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INPUTS SUBSYSTEM STUDY

APRIL 30, 2017

This publication was produced for review by the United States Agency for International Development. It was prepared by the Massachusetts Institute of Technology (MIT) and The George Washington University (GWU)

FEED THE FUTURE UGANDA MARKET SYSTEM MONITORING ACTIVITY

INPUTS SUBSYSTEM STUDY

APRIL 30, 2017

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Implemented by Feed the Future Uganda Market System Monitoring Activity (MSM), headquartered at the Massachusetts Institute of Technology (MIT) and The George Washington University (GWU).

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ABBREVIATIONS

4A	Acceptable, available, accessible, and affordable
AgInputs	Feed the Future Uganda Agricultural Inputs Activity
BRC map	Behaviors-relationships-conditions map
CPM	Feed the Future Uganda Commodity Production and Marketing Activity
EEA	Feed the Future Uganda Enabling Environment for Agriculture Activity
FTF-VC	Feed the Future Value Chain project of USAID/Uganda
GWU	The George Washington University
M&E	Monitoring and evaluation
MIT	Massachusetts Institute of Technology
MSM	Feed the Future Uganda Market System Monitoring Activity
SCR map	Supply chain role map
USAID	United States Agency for International Development
VA	Village agent
VC	Value chain
YLA	Feed the Future Uganda Youth Leadership for Agriculture Activity

EXECUTIVE SUMMARY

Background & Goal

The USAID Uganda Feed the Future Value Chain (FTF-VC) project uses a market facilitation approach to impact the value chains that serve smallholder farmers in Uganda. This study focuses on the "inputs subsystem": the part of the value chain that enables farmers to access inputs such as fertilizer and seeds. We aimed to understand whether and to what extent expected changes were occurring in the last four years of FTF-VC work by asking "**How has the inputs "subsystem" been changing over time?**" We focus on changes in key behaviors and relationships targeted by the FTF-VC project, and how they have manifested in three types of actors (see Figure 1): wholesalers and input dealers (or "agrodealers"), farmers, and output value chain actors (such as collectors / village agents or traders) who are involved in the inputs value chain.

Key Recommendations:

Feed the Future Uganda should

- **Investigate barriers to adoption by input wholesalers/dealers of a mindset focusing on delivering greater value to customers**
- **Examine how output actors selling inputs affects the inputs value chain**

Market facilitation projects should

- **Design monitoring strategies that address both the need for longitudinal data and the need for widespread, adaptive measurement**
- **Understand and account for delays in reaping benefits of changes**

Approach

The data used for these analyses comes from two FTF-VC activities: the Commodity Production and Marketing Activity and the Agricultural Inputs Activity. Our goals were **to examine existing data for evidence of systemic change, identify potential indicators, and identify data and knowledge gaps that need to be filled**. We utilized methods such as descriptive statistics, regression, and social network analysis. We extend prior analysis by focusing on change over time, across actors, and throughout geographic space; by investigating whether changes have been linked to outcome measures (such as profitability); and by linking data across multiple activities.

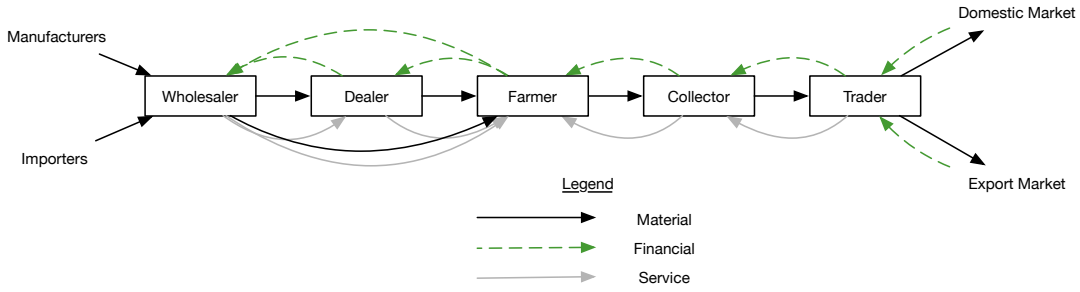

Figure 1: Simplified Value Chain Role Map

Findings: Changes in the inputs subsystem

Our analysis of existing data identified some expected changes in the inputs subsystem and highlighted areas that are not changing as expected.

- Provision of product knowledge and extension services by input wholesalers/dealers has been increasing and appears relatively widespread; furthermore, it appears linked to profitability.
- Input wholesaler/dealer sources of finance have changed very little over time, with the exception of increased usage of supplier credit; personal resources remain the largest source of finance.
- Input wholesaler/dealer business practices were expected to change as dealers' mindsets transitioned to a focus on delivering greater value to customers. However, change in customer, financial/accounting, outreach, and supplier practices is not widespread and has only increased slightly in the last season; the only widespread change is a high rate of joining associations. It is unclear whether changes in business practices enable increased profits: only outreach to farmers and selling mechanized equipment are clearly linked to increased profits. On the whole, most input dealers have not adopted a customer-oriented mindset, although some have done so and are reaping some advantages.
- Relationships along the inputs value chain were expected to increase in length, strength, and utility (where utility refers to the provision of product knowledge through a relationship). However, these characteristics have been decreasing until the most recent season; on the other hand, relationship strength and utility are highly correlated, as we would expect, and the latest season indicates an increase

in both. A network analysis suggests that wholesalers are becoming less influential in their networks, suggesting that suppliers and dealers have more choices or a lack of strong relationships throughout the value chain.
- Farmers' use of inputs is increasing, except in the north. The impact appears to be positive: there is a potential link between the availability of extension services and farmer success (measured by crop yield).
- Output value chain actors, such as collectors / village agents and traders, are beginning to sell inputs, but the extent and impact of this change is unclear based on the available data.

Overall, the results suggest that while change has been slow, it may be gathering momentum now. If provision of extension services is an enabler of other desired changes, then its relatively widespread presence suggests further systemic change is on its way.

Findings: Data gaps and measurement

This study represents a first attempt to analyze systemic change by examining data from multiple activities. We identified several data gaps and measurement challenges that are general and likely to apply to other parts of the system:

- Longitudinal data on some key indicators was unavailable due to inconsistencies in collection over time.
- Measurements of actor success (e.g. dealer profitability, farmer yields) were limited.
- Better consistency across activities in terminology, time frame, and geographical location would enable more holistic analysis.
- Data on the reasons for change propagation (or barriers to it) were not typically available.

A number of data gaps for specific aspects of the subsystem (such as rural input dealers and farmer cooperatives) are also identified in the report.

Recommendations

We recommend further investigation of the inputs subsystem in the following key areas:

- Findings should be verified by collecting similar data in the next season, particularly because so many changes showed evidence of speeding up in the most recent season after several seasons of stagnation (relationship strength, length, and utility; link between crop yield and extension services; product knowledge provision; etc.).
- The impact of output actors selling inputs to farmers on the inputs value chain should be investigated. This is a relatively new trend, and we do not have enough data to understand its impact on the system.
- Barriers to the adoption by input wholesalers/dealers of a mindset focusing on delivering greater value to customers should be investigated, and future efforts should be designed to overcome these barriers. While product knowledge provision is relatively widespread, limited changes in other business practices suggests little widespread change in the underlying business mindset. An understanding of the barriers to such change should inform future interventions in the inputs value chain.

We recommend that the following issues be investigated to support market systems facilitation interventions in general:

- Delays in reaping benefits of changes should be understood. Delays may impact both our ability to measure systemic change and the value chain actors' receptiveness to maintaining changes. For example, if profitability does not increase until four seasons after the start of new knowledge provision services, dealers may not see a fast enough return to continue the new services. We recommend examining delays and developing strategies to account for them in measuring systemic change.
- Monitoring and evaluation strategies should address both the need for longitudinal data on large, representative samples and the need for data about many different parts of the system. Possible strategies include: identifying and measuring early changes that precede or enable wider systemic change; a two-pronged collection effort that measures a few key indicators consistently and adapts the remaining indicators as the system changes.
- Successful monitoring requires a set of easily collected data that collectively provide insight into systemic change; these indicators must be carefully selected before and adapted during the intervention.

1. INTRODUCTION

The Market System Monitoring activity's (MSM) goals are to develop new approaches that assess the impact of market facilitation activities in the USAID/Uganda Feed the Future Value Chain (FTF- VC) project and to assess systemic change in markets in cooperation with the relevant partners. This effort should complement monitoring and evaluation efforts of individual activities with methods to assess how the combination of activities in the project portfolio is enabling systemic change in markets. This report describes the findings of an in-depth study of one part of the market system: the agricultural inputs value chain.

1.1. Background: MSM's approach

To address the difficulty of monitoring outcomes for a portfolio of market facilitation activities, the MSM activity will conduct analysis at two levels: the entire market system and subsets of components in the market system (subsystems). At the market system level, we aim to identify, understand, and analyze the relationships among the system components. Based on this understanding, we can identify key parts of the system that may be measured to assess systemic changes. At the market subsystem level, we aim to analyze key dynamics, actors, supply chains, and other interacting components to refine the indicators identified at the market system level. To do so, we will develop subsystem models, using methodologies appropriate to the unique characteristics of each subsystem and aligned with the purpose of the analysis.

Our approach is to iterate between these two levels with methodological development, data acquisition, and analysis at each level (depicted in Figure 2). For example, we would begin at the market system level of analysis by developing a conceptual map of the market system and use it to identify potential systemic change indicators. Next, we would select some of these potential indicators for further study at the subsystem level of analysis. We would identify a subsystem for which indicator(s) have been proposed, and begin to study it more deeply. To do so, we would identify data that exist or can be collected, model the subsystem, and analyze the data and models in order to formalize methodologies for measuring change in the subsystem. In this manner, we would refine the proposed indicators and develop a method for measuring them. Finally, the insights from this deeper study would be captured at the market system level of analysis, by updating the market system maps and the systemic change indicators. Further analysis at the market system level would enable identification of additional indicators and selection of additional subsystems. This iterative approach invites collaboration, learning and adaption across activities.

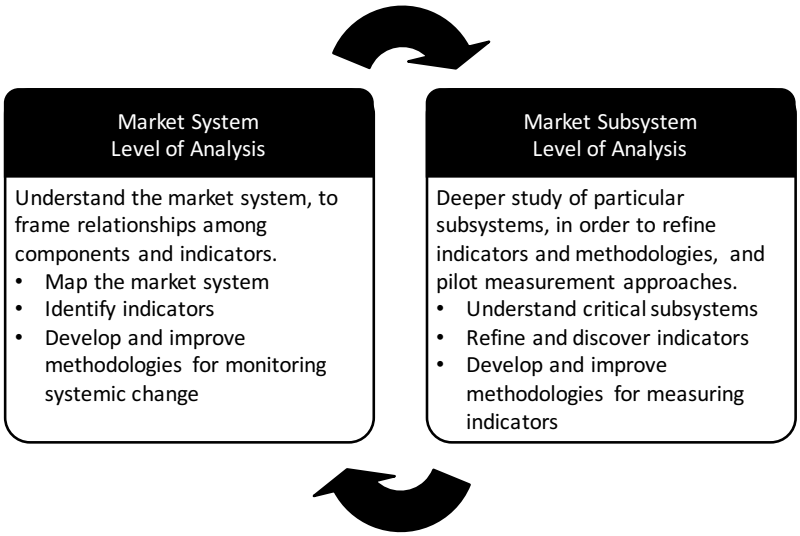

Figure 2: Levels of analysis

1.2. Goals of this report

This report represents an in-depth analysis of one of the subsystems in the market system: the agricultural inputs value chain.

This study investigates changes over time in the inputs subsystem and attempts to link them to firm profitability and other outcome measures. We focused primarily on understanding change from the wholesaler perspective: changes in their business practices, relationships, and financing. A second focus is the entry of actors from the outputs side into the inputs value chain: we examined the extent and characteristics of their involvement in input sales. Finally, we examined whether and how farmers are impacted by these changes.

Key research questions include:

1. How are wholesaler business practices changing?
2. How are relationships in the inputs value chain changing?
3. How are wholesalers financing their businesses and how is this changing?
4. How is wholesaler provision of product knowledge to customers changing?
5. Do certain wholesaler business practices lead to business profitability?
6. How are output value chain actors providing inputs?
7. How does output value chain actors providing inputs impact farmers?

Our analysis depends entirely on data previously collected by two Feed the Future Value Chain (FTF-VC) activities: AgInputs and Commodity Production and Marketing (CPM). Our intent was to examine existing data to determine what can be learned and what gaps need to be filled. Most of the analysis is based on a survey of wholesalers conducted by AgInputs. The remainder utilizes data collected by CPM that surveyed output value chain actors and farmers.

While the FTF-VC activities and others have analyzed much of this data already, our analyses aim to add value in several key areas. Primarily, we investigate change over time, aiming to understand whether and how changes are diffusing across actors and geographical space. Second, we investigate new themes that may not have been explored extensively in previous work, including whether and how change has been linked to improved business performance. Third, we attempt to connect data across FTF-VC activities, examining both the agrodealers' and output VC actors' involvement in the inputs subsystem.

2. INPUTS VALUE CHAIN

MSM developed two maps as part of the effort to analyze the market system for maize, coffee and beans. The first map is the Supply Chain Role (SCR) map. The SCR map is useful as an introduction as it sets a common terminology and scope of the value chain analysis. Since there are as many interpretations of a market system as there are people analyzing it, using the SCR map as a reference ensures that knowledge is easily transferable and exchangeable.

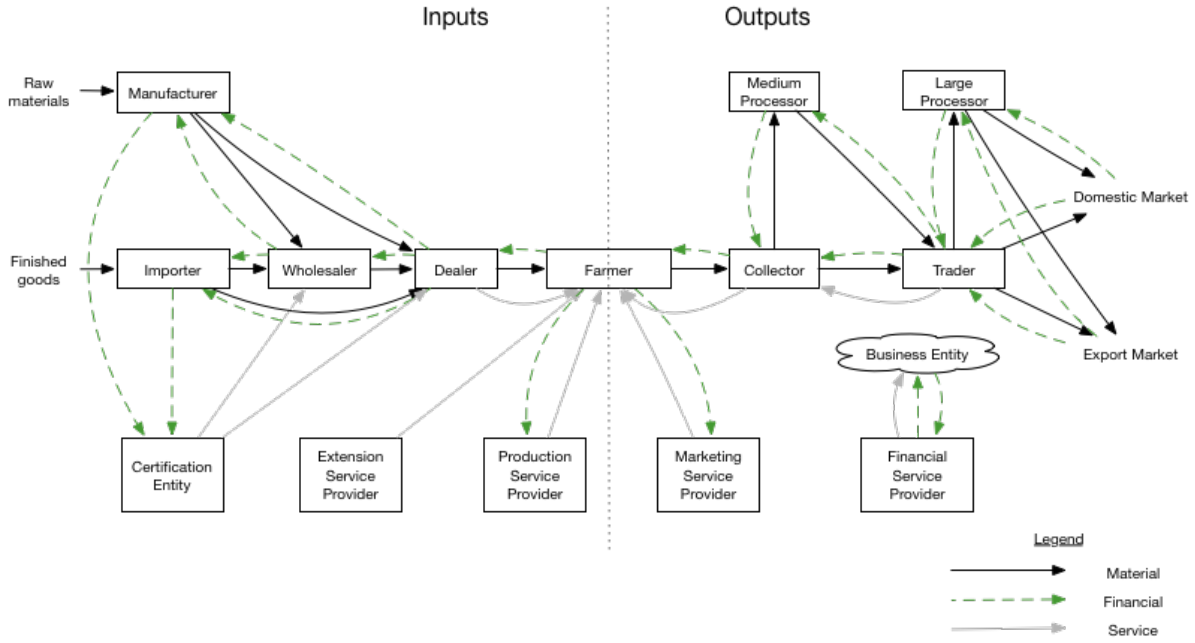

Figure 3: Supply chain role map

The SCR map (Figure 3) clearly communicates the roles and linkages. For the discussion in this study, the left-hand side of the SRC will be the focus. All of the roles, services and transactions that occur before a farmer has harvested their crops are under consideration. The terminology that MSM uses differs from that of other FTF-VC activities in a few ways. MSM considers anyone supplying a farmer an agricultural input as playing the role of a dealer. Other FTF-VC activities refer to agrodealers, stockists, and village agents as middle value chain actors that provide inputs. These actors often play multiple roles. For instance, an agrodealer can sell inputs to others as a wholesaler or direct to farmers. MSM considers this an actor playing both a wholesaler role and a dealer role. Another difference is in how the term supplier is used. MSM uses the roles of manufacturer and importer instead of supplier. Other FTF-VC activities combine these roles into a single actor called a supplier. In this report, we use both sets of terminologies and link them where appropriate.

