Gendered Perceptions in Maize Supply Chains: Evidence from Uganda

Abstract

Motivation: Faced with imperfect information about the performance of value chain actors, transactions are often based on perceptions. Inaccurate perceptions may result in inefficient value chains and biased perceptions may affect inclusiveness.

Purpose: First, we establish how the ratings given by farmers align with self-ratings of dealers, traders and processors. Second, we test if male farmers rate systematically different than female farmers. Third, we test for gender related differences in self-rating and fourth, we test if these actors are rated differently because of their gender. Finally, we test for gender-based homophily among women.

Approach and methods: A random sample of farmers were asked to rate agro-input dealers, traders and processors on a set of important attributes-ease of access, quality of services, price competitiveness, and reputation. These value chain actors were then tracked and asked to assess themselves. Descriptive analysis, t-tests and multivariate regression models with two-way non-nested clustering are used.

Findings: We find that input dealers, traders and processors assess themselves more favourably than how farmers perceive them to be. For self-assessments, the gender of the value chain actor does not matter. However, the difference between self-assessments and farmer ratings is larger for male than for female farmers, as female farmers appear to rate significantly higher in several dimensions. The gender of the actor being rated does not affect the rating they get, and gender-based homophily among women is not present.

Policy implications: Policy interventions that reduce the gap between actor self-assessments and farmer ratings can increase value chain efficiency. Interventions that reduce gender bias, such as certification by an independent agency, may prevent gender segregation in value chains.

Keywords: gender, maize supply chain, perceptions, ratings, Uganda

1 Introduction

Neoclassical economic theory is built on the premise that rational agents interact in a context of full information. However, in the real world, both consumers and producers face substantial information frictions. Sometimes, agents lack skills to correctly assess information about the counterpart. In other cases, agents may strategically decide to hide valuable information. As a result, when decisions need to be made, economic agents usually rely on incomplete information that is combined with heuristic techniques prone to bias, and updated as new information becomes available. Similarly, in commodity supply chains, information frictions may exist, especially in informal value chains where quality is hard to track and agreements difficult to

enforce. As a result, value chain actors base a substantial part of their decisions on perceptions and beliefs about actors up- and downstream.

Perceptions that do not align with reality can have significant consequences for the entire supply chain. Erroneous perceptions may lead to inefficient supply chains and can hamper value chain innovation. More importantly, systematic bias in perceptions may hamper inclusiveness of value chains. For instance, if traders of a certain clan or tribe are traditionally regarded as good traders, other actors may experience barriers to entry. Despite the importance of beliefs and perceptions for transactions within food supply chains, there are few studies that track perceptions throughout the chain, partly because perceptions are not easy to measure.

In this paper, we study how perceptions align throughout maize value chains in Uganda with a particular focus on heterogeneity related to gender. To do so, a representative sample of 1,526 maize farmers were asked to rate—on a scale of 1 being very poor to 5 being excellent—agro-input dealers, maize traders, and maize processors, on dimensions such as ease of access, quality of services rendered, price competitiveness, and overall reputation. These agro-input dealers, traders and processors were then traced and asked to assess themselves on the same dimension, resulting in self-assessments of 78 agro-input dealers, 341 assembly traders, and 174 processors. This information is then used to document (in)consistencies between how farmers perceive input dealers, traders, and processors, and how these actors perceive themselves. To investigate systematic bias along gender lines, we further test if the gender of the farmer and/or the actor that is being rated has an impact on the ratings.

Ratings are often used to reveal perceptions. Advances in information and communication technology has facilitated the use of simple rating applications at a large scale to reveal consumer perceptions of a variety of products and services (Reimers and Waldfogel, 2021). Self-ratings have also been used to assess own performance in various settings (eg. Horswill et al., 2013). Perceptions have been found to correlate with innovations in food supply chains and identify performance issues of actors involved (Ola and Menapace, 2020; Odongo et al., 2016).

