Uganda Farmer Market Engagement Study Final Report v1

USAID/Uganda Feed the Future Market System Monitoring Activity

July 2019

This report was prepared for the United States Agency for International Development (USAID) under contract number AID-OAA-A-12-00095.
The authors' views expressed in this publication do not necessarily reflect the view of USAID or the United States Government.

CONTENTS

0 INTRODUCTION

The USAID/Uganda Feed the Future Market System Monitoring Activity (MSM) applies principles from systems engineering and supply chain management to develop methodologies and tools that can be used to assess the impact of market facilitation activities. The Activity is implemented by the Humanitarian Supply Chain Lab at the Massachusetts Institute of Technology (MIT) in partnership with The George Washington University (GW). Our Activity team has developed two flagship methodologies for practitioners to learn and apply: the Systems Pathways Mapping Toolkit and the Systems Pathways Measurement Toolkit. We also foster collaboration and learning through workshops and stakeholder engagement, and consult with implementing partners and other stakeholders on applying systems thinking to specific challenges or contexts.

In addition to developing methodologies for mapping and monitoring complex change in systems, the MSM Activity has also conducted deep-dive studies into different sectors of the Ugandan market system in order to build the evidence base for learning, adaptation, and investment decisions. This report outlines the findings from one of our deep-dive studies, the Farmer Market Engagement Study, which explored how farm households interact with the market system. Effective market linkages between farmers and their immediate service providers are crucial to delivering higher incomes for farmers, one of USAID's major objectives. In order to fully understand the functioning of the agricultural market system in Uganda and how well it is enabling that objective, the MSM team sought to better understand how farmers engage with the market system.

In consultation with USAID, our team developed two surveys: one for farm households, and one for agribusinesses. The surveys were conducted in March 2018 across five districts in Uganda: Gulu, Ibanda, Iganga, Mubende, and Pader. In total, we surveyed almost 500 farm households and more than 150 agribusinesses.

This first release of our findings presents the preliminary results of the farm household survey, including descriptive statistics for each of the questions and a regression analysis of the household characteristics that are linked to increased market participation. The next release (v2) will include the results of the agribusiness survey, as well as further secondary analysis.

The report is organized as follows: Section 1 discusses the survey design and the topics that were included. Section 2 details our sampling and data collection procedures. For nearly every question asked in the survey, Section 3 provides a snapshot of the responses we received. This is intended as a brief summary, providing a quick reference for results from the survey. Section 4 discusses the econometric modelling that was conducted.

Given the breadth of information captured in the survey, we will be conducting additional secondary analysis during the coming months. We look forward to your feedback, questions, and suggestions of areas for further inquiry. Please reach out to our research team at msm.uganda@mit.edu.

1 SURVEY DESIGN

The farm household is the core of the agricultural market system in Uganda. According to the most recent national census, almost 80% of households participate in agriculture in one form or another (Uganda Bureau of Statistics, 2016a). In this complex system, there are a variety of factors that impact farm households' ability to engage with the market and influence their propensity to do so. The objective of our study was to understand the behaviors, relationships, and conditions that enable farmers to participate in the market system, to inform USAID's market system facilitation programs.

For the purposes of this study, market participation, or "market engagement", was defined to encompass any interactions the household may have with other market actors. Though some projects have considered "market participation" to mean "engages with the market as a source of income by selling crops or labor" we chose to include other activities, such as purchasing inputs from a dealer, in order to capture all forms of interaction with the market system.

Farm households connect with market in several basic ways. They interact with the inputs supply chains to procure seeds, chemicals, tools, land, and labor. They also connect with the outputs supply chains to sell their harvest and earn income. However, these interactions may be influenced by their access to finance, transportation, and information, among many other factors. We sought to capture and understand this complexity, in order to analyze the enablers and barriers to market participation.

Based on a literature review and consultation with stakeholders from the USAID/Uganda Mission, the team identified the following factors that contribute to market participation:

- Sufficient household or community assets (land, livestock, etc.) to produce a marketable surplus
- Access to relevant inputs (seeds, fertilizer, etc.)
- Access to relevant information (market prices, planting techniques, etc.)
- Market linkages (relationships with input dealers, buyers, cooperatives, etc.)
- Financial stability, also described as risk tolerance (able to purchase inputs and/or obtain credit)
- Food security (sufficient income/production to meet household needs)
- Health (ability to work productively)
- Appropriate skill set (trained in farming or other marketable trade, life skills such as numeracy and literacy)
- Physical proximity to other market actors

There were also a few external factors identified that impact smallholder market access, particularly adequate local infrastructure (roads, electricity, water, etc.) and the presence of local market opportunities (such as demand for crops or labor).

Based on our background research, and knowledge gaps identified by USAID, our study was designed to answer the following research questions:

1. What are the main channels/relationships/actors through which individual farmers purchase inputs, procure agriculture-related services, and sell their outputs? How formal or informal are they? If these relationships do not exist, why not? What are the farmers' primary sources of information about farming techniques, market prices, quality products, etc.?
2. How is the current market system failing to meet farmers' needs? Which products, services, or kinds of information are not currently available in the "last mile", and why? What would enable the market system to better reach farmers that are currently considered as vulnerable or "not market ready"?
3. If there are farm households that are not engaging with the market system, what are the main obstacles or barriers preventing them from doing so?

To answer these questions, our team designed both a household survey and an agribusiness survey (which will be discussed in v2 of this report). The household survey consisted of seven sections focusing on different dimensions of household characteristics:

- Household demographics
- Finance
- Agronomic practices
- Agricultural inputs
- Production and harvest
- Market linkages
- Access to information

In Section 3, we will review the survey questions and discuss the responses we received. The full text of the household survey can be found in Appendix A.

Approval to conduct this study was obtained from the institutional review board at the Massachusetts Institute of Technology (MIT COUHES), as well as the Research Ethics Committee at the Makerere University School of Social Sciences and the Uganda National Council for Science and Technology (UNCST), certifying the survey's compliance with ethical and legal standards.

2 SAMPLING & DATA COLLECTION PROCEDURES

This section provides a brief overview of the sampling procedures used to generate our pool of respondents; further detail on the sampling procedures can be found in Appendix B.

2.1 DISTRICT SELECTION

The survey was conducted in five districts in Uganda: Gulu, Ibanda, Iganga, Mubende, and Pader. These districts were purposively chosen based on time and resource constraints. In consultation with USAID, one Feed the Future district was selected to represent each of Uganda's four regions: North (Gulu), East (Iganga), West (Ibanda), and Central (Mubende).

The fifth district was purposively selected to represent a more rural population. The districts were sorted based on population density according to the 2014 census. Districts in the Karamoja region were not considered, given their unique demographic and agroecological characteristics, and districts bordering South Sudan were not considered for security reasons. Pader was chosen for its proximity to Gulu, one of the other selected districts, in order to streamline the data collection process.

The five selected districts were Gulu, Ibanda, Iganga, Mubende, and Pader, as seen in Figure 1.

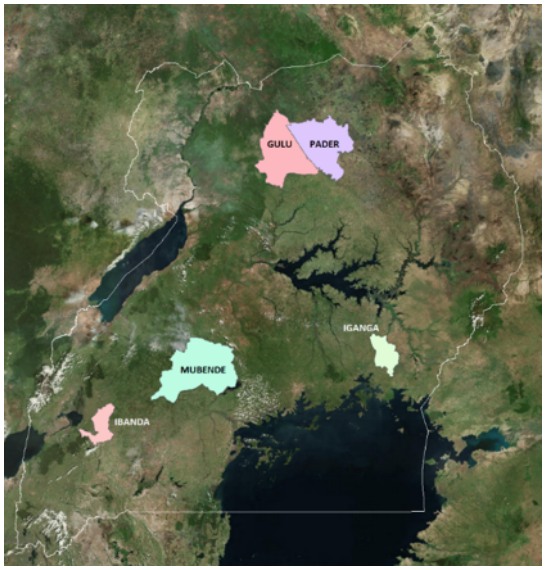

Figure 1: The five sampled districts within Uganda: Gulu, Ibanda, Iganga, Mubende, and Pader.

2.2 HOUSEHOLD SAMPLING PROCESS

Within each district, we sought to interview 100 households, for a total sample of 500 households. We generated a random sample of households within each district, using satellite maps and population data to ensure a representative sample.

Since the purpose of the study was to investigate market access among farming households, those households living in dense population centers (Town Councils and Municipalities) were purposively excluded. These households may be less likely to participate in agriculture due to land constraints. In addition, their proximity to market centers could provide greater access to knowledge and opportunities than are available to households in rural areas, such that we would expect these households to interact with the market in different ways.

A two-stage clustered sampling process was used to identify the households that were interviewed. For the first stage, we used satellite maps to divide each district into 2x2 km squares, which became the primary sampling unit. Squares that fell within sub-counties that contained Town Councils and Municipalities were excluded, and the remaining squares were weighted according to the population density of farmers in the sub-county, in order to give each farm household approximately equal probability of being selected. We then randomly selected 30 of these 2x2 km squares in each district - 10 as the primary sample, and 20 as a reserve in case replacements were needed.

The squares were inspected using satellite imagery, and a few were eliminated from the sample either because of their geographical features (primarily forest or water), or because they had fewer than 10 visible buildings/compounds (our target was to interview 10 households in each square).

Once the squares for each district were selected, we used satellite from Google Maps to identify and number the man-made structures in the squares according to certain criteria. Buildings that were already labeled on Google Maps as churches or commercial buildings were not included.

Finally, for the second-stage sampling, we randomly selected 30 man-made structures in each square from this numbered list - again, the first 10 serving as the primary sample, with 20 potential replacements if needed. In total, this gave us 100 target households for each district: 10 structures in each of the 10 2x2 km squares.

2.3 FIELDWORK

A local firm was hired to conduct the fieldwork, which took place in March 2018. For each district, the enumerators were given the GPS locations of the 10 target structures in each of the 10 target boxes.

Since the purpose of the survey was to collect information about farmer market engagement, using the household as the unit of observation, we sought to limit our sample to households that participate in agriculture. If a chosen structure turned out to be a business, no one was present, or the household did not participate in agriculture, enumerators were instructed to choose a replacement from the list provided to them. Furthermore, if the enumerators found that they could not visit a designated square because of operational feasibility issues (such as finding that the area was truly inaccessible or the local community was unwelcoming), they were instructed to choose another square from the list provided to them.

The households were interviewed after an initial pre-screening. The enumerators were instructed to interview any available adult; the head of the household was not required. The

responses were collected using FieldTask software on tablets and the raw data was provided to our team. Each respondent was given an honorarium in exchange for their time and participation.

Figure 2: Enumerators interviewing respondents.

2.4 SUMMARY OF RESPONSES COLLECTED

In total, we collected responses from 498 households. Two replacement squares were sampled, one each in Gulu and Pader.

In all of the districts, the enumerators sometimes struggled to find 10 households in each square. Their instructions were to move to a replacement square and visit more sampled locations until they had reached their target of 10. Unfortunately, the enumerators instead tried to compensate by oversampling in other squares from the original list. This over- and under-sampling of certain squares should not significantly impact our results.

The final breakdown of respondents per square per district is show in Table 1.

Ibanda	
Square ID	# Households
1	12
2	7
3	9
4	10
5	10
6	12
7	8
8	10
9	10
10	12

Gulu	
Square ID	# Households
1	11
2	10
3	8
4	10
5	7
6	12
7	10
9	10
10	9
11	12

Iganga	
Square ID	# Households
1	10
2	10
3	10
4	7
5	10
6	10
7	10
8	10
9	10
10	10

Mubende	
Square ID	# Households
1	10
2	11
3	10
4	11
5	10
6	7
7	10
8	12
9	10
10	10

Pader	
Square ID	# Households
1	14
2	9
3	10
4	10
5	10
7	10
8	10
9	10
10	10
11	9

Table 1: Number of respondents in each square.

3 SURVEY RESULTS

This section presents a summary of the responses we received to the questions in the household survey, broken down into thematic sections, as well as some geospatial analysis using the respondents' locations. As mentioned above, version 2 of this report will include further secondary analysis of these responses.

Most districts in Uganda have two growing seasons, including the ones in our sample. Many of the questions in our survey asked farmers about the two previous seasons. Since the survey was conducted in March 2018, the two most recent seasons were 2017B (November-December harvest) and 2017A (June-July harvest). In our questionnaire, "last season" would have indicated 2017B, while "the season before" would have indicated 2017A. For most of the results reported here, we combined the responses for both seasons to paint a picture for 2017 as a whole; the figures for the individual seasons are available.

3.1 HOUSEHOLD DEMOGRAPHICS

The purpose of this section of the survey was to establish some baseline facts about the household: how many people it supports, whether it owns or has access to certain assets, whether it received non-farm income, etc. These questions provide some intuition about the household's economic position, which could impact the household's ability to participate in the market.

At each household, the respondent was asked for basic information about themselves and the other people living in the household. For logistical reasons, we did not require the enumerators to interview the head of household; rather, the respondent could be any adult from the household who was available during the time of the interview. This allowed for easier data collection than requiring the head of household be available at each location. The survey included questions on the age, gender, and level of education of the respondent, but as this respondent was not necessarily the head of household, it would be difficult to draw any definitive conclusions using these responses, which are not reported here.

3.1.1 HOUSEHOLD SIZE

The number of children and adults in the household contributes to understanding the household's available labor capital and food consumption needs. Respondents were asked to report the number of children and adults living in the household. A household was defined to include "everyone who usually lives here, sleeps here, and eats from the same source". They were asked to include children, relatives, and orphans, even if they were not currently present at the home. Children who were away at school were included, but temporary visitors were not.

Overall, respondents reported an average of approximately 3 adults and 4 children in each household. Averages for each district are shown in Figure 3. The number of adults remained relatively constant, while residents of Iganga district reported more children on average.

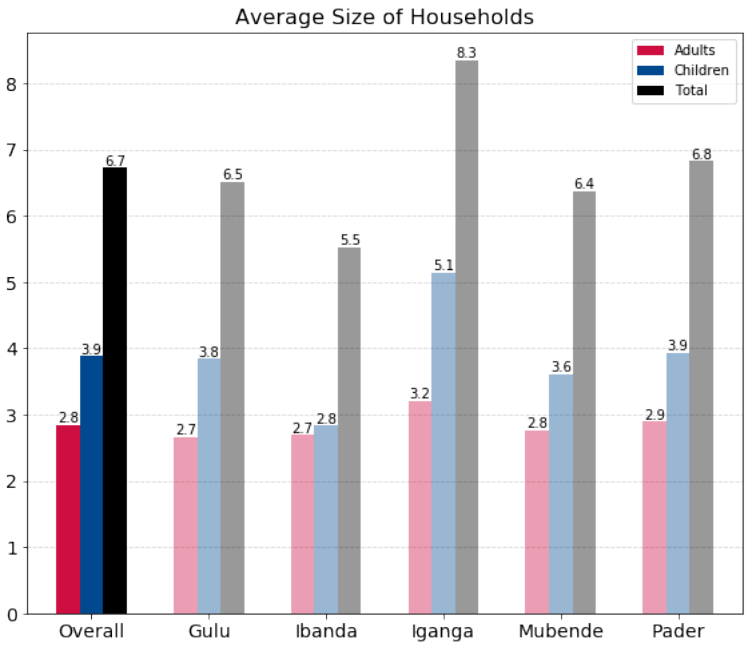

Figure 3: The average number of household members in each district. $n = 498$

There were some very large households, as can be seen in Figure 4. This is not uncommon in Uganda, where multiple generations and/or branches of families often live together. The median number of adults was two per household, though 13% of households reported five or more adults, with three reporting 10, 12, and 18 adults. The median number of children was four per household, and 36% of households reported five or more children. One household reported having 15 children, three had 16, one had 20, and one had 21. Across the sample, household size has a standard deviation of 3.48. It should be noted that the averages reported in Figure 3 include these larger households.

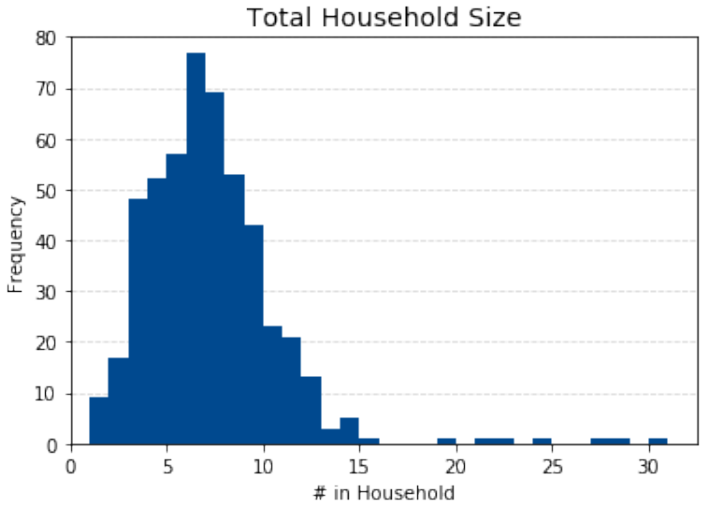

Figure 4: The distribution of household size across the entire sample. $n = 498$

3.1.2 CHILDREN AT BOARDING SCHOOL

As boarding school is a common educational option in Uganda, we asked how many children from the household were away at boarding school. This contributes to our understanding of the household's expenses. Overall, around 27% of households reported having children in boarding school.

Of the 134 households that reported having children in boarding school, on average they sent 2 children. There was not much variation across districts, except in the case of Mubende, where households reported approximately one more child on average (2.8) in boarding school than in the other districts (1.65).

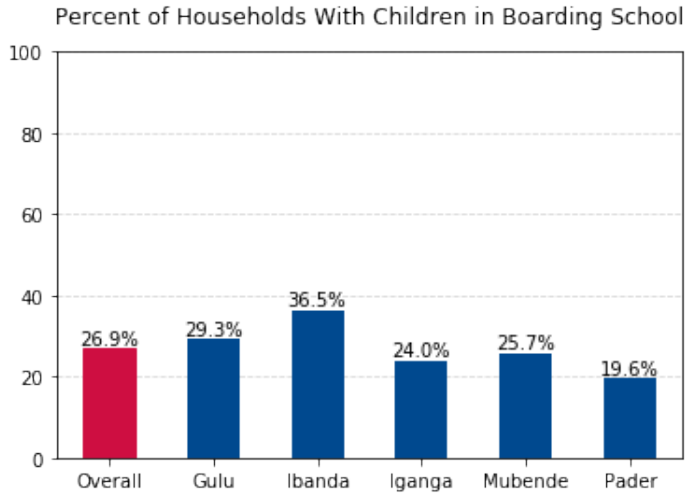

Figure 5: The percent of households with children in boarding school. $n = 498$

3.1.3 SUPPORTING PEOPLE OUTSIDE THE HOUSEHOLD

Many households send remittances to support family members and others who do not live in the household. This could make a household more likely to sell crops or engage in economic activities outside of subsistence agriculture, in order to generate cash income.

Almost half of all households reported financially supporting people outside of the household. This practice is most common in Iganga, where 60% of households send financial support elsewhere.

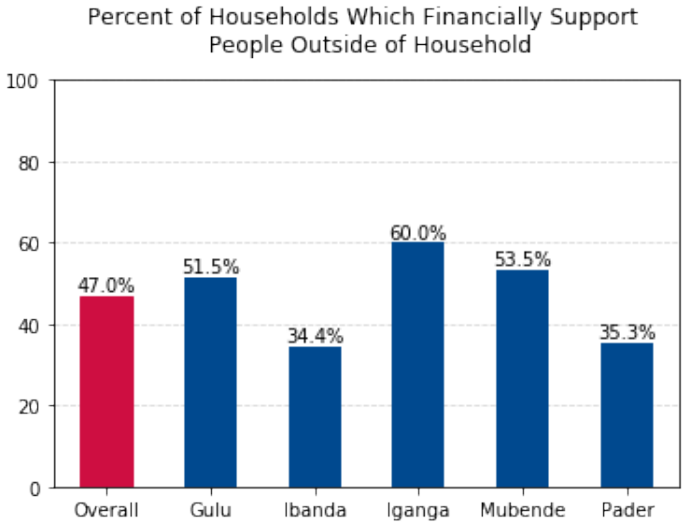

Figure 6: The percent of households financially supporting people outside of the household. $n = 498$

Across the entire sample, on average the respondents reported supporting 1.3 people outside the household. In addition to having the highest rate of outside support, households in Iganga tended to support more people on average (2.0).

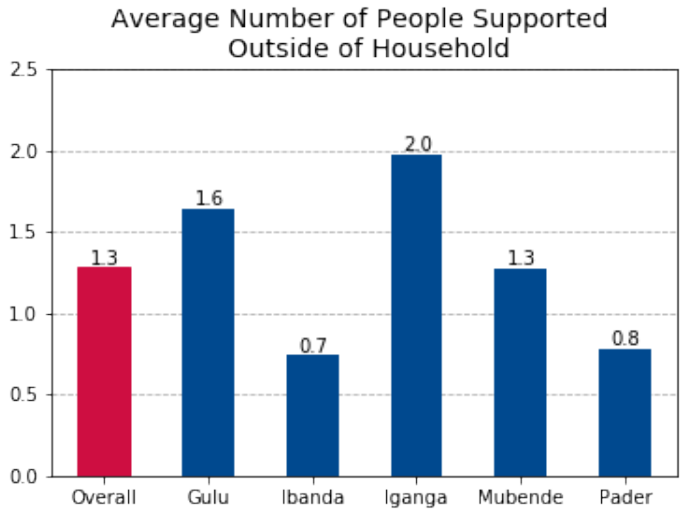

Figure 7: The average number of people supported outside the household in each district. $n = 498$

Note that these averages did include some larger numbers - for example, two households reported supporting 10 people outside the household, one reported supporting 15, and two reported supporting 20 people outside the household. The distribution across the full sample can be seen in Figure 8.

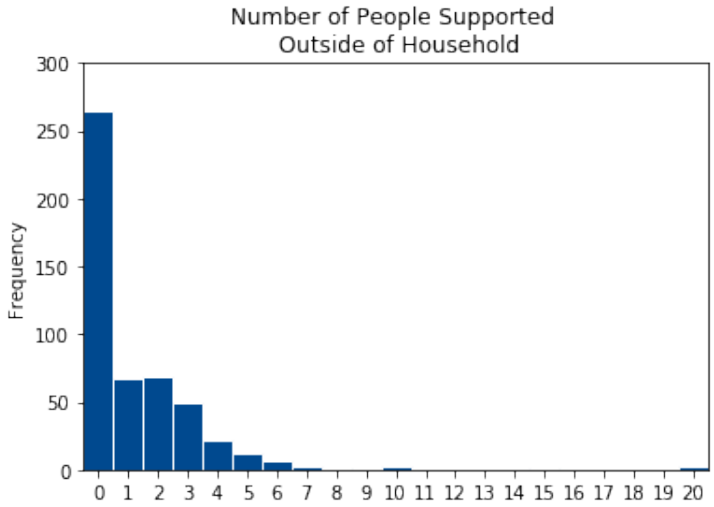

Figure 8: The distribution of number of people supported outside the household. $n = 498$

3.1.4 MOBILE PHONE OWNERSHIP

Owning a mobile phone can play an important role in connecting households to their communities and to other market actors. Besides serving as a communication tool and a potential source of information, mobile phones can also be used to access financial services, through a mobile money account.

Overall, 63% of households reported owning a mobile phone. Pader, the district in the sample with the lowest population density, had a much lower rate of mobile phone ownership than the other districts, with only 27.5% of households reporting mobile phone ownership. The second-lowest rate of mobile phone ownership was in Gulu, also a relatively rural district, with 51.5% of households owning a mobile phone.

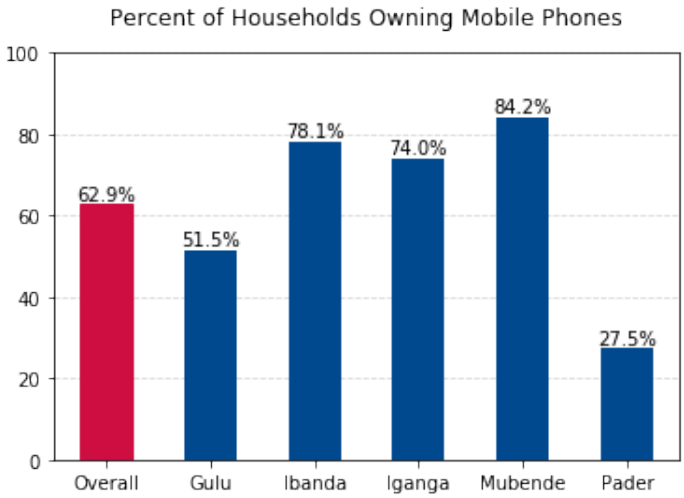

Figure 9: The percent of households that own a mobile phone. $n = 498$

3.1.5 TRANSPORTATION ACCESS

Respondents were asked if their household owned or had access to a bicycle, motorcycle, car, truck, or other form of transportation. Access to transportation can reduce barriers to reaching markets. It may also change a household's perception of what services are nearby and available.

In the entire sample, almost 40% of households reported that they did not own or have access to these forms of transportation. Figure 10 illustrates the breakdown by district. Note that those reporting lack of access may still have access to public means of transportation, and it is possible that some respondents may have interpreted access to public transportation or transportation-for-hire as meaning they had "access" for purposes of this question.

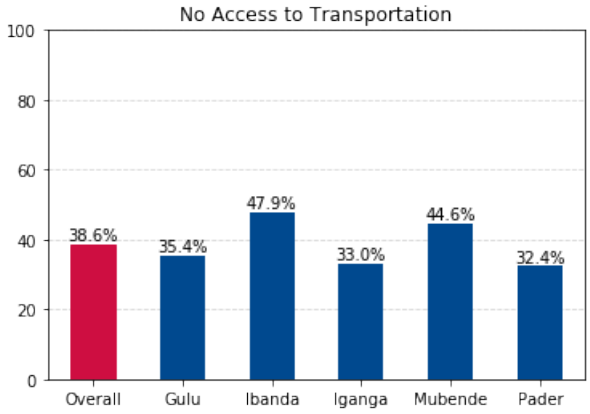

Figure 10: The percent of households without access to transportation. $n = 498$

Of the households which did report owning or having access to transportation, motorcycles and bicycles were by far the most common means. Almost half of households reported having access to a bicycle and about 1 in 5 had access to a motorcycle. In Gulu, Ibanda, Iganga, and Pader, the rate of access to bicycles was 2 to 3 times greater than that of access to motorcycles. Mubende stands out in that it is the only district where the rate of access to motorcycles is greater than the rate of access to bicycles. Only 3 households reported owning or having access to a truck; all were in Mubende. Only 8 households reported owning or having access to a car: 3 in Mubende, 3 in Iganga, and 2 in Ibanda.

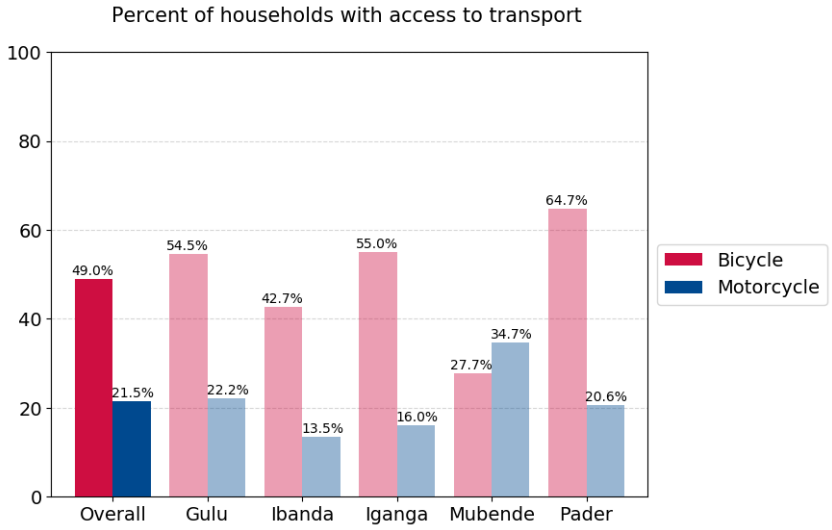

Figure 11: The percent of households that own or have access to bicycles or motorcycles. $n = 498$

3.1.6 OUTSIDE INCOME

In addition to farming, households may engage in other economic activities. Having an outside income may influence a household's decision to participate in the market. They may focus their energy on their other economic activity and only participate in agriculture for food production, or their outside income may provide cash that can be invested in the farm, such as for inputs or labor.

Respondents were asked whether they earned any income outside of the farm in the previous year. They reported what the source of outside income was, the approximate percent this income represented of the total household earnings (0-25%, 25-50%, 50-75%, 75-100%), and whether it was considered the primary source of income.

Figure 12 illustrates the percent of household income that the households reported from non-farm activities. Across the sample, about one-third of households reported outside income. Income from outside of the farm was less common in Pader district, which is more rural than the others; the figures for Ibanda were lower than expected, given this is a relatively more densely populated district, where one would expect more off-farm income opportunities.

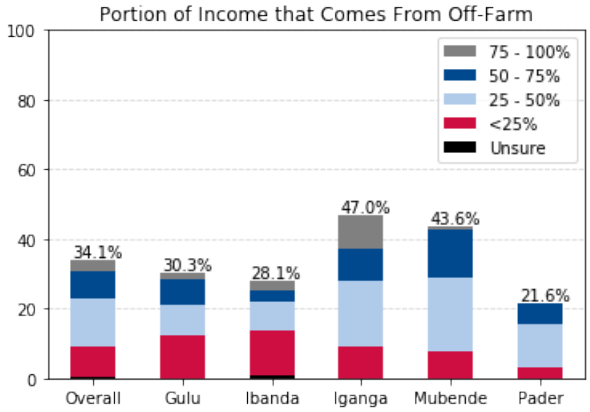

Figure 12: The percent of households with income outside of the farm. $n = 498$

Out of the entire sample, only 11% of households reported that more than half of their total household income in the prior year came from work outside of the farm.

Households that reported having outside income provided a short answer describing the source of this income. These responses were grouped together into categories, as displayed in Figure 13. The "transportation" category includes drivers and motorcycle taxis (boda bodas). Agriculture includes both farming and animal husbandry. The most common sources of income were shops and construction work.

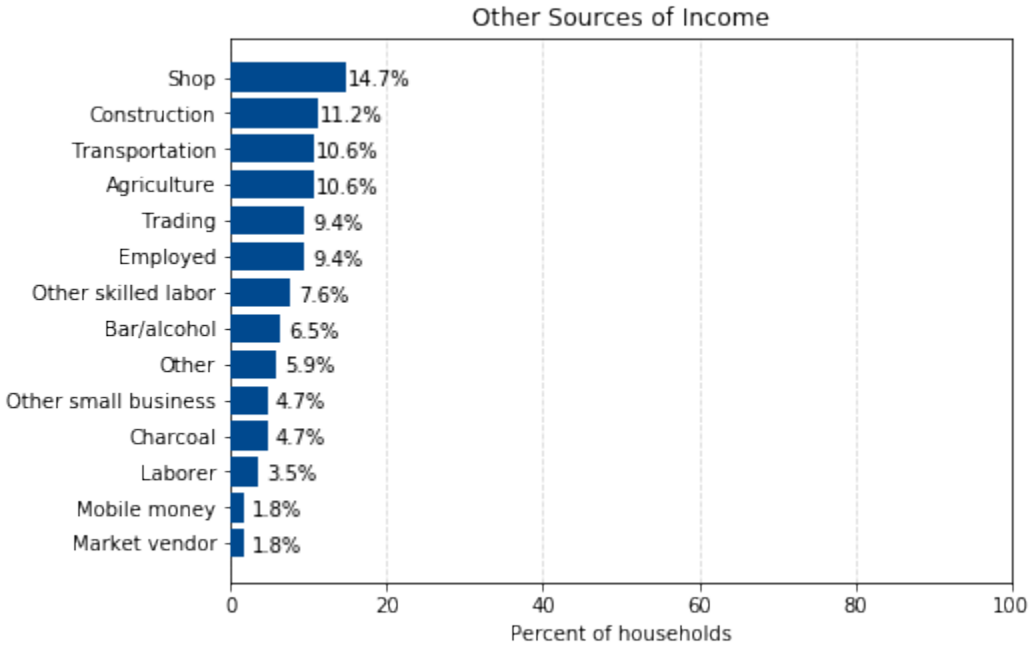

Figure 13: For the households that have outside income, the category the source fits into. $n = 170$

3.1.7 SUPPORT FROM NGOS OR THE GOVERNMENT

Respondents were asked if the household had participated in or received training or support from any government or NGO programs in the past year. If yes, they were asked about the nature of the support and which organization provided it. Households who receive extra training and support may be more likely to participate in the market. It may be that the support helped them in some way (accessing credit, learning more efficient farming techniques, etc) that has allowed them to increase their agricultural production and market connections, or it may reflect that more entrepreneurial households that participate in markets are also more likely to seek out support opportunities or have access to information about these programs.

27% of households reported receiving such support.

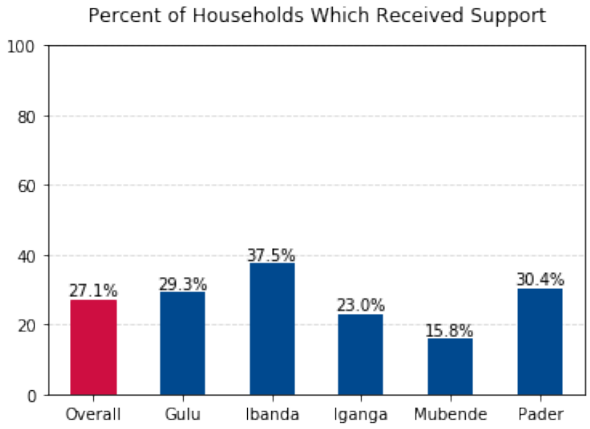

Figure 14: The percent of households which received support or training from the government or an NGO in the past year. $n = 498$

3.2 ACCESS TO FINANCE

In this section of the survey, households were asked questions about their access to financial services, such as loans or credit. Households can use formal or informal loans to finance agricultural production or other business activities, or to meet emergency cash needs.