3. FTF-VC INTERVENTIONS

In Uganda, 85 percent of the people earn their income through farming. Farms are mostly smallholder farmers producing small amounts of produce. The FTF-VC activities all work to reduce poverty by increasing the quantity and quality of smallholder crops. Some efforts focus on youth in agriculture and the enabling environment for agriculture. The following two activities have a focus that includes agricultural inputs, and they were a focus of this report.

3.1. Agricultural Inputs (AgInputs)

The Feed the Future Uganda Agricultural Inputs Activity (AgInputs) is in its final year of a five-year program (2012-2017) using a market facilitation approach in FTF-VC target districts to increase the use of high quality, non-counterfeit agricultural inputs. AgInputs works with stakeholders such as the Ugandan government, industry associations, input suppliers, wholesalers, retailers, industry associations, and the Ugandan government. They

expect to reach 25 percent of the agrodealers in the FTF-VC target districts by the project's end and work with them to increase service provision and profitability. Their goal is through their outreach efforts to support sustainable agricultural input practices through systemic market changes resulting in reduced counterfeit inputs on the market, increased certified seed on the market, and a higher number of farmers reporting they purchased inputs.

3.2. Commodity Production and Marketing (CPM)

The Feed the Future Uganda Commodity Production and Marketing Activity (CPM) is also a five-year program (2013-2018) also using a market facilitation approach. They are working across FTF-VC target districts with middle value chain actors, such as traders, processors, and cooperatives, to increase incomes through the production of higher quality commodities in larger quantities. CPM focuses on boosting crop productivity, encouraging support services for farmers, strengthening relationships between buyers and sellers, and creating ties between traders and exporters. Their goal is to improve domestic production in such a way that the export market grows and increases farmer income.

4. INTRODUCTION TO ANALYSIS AND DATA SOURCES

In this subsystem study, we discuss the state of the inputs subsystem with analysis from three different types of market actors, shown in the simplified value chain role map in Figure 4. We focus on three categories of actors: (1) the "agrodealers" (who may be wholesalers or dealers as depicted in Figure 4); (2) output value chain actors (collectors and traders), and farmers.

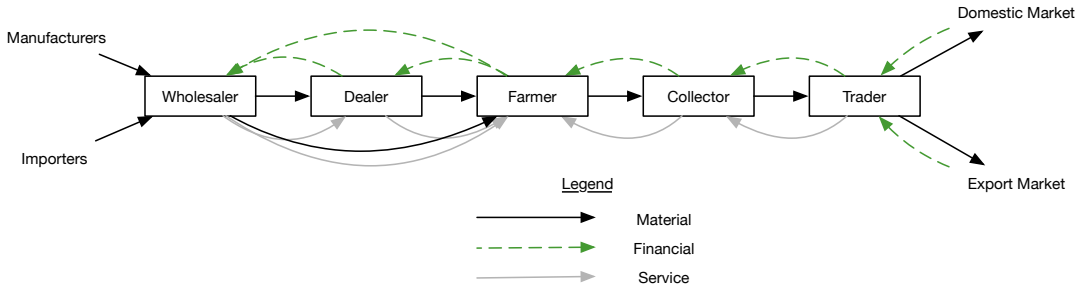

Figure 4: Simplified value chain map role map

Our analyses take a bottom-up approach, asking what we can learn from the data available from these two activities. The analysis questions were driven by important themes in the FTF-VC project, and the broad question of whether and how we can "see" systemic change. When conducting the analyses from the perspectives of these three actors, we focused on particular areas of the system that have strong influences on the desired outcomes of the FTF-VC project, such as increased farmer income, as well as areas that we saw as gaps or areas of interest.

When looking at the wholesalers, we considered four main areas. First, we desired to know more about their business practices, specifically how they were changing and if that influenced success in the market. For example, have more wholesalers adopted positive customer relations practices instead of outreach practices, and how has that impacted their profit. We also considered their relationships with other actors in the system, looking at selling patterns and changes over time. Then we analyzed their financing and whether use has changed over time, and what effect it may have on their success. And finally, we looked at the propagation of knowledge on products to customers, and if that could have a positive impact on their success.

Next, we began to consider the output value chain actors' role in the inputs subsystem. Traditionally we think of these actors as collectors exclusively, not involved in the input subsystem. However, some of the data suggests we needed to dive deeper into this possibility to better inform our knowledge of the system. We specifically looked at whether they are providing inputs to farmers, if so, what particular inputs, and finally how these habits may have changed over time.

Finally, we considered the impact on farmers. The main areas of analysis were the extent of farmers purchasing inputs, how that has changed over a period of time, and what impact has this had on their success. Additionally, we looked at their access to extension services, and how that may have impacted their success as well.

The wholesaler perspective is the most extensive analysis and is based on data from the AgInputs activity. Data from the CPM activity is used to investigate the perspective of the collectors and farmers. Our goals were described in Section 1.2, above.

In the following subsections, we describe the data sources we used in the analysis.

4.1. Agrodealer survey

At the end of each growing season, AgInputs conducts a census-type survey of agrodealers concerning their activities during the prior six months. These agrodealers ranged across 25 districts in Uganda. They attempted to survey 80% of all agrodealers in the district town centers. The goal was to visit all open businesses at the time of the interview.[1] The first four surveys were conducted by two staff members. The last survey was conducted simultaneously by a larger group of interviewers. This effort captures change occurring in the market system over time.

Season	Agrodealer Count
Apr-Sep 14	221
Oct 14-Mar 14	261
Apr-Sep 15	221
Oct 15-Mar 16	194
Apr-Sep 16	272

Figure 6: Count by season

Seasons	Count
5	87
4	88
3	63
2	51
1	91

Figure 5: Total seasons each agrodealer was surveyed

Both Figure 5 and Figure 6 capture the difficulty of conducting surveys. Figure 5 shows the sample size of the surveys. The population varies over time as it is difficult to interview all of the businesses. Figure 6 shows the number of agrodealers surveyed in multiple seasons. The nature of these businesses makes it difficult to capture longitudinal data across these actors. Only 87 dealers were present in all five of the surveys. Business owners could be traveling on business, at a funeral or wedding, or out of business. AgInputs described it this way:

> *"Most businesses who closed seems to have simply stopped selling agro-inputs and opened up a different type of business, rather than the business owner having left the area – they are sometimes even still in the same location, but branded under a different name and with different products for sale."* [1]

Another way to look at how the population changed over time is churn. Churn is a measure of the attrition rate. The churn is usually measured by the number of lost members of the set divided by the number of members at the start of the time period in question. This is known as the gross churn rate and measures the number of people leaving a set. The net churn rate is similar, but instead, considers the sum of those lost and gained. You can see in Figure 7 the high amount of turnover in the data with anywhere from 18 to 30 percent of respondents dropping out before the next survey. The net churn shows how the total population changes. The changes range from a negative 15.3% change to a positive 40% jump. This explains how the total population has remained relatively flat over time, but the individual agrodealers taking part in the survey were changing.

[1] Agro Dealer Survey 2016 (AgInputs)

	Churn	
Season	Gross	Net
Apr-Sep 14	18.6%	18.1%
Oct 14-Mar 14	29.1%	-15.3%
Apr-Sep 15	30.3%	-12.2%
Oct 15-Mar 16	19.1%	40.2%

Figure 7: Gross and net churn by season

Figure 8 shows this entry and exit from the survey population in a visual way. Each agrodealer is colored blue when surveyed in a season. You can see how they drop in and out of the sample and how new agrodealers are added with each survey. All of this points to a very active sector with a low barrier to entry.

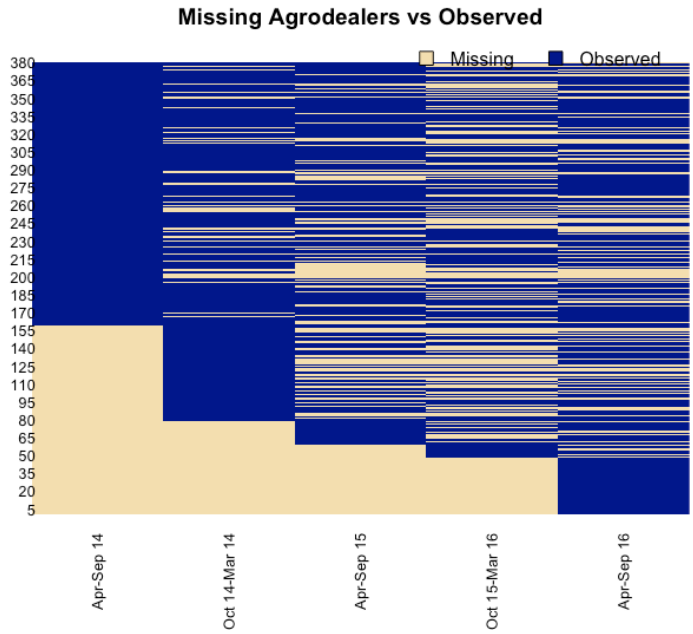

Figure 8: Missing data map across five seasons

4.2. CPM data

The CPM Activity also collects a variety of data, and we focus on a subset of the CPM data that is related to the inputs subsystem.

As part of their M&E process, CPM developed eight data collection forms used to collect and report performance data to USAID/Uganda. The data are housed in a management information system that aids in report generation, data sharing, and data cleanup. The specific data studied are contained in four tables from CPM's database: (1) Village Agent, (2) traders, (3) Form 2- Input Sales, and (4) Form 5- Village Agent. The Village Agent (1) and Trader (2) tables were primarily used for geographical, demographic and related information. The Input Sales (3) and Form 5 Village Agent (4) tables contain survey results from a sample population of collectors and traders regarding various business practices, including practices focused on selling inputs. For organizational purposes, this section will first discuss the methods used to analyze the Inputs Sales (3) and then discus the methods used to analyze the Form 5 Village Agent (4) table.

The Input Sales (2) table contains information regarding traders and collectors. There are two seasons of data recorded, Oct 2015- Mar 2016 and Apr 2016- Sep 2016.

The number of traders and collectors recorded for each season of this study are shown in Figure 9 below.

These data are obtained by the CPM activity through its partners, so they reflect a population of actors who have been directly or indirectly influenced by the CPM intervention. As a result, the sample may not be representative of the population as a whole.

Type of VC Actor	Oct – Mar 2015	Apr – Sep 2016
Both	2	3
Trader	21	70
Collectors	0	16
Total	23	89

Figure 9: Number of traders and collectors by season

The Input Sales (3) table contains six fields regarding the value of inputs sold for seeds ("Inputs Sold- Seeds"), chemicals ("Inputs Sold- Chemicals"), fertilizer ("Inputs Sold- Fertilizer"), herbicides ("Inputs Sold- Herbicides"), farm implements ("Inputs Sold- Farm Implements"), and other ("Inputs Sold- Other"). Additionally, there is a field regarding the amount invested in setting up input sales business in UGX ("Amount Invested").

The Input Sales (3) table provides a very small sample of collectors. CPM's Form 5- Village Agent (4) table provides a larger sample of 117 collectors that can be used to give a more accurate representation of their selling behaviors. This form organizes the values of inputs sold by crop type- Maize ("Value Sold- Maize"), Coffee ("Value Sold- Coffee"), and Beans ("Value Sold- Beans"). There is no significant overlap in the samples of collectors surveyed in the Input Sales (3) and Form 5 Village Agent (4) table. Our analysis focuses largely on the Input Sales (3) data, as the multiple seasons reported provide a more robust analysis.

5. AGRODEALER ANALYSIS

This section analyzes data on business practices, selling patterns and relationships, finance, and extension and knowledge transfer.

5.1. Business practices

This section assesses changes in business management practices amongst agrodealers and evaluates patterns in how changes are spreading. To capture this data AgInputs asked agrodealers an open question:

> "In the past six months, what internal changes have you made to your business practices? (These are not external problems, but things that you have done as a business manager.)"

Agrodealers were asked to indicate whether they had made any of a predefined set of business practice changes, but an "other" field was also included to allow new types of practices to appear in the data. New categories were created for those practices in subsequent surveys.

Figure 10 shows the instances of practices and internal business practice changes made within the last six months reported across the seasons. The data show the rate of change being made rather than a snapshot of current practices. These changes vary by type and season. For example, in the first season, 24% of agrodealers surveyed reported making changed to farmer outreach. The very next season 42% of them reported making the same change. The change "Association Member" was extremely popular, which may indicate an importance attached to developing relationships or collective action. "Customer" was also a relatively popular change, especially in the most recent season, potentially indicating an increasing emphasis on understanding and meeting customer needs.

The higher percentages in the most recent season generally suggest an increasing pace of change. Since the same farmers are not surveyed in each season,

		Season				
	Business Practices	Apr-Sept 14	Oct 14-Mar 15	Apr-Sept 15	Oct 15-Mar 16	Apr-Sept 16
Internal Changes	Customer	44%	15%	12%	18%	52%
	Financial / Accounting	75%	9%	4%	6%	21%
	Outreach	24%	42%	10%	9%	21%
	Supplier		2%	2%	2%	14%
	Other Change		22%	14%	24%	
Practices	Sell Mechanized		5%	8%		
	Association Member		59%	60%	76%	79%
	Spray Services	19%	20%		11%	6%
	ICT Services	24%	20%			

Figure 9: Percentage of respondents reporting business practices

When looking this data, we first asked which practices influence business success. Two questions indirectly measure business success: revenue band and gross profit. In the first three surveys, from April 2014 to September 2015, agrodealers were asked about their revenue band and to place themselves in ranges roughly UGX 5,000,000 wide (e.g. 10-15M) from zero to UGX 100,000,000. A multinomial logistic regression was performed to understand which business practices contributed to gross margins. This approach was necessary as the gross margin question was structured as a list of ranges.

After running the regression, there no findings that were statistically significant (Figure 11). Normally an R-squared statistic is used to test the goodness-of-fit of a model. That measure is not available in multinomial logistic regression. To test the model fit, a McFadden R was used (Figure 12). The model is a reasonable fit, with 70.5% of the variability predicted by the variables.

