tanaka, T. (2017). Pathways to prosperity in rural Malawi. Technical report, World Bank.

Dorner, J. W. (2010). Efficacy of a Biopesticide for Control of Aflatoxins in Corn. *Journal of Food Protection*, 73(3):495–499. Publisher: Allen Press.

Duflo, E., Kremer, M., and Robinson, J. (2008). How High Are Rates of Return to Fertilizer? Evidence from Field Experiments in Kenya. *American Economic Review*, 98(2):482–488.

Dupas, P. (2011). Health Behavior in Developing Countries. *Annual Review of Economics*, 3(1):425–449. _eprint: https://doi.org/10.1146/annurev-economics-111809-125029.

Dupas, P. (2014). Short-Run Subsidies and Long-Run Adoption of New Health Products: Evidence From a Field Experiment. *Econometrica*, 82(1):197–228. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA9508.

Feder, G., Just, R. E., and Zilberman, D. (1985). Adoption of Agricultural Innovations in Developing Countries: A Survey. *Economic Development and Cultural Change*, 33(2):255–298. Publisher: University of Chicago Press.

Foster, A. D. and Rosenzweig, M. R. (1995). Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture. *Journal of Political Economy*, 103(6):1176–1209. Publisher: University of Chicago Press.

Foster, A. D. and Rosenzweig, M. R. (2010). Microeconomics of Technology Adoption. *Annual Review of Economics*, 2(1):395–424. _eprint: https://doi.org/10.1146/annurev.economics.102308.124433.

Gollin, D., Morris, M., and Byerlee, D. (2005). Technology Adoption in Intensive Post-Green Revolution Systems. *American Journal of Agricultural Economics*, 87(5):1310–1316. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1467-8276.2005.00824.x.

Gong, Y., Hounsa, A., Egal, S., Turner, P. C., Sutcliffe, A. E., Hall, A. J., Cardwell, K., and Wild, C. P. (2004). Postweaning exposure to aflatoxin results in impaired child growth: a longitudinal study in Benin, West Africa. *Environmental Health Perspectives*, 112(13):1334–1338.

Grace, D. (2015). Food Safety in Low and Middle Income Countries. *International Journal of Environmental Research and Public Health*, 12(9):10490–10507.

Groote, H. D., Narrod, C., Kimenju, S. C., Bett, C., Scott, R. P. B., Tiongco, M. M., and Gitonga, Z. M. (2016). Measuring rural consumers' willingness to pay for quality labels using experimental auctions: the case of aflatoxin-free maize in Kenya. *Agricultural Economics*, 47(1):33–45. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/agec.12207.

Hoffmann, V. and Gatobu, K. M. (2014). Growing their own: Unobservable quality and the value of self-provisioning. *Journal of Development Economics*, 106:168–178.

IITA (2015). Technical Policy Paper 8. Aflatoxin Standards for Food. Knowledge Platform 2015. Situational Analysis East Africa Region. Technical report.

IITA (2020). How-to leaflet for Senegal in French on Aflasafe SN01: L'aflatoxine tue! Aflasafe protège votre maïs et votre arachide de ce poison mortel. Technical report.

Isakeit, T. (2015). Evaluation of atoxigenic strains of Aspergillus flavus for aflatoxin control in corn on commercial farms in Texas. *AgriLife. Ext. Tex. A &M.*

Kadjo, D., Ricker-Gilbert, J., Shively, G., and Abdoulaye, T. (2020). Food Safety and Adverse Selection in Rural Maize Markets. *Journal of Agricultural Economics*, 71(2):412–438. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/1477-9552.12350.

Kamala, A., Shirima, C., Jani, B., Bakari, M., Sillo, H., Rusibamayila, N., De Saeger, S., Kimanya, M., Gong, Y., and Simba, A. (2018). Outbreak of an acute aflatoxicosis in Tanzania during 2016. *World Mycotoxin Journal*, 11(3):311–320. Publisher: Wageningen Academic Publishers.

Kremer, M. and Miguel, E. (2007). The Illusion of Sustainability. *The Quarterly Journal of Economics*, 122(3):1007–1065. Publisher: Oxford Academic.

Liu, Y. and Wu, F. (2010). Global Burden of Aflatoxin-Induced Hepatocellular Carcinoma: A Risk Assessment. *Environmental Health Perspectives*, 118(6):818–824.

Magnan, N., Spielman, D. J., Lybbert, T. J., and Gulati, K. (2015). Leveling with friends: Social networks and Indian farmers' demand for a technology with heterogeneous benefits. *Journal of Development Economics*, 116:223–251.

Manski, C. F. (1993). Identification of Endogenous Social Effects: The Reflection Problem. *The Review of Economic Studies*, 60(3):531–542. Publisher: Oxford Academic.

Niane Ndoye, A. F., English, P., ogo, Kreuzwieser, E., Cisse, A., Toure, d. A., Tre, J.-P., and Ouedra, I. (2015). Etude diagnostique de la chaîne de valeurs arachide au Sénégal et propositions de réformes. Technical Report ACS16609, The World Bank. Issue: ACS16609.

Oster, E. and Thornton, R. (2012). Determinants of Technology Adoption: Peer Effects in Menstrual Cup Take-up. *Journal of the European Economic Association*, 10(6).