Given the high upfront costs of agriculture (seeds, chemicals, land, labor, etc.), access to capital is often seen as essential to increasing agricultural productivity, as many smallholder farmers do not have enough cash on hand at the beginning of the season to invest in good quality seeds, agricultural chemicals, or additional land or labor. However, farmers do not see a return on their investment for many months, and unpredictable weather and pests can make production loans quite risky. Access to finance could also enable farmers to pay transportation or other costs required to participate in the market at the end of the season. We sought to understand how many households had access to capital, how many were using loans for agricultural production or marketing, and whether there was any linkage to market participation.

3.2.1 BANK ACCOUNT

Respondents were asked whether anyone in the household had a bank account. Having a bank account would increase the likelihood that the household could access loans and other financial services, and would imply access to a nearby bank branch.

Overall, 15.9% of households responded affirmatively. Bank accounts were most common in Ibanda and Mubende, while Pader had a much lower penetration rate.

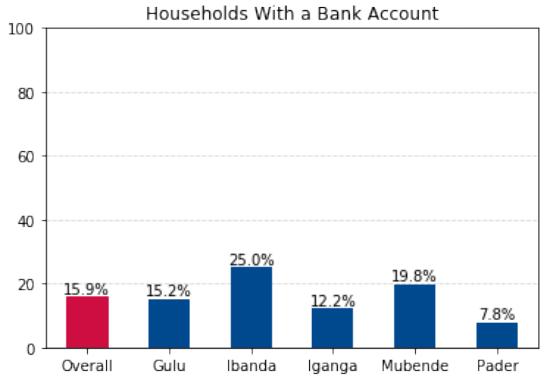

Figure 15: The percent of households with a bank account. $n = 498$

3.2.2 MEMBERSHIP IN A SAVINGS GROUP

Households were asked if they belonged to a village savings and loan association (VLSA), savings and credit cooperative organization (SACCO), or other savings group. These more informal financial institutions provide mechanisms for households to save and borrow and are often more easily accessible than formal financial institutions such as commercial banks. In particular, credit is often given on the basis of social capital / group membership, which can be beneficial for those without collateral or the other requirements for a loan from a formal financial institution.

Additionally, participating in one of these groups provides a household with a network through the other members. Social connections with other farmers could increase the market information a household has access to, such as prices, trainings, new techniques, selling opportunities, etc. It may increase the level of "connectedness" of the household to the market system.

Most households reported participating in some type of savings group, whether a VLSA, SACCO, or other type. Participation was highest in Ibanda, Pader, and Gulu. Iganga is the only district in which fewer than half of households reported participating in one of these groups.

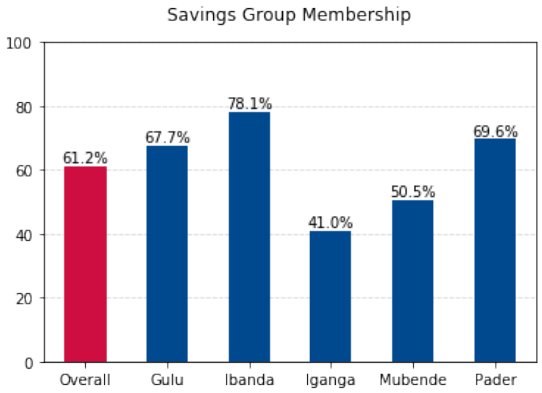

Figure 16: The percent of households which belong to a VSLA, SACCO, or savings group $n = 498$.

3.2.3 MOBILE MONEY ACCOUNT

Mobile money is an electronic wallet service popular in many developing economies, usually provided by telecom companies. An individual can set up a mobile money account attached to their phone number. Users can deposit or withdraw cash via a mobile money agent, and then transfer money to others through the system. The transactions are fast and secure. Mobile money has dramatically increased access to financial services in Uganda, particularly in rural areas.

Two out of three households in the sample reported having a mobile money account. Pader had the lowest rate of mobile money accounts, which tracks with the finding that it also had the lowest rate of mobile phone penetration (see Figure 9).

Interestingly, for every district except Mubende, more people report having access to mobile money than own a mobile phone. This may indicate that informal channels exist to allow households without mobile phones to access mobile money, such as by using the account of a neighbor or vendor.

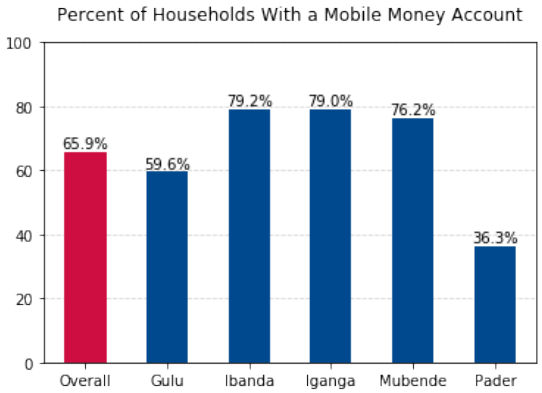

Figure 17: The percent of households with a mobile money account. $n = 498$

3.2.4 BORROWED MONEY

Respondents were asked if anyone in the household had borrowed money in the past year. If yes, they were asked how much, from whom, and the reason for borrowing. If no, they were asked whether anyone in the household had attempted to borrow money in the past year and been unsuccessful, and if so, why they were denied a loan. In asking these questions, we sought to understand how many households had taken out loans, specifically loans for agriculture, and what the barriers were for those who were unable to obtain a loan. As mentioned above, access to finance can enable increased agricultural productivity, by enabling the purchase or rental of land and other agricultural inputs and services, and could enable greater market participation. Learning about the barriers to access to finance could also inform USAID's thinking on how to improve the financial system to reach more households.

This section and sections 3.2.5, 3.2.6, and 3.2.7 focus on those households that were able to access loans. Sections 3.2.8 and 3.2.9 focus on the subset of households that tried to borrow money but were denied.

Across the entire sample, 40% of households reported having attempted to borrow money in the previous year, while 37% of households successfully received a loan over that period - a 92.5% success rate. Ibanda stands out as having the highest percentage of households that borrowed money, at 51%.

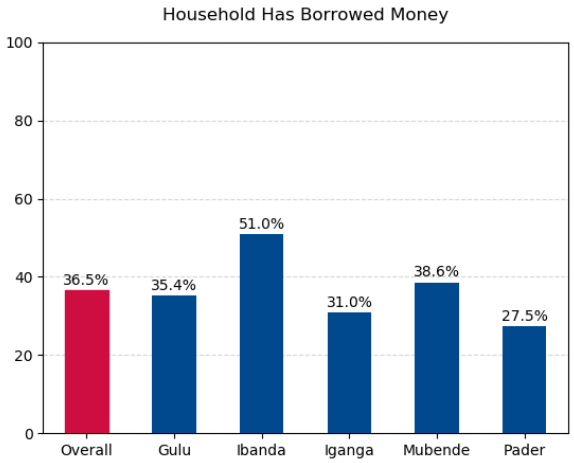

Figure 18: The percent of households that borrowed money within the past year. $n = 498$

3.2.5 AMOUNT OF MONEY BORROWED

In total, 182 households (37%) reported borrowing money in the previous year. One was unsure of the amount borrowed; for the other 181 households, the median amount borrowed was 67.50 USD (250,000 UGX).[1]

[1]On the survey, households reported all answers in UGX. Throughout this analysis, a conversion of 3,703.70 UGX per 1 USD is used.

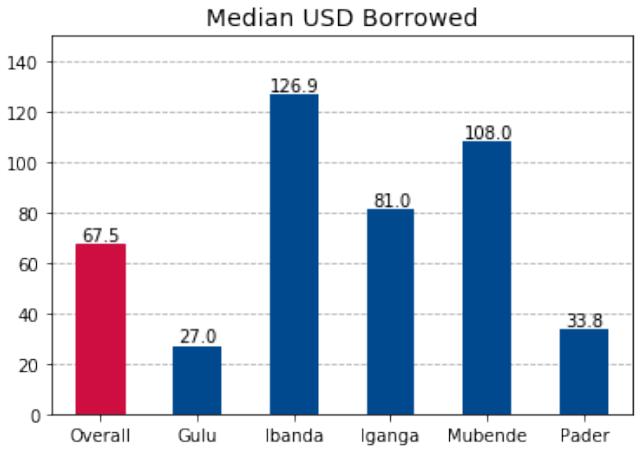

Figure 19: For households that did borrow money, the median amount borrowed by households in USD for each district. $n = 181$

The median amounts borrowed in Gulu and Pader were drastically lower than in the other three districts. Meanwhile, not only did Ibanda have the highest rate of households borrowing money (see Figure 18), but the district also had the highest median amount borrowed compared to the other districts.

Most households borrowed 150 USD or less, but some borrowed larger amounts, including seven households that borrowed more than 1,000 USD.

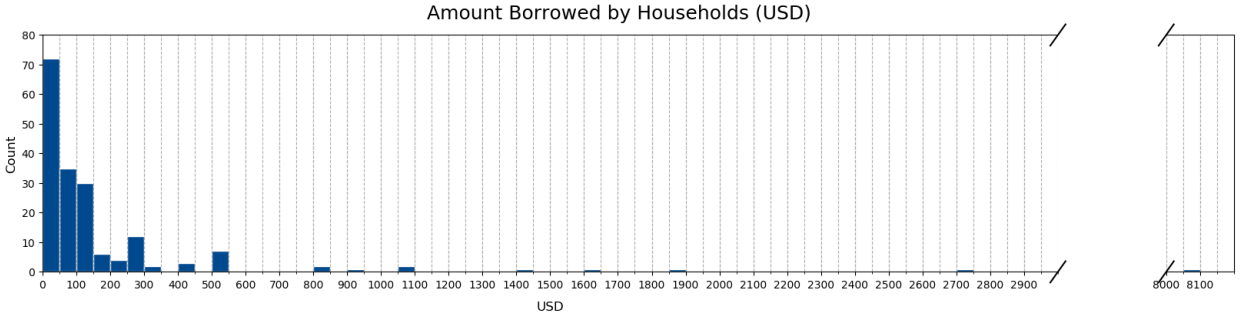

Figure 20: For households that did borrow money, the distribution of the amount borrowed in USD. Each bar on the histogram represents a 50 USD increment. $n = 181$

3.2.6 REASONS FOR BORROWING MONEY

If the household reported receiving a loan, we asked what the money was borrowed for, allowing for multiple responses. For the 182 households that borrowed money in the previous year, the most common reasons given were to pay school fees and to purchase agricultural inputs.

Out of the 182 households that borrowed money, almost a third (58) responded "Other" and provided their own reason for borrowing. 26 of these (14% of all households which borrowed) indicated the money was for a business. 15 of these (8% of all households which borrowed)

indicated the money was for an agricultural investment, such as purchasing land or cattle. The remaining answers were varied, including paying for medical bills, buying food, purchasing a motorcycle (which could have been a business investment), or funding construction.

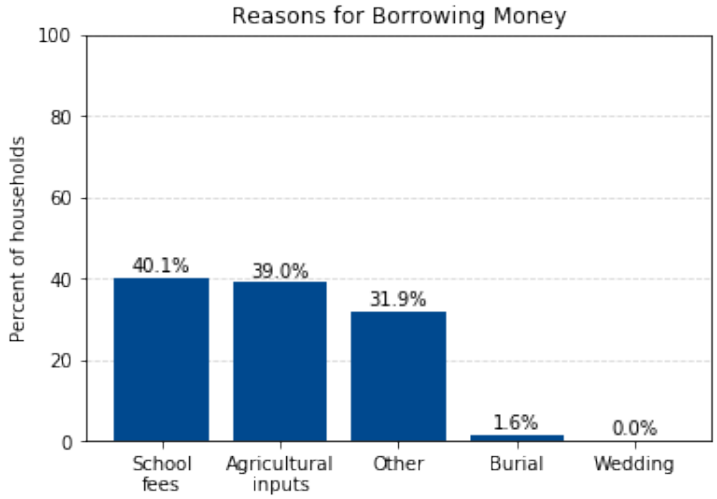

Figure 21: For households that borrowed money, the reasons they cited for borrowing. $n = 182$

3.2.7 SOURCES OF BORROWED MONEY

We also asked households that borrowed money about the source of their loan. For the 182 households that did borrow money, by far the most common source of the loan was from a VSLA - more than 50% of the loans reported came from VSLAs. Only 7% of borrowing households received money from banks, despite 25% of these households having bank accounts.

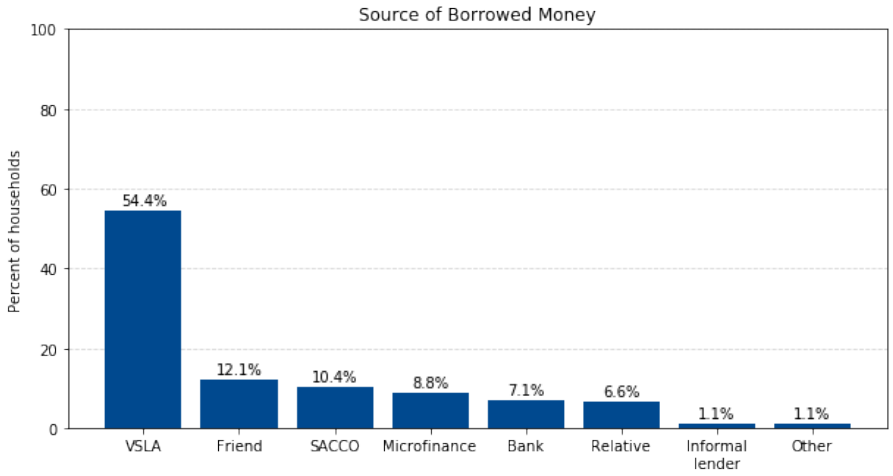

Figure 22: For households that did borrow money, the sources of their loans. $n = 182$

3.2.8 LOAN DENIAL RATE

As mentioned above, 40% of households reported having attempted to borrow money in the previous year. Of these 200 households, 18 (9%) were not successful. These included 1 out of every 5 households in Gulu that attempted to borrow money; no respondents from Iganga reported having been denied a loan in the previous year.

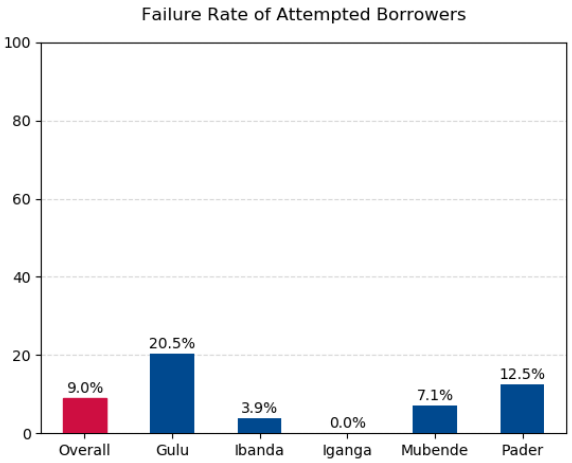

Figure 23: Percentage of households that attempted to borrow money but were denied. $n = 200$

3.2.9 LOAN DENIAL REASONS

For the 18 households that attempted to borrow money and were denied, the most common reason provided was a lack of collateral, while 11% of these respondents reported not knowing the reason.

The "other" reasons reported were problems with savings groups, high interest, not having access to a loan, and fear of failing to pay.

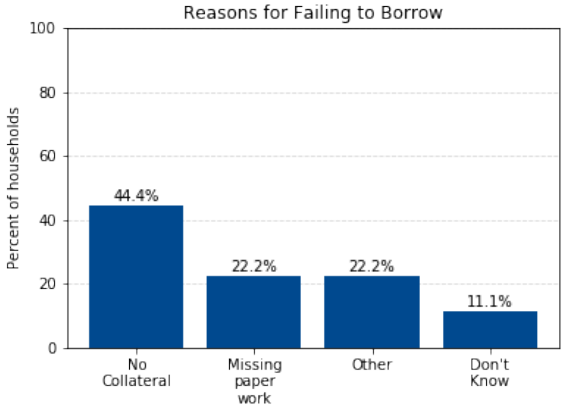

Figure 24: For households that were denied a loan, the reasons they were unsuccessful. $n = 18$

3.2.10 CREDIT FROM A BUSINESS

Since small businesses in Uganda are known to occasionally provide credit to their customers, we separately asked whether anyone in the household had received credit from a business in the previous year. This kind of credit can be a signal of positive relationships along the supply chain. The example we gave was that of an agro-input dealer providing inputs on credit that are paid for at the end of the season.

Overall, 9% of households reported having received credit from a business in the previous year.[2]This type of arrangement between farmers and businesses was least common in Pader, with only 1% of respondents having received credit from a business.

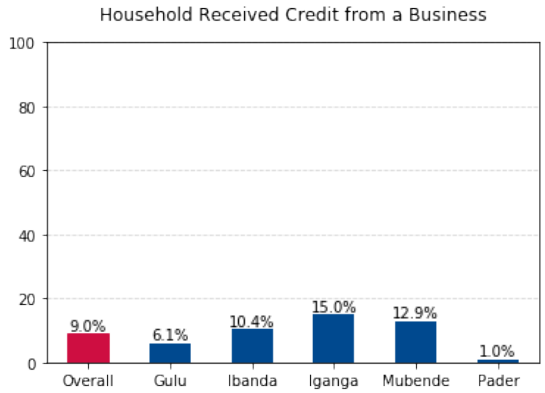

Figure 25: The percent of households that received credit from a business in the past year. $n = 498$

3.2.11 SOURCES OF BUSINESS CREDIT

The households that had received credit from a business were asked which type of business had extended it to them. For the 45 households that did receive credit from a business, the most frequent source was from an input dealer.

[2]The responses included 19 households that answered "other" for the source of the credit. When asked to specify what type of business had provided the credit, 18 of the 19 gave responses that were not businesses (such as a friend, relative, VLSA, or microfinance organization). These 18 households were not counted as having received credit from a business.

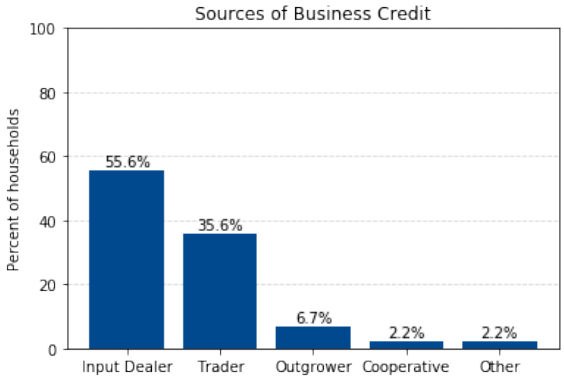

Figure 26: For households that did receive credit from a business, the source of this credit. $n = 45$

3.2.12 LENDING MONEY

Respondents were asked if anyone in the household had lent money to someone outside the household in the previous year. This informs our understanding of the financial flows of a household, which could impact its decision to participate in the market.

About 30% of households reported having lent money to someone outside of the household in the prior year; this was less common in Gulu and Pader districts.

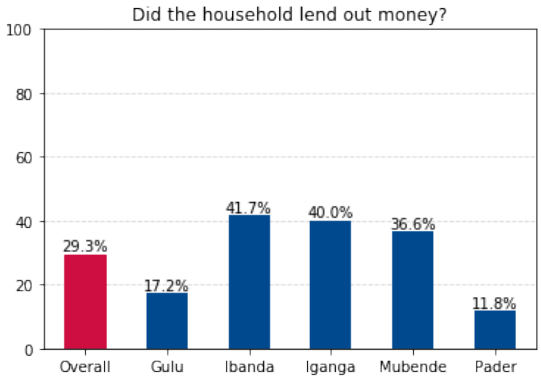

Figure 27: The percent of households that lent money to someone outside of the household in the previous year. $n = 498$

3.3 AGRONOMIC PRACTICES

Households were asked a wide range of questions to gather information on their level of engagement with agriculture. Topics included land use, livestock ownership, trainings received, and problems they have recently experienced.

3.3.1 ACRES PLANTED

We asked households how much land they farm. Households that farm more land may have a larger harvest that exceeds their food security requirements, and therefore they may be more likely to sell some of it.

In the survey, households reported the acreage that they planted of various crops for the two seasons of 2017.[3]These acreages were summed to calculate the total area of land a household cultivated across both seasons of 2017. We will discuss the specific crops planted in Section 3.6.

For the entire sample, the median number of acres cultivated was 5. Figure 28 demonstrates how the median by district differs. Respondents in Gulu and Pader reported the highest number of acres under cultivation; respondents in these districts also reported owning the highest number of acres on average.

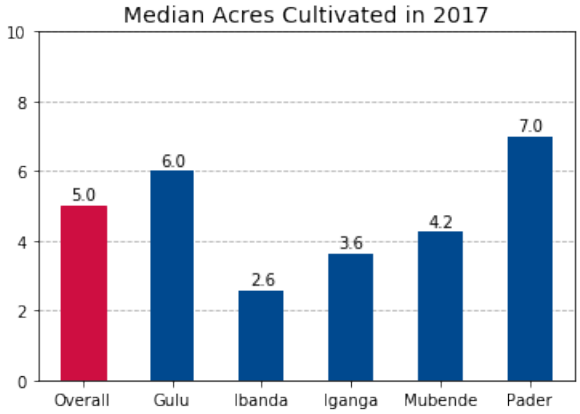

Figure 28: The median number of acres planted in 2017 (sum of both seasons) in each district.

As can be seen in Figure 29, though half of the sample reported planting 5 or fewer acres in total in 2017, there was a great deal of variation in the other half of the sample, with a handful of respondents reporting upwards of 20 total acres planted across the two seasons.

[3]We asked this question two different ways: first, we asked households how much land they farm, how much of it they owned, and how much of it they were renting or borrowing. Then, we asked which crops they planted in the two previous seasons, and how many acres they had planted of each. The number of acres planted were lower in many cases than the number of acres reported as "amount of land farmed", suggesting that the responses to this question indicated how much land the household had available to it, not necessarily how much it was actively farming. Given the ambiguity in these responses, we chose to focus on the total number of acres planted as a more reliable metric of the amount of land the household "farmed" in 2017.

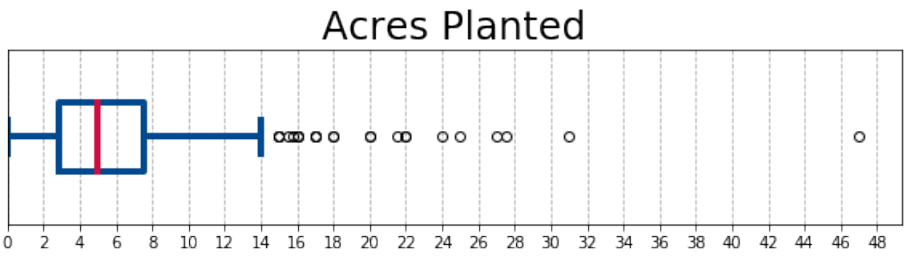

Figure 29: The distribution of acres planted. $n = 498$

3.3.2 LAND OWNERSHIP

We also asked households how many acres of land they own. Land ownership is not a prerequisite for cultivation - there are several different land tenure systems in Uganda, and land can be rented relatively easily. However, land ownership informs our understanding of a household's assets and level of economic security, in addition to its production potential. Almost every household in the sample reported owning land.

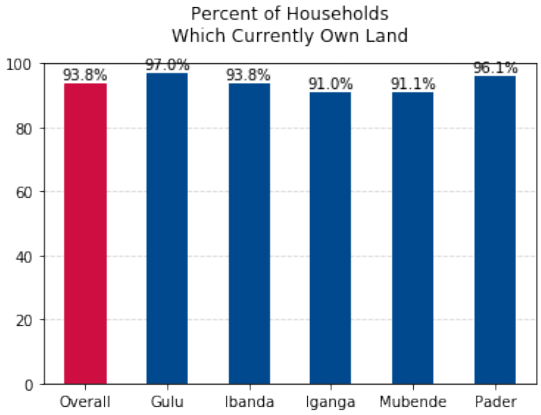

Figure 30: The percent of households that own land. $n = 498$

Out of the 467 households that reported owning land, the median number of acres owned was 3 acres. Households in Gulu and Pader typically owned more land than those in the three other districts.

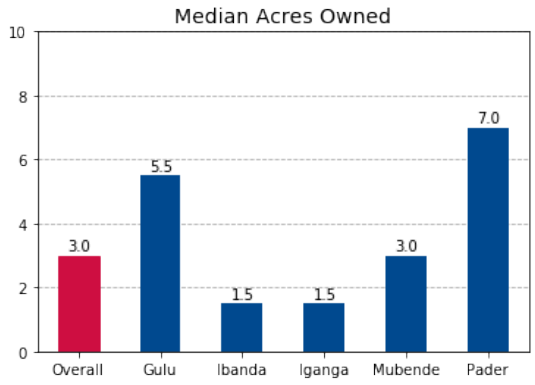

Figure 31: The median acres owned by households. $n = 467$

3.3.3 LAND RENTAL

Renting land for farming is common in Uganda - households can rent land to supplement their own land holdings, or those without land can rent some for farming. Cultivating on rented land involves more risk than farming on land the household owns, however, because the proceeds from the season must also cover the cost of renting the land.

In our sample, 38% of households reported renting land. Households in Gulu and Pader, which owned more land on average, were slightly less likely to rent land.

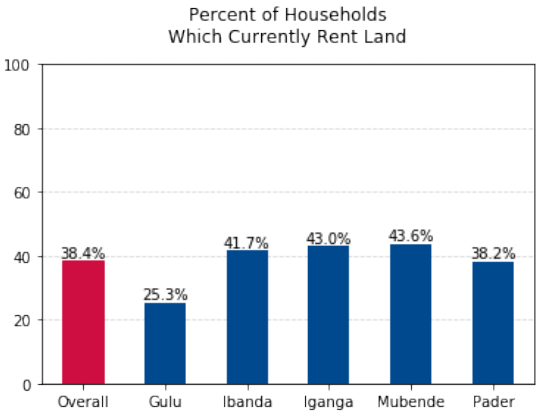

Figure 32: The percent of households that currently rent land. $n = 498$

Out of the 191 households which reported renting land, the median amount rented was 2 acres. Households in Gulu and Pader rented a greater number of acres than those in other districts.

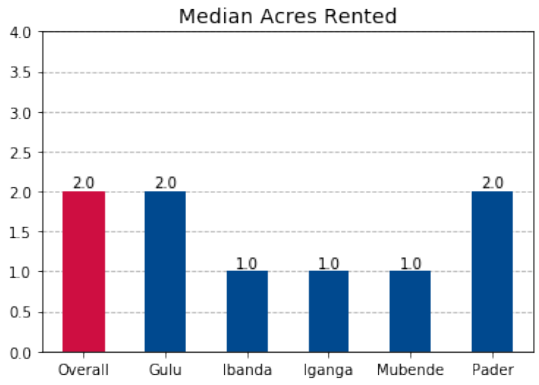

Figure 33: The median acres rented by households. $n = 191$

3.3.4 PAST LAND RENTAL

Households were asked if they had rented land in the past. If yes, they were asked which years (from "before 2007" through to 2018). If they reported renting land after 2012, they were asked how much land and at what price. These questions were asked to contribute to the evidence base on how common land rental is, and the average price of renting land in different districts.

Households that did not rent land in the past were asked why they did not rent, to build our understanding of why some households choose to supplement their production capacity and others do not.

Across the sample, 47% of households reported having rented land at some point in the past.

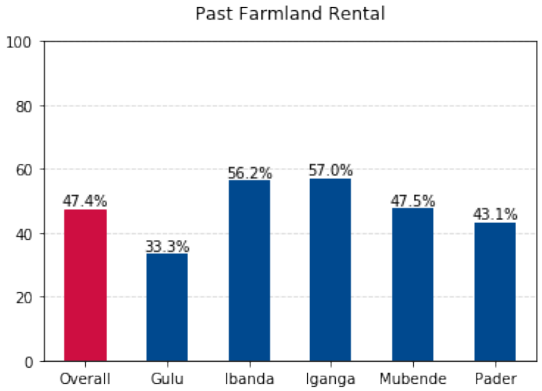

Figure 34: The percent of households that have rented land in the past. $n = 498$

These 236 households were asked to indicate which years they had rented land. The most recent years were most common, though it is possible that these years were simply fresher in their memory.

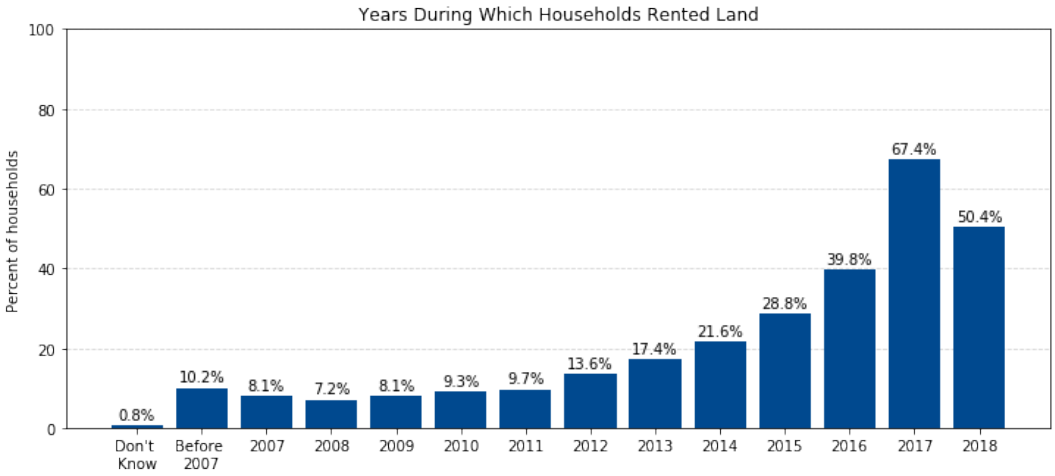

Figure 35: The years in which households reported having rented land. $n = 236$

3.3.5 REASONS FOR NOT RENTING LAND

The 262 households that had not previously rented land were asked why, and could select more than one reason in their response. The most common reason cited was that they did not need to rent land; the second most common was that they could not afford it.

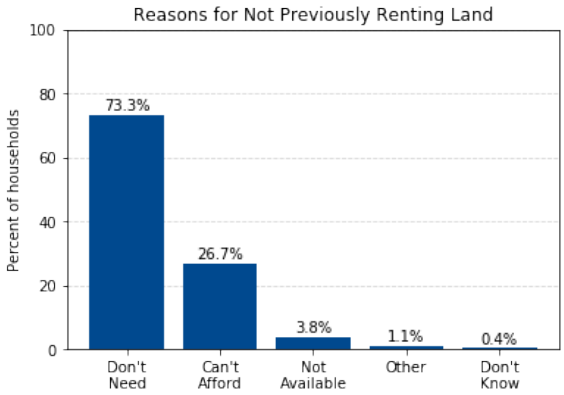

Figure 36: The reasons why households did not rent land in the past. $n = 262$

3.3.6 HIRED LABOR

Respondents were asked if the household had hired any farm labor for either of the previous two seasons. If yes, they were asked how many people were hired and the average number of days each worked. We sought to understand how common this practice is, and approximately how much of an expenditure it represents for the household.

About half of the households reported hiring laborers to work on their farm in either of the previous two seasons. This practice was most common in Pader and Gulu, where 62% and 59%

of households respectively hired laborers. These were also the two districts where households tended to plant more acres than in other districts (see Figure 28). It was least common to hire labor in Iganga, where only 39% of households engaged in the practice.

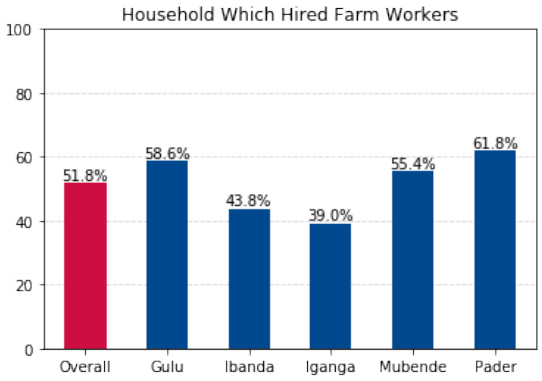

Figure 37: Percent of households that hired laborers for their farm in 2017. $n = 498$

For the 258 households that did hire outside labor, on average they reported hiring 7 workers. Not only were households in Pader more likely to hire labor, but they also hired a much higher median number of laborers.

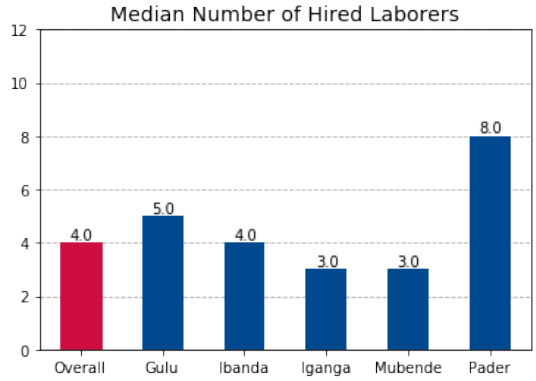

Figure 38: For the households that hired farm labor in 2017, the median number of laborers hired. $n = 258$

These households were also asked how many many days each laborer worked on average. 5 households responded that they did not know. For the remaining 253 households, the median hired laborer worked for 3 days. Even though Pader had the highest number of laborers hired, they tended to work for a shorter number of days compared to the other districts.