	(Intercept)	Internal.Change1	Sell.Mech1	Industry.Assoc1	Spray.Services1	ICT.Services1
0-5M	1.846828e-07	0.1075072	0.42934057	0.4863529	0	0.07170493
10-15M	7.351249e-01	0.9674813	0.00000000	0.9042071	0	0.64953313
15-20M	7.976418e-01	0.3344683	0.73029090	0.3179316	0	0.67486166
20-30M	6.141075e-01	0.6618877	0.74507560	0.7345557	0	0.56193430
30-40M	5.876824e-01	0.4254197	0.00000000	0.2761284	0	0.74221894
40-50M	6.743750e-01	0.8716252	0.00000000	0.6079129	0	0.00000000
5-10M	4.751163e-01	0.7813009	0.97428930	0.6891592	0	0.28116232
50-60M	4.997139e-01	0.7191811	0.00000000	0.9193226	0	0.73366473
70-80M	0.000000e+00	0.7743423	0.00000000	0.0000000	0	0.63033611
80-100M	0.000000e+00	0.3671475	0.09787671	0.0000000	0	0.57184131

Figure 10: P-values for multinomial logistic regression

```
fitting null model for pseudo-r2
# weights:  24 (11 variable)
initial  value 1697.191242
iter  10 value 1258.182247
final  value 1254.671970
converged
          llh       llhNull            G2      McFadden          r2ML          r2CU
 -369.1366437 -1254.6719700  1771.0706526     0.7057903     0.9990884     0.9991376
```

Figure 11: Model fit test

While there was a good fit, the absence of statically relevant predictors could mean there are very high intercorrelations among the predictor variables thus making it difficult to determine results. Future work will investigate this further. It is interesting to note that the lowest revenue band 0-5M was made up of 46% of the respondents in these surveys. Future work will break out the lower band into more categories or use a continuous variable to capture gross revenue.

The second analysis undertaken concerning business success involved gross profit. In a single survey, April – September 2015, agrodealers were asked if they had a gross profit. The answer was yes or no. This analysis used a binary logistic regression to evaluate which business practices predicted a gross profit. Binary logistic regression is used when the outcome variable, gross profit in this case, is either true or false.