PACA (2018). Strengthening Aflatoxin control in Malawi: Policy Recommendations. Technical report.

Senghor, L. A., Ortega-Beltran, A., Atehnkeng, J., Callicott, K. A., Cotty, P. J., and Bandyopadhyay, R. (2019). The Atoxigenic Biocontrol Product Aflasafe SN01 Is a Valuable Tool to Mitigate Aflatoxin Contamination of Both Maize and Groundnut Cultivated in Senegal. *Plant Disease*, pages PDIS–03–19–0575–RE. Reporter: Plant Disease.

Shimamoto, D., Yamada, H., and Wakano, A. (2017). The Effects of Risk Preferences on the Adoption of Post-Harvest Technology: Evidence from Rural Cambodia. *The Journal of Development Studies*, 54(10).

Suri, T. (2011). Selection and Comparative Advantage in Technology Adoption. *Econometrica*, 79(1):159–209. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA7749.

Turner, P. C., Sylla, A., Gong, Y. Y., Diallo, M. S., Sutcliffe, A. E., Hall, A. J., and Wild, C. P. (2005). Reduction in exposure to carcinogenic aflatoxins by postharvest intervention measures in west Africa: a community-based intervention study. *The Lancet*, 365(9475):1950–1956. Number: 9475 Reporter: The Lancet.

Weaver, M. A., Abbas, H. K., Falconer, L. L., Allen, T. W., Pringle, H. C. L., and Sciumbato, G. L. (2015). Biological control of aflatoxin is effective and economical in Mississippi field trials. *Crop Protection*, 69:52–55.

WHO (2015). WHO estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group. Technical report, World Health Organization.

7 Figures

Figure 1: Study Timeline

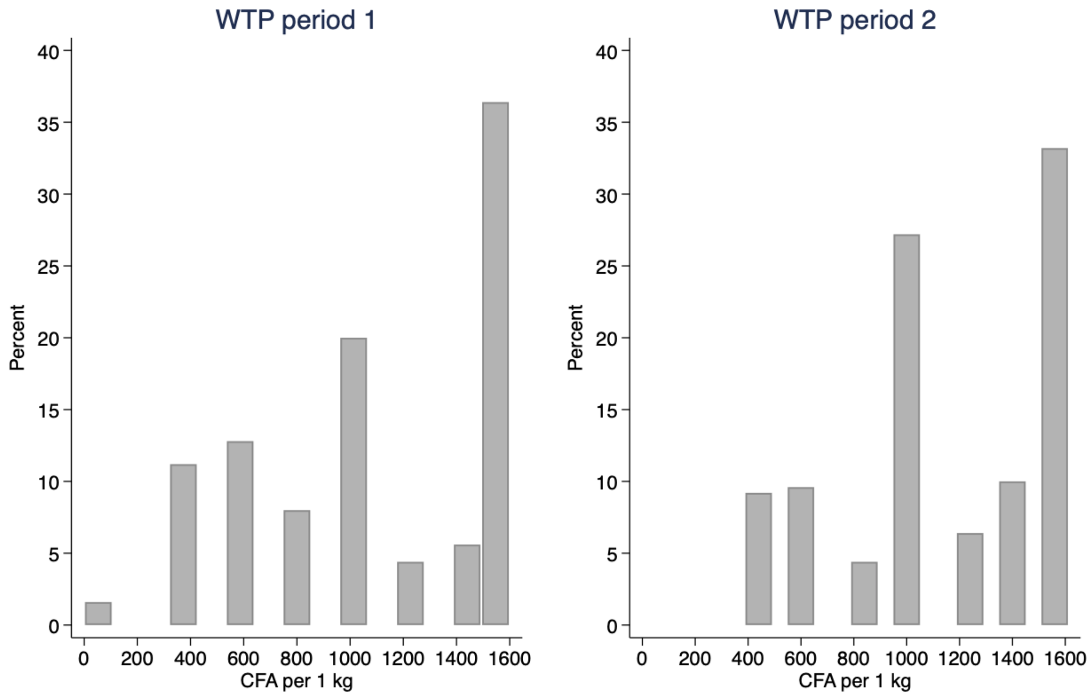
Notes: This figure presents the study timeline. The first auction was carried out in March 2020. The second auction was carried out in May 2021. Farmers who received Aflasafe applied it during the winter season in Senegal from June to August 2020.

Figure 2: Low-high and high-low BDM variations

Method 2: Low-high	Method 3: High-low
Are you willing to pay 400 CFA for this bag of Aflasafe? Yes/No	Are you willing to pay 1600 CFA for this bag of Aflasafe? Yes/No
Are you willing to pay 600 CFA for this bag of Aflasafe? Yes/No	Are you willing to pay 1400 CFA for this bag of Aflasafe? Yes/No
Are you willing to pay 800 CFA for this bag of Aflasafe? Yes/No	Are you willing to pay 1200 CFA for this bag of Aflasafe? Yes/No
Are you willing to pay 1000 CFA for this bag of Aflasafe? Yes/No	Are you willing to pay 1000 CFA for this bag of Aflasafe? Yes/No
Are you willing to pay 1200 CFA for this bag of Aflasafe? Yes/No	Are you willing to pay 800 CFA for this bag of Aflasafe? Yes/No
Are you willing to pay 1400 CFA for this bag of Aflasafe? Yes/No	Are you willing to pay 600 CFA for this bag of Aflasafe? Yes/No
Are you willing to pay 1600 CFA for this bag of Aflasafe? Yes/No	Are you willing to pay 400 CFA for this bag of Aflasafe? Yes/No