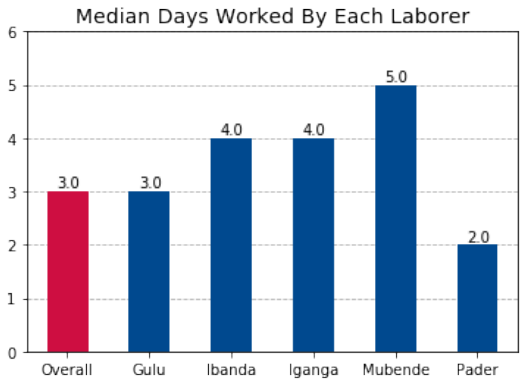

Figure 39: For the households that hired farm labor in 2017 and knew how many days they worked, the average days worked by the hired labor. $n = 253$

3.3.7 LIVESTOCK

Households were asked whether they owned livestock, in order to form a more complete picture of the household's assets. Those that did were asked what kind and how many of each.

Across the entire sample, 79% of households reported owning livestock. Rates were higher in Gulu and Pader, with 93% and 96% of households, respectively, owning livestock.

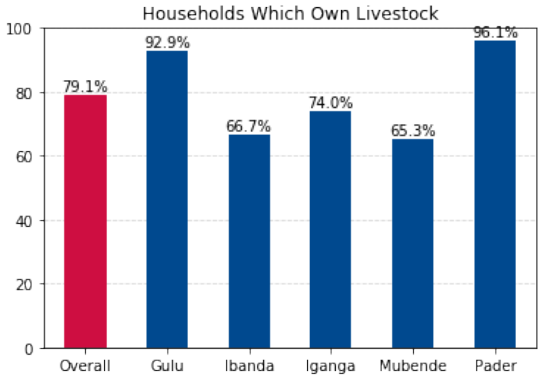

Figure 40: The percent of households that own livestock. $n = 498$

Overall, chickens were the most common type of livestock owned, followed by goats and cattle. [4]

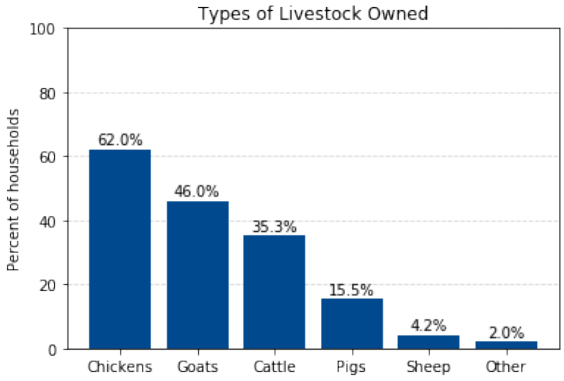

Figure 41: The percent of households that own each type of livestock. $n = 498$

3.3.8 FORMAL TRAINING IN AGRICULTURE

Households were asked whether they had ever received any formal training on farming techniques. Government extension workers and aid organizations often organize trainings to educate farmers about best practices in agriculture, with the goal of increasing yield and quality of production. Households that answered affirmatively were asked follow-up questions about their most recent training: the year it happened, who provided it, what it was about, and how they learned about the training opportunity.

27% of households reported having received formal training on farming techniques. The figure for Mubende was the lowest (11%), while Ibanda district's was the highest (39%).

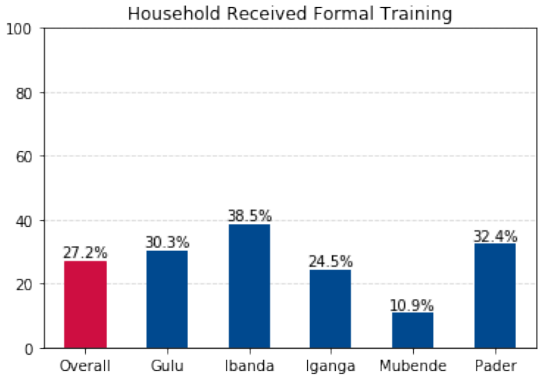

Figure 42: The percent of households that had received formal training on farming techniques. $n = 498$

Looking at all households, 15% reported having received training in the previous two years. However, this could be because respondents had clearer memories of more recent events.

[4]We also asked respondents how many of each type of livestock they owned; those figures are available upon request.

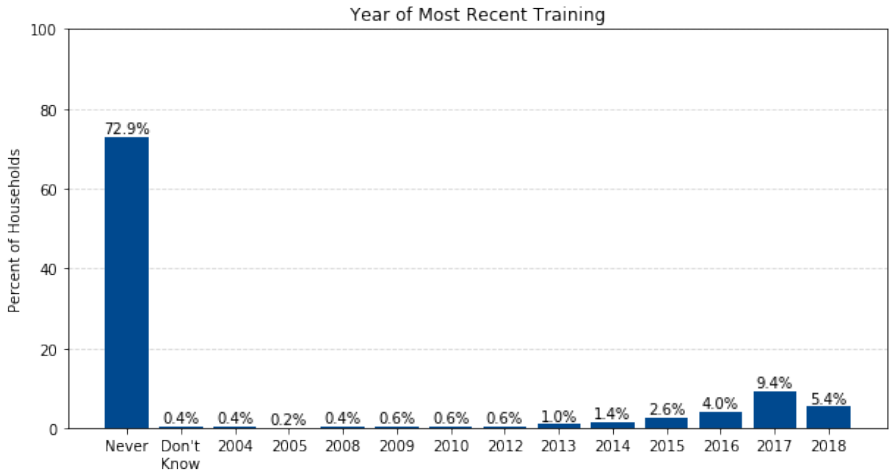

Figure 43: For households that have received formal training, the year of the most recent training. $n = 498$

Across the sample, 135 households reported having received training at some point. The most common provider of these trainings was an NGO (55%), followed by a government program.

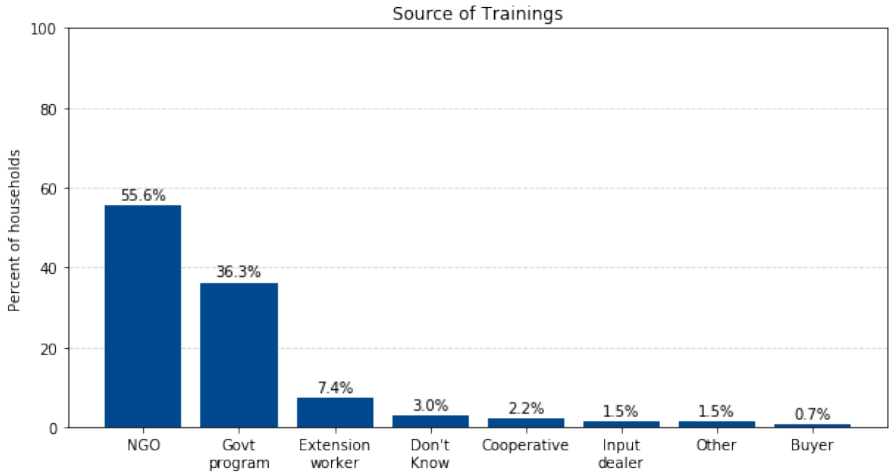

Figure 44: For households that have received formal training, the provider of the most recent training. Households could choose more than one training provider. $n = 135$

We were interested in how households had heard about these trainings, one way of gauging how connected they are within their communities, which could impact their access to knowledge about market opportunities. Social networks seemed to be the most common way of hearing about these trainings. 72% of households indicated learning about the training they received through word of mouth, while 36% reported they had been personally invited. Respondents could choose more than one answer choice for this question.

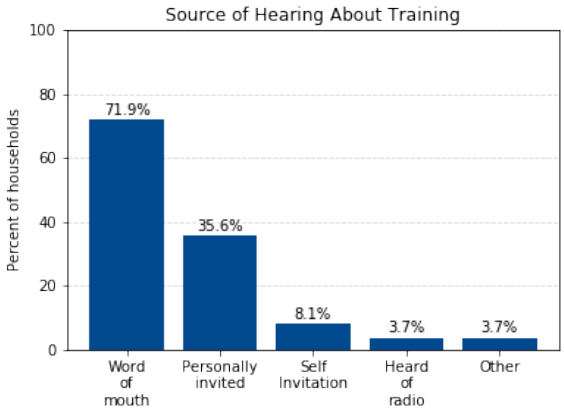

Figure 45: For households that have received formal training, the ways they heard about the most recent training. Households could choose more than one option. $n = 135$

3.3.9 CROP PROBLEMS

For each of the two most recent harvest seasons (November-December 2017 and June-July 2017), households were asked whether they had experienced any problems with their crops. The answer choices provided included drought, heavy rains, late rains, Fall Army Worm (a pest that has plagued Uganda in recent seasons), other insects, crop diseases, and fires. Respondents were allowed to select multiple answers. Experiencing any of these problems could negatively impact the farm's yield, which could then impact the household's food security and/or level of market engagement.[5]

More households reported problems for the second season (2017B; November-December harvest) than for the first season (2017A; June-July harvest). Drought was the most common problem reported, followed by Fall Army Worm and crop diseases.

[5]Although the intent of this question was to ask about problems related to cultivation, a few farmers answered "other" and specified that they had had trouble marketing their crops. These responses have been omitted from the "other" category reported here. For the June-July 2017 harvest (2017A), 2 households reported this issue. For the November-December 2017 harvest (2017B), 3 households reported this issue.

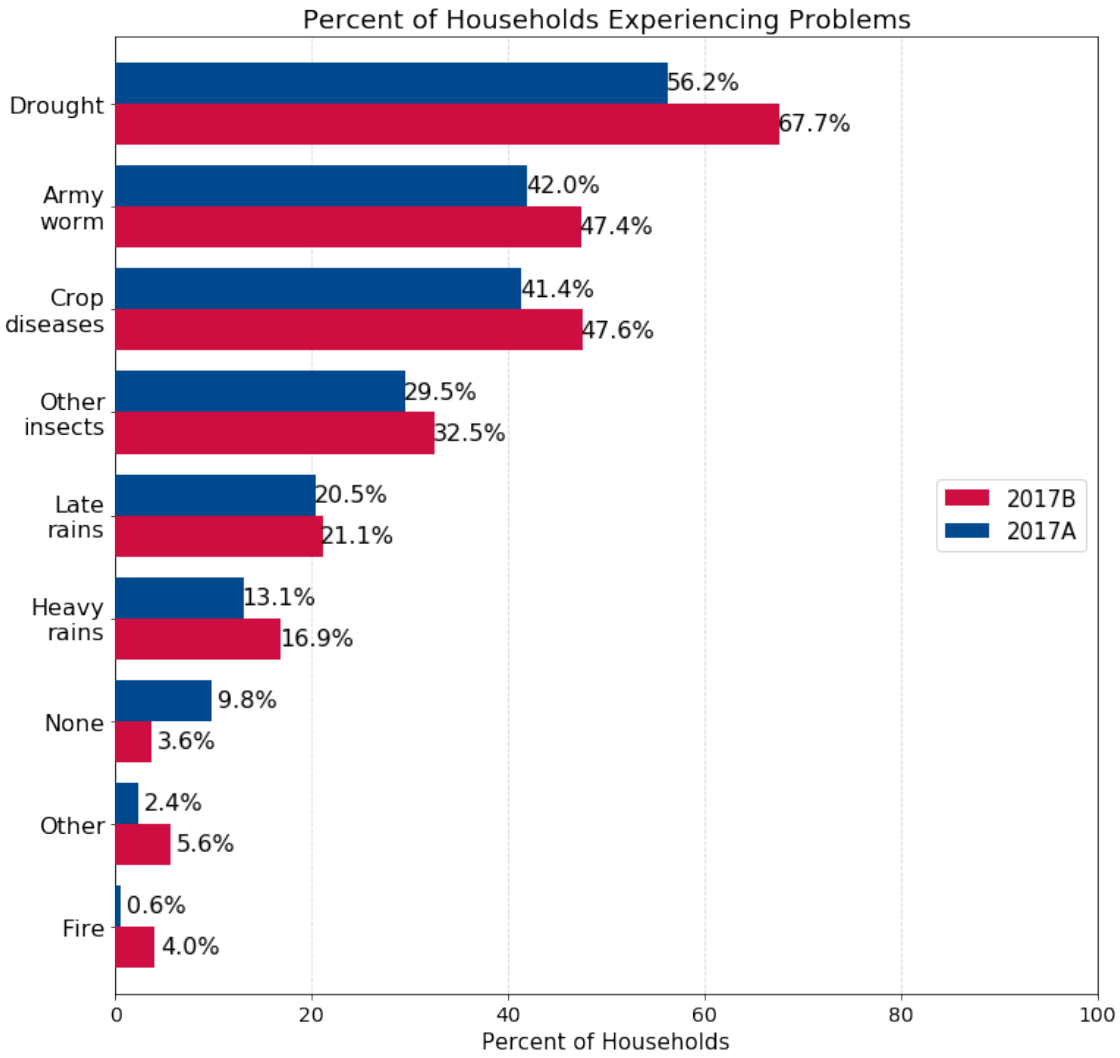

Figure 46: Crop problems reported for the two most recent seasons, 2017A and 2017B.$n = 498$

3.3.10 FOOD SECURITY

We define food security as the ability of a household to feed all members nutritious meals such that they do not regularly or acutely experience hunger. One hypothesis for why some households are more engaged in the market than others is that the household's level of food security influences its decision to participate in the market. If households are relying on farming for subsistence, for example, they may not be able to afford agricultural inputs to increase their yields, or may not have a surplus to sell if the harvest is intended for household consumption.

We asked the respondents a series of questions intended to create a picture of the household's level of food security in the previous year.

3.3.11 MEALS SKIPPED

Respondents were asked if anyone in the household ever had to skip meals because there was not enough food, a common indicator of food insecurity. This question was meant to roughly assess the household's level of food security. Respondents were given the following options:

- Never
- A few times per year
- Once or twice a month
- Once or twice a week
- Other

Almost 80% of the households reported never having to skip meals. This is only a single dimension of food security, and gives us no information on the size or nutrition content of those meals, but it suggests these households had a basic level of food security.

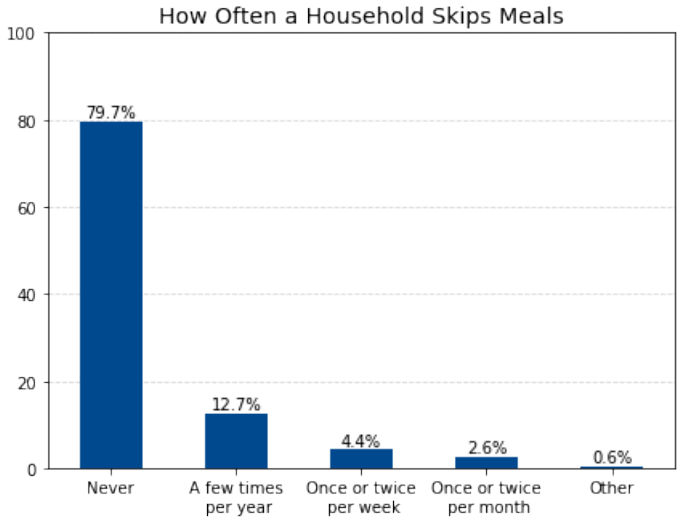

Figure 47: The frequency with which households skip meals. $n = 498$

Figure 48 shows the percentage of households in each district that reported never having to skip meals. Households in Iganga had the lowest rate of food security in this dimension, with 38% of households occasionally skipping meals.

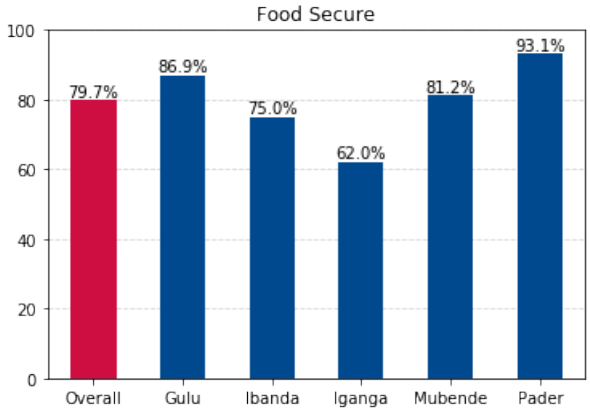

Figure 48: The percent of households that never skip meals in each district. $n = 498$

3.3.12 RELIANCE ON OWN PRODUCTION

Respondents were asked how many months out of a typical year the household primarily eats food grown on the farm. This was asked to triangulate how self-sufficient the households were, and/or how dependent they were on their own food production. Overall, 39% of households reported that for most years, they primarily eat food grown on the farm every month. More than half reported that they consume food grown on the farm for 10 months out of the year or more.

For those households that reported relying on the farm for fewer months each year, two explanations are possible. These households may aspire to meet their household consumption needs from their farming activities, but may not farm enough land or have large enough harvests. Or it is possible that these households do not rely on their farm as their main food source, if for example they have other sources of income that are used to finance their consumption needs.

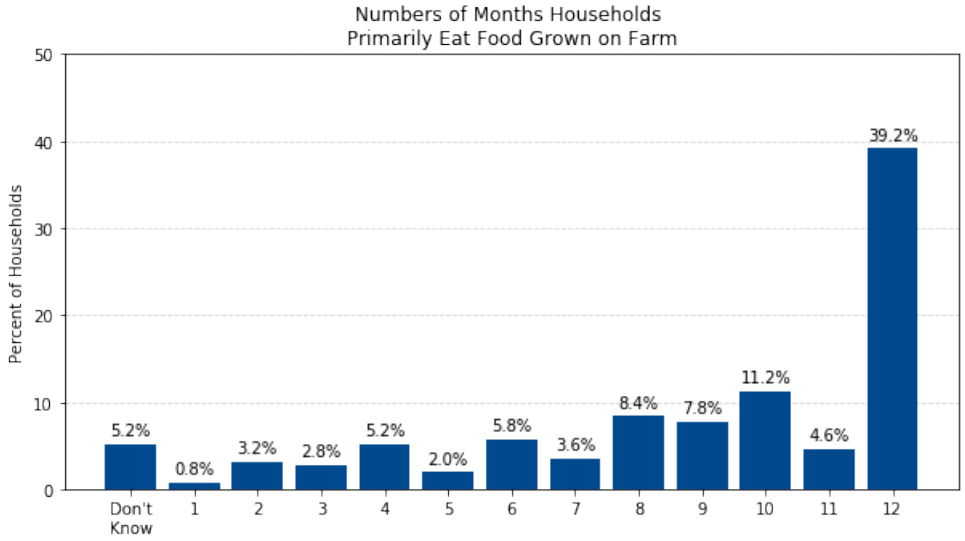

Figure 49: The number of months of out the year households primarily eat food grown on the farm. $n = 498$

Figure 50 breaks the results down by district. The median household in Mubende reported that most years, they consume food grown on the farm all year, while the median household in Iganga ate food grown on the farm for eight months out of the year most years.

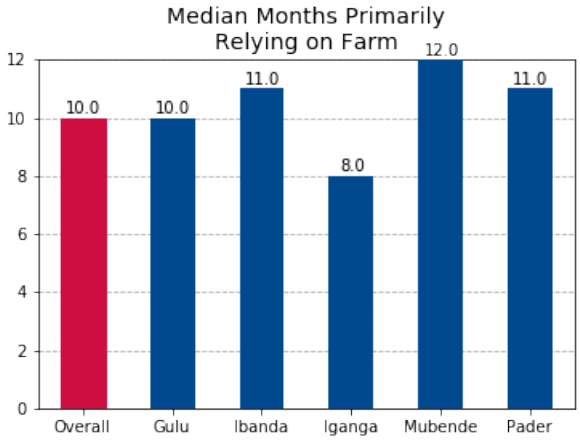

Figure 50: The median number of months households primarily rely on the farm for food most years. $n = 498$

3.3.13 FOOD PURCHASES

To further understand how households were supplementing the food grown on their farm, respondents were asked whether the household had purchased food for consumption in the past year. Overall, 68% of households reported purchasing food for consumption within the last year. The numbers were higher for Gulu and Iganga, which is consistent with Figure 50, where respondents from these districts reported relying on their farms for fewer months most years.

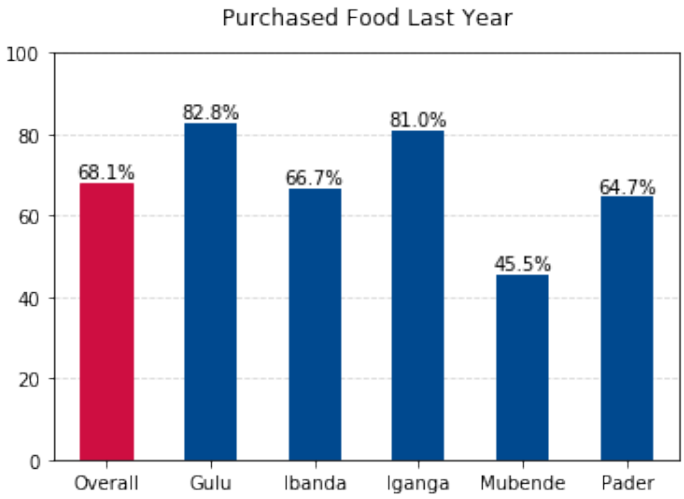

Figure 51: The percent of households that purchased food within the last year. $n = 498$

Respondents were then asked which months they had purchased food in the past year. Overall,

households reported purchasing food approximately two months out of the past year (mean: 1.8, median: 1.0).

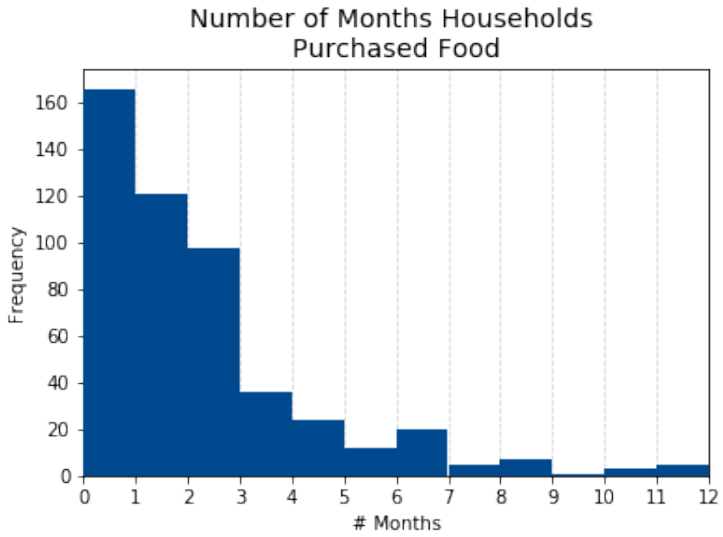

Figure 52: The distribution of the number of months in which households purchased food. $n = 498$

Figure 53 shows the percentage of households that reported purchasing food in a given month. The greatest percent of households purchased food in June, while the smallest percentage did so in December

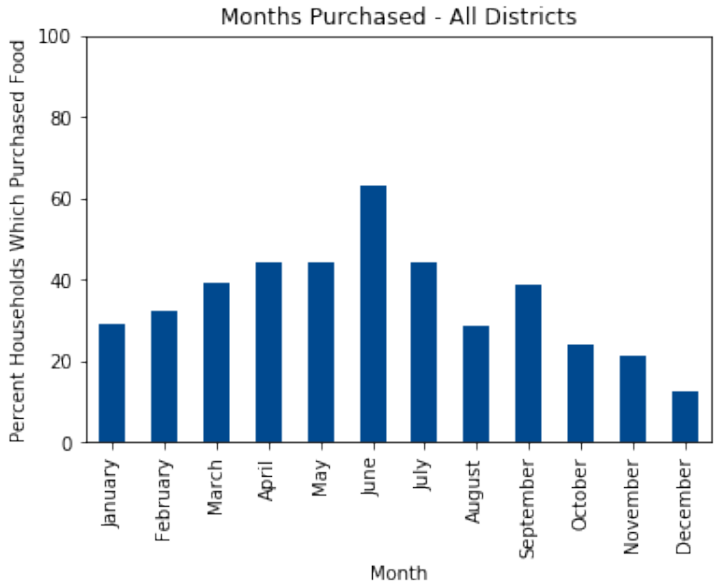

Figure 53: The percent of households that purchased food each month. $n = 498$

3.3.14 ANNUAL FOOD EXPENDITURES

For each month that a household indicated that it purchased food in the past year, the respondent was asked the total amount spent. These monthly expenses were aggregated to create a figure for the total expenditure on food in the past year.[6] The median household spent 16.20 USD (60,00 UGX). There were 21 households that gave information on the months in which they purchased food, but responded "don't know" for the actual cost. This missing data is excluded from this summary.

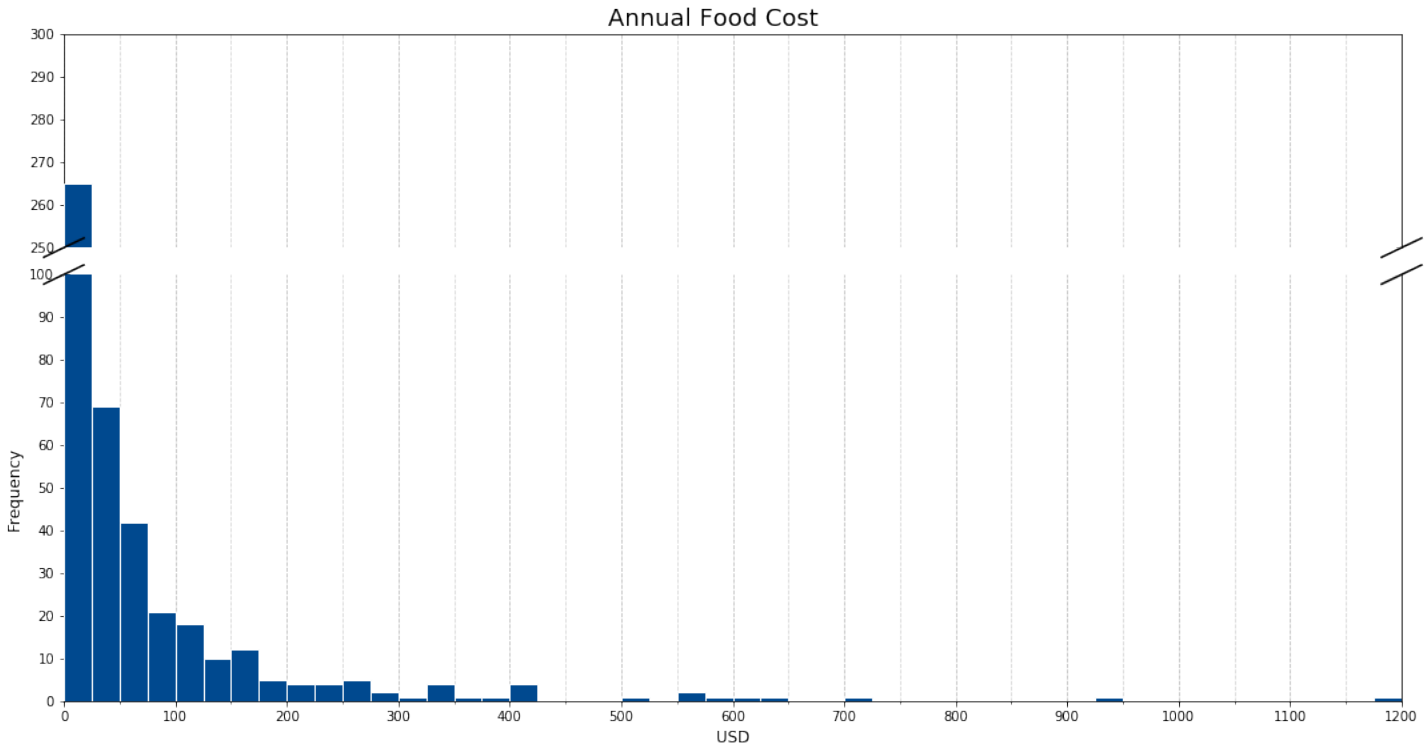

Figure 54: The distribution of the amount in USD that households spent on food. Each bar represents a 25 USD increment. $n = 477$

[6] On the survey, households reported all answers in UGX. Throughout this analysis, a conversion of 3,703.70 UGX per 1 USD is used.

3.3.15 ANNUAL QUANTITY OF FOOD PURCHASED

For each month that a household indicated it purchased food in the past year, the respondent was asked the quantity of food purchased. The monthly totals were aggregated to come up with a total for the past year. Some respondents reported the quantity purchased in units that could not be accurately converted to kilograms (e.g. basins, bunches) while others reported "don't know" for the amount purchased. These 32 respondents are excluded from this summary.

The median household purchased 50.0 kg of food.

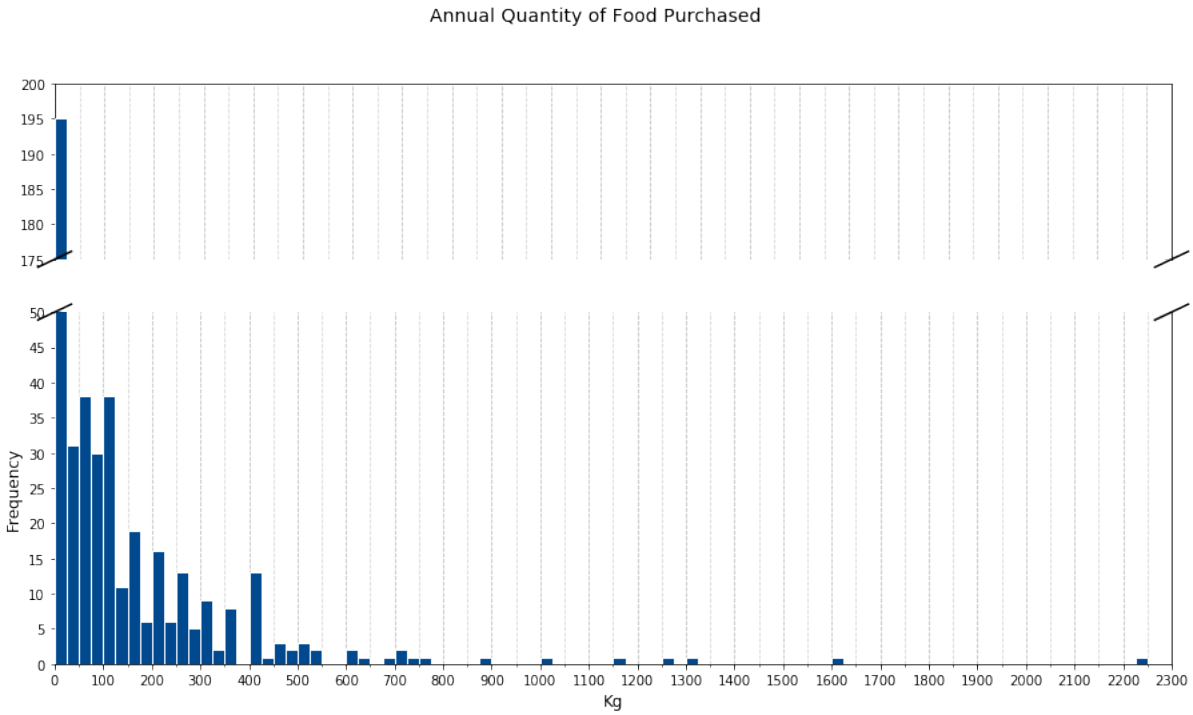

Figure 55: The distribution of the quantity of food purchased by households. Each bar represents a 25 kg increment. $n = 466$

3.4 REGULARITY OF ANNUAL FOOD PURCHASES

The previous set of questions asked respondents about their food expenditures during the previous year. In order to gauge how common this practice is, and whether 2017 may have been an exceptional year, we also asked respondents that reported purchasing food in the past year whether they do so every year. Note that this question was only asked of those who had purchased food in 2017 - it is possible that the households that did not purchase food in 2017 have done so in other years, but they were not asked this question.

Respondents could choose from the following options:

- Yes
- Only if harvest is bad

- Only in exceptional cases[0]
- Other
- Don't know
- Refused

Of the 339 households that had purchased food in 2017, 40% said they do so every year, while 43% reported that they only purchase food in case of a bad harvest.

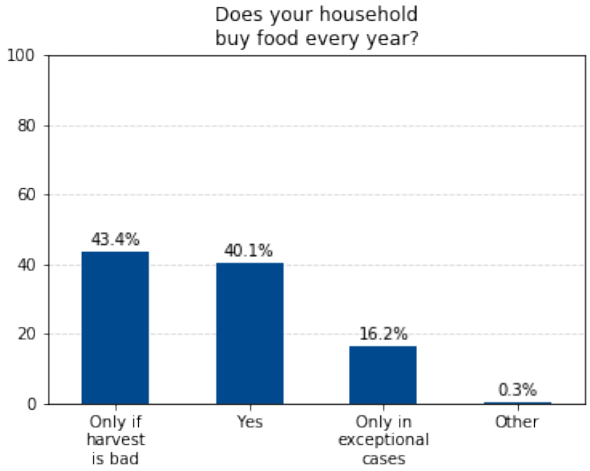

Figure 56: For the households that purchased food in 2017, how frequently they purchase food. $n = 339$

3.5 AGRICULTURAL INPUTS

This section gathers information about the use of consumable agricultural inputs. While the previous section asked about land and labor, the following questions asked about the households' access to inputs, their usage of seeds and agricultural chemicals, and their awareness of counterfeit inputs. These questions were designed to assess another dimension of market connectivity, access to agricultural inputs, and to establish what kinds of inputs the household had used.