Using an ANOVA Chi-Squared test (Figure 13), two of the internal business changes showed statistical significance. Business changes using outreach to farmers and if an agrodealer sold mechanized equipment had p-values of 0.017 and 0.014 respectively. There is strong evidence that these practices influence whether an agrodealer made a gross profit. Although, when a McFadden fit test was run against this model, the fit was only 13.7%. This means that the model only explains a small portion of the variance. Further research into this could be useful.

```
Analysis of Deviance Table

Model: binomial, link: logit

Response: gross.profit

Terms added sequentially (first to last)


                         Df Deviance Resid. Df Resid. Dev Pr(>Chi)
NULL                                       139    107.425
Internal.Change.Customer  1   0.0021       138    107.423  0.96370
Internal.Change.Financial 1   0.0123       137    107.411  0.91178
Internal.Change.Outreach  1   5.6710       136    101.740  0.01725 *
Internal.Change.Supplier  1   1.4196       135    100.320  0.23346
Internal.Change.Other     1   1.0000       134     99.320  0.31730
Sell.Mech                 1   6.0754       133     93.245  0.01371 *
Industry.Assoc            1   0.5727       132     92.672  0.44918
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 12: ANOVA test

5.2. Selling patterns and relationships

AgInputs' network data describe transactions between suppliers and agrodealers, and agrodealers and retailers. MSM has decided an agrodealer is mostly a type of wholesaler and a retailer is mostly a type of dealer. MSM terminology is used in these analyses, but it is important to recall that retailers do not represent all dealers and there is probably overlap between the two categories. The final analysis in this section will give insight into how agrodealer wholesalers' customer bases have changed over time.

In Figure 14, we see the number of wholesalers surveyed is about the same in each of the first four seasons, but increases by 38 percent in the final season over the previous season. The number of suppliers named by wholesalers remains relatively constant. We expect there are not many suppliers entering or exiting the inputs market each season. The most significant attribute of this chart is the decrease in number of dealers named by wholesalers each season. This trend is also reflected in analyses below along with supposed explanation. As for the consistency of relationships between suppliers and wholesalers captured in each season, around 30-50 percent of these relationships in each season appear in the following season's data; this value tends to decrease in time. As for ongoing relationships between wholesalers and dealers, this value is about 30 percent and is about consistent over time, except in the final season, where it is about 10 percent (see Figure 15). In this season, we see fewer dealers than the previous and more wholesalers. The data indicate a high "churn" in relationships; in other words, fewer than half of relationships are maintained for more than one year. This suggests that actors have a hard time building customer and supplier relationships.

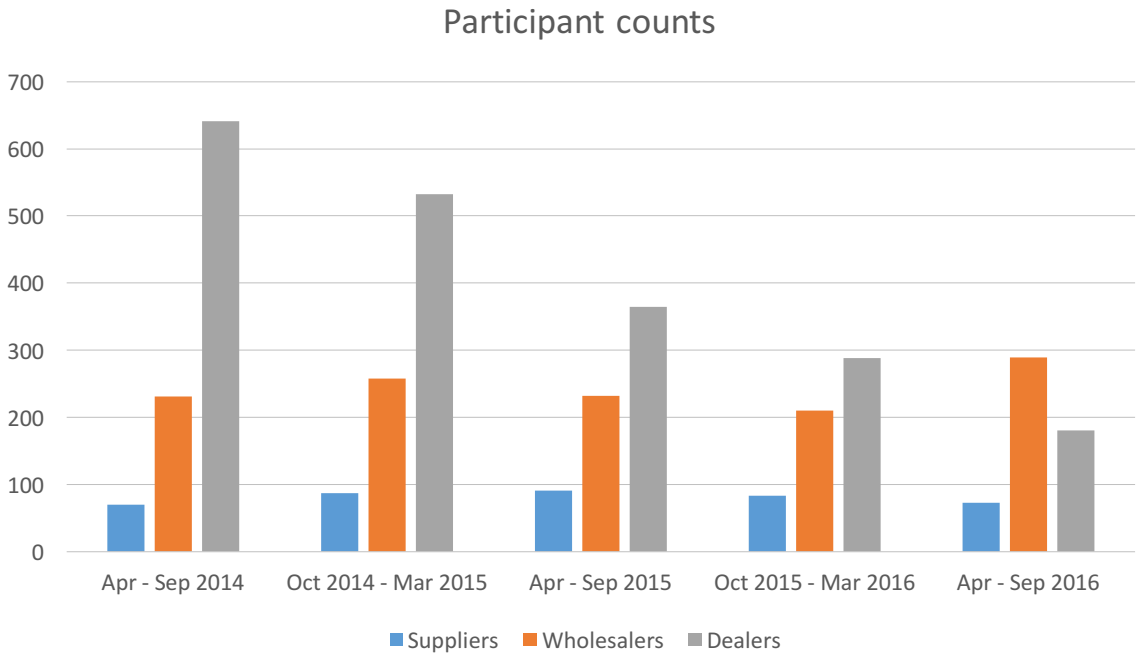

Figure 13: Participants by type and season

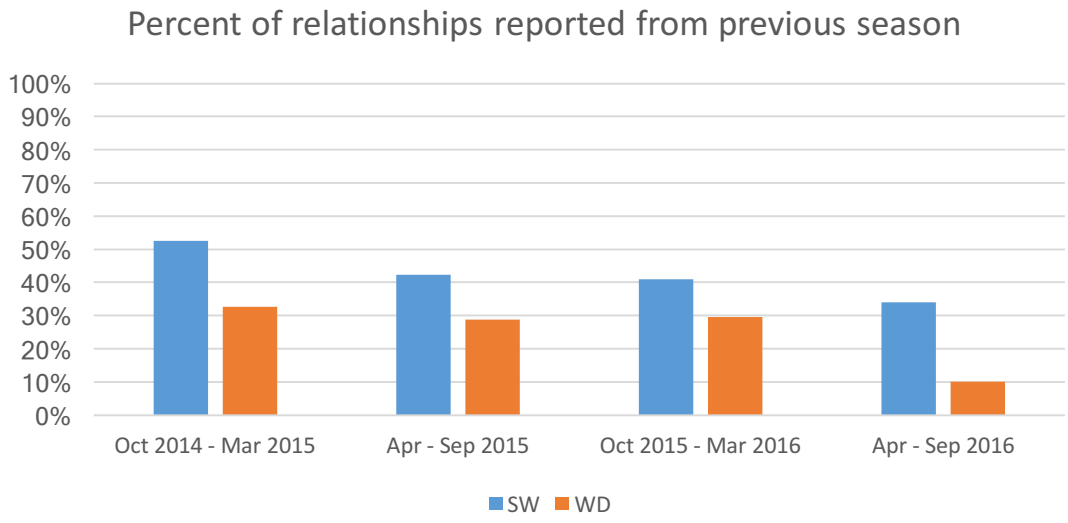

Figure 14: Percent of relationships reported from previous season

5.2.1. Inputs providers (downstream perspective)

Figure 16 depicts the average, minimum and maximum numbers of wholesalers to whom suppliers sold inputs in each season. The minimum is always one wholesaler. The average supplier sells inputs to about 20 wholesalers. The maximum is much larger than the average, suggesting there are some suppliers that have much more reach than the average. Moreover, the maximum is just under 200, while the total number of wholesalers (see Figure 14, above) is just over 200, showing at least one supplier works with most of the wholesalers surveyed. In fact, Bukoola and East African Seeds are the top "performers" (as defined by the number of wholesalers who mention these companies as suppliers) in each season, alternating between the first and second positions. In the Apr-Sep 2016 season, the number of wholesalers who said they purchased inputs from Bukoola increased by 53 percent. The same number increased by 34 percent for East African Seeds. Bukoola is a target firm that AgInputs focused

efforts on outside of data collection. We may speculate as to whether this change may be attributed to intervention.

Figure 16 shows the number of dealers to whom wholesalers reported selling inputs. Again, we see the minimum is always one dealer. The maximum varies, decreasing 63 percent, from 30 to 11, between the third and final seasons. The average also decreases relatively significantly between the fourth and final seasons; this decrease is 48 percent, from 4.17 to 2.16. Thus, the average number of dealers to whom suppliers report selling in the Apr-Sep 2016 season is about half of the number in the previous season.

The data in these plots appear to follow a similar trend in the first four seasons. It is interesting, however, that between the fourth and final seasons, suppliers sell to more wholesalers, but wholesalers sell to fewer dealers. It may be that agrodealer wholesalers are in fact selling to fewer retailer dealers and more to other types of actors, such as directly to farmers or farmer groups. Leanne Rasmussen[2] found this is approximately the case in the first four seasons. She reports that 68 percent of agrodealers sell to retailers in the first 2014 season. That number decreases to 55 percent in the next season, 21 percent in the next, and rises to 40 percent in the final season of 2015. Perhaps more comprehensive data collection about wholesalers' customer base could direct us in understanding why we observe this trend. Ideally, we want to observe wholesalers becoming more successful; increase in the average number of customers would be an indicator of success.

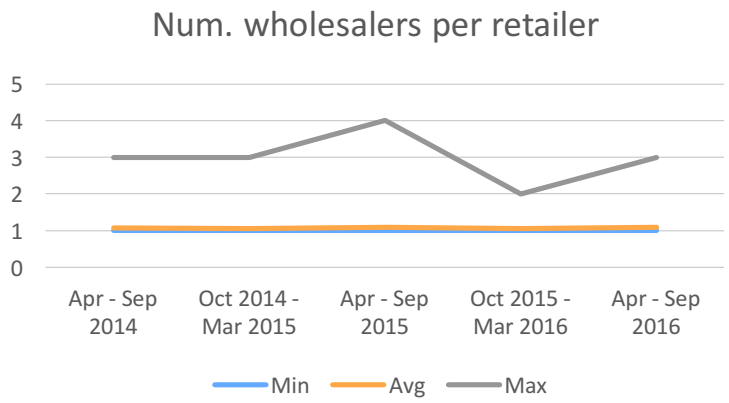

Figure 15: Number of wholesalers per supplier

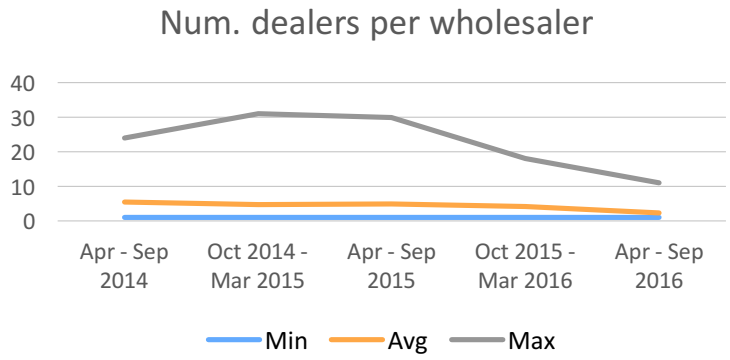

Figure 16: Number of dealers per wholesaler

[2] USAID Feed the Future Agricultural Inputs Activity Systemic M&E Report: July 2016 (Leanne Rasmussen for AgInputs)

5.2.2. Inputs buyers (upstream perspective)

Figure 18 depicts the number of suppliers from whom wholesalers reported purchasing inputs. Recall this is different from Figure 16 in that it is from the wholesaler perspective. As in each of these plots, the minimum is always one. Both the maximum and the average rise in the second season and drop in the final season. The most significant feature of this plot is the decrease in the maximum from the second to final seasons: a 40 percent decrease. These data points do not represent the same group of wholesalers, but one wholesaler who purchased inputs from 30 suppliers in the last 2014 season purchased inputs from half that amount of suppliers in the final season. In fact, in the final 2014 season, only about 3.5 percent of wholesalers purchased inputs from more than 18 suppliers; the averages are about the same. The highest average occurs in the final 2015 season. The mode of these data is 14 suppliers, only slightly higher than that of the other seasons' data.

If we look back to Figure 16, we observe a slight increase in the number of wholesalers who purchase inputs from the average supplier between the final two seasons, perhaps attributable to an increase in the number of wholesalers surveyed. Here, we observe a slight decrease in the number of suppliers from whom the average wholesaler purchases inputs. Perhaps suppliers stock more inputs and/or relationships between suppliers and wholesalers grow in strength; so, either wholesalers require fewer suppliers or desire to purchase from fewer suppliers. In fact, we observe an increase in the number of wholesalers with whom suppliers have a strong relationship and the number of wholesalers who receive product knowledge from suppliers.

Figure 18 shows the number of wholesalers from whom dealers purchase inputs. Recall these data are collected at the wholesaler level, but this analysis is from the dealer's perspective. We do not see a trend in these data; however, it is clear that dealers purchase from very few wholesalers: often, just one and several at most. Unlike the previous plots from the downstream perspective, there is no approximate mirroring of trends between these two plots.

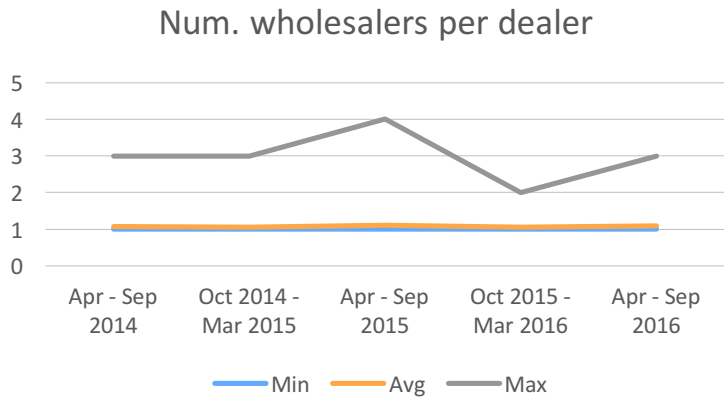

Figure 17: Number of suppliers per wholesaler

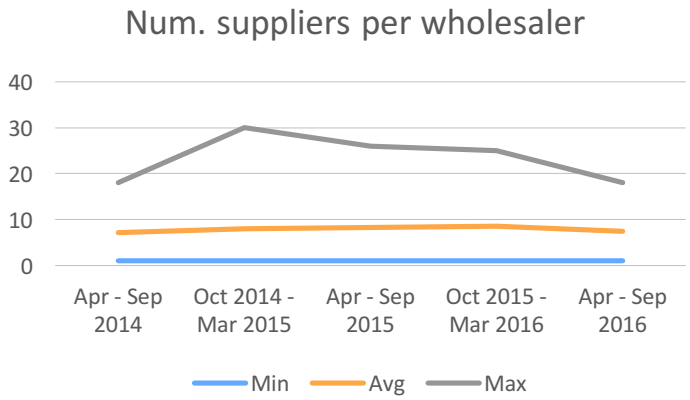

Figure 18: Number of wholesaler per dealer

5.2.3. Relationship strength and product knowledge

Figure 20 shows the average number of suppliers from whom wholesalers report receiving product knowledge or with whom wholesalers report have strong relationships in each season. The number of strong relationships declines until the final season, where it increases sharply. The number of suppliers from whom the average wholesaler receives product knowledge does not follow a trend, but increases with reported strong relationships in the final season's data. The number of wholesalers receiving product knowledge from or having strong relationships with suppliers follow this trend, as well. In the Apr-Sep 2016 season, the average supplier gives product knowledge to 16.40 of the 25.63 wholesalers to whom the company sells inputs; so, we can conclude the average supplier shares product knowledge with about 64 percent of its customer base in this season.

These increases could suggest positive change due to intervention. Data suggest the transfer of product knowledge is important in developing, or indicative of, strong relationships between suppliers and wholesalers. In addition, these data follow the same trend as the percent of consistent relationships between seasons, suggesting product knowledge or perceiving a strong relationship may be factors in a wholesaler's decision to purchase inputs from a supplier.

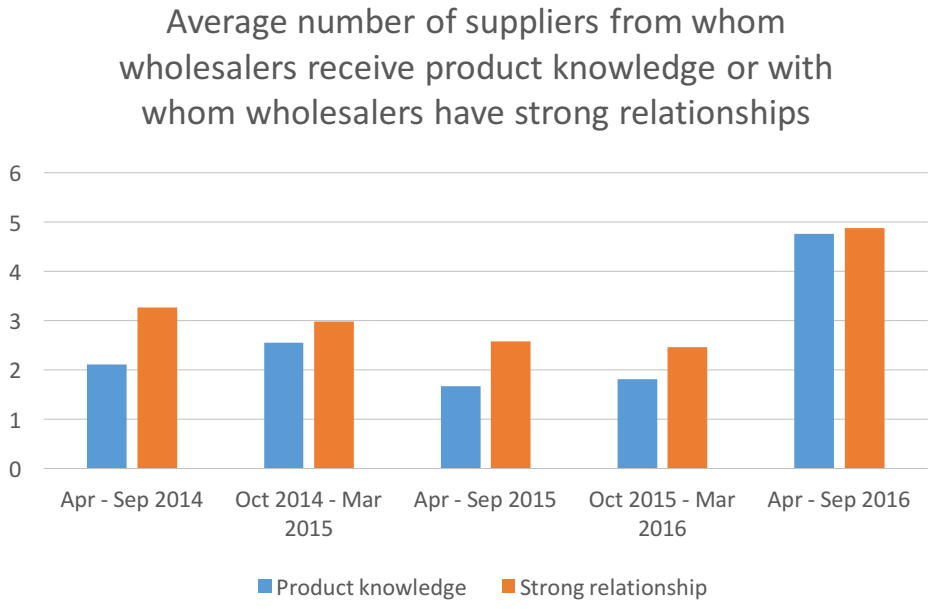

Figure 19: Average number of suppliers that provide product knowledge and have a strong relationship

Figure 21 shows the average number of dealers with whom wholesalers share product knowledge and have strong relationships. These data show a steady decrease between each season. However, we may infer some of the same information here as in the previous data about relationships between suppliers and wholesalers: product knowledge and strong relationships follow about the same trend, and the relationship between the two appears to be stronger here. Because dealers and wholesalers are generally smaller businesses and dealers have a broader wholesaler base from which to purchase inputs, providing product knowledge may be especially important in the strength of these relationships.

These data seem to follow the same trend as the number of dealers per wholesaler in the latter four seasons; so, wholesalers may not be providing product knowledge to fewer dealers proportional to their customer bases. In addition, if we say the average dealer purchases inputs from about one wholesaler, which is about true according to Figure 19, dealers received product knowledge about 70 percent of the time in the Apr-Sep 2016 season. This seems to be positive.

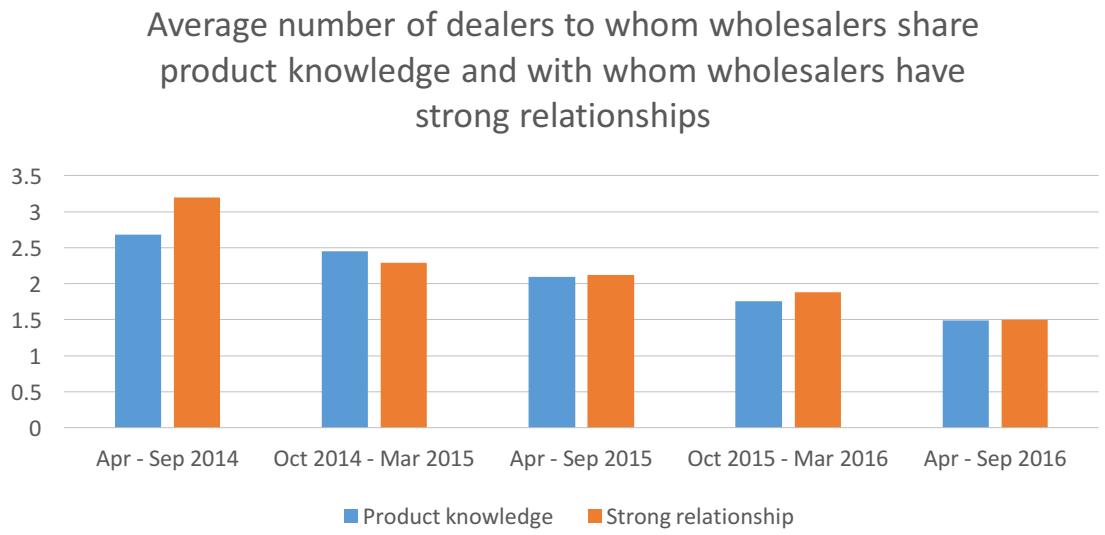

Figure 20: Average number of dealers who receive knowledge and have a strong relationship

5.2.4. Network metrics

Figure 22 shows wholesaler centrality measures over time. Centrality describes how well-connected an actor is in a network. There are several types of centrality. Two are depicted here for wholesalers. Degree centrality is simply the sum of the number of other actors to which an actor is connected. Betweenness centrality as plotted in Figure 22 describes the extent to which the average wholesaler "connects" dealers to suppliers. It's the number of shortest-path distances between all actors that go through an actor.

The data show the average wholesaler connects to less other actors over time, which is also reflected in data about the number of retailers to whom the average wholesaler sells and suppliers from whom he purchases inputs (seen in Figure 17 and Figure 18). Betweenness centrality decreases with a much larger slope. The trend indicates wholesalers are effectively becoming less influential in the inputs supply chain.

We would like to see an opposite trend. However, if the increase in the number of wholesalers surveyed in the final season is indicative of a general increase in the number of wholesalers who entered the market in that season, the sharpest decline in network centrality in the last season may be attributed to this increase.

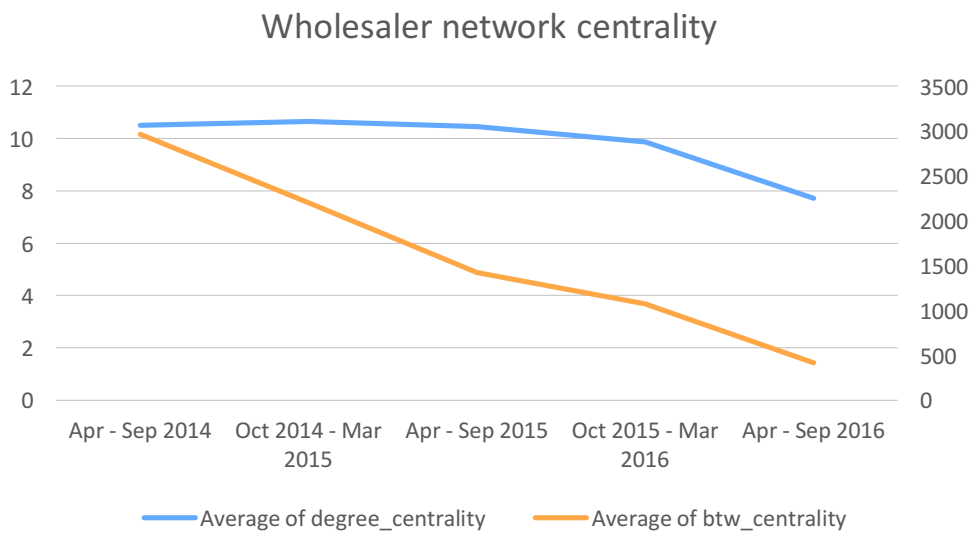

Figure 21: Wholesaler network centrality

Figure 23 shows average Eigenvalue centralities for suppliers and retailers in each season. Eigenvalue centrality is the degree to which a node is connected to other nodes by association. If a dealer or supplier is connected to a very highly connected wholesaler, that dealer or supplier will have high Eigenvalue centrality.