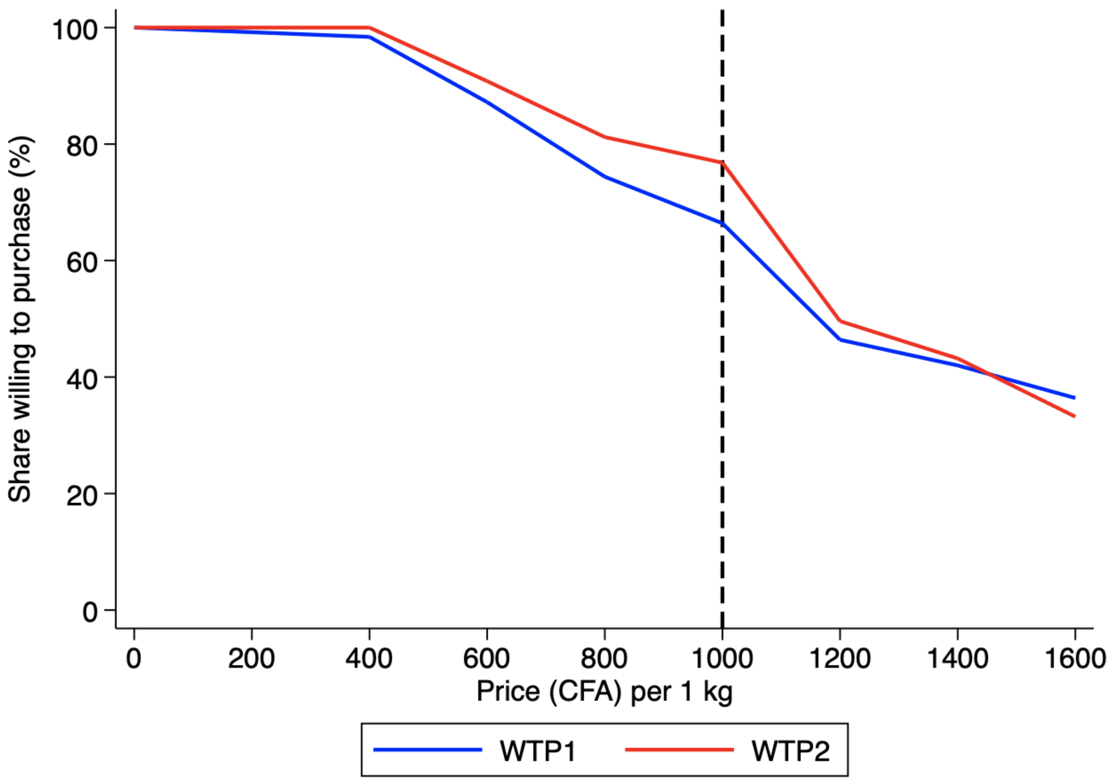
Notes: This figure presents the multiple price list formats used to elicit WTP. Method 1 is the standard BDM procedure. Method 2 is a list increasing in prices with Yes/No questions for each price. Method 3 is a list decreasing in prices with Yes/No questions for each price.

Figure 3: WTP period 1 and 2



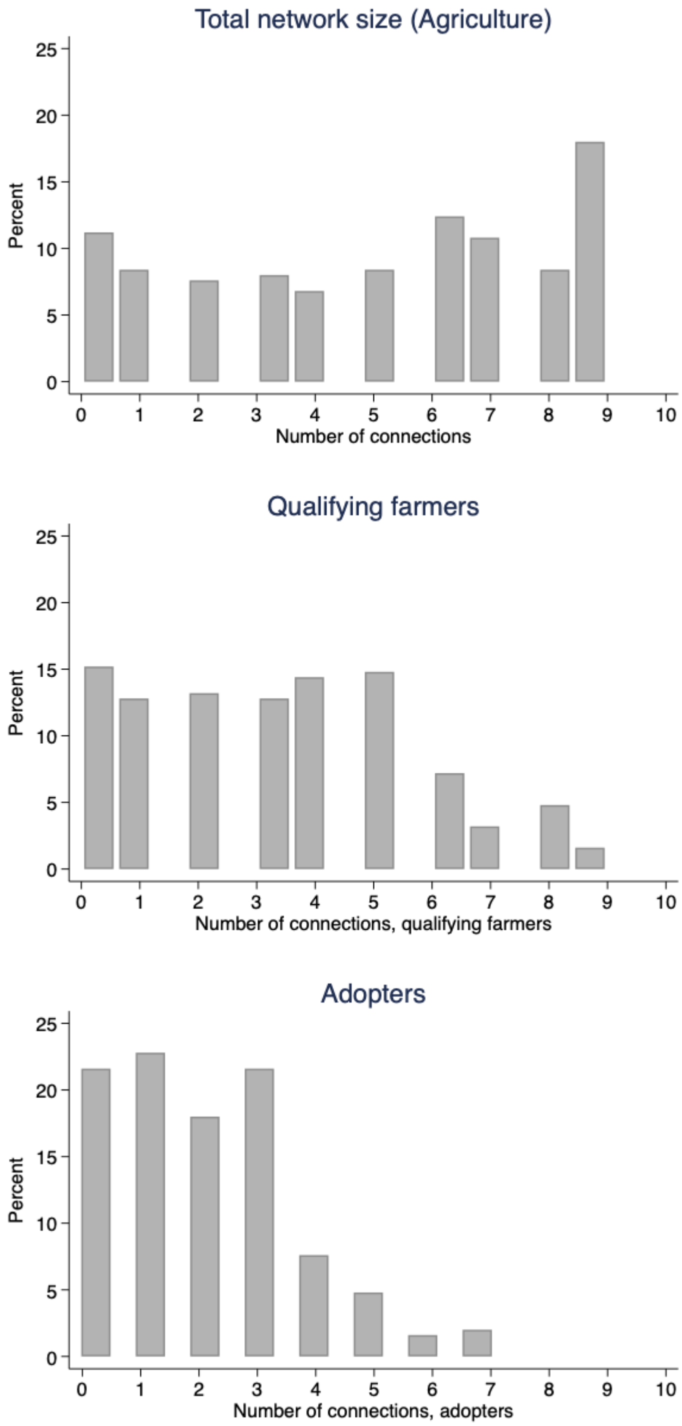
Notes: This figure shows the valuations for 1 kg of Aflasafe in two different periods. Period 1 was March 2020 and period 2 May 2021. Prices range from 0 to 1,600 CFA. The market price is 1,000 CFA per kg.