One of our original hypotheses about market participation was that households sell the portion of the harvest that remains once the household's consumption needs have been met, meaning that households with higher yields would be more likely to have a surplus and potentially more likely to sell. As such, we asked households about the inputs they had used, to see if the use of improved seeds or agricultural chemicals increased yields as expected, and whether this impacted the amount of the harvest that was sold. We were also interested in whether or not the farmers investing in agricultural inputs tended to be more commercially oriented (i.e. consistently sell their harvest).

[6]The phrase "exceptional cases" may have been confusing - for some, a bad harvest may be an "exceptional case". The intent was to cover exigencies/emergencies other than a poor harvest, but it is possible that this is not how the question was understood.

3.5.1 NEARBY INPUT SHOP

Respondents were asked whether there was an agricultural input shop nearby. These shops are usually small businesses that stock agricultural inputs such as seeds and agricultural chemicals, and may offer spray pumps, hoes, tarpaulins, grain storage bags, and other farm implements. Shop owners may also provide valuable information to farmers about the proper use of the products.

The meaning of "nearby" was left purposely vague, and the interpretation was left up to the respondent. Based on the road quality in the area and the transportation options available to the household, the meaning of "nearby" could differ from household to household. However, respondents who indicated that there was an input shop nearby were asked the location of the input dealer (town/village). These locations are not reported here, but will be used in future analysis to look at the coverage and interconnections of farmers and agrodealers in a particular area.

Overall, 43% of households reported having an input shop nearby, as shown in Figure 57. A higher percentage of households in Mubende district reported having an input shop nearby (55%) than in the other districts, while Pader district had the lowest percentage of households reporting an input shop nearby (29%).

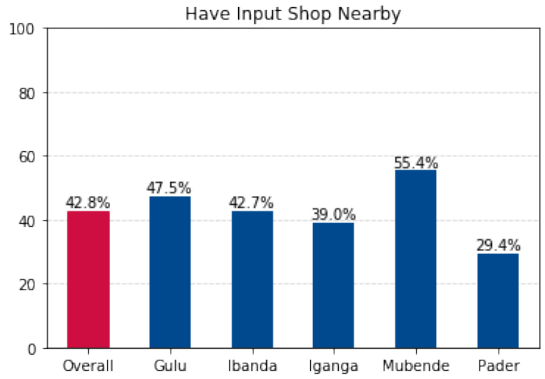

Figure 57: The percent of households with an input shop nearby. $n = 498$

3.5.2 PURCHASING FROM NEARBY INPUTS SHOP

The households that reported a nearby input shop were asked whether they had ever purchased inputs from this business. Of these 213 households, the overwhelming majority responded that they had patronized these businesses.

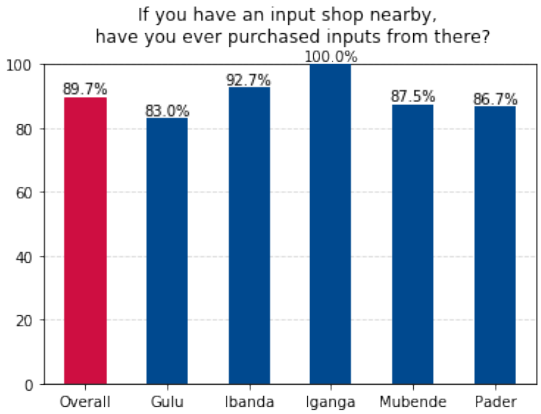

Figure 58: Out of the households that have a nearby input shop, the percent that have purchased inputs there. $n = 213$

3.5.3 FREQUENCY OF PURCHASING FROM NEARBY INPUT SHOP

In total, 191 households responded that they had an input shop nearby and that they had purchased inputs from that shop. These respondents were asked how often they purchased inputs there. Almost 46% of respondents responded that they patronize the shop every time time they buy inputs, and 47% responded that they "sometimes" shop there.[7]

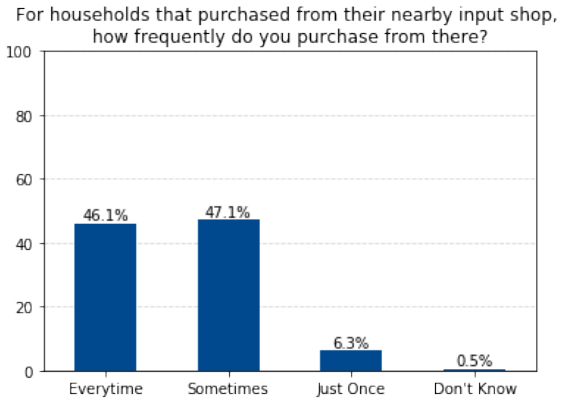

Figure 59: Out of the households that have a nearby input shop and have purchased from it, the frequency with which they patronize it. $n = 191$

3.5.4 REASONS FOR PURCHASING FROM NEARBY INPUT SHOP

The same group of 191 households that have a nearby input shop and have purchased from it were asked to select one or more reasons why they chose to buy from that shop. The main reason cited was the proximity of the shop (76%), while 23% cited the shop's reputation.

[7]This question may have been unclear, however - the intent was to ask whether they purchased from the nearby shop every time they bought inputs, or if they sometimes went to another shop. But it is possible that the respondents took "sometimes" to mean "I don't buy inputs every season, but sometimes I buy inputs".

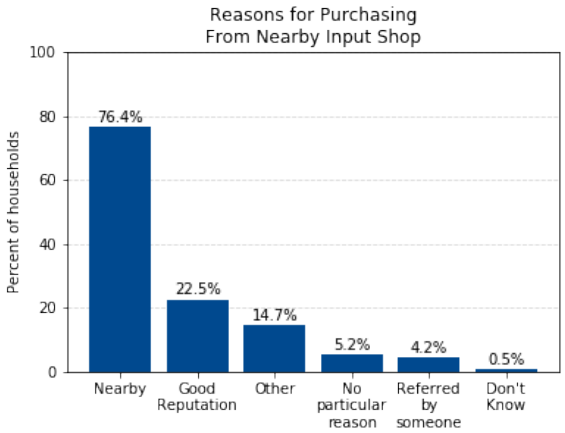

Figure 60: Out of the households that have a nearby input shop and have purchased from it, the reasons they cited for purchasing from that shop. Note that households could choose more than one reason. $n = 191$

3.5.5 TRUST OF NEARBY INPUT SHOPS

The households that reported having purchased from their nearby input shop (191 households) were also asked whether they trusted the shop owner. Overall, the level of trust was very high. More than 90% of respondents said they at least somewhat trust the owners of their nearby shop.

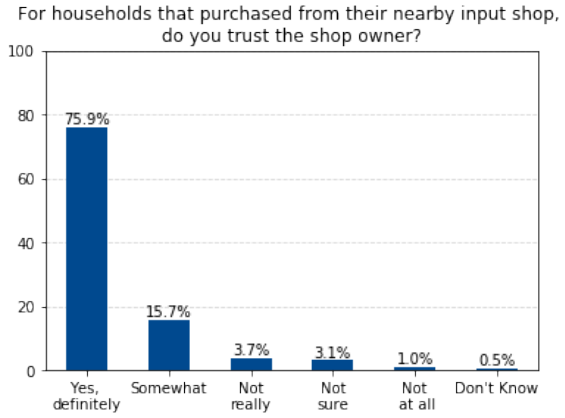

Figure 61: Out of the households that have a nearby input shop and have purchased from it, the level of trust that they have in the shop owner. $n = 191$

3.5.6 REASONS FOR NOT PURCHASING FROM NEARBY INPUT SHOPS

There were 22 households that indicated having an input shop nearby but had never purchased from it. They were asked why not, and were provided the following options (more than one answer was accepted):

- Do not purchase inputs

- Cannot afford inputs
- The shop is too far away
- The shop has a bad reputation
- They do not trust the shop owner
- Other

More than half responded that they do not purchase inputs, while slightly over a quarter said they cannot afford them. The "other" reasons given were purchasing from other shops and lacking information.

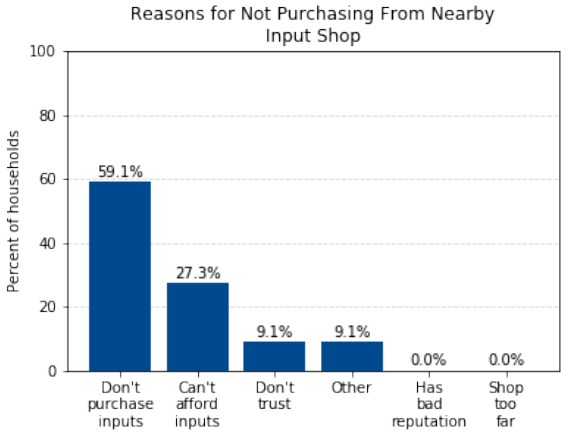

Figure 62: Out of the households that have a nearby input shop but have not purchased from it, the reasons why they have not bought inputs there. $n = 22$

3.5.7 SOURCES OF SEEDS FOR PLANTING

The households were asked where they had obtained the seeds that they used for planting each season. This question was of particular interest to USAID, to understand what proportion of households are using home-saved seeds as opposed to purchasing seeds from an input shop. Home-saved seeds are seeds that are recycled from the previous season's harvest, and the yield and quality of harvest from these seeds will eventually decrease after too many seasons of re-use. Farmers are encouraged to buy new seeds, which have been specifically grown for the purpose, as often as possible.

For each of the two seasons in 2017, households were asked where their seeds came from. They could choose from one or more options:

- Home saved
- Purchased
- NGO
- Government

- Other

The most common way of sourcing seeds was to use seeds that had been saved from a previous season ("home saved" seeds), with almost 3 out of 4 households doing this in 2017. About 60% of households reported having purchased seeds. The "other" responses were that seeds came from relatives or neighbors.

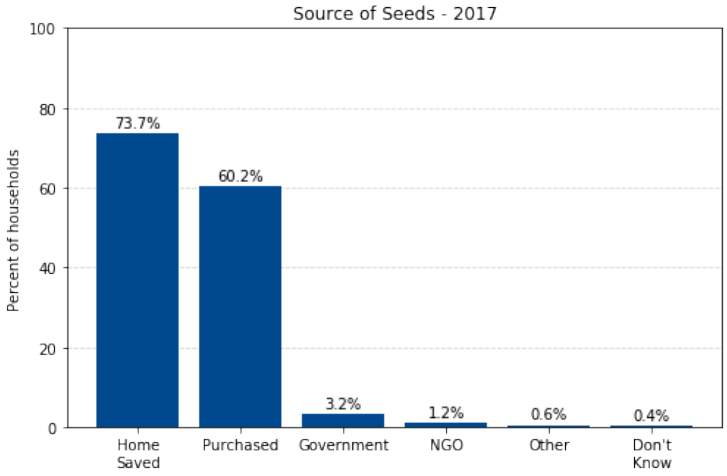

Figure 63: The percent of households which obtained seeds from each source. Households could choose more than one source. $n = 498$

3.5.8 USAGE OF AGRICULTURAL CHEMICALS

The households were also asked whether they had used agricultural chemicals in either of the two previous seasons. These questions are of general interest to USAID and also contribute to our understanding of the household's expenditures on agricultural inputs. Herbicides, pesticides, and fertilizers can increase yield when correctly applied, and as shown in Figure 46, pests and crop diseases were among the most common problems the households reported having with their crops.

For each season, about a third of households in the sample reported using chemicals. However, usage varied greatly across the districts. Use of agricultural chemicals was more common in Iganga and Mubende, with a majority of households using them. Adoption was lowest in Pader, with just under 10% of households using chemicals.

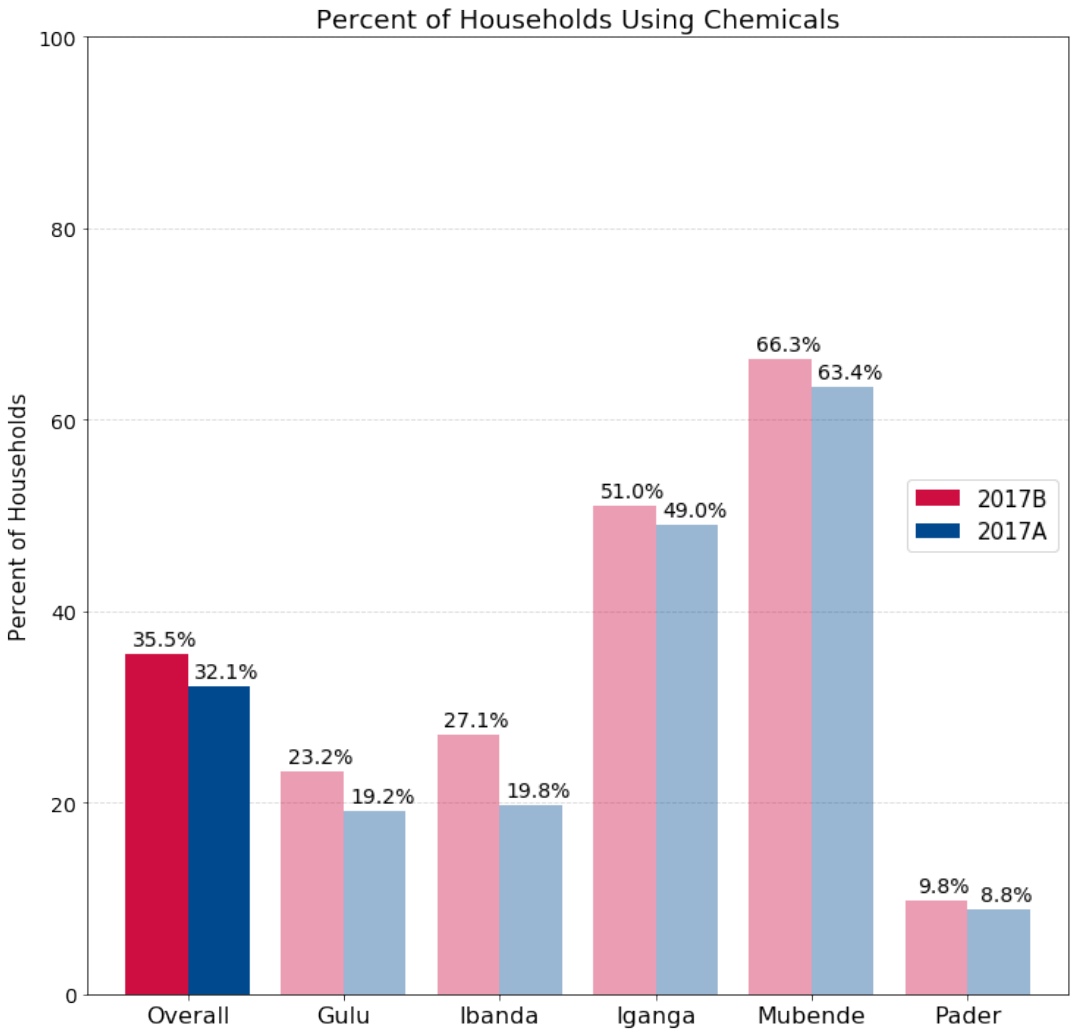

Figure 64: Percent of households using agricultural chemicals in the two seasons of 2017. $n = 498$

In total, 195 households reported having used chemicals in 2017, and most (73%) used them in both seasons. 18 households (9%) said they only used chemicals during the 2017A season, while 35 (18%) used them only in the 2018B season. Meanwhile, 303 households in the sample (61%) did not use chemicals in either season during 2017.

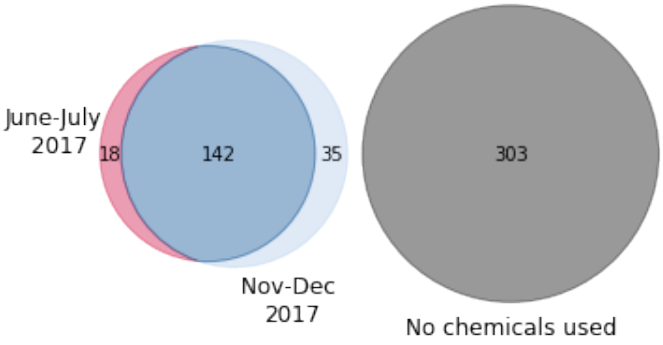

Figure 65: The seasons during which households used agricultural chemicals during 2017. $n = 498$

The households that had used chemicals in 2017 were asked which types of chemicals they used (more than one answer was allowed). Pesticides were the most common in both seasons, followed by herbicides and then fertilizer.

Out of the entire sample of 498 households, use of each type of chemical remains low. Pesticides were the most commonly used type of chemicals, while fertilizers and herbicides were approximately half as common.

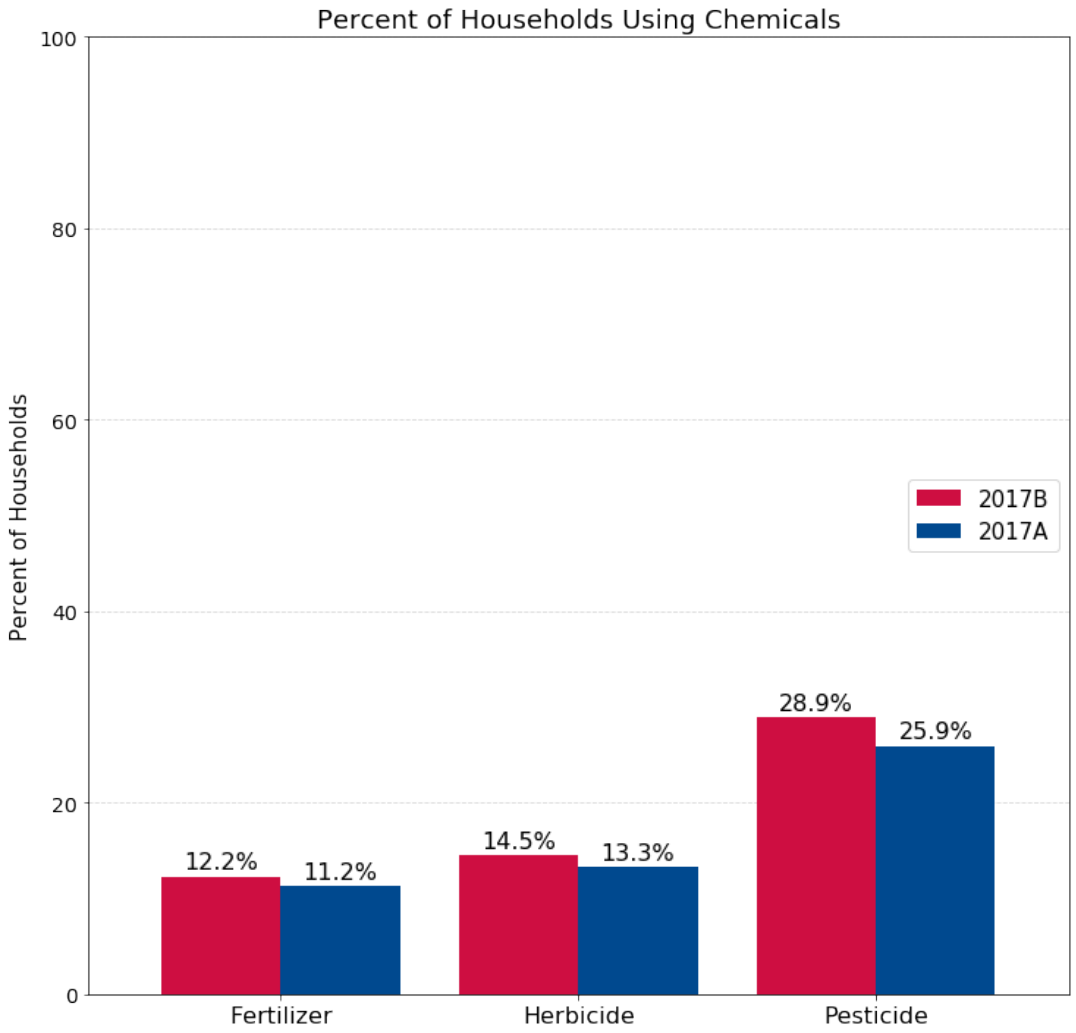

Figure 66: Rate of usage of different types of agricultural chemicals in both seasons of 2017. $n = 498$

For every season that a household indicated using chemicals, they were asked where they had purchased them. Households could choose more than one source. Out of the households that purchased chemicals in either season, 95% of them made purchases from input shops.

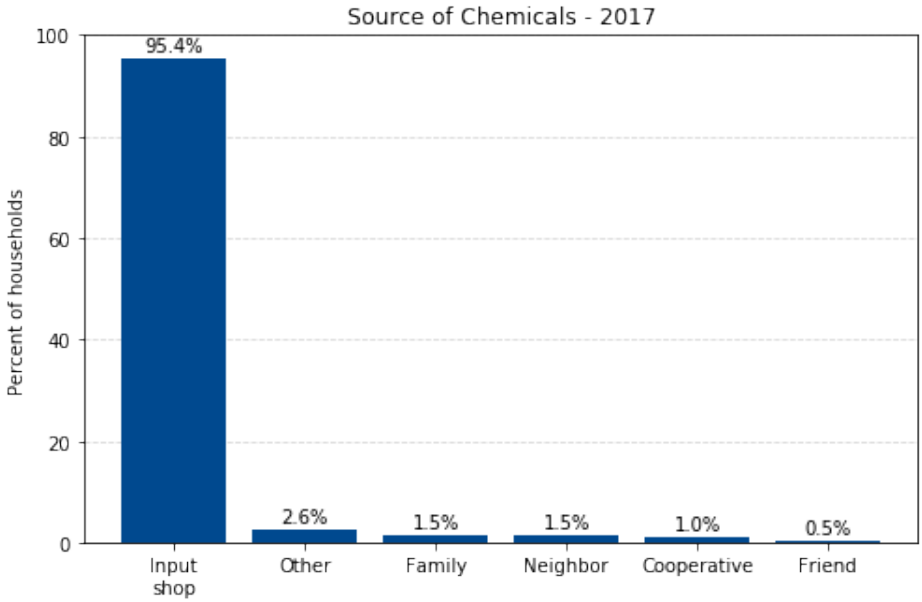

Figure 67: Out of households which used chemicals at least one season in 2017, the percent which purchased chemicals from each source. $n = 195$

As mentioned above, 303 households did not use chemicals in either season, and 53 only used them in a single season (see Figure 65). For each season that a household did not use chemicals, they were asked why not. Households could choose multiple reasons. Figure 68 shows the percent of these households that cited each reason at least once. The most common reason cited was that the household could not afford to purchase chemicals (67%). The second most common reason was that the chemicals were not available (17%). For the households that responded "Other" to this question, the most common reason they provided was that they lack knowledge on how to use agricultural chemicals.

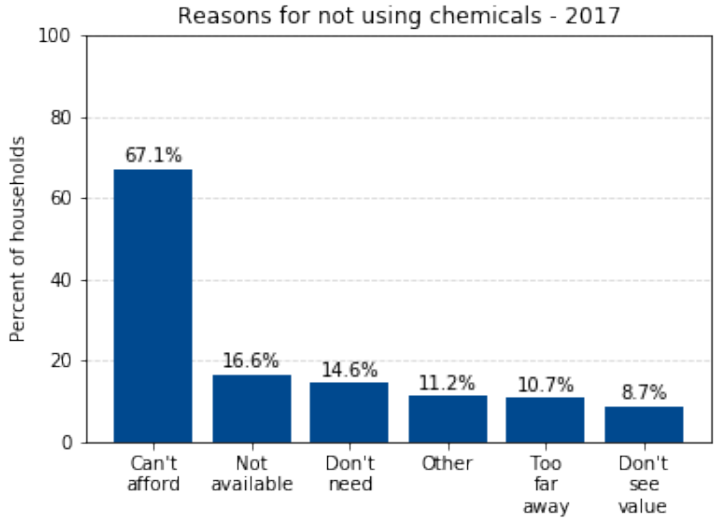

Figure 68: Out of all households which did not use chemicals in one or both seasons, the percent that cited each reason. $n = 356$

3.5.9 AWARENESS OF COUNTERFEIT INPUTS

Counterfeit, adulterated, and poor quality chemicals and seeds have been causing problems in the input market throughout Uganda. The reduced quality has eroded farmers' confidence in these products and dampened rates of adoption (Ashour et al., 2019). Many farmers deem the risk of purchasing inputs to be too high, especially since some households have extremely limited financial resources and cannot afford to invest money in inputs that turn out to be counterfeit, adulterated, or poor quality

Households were asked if they were aware of the problem with counterfeit inputs. Overall, 39% of respondents responded affirmatively. Almost half of Gulu district respondents said they were aware of counterfeit inputs, while Iganga district had the lowest awareness rate, at 30%.

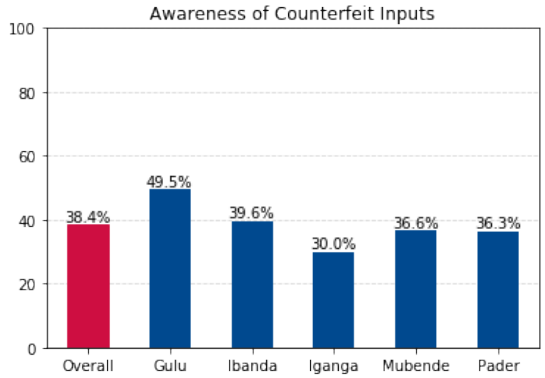

Figure 69: The percent of households that are aware of counterfeit inputs. $n = 498$

3.5.10 LEARNING ABOUT COUNTERFEIT INPUTS

Households that were aware of the problem with counterfeit inputs were also asked how they learned about the problem; more than one answer was accepted.

The most common source was a friend or neighbor, highlighting the importance of social connections. Almost a quarter of respondents who knew about counterfeits learned about the problem from an "other" source. Of the short answers explaining what the "other" source was, almost all of them described some kind of personal experience with counterfeits. For example, respondents reported trying seeds that didn't grow or resulted in a poor harvest, concluding that they must have been counterfeit.

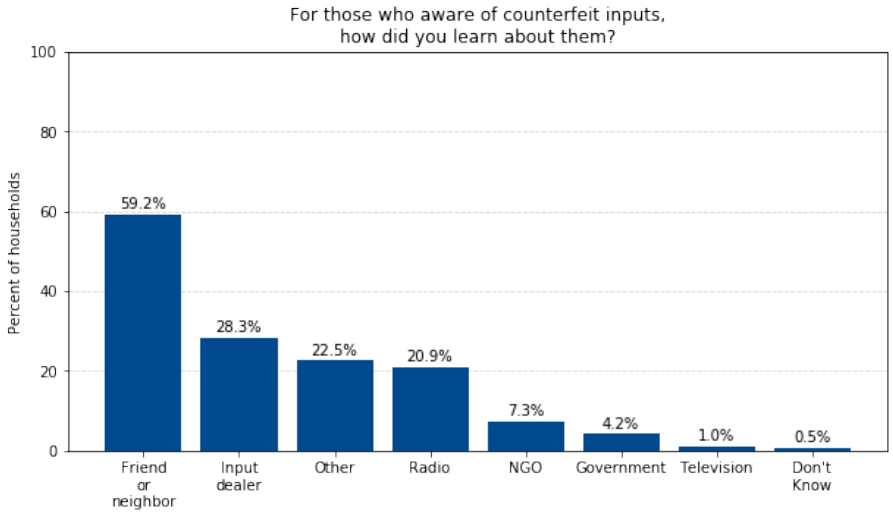

Figure 70: Out of households that are aware of counterfeit inputs, the sources from which they learned about the problem; more than one answer was accepted. $n = 191$

3.5.11 WILLINGNESS TO PAY FOR GUARANTEED QUALITY INPUTS

Two questions were asked to assess households' willingness-to-pay for agricultural inputs that were guaranteed to be of genuine quality. The answers to these questions can reveal the extent to which farmers perceive there to be problems with the current products on the market. Expectation that these products are low quality will be reflected in a non-zero willingness-to-pay above the stated price.

The first question asked respondents to consider a 50g tin of seeds valued at 20,000 UGX (equivalent to 5.35 USD). They were asked how much additional money they would be willing to pay for a tin that was guaranteed to have a germination rate of 85-90%. Poor quality/adulterated/counterfeit seeds often have very low germination rates, so for many farmers the germination rate is seen as a signal of quality. [8]

They were presented with the following options:

- 1,000 UGX [0.27 USD]
- 2,000 UGX [0.54 USD]
- 5,000 UGX [1.35 USD]
- 10,000 UGX [2.71 USD]
- Other

[8] Note: though generally these types of questions provide a baseline (e.g. this tin of seeds costs 20,000 UGX) and then ask respondents' willingness to pay based on that price, it may have been easier for the respondents if we had specified what kind of seed it was. Vegetable seeds, for example, often cost around 20,000 UGX for a 50g tin, and specifying the type of seed would have provided a real-world benchmark that may have made it easier for respondents to answer the question.

- Don't Know
- Refused

Almost all households placed some value on this guarantee, with 92% of households expressing willingness to pay a premium. Only 0.8% were unwilling to pay any more than the normal price (they chose the "other" category with a response of 0 UGX), 0.4% declined to answer the question, and 7% were unsure.

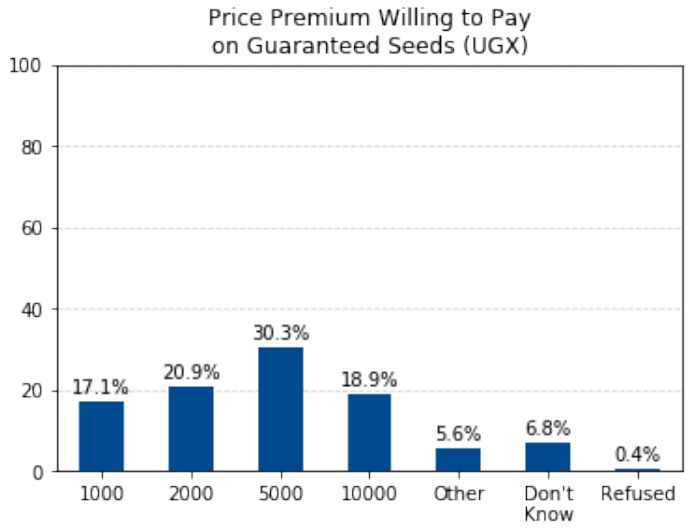

Figure 71: How much more households were willing to pay for certified genuine seeds. $n = 498$

The second question asked respondents to consider a 1L container of pesticide valued at 20,000 UGX (equivalent to 5.35 USD). They were asked how much additional money they would be willing to pay if the product was certified as genuine and effective.

They were presented with the following options:

- 1,000 UGX [0.27 USD]
- 2,000 UGX [0.54 USD]
- 5,000 UGX [1.35 USD]
- 10,000 UGX [2.71 USD]
- Other
- Don't Know
- Refused

Almost all households placed some value on this guarantee, with 89% of households expressing willingness to pay a premium. Only 2% were unwilling to pay any more than the normal price (they chose the "other" category with a response of 0 UGX), 0.8% declined to answer the question, and 8% were unsure.

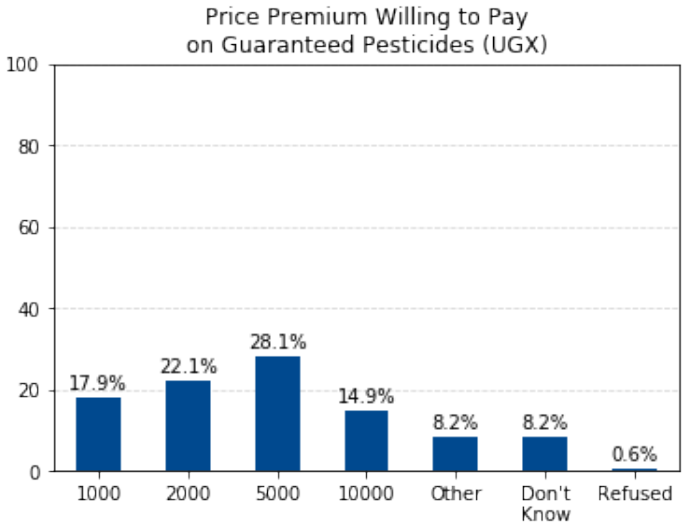

Figure 72: How much more households were willing to pay for certified genuine pesticide. $n = 498$

3.6 PRODUCTION AND HARVEST

In this section of the survey, we asked the respondents about the crops they had planted and harvested during the two most recent seasons, 2017A and 2017B. We also asked whether they had sold the crop, and questions about their relationship with their buyer, among others. The purpose of these questions was to learn how many households had sold their crops, as well as some of the key details about their seasons that could have influenced their decision to sell - the crops they planted, how much they planted and harvested, the price they received, etc.

3.6.1 TYPES OF CROPS

Households were asked to choose from a list of options and identify which crops they planted for the 2017A season (June-July harvest) and which they planted for the 2017B season (November-December harvest). Depending on the region, some crops serve as cash crops while others are grown primarily for home consumption.

As seen in Figure 73, maize and beans were by far the most commonly planted crops in either season in 2017.