So, we infer different meaning: if a dealer has high Eigenvalue centrality, he purchases from a "successful" wholesaler who has many customers and/or purchases inputs from many suppliers and may stock diverse products. Both are likely good, except in the case where a wholesaler must purchase from many suppliers in order to get the right amount of product on his shelves, due to supplier stockouts or shortages in delivery networks. A high Eigenvalue centrality may imply more reach for a supplier. It is good if a supplier sells to a wholesaler with many customers. However, it may not be good for the supplier if it provides only a small share of its customers' inventory. In either case, Eigenvalue centralities do not particularly follow a trend in these data and do not vary much, but the observance of a trend in these metrics in the future may be beneficial in our understanding of actors in the inputs supply chain network.

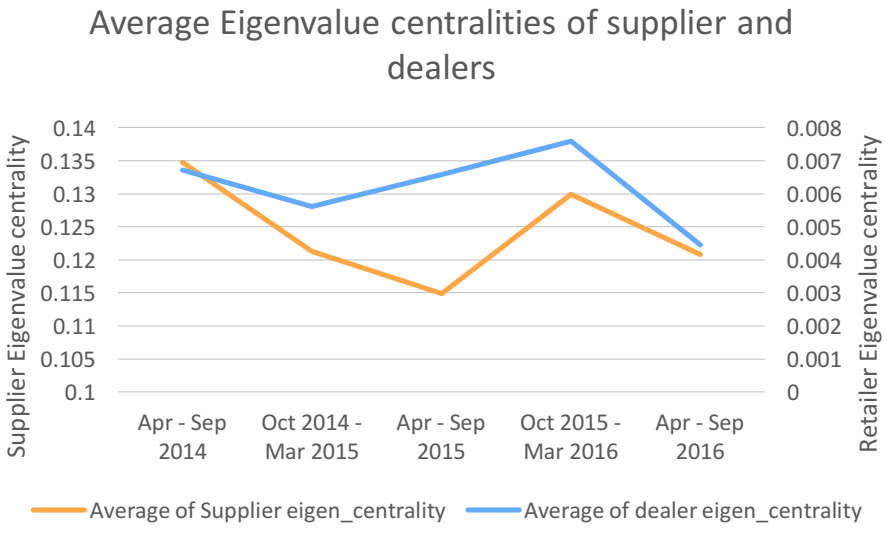

Figure 22: Average Eigenvalue centralities of suppliers and dealers

5.2.5. Selling patterns

Figure 24 depicts the number of wholesalers who have sold inputs to various types of actors. Figure 25 shows the average percent of total inventory sold to these actor types. In each category, only the wholesalers who sold inputs to those actors are counted. We see that proportionally, the number of agrodealer wholesalers selling to each type of actor is relatively consistent over time, as is the average amount sold to each type of actor.

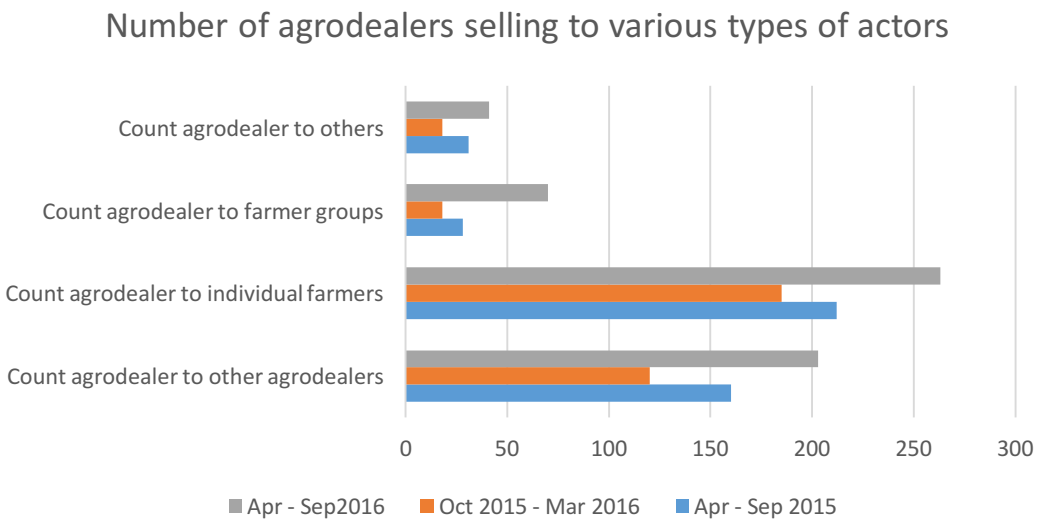

Figure 23: Num of agrodealers selling to types of actors

	Avg pct agrodealer to other agrodealer	Avg pct agrodealer to farmers	Avg pct agrodealer to farmer groups	Avg pct agrodealer to others
Apr - Sep 2015	30	72	20	17
Oct 2015 - Mar 2016	33	75	23	18
Apr - Sep 2016	34	71	16	11

Figure 25: Percentage of sales to groups

Analyses about the inputs network are ongoing.

5.3. Financing

In order to get a more comprehensive understanding of the finances of Agrodealers, we analyzed the AgInputs data regarding sources of working capital, loans, reinvestments, and the influence of these financial issues on profitability.

First, we looked at the sources of working capital as captured in the three seasons to see if there were any trends across the seasons (see Figure 26). What was found is that the majority of firms get their working capital at least partially from personal savings, friends or family members. Through the seasons the count of firms getting their finances from a bank has been decreasing slightly. While SACCO, Money Lenders, and Micro Financing all seem to be staying at relatively low rates, the number of dealers utilizing Supplier Credit for their working capital has increased substantially from the Oct 2015 - Mar 2016 season to the Apr-Sep 2016 season.

This does suggest that changing the financial dependencies for most firms is a harder task than implementing business improvements. This could be due to loans not being available or accessible to small businesses in the sector of agricultural inputs, especially from banks. This shows there is still much work to be done enabling the system to be financially stable. However, suppliers do seem to be willing to negotiate with dealers to help sustain the industry as can be seen by Supplier Credit increasing in the past few seasons.

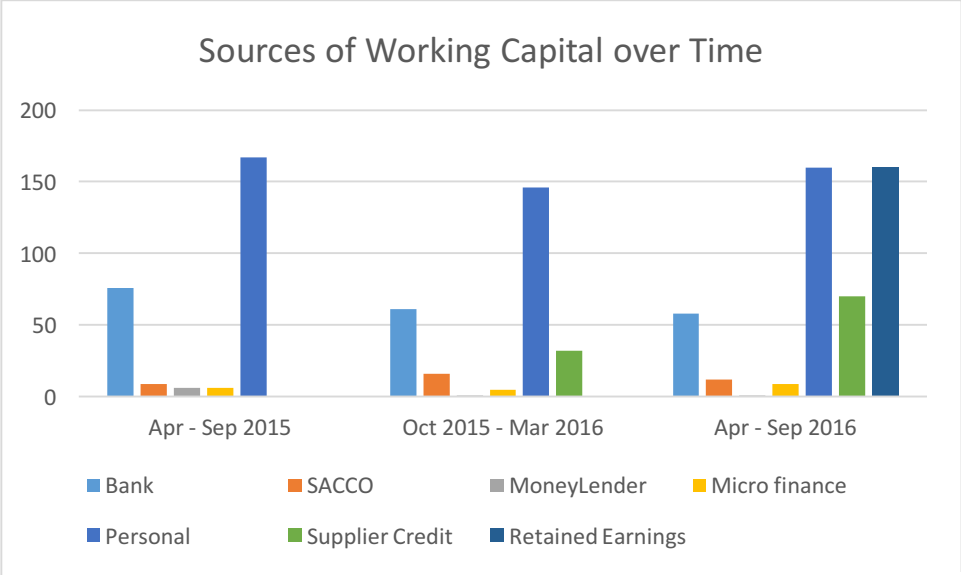

Figure 24: Sources of capital over time

After looking at where the majority of working capital comes from, we dove deeper into looking at the sources of loans that dealers identified. Using the two seasons of data, the loan sources were analyzed. Both seasons seemingly have a similar percentage of loans provided by Centenary Bank, a little over half.

Because of the low number of responses to the question in the earlier season, all of the answers were able to be displayed in Figure 27 Shown here, SACCOs were the next most popular source for loans, followed by three other banks.

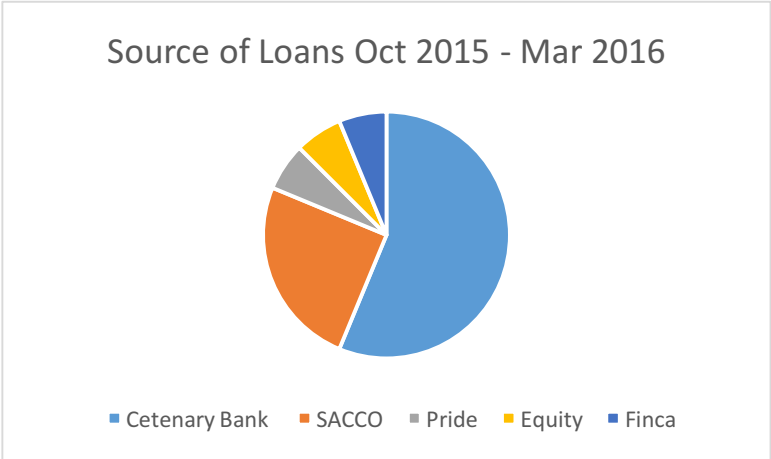

Figure 25: Source of loans Oct 2015 - Mar 2016

In the Apr-Sep 2016 season, shown in Figure 28, there was a much larger variety of sources identified. This could be due to the much larger sample from this season that responded to the loan source question. Additionally, it could be due to the wording of the survey which changed slightly over the seasons. Regardless, it was clear that Centenary Bank still prevailed as the primary source of loans for Agrodealers by a significant margin. In addition to formal bank loans, this season did have some data referencing taken loans from family members or friends, which

totaled to be the next highest source. Every other source had fewer than three references, such as other SACCOs or banks, makes up the last 38% of the loans, each not having more than three firms cite its use.

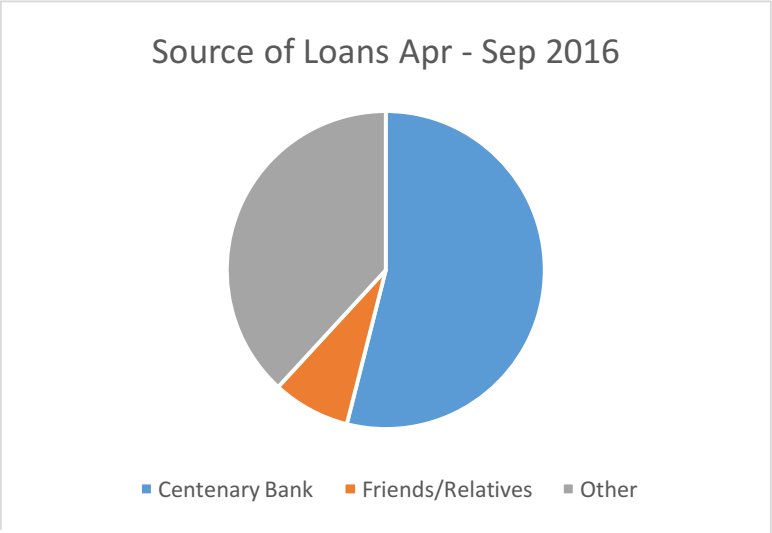

Figure 26: Source of loans Apr - Sep 2016

Next, we analyzed whether loans contributed to an increase in profitability. To do this, we looked at any firm that had identified accessing a loan and compared that with their profitability relative to the previous season. These results are shown in Figure 29. The percentages of firms that identified as less profitable, more profitable, or no change had very little differences. This suggests that taking a loan has little impact on the profitability of the firm. However, it is important to note that a majority of firms had identified taking a loan the same season that profitability information became available. There could very well be a delay from accessing a loan and reaping the benefits of it. This will be something interesting to continue to look at into the future.

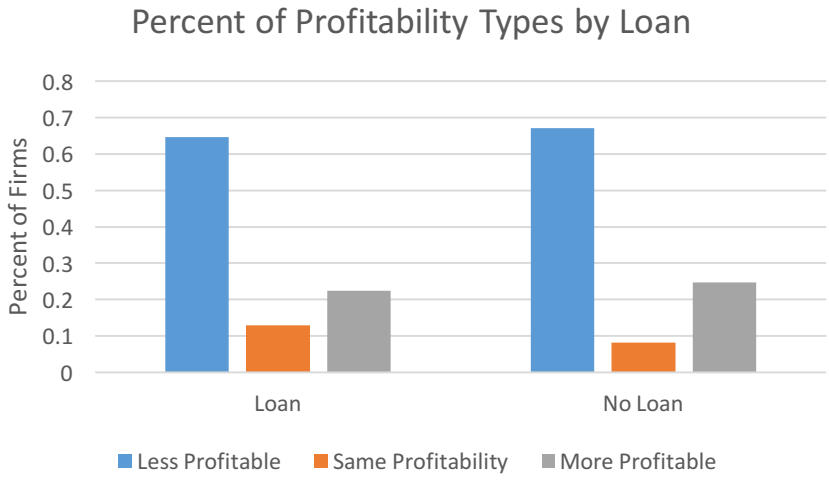

Figure 27: Percent of profitability types by loan

5.4. Product knowledge extension

Extending product knowledge to customers is an important behavior change because it enables farmers and other customers to understand and use products and it indicates an investment by the business in building relationships with customers.

To gain a better knowledge of firms that are giving product knowledge to their customers, we looked at the internal changes over the past four seasons of data. To get these data, the comments section of two questions – internal customer relations and internal outreach changes – were searched to see if product knowledge was mentioned as a specific change in a season. Over the four seasons, a total of 45 firms identified product knowledge as an internal change they were making to help improve their business. The cumulative total of firms who identified giving product knowledge as an internal change is shown below in Figure 30. The most product knowledge changes were identified in the most recent season, after a relatively flat rise over the previous seasons. This could suggest that more firms now see value in explaining the purpose of and difference between products. This shows an uptake of firms adapting behaviors promoted by FTF-VC activities since the inception of the program.

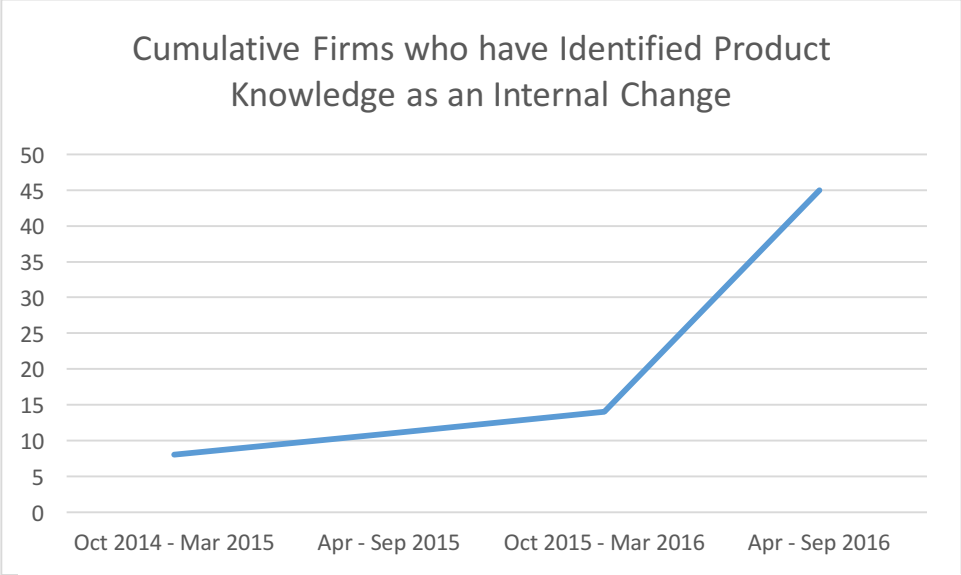

Figure 28: Cumulative firms who have identified product knowledge as an internal change

In the most recent season, interviewers were also asked to report if they observed the firm giving product knowledge to customers. This data shows that a large portion of companies were advising customers on products. In fact, as shown in Figure 31, the amount observed giving knowledge far exceeds those that identified it as an internal change to their company. This suggests that either many of these companies have been doing this since before the data started to be collected, or they didn't recognize it as a change that occurred. Still, it is positive to see so many firms partaking in the practice.

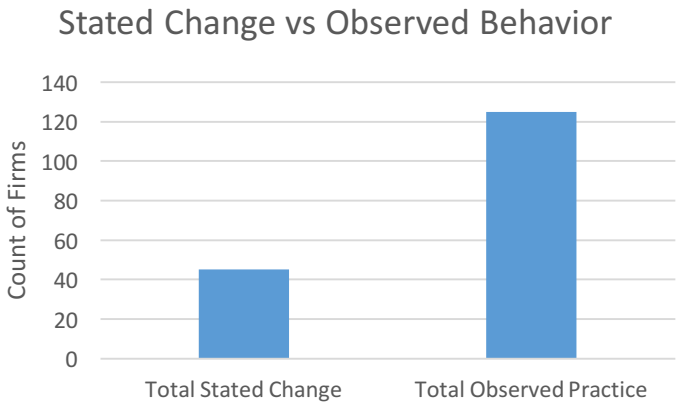

Figure 29: Stated change vs. observed behavior

To look at how the change of giving product knowledge affects company success, we looked at the profitability of companies that partake in the practice versus those that do not. Overall, firms that identified product knowledge as a change were more likely to be more profitable than those who did not identify it as a change. In fact, 35% of firms that claimed to internally start providing product knowledge stated they were more profitable compared to 22% of firms who did not. This can be seen in Figure 32. Additionally, these firms were less likely to say they were less profitable than the previous season; about 50% claimed to be less profitable, compared to 69% of the group that did not think of product knowledge as a change.

Similar results were seen when looking at the group which was observed giving product knowledge vs those that were not observed giving product knowledge, seen in Figure 33. About 24% of firms observed giving product knowledge were more profitable than the previous season, compared to 13% of those who were not observed giving product knowledge. Their likelihood of being less profitable was also lower, 66% compared to 87%.

These numbers overall are not as positive as the percentages of those who identified product knowledge as a change. This could be because those that identified it as a change are more aware of the practice and focus on its impact on the customer.

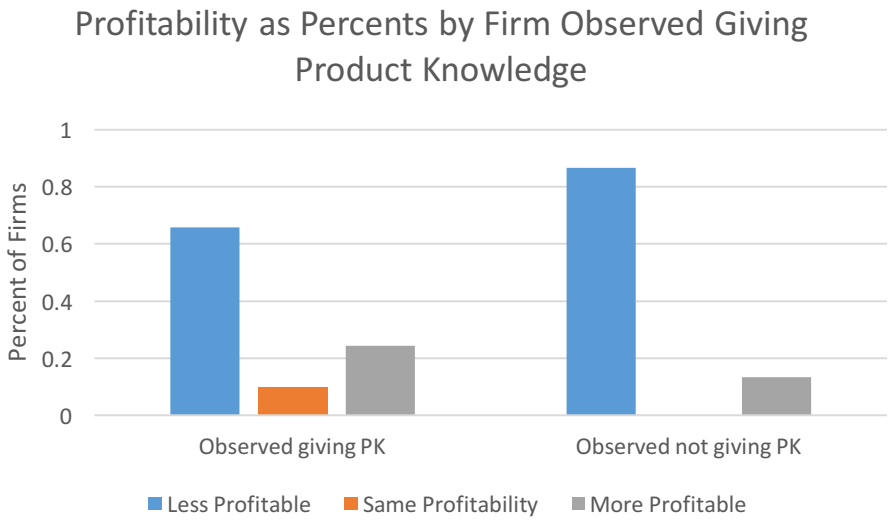

Figure 30: Profitability as percentage of firms with internal change of product knowledge

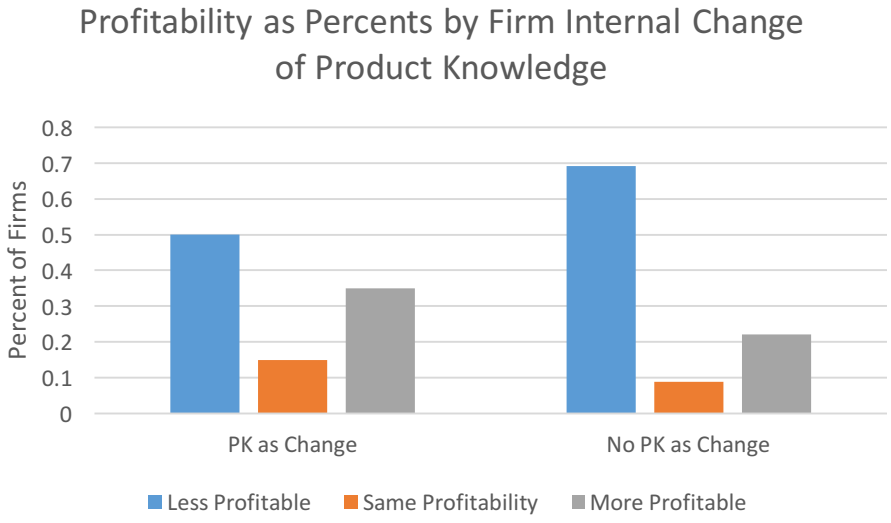

Figure 31: Profitability as percentage of firms giving product knowledge

6. OUTPUT VALUE CHAIN ACTORS INVOLVED IN INPUTS

6.1. Background

Ugandan agriculture value chains are not strictly linear. Actors can perform one or many roles; for example, traders who traditionally work on the outputs side are also supplying inputs to the farmers they buy from. It is, therefore, important to study value chain actors that traditionally perform output roles but also provide inputs to create a robust picture of the inputs system. This section aims to answer three primary questions:

1. Are output value chain actors providing inputs?
2. What types of inputs are output value chain actors providing?
3. Are output value chain actors' selling habits changing over time?

To answer these questions, this section focuses on two critical output value chain actors, collectors (Village Agents) and traders.

The data used for this study are provided from USAID FTF Uganda's CPM activity, which was described above in Section 4.2. These data are obtained by the CPM activity through its partners, so they reflect a population of actors who have been directly or indirectly influenced by the CPM intervention. As a result, the sample may not be representative of the population as a whole. (Also note that the data for this analysis are drawn from two different database tables, referred to as the Input Sales (3) table and the Form 5 Village Agent (4) table. Where relevant, we highlight the differences between the data in these tables.)

6.2. Input provision by output VC actors

Figure 34 shows the percentage of collectors and traders that recorded selling inputs, out of the total sample population provided from the Input Sales (3) table (regardless of the number of entries provided in the table, business entities were counted only once per season).[3] The table demonstrates that a large percentage – nearly two-thirds – of the output VC actors in the sample were involved in selling inputs. Because this is a sample of actors who were directly or indirectly influenced by CPM (who are promoting this practice), it is probably a smaller percentage in the general population. Nevertheless, such a large number of new actors getting into the inputs business could potentially disrupt the input markets.

	Oct 2014 – Mar 2015	Apr – Sep 2016
Actors Performing Both Roles	50% (1)	33% (1)
Trader	76% (16)	61% (43)
Collectors	-	69% (11)
Total	74% (17)	62% (55)

Figure 324: Percentage of collectors and traders recorded selling inputs

Figure 35 shows what percentage of actors are selling Chemicals, Farm Implements, Fertilizers, Herbicides, Seed and Other Inputs. Figure 36 shows, out of the actors selling inputs, the average value sold per actor per season. In the more recent season, the most popular inputs sold are Chemicals and Herbicides, followed closely by seeds and fertilizer, while the highest value comes from seeds sales. The jump in fertilizer sold is the result of one actor, Bukusu Ace, selling UGX 123,000,000.00 worth of fertilizer in Oct 2015 - Mar 2016. Approximately two-thirds of output value chain actors are selling inputs and one-third are providing inputs that are critical for improving farmer yield. However, there is little additional information provided regarding the input sales business of output value chain actors. Assuming this trend continues, it would be useful to have additional data regarding business practices,

[3] Form 5 Village Agent (4) table records 57% of Village Agents participating in selling inputs. The slight difference in numbers in the Input Sales (3) table and the Form 5 Village Agent (4) table is a result of slightly different samples. However, based on both numbers, we can assume that the majority of Village Agents are selling inputs.

such as certified seed sales, extension services, and knowledge provision. This additional information would provide further insight into how farmers get access to quality inputs.

Type	Oct 2014 – Mar 2015	Apr – Sep 2016
Chemicals	22%	37%
Farm. Imp.	22%	9%
Fertilizer	61%	27%
Herbicides	52%	33%
Other	0%	3%
Seeds	74%	31%

Figure 335: Percentage of actors selling types of inputs

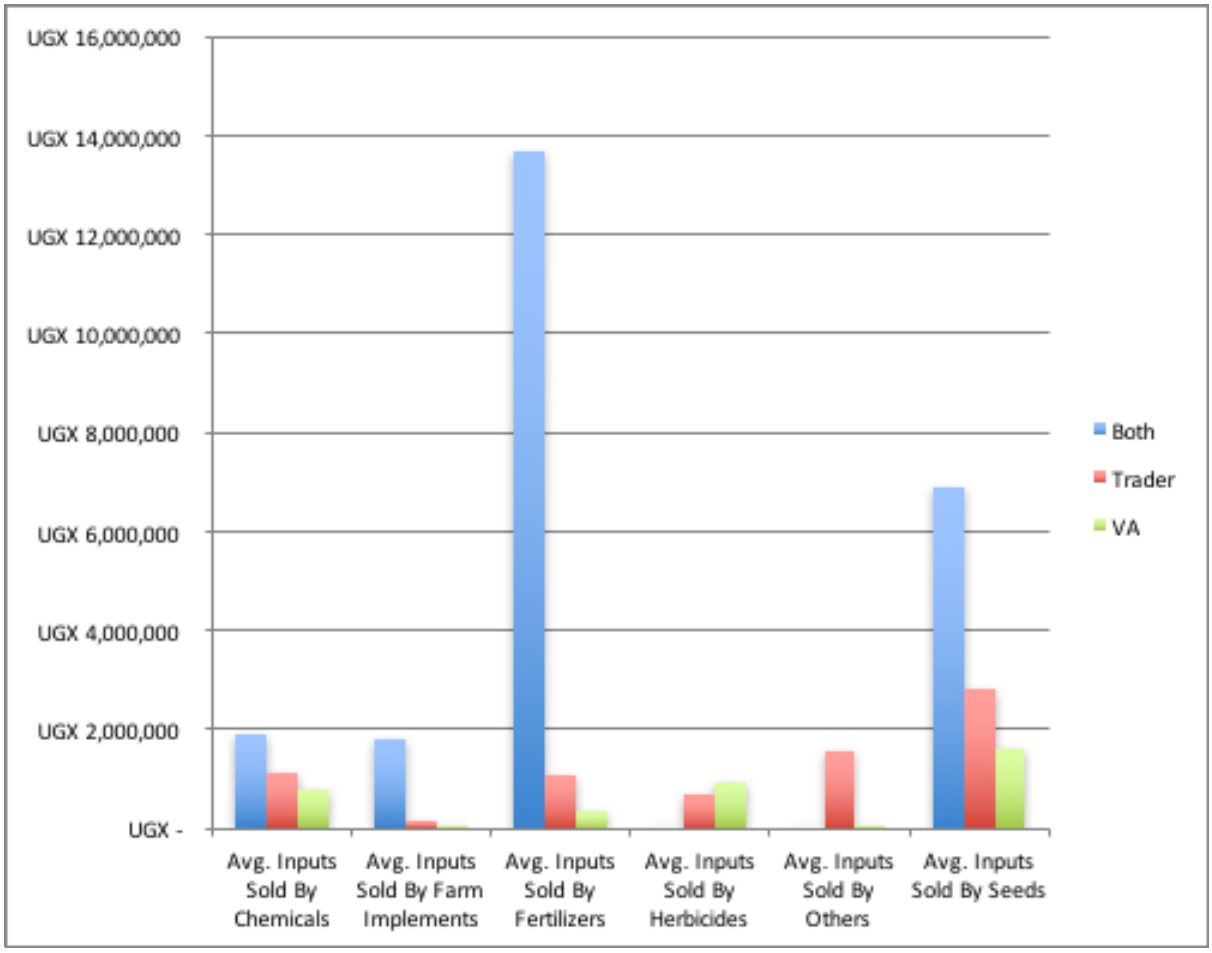

Figure 34: Average value of inputs sold by type and actor

6.3. Change over time in output value chain actors' selling habits