Figure 4: Demand curves for Aflasafe period 1 and 2



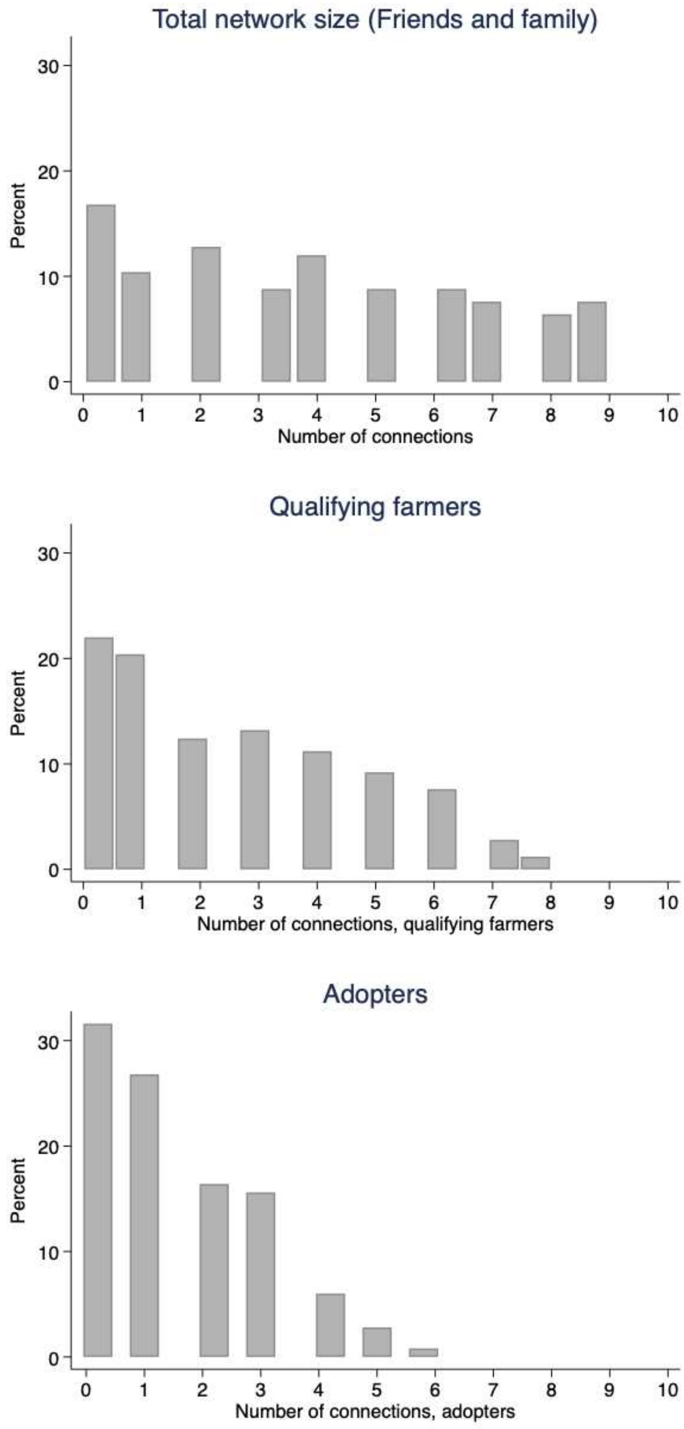
Notes: This figure shows the demand curves for 1 kg of Aflasafe in two different periods. Period 1 was March 2020 and period 2 May 2021. Prices range from 0 to 1,600 CFA. The market price is 1,000 CFA per kg.