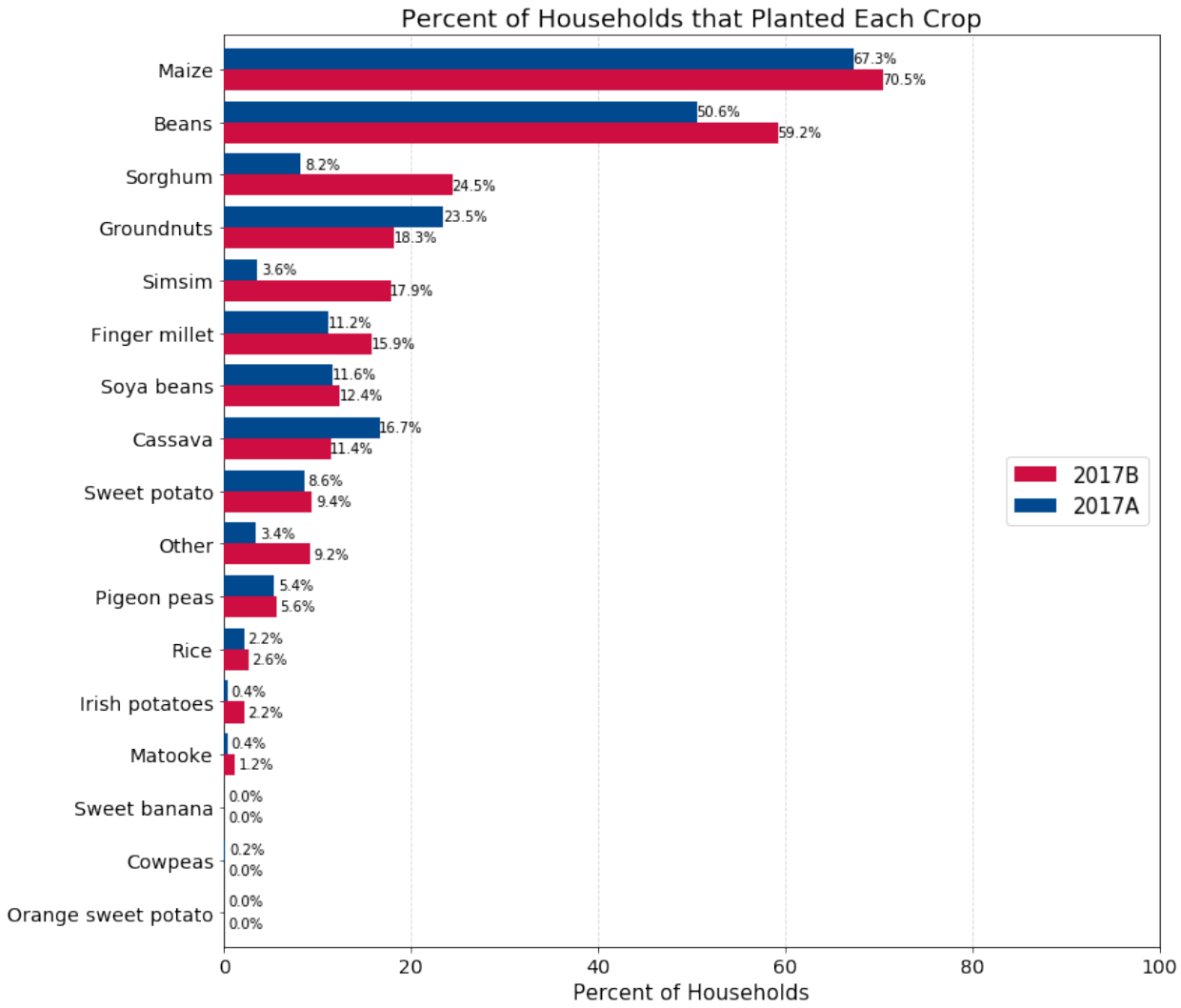

Figure 73: The percent of households which planted each crop in each season. $n = 498$

Very few households reported planting matooke and none reported planting sweet banana. This may reflect that households interpreted "planted" differently than they may have interpreted "cultivated." Matooke and banana trees do not need to be planted every season, so they do not necessarily show up in the dataset.

The "other" crops planted in November - December consisted of:

- cotton (19)
- sunflower (13)
- tomatoes (5)
- choroko (mung beans) (4)
- coffee (2)
- watermelons (1)

- onions (1)
- sugarcane (1)
- yams (1)
- red peppers (1)
- eggplants (1)

The "other" crops planted in June - July consisted of:

- cotton (8)
- sunflower (3)
- choroko (mung beans) (3)
- tomatoes (2)
- eggplants (1)
- other grains (1)

For the next set of questions, the households were asked to consider their top three crops by number of acres planted, for each season. (In order to save time, we did not ask this set of questions about every crop planted.) For these top three crops that represented the most number of acres planted, they were asked the amount harvested, whether they stored any, whether they sold any, and if so, to whom.[9]

3.6.2 STORAGE

For each of the top three crops by area planted each season, households were asked if they stored any of the harvest. Over 95% of households reported storing some portion of their harvest during either season of 2017.

[9]The survey software did not allow us to automatically populate the top three crops based on the responses to how many acres of each crop had been planted. As such, the respondents were asked to identify their top three crops by area planted for this series of questions. Unfortunately, there were some discrepancies. First, the number of crops differed in some cases - for example, the respondent may have said they planted maize, beans, and sorghum, and specified the number of acres planted of each, but then when responding to the questions about top crops, they may have only given answers about maize. Second, in some cases the top three crops differed - the top three according to the number of acres they reported planting did not match the top three they identified in the subsequent questions. We are unable to rectify this after the fact, so we have reported these figures based on the answers that were provided.

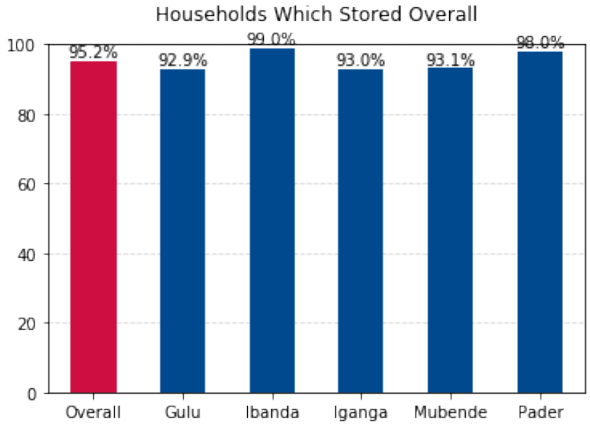

Figure 74: The percent of households which stored some of their harvest in 2017. $n = 498$

For each of the top crops stored by a household, they were asked to indicate which types of storage technology they used. Grain storage bags were used for 85% of stored crops, making them the most common method. The most common "other" methods were granaries, jerrycans, and the floor.

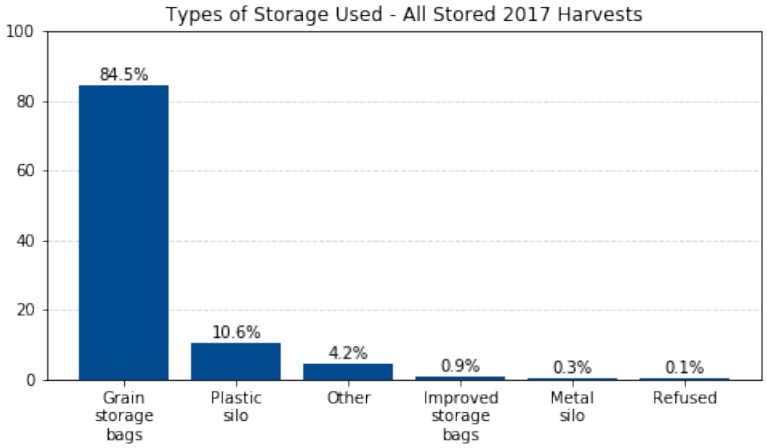

Figure 75: Out of all of the top crops stored, the method used. For a single crop, households could indicate storing it using multiple methods. $n = 1,519$

All households were asked if they were aware of improved storage bags and silos. Households who are aware of improved storage bags/silos may have better access to information. They could have learned about these new technologies from an input dealer, an organization which provides training, or any other connection in the marketplace. Awareness was more than double in Pader and Iganga compared to all other districts.

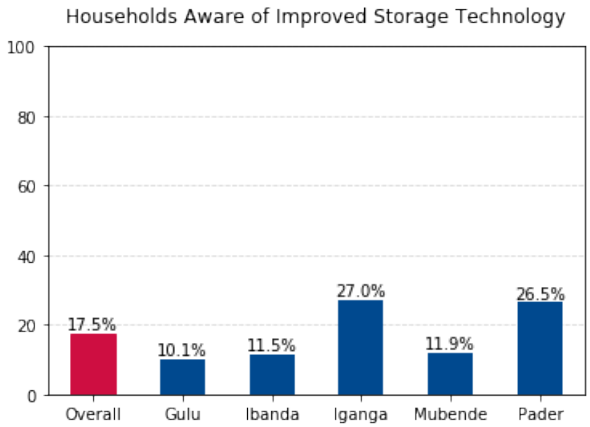

Figure 76: The percent of households aware of improved storage bags and silos. $n = 498$

3.6.3 SELLING THE HARVEST

For each of the top three crops for 2017A and 2017B, the households were asked whether they had sold any of their harvest. This is one of the main definitions of "market participation" - whether or not a household sold any of their produce, either through a contract or on the open market.

As seen in Figure 77, 82% of households sold some portion of at least one of their top three crops in either season of 2017. Selling was least common in Iganga, where only 64% of households reported having sold some of their harvest.

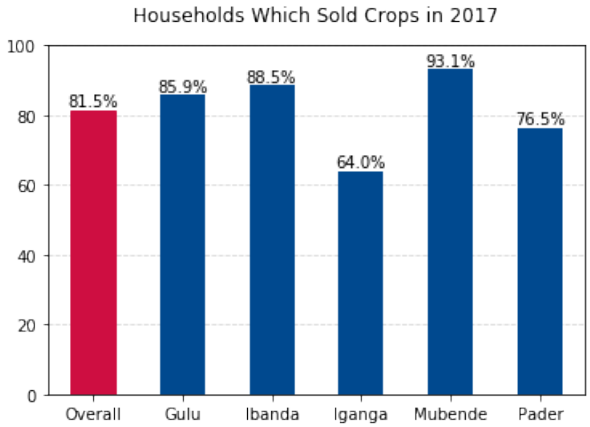

Figure 77: The percent of households that sold any of their top 3 crops by acres planted in either season of 2017 $n = 498$

3.6.4 CONNECTIONS WITH BUYERS

For each crop sold, households were asked to provide a short answer describing who they sold it to and where that buyer is located. They were also asked how they came to know this buyer

and why they decided to sell to them. Respondents who chose the option that their buyer has a good reputation were asked to provide a short answer describing why they have this good standing. Respondents were also asked if they had a formal arrangement with the buyer and for how many previous seasons they have done business with the buyer (if ever). Respondents were also asked to rank how much they trust this buyer. Households that have a positive, established relationship may sell more often and may receive higher, more stable prices than others. Breaking down the various components of how households connect to buyers and why they choose to continue to sell to them informs our understanding of ways to strengthen those connections.

For each of the three top crops per season that a household sold, they were asked to indicate how they knew the buyer. In 62% of instances, farmers reported being approached by buyers.

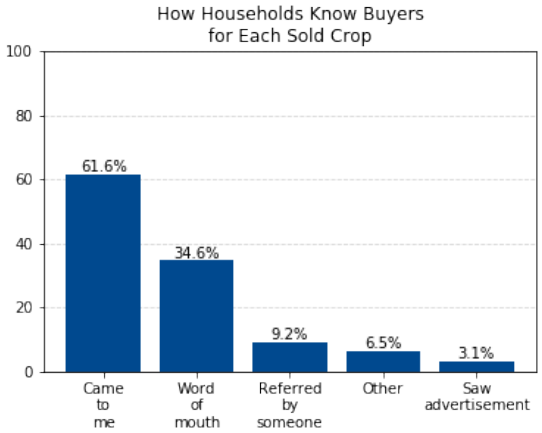

Figure 78: The channels through which households connected with their buyer for each top crop sold. $n = 991$

For each top crop that a household sold, they were also asked to indicate why they choose to sell to the buyer who purchased their harvest. Proximity was the greatest motivator. Out of all harvests sold, 41% of the time, the buyer was chosen because they were nearby. Only 13% of the time was the buyer the only one available. Just over 7% of the reasons given were "other"; the most common reasons specified were that the buyer offered credit and that they chose the buyer because they needed money.

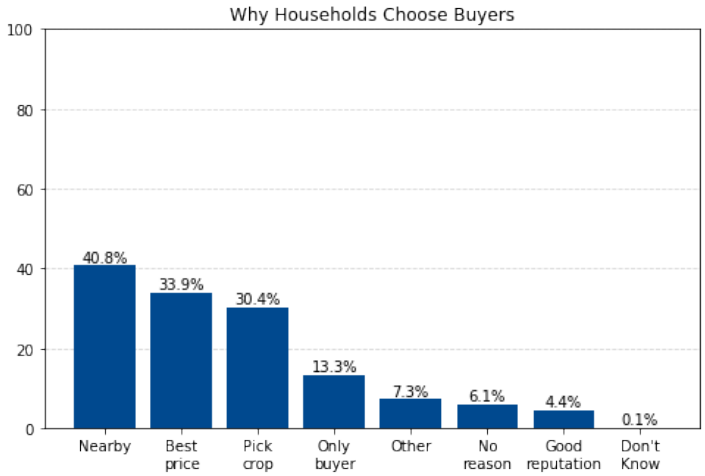

Figure 79: The reasons why households chose their buyer for each top crop sold. Households could choose more than one reason. $n = 991$

For each selling transaction, a household was asked how often they had sold to this buyer in previous seasons. Out of all transactions, 38% of the time, the household was using the buyer it always used. For 29% of transactions, households were selling to a new buyer with whom they had not previously done business.

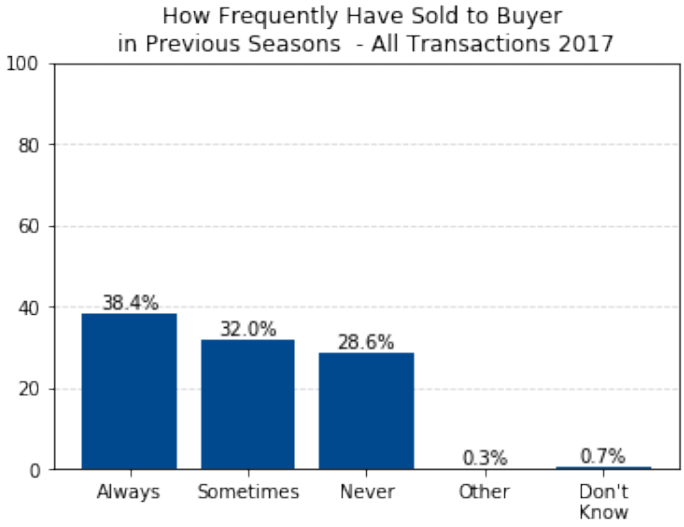

Figure 80: The frequency with which households have sold to the buyer in previous seasons. $n = 991$

In only 5% of selling transactions was there a contract or formal arrangement in place for a household to sell to a buyer.

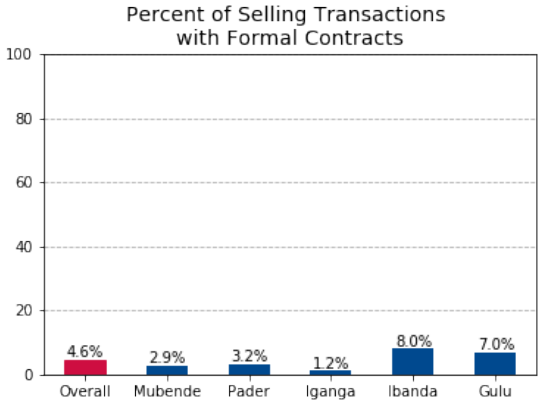

Figure 81: The percentage of transactions that involved a contract or formal arrangement. $n = 991$

3.6.5 TRUST IN BUYERS

Generally, households trusted the people they sold to. In 56% of transactions, households reported definitely trusting their buyer. Only in 17% of transactions was there some distrust (either "Not really" trusting the buyer or not trusting at all).

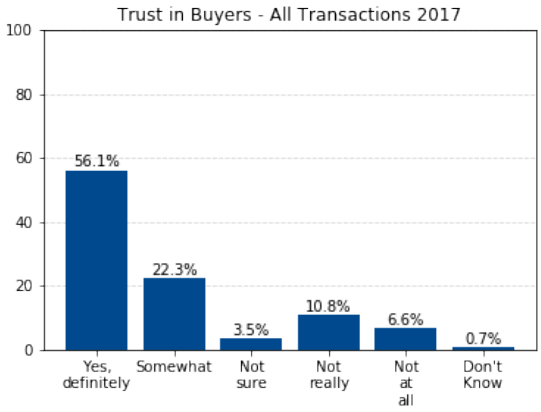

Figure 82: For each selling transaction, the level of trust which households have in their buyer. $n = 991$

3.6.6 BUYER PICK UPS

For each crop sold, households were asked if the buyer came to pick up the produce or if the households had to deliver it. Households that delivered their produce were asked what mode of transportation they used and how much it cost them. In infrastructure-poor environments, there may be some benefit to connecting with buyers who are willing to pick up the produce. However, it may impact the price that a household receives.

For each transaction, households indicated whether they delivered the harvest to the buyer or if the buyer picked it up. Overall, almost 3 out of every 4 buyers picked up the harvest. This was least common in Gulu and Pader.

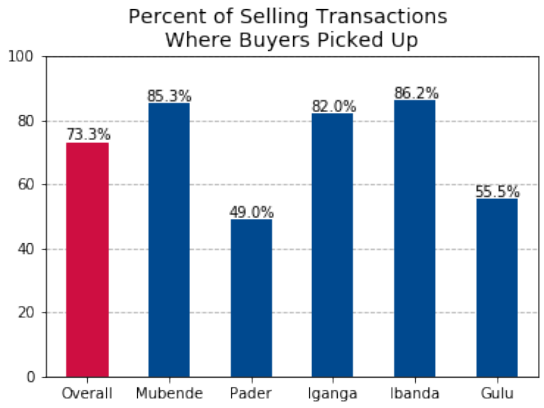

Figure 83: For each selling transaction, whether the buyer picked up the crop. $n = 991$

3.6.7 QUALITY DIFFERENTIATED PRICING

Households were asked if they were aware of any farmers who had received better prices for their crops because they were higher quality. Farmers may not have the knowledge or tools to assess the quality of their own harvest, and they may have limited information about market pricing in general. If buyers offer a set price for produce, farmers have little incentive to expend time and resources to achieve higher quality crops. Awareness may reflect a farmer being more connected to the market and having higher access to information. Households that are aware of opportunities for quality-differentiated pricing may be more likely to produce higher quality crops.

All households were asked whether they knew of any farmers who had received better prices for higher quality crops. Only 1 in 4 households had.

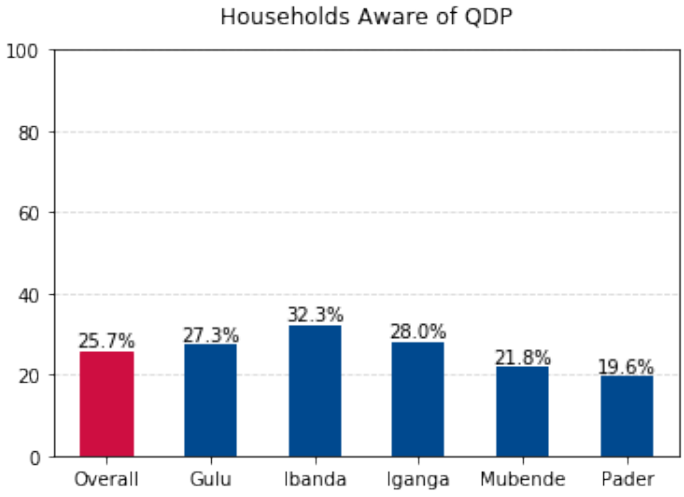

Figure 84: Whether households knew anyone who had received higher prices for higher quality crops. $n = 498$

3.7 MARKET LINKAGES

3.7.1 ACCESS TO AGRICULTURAL SERVICES

From a long list of agricultural services, households were asked which ones were accessible to them. Households with greater access to services may have a more well developed market environment.

The list of services includes:

- Plowing/tilling
- Soil testing
- Irrigation
- Weeding
- Spraying
- Pruning
- Harvesting
- Drying
- Grain cleaning
- Hulling
- Shelling/threshing
- Milling
- Packaging
- Storage
- Transportation
- Extension/training

The top 3 most commonly available services were weeding, plowing/tilling, and harvesting. Some of the less available services were those that require specialized equipment, such as irrigation, spraying, threshing, or milling. Extension services, irrigation, and soil testing were the least accessible services.

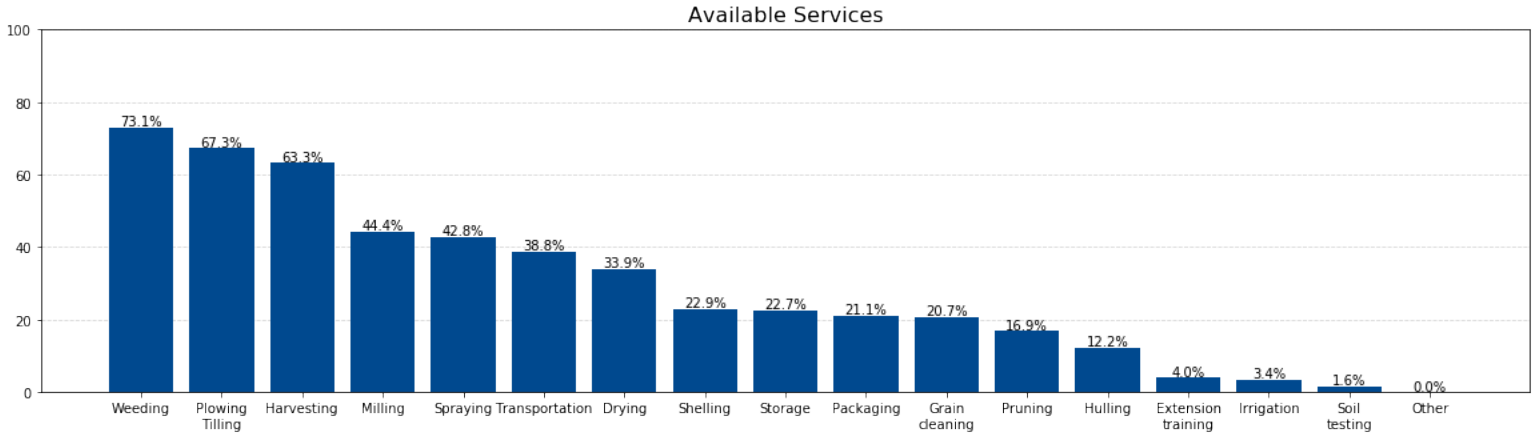

Figure 85: The percent of households that stated that each service was accessible to them. $n = 498$

The number of services each household indicated having access to was summed and used as a proxy for the development of the surrounding market infrastructure. The mean is 4.9 (the average household had access to almost 5 types of services) and the standard deviation is 2.9.

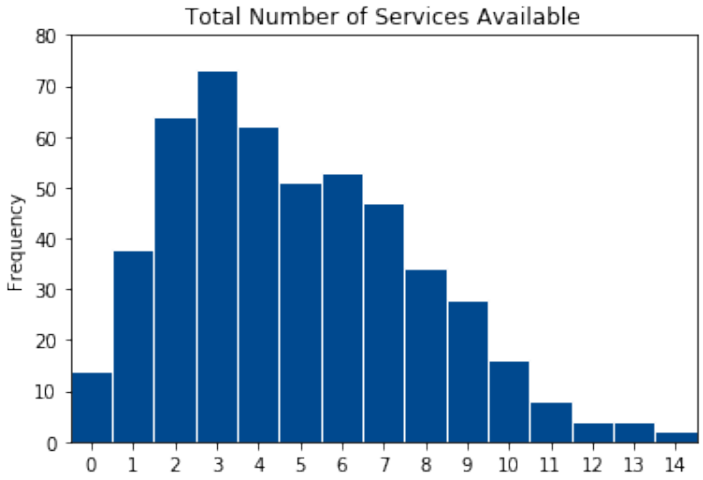

Figure 86: The number of services accessible to households. $n = 498$

From the same list of services above, households were asked which services they had previously paid for. The number of services they had engaged may reflect a household's wealth, commercial orientation, or lack of labor capital. It also reflects a willingness to pay for specialized equipment and skills. The highest percentage of households had previously paid for plowing/tilling services; weeding and milling were the next most common services that households reported having paid for in the past.

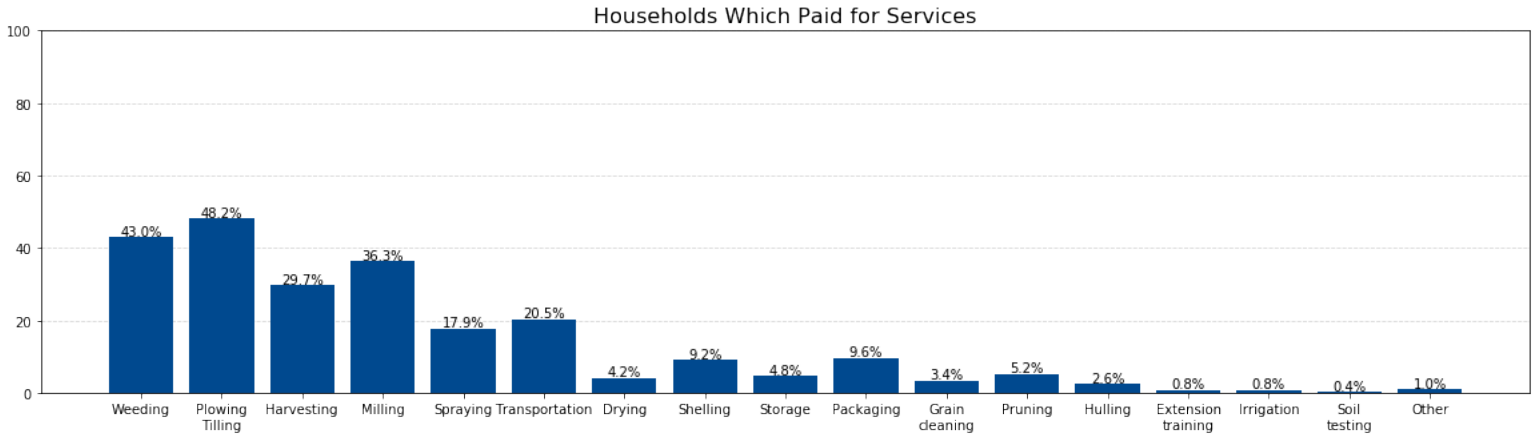

Figure 87: The services that households had previously paid for. $n = 498$

Finally, households were asked to indicate which of the services they would use if they could afford them. Every household may conceive of the level of "affordable" differently, but the answers can paint a picture of how farmers value their money vs. the time, effort, and equipment needed for various services.

Households have a strong desire for some of the services that are least available to them. Many households expressed interest in extension training (40%), irrigation (48%), and soil testing (34%), even though these were actually available to fewer than 4% of households.

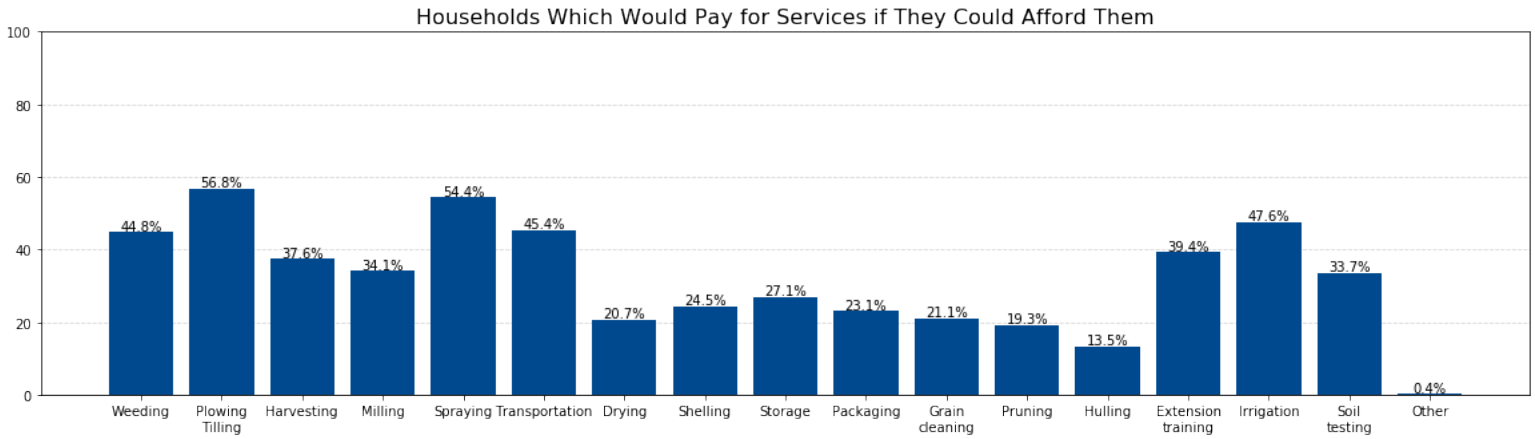

Figure 88: The services which, if affordable, a household would be interested in using. $n = 498$

There were large differences between the percentage of households that had actually paid for each type of service in the past and the percentage that would pay for them if they could afford them. There was less than ten percentage points' difference between the number of households that have previously paid for weeding, plowing/tilling, harvesting, and milling and the number of households that would pay for them if they could afford to.

3.7.2 EQUIPMENT RENTAL

Households were asked if they had ever rented any equipment. If yes, they were asked to indicate what kind of equipment.

Overall, 23% of households reported having rented equipment, such as spray pumps, processing equipment, or a vehicle.

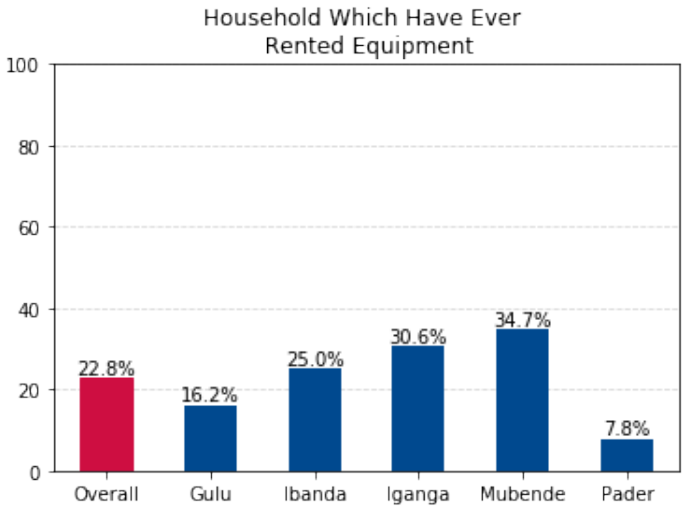

Figure 89: The percent of households that had ever rented equipment. $n = 498$

3.7.3 PRODUCER ORGANIZATION MEMBERSHIP

Producer organizations are independent, member-led collectives which can allow farmers to engage in collective marketing that improves economies of scale. They can reduce transportation costs, provide crop processing services, and achieve higher prices for crops than individual farmers could negotiate (Latynskiy and Berger, 2016). This type of group can also provide a household with access to a large network of farmers. Social network effects may increase access to and diffusion of information (Bosc et al., 2002). Membership in such an organization may be an indicator that a household is highly connected with and engaged in the market.

Overall, 8.8% of households reported belonging to a producer organization. One respondent was unsure while all others reported not being a member. Participation in these groups was lowest in Mubende (2%).

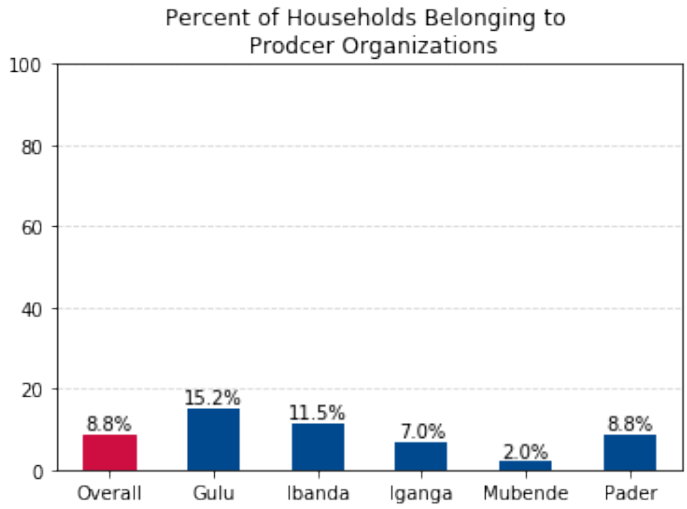

Figure 90: The percent of households belonging to producer organizations. $n = 498$

The 44 households which belonged to producer organizations were asked what year they joined. As shown in Figure 91, most households which belong to POs have joined them very recently. A third of them have only been members for a year. Two thirds have been members for three or fewer years.

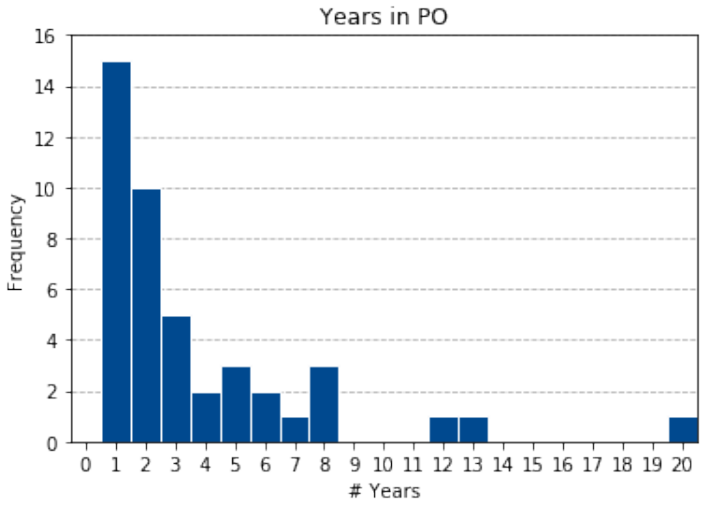

Figure 91: The number of years belonging to a producer organization. $n = 44$

Households which did belong to a producer organization were then asked to choose from a list of services to identify those provided by their group.