Figure 37 shows the average value of inputs sold per actor from two seasons: Oct 2015 - Mar 2016 and Apr-Sep 2016. The average value of inputs sold per actor for all inputs decreased from Oct 2015 - Mar 2016 and Apr-Sep 2016. The average value of all individual inputs decreased as well, with the exception of "Chemicals" and "Other." However, as presented in Figure 34, there are more actors in the sample in the Apr-Sep 2016 season; the small sample size in the earlier season could mean these data are not accurate. More data and future analysis could be helpful in identifying the nature of this trend and its causes or identifying the flaws in the analysis.

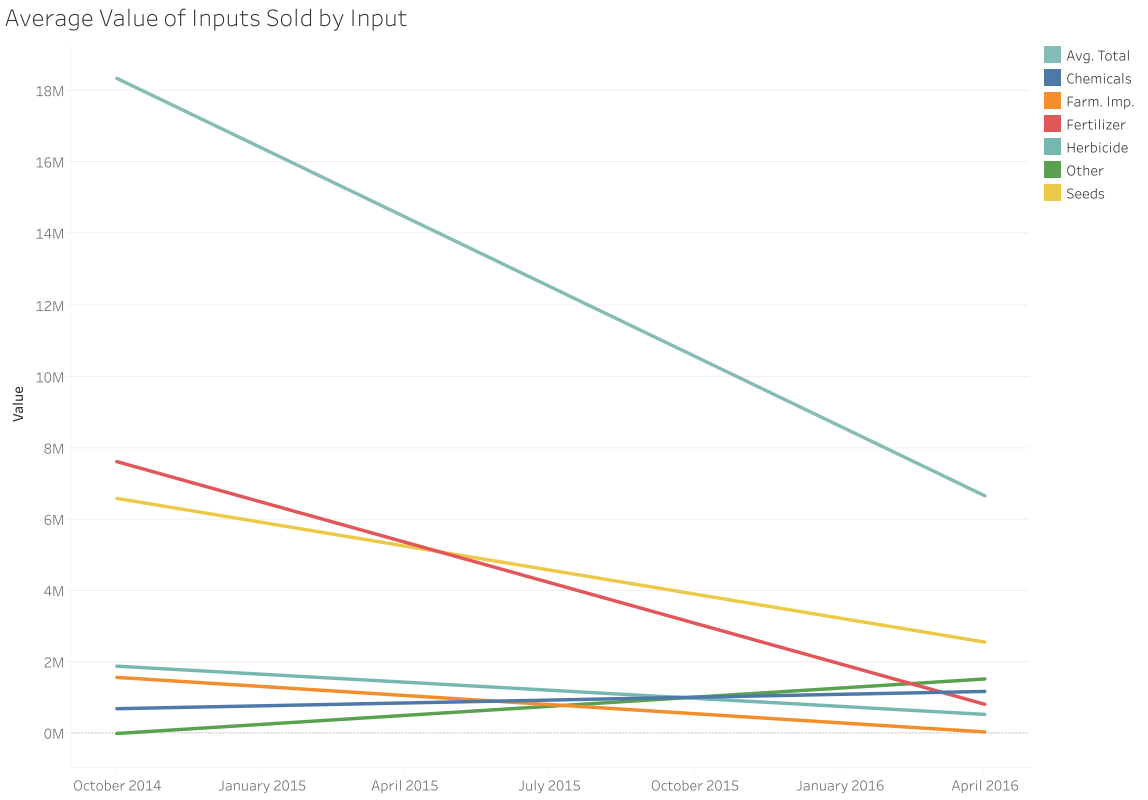

Figure 35: Average value of inputs sold by input

7. FARMERS ANALYSIS

7.1. Background

FTF-VC Activities aim to influence farmer behavior, so it is important to study how changes in the inputs subsystem affect the entire value chain. The hypothesis is that FTF-VC interventions influence the retail input market, and as a result, farmer behavior changes; in turn, the changes in farmer behavior positively impact the businesses of middle VC actors. This section breaks down this hypothesis and focuses on studying four major points:

(1) Farmer purchases of physical inputs over time

(2) How the purchase of physical inputs impacts business performance

(3) Farmer ability to use extension services over time

(4) How extension services impact business performance

Data on farmer behavior are difficult to obtain in the FTF-VC project, because most of the activities do not work directly with farmers (due to the market facilitation approach). Here, we draw on data from the CPM Activity to shed a little light on how changes in the inputs subsystem influence farmer behavior, and we attempt to connect it to the data from the AgInputs Activity.

This section assigns inputs into two categories, physical inputs, such as herbicides and fertilizers, and extension services, such as spray services and training, to determine the impact of these types of inputs on farmer success.

The data used for this study, provided by USAID FTF Uganda's CPM activity, are compiled from a survey conducted over three different seasons, Oct 2014 - Mar 2015, Apr-Sep 2015, and Oct 2015 - Mar 2016. (The collection tool was revised this past year, resulting in some overlap between the fourth season reported and previous seasons. For this reason, the last season of data was not used. If data collection continues, this should not be a problem in the future.) The number of surveys taken for each season of this study is shown in Figure 38 below. While CPM does not work directly with farmers, the farmers surveyed may be indirectly influenced by CPM interventions (e.g. the traders to whom they sell may be working with CPM), so the sample may not be representative of the population as a whole.

Oct 2014 – Mar 2015	Apr 2015 - Sep 2015	Oct 2015 – Mar 2016
617	344	1,549

Figure 368: Surveys taken by season

7.2. Physical inputs

Figure 39 below depicts the average value of inputs used (seeds, fertilizers, herbicides, etc.), reported by farmers over the three seasons of data. In the last season, there are three distinct months reported, October, November and March and the recorded values vary significantly between the months. Because of this, the data is shown by the month collected, instead of by season. March, the last month of Oct 2015 - Mar 2016, has no record of the value of inputs used by farmers. The lack of entries for the value of inputs in the month of March in Oct 2015 - Mar 2016 could be due to export errors or data issues.

Figure 39 depicts a general increase in the value of inputs per farmer, with the exception of the northern region, in which the value of inputs decreased in October 2015 from its previous rising levels. However, given the gaps and inconsistencies in the data, this analysis requires revisiting when additional data become available.

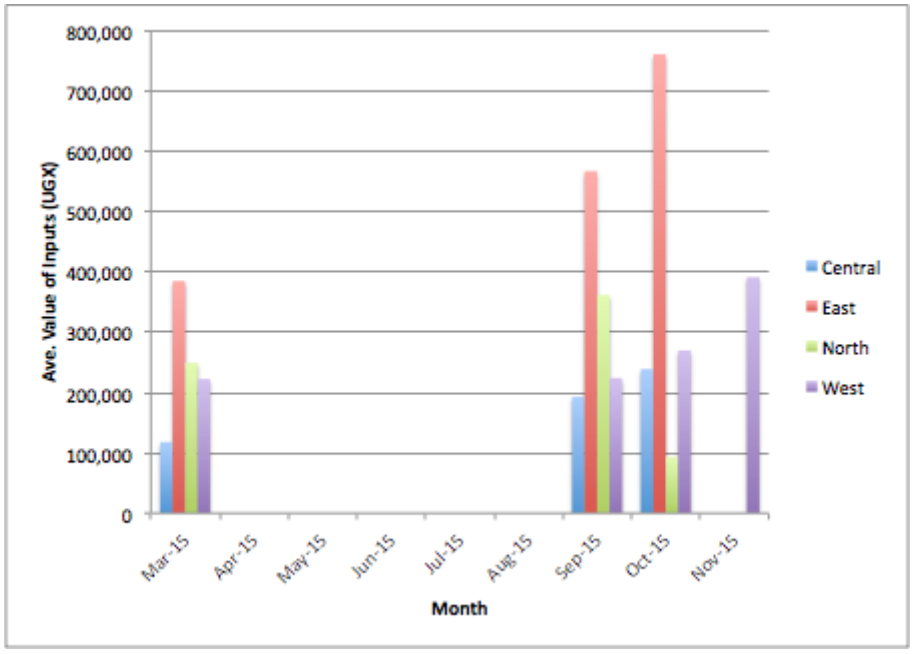

Figure 37: Average value of inputs used

Next, we investigated whether input use improved business performance. To do so, we examined the correlation between the value of inputs used by farmers and business performance. One variable of interest is crop yield per acre, as this would indicate that the value of inputs is positively affecting crop performance. According to an ANOVA analysis, the value of inputs per acre may be a significant predictor of yield per acre. However, yield per acre and inputs per acre have a very low correlation coefficient, 0.034, meaning that there is a weak relationship between the value of inputs and the yield. The results of these analyses suggest that there is a weak but statistically significant relationship between inputs per acre and yield per acre.

The second variable of interest is volume sold per acre. Volume sold per acre may provide additional insight beyond yield per acre, as volume sold per acre may indicate that the amount of inputs invested is positively affecting crop quality. An ANOVA analysis was conducted, and the variable was found not to be significant, meaning that the amount invested in inputs per acre has little impact on the volume of crops sold per acre.

The analyses conducted above may indicate that farmer production and success may not be strictly a function of the amount they are investing. However, given the limited data available, further investigation is required.

7.3. Extension and knowledge services as inputs

Next, we examine extension and knowledge services and their impact on farmer performance.

The AgInputs data provides information on which businesses are providing extension services to farmers. This section focuses on three main services: farmer field days, farmer demonstrations and spraying services. The data was aggregated by business location to find districts where these extension services were taking place, assuming businesses perform these services within the same district in which they are located. Using district location and the growing season, this data was then linked to the CPM's Farmer Survey data. The resulting data is shown for Oct 2015 - Mar 2016 ("2016") and Mar - Sep 2015 ("2015") in Figure 40 and Figure 41 below.

District	Season	Avg. Yield/ Acre (Kg)	Demos Occurring?	Field Days Occurring?	SS Occurring?
SIRONKO	2016	810.02	1	1	1
RAKAI	2016	748.44	1	1	1
MUBENDE	2016	908.18	1	1	0
MITYANA	2016	924.70	1	1	1
MBALE	2016	457.92	1	1	1
MASINDI	2016	744.08	1	1	1
LUWERO	2016	533.51	1	1	0
LIRA	2016	10.09	1	1	1
KISORO	2016	234.40	1	1	1
KASESE	2016	155.39	1	1	1
KAPCHORWA	2016	1151.19	1	1	1
KAMULI	2016	753.17	1	1	1
KABALE	2016	513.01	1	1	1
JINJA	2016	768.74	1	0	0
IGANGA	2016	490.53	1	1	0
IBANDA	2016	456.20	1	1	1
GULU	2016	226.14	1	1	1
SIRONKO	2015	755.00	1	0	0
RAKAI	2015	450.00	1	1	1
MUBENDE	2015	663.35	1	1	0
MASAKA	2015	212.50	1	1	1
KASESE	2015	179.37	0	1	0
KABALE	2015	397.00	0	1	0
IBANDA	2015	456.08	0	0	0

Figure 380: Yield by district and growing season with extension services

District	Season	Avg. Yield/ Acre (Kg)	Sum of Demos	Sum of Farmer Field Days	SS Occurring?
SIRONKO	2016	810	40	72	1
RAKAI	2016	748	18	110	1
MUBENDE	2016	908	4	16	0
MITYANA	2016	925	6	62	1
MBALE	2016	458	100	226	1
MASINDI	2016	744	22	10	1
LUWERO	2016	534	2	18	0
LIRA	2016	10	106	106	1
KISORO	2016	234	0	94	1
KASESE	2016	155	36	258	1
KAPCHORWA	2016	1,151	64	146	1
KAMULI	2016	753	26	200	1
KABALE	2016	513	2	166	1
JINJA	2016	769	2	0	0
IGANGA	2016	491	28	2	0
IBANDA	2016	456	14	64	1

GULU	2016	226	52	48	1

Figure 391: Yield by district and growing season with count of services provided

In Figure 40, the status of the services is shown using a binary scale. "1" indicates that at least one business in the region during that season reported supplying this service. "0" indicates that no input providers recorded providing the service in that region, during that season. Oct 2015- Mar 2016 provides more information regarding the number of demonstrations and farmer field days taking place in each region. Figure 41 shows the number of demonstrations and farmer field days that took place in Oct 2015- Mar 2016. There is no information regarding the number of spraying services, so this remains a binary variable. Furthermore, the number of farmers reached by these services could vary greatly depending on location. The data only measure the number of services offered.

In attempting to understand whether the existence of each service impacts farmer yield, there are two models of interest. Viewing each service as factors with two levels, as in Figure 40, we analyzed whether these services impacted farmer yield. Similarly, using Figure 41, we examined whether the number of services occurring in a region affects the Average Farmer Yield Per Acre in that region. While these two models indicate that there is little relationship between the number of demonstrations, number of farmer field days, spraying services, and Yield, there are several other factors that cannot be accounted for when using this type of analysis. For instance, there could be a time delay in the response variable that would not be recognizable until more data is collected. It is also possible that the farmers surveyed did not have access to these services.

To provide an early indication of change over time, additional preliminary analysis can be conducted using the current data. First, we would like to see if Average Farmer Yield per Acre is increasing from season to season. Then we would like to view this increase as a result of increasing services. While we cannot, at this point, conclude that increasing services causes an increase in yield, there is evidence that this relationship exists.

There are six districts that recorded data for Mar-Sep 2015 and Oct 2015 - Mar 2016 in both the CPM and AgInputs tables. For these six districts, a simple paired t-test can be used to see whether or not average yield per acre is increasing. According to this test, there is sufficient evidence to show that the Average Yield per Acre increased from Mar - Sep 2015 to Oct 2015- Mar 2016. While we cannot currently test if this increase is due to an increase in the service inputs, Figure 42, below, shows the general trends of Average Yield per Acre and the average number of businesses providing farmer field days, spraying services and demonstrations per region. For these two seasons, there is an increase in all of the factors, indicating a potential relationship between the variables. More seasonal data and additional analyses would provide stronger evidence for a potentially causal relationship and provide additional insights into farmer behavior.

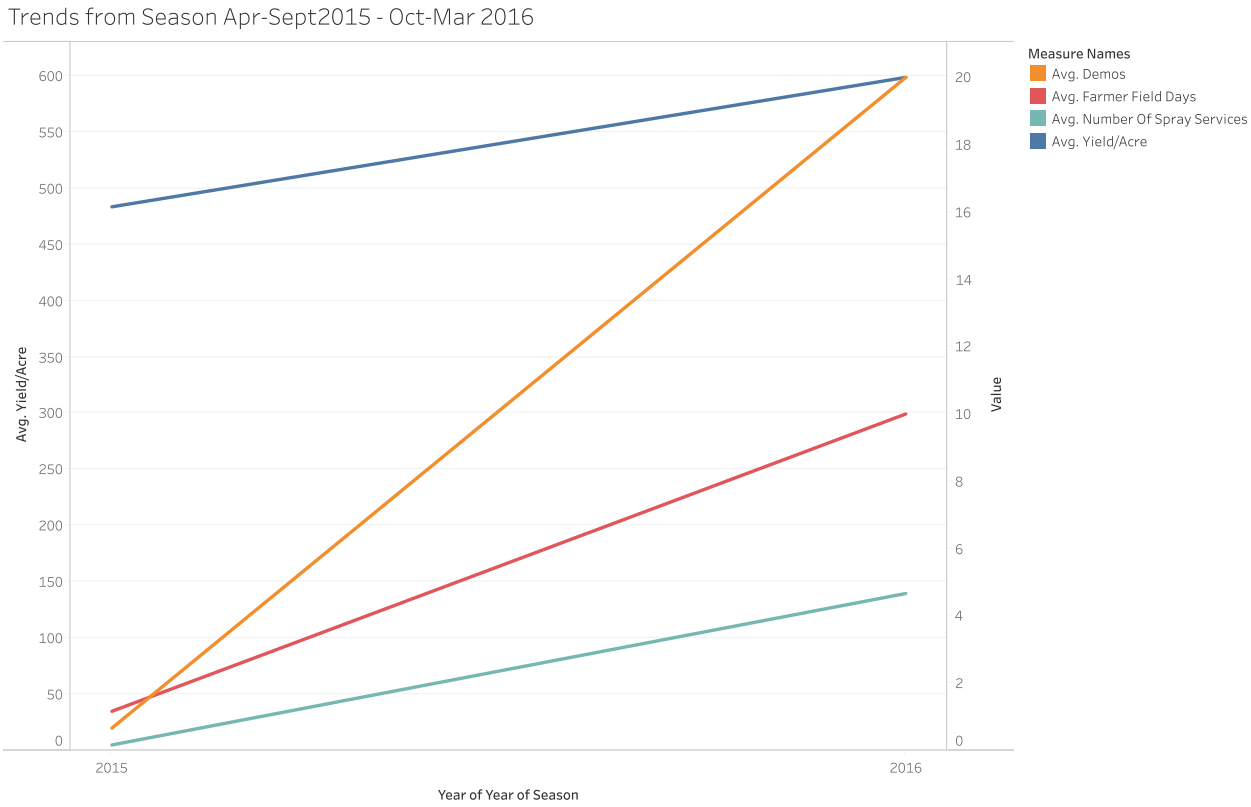

Figure 40: Yield trends from Apr - Sep 2015 to Oct 2015 - Mar 2016

8. DISCUSSION

8.1. Summary and discussion of results

This study aimed to investigate changes over time in the inputs subsystem and link them to firm profitability and other outcome measures. We focused on several key themes.

8.1.1. Changes in wholesalers (agrodealers)

First, we focused on the wholesaler (agrodealer), the key middle value chain actor on the inputs side. The wholesaler is the primary target of the AgInputs activity, so a deep analysis of this actor was both feasible and relevant. We examined wholesaler business practices, selling patterns and relationships, finance, and extension provision to investigate how these behaviors are changing over time. In each analysis, we examined whether behaviors were changing and to what extent, and then investigated whether the behavior change impacts the success of the wholesaler.

Business practices. We examined several changes in wholesaler business practices that are desirable because they indicate a more business-oriented mindset and a set of changes in services provided that indicate wholesalers are branching out into new services. Wholesalers reported making changes in most of these business practices, but some showed very limited change. There is slight evidence for an increasing pace of change in customer, financial/accounting, outreach, and supplier practices. There is also strong evidence that many wholesalers join associations every year, suggesting that they attach importance to developing relationships or to collective action. There is limited evidence that these changes in business practices led to successful outcomes (e.g. profits): outreach to farmers and selling mechanized equipment increased profits, but analysis of the remaining changes was inconclusive. On the whole, the only changes that appear widespread in the last year are changes in customer practices and association memberships, suggesting that wholesalers have not in general adopted a more business-oriented mindset, although some have done so and are reaping some advantages.