Figure 5: Agricultural connections in social network



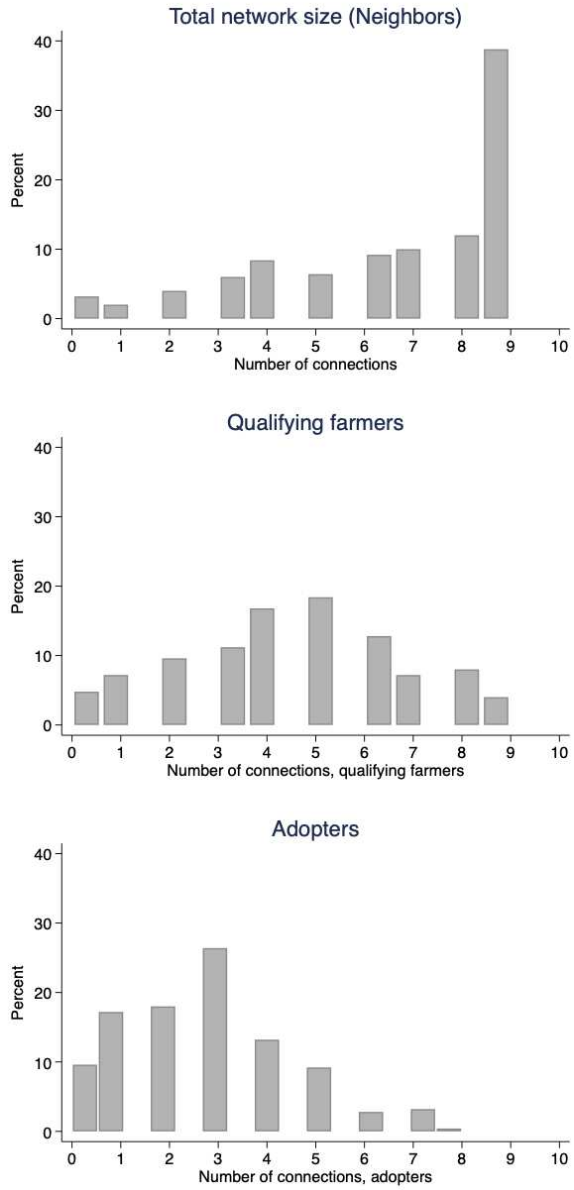
Notes: This figure shows the distribution of agricultural connections in a participant's social network. The top panel shows the total network size (only those who discussed agriculture with), the medium panel shows the distribution of qualifying farmers, and the bottom panel the number of adopters in that network.

Figure 6: Friends and family connections in social network



Notes: This figure shows the distribution of friends or family connections in a participant's social network. The top panel shows the total network size (only friends or family), the medium panel shows the distribution of qualifying farmers, and the bottom panel the number of adopters in that network.

Figure 7: Neighbors in social network



Notes: This figure shows the distribution of connections classified as neighbors in a participant's social network. The top panel shows the total network size (only Neighbors), the medium panel shows the distribution of qualifying farmers, and the bottom panel the number of adopters in that network.

8 Tables

Table 1: Descriptive statistics household and auction variables

	Mean	Median	SD
Panel A.Household characteristics			
=1 if respondent is female	0.24	-	0.43
Respondent age	44.62	44.00	13.59
=1 if respondent max educ level is Koranic school	0.80	-	0.40
=1 if respondent max educ level is primary school	0.14	-	0.35
=1 if respondent max educ level is above primary school	0.03	-	0.18
Total HH income CFA	532,476	300,000	908,676
Total land HH has in hectares	6.53	5.00	7.70
HH has a radio, tv, bicycle, motorcycle, or vehicle	0.83	-	0.38
=1 if heard about aflatoxins before	0.20	-	0.40
=1 if heard about aflasafe before	0.03	-	0.18
Panel B. Auction results			
WTP period 1	1099.20	1000.00	461.27
WTP period 2	1149.60	1000.00	408.17
=1 if WTP increased	0.41	0.00	0.49
=1 if WTP decreased	0.37	0.00	0.48
=1 if WTP stayed the same	0.22	0.00	0.42
Switched	0.27	0.00	0.44
Auction method: BDM	0.33	0.00	0.47
Auction method: Low-High	0.32	0.00	0.47
Auction method: High-Low	0.34	0.00	0.48
Panel C. Networks			
Network size in village	8.74	9.00	0.68
Network size (agriculture)	4.96	5.00	3.07
Network size (friends/family)	3.80	4.00	2.87
Network size (neighbors)	6.64	8.00	2.63
N. adopters (agriculture)	1.52	1.00	1.54
N. adopters (friends/family)	1.18	1.00	1.33
N. adopters (neighbors)	2.15	2.00	1.69
N. lottery winners (agriculture)	2.02	2.00	1.68
N. lottery winners (friends/family)	1.49	1.00	1.43
N. lottery winners (neighbors)	2.74	3.00	1.74
N. qualifying farmers (agriculture)	3.28	3.00	2.37
N. qualifying farmers (friends or faimly)	2.50	2.00	2.15
N. qualifying farmers (neighbors)	4.46	5.00	2.31
Observations	250		

Notes: Descriptive statistics for all households in sample.