Women are important actors in food supply chain. In many places, we see patterns of women's share in agricultural labor increasing, creating more space for women to engage in a sector that is considered important for poverty reduction (Kawarazuka et al., 2021). Furthermore, while in smallholder agriculture, women often only participate in agricultural production as unpaid family laborers, they often have considerably more agency in other nodes of the value chain. For instance, Maertens and Swinnen (2012) find that in Senegal's emerging high-value horticulture supply chains, women participate as paid wage laborers on large-scale estates and in agro-industrial processing. A range of studies looks at the opportunities of and constraints faced by women in agricultural value chains (Barrientos, 2019; Kruijssen et al., 2018; Mnimbo et al., 2017). While the inclusion of women in food supply chains is important for food and nutrition security, there is also intrinsic value in more inclusive agricultural value chains.

In light of the importance of perceptions in informal value chains, an important barrier to increased participation of women may be related to gender related biases. Systematic differences in ratings related to gender, where women are rated significantly lower than their male counterparts, have been found in a variety of contexts (Mitchell and Martin, 2018; Furnham, 2005; Patiar and Mia, 2008). Gender bias in perceptions can constitute important barriers to market access for women, leading to mistrust, lower access to credit, etc. Bias in self-rating along gender lines may also constrain women's entry and performance, as this may affect aspirations which have been found to be an important determinant for success (eg. Riley, 2017).

The first objective of this study is to establish how the ratings given by farmers align with self-ratings

of dealers, traders and processors. Here we answer questions such as: Do agro-input dealers think they sell better quality seed than what farmers think? Do farmers agree that traders offer a good price when they buy at the farm-gate? Do processors know that they are difficult to reach if farmers think this is a problem? Second, we focus on the rater gender effect and test if male farmers rate systematically different than female farmers. The third objective is to test for gender related differences in self-rating of the agro-input dealers, traders, and processors. A fourth research objective is to test if dealers, traders and processors are rated differently because of their gender. The final objective is to test for the presence of gender related homophily among women, where female farmers give higher rating to female dealers, female traders, and female processors (McPherson et al., 2001).

We find that agro-input dealers, traders and processors consistently rate themselves higher than how farmers rate them, except for one attribute that is easily observable by both those who rate and those who get rated. We do not find that gender plays a significant role in self-assessments. The gender of the actor being rated also does not affect the rating that they receive and we find no signs of gender-based homophily among women in the ratings. There is some evidence that female farmers rate more favorably than male farmers, but only in some dimensions. In the sections that follow, we expound on the study context and hypotheses; explain the data used and econometric models we estimate; present the results; and finally provide a conclusion and reflect on the consequences.

2 The structure of the maize supply chain

We focus on the maize value chain in Uganda. Maize is both a staple and cash crop in Uganda, prioritized by the government for food security and household income. Judged in terms of land area, maize is the most important agricultural commodity in Uganda, covering 30% of total cropped land, followed by beans, covering 15% of cropped land.

The government's interventions in the maize sub-sector over the past decade have focused on increasing on-farm productivity and production, yet productivity remains low. On-farm maize production data from the Uganda Annual Agricultural Survey (2018) reports average yields of about 600 kg per acre, a figure that falls almost midway the yield range of 270 and 995 kg per acre found in a recent study that focused on estimating maize yields in Uganda (Gourlay et al., 2019). Still, this is considerably lower than the figures that research stations report, which range between 730 kg per acre and 1,820 kg per acre (Fermont and Benson, 2011).