Selling patterns and relationships. We examined several changes in the relationships among suppliers, wholesalers, and input dealers using a network analysis. First, we examined the churn in relationships because it indicates whether relationships are maintained season-to-season. The churn has been increasing slightly over time in all the relationships we examined, which suggests the value chain actors are not developing long-term relationships (as had been hoped). Second, we examined how many relationships were perceived as "strong" and/or involved transfer of product knowledge. Product knowledge and strong relationships were highly correlated. On average, wholesalers are receiving product knowledge and maintaining strong relationships with more suppliers in the final season, disrupting a trend characterized by a decrease in these two variables over the previous four seasons. (It is unclear whether wholesalers ask for product knowledge more often and seek strong relationships with more suppliers, or suppliers led the increase.) Long-term and strong relationships are believed to be beneficial for business profitability and development, and transfer of product knowledge helps actors throughout the value chain, so improvements in all three are desirable. Our results suggest that all three had been steadily getting worse until the most recent season, so future data collection is required to determine whether there is a new trend of improvement. Third, we examined the structure of the network by looking at the "centrality" of wholesalers, which decreases with time. The average wholesaler effectively "connects" to fewer suppliers and dealers, which may indicate retailers and suppliers have more options available to them or may indicate a lack of strong relationships in general. Fourth, we were unable to analyze whether these relationship characteristics were correlated with the success of businesses. Because network characteristics are complex, it is difficult conclude what types of relationships are actually beneficial. Future work should explore this question. On the whole, the network analysis reveals that desirable relationship characteristics were steadily getting worse until the most recent season.

Financing. We examined changes in the sources of capital and loans, to investigate whether access to financing has changed over time and whether it has impacted wholesaler success. The majority of firms get their financing from personal resources, with much fewer utilizing bank loans; these numbers have remained largely constant over time. The use of supplier credit has increased steadily from limited usage to around the same level as bank loans. There is no evidence that accessing a loan contributes to firm success, but if there is a time delay between the loan and the change in profitability (as we might expect), future analyses would be required to capture it. On the whole, access to financing has not changed significantly with the exception of an increase in use of supplier credit, and the current data do not enable a good analysis of the impact of financing on wholesaler profitability.

Extension. We examined changes in wholesaler provision of product knowledge to customers, which is a desirable change because it enables farmers and other customers to understand and use input products and services (enabling behavior change by farmers) and because it indicates an investment by the wholesaler in improving customer service. An increasing number of firms appear to be providing product knowledge, suggesting a relatively widespread adoption of this practice. Improving the provision of product knowledge also appears linked to improved profitability. On the whole, provision of product knowledge has become more widespread and has had a positive impact on wholesaler profitability.

8.1.2. Changes in output VC actors involved in inputs

Second, we investigated how the provision of inputs by actors traditionally involved in the outputs side of the value chain may be affecting the inputs subsystem. We examined the number of output actors selling inputs and how the value of inputs sold has changed over time, to learn the scale of the input business captured by output actors. A significant percentage of the surveyed output VC actors report selling inputs (nearly two-thirds of the sample, although CPM has been promoting this practice), but there is limited data on how this has changed over time. In addition, there is little information regarding their inputs business practices, such as extension services, product knowledge and farmer outreach (as we examined for input actors, above). Furthermore, these data do not allow us to examine what percentage of the input sales come from output VC actors overall; this would enable a clearer picture of its influence on the inputs subsystem. On the whole, a large percentage of VC actors appear to be selling inputs, but there is insufficient information to understand how this has changed over time, how widespread the practice is, and whether and how it influences the inputs market.

8.1.3. Impact on farmers

Finally, we investigated the impact of changes in the inputs subsystem on farmer behavior and farmer success. While it is difficult to obtain data on farmers because FTF-VC does not work directly with them, we used some data from CPM and linked it with the AgInputs data to accomplish a preliminary analysis. First, we examined changes in farmers' use of inputs, and found that they were generally increasing except in the northern region; however, the data were very limited and the analysis should be repeated with additional data. Second, we examined how provision of extension services affected farmer success. There appears to be a potential relationship between extension services and farmer crop yield: crop yield per acre over time increased alongside the increase in number of extension services taking place. However, data from future seasons are required to determine whether the relationship is valid. On the whole, the data on farmer behavior suggest that farmers are responding to changes in the inputs system, but the data are scarce and these conclusions are preliminary.

8.1.4. Discussion: systemic change in the inputs subsystem

Our analysis of existing data was able to identify some expected changes in the inputs subsystem and also highlight areas that are not changing as expected. Wholesaler business practices were expected to change, but few of the changes are widespread and their pace has only increased in the most recent season. Relationships along the value chain were expected to increase in length, strength, and utility (in terms of product knowledge provision), and they did so, but only in the most recent season. Wholesaler access to finance has changed very little (with the exception of increased usage of supplier credit), although it could have been expected to increase. On the other hand, provision of extension services has been increasing and appears relatively widespread; furthermore, it appears linked to profitability.

Overall, the results suggest that while change has been slow, it may be gathering momentum now. Furthermore, provision of extension services may be a critical enabler of other systemic changes. Intuitively, it makes sense that farmers need to absorb the knowledge of why inputs are beneficial *before* they will invest resources in using them. Provision of extension services may be the "leading edge" of systemic change, and others will follow.

However, it must be emphasized that this conclusion is preliminary. To verify our speculation that change is gathering momentum, we need to collect similar data for the next season to verify that the sudden uptake in several key changes (wholesaler business practices and relationship quality) is not a fluke. On the other hand, waiting several seasons to verify a trend does not enable a quick pace of adapting development strategy. Potentially, with further data we can identify "leading edge" changes, such as the provision of extension services discussed above, and track these as early indicators of system-wide change. The identification of reliable means to quickly detect systemic change is a critical area for future research.

8.2. Potential Indicators

A primary objective of this subsystem study is to identify and inform indicators of change relevant to FTF-VC's targeted impact on the market system. This section discusses indicators and measurement approaches suggested by our analysis of the inputs subsystem.

8.2.1. Pathway indicators

To properly measure the market system, it is crucial to have easily understood indicators that show change throughout the entire system. In order to do this, we are developing pathway indicators in many places in the system that measure key aspects of change. These pathway indicators will be derived from the BRC map and show how early evidence of change in one area of the system can lead to change down the road for another aspect of the system. We hope to use the information learned from this study to develop some of these indicators and pathways.

8.2.2. Potential indicators identified by this study

Subsystem studies help MSM identify potential indicators of change in the system's state that are not tied directly to a particular intervention, but measure important parts of the subsystem. The potential indicators we have outlined below will help inform the development of our systemic measurement approach.

It is clear from our analysis that the data collected for the individual activities is useful for assessing the state of the system. Therefore, there is significant overlap in our indicators with those identified by the activities.

However, the indicators below are intended to capture certain key dynamics of the subsystem, which were identified through the subsystem study. They therefore represent a subset of all the important changes, but attempt to measure those that indicate broader change is likely or at least is possible. We focus on three key dynamics: enabling the propagation of change, incentives for change, and the extent of change.

Indicators of change propagation. In our analysis, we found that some changes are required before other changes can occur, or assist in the propagation of other changes through the system. The following indicators build on this concept to identify and monitor precursor changes that likely precede or enable wider systemic change.

> **Network-central actors adopt practices that propagate change.** Our analysis shows that some actors are more central to the network of value chain actors, i.e., they "connect" more actors to one another. Because of their connections, these network-central actors are well-positioned to propagate changes to many other actors throughout the network. Logically, if these central actors adopt practices that enable propagation of beneficial changes (and maintain their central position and success), other actors are likely to change as well through direct influence and/or imitation and crowding in. For wholesalers, for example, key practices could include the dissemination of product knowledge (a practice that propagates change), and few stockouts (a condition that likely maintains their many relationships). Identifying and measuring these practices in network-central actors could herald broader change in the near future.
>
> **Identification and monitoring of "leading edge" changes, such as knowledge extension.** Our analysis suggested that knowledge extension may be a necessary precursor to other types of changes, such as adoption of new agricultural practices. Intuitively, potential adopters must understand the value of a change before they will adopt it, so this is an example of a change that enables other changes to propagate through the system; we term these "leading edge" changes. Identifying these leading edge changes and monitoring their propagation through the system could herald broader change in the near future, or explain why it has not occurred.
>
> **Identification and monitoring of potential "blockers" of change.** Our system map suggests that access to financing is an enabler of broader systemic change. Our analysis finds that such access is not increasing. While the use of financing may trail other changes, in that loans are not needed until some evidence of success proves the investment is worthwhile, it is worthwhile to monitor access to finance because if it is not available it may constrain systemic change later. However, monitoring the *use* of finance does not indicate whether there is *access* (only whether there is adoption). For our purposes in understanding the removal of "blockers," it is necessary to develop measures of access (which we leave to future work).

Indicators of business success as incentive for change. Market facilitation depends in large part on the development of business incentives for desired changes, based on assumptions that the changes will enable greater success for businesses. Therefore, it is important to monitor both whether businesses are able to see the potential for success and whether these changes do indeed bring about success. The following indicators measure these two dynamics.

> **Adoption of a critical collection of business practices.** Adoption of business practices is important not only for the practices themselves but also as an indication that businesses are adopting a "business

mindset" in which they take ownership of investing in changes that will increase the value they provide and, in turn, the profit they earn. Examining the extent of adoption of a critical set of practices (those that best indicate investment/ownership) should enable assessment of a systemic change toward a business mindset.

Outcomes for businesses. It is important to monitor not only whether changes are being adopted but also whether the adoption of changes enables increased success for businesses. Our ability to measure business success is limited with the current data, and profitability questions are sometimes resisted. Further research is required to develop appropriate measures of success that are observable in short time frames and data collection strategies that enable connection of change adoption to business outcomes.

Indicators on reach (to farmers). Market facilitation approaches rest on the assumption that facilitating private sector improvements will benefit others in the system, and particularly farmers. Therefore, it is critical to know whether and how changes are reaching farmers in order to gauge potential impact.