Table 2: Balance auction winners and losers

Variable	(1) Losers Mean/SE	(2) Winners Mean/SE	t-test p-value (1)-(2)
=1 if respondent is female	0.207	0.256	0.388
	(0.045)	(0.034)	
Respondent age	43.84	45	0.520
	(1.452)	(1.067)	
=1 if respondent max educ level is Koranic school	0.780	0.810	0.598
	(0.046)	(0.030)	
=1 if respondent max educ level is primary school	0.159	0.137	0.656
	(0.041)	(0.027)	
=1 if respondent max educ level is above primary school	0.0370	0.0300	0.782
	(0.021)	(0.013)	
Total HH income CFA	611000	495000	0.330
	(90455.595)	(76311.170)	
Total land HH has in hectares	7.475	6.067	0.290
	(1.276)	(0.380)	
HH has a radio, tv, bicycle, motorcycle, or vehicle	0.878	0.804	0.119
	(0.036)	(0.031)	
=1 if heard about aflatoxins before	0.256	0.173	0.141
	(0.048)	(0.029)	
=1 if heard about aflasafe before	0	0.0480	0.004***
	(0.000)	(0.016)	
WTP period 1	682.9	1302	0.000***
	(33.818)	(29.393)	
Network size (agriculture)	4.671	5.101	0.293
	(0.331)	(0.240)	
Network size (friends/family)	4.232	3.589	0.098*
	(0.318)	(0.221)	
Network size (neighbors)	6.256	6.827	0.125
	(0.318)	(0.192)	
N. lottery winners (agriculture)	1.915	2.065	0.495
	(0.177)	(0.132)	
N. lottery winners (friends/family)	1.829	1.327	0.017**
	(0.185)	(0.098)	
N. lottery winners (neighbors)	2.415	2.893	0.040**
	(0.189)	(0.134)	
At least one lottery winner (Agriculture)	0.780	0.786	0.925
	(0.046)	(0.032)	
At least one lottery winner (friends/family)	0.732	0.661	0.248
	(0.049)	(0.037)	
At least one lottery winner (neighbors)	0.878	0.917	0.360
	(0.036)	(0.021)	

Notes: The value displayed for t-tests are p-values. Standard errors are robust. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 3: Balance lottery winners and losers

Variable	(1) Losers Mean/SE	(2) Winners Mean/SE	t-test p-value (1)-(2)
=1 if respondent is female	0.190	0.295	0.120
	(0.050)	(0.045)	
Respondent age	45.22	44.87	0.869
	(1.651)	(1.396)	
=1 if respondent max educ level is Koranic school	0.762	0.838	0.243
	(0.054)	(0.036)	
=1 if respondent max educ level is primary school	0.143	0.133	0.864
	(0.044)	(0.033)	
=1 if respondent max educ level is above primary school	0.0480	0.0190	0.345
	(0.027)	(0.013)	
Total HH income CFA	478000	505000	0.838
	(62276.850)	(1.15e+05)	
Total land HH has in hectares	6.504	5.803	0.371
	(0.616)	(0.483)	
HH has a radio, tv, bicycle, motorcycle, or vehicle	0.857	0.771	0.159
	(0.044)	(0.041)	
=1 if heard about aflatoxins before	0.159	0.181	0.711
	(0.046)	(0.038)	
=1 if heard about aflasafe before	0.0630	0.0380	0.484
	(0.031)	(0.019)	
WTP period 1	1308	1299	0.883
	(46.775)	(37.905)	
Network size (agriculture)	5.159	5.067	0.856
	(0.414)	(0.294)	
Network size (friends/family)	3.556	3.610	0.910
	(0.397)	(0.262)	
Network size (neighbors)	6.921	6.771	0.708
	(0.315)	(0.243)	
N. lottery winners (agriculture)	1.937	2.143	0.433
	(0.194)	(0.177)	
N. lottery winners (friends/family)	1.333	1.324	0.963
	(0.168)	(0.121)	
N. lottery winners (neighbors)	2.857	2.914	0.833
	(0.203)	(0.178)	
At least one lottery winner (agriculture)	0.794	0.781	0.846
	(0.051)	(0.041)	
At least one lottery winner (friends/family)	0.651	0.667	0.835
	(0.061)	(0.046)	
At least one lottery winner (neighbors)	0.921	0.914	0.885
	(0.034)	(0.027)	

Notes: The value displayed for t-tests are p-values. Standard errors are robust. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 4: Treatment-on-the-Treated (TOT) impacts of agriculture social networks on Demand for Aflasafe

	(1) WTP period 2	(2) WTP increased	(3) WTP decreased	(4) Switched
At least one adopter	30.689	0.327***	-0.145	0.179**
	(192.808)	(0.116)	(0.196)	(0.080)
One qualifying farmer	21.362	-0.069	0.145	-0.102
	(121.775)	(0.087)	(0.130)	(0.072)
Two qualifying farmers	130.740	-0.010	0.033	-0.062
	(152.903)	(0.094)	(0.150)	(0.090)
Greater than 2 qualifying farmers	165.031	0.030	0.110	-0.007
	(211.278)	(0.126)	(0.205)	(0.132)
Network size (agriculture)	-20.292	-0.045***	0.017	-0.029
	(18.207)	(0.015)	(0.019)	(0.019)
WTP period 1	0.108			
	(0.087)			
Constant	1065.076***	0.783***	0.046	0.673***
	(104.641)	(0.070)	(0.085)	(0.069)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline, if he obtained the product at baseline, and 2 dummy variables indicating whether the auction methodology was a list increasing or decreasing in prices. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 5: Treatment-on-the-Treated (TOT) impact of agriculture social networks on Demand for Aflasafe, mechanisms