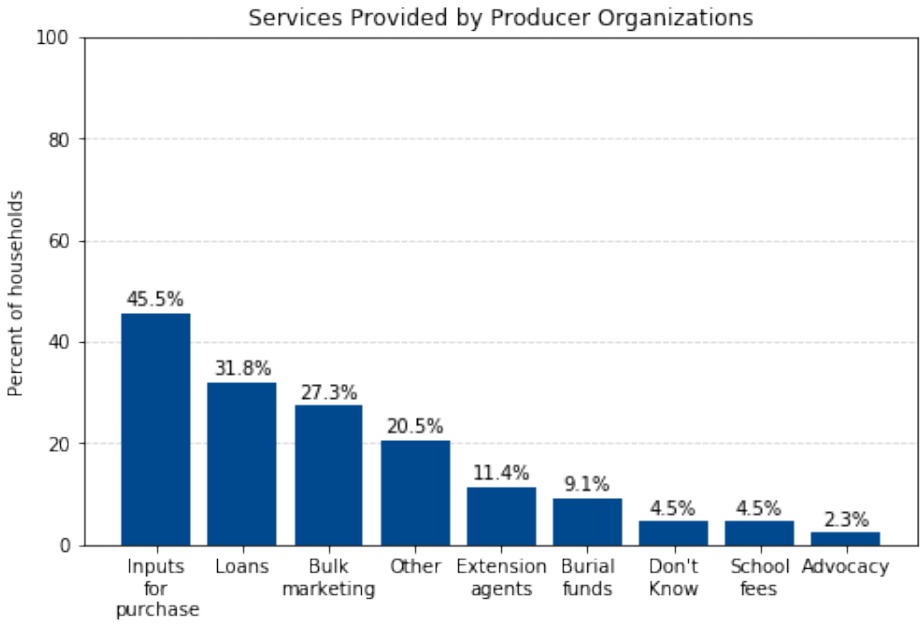

Figure 92: The services offered by producer organizations. $n = 44$

Of the 9 households which indicated "other," they specified that their producer organizations provided:

- working in turns on members' plots (5)
- trainings (2)

- government grants (1)
- banana plantation improvements (1)

The 453 households which reported not being members were asked if there was a group in the district or sub-county which they could join. "Don't know" was a very common response to this question, with 13.5% of respondents being unsure. Overall about a quarter of households that were not currently members of a producer organization knew about one in their region that they could join.

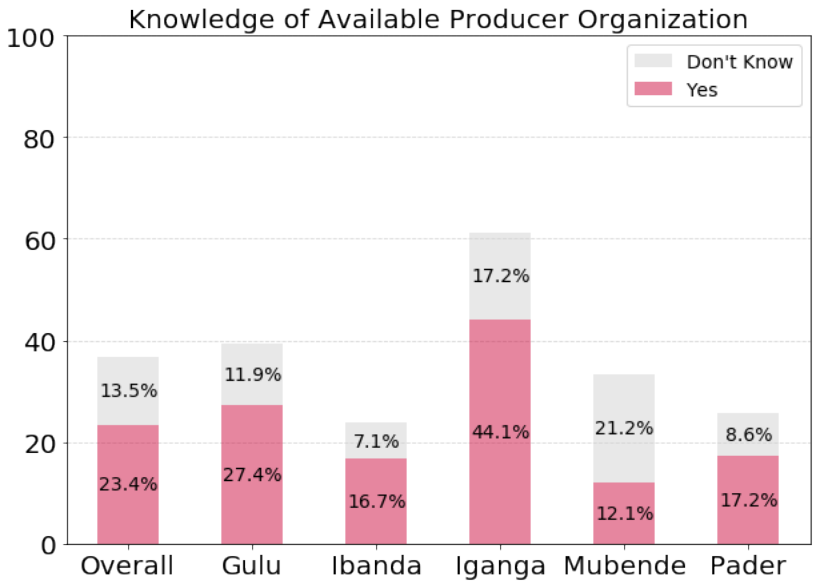

Figure 93: Knowledge of a PO in the district or sub-county. $n = 453$

Households indicated whether or not they were a part of any other groups. If so, they specified what kind. Although membership in producer organizations is low, 40% of households are members of other types of group. The overwhelming majority of these were savings groups.

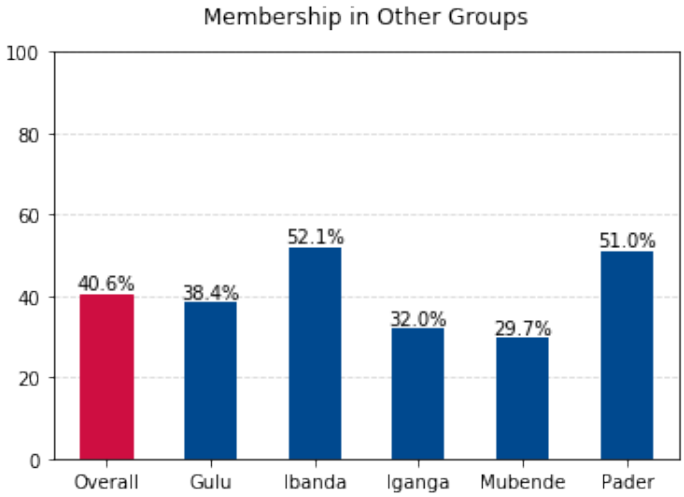

Figure 94: The percent of households belonging to other types of organizations. $n = 498$

3.8 ACCESS TO INFORMATION

3.8.1 INFORMATION ACCESS

From a list of different types of information, respondents were asked to indicate which the household had access to. They could choose from:

- Market prices
- Weather data
- Opportunities to sell crops
- New planting, harvesting, or post-harvest handling techniques
- New products or services
- Product quality
- Anti-counterfeit programs
- Government programs
- NGO programs

For each type of information a household had access to, they were asked about how often they received it and from what source they received it:

- Mobile
- Newspaper
- Radio
- Television

- Word of mouth
- Local business
- Other

Better access to market information should help farmers learn about opportunities to sell their crops and what prices are fair. The way they typically learn this information can help assess what modes of communication are the most effective at reaching farming households.

Households were asked to indicate which types of information they had access to. The most commonly available category was market prices, with almost three quarters of respondents having a way to learn about it. Interestingly, market prices were accessible to households that sold their crops and households that didn't at an almost equal rate. Of households which sold anything from any of their top 3 crops in either season in 2017, 74.0% had access to market prices. Of households which did not sell, 72.8% had access to market prices. Similarly, the rates of access to information about opportunities to sell crops are almost the same for both sellers and non-sellers. 20.8% of selling households had access to this information, and 23.9% of non-sellers did. The low response rate may reflect that even many sellers do not have a way to learn about potential buyers outside of the network they already do business with, reducing the competition in the marketplace.

Slightly more than half of small-holder farmers did not have access to weather data. Access to information about new products/services and new planting/harvesting/post-harvest handling techniques were both around 11%.

Although about 39% of respondents reported being aware of problems with counterfeit inputs (see Figure 69), only 10.5% reported having access to information about anti-counterfeit programs.

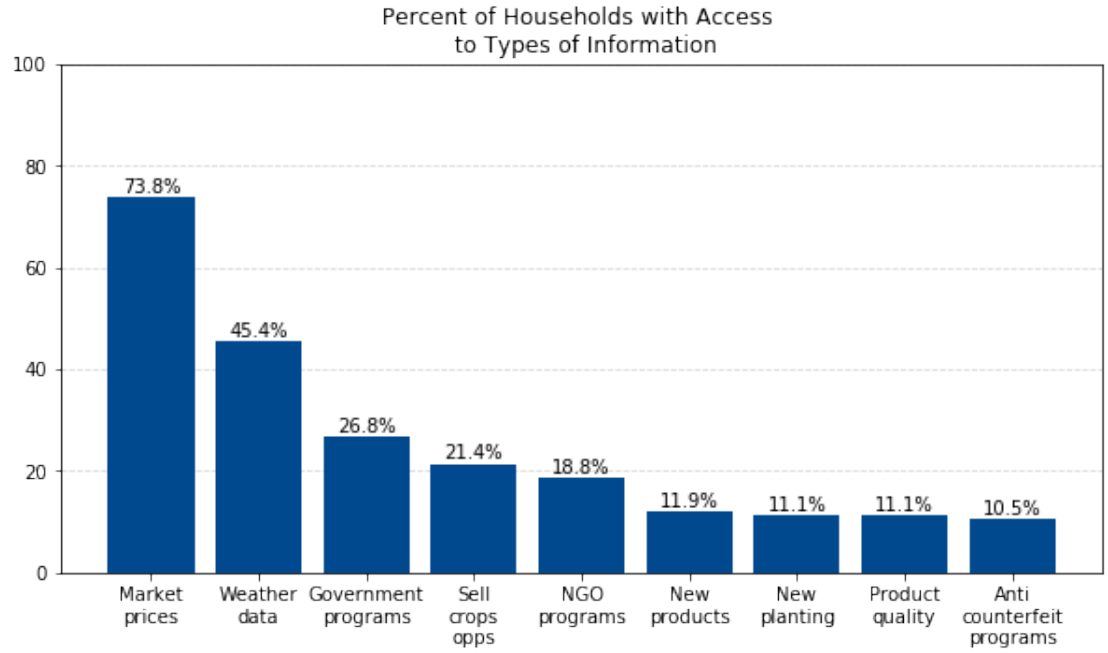

Figure 95: The percent of households which have access to each type of information. $n = 498$

3.8.2 INFORMATION SOURCES

Every time a household indicated having access to a particular type of information, they were asked from which source they received it. Radio and word of mouth were by far the most common sources of information.

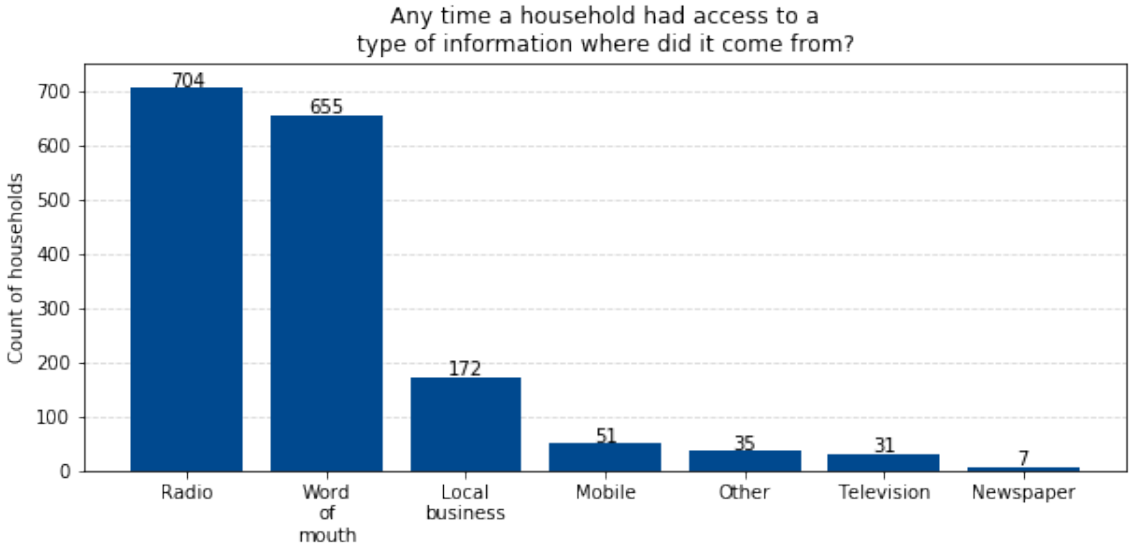

Figure 96: Each time a household indicated they had access to a type of information, they were asked to indicate a source. These sources were tallied to find what methods of receiving information were most popular. $n = n = 1,655$

3.9 GEOSPATIAL ANALYSIS

Each survey was geotagged with the location of the respondent, and this location data was analyzed to develop greater intuition on the impact of geographical location and distance to the nearest market on market access.

3.9.1 DISTANCE TO NEAREST TOWN

A household's distance to the nearest town is another factor that could impact available market opportunities. It is commonly suggested that the further a household is from a market center, the more difficult or expensive it will be for that household to participate in the market. The road infrastructure in rural areas is often less well-developed, which can make transporting goods to market more challenging and expensive. Households in rural areas may be less likely to have market connections than those closer to market centers, though this could be mitigated by mobile phone ownership. There is some debate about the impact of road infrastructure and distance to market on market participation, and we were interested in exploring this impact for the households in our sample.

Using the GPS locations that were collected for each household, we calculated the minimum distance each household would have to travel along roads to reach a town or city. The GIS data that we used came from OpenStreetMap (OSM), an open-source mapping tool whose data is generated by users worldwide. The OSM maps were the most detailed and up-to-date maps available for Uganda, particularly their coverage of the road network.

An origin-destination cost matrix was run to determine the minimum distance traveled along roads between each household and the nearest town/city. This calculated distance may not reflect the reality experienced by households: they may usually do business in a town that is slightly further away, or take a different route than the one found by the mapping tool. They may also use more informal routes that do not show up in the OSM road network. However, this distance measurement is a useful proxy for understanding how accessible the nearest market centers are to the households.

Based on these calculations, households in Gulu and Mubende would travel the greatest median distance along roads to reach the nearest town (35.0 km and 34.7 km, respectively). These distances are almost three times the median travel distance for households in Ibanda (12.2 km), and almost four times the median travel distance in Iganga (8.7 km).

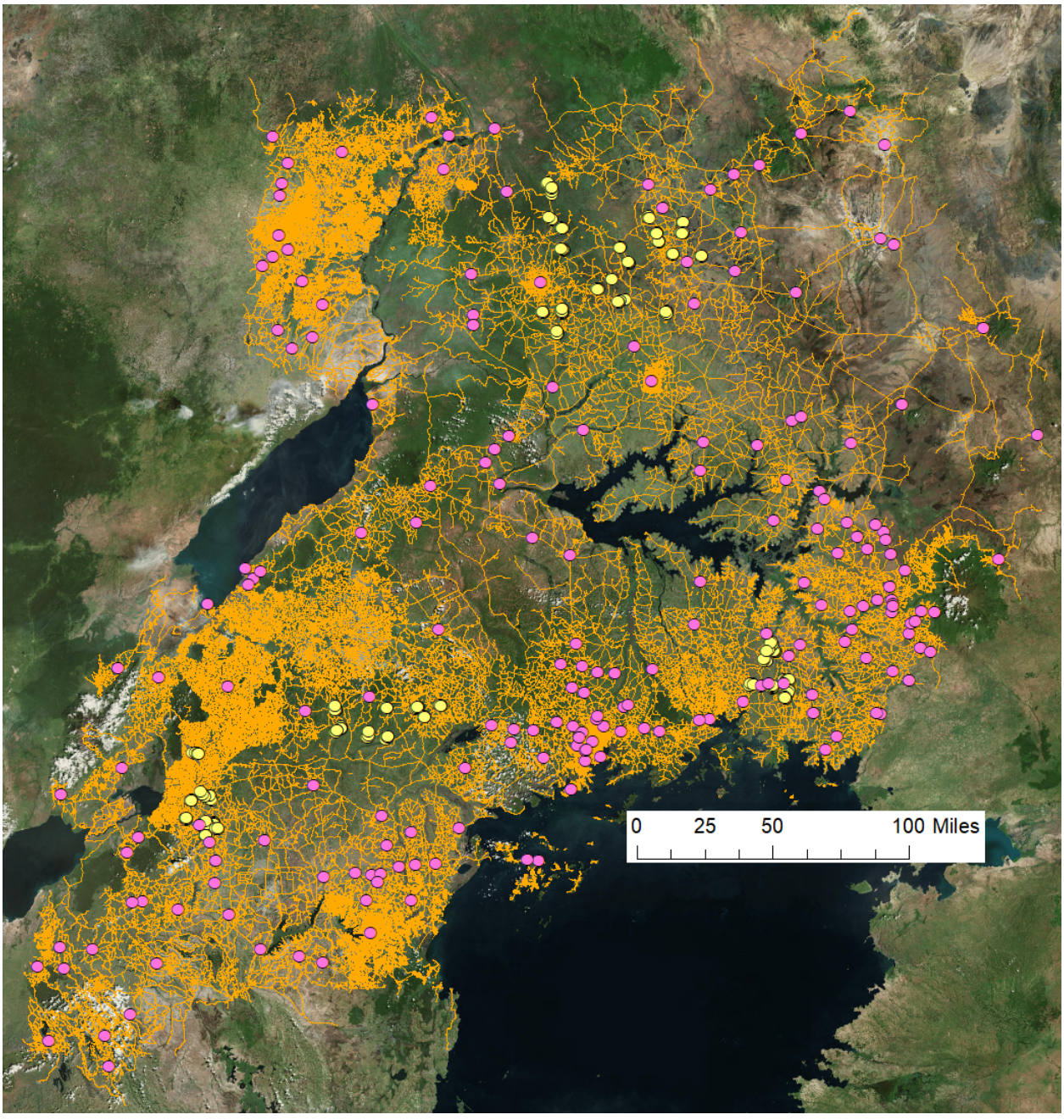

Figure 97: The entire OSM road network for Uganda. Respondent locations are shown with yellow markers. Towns and cities are shown with pink markers.

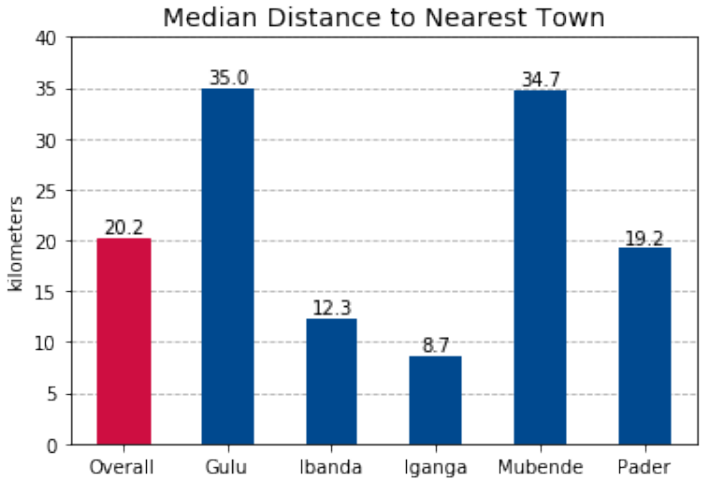

Figure 98: Median kilometers along roads to the nearest town. $n = 498$

3.9.2 KILOMETERS TO NEAREST MAJOR ROAD

Roads labelled as "primary" (which includes highways) or "secondary" within the OSM database were classified for "major" for this dataset. These classifications are intended to reflect a road's function and importance at the national level. These categories exclude residential roads, footpaths, and tertiary roads. Figure 99 shows the road network overlaid on satellite imagery, with the location of respondents show in yellow.

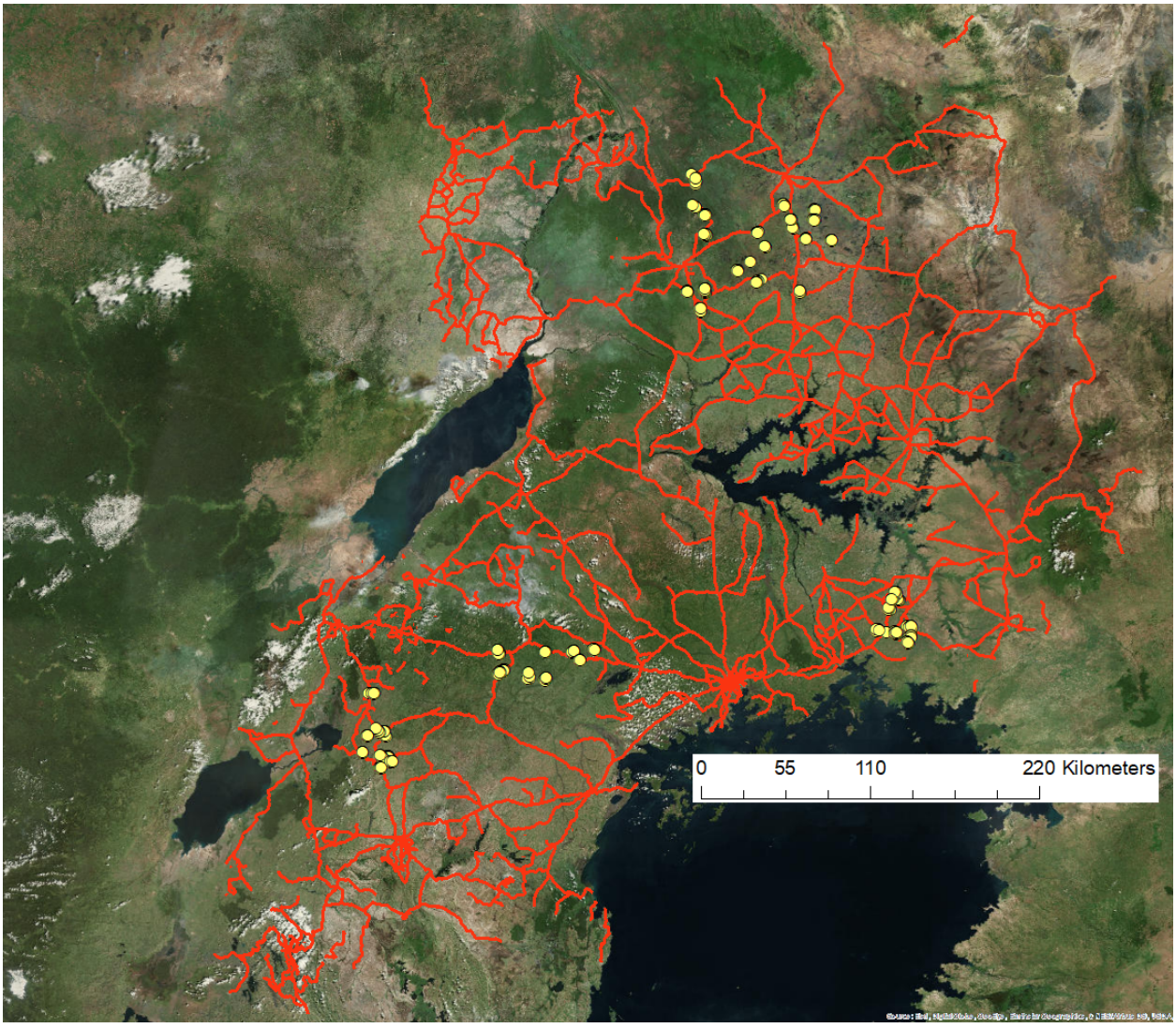

Figure 99: The primary and secondary roads of Uganda. Respondent locations are shown with yellow markers.

For each household, the minimum straight-line distance to the road network was calculated - this would be the shortest distance between the the household and the closest "major" road, not necessarily along a path or road. It is possible that the household actually travels a more circuitous route to get to the nearest road, such as along a smaller road or footpath, but the straight-line distance is a reasonable proxy based on the available data. The distribution of these distances is shown in Figure 101. Half of households live within 1.6 km of a major road.

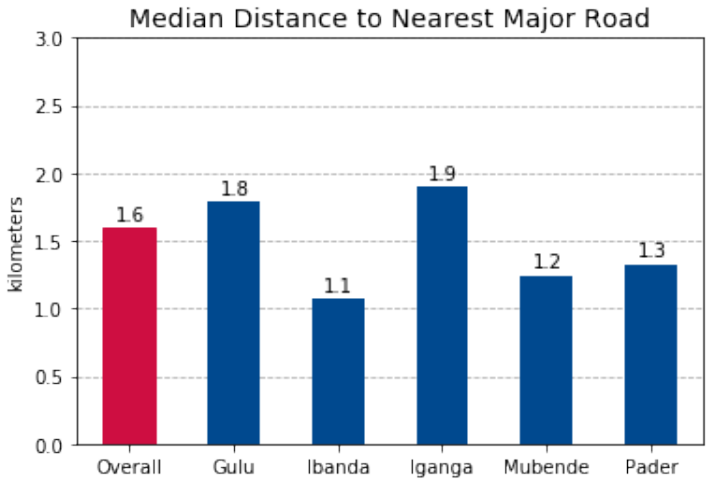

Figure 100: Median kilometers to the nearest major road. $n = 498$

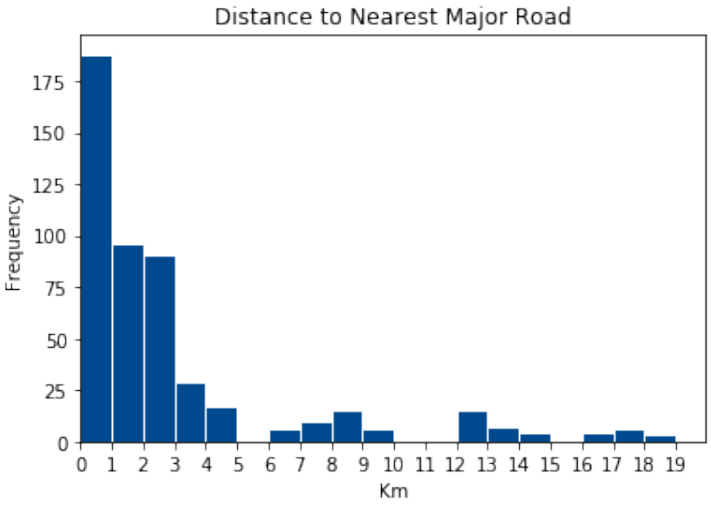

Figure 101: Kilometers to nearest major road. $n = 498$

We also calculated the correlation between the two distance measures: the distance along roads to the nearest town and the straight-line distance to the nearest road. The correlation coefficient was 0.29, suggesting that there is not a strong linkage between

how far the households are from the nearest road and how far they are from the nearest town. In other words, the households in more rural areas that are further from town centers are not necessarily far removed from the road network.

Figure 102 shows that no matter how far people must travel to get to town, 85% of them live with 5km of a major road. From this, we can infer that even people who live in more rural areas (further from the nearest town) tend to have access to transportation infrastructure.

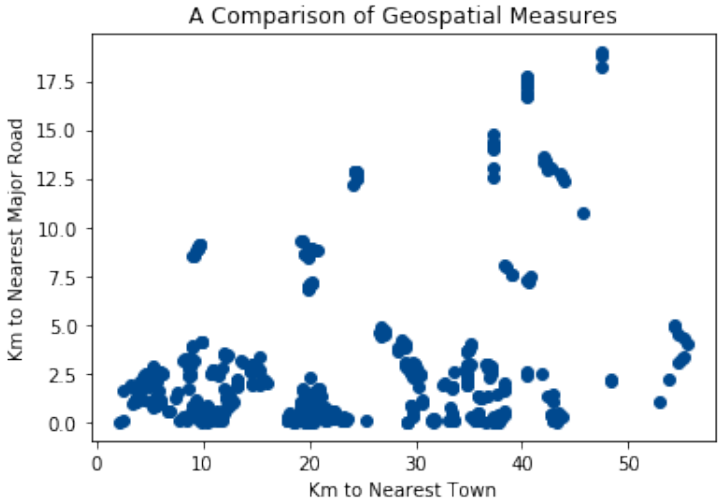

Figure 102: Km to nearest town vs km to nearest major road. $n = 498$

3.9.3 POPULATION OF NEAREST TOWN

Throughout our preliminary analysis, we began to see a pattern: for many of the households that sold their crops, their nearest town was a larger market/population center. We hypothesized that the more established and developed market infrastructure of larger towns could be enabling more nearby households to sell. To study this effect, we looked up the population for the nearest town to each household, using data from the 2014 National Population and Housing Census. Table 2 provides a list of the towns that were closest to the households in our sample, as well as their most recent population figures.

Town	Population
Gulu	149,802*
Mityana	96,075*
Mubende	95,416*
Iganga	55,263 ‡
Ibanda	32,752 §
Kyenjojo	22,960 §
Kyegegwa	18,763 §
Kaliro	16,753 ‡
Pader	13,382 †
Nakalama	13,010**
Busembatia	11,948 ‡
Oyam	11,727 †
Kole	8,860 †
Busesa (Ibaako)	6,093**
Igorora	5,880 §
Achol-Pii	3,417**
Latayi (Latigi)	2,290**
Atiak (Pungole)	2,224**

Table 2: Numbers marked with * come from Table 2.6 of the UBOS 2014 NPHC Main Report (Uganda Bureau of Statistics, 2016a). Numbers marked with † come from the census report for the northern region (Uganda Bureau of Statistics, 2016c). Numbers marked with ‡ come from the census report for the eastern region (Uganda Bureau of Statistics, 2016b). Numbers marked with § come from the census report for the western region (Uganda Bureau of Statistics, 2016d). Numbers marked with ** come from tables published by UBOS detailing the population of parishes (Uganda Bureau of Statistics, 2014a,b,c,d).

4 REGRESSION MODELING

As previously discussed, one of USAID's main objectives is increasing the livelihood of farming households. Encouraging farmers to participate in markets by selling some of what they grow presents one opportunity to achieve this goal. Central to this strategy is understanding the ways in which households participate in markets in the first place. One way to learn about this is to research what household characteristics separate those who sell some of their harvest from those who don't. There is a confluence of market incentives, infrastructure, and assets that enable and encourage households to sell their crops.

Market engagement as a concept cannot be measured, and there are many different ways of framing it. This chapter explores several of these different framings using regression analyses. These models focus solely on the outputs market. That is, does a household sell the harvest that they grow? Throughout this chapter, "market participation" and "market engagement" will be used interchangeably to indicate selling crops. Future analyses may investigate how participation in the inputs market overlaps with participation in the outputs market.

First, Section 4.1 will examine household characteristics related to the decision to participate in the market at all. This analysis informs our understanding of the factors which impact farmers' decisions to participate in the market and what obstacles may be holding back households which do not participate.

Focusing only on the households which did participate, Section 4.2 then seeks to understand the dynamics underlying the level of intensity of that participation. Once a household has made the decision to sell some of their harvest, what characteristics impact the extent of that participation? We discuss two different metrics for this concept and create a multiple linear regression model for each one.

While some models in the literature use regional prices as an endogenous variable (Alene et al., 2008; Goetz, 1992; Heltberg and Tarp, 2002; Lifeyo, 2017), we could not incorporate that here. Appropriate price data for the regions and time frame could not be gathered. For each instance in which a household sold a crop, they reported the price that they received. There is wild variation in these numbers, reflecting the decentralized nature of these rural markets. While regional prices may serve as incentives, the reality of what price a household received is not an independent variable. Households without transportation may have a buyer come pickup their crop for a lower price. Those with increased access to market information may be able to seek out the best prices. It is possible that the relative market price in general motivates households, but for these analyses we examine alternate factors.

4.1 DECISION TO PARTICIPATE IN THE MARKET

The most basic way of defining market engagement is whether a household sells any of their harvest at any point during a given time period. This binary model is commonly used in market engagement analyses in the literature (Alene et al., 2008; Goetz, 1992; Heltberg and Tarp, 2002; Key et al., 2000; Lifeyo, 2017; Omiti et al., 2009; Vance and Geoghegan, 2004; Yusuf et al., 2015).

Those classified as "engaged" have sold a crop to some buyer, regardless of the amount of the crop sold. Those who are "not engaged" do not sell their crops.

In the household survey, questions were asked about the two most recent harvest seasons: June-July 2017 and November-December 2017. Respondents were asked to choose from a list of crops indicating what their household grew. For each crop they indicated, they were asked about the acreage planted. For the three crops that were reported with the highest acreage planted, respondents were asked if they sold any of the harvest or not. Across the two seasons and the three top crops in each season for each respondent, we have a total of six datapoints on selling a crop or not. Therefore, a household is classified as engaged if they answered "Yes" at least once for the six datapoints about selling their harvest. A household that sells large amounts from all of its top three crops in both seasons and a household that sells a small fraction of a single crop in only the second season are on equal footing in this model. No overarching question was asked about whether any crop outside of the top three was sold. If there are households which do not sell anything from their top three crops by acreage but do sell from their other crops, they will be classified as "not engaged" under this scheme. Our classification relies upon the assumption that households which are engaged with the market will plant a larger area of the crops that they sell.

We chose to expand our definition of market participation beyond the single crop models used in some of the literature. Observing market participation across all crops is the same approach taken by Heltberg and Tarp (2002). While different crops may involve different dynamics in terms of land needed, preference for home consumption, ability to be stored, and market demand, we are ultimately interested in the overall decision to sell and engage in agriculture as an economic activity. In addition, examining market participation in aggregate broadly reduces the influence of substitution effects of crops.

Our data set has 498 respondents, 406 who sold any of their top three crops during either season of 2017 and 92 who did not. Of the people who did not sell, 2 did not plant any crops during 2017, 3 did not harvest any of the crops that they planted, and 1 could not remember any of the quantities harvested. These 6 respondents have been left out of this logistic regression model. We want our model to focus on factors which influence decisions to sell crops or not. Households which do not have any harvest to sell implicitly do not have to make this decision. There will be perfect separation between non-selling and non-harvesting. Removing these 6 households, our sample has the following break-down shown in Table 3.

Sellers	406
Non-sellers	84
Total	**492**

Table 3: The count of sellers and non-sellers within the data.