Farmer access to and uptake of knowledge extension (and other "leading edge" changes). Knowledge extension seems to be required for other changes to take place, and there may be other such "leading edge" changes (see discussion above). Monitoring these specifically at the farmer level will enable an assessment of whether these leading-edge changes have propagated as far as the desired end beneficiary.

Farmer behaviors: purchasing and source. The ultimate goal of the facilitation effort is to enable farmers to change their own businesses in positive ways. In our case, measuring what they purchase shows what they see value in, as concrete evidence that they have adopted a behavior change. It is also important to identify the source of their purchases. Our study showed that nontraditional actors are entering the inputs value chain, so monitoring farmer purchases will tell us whether this has been a successful strategy and how the value chain is changing.

Discussion. One challenge in developing indicators is balancing two goals: the need for complete and reliable information about the system and the need for fast assessment so that strategies can be adapted if they are not working. These two goals are generally in opposition, so there is a spectrum from more complete and reliable to faster (and less complete/reliable). The indicators above range on both sides of this spectrum. Future work should explore how to balance these goals, whether with indicators on both sides or the development of creative ways to achieve both goals.

A second challenge in developing indicators is down-selecting from a large number of desired indicators to a smaller number of key indicators. We have made a first attempt at this by focusing on several key dynamics identified in the subsystem study, but the approach should be refined in future work.

8.3. Gaps and Limitations

We have identified some gaps in data as we have performed these analyses. First, there is a lack of longitudinal data. We have some data about output value chain actors selling inputs and about farmer usage, but not in every season. Some plots show data for only two seasons. If we observed more longitudinal data, we would obtain a better view of change in the system over time. For example, questions in the agrodealer survey change over time to capture new information about or changes in understanding of the system. These changes add to and do not invalidate previous data; however, it is difficult for us to interpret meaning in change over time with inconsistent questions.

There are also challenges in measuring success of actors. There is no agrodealer business practice baseline measurement in addition to changes in the last six months to provide a sense of system state. One of the goals of our analysis was to understand not only what has been changing but how it has impacted the success of businesses and farmers. Very limited data was available to indicate success: revenue bands were collected in three seasons,

and gross profit was collected in a single season. Building indicators of success into future data collection efforts would enable better evaluation of how each type of behavior change impacts the profitability of those expected to implement it.

A third challenge is inconsistency in terminology. In AgInputs' business practices data, there is a question about to what type of actors agrodealers sell. This is a useful question; however, the fields do not match well with the network data. For example, many wholesalers sell directly to farmers and few sell to other actors. It is not clear how a retailer fits in these data. The language used in these data does not match MSM terminology. This discrepancy is one we will continue to mitigate. The network analyses presented here are representative only of agrodealer wholesalers and retailer dealers. If we examine the selling practices data, we see we may be missing large parts of the wholesaler network and their customer bases.

Fourth, data collected across activities are not cohesive. Data collected across activities may not actually be representative of the same time period. CPM is collecting valuable data about extension provision by collectors. Perhaps some of these are also retailers. To add to this, we are concerned that as activities reach the end of their lifetime, that the data that has been developed will cease being collected. There is a need to continue this data collection and possibly shape it for the future.

For future analyses, we will need to identify more data needs. The AgInputs data is focused at the city center agrodealers. There is a chance there are different realities in the villages. There could be an opportunity to visit some village level agrodealers and do a small study. We may also want to collect data about cooperatives to investigate how they compete with agrodealers and village agents. As for network and relationship data, we see that product knowledge and strong relationships follow the same trends. We would like to know more about what a strong relationship means to a wholesaler. For example, do wholesalers report strong relationships when a supplier gives product knowledge, or because of trust, financial reasons, or because of reliable and consistent stock of a particular product? Lack of farmer-level data is another gap that constrains us from studying farmer behavior at the production level in the value chain.

9. RECOMMENDATIONS

9.1. Recommendations to the investigation of the input subsystem

Findings should be verified by collecting similar data in the next season, particularly because so many changes showed evidence of speeding up in the most recent season after several seasons of stagnation (relationship strength, length, and utility; link between crop yield and extension services; product knowledge provision; etc.).

Many of our analyses showed that when looking at longitudinal data across the input subsystem, change seemed to be slow to start but recently may have been gathering more momentum. In order to confirm our analyses, they should be verified using the data collection from the following seasons. Areas of particular interest include strength, length, and utility of dealer relationships, provision of product knowledge, and the correlation between extension services and crop yield. If these future analyses can provide similar and consistent results, then we can further confirm our suspicions about the uptake of these qualities in the subsystem.

In addition to the desire to validate our findings with upcoming data results, we have discovered many areas of potential deeper investigation for each of our analyses.

Barriers to the adoption by input wholesalers/dealers of a mindset focusing on delivering greater value to customers should be investigated, and future efforts should be designed to overcome these barriers. While product knowledge provision is relatively widespread, limited changes in other business practices suggests little widespread change in the underlying business mindset. An understanding of the barriers to such change should inform future interventions in the inputs value chain.

We recommend looking deeper into the business practices of dealers, and what barriers to adopting changes to business practices exist. Input dealer business practices were expected to change as dealers' mindsets transitioned to a focus on delivering greater value to customers. This customer-oriented business model was expected to be shown through adoption of changes in outreach, customer, financial/accounting, and supplier-related practices. Ultimately, these results only showed a slight increase in these behaviors in the most recent season. Looking into barriers to adoption of these practices could help identify limitations to reduce in order to allow dealers to focus their businesses on delivering the best value.

Additionally, when looking at business practices, it may be worth investigating the possibility of delays on reaping benefits of selected changes. While it is hard to know from the data if they kept continuing the practice after they mention first adopting it, it may be worth looking at profitability after a time delay to see if the two are linked after a particular period in time.

Selling patterns should continue to be looked at from the dealer perspective. While percentages of the sales going to different types of customers can be helpful, classification of specific customers by their role in the value chain would be more informative. Continuing this research with the next collections would be valuable.

The information surrounding *financing* can be expanded upon as well. This is another area where looking for a delay in reaping the benefits of the behavior would be worth looking into. This requires longitudinal data about profitability, but could show that being able to access a loan might strengthen a business down the road. The question of whether there is a clear point where a business could run exclusively on its own retained earnings is another investigation that may be informative.

Extension characteristics outside of product knowledge propagation should be looked at. This would involve looking at the ways the extension subsystem and input distribution subsystems are linked, for both farmers receiving extension, as well as those providing it.

The impact of output actors selling inputs to farmers on the inputs value chain should be investigated. This is a relatively new trend, and we do not have enough data to understand its impact on the system. Understanding their impact on the system can allow for a more comprehensive view of input distribution realities throughout the value chain.

9.2. Recommendations to investigation of market facilitation interventions

While looking at the data as a whole, a few common questions applicable to the analysis of market facilitation interventions arose.

Delays in reaping benefits of changes should be understood. This was especially applicable to some of the areas we discussed earlier (such as financing and business practices) but is important to understand completely when using market facilitation. Delays may impact both our ability to measure systemic change and the value chain actors' receptiveness to maintaining changes. For example, if profitability does not increase until four seasons after the start of new knowledge provision services, dealers may not see a fast enough return to continue the new services. We recommend examining delays and developing strategies to account for them in measuring systemic change. This many include creating measures used consistently across a time frame thought to be long enough to account for the delay, and following up with the business about their continuation of the practice.

Monitoring and evaluation strategies should address both the need for longitudinal data on large, representative samples and the need for data about many different parts of the system. To collect longitudinal data, we need monitoring and evaluation strategies that would ask consistent and informative questions over time. This could be done by identifying early changes to the system that could indicate future developments and monitoring those over time. It could also be done through a two-pronged approach. This would include data collection that remains consistent over time when looking at some key indicators, but also includes some adaption of the data collection over time as the system changes. This ensures the system can easily be analyzed for changes over time, but can also look at specific points of interest when they become relevant or interesting.

Finally, the data in general should be easy to collect and should aim to provide insight into systemic change. This means that the indicators that are selected and looked into should all be key parts of the subsystem that have been identified as areas that are wanted to change, either directly or indirectly through intervention. Ultimately, we think this data collection would be more informative and show clearer results about systemic change in market facilitation approaches.

There is a need for an approach to systemic monitoring and evaluation that is both tractable and comprehensive. These two needs are often at odds. Comprehensive monitoring requires large sets of longitudinal data on many parts of the system, while tractable monitoring requires manageable data collection and results that are abstracted enough to be perceived and understood at a system level. This report showcases these tensions: we highlight many gaps in our ability to understand the subsystem (i.e., our data are not comprehensive); however, it is also difficult to present findings in an abstract enough format to be understood at the system level (i.e., not tractable). Future work for MSM is to develop approaches that are more tractable and more comprehensive, based on our experience in this and other subsystem analyses.

10. NEXT STEPS

MSM encourages engagement with all stakeholders and we welcome feedback on this report. We plan to build on this analysis in our ongoing work.

We will continue the iterative system-subsystem approach, see section 1.1 Background: MSM's approach, and intend to release approximately two subsystem reports per year and a full release of system maps once per year, with iterative releases in the interim.

11. ACKNOWLEDGEMENTS

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12. CONTACT

MSM welcomes feedback. Please contact us at msm.uganda@mit.edu.