	Aflasafe		Aflatoxins	
	(1)	(2)	(3)	(4)
	Discussed	Heard/saw	Discussed	Heard/saw measures
At least one adopter	0.394***	0.380***	0.307**	0.491***
	(0.097)	(0.086)	(0.121)	(0.127)
One qualifying farmer	-0.101**	-0.058	-0.080	-0.038
	(0.049)	(0.056)	(0.066)	(0.071)
Two qualifying farmers	-0.133	-0.179*	-0.315***	-0.199**
	(0.093)	(0.097)	(0.092)	(0.099)
Greater than 2 qualifying farmers	-0.137	-0.176	-0.119	0.004
	(0.115)	(0.160)	(0.147)	(0.192)
Network size (agriculture)	0.040**	0.038	0.049**	0.021
	(0.018)	(0.023)	(0.024)	(0.031)
Constant	-0.081***	-0.090***	-0.015	-0.002
	(0.027)	(0.026)	(0.026)	(0.023)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline and if he obtained the product at baseline. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 6: Treatment-on-the-Treated (TOT) impacts of friends/family social networks on demand for Aflasafe

	(1)	(2)	(3)	(4)
	WTP period 2	WTP increased	WTP decreased	Switched
At least one adopter	-71.056	-0.028	-0.082	0.070
	(105.288)	(0.126)	(0.129)	(0.110)
One qualifying farmer	81.241	-0.005	-0.101	-0.049
	(84.257)	(0.113)	(0.112)	(0.108)
Two qualifying farmers	156.367	0.198*	-0.177	0.093
	(125.008)	(0.119)	(0.142)	(0.139)
Greater than 2 qualifying farmers	61.546	0.102	-0.088	0.158
	(126.677)	(0.148)	(0.162)	(0.158)
Network size (friends/family)	3.289	-0.021	0.023	-0.042**
	(20.286)	(0.021)	(0.017)	(0.016)
WTP period 1	0.108			
	(0.090)			
Constant	1061.723***	0.833***	0.148**	0.690***
	(99.236)	(0.061)	(0.061)	(0.066)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline, if he obtained the product at baseline, and 2 dummy variables indicating whether the auction methodology was a list increasing or decreasing in prices. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 7: Treatment-on-the-Treated (TOT) impacts of friends/family social networks on demand for Aflasafe, mechanisms

	Aflasafe		Aflatoxins	
	(1)	(2)	(3)	(4)
	Discussed	Heard/saw	Discussed	Heard/saw measures
At least one adopter	0.318***	0.309***	0.325***	0.405***
	(0.074)	(0.060)	(0.065)	(0.075)
One qualifying farmer	-0.040	-0.042	-0.002	-0.015
	(0.026)	(0.034)	(0.035)	(0.053)
Two qualifying farmers	0.019	0.015	0.009	0.055
	(0.120)	(0.107)	(0.122)	(0.126)
Greater than 2 qualifying farmers	0.093	0.052	0.138	0.236*
	(0.103)	(0.118)	(0.125)	(0.132)
Network size (friends/family)	0.003	0.007	-0.010	-0.014
	(0.013)	(0.017)	(0.018)	(0.021)
Constant	-0.035	-0.038*	0.019	0.035
	(0.023)	(0.022)	(0.022)	(0.025)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline and if he obtained the product at baseline. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 8: Treatment-on-the-Treated (TOT) impacts of neighbors on demand for Aflasafe

	(1) WTP period 2	(2) WTP increased	(3) WTP decreased	(4) Switched
At least one adopter	-36.499	-0.167	0.170	-0.178
	(140.369)	(0.196)	(0.175)	(0.189)
One qualifying farmer	173.571	0.150	-0.311	0.203
	(192.900)	(0.136)	(0.216)	(0.144)
Two qualifying farmers	171.417	0.444**	-0.456*	0.424**
	(217.667)	(0.187)	(0.233)	(0.181)
Greater than 2 qualifying farmers	42.193	0.254	-0.291	0.262
	(209.548)	(0.215)	(0.248)	(0.199)
Network size (neighbors)	16.529	-0.005	-0.007	0.010
	(11.588)	(0.019)	(0.016)	(0.018)
WTP period 1	0.122			
	(0.084)			
Constant	965.816***	0.740***	0.291*	0.473***
	(168.306)	(0.130)	(0.158)	(0.104)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline, if he obtained the product at baseline, and 2 dummy variables indicating whether the auction methodology was a list increasing or decreasing in prices. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 9: Treatment-on-the-Treated (TOT) impacts of neighbors on demand for Aflasafe, mechanisms