4.1.1 MODELING THE DECISION TO PARTICIPATE IN MARKETS

In order to determine which features to include in our model, a combination of intuition and computational methods were used. Since this regression focuses on the decision to sell or not, all features relating to sellers (such as how much they sold, the price that was received, how they knew the buyer, etc) were removed. Although these factors may influence the decision to sell or not, we do not have any of this counterfactual information for the non-sellers.

A summary of the responses for most of the variables chosen below can be found in Chapter 3. This model uses an additional variable for the log of the kilograms harvested per capita, which is described in Appendix C.

The resulting model is shown in Table 4.

	β	Change in Odds	Std.Err.	z	P $>\|$ z $\|$	[0.025	0.975]
Constant	-5.1333		0.8224	-6.2421	0.0000	-6.7451	-3.5215
Log Kg Harvested Per Capita	1.1848	+227.0%	0.1555	7.6179	0.0000***	0.8800	1.4897
Population of Nearest Town in Thousands	0.0132	+ 1.3%	0.0039	3.3442	0.0008***	0.0055	0.0209
Services Sum	0.0984	+10.3%	0.0572	1.7186	0.0857*	-0.0138	0.2106
Nearby Input Shop	0.3536	+42.4%	0.3111	1.1367	0.2557	-0.2561	0.9633
Off-Farm Income 75 - 100% of Total	-1.5674	-79.1%	0.7474	-2.0971	0.0360**	-3.0323	-0.1025
Km to Nearest Town	-0.0043	-0.4%	0.0123	-0.3498	0.7265	-0.0283	0.0197
Km to Nearest Road	0.0254	+2.6%	0.0414	0.6126	0.5402	-0.0558	0.1066
Transportation Access	-0.3825	-31.8%	0.3063	-1.2487	0.2118	-0.9829	0.2179
Food Secure	-0.4024	-33.1%	0.3573	-1.1265	0.2600	-1.1026	0.2978
Mobile Phone Ownership	0.6529	+92.1%	0.2956	2.2085	0.0272**	0.0735	1.2324
Member of Producer Organization	1.4883	+343.0%	0.8191	1.8170	0.0692*	-0.1171	3.0937

Table 4: The final logistic regression model. *, **, *** represent significance at the 10%, 5%, and 1% levels.

The final multiple logistic regression model has a pseudo R^2 of 0.306. The chi-squared test of its likelihood ratio test against the null yields a p-value of 1.22e-24, giving us high confidence that this model is better than the null. The Hosmer-Lemeshow test with 10 groupings results in a χ^2 = 5.9283 with a p-value = 0.6553, indicating that we do not reject the null that the model fits well. Even varying the number of groupings used for the Hosmer-Lemeshow test yields robust results for good fit. With 9 groupings, we find χ^2 = 2.9799 with a p-value = 0.8869. With 11 groupings, we find χ^2 = 9.2953 with a p-value = 0.4105. With 12 groupings, we find χ^2 = 4.5544 with a p-value = 0.9189.

For this model, the apparent AUC (area under the receiver operating curve) is 0.86.

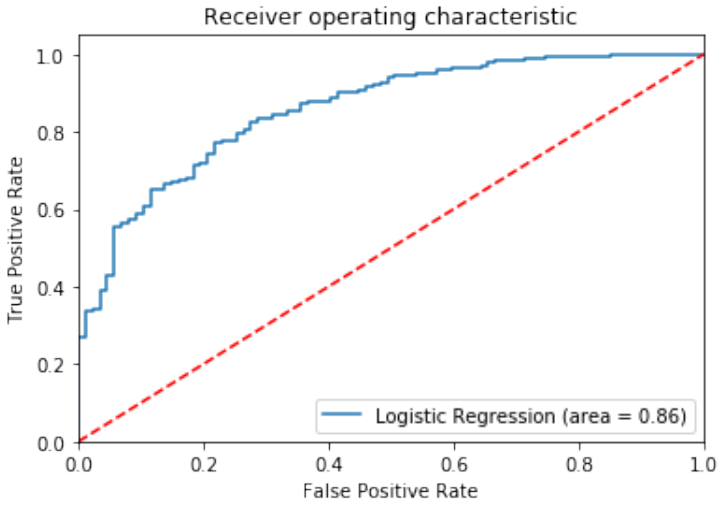

Figure 103: The receiving operator curve for the logistic regression model.

4.1.2 DISCUSSION

Log Kg Harvested Per Capita: The level of production per household member is statistically significant at the 1% level. An increase in the mass of the harvest per household member leads to an increase in the likelihood of selling. The more food a family has on hand per person, the more it may be willing to allocate that food away from consumption and toward earnings in the market. Note that this independent variable represents the aggregated kg of the entire mix of crops produced. Although the differing yield and weight of various crops can result in differences across households with different crop portfolios, we believe that the total amount harvested still provides a useful metric of overall production. For this analysis, we have taken the log in order to transform an initially skewed distribution to approximately normal. Therefore, the coefficient must be interpreted in terms of the effect of a one-unit increase in the the log of kg harvested on the log-odds of selling.

Population of Nearest Town in Thousands: At the 1% level, households whose closest town is more populous are more likely to participate in markets. More populous towns will have more traders, more opportunities for transport, and better developed market system infrastructure. The greater number of available traders may mean that farmers can access more competitive and favorable prices for their products. The significance of this variable and its positive coefficient help inform our understanding that more developed markets are linked to market participation. Market development may be an important enabler of participation.

Services Sum: The results show that the more services a household reports are accesible, the greater their probability of participating in the market. Note that this sum is not necessarily the services that a household took advantage of, but simply that there are people nearby who could perform them if a household was willing to purchase them. Therefore, this measure can be a proxy for the strength of the agricultural system infrastructure around a households. We find that it has a positive impact that is significant at the 10% level. This underscores our finding above about larger towns, showing that more developed markets are linked to more market

participation. Market development may be an important enabler of participation.

Nearby Input Shop: The dummy variable for whether or not a household had an inputs shop nearby was not significant in contributing to market participation. This can be another measure of market development as well as market access as it reflects whether or not inputs are both available and accessible. The fact that this does not significantly impact market participation may be a result of market development being encapsulated by the "services sum" variable while market access is captured by the geospatial measures discussed below.

Off-Farm Income 75 - 100% of Total: Having a job or small business off-farm that is responsible for 75 - 100% of a household's income had a significant effect at the 5% level on decreasing a household's market participation. They may use what they grow exclusively for household consumption since their need for cash liquidity is met through alternate economic activities. This barrier does not necessarily require the attention of market facilitation efforts; not all households are interested in commercializing agriculture.

Km to Nearest Town: Interestingly, we find that the distance that must be traveled along roads to reach the nearest town has no impact on market participation. Distance to market and the cost of transportation are not a barrier to selling; people are motivated to sell their crop regardless of how far they are from market centers. This may suggest that there are intermediary points of selling that are not associated with town markets.

Km to Nearest Major Road: Again we find that geospatial characteristics do not impact market participation. This variable is the straight-line km from a household to the nearest major road and can be a proxy for the accessibility of transportation infrastructure. This is not a barrier impacting households' decisions to sell their crops.

Transportation Access: We find that households which report having private transportation access (ie, bicycle, motorcycle, truck, or car) do not have an advantage in participating in markets. Similar to the geospatial measures, this dummy variable reflects an element of market access. Within the Ugandan context, transportation does not serve as an enabler to market engagement. Conversely, households without access to transportation are not excluded from participating in markets.

Food Secure: Households which never skip meals are not more likely to participate in markets than others. Instead of eschewing selling in order to eat what they produce, food insecure households still participate in markets. This may reflect the fact that households may sometimes prioritize their need for cash liquidity over food security. With school fees and medical bills, households have to make difficult choices about how to allocate resources. The fact that food security had no significant impact on market participation suggests that market facilitation efforts will not exclude households which don't have enough to eat.

Mobile Phone Ownership: At the 5% level, households which own a mobile phone are more likely to participate in markets. A phone is a technology which can strengthen a household's connection to the market and ability to access information. It acts as an enabler by reducing the variable costs associated with traveling outside of the home to learn about market prices, available buyers, agricultural products, and transportation opportunities.

Member of Producer Organization: At the 10% level, membership in a producer organization

yields a statistically significant increase in a household's likelihood of participating in the market. These groups serve as enablers by providing valuable leadership and organization to smallholder farming communities. Collective marketing can yield more favorable prices from buyers, lower transportation costs, and increased opportunities to learn about agricultural trainings, techniques, and products. In addition to reductions in transaction costs, these groups also expand a farmer's social network and opportunity for market-oriented relationships (Bosc et al., 2002). All of these benefits contribute to membership in a producer organization serving as an enabler to market participation.

4.2 LEVEL OF MARKET PARTICIPATION

Beyond the binary choice of whether or not to participate, another way of thinking about market engagement is the level of engagement of a household. We are interested in understanding what household characteristics are connected to an increased intensity of market participation. Once we understand some of the factors that push/pull households to markets, what can increase how intensely they participate? An increase in the level of market participation will yield an increase in revenue generated from agriculture. To understand some of these factors, we build two linear regression models around two different ways of quantifying the level of engagement. Beyond seeing what factors these models deem significant, we are interested in comparing and contrasting them to gain insight into the ways different metrics for level of engagement may be connected with different factors. Does looking at different metrics suggest different market facilitation strategies be used? If so, how can those strategies be compared and prioritized?

For the two metrics examined, we perform a mono-crop analysis over a single season. Narrowing the focus of the model to one crop can better allow for a better comparison across households. Different crops will have different densities, so it is challenging to compare the farmer who sells 100kg of beans and the one who sells 100kg of cassava. To ensure a consistent comparison across households, we focus on maize sold from the November - December 2017 season. Maize was the crop grown by the largest share of households, with 351 (70.5%) respondents cultivating it in November - December 2017. This is slightly higher than the 335 (67.3%) households which cultivated it in June - July 2017, so we focus on the former season in order to have a larger dataset. As the country's top crop grown for consumption, maize is versatile in terms of home consumption and selling on well-developed markets (FAPDA, 2015).

Of the households that cultivated maize in November - December 2017, 180 reported selling it. Our analyses of level of market participation will focus only on this subset that participated in the maize market.

In order to better compare the two different metrics of market participation, the same set of independent variables will be used for both models. To understand what features impact the level of market participation, a subset of features was chosen using subject matter knowledge, computational methods, and intuition for features which could describe the household experience and connect to market facilitation. This included many of the factors from the logistic regression model for market participation. We used these factors from the previous model in order to inform our understanding of how the decision to participate and level of participa-

tion may have similar or different barriers and enablers. Definitions and descriptions for the variables can be found in Chapter 3 and Appendix C.

Beyond the features chosen for these models, there are likely exogenous market factors impacting household selling decisions. Maize grain prices in November 2017 were 12% lower than November 2016 and maize flour prices in November 2017 were 6% lower than November 2016 (WFP, 2017). Regional market trends may have an impact on market participation that we are unable to uncover by focusing on a single season.

Section 4.2.1 first discusses the model for market participation intensity using the log of the amount of maize sold as the dependent variable. Section 4.2.2 then presents a model using the logit of the percent of maize sold as the dependent variable. Section 4.2.3 discusses and compares the results for these two models.

4.2.1 AMOUNT SOLD

In this analysis, we quantify level of market engagement over a continuous range by examining the total amount of maize a household sold in a single season. The continuous range of amount sold will allow for a more nuanced exploration of the factors that impact market engagement. It is intuitive that there is some difference between a farmer who sells massive quantities and a farmer who sells a small amount. What influences the success of the first farmer? Comparing this continuous model to the binary one above, are there some enablers that are "gates" in that they must be present for selling, but the extent and magnitude does not matter? Are there some enablers that work on a scale? As in, do farmers who have a linear quantity of something linearly sell more of their harvest?

	β	Std.Err.	z	P $>\|$ z $\|$	[0.025	0.975]
Constant	-0.9365	0.240	-3.900	0.000***	-1.411	-0.462
Log Maize Harvested	1.0676	0.041	26.102	0.000***	0.987	1.148
Log Other Harvested	-0.0228	0.033	-0.700	0.485	-0.087	0.042
Household Size	-0.0141	0.012	-1.176	0.241	-0.038	0.010
Population of Nearest Town in Thousands	0.0008	0.001	0.872	0.384	-0.001	0.003
Services Sum	0.0049	0.013	0.381	0.704	-0.021	0.030
Nearby Input Shop	-0.0319	0.075	-0.427	0.670	-0.179	0.115
Off-Farm Income 75 - 100% of Total	-0.1799	0.250	-0.720	0.473	-0.674	0.314
Km to Nearest Town	0.0063	0.003	1.845	0.067*	-0.000	0.013
Km to Nearest Road	-0.0250	0.009	-2.794	0.006***	-0.043	-0.007
Transportation Access	0.0099	0.081	0.122	0.903	-0.150	0.170
Pickup	0.0829	0.112	0.737	0.462	-0.139	0.305
Food Secure	0.0425	0.093	0.456	0.649	-0.141	0.226
Mobile Phone Ownership	0.1149	0.089	1.290	0.199	-0.061	0.291
Member of Producer Organization	-0.0620	0.154	-0.402	0.688	-0.367	0.243

Table 5: The final linear regression model using log(kg maize sold) as the dependent variable. *, **, *** represent significance at the 10%, 5%, and 1% levels. $R^2 = 0.884; N = 180$

Our model yields an R^2 of 0.884, indicating that it explains much of the variation in the data. Plotting the actual values against the predictions yield a clear linear pattern. Much of the explanatory power comes from the inclusion of the log of maize harvested. The residuals do not show any pattern and the Breusch-Pagan test yields a high p-value (0.970), indicating homoskedasticity.

4.2.2 PERCENT SOLD

The second way of measuring market engagement that we will explore is the percent of a harvest that a household sells. More commercially oriented households will sell a higher percent, while those who may mostly eat what they grow but have some cash needs will sell a lower percent.

A portion bounded between 0 and 1 poses issues for a fitting an unbounded linear regression model. To mitigate this issue, we take the logit of the percent sold and perform multiple linear regression on that dependent variable. Of the 180 maize sellers, 21 of them sold 100% of their harvest. We adjust this value to 99% in order to be able to take the logit. Models were built replacing 100% with values from 95% to 99.9% to test how choosing this value impacted the output and found only small changes in the coefficient values and no changes in the significance of independent variables.

	β	Std.Err.	z	P >| z |	[0.025	0.975]
Constant	-0.0050	0.815	-0.006	0.995	-1.614	1.604
Log Maize Harvested	0.3001	0.139	2.161	0.032**	0.026	0.574
Log Other Harvested	-0.1704	0.111	-1.538	0.126	-0.389	0.048
Household Size	-0.0523	0.041	-1.282	0.202	-0.133	0.028
Population of Nearest Town in Thousands	0.0023	0.003	0.720	0.473	-0.004	0.009
Services Sum	0.0422	0.044	0.961	0.338	-0.044	0.129
Nearby Input Shop	-0.2756	0.253	-1.089	0.278	-0.775	0.224
Off-Farm Income 75 - 100% of Total	-0.9619	0.849	-1.133	0.259	-2.638	0.714
Km to Nearest Town	0.0244	0.012	2.119	0.036**	0.002	0.047
Km to Nearest Road	-0.0861	0.030	-2.838	0.005***	-0.146	-0.026
Food Secure	0.1748	0.316	0.553	0.581	-0.449	0.799
Transportation Access	-0.0667	0.276	-0.242	0.809	-0.611	0.478
Pickup	-0.1110	0.381	-0.291	0.771	-0.864	0.642
Mobile Phone Ownership	0.2056	0.302	0.680	0.498	-0.391	0.802
Member of Producer Organization	-0.5077	0.524	-0.970	0.334	-1.541	0.526

Table 6: The final linear regression model using the logit of the percent of maize sold as the dependent variable. *, **, *** represent significance at the 10%, 5%, and 1% levels. $R^2 = 0.162; N = 180$

Our model yields an R^2 of 0.162, indicating that there is a large amount of unexplained variation. Plotting the actual values against the predictions, a pattern barely emerges. This model is not a great fit. The residuals do not seem to show any pattern and the Breusch-Pagan test yields a high p-value (0.326), indicating homoskedasticity. There are factors driving these decisions that we are not able to account for in this analysis.

4.2.3 DISCUSSION

Comparing the model for percent sold to the model for the amount sold, it is interesting that the percent sold model fits so poorly while the other one fits well. One reason may be that fitting models for a bounded range (a proportion from 0 to 1) can be challenging, especially when there are samples which take on one of the limiting values (21 households sell 100% of their harvest). In addition, there may be complex decision making processes behind the portion sold that are not captured by the factors in this model. For example, we see that 31 of the 180 maize sellers (17%) sell exactly 50% of their crop, making it the mode for the percent sold data. Of these households, 16 harvested 200kg, while the others harvested between 80kg and 1600kg. These households are modeled on the same dependent variable in the percent model, even though we expect that they experience very different decision making factors.

Between the two models for level of market participation, results are consistent. Both models find that the only factors which have a statistically significant impact on increasing level of market engagement are an increase in the amount of maize harvested, a decrease in the distance to the nearest primary road, and an increase in the distance traveled to town. The two different metrics are in complete agreement in identifying barriers and enablers. This concurrence suggests that, should USAID choose to monitor the level of market participation as an indicator of the success of market facilitation, they may find similar results if they choose either of these metrics. In terms of ease of data collection, however, it would make the most sense to gather information on the amount that a household sells. The portion that a household sells requires a second datapoint for the amount that they harvested.

This consistency across these two models should be tested using other types of crops to see if the results hold. Future work could build a model with revenue as the target variable to compare for differences in the relevant factors. In addition, a model could also be built for acres planted, as was used as a proxy for level of market engagement by Vance and Geoghegan (2004). We expect that such a model may differ from the others, as it is less direct in reflecting market transactions and may also capture consumption needs.

Log Maize Harvested: Households which harvested more maize tended to sell a larger portion and amount, a finding that is statistically significant at the 1% level. Increased harvest also played a role in the decision to participate in the first place. The consistent importance of this variable suggests that increasing production is crucial to increasing market participation.

Log Other Harvested: The amount of all other crops was included to control for crop substitution dynamics. It may be that households which grew other crops sold those instead of the maize. However, the results do not show any effect.

Household Size: There was no statistically significant impact of household size on the portion or amount of the harvest sold. This was an unexpected result. We expected that, all else being equal, households with more members would sell less than others because they keep more for household consumption. The fact that this is not the case may suggest that households are substituting other crops for consumption in the place of maize.

Population of Nearest Town in Thousands: The size of the nearest town does not impact

the amount of maize that households sell, suggesting that level of market development plays a reduced role in level of market engagement. Results from Section 4.1.1 showed that this factor was significant in encouraging the decision to participate in the market. The level of development of markets encourages participation, but once someone is selling, further development does not impact the amount or portion sold.

Services Sum: The number of services available to a household did not impact the level of intensity of engagement, even though it influences the decision to sell. Consistent with the result for the population of the nearest town, the level of market development seems to encourage market participation but has no impact on the level of that participation. It is purely an enabler to selling versus not.

Nearby Input Shop: Having a nearby input shop does not impact the amount or portion of the harvest sold. This suggests that connectedness and level of development do not play a large role in the level of market engagement.

Off-Farm Income 75 - 100% of Total: Employment off the farm that makes up the large majority of a household's cash income did not impact the amount or percent of maize that a household sells. Our model for market participation found that this was a significant variable. Having a large share of income from off the farm may be a "gated" enabler. The fixed transaction costs associated with selling may not be worth it to some households with other economic activities, but once those fixed costs are met, the level of participation is unaffected by outside income.

Km to Nearest Road: A statistically significant effect at the 1% level was found that households closer to roads sell a greater amount and portion of their maize harvest. This result may suggest that the level of effort to transport bags of maize along footpaths and smaller, rougher roads limits the amount that a household chooses to sell. The hassle involved in traversing these very rural transportation networks before hitting a primary road may influence households to eat what they have grown instead of making multiple trips to sell more.

Km to Nearest Town: The distance that a household must travel along the road network to reach the nearest town has a statistically significant effect in both models. Unexpectedly, the coefficient for this variable has a positive sign, implying that the further a household must travel into town, the more they will sell. This result could suggest that households which live further away need to sell more in order to offset transportation costs, or that those who are closer to town may have additional employment options.

Transportation Access: Having access to a bicycle, motorcycle, car, or truck does not impact the amount or portion of maize that a household chooses to sell.

Pickup: Whether or not the buyer picked up the harvest did not have a statistically significant impact on the portion or amount that was sold. We were interested to see if structuring relationships with buyers to be more convenient could increase the level of intensity of market engagement. However, this does not seem to be the case.

Food Secure: Household food security had no impact on the level of market engagement in either model. This is an unexpected result. We saw that the decision to participate was not impacted by food security, suggesting that food insecure households may sell their harvest

when they have cash needs. However, it could be expected that food insecure households which sell their crop limit it to a smaller portion and a smaller amount. This is not what we see reflected in the models. Controlling for the amount harvested, a food insecure household does not sell less than a food secure household. There may be substitution effects in which the food insecure households consume crops other than maize. It may also be the case that the cash needs of these households are so high that they must have an increased level of participation. Further research should explore the dynamics behind the marketing decisions of food insecure households in order to better understand the experience of these vulnerable families and how to better serve them with interventions.

Mobile Phone Ownership: Ownership of a mobile phone did not impact the level of market engagement, even though it does play a role in the decision to participate in the first place.

Member of Producer Organization: Membership in a producer organization does not impact the level of market engagement using either metric, even though it was important to the decision to participate.

A APPENDIX A: SURVEY

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

FARMER HOUSEHOLD SURVEY QUESTIONNAIRE

0.1	DATE	*[DATE]*
0.2	START TIME	*[TIME]*
0.3	DISTRICT	*[SINGLE CODE]* *GULU* *IBANDA* *IGANGA* *MUBENDE* *PADER*
0.4	VILLAGE	*[SHORT ANSWER]*
0.5	INTERVIEWER ID	*[NUMBER]*
0.6	INTERVIEWER NAME	*[SHORT ANSWER]*

[INTERVIEWER SCRIPT]

Thank you for agreeing to participate in this study. We are conducting research for USAID in order to understand how farmers like you engage with the market. We will ask some basic questions about your household, and then ask about your farm and your business partners. We appreciate your participation. Let's get started.

1. DEMOGRAPHIC QUESTIONS

1.1	Name	*[SHORT ANSWER]*
1.2	Age	*[NUMBER]*
1.3	Gender	*MALE* *FEMALE*
1.4	Highest level of education attained	*[SINGLE CODE]* *NO FORMAL EDUCATION* *SOME PRIMARY* *COMPLETED PRIMARY* *SOME O-LEVEL* *COMPLETED O-LEVEL* *SOME A-LEVEL* *COMPLETED A-LEVEL* *SOME UNIVERSITY* *COMPLETED UNIVERSITY* *ADULT LITERACY ONLY (NO FORMAL EDUCATION)* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
Interviewer script		*Now I will ask some questions about*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		*your household. Your household includes everyone who usually **lives here, sleeps here, and eats from the same source.** Please include children, relatives, or orphans, even if they are not at home at the time of interview, but do not count temporary visitors. Please include children who may be away at school.*
1.5	How many adults live in the household?	*[NUMBER]* *DON'T KNOW* *REFUSED*
1.6	How many children under 18 live in the household?	*[NUMBER]* *DON'T KNOW* *REFUSED*
	IF 1.6 > 0	
1.6A	Do any of the children live away at boarding school?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 1.6A	
1.6B	How many?	*[NUMBER]* *DON'T KNOW* *REFUSED*
1.7	Do you financially support any other people who do not live in the household?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 1.7	
1.7A	How many?	*[NUMBER]* *DON'T KNOW* *REFUSED*
1.8	Do you own a mobile phone?	*YES* *NO* *DON'T KNOW* *REFUSED*
1.9	Do you own or have access to a bicycle or other means of transportation?	*[MULTICODE]* *BICYCLE* *MOTORCYCLE* *CAR* *TRUCK* *OTHER [SPECIFY]* *NONE* *DON'T KNOW*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		REFUSED
1.10	Did your household earn income from outside the farm in the past year?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 1.10	
1.10A	What portion of the household's income comes from work outside the farm?	*[SINGLE CODE]* *LESS THAN 25%* *25-50%* *50-75%* *75-100%* *DON'T KNOW* *REFUSED*
1.10B	What are the other sources of household income?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
1.10C	What do you consider your primary source of income?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
1.11	Have you participated in or received support or training from any NGO or government programs in the past year?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 1.11	
1.11A	What kind of support or knowledge? Who provided it?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
1.11B	Who provided it?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*

2. FINANCE QUESTIONS

2.1	Does anyone in the household have a bank account?	*YES* *NO* *DON'T KNOW* *REFUSED*
2.2	Does anyone in the household belong to a VSLA, SACCO, or savings group?	*YES* *NO* *DON'T KNOW* *REFUSED*
2.3	Does anyone in the household have a mobile money account?	*YES* *NO*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		DON'T KNOW *REFUSED*
2.4	Has anyone in the household borrowed money in the past year?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 2.4	
2.4A	What was the amount borrowed?	*[NUMBER]* *DON'T KNOW* *REFUSED*
2.4B	What was the money borrowed for?	*[MULTI CODE]* *AGRICULTURAL INPUTS* *SCHOOL FEES* *WEDDING* *BURIAL* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
2.4C	What was the source of the money?	*[MULTI CODE]* *RELATIVE* *FRIEND* *INFORMAL LENDER* *BANK* *MICROFINANCE* *SACCO* *VSLA* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF NO @ 2.4	
2.4D	Did anyone in the household try to borrow money or get a loan in the past year and not succeed?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 2.4D	
2.4E	Why not?	*[MULTI CODE]* *NO COLLATERAL* *MISSING PAPERWORK* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
2.5	Has anyone in the household received credit from a business in the past year, such as inputs that are paid for at the end of the season?	*YES* *NO* *DON'T KNOW* *REFUSED*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

	IF YES @ 2.5	
2.5A	What was the source of this credit?	*[MULTI CODE]* *INPUT DEALER* *TRADER* *COOPERATIVE* *OUTGROWER SCHEME* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
2.6	Has anyone in the household lent money to someone outside the household in the past year?	*YES* *NO* *DON'T KNOW* *REFUSED*

3. AGRONOMIC PRACTICES

3.1	How much land does your household farm?	*[NUMBER] [ACRES/HA]* *DON'T KNOW* *REFUSED*
3.2	How much of this land does your household own?	*NUMBER [ACRES/HA]* *DON'T KNOW* *REFUSED*
3.3	How much of this land are you renting or borrowing?	*NUMBER [ACRES/HA]* *DON'T KNOW* *REFUSED*
3.4	Has the household ever rented land for farming in the past? (this question should be asked with an emphasis on the past, even if the family currently rents all or some of their land)	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 3.4	
3.4A	When was this?	*YEAR* *DON'T KNOW* *REFUSED*
	IF YEAR @ 3.4A > 2012	
3.4B	How many acres/hectares?	*[NUMBER] [ACRES/HA]* *DON'T KNOW* *REFUSED*
3.4C	At what price?	*NUMBER [TOTAL / PER ACRE / PER HA / OTHER]* *DON'T KNOW* *REFUSED*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

	IF NO @ 3.4	
3.4D	Why haven't you rented land?	*[MULTI CODE]* *DON'T NEED* *CAN'T AFFORD* *NOT AVAILABLE* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
3.5	How much does it usually cost per season to rent an acre in this area?	*[NUMBER] [PER ACRE / PER HA]* *DON'T KNOW* *REFUSED*
3.6	Did you hire anyone to work on your farm this past season or the season before?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 3.6	
3.6A	How many people did you hire?	*[NUMBER]* *DON'T KNOW* *REFUSED*
3.6B	How many days did each person work on average?	*[NUMBER]* *DON'T KNOW* *REFUSED*
3.7	Do you have any livestock?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 3.7A	
3.7A	What kind?	*[MULTI CODE]* *CATTLE* *GOATS* *PIGS* *SHEEP* *CHICKENS* *DONKEYS* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	LOOP FOR EACH ANSWER @ 3.7A	
3.7B	How many?	*[NUMBER]*
3.8	Have you ever received any formal training on farming techniques?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 3.8	

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

3.8A	When was the most recent training?	*YEAR* *DON'T KNOW* *REFUSED*
3.8B	From whom?	*[MULTI CODE]* *NGO* *EXTENSION WORKER* *COOPERATIVE* *GOVERNMENT PROGRAM* *INPUT DEALER* *BUYER* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
3.8C	What was the training about?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
3.8D	How did you hear about the training?	*[MULTI CODE]* *PERSONALLY INVITED* *WORD OF MOUTH* *HEARD ON RADIO* *SELF-INVITATION* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
3.9	Did you have any of these problems with your crops last season (ending November-December 2017)? (Pease ask, "Did you have ____ " for each option)	*[MULTI CODE]* *DROUGHT* *HEAVY RAINS* *LATE RAINS* *FALL ARMY WORM* *OTHER INSECTS* *CROP DISEASES* *FIRE* *OTHER [SPECIFY]* *NONE* *DON'T KNOW* *REFUSED*
3.10	Did you have any of these problems with your crops the season before (ending June-July 2017)? (Please ask, "Did you have ____ " for each option)	*[MULTI CODE]* *DROUGHT* *HEAVY RAINS* *LATE RAINS* *FALL ARMY WORM* *OTHER INSECTS* *CROP DISEASES* *FIRE* *OTHER [SPECIFY]*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		NONE *DON'T KNOW* *REFUSED*
3.11	For most years, how many months out of the year does the household eat primarily food grown on the farm?	*[NUMBER]* *DON'T KNOW* *REFUSED*
3.12	In the last year, did your household purchase food for consumption?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 3.12, ASK 3.12A-3.12E. **3.12B-D should be looped in a subgroup for each month checked.**	
3.12A	During which months did you buy food this past year?	*[MULTI CODE]* *JANUARY* *FEBRUARY* *MARCH* *APRIL* *MAY* *JUNE* *JULY* *AUGUST* *SEPTEMBER* *OCTOBER* *NOVEMBER* *DECEMBER* *DON'T KNOW* *REFUSED*
	LOOP 3.12B-D FOR EACH MONTH SELECTED	
3.12B	How much did you purchase?	*[NUMBER] [KG / SPECIFY UNIT]* *DON'T KNOW* *REFUSED*
3.12C	How much did you pay in total?	*[NUMBER] [UGX / SPECIFY UNIT]* *DON'T KNOW* *REFUSED*
3.12D	Why did you purchase the food?	*[MULTI CODE]* *DIDN'T PLANT THIS CROP* *POOR HARVEST* *LITTLE STORAGE CAPACITY* *NOT ENOUGH PRODUCTION BECAUSE OF SMALL LAND SIZE* *SALE OF HARVEST DUE TO URGENCY* *OTHER [SPECIFY]* *DON'T KNOW*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		REFUSED
3.12E	Do you buy food every year?	*[SINGLE CODE]* *YES* *ONLY IF HARVEST IS BAD* *ONLY IN EXCEPTIONAL CASES* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
3.13	Does anyone in your household ever have to skip meals because there is not enough food?	*[SINGLE CODE]* *ONCE OR TWICE A WEEK* *ONCE OR TWICE A MONTH* *A FEW TIMES PER YEAR* *NEVER* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*

4. AGRICULTURAL INPUTS

4.1	Is there an input shop nearby where you can purchase inputs?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 4.1	
4.1A	Name of input dealer	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
4.1B	Town / Village	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
4.1C	Have you ever purchased inputs from this shop?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 4.1C	
4.1D	How often do you buy from them?	*[SINGLE CODE]* *EVERY TIME I BUY INPUTS* *SOMETIMES* *JUST ONCE* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.1E	Why did you decide to purchase from	*[MULTI CODE]*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

	this input shop?	*NEARBY* *REFERRED BY SOMEONE* *SAW ADVERTISEMENT* *HAS GOOD REPUTATION* *NO PARTICULAR REASON* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF HAS GOOD REPUTATION @ 4.1E	
4.1F	Why does this shop have a good reputation?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
4.1G	Do you trust the shop owner?	*[SINGLE CODE]* *1: NOT AT ALL* *2: NOT REALLY* *3: NOT SURE* *4: SOMEWHAT* *5: YES, DEFINITELY* *DON'T KNOW* *REFUSED*
	IF NO @ 4.1C	
4.1H	Why haven't you purchased inputs from them?	*[MULTI CODE]* *DON'T PURCHASE INPUTS* *CAN'T AFFORD INPUTS* *SHOP TOO FAR* *SHOP HAS BAD REPUTATION* *DON'T TRUST OWNER* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF NO @ 4.1	
4.2	For the crops that were planted last season, where did your seeds come from?	*[MULTI CODE]* *HOME-SAVED* *PURCHASED* *NGO* *GOVERNMENT* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF PURCHASED @ 4.2	
4.2A	Where did you purchase them?	*[MULTI CODE]* *INPUT SHOP* *FAMILY* *FRIEND* *NEIGHBOR*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		COOPERATIVE *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.3	For the crops that were planted for the first season of 2017, where did your seeds come from?	*[MULTI CODE]* *HOME-SAVED* *PURCHASED* *NGO* *GOVERNMENT* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF PURCHASED @ 4.3	
4.3A	Where did you purchase them?	*[MULTI CODE]* *INPUT SHOP* *FAMILY* *FRIEND* *NEIGHBOR* *COOPERATIVE* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.4	Did you use any agricultural chemicals last season, which ended in November-December 2017?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 4.4	
4.4A	What did you use?	*[MULTI CODE]* *FERTILIZER* *PESTICIDE* *HERBICIDE* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.4B	Where did you purchase it?	*[MULTI CODE]* *INPUT SHOP* *FAMILY* *FRIEND* *NEIGHBOR* *COOPERATIVE* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF NO @ 4.4	
4.4C	Why didn't you use any?	*[MULTI CODE]*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		COULDN'T AFFORD *DON'T NEED* *NOT AVAILABLE* *DON'T SEE VALUE* *TOO FAR AWAY* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.5	Did you use any agricultural chemicals the season before, which ended in June-July 2017?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 4.5	
4.5A	What did you use?	*[MULTI CODE]* *FERTILIZER* *PESTICIDE* *HERBICIDE* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.5B	Where did you purchase them?	*[MULTI CODE]* *INPUT SHOP* *FAMILY* *FRIEND* *NEIGHBOR* *COOPERATIVE* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF NO @ 4.5	
4.5C	Why didn't you purchase any?	*[MULTI CODE]* *COULDN'T AFFORD* *DON'T NEED* *NOT AVAILABLE* *DON'T SEE VALUE* *TOO FAR AWAY* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.6	Are you aware of the problem with counterfeit inputs?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 4.6	

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

4.6A	How did you learn about this problem?	*[MULTI CODE]* *FRIENDS OR NEIGHBORS* *INPUT DEALER* *NGO* *GOVERNMENT* *NEWSPAPER* *RADIO* *TELEVISION* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.6B	What do you do to avoid counterfeit inputs?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
4.7	Let's say a particular tin of seeds costs 20,000/= for 50g. How much more would you pay for a tin that was guaranteed to have a germination rate of 85-90%?	*[SINGLE CODE]* *1000 UGX* *2000 UGX* *5000 UGX* *10000 UGX* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
4.8	Let's say 1L of pesticides costs 20,000/=. How much more would you pay for 1L of pesticides that were certified as genuine and effective?	*[SINGLE CODE]* *1000 UGX* *2000 UGX* *5000 UGX* *10000 UGX* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*

5. PRODUCTION & HARVEST

Now I want to ask you about your harvests. First we will talk about the most recent harvest, from November-December 2017. Then we will talk about the one before that, which started in June-July 2017.