	Aflasafe		Aflatoxins	
	(1)	(2)	(3)	(4)
	Discussed	Heard/saw	Discussed	Heard/saw measures
At least one adopter	0.096*	0.092	0.162***	0.361***
	(0.058)	(0.058)	(0.062)	(0.076)
One qualifying farmer	-0.140***	-0.174***	-0.044	0.013
	(0.054)	(0.045)	(0.054)	(0.063)
Two qualifying farmers	-0.141*	-0.144*	-0.123**	-0.125
	(0.084)	(0.080)	(0.056)	(0.079)
Greater than 2 qualifying farmers	-0.036	-0.189*	0.071	0.135
	(0.152)	(0.104)	(0.110)	(0.136)
Network size (neighbors)	0.035	0.051***	0.013	-0.010
	(0.024)	(0.017)	(0.017)	(0.018)
Constant	-0.051	-0.070**	0.005	0.024
	(0.031)	(0.029)	(0.022)	(0.029)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline and if he obtained the product at baseline. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

9 Appendix

Table 10: Intent to treat (ITT) impacts of Agriculture social networks on demand for Aflasafe

	(1) WTP period 2	(2) WTP increased	(3) WTP decreased	(4) Switched
At least one adopter	64.218	0.184**	-0.135	0.034
	(82.883)	(0.071)	(0.090)	(0.066)
One qualifying farmer	5.393	-0.002	0.140	-0.033
	(95.604)	(0.091)	(0.114)	(0.084)
Two qualifying farmers	109.189	0.081	0.026	0.030
	(122.466)	(0.091)	(0.130)	(0.086)
Greater than 2 qualifying farmers	138.608	0.142	0.101	0.107
	(155.705)	(0.104)	(0.160)	(0.134)
Network size (agriculture)	-20.975	-0.042**	0.017	-0.026
	(18.610)	(0.015)	(0.020)	(0.019)
WTP period 1	0.111			
	(0.089)			
Constant	1062.734***	0.786***	0.046	0.675***
	(108.807)	(0.072)	(0.087)	(0.070)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline, if he obtained the product at baseline, and 2 dummy variables indicating whether the auction methodology was a list increasing or decreasing in prices. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 11: Intent to treat (ITT) impacts of Agriculture social networks on demand for Aflasafe, mechanisms

	Aflasafe		Aflatoxins	
	(1)	(2)	(3)	(4)
	Discussed	Heard/saw	Discussed	Heard/saw measures
At least one adopter	0.044	0.169**	0.025	0.085
	(0.070)	(0.072)	(0.079)	(0.088)
One qualifying farmer	0.065	0.041	0.054	0.154
	(0.076)	(0.087)	(0.122)	(0.126)
Two qualifying farmers	0.089	-0.046	-0.136	0.059
	(0.117)	(0.114)	(0.134)	(0.153)
Greater than 2 qualifying farmers	0.140	-0.009	0.105	0.327
	(0.131)	(0.174)	(0.191)	(0.230)
Network size (agriculture)	0.046**	0.042*	0.055**	0.029
	(0.018)	(0.024)	(0.022)	(0.030)
Constant	-0.076**	-0.087***	-0.011	0.003
	(0.028)	(0.027)	(0.026)	(0.022)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline and if he obtained the product at baseline. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 12: Treatment-on-the-Treated (TOT) impact of agriculture social networks (continuous variables) on demand for Aflasafe

	(1) WTP period 2	(2) WTP increased	(3) WTP decreased	(4) Switched
N. adopters (agriculture)	-13.052	0.068***	-0.036	0.046**
	(24.330)	(0.016)	(0.023)	(0.020)
N. qualifying (agriculture)	-43.638**	-0.039**	0.038	-0.017
	(20.380)	(0.019)	(0.025)	(0.019)
Network size (agriculture)	35.191**	-0.002	-0.003	-0.011
	(16.953)	(0.015)	(0.019)	(0.014)
WTP period 1	0.102			
	(0.092)			
Constant	1102.582***	0.839***	0.058	0.668***
	(96.139)	(0.057)	(0.069)	(0.051)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline, if he obtained the product at baseline, and 2 dummy variables indicating whether the auction methodology was a list increasing or decreasing in prices. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.

Table 13: Treatment-on-the-Treated (TOT) impact of agriculture social networks (continuous variables) on demand for Aflasafe, mechanisms

	Aflasafe		Aflatoxins	
	(1)	(2)	(3)	(4)
	Discussed	Heard/saw	Discussed	Heard/saw measures
N. adopters (agriculture)	0.049*	0.040*	0.036	0.047
	(0.030)	(0.023)	(0.031)	(0.039)
N. qualifying (agriculture)	0.013	0.029	0.038*	0.063*
	(0.027)	(0.025)	(0.020)	(0.033)
Network size (agriculture)	0.041**	0.024	0.033	0.014
	(0.020)	(0.020)	(0.020)	(0.030)
Auction method: Low-High	-0.039	-0.058	0.087	0.138**
	(0.055)	(0.052)	(0.066)	(0.066)
Auction method: High-Low	-0.015	-0.024	0.207***	0.207***
	(0.077)	(0.065)	(0.067)	(0.072)
Constant	-0.008	-0.004	-0.150***	-0.063
	(0.074)	(0.062)	(0.057)	(0.058)
Controls	YES	YES	YES	YES
Observations	250	250	250	250

Notes: Clustered standard errors at the village level in parentheses. Control variables are if participant knew about Aflasafe at baseline and if he obtained the product at baseline. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level.