	LOOP ENTIRE SECTION TWICE: ONCE FOR JUNE 2017 HARVEST SEASON, ONCE FOR DECEMBER 2016 HARVEST SEASON	
5.1	Which crops did you plant?	*[MULTI CODE]* *MATOOKE* *SWEET BANANA*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		CASSAVA *MAIZE* *BEANS* *SORGHUM* *FINGER MILLET* *RICE* *IRISH POTATOES* *SWEET POTATO* *ORANGE SWEET POTATOES* *GROUNDNUTS* *SIMSIM* *SOYA BEANS* *PIGEON PEAS* *COWPEAS* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	LOOP FOR EACH CROP SELECTED @ 5.1	
5.2	How much (in acres) did you plant?	*[NUMBER]* *DON'T KNOW* *REFUSED*
	LOOP 5.3 FOR TOP 3 CROPS BY AREA PLANTED FROM 5.2	
5.3	How much did you harvest?	*[NUMBER] [KG / 100KG BAGS / SPECIFY UNIT]* *DIDN'T MEASURE* *DON'T REMEMBER* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
5.4	Did you store any of your harvest?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES *@ 5.4, LOOP 5.4A-B*	
5.4A	How much did you store?	*[NUMBER] [KG / 100KG BAGS / PERCENTAGE OF HARVEST / SPECIFY UNIT]* *DIDN'T MEASURE* *DON'T REMEMBER* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
5.4B	What did you use to store the crop?	*[MULTI CODE]* *GRAIN STORAGE BAGS*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		IMPROVED STORAGE BAGS *PLASTIC SILO* *METAL SILO* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
5.4C	Are you aware of improved storage bags / silos?	*YES* *NO* *DON'T KNOW* *REFUSED*
5.5	Did you sell any of your harvest?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES *@ 5.5, LOOP 5.5A-N.* ***If NO @ 5.5, skip to 5.5O***	
5.5A	How much did you sell?	*[NUMBER] [KG / 100KG BAGS / PERCENTAGE OF HARVEST / SPECIFY UNIT]* *DIDN'T MEASURE* *DON'T REMEMBER* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
5.5B	What price did you receive?	*[NUMBER] [UGX PER KG / SPECIFY UGX PER UNIT]* *DON'T KNOW* *REFUSED*
5.5C	Who did you sell it to?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
5.5D	Where are they located?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
5.5E	How did you come to know this buyer?	*[MULTI CODE]* *CAME TO ME* *WORD OF MOUTH* *REFERRED BY SOMEONE* *SAW ADVERTISEMENT* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
5.5F	Why did you decide to sell to this buyer?	*[MULTI CODE]* *NEARBY* *BEST PRICE*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		ONLY BUYER *CAME TO PICK CROP* *HAS GOOD REPUTATION* *NO PARTICULAR REASON* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF HAS GOOD REPUTATION @ 5.5F	
5.5G	Why does this buyer have a good reputation?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
5.5H	Did you have a contract or formal arrangement to sell to this buyer?	*YES* *NO* *DON'T KNOW* *REFUSED*
5.5I	Have you sold to this buyer in previous seasons?	*ALWAYS* *SOMETIMES* *NEVER* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF ALWAYS / SOMETIMES @ 5.5I	
5.5J	How many years have you sold to them?	*[NUMBER]* *DON'T KNOW* *REFUSED*
5.5K	Do you trust this buyer?	*[SINGLE CODE]* *1: NOT AT ALL* *2: NOT REALLY* *3: NOT SURE* *4: SOMEWHAT* *5: YES, DEFINITELY* *DON'T KNOW* *REFUSED*
5.5L	Did you bring the produce to the buyer, or did they come to you?	*[SINGLE CODE]* *DELIVERED TO BUYER* *THEY CAME TO PICK PRODUCE* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
5.5M	What was the mode of transportation?	*[MULTI CODE]* *ON FOOT* *BICYCLE* *MOTORCYCLE* *TRUCK* *BUYER PICKED UP FROM FARM*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		THROUGH COOPERATIVE *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
5.5N	How much did transport cost you?	*NUMBER [UGX]* *DON'T KNOW* *REFUSED*
	IF NO @ 5.5	
5.5O	Why didn't you sell any of your harvest?	*[MULTI CODE]* *NO SURPLUS* *NO BUYERS AVAILABLE* *PRICE TOO LOW* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
5.6	Do you know any farmers that have received better prices for better quality crops?	*YES* *NO* *DON'T KNOW* *REFUSED*
5.7	How do you determine crop quality? What do you look for to know if crops are good quality or bad quality?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*

6. MARKET LINKAGES

6.1	Which of these services are accessible to you? (If unclear, prompt with "Is there someone near you who could provide these services if you wanted or needed them?")	*[MULTI CODE]* *PLOWING/TILLING* *SOIL TESTING* *IRRIGATION* *WEEDING* *SPRAYING* *PRUNING* *HARVESTING* *DRYING* *GRAIN CLEANING* *HULLING* *SHELLING/THRESHING* *MILLING* *PACKAGING* *STORAGE* *TRANSPORTATION* *EXTENSION/TRAINING*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

		OTHER [SPECIFY] *DON'T KNOW* *REFUSED*
6.2	Have you ever paid for any of these services?	*[MULTI CODE]* *PLOWING/TILLING* *SOIL TESTING* *IRRIGATION* *WEEDING* *SPRAYING* *PRUNING* *HARVESTING* *DRYING* *GRAIN CLEANING* *HULLING* *SHELLING/THRESHING* *MILLING* *PACKAGING* *STORAGE* *TRANSPORTATION* *EXTENSION/TRAINING* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
6.3	If you could afford to, which of these services would you use?	*[MULTI CODE]* *PLOWING/TILLING* *SOIL TESTING* *IRRIGATION* *WEEDING* *SPRAYING* *PRUNING* *HARVESTING* *DRYING* *GRAIN CLEANING* *HULLING* *SHELLING/THRESHING* *MILLING* *PACKAGING* *STORAGE* *TRANSPORTATION* *EXTENSION/TRAINING* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
6.4	Have you ever rented equipment, such as spray pumps, processing equipment, or a	*YES* *NO*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

	vehicle?	*DON'T KNOW* *REFUSED*
	IF YES @ 6.4	
6.4A	What kind of equipment?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*
6.5	Are you a member of a producer organization / cooperative?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 6.5	
6.5A	When did you join?	*[YEAR]* *DON'T KNOW* *REFUSED*
6.5B	What services does the group provide?	*[MULTI CODE]* *INPUTS FOR PURCHASE* *BULK MARKETING* *EXTENSION AGENTS* *ADVOCACY FOR ORDINANCES* *LOANS* *BURIAL FUNDS* *SCHOOL FEES* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
	IF NO @ 6.5	
6.5C	Is there one in this district or sub-county that you could join?	*YES* *NO* *DON'T KNOW* *REFUSED*
6.6	Are you a member of any other groups?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 6.6	
6.6A	What type of group?	*[SHORT ANSWER]* *DON'T KNOW* *REFUSED*

7. ACCESS TO INFORMATION

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

7.1	Which of the following types of information do you have access to?	MARKET PRICES WEATHER DATA OPPORTUNITIES TO SELL CROPS NEW PLANTING/HARVESTING/PHH TECHNIQUES NEW PRODUCTS OR SERVICES PRODUCT QUALITY ANTI-COUNTERFEIT PROGRAMS GOVERNMENT PROGRAMS NGO PROGRAMS *DON'T KNOW* *REFUSED*
	LOOP FOR EACH TYPE OF INFORMATION SELECTED IN 7.1:	
7.1A	How do you get this information?	*[MULTI CODE]* *MOBILE* *NEWSPAPER* *RADIO* *TELEVISION* *WORD OF MOUTH* *LOCAL BUSINESS* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
7.1B	How often do you receive this information?	*[SINGLE CODE]* *ONE TIME ONLY* *DAILY* *WEEKLY* *MONTHLY* *SOMETIMES* *NEVER* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
7.2	Have you attended trainings on any of the following topics? Category: Product Knowledge 1. Identifying genuine inputs 2. Safe use of chemicals and herbicides	*[SHORT ANSWER]* *NONE OF THESE* *DON'T KNOW* *REFUSED*
7.2A	Who provided these trainings?	*[SHORT ANSWER]* *OTHER [SPECIFY]*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

	1. NGO 2. Extension worker 3. Cooperative 4. Government program 5. Input dealer 6. Buyer	*DON'T KNOW* *REFUSED*
7.3	Have you attended trainings on any of the following topics? Category: Agricultural Practices 1. No-till planting 2. When to plant/harvest crops 3. Agricultural machinery & using machines 4. Environmental mitigation practices 5. Good agronomic practices 6. Integrated pest management 7. Labor-saving technologies 8. Intercropping	*[SHORT ANSWER]* *NONE OF THESE* *DON'T KNOW* *REFUSED*
7.3A	Who provided these trainings? 1. NGO 2. Extension worker 3. Cooperative 4. Government program 5. Input dealer 6. Buyer	*[SHORT ANSWER]* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
7.4	Have you attended trainings on any of the following topics? Category: Business Practices 1. Record keeping for inventory/sales 2. Farming as a family business 3. Leadership 4. Entrepreneurship 5. Business plan development 6. Literacy 7. Numeracy 8. Marketing 9. Pricing 10. Business registration	*[SHORT ANSWER]* *NONE OF THESE* *DON'T KNOW* *REFUSED*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

7.4A	Who provided these trainings? 1. NGO 2. Extension worker 3. Cooperative 4. Government program 5. Input dealer 6. Buyer	*[SHORT ANSWER]* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
7.5	Have you attended trainings on any of the following topics? Category: Financial Management Practices 1. Bookkeeping 2. Saving 3. E-payments 4. Credit access 5. Insurance	*[SHORT ANSWER]* *NONE OF THESE* *DON'T KNOW* *REFUSED*
7.5A	Who provided these trainings? 1. NGO 2. Extension worker 3. Cooperative 4. Government program 5. Input dealer 6. Buyer	*[SHORT ANSWER]* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*
7.6	Have you attended trainings on any of the following topics? Category: Post-Harvest Handling and Production Practices 1. Harvesting 2. Post-harvest handling techniques 3. Grading 4. Quality control	*[SHORT ANSWER]* *NONE OF THESE* *DON'T KNOW* *REFUSED*
7.6A	Who provided these trainings? 7. NGO 1. Extension worker 2. Cooperative 3. Government program	*[SHORT ANSWER]* *OTHER [SPECIFY]* *DON'T KNOW* *REFUSED*

Jarrod Goentzel, Director, Humanitarian Response Lab
Massachusetts Institute of Technology, 77 Massachusetts Ave.,
Cambridge, MA 02139 USA
goentzel@mit.edu +1 617-253-2053

	4. Input dealer 5. Buyer	
7.3	What information about agriculture or farming as a business do you not have access to that you wish you did?	*[OPEN-ENDED]*

8. OPEN-ENDED QUESTIONS

8.1	Did your household experience any major problems this year or last year? Such as an illness or a death in the family?	*[OPEN-ENDED]*
8.2	Are there any products or services that you need to successfully run your farm that you don't have access to here?	*[OPEN-ENDED]*

9. HONORARIUM

Thank you for your participation in this survey. When this study is completed, we will make the results of our research available to your community.

We would like to give you 20,000 UGX in appreciation for your time today.

9.1	Do you have a mobile money account that we can send the money to?	*YES* *NO* *DON'T KNOW* *REFUSED*
	IF YES @ 9.1	
9.1A	Enter mobile money number	*[PHONE NUMBER]*
9.1B	Confirm mobile money number	*[PHONE NUMBER]*

B APPENDIX B: SAMPLING PROCEDURES

A two-stage cluster sampling process was used to identify the households that were interviewed. For the first stage, each district was divided into 2x2 km squares, which became the primary sampling unit. Within the sampled set of squares, the secondary sampling unit was individual farm households, which were selected from a set of buildings identified using satellite imagery.

B.1 STAGE ONE: PRIMARY SAMPLING UNIT

1. We used GIS shapefiles that were created by the Ugandan Energy Sector GIS Working Group based on 2014 data provided by the Uganda Bureau of Statistics[10]. This dataset provides information that is the most up to date possible and provides information at the sub-county level, the smallest geographic unit of measure used by the census. The shapefile contains:
    - an outline for every sub-county in the country
    - the name of each sub-county
    - the name of the county and district to which each sub-county belongs
2. Since the purpose of the study was to investigate market access among farming households, those households living in dense population centers were purposively excluded. These households may be less likely to participate in agriculture due to land constraints. In addition, their proximity to market centers could provide greater access to knowledge and opportunities than are available to households in rural areas, such that we would expect these households to interact with the market in different ways. We defined these population centers based on official administrative units: Municipalities and Town Councils. To achieve this, we removed any sub-county in the shapefile that had the phrase "Town Council" in its name. We also removed any sub-county which belonged to a county that had the word "Municipality" in its name.
3. The remaining sub-counties for each chosen district were mapped in ArcGIS. A 2km x 2km grid was placed over each district. Figure 104 demonstrates how this looked for Gulu and Pader.
4. Boxes that fell on the border of a district of interest were excluded if more than 2 km^2 (half the area of the box) lay outside the target districts.
5. In order to give each farm household in the district approximately equal probability of being selected, the boxes had to be assigned a non-uniform probability distribution using a probability proportional to size method. In the ideal world, the total number of farming households in each box would be known, and each box would be assigned a probability of:

[10] This data can be found at https://energydata.info/dataset/subcounty-boundaries-2014

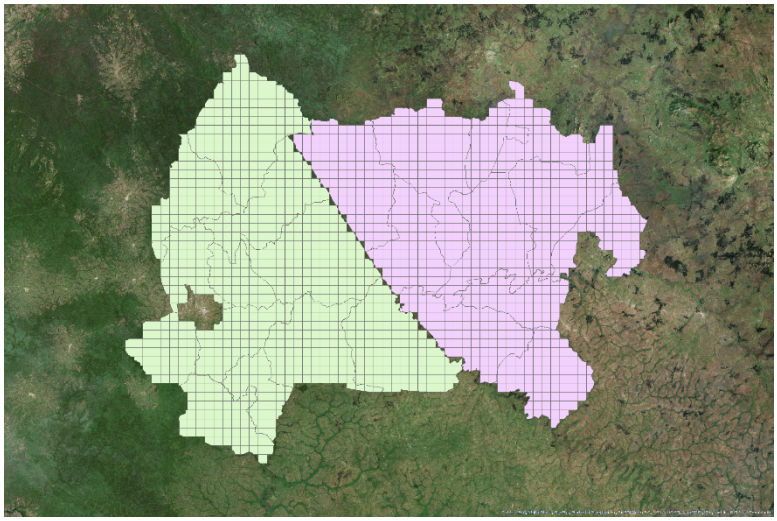

Figure 104: The primary stage sampling units. Gulu is highlighted in green, and Pader is highlighted in pink. The urban regions of each district have been removed, as evidenced by the hole in Gulu. Along the border of the two districts, sampling units less than 2 km^2 in area have been removed.

$$P_{box} = \frac{\text{\# farming households in box}}{\text{\# farming households in district}}$$

Since these exact numbers are impossible to know, the farmer population density of a sub-county was used to approximate the number of farmers in a given area. This approach assumes the population of farming households is distributed uniformly across a sub-county. The simplest case is a 2km x 2km box that sits directly in a single sub-county and does not straddle any borders. The farming household density for a sub-county can be calculated using the sub-county area and the number of subsistence farming households in a sub-county as given in the 2014 UBOS census. The census defined a subsistence farming household as one for which subsistence farming was their main source of livelihood. The estimated number of farming households would be the area of the box multiplied by the farming household density of that sub-county.

$$\text{estimated \# of farming households} = \text{box area} * \frac{\#\text{farmers in sub-county}}{\#\text{farmers in district}}$$

Some boxes straddled more than one sub-county such that there were multiple polygons created by the intersection of the box and the borders . The number of farming households in these boxes was calculated by:

$$\text{estimated \# of farming households} = \sum_{n=1}^{i} \text{area of polygon } i * \frac{\#\text{farmers in sub-county } i}{\#\text{farmers in district}}$$

The probability of choosing any given box is the estimated number of farming households in that box divided by the total number of farming households within the district.

$$P_{box} = \frac{\text{\# estimated farmers in box}}{\text{\# farmers in district}}$$

6. Once each box had been assigned a weighted probability according to the estimated number of farming households, 30 boxes were chosen at random for each of the districts - 10 as the primary sample, and 20 as a reserve in case replacements were needed.
7. The 150 boxes were then inspected using Google Maps satellite imagery, and 13 were eliminated according to the following criteria:
    - Topography: Boxes with more than 50% of their area covered by water or forest cover were eliminated. Two squares in Mubende were covered by a lake and three squares in Ibanda were covered by a forest.
    - Population size: Given our target of 10 interviews per box, those boxes with fewer than 10 visible buildings/compounds were eliminated. Five squares in Mubende, two in Gulu, and one in Pader were sparsely populated and thus eliminated. This may bias the sample toward farmers who are more connected to other market actors, have better infrastructure, and have smaller farm sizes. However, interviewing extremely rural areas that would require extra visits to other areas to make up for the lack of 10 interviews was unfeasible given the constraints in terms of transportation, time, and resources.

B.2 STAGE TWO: SECONDARY SAMPLING UNIT

1. We used satellite imagery from Google Maps to identify and number the man-made structures in the 2x2 km boxes according to certain criteria. Buildings that were already labeled on Google Maps as churches or commercial buildings were not included.

    This process was completed for the first 22 boxes in each district.

    - Gulu and Pader: In these two rural districts, the secondary sampling units were compounds/homesteads, defined as a cleared area with buildings. Most of the population does not live in structures made with modern building materials. A single household will live on a compound with multiple huts.

        Though it is possible that some of these compounds contained multiple households, such as several families within an extended clan, we determined that the market access characteristics of these households are likely to be the same for the purposes of our study, and therefore the households did not need to be considered separately. Each clearing was marked and numbered, as were any buildings located outside of these groupings. Figure 105 provides an example of compounds, with each grouping that was counted circled in yellow.

Figure 106: A satellite view of example farmland in Ibanda. Each pin represents an individual household.

Figure 105: A satellite view of example farmland in Uganda. Units that would have been identified as "households" have been circled.

- Ibanda, Iganga, and Mubende: In these districts, a single unit was marked as groupings of buildings that seemed part of the same household based on to each other proximity and separation from other buildings. Buildings close together but on separate clearings indicates separate households. Buildings on the same clearing were typically grouped together. All other individual buildings were marked and numbered individually. Figure 106 provides an example of counting buildings in this setting.
- Buildings lying on the border of the box boundary were included.

We acknowledge that it is challenging to determine whether a building is a household or a business. Therefore, we included all buildings that did not meet the exclusion criteria above.

2. For the second stage of sampling, uniform random sampling was used to choose 30 households from the list of identified households for each square - again, the first 10

serving as the primary sample, with 20 potential replacements if needed. In total, this gave us 100 target households for each district: 10 structures in each of the 10 2x2 km squares.

C APPENDIX C: OVERVIEW OF TRANSFORMED VARIABLES FOR REGRESSION

C.1 KILOGRAMS HARVESTED

For each of a household's top three crops (by acres planted) for each of the two growing seasons in 2017, households reported how much was harvested. Most households reported the quantity in kg, while others used bags or bunches. Bags and bunches were converted to kg using conversion factors from the World Bank (Oseni et al., 2017).

The median value is 959 kg. Note that this includes a mix of different crops.

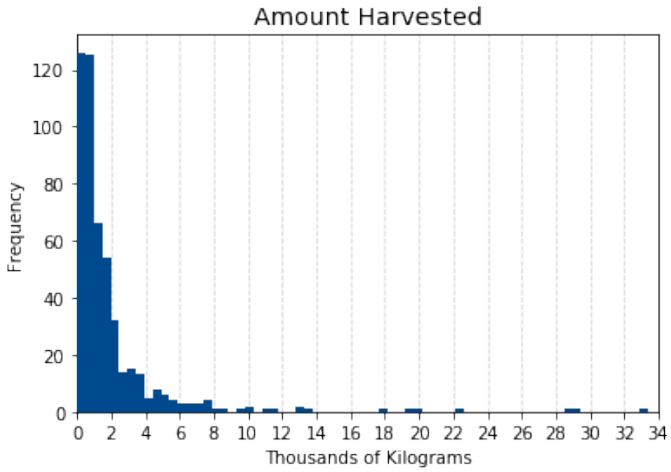

Figure 107: The harvest size distribution.

For the purposes of our model of the decision to sell some of the harvest of not, discussed in Section 4.1.1, we were interested in the amount of food harvested relative to the number of people in a household. To that end, we divided the amount harvested by each household by the number of people living there to come up with the amount of food generated per capita. The distribution for the per capita harvest is skewed similarly to the distribution of the total harvest shown in Figure 107. Since the distribution is so skewed, we transformed it by taking the natural log to get the approximately normal shape shown in Figure 108.

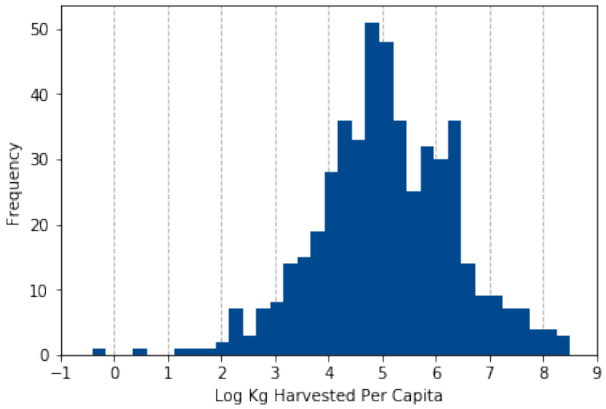

Figure 108: The harvest size distribution. $n = 492$

As discussed in Section 4.2, the two models exploring factors connected to level of market participation focus specifically on maize sold in November - December 2017. We wanted our model to include the impact the quantity of maize a household harvests has on the portion sold and the quantity sold. The amount of maize harvested was found to be an approximately log-normal distribution. Therefore, the feature included in our model has been log transformed. The distribution of the log of maize harvested by the subset of households which sold maize in November - December 2017 is shown in Figure 109.

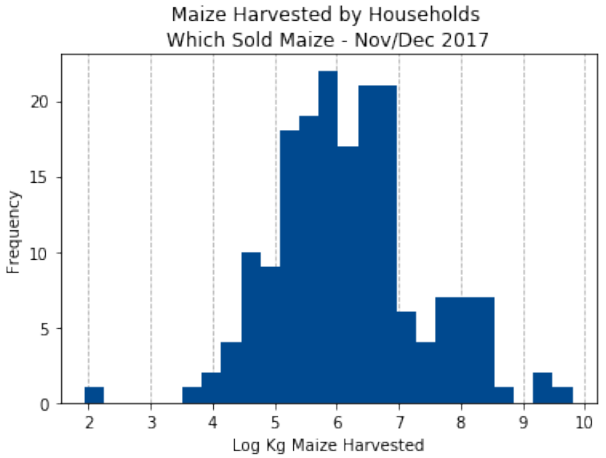

Figure 109: The distribution of how much log(maize) was harvested in November/December 2017 by households which sold maize in November/December 2017. $n = 180$

C.1.1 KILOGRAMS SOLD

For both seasons in 2017, each household was asked about the amount that they sold for each of their top three crops (according to the area planted). The kg sold value is the sum of the amount sold for these six crops. Out of the 406 households which decided to participate in the market at all, the median amount sold is 506 kg.

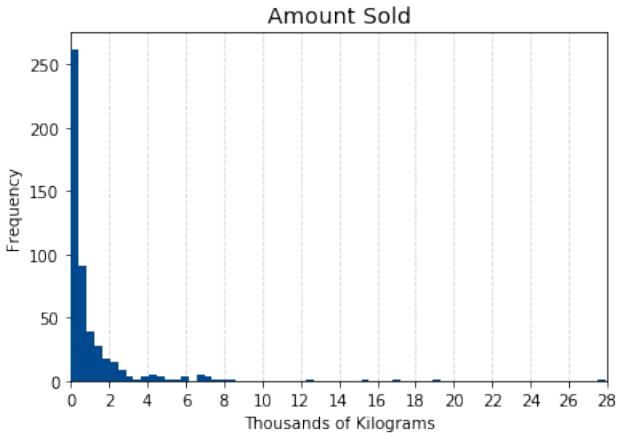

Figure 110: The harvest size distribution. $n = 492$

Section 4.2 examines the subset of households which sold maize in November - December 2017. The amount sold is used as a proxy for the level of market participation. To achieve a more normal target distribution, the log of the kg of maize sold is used as the dependent variable. The mean is 5.7 and the standard deviation is 1.3.

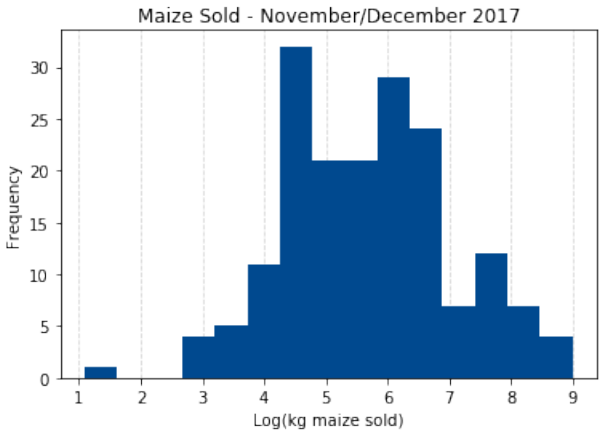

Figure 111: The distribution of the log(kg maize sold) for households which sold maize in November - December 2017. $n = 180$

C.1.2 PORTION SOLD

The second model explored in Section 4.2 used the logit of the portion sold as the dependent variable to explain level of market participation. This model focused on the subset of households which sold maize during November - December 2017. Figure 112 shows the distribution of the portion of the maize harvest that households sold.

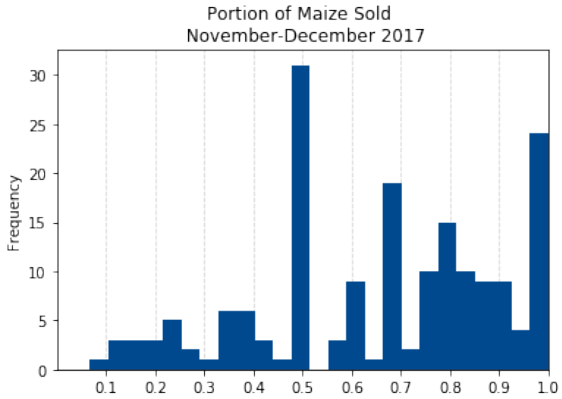

Figure 112: The distribution of the portion of maize sold in November - December 2017. $n = 180$

To transform this bounded portion into an unbounded value which can be used as the dependent variable in multiple linear regression, we take the logit.

$$\text{logit}(p) = \ln \frac{p}{1-p}$$

This distribution now looks more normal and takes on a continuous range. The mean is 1.1 and the standard deviation is 1.7. There were 21 households which sold their entire maize harvests, creating a spike on the upper end of the distribution. Since the logit of 1 is infinite, all farmers who sold 100% of their crop were adjusted to 99%, the logit of which is 4.6. Replacement values from 95% to 99.99% were experimented with in the model building process and found to have very minimal impact on the results. For simplicity, 99% was chosen as the final replacement value.

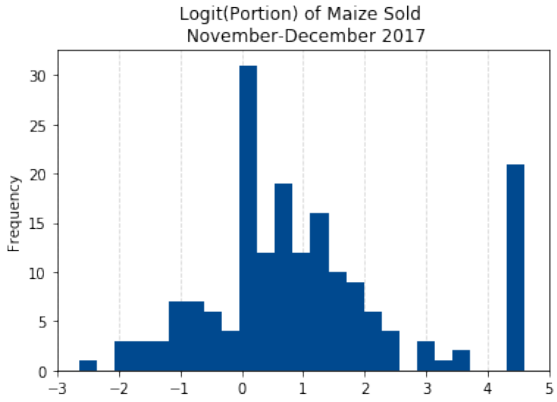

Figure 113: The distribution of the logit of the portion of maize sold in November - December 2017. $n = 180$

REFERENCES

Alene, A., Manyong, V., Omanya, G., Mignouna, H., Bokanga, M., and Odhiambo, G. (2008). Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. *Food Policy*, 33(4):318–328.

Ashour, M., Gilligan, D. O., Hoel, J., and Karachiwalla, N. (2019). Do Beliefs About Herbicide Quality Correspond with Actual Quality in Local Markets? Evidence from Uganda. *The Journal of Development Studies*, 55(6):1285–1306.

Bosc, P.-M., Eychenne, D., Hussein, K., Losch, B., Mercoiret, M.-R., and Rondot, P. ... Sadie, P. M.-W. (2002). The role of rural producer in the world bank development strategy.

FAPDA (2015). Uganda Country Fact Sheet on Food and Agriculture Policy Trends. , Food and Agriculture Policy Decision Analysis.

Goetz, S. (1992). A Selectivity Model of Household Food Marketing Behavior in Sub-Saharan Africa. *American Journal of Agricultural Economics*, 74(2):444–452.

Heltberg, R. and Tarp, F. (2002). Agricultural supply response and poverty in Mozambique. *Food Policy*, 27:103–124.

Key, N., Sadoulet, E., and de Janvry, A. (2000). Transactions Costs and Agricultural Household Supply Response. *American Journal of Agricultural Economics*, 82(2):245–259.

Latynskiy, E. and Berger, T. (2016). Networks of Rural Producer Organizations in Uganda: What Can be Done to Make Them Work Better? *World Development*, 78:572–586.

Lifeyo, Y. (2017). Market Participation of Smallholder Common Bean Producers in Malawi. , International Food Policy Research Institute (IFPRI). MaSSP Working Paper 21.

Omiti, J. M., Otieno, D. J., Nyanamba, T. O., and McCullough, E. B. (2009). Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. *African Journal of Agricultural and Resource Economics*, 3(1):57–82.

Oseni, G., Durazo, J., and McGee, K. (2017). The Use of Non-Standard Units for the Collection of Food Quantity. , World Bank.

Uganda Bureau of Statistics (2014a). Total Population by Sex, Total Number of Households and proportion of Households headed by Females by Subcounty and Parish, Central Region, 2014.

Uganda Bureau of Statistics (2014b). Total Population by Sex, Total Number of Households and proportion of Households headed by Females by Subcounty and Parish, Eastern Region, 2014.

Uganda Bureau of Statistics (2014c). Total Population by Sex, Total Number of Households and proportion of Households headed by Females by Subcounty and Parish, Northern Region, 2014.

Uganda Bureau of Statistics (2014d). Total Population by Sex, Total Number of Households and proportion of Households headed by Females by Subcounty and Parish, Western Region, 2014.

Uganda Bureau of Statistics (2016a). The National Population and Housing Census 2014 – Main Report.

Uganda Bureau of Statistics (2016b). The National Population and Housing Census 2014 – Sub-county Report: Eastern Region.

Uganda Bureau of Statistics (2016c). The National Population and Housing Census 2014 – Sub-county Report: Northern Region.

Uganda Bureau of Statistics (2016d). The National Population and Housing Census 2014 – Sub-county Report: Western Region.

Vance, C. and Geoghegan, J. (2004). Modeling the Determinants of Semi-Subsistent and Commercial Land Uses in an Agricultural Frontier of Southern Mexico: A Switching Regression. *International Regional Science Review*, 27:326–347.

WFP (2017). Monthly Market Monitor - Uganda. 44, The World Food Programme.

Yusuf, S. A., Ashagidigbi, W. M., and Mustapha, T. I. (2015). Choice and Level of Dry Season Vegetable Market Participation Under Tropical Conditions. *International Journal of Vegetable Science*, 21:272–280.