Various factors constrain the development of efficient and inclusive value chains in Uganda. Limited use of improved inputs by producers, especially improved seed, constitutes a key supply side constraint (Gollin et al., 2021). Other important demand side constraints include access to markets, due to the fact that farmers are generally located in remote areas linked by poor roads that become impassable during the rainy season (Stifel and Minten, 2008). Limited processing capacity also leads to issues related to quality and shelf life, further depressing demand for the commodity. As input dealers, farmers, maize traders and maize processors are intricately related in Ugandan maize supply chains, performance issues in one node can have consequences for the entire value chain.[1]

2.1 Agro-input dealers

There is ample evidence of the key role of modern agricultural inputs, especially improved seed varieties

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[1] Throughout this study we will differentiate between farmers and actors, where the latter is used to refer to the agro-input dealers, traders and processors as a group.

and inorganic fertilizers, in increasing agricultural productivity, poverty reduction, and structural transformation more in general (Gollin et al., 2021; McArthur and McCord, 2017; Evenson and Gollin, 2003). Yet, despite decades of policy and institutional reforms to promote their use in low and middle income countries, adoption levels of these inputs remain low, especially in sub-Saharan Africa (Sheahan and Barrett, 2017; Benin, 2016). Some studies point out the limited availability of improved input technologies in low- and middle-income countries (Asfaw et al., 2012; Maredia et al., 2000). However, due to increased government action in the area of research and breeding, privatization/liberalization of the inputs market, and in some cases input subsidy programs, over time, improved inputs become more available in low- and middle-income countries (Minten et al., 2013; Jayne and Rashid, 2013). Lately, poor quality of purchased input, is emerging as an additional explanation for limited adoption (Barriga and Fiala, 2020; Ashour et al., 2019; Bold et al., 2017). As such, perceptions related to the conduct and performance of agro-input dealers and the quality of the products they sell will have important consequences for the value chain structure and performance.

In our sample, there is significant heterogeneity in agro-input dealers. Some are large shops located in town centers with several branches that specialize in farm inputs and implements. Others are small shops in villages that only stock seed during planting season, but generally sell food and other consumables. In our sample, 41 percent of shops are formal businesses operating with required licenses. Agro-input shops are often clustered in towns or trading centers.

Shop owners in our sample are generally well educated. Being on average 36 years old, agro-input dealers are also younger than other actors in the value chain. About 29 percent of dealers are women. On average, an agro-input dealer sells 3 different types of improved maize seed varieties. The average shop sold about 438 kg of hybrid seed and 522 kg of Open Pollinated Varieties during the first agricultural season of 2018.

2.2 Traders

Maize traders link producers to processors and consumers. Local assembly traders, using bicycles or light motorbikes, visit several farmers in a day to buy maize at the farm gate. These traders then aggregate and sell further to larger traders or large scale processors. Larger traders also often use (shared) storage facilities to engage in arbitrage over time, as maize prices are known to display significant seasonality (Van Campenhout et al., 2015).

Assembly trader performance has important consequences for quality downstream. Bulking and mixing of smallholder supply dilutes incentives to supply high quality (Anissa et al., 2021). Procuring sufficiently dried maize and proper storage and handling are important to reduce aflatoxin contamination (Bauchet et al., 2021). Furthermore, while small traders are often cast in a negative light and many development interventions attempt to bypass middlemen, most studies find that (sufficiently large numbers of) small traders are essential for smallholder market participation (Barrett, 2008). For example, studying market access in southern and eastern Africa, Mather et al. (2013) note that access to assembly traders has increased over time and argue that this has created important opportunities to remote areas in terms of access to maize markets. Sitko and Jayne (2014) find that trading is highly competitive in eastern and southern Africa in terms of marketing margins and the number of traders operating.

Generally, the traders in our sample are not just service providers offering transport services, but become owner of the commodity during trading, hence also internalizing the risks inherent to trading. On a typical day immediately after harvest when prices are typically lowest and most traders are active, traders

visit 12 smallholder farmers to collect 1,308 kgs of maize. Downstream, we see that the average trader delivers to about 4 different buyers during peak season. The average storage capacity of a typical trader is about 13,000 kgs. 93 percent of traders indicate that they also trade in other agricultural commodities aside from maize. Only 7 traders out of the 341 were women.

2.3   Processors

A third important actor in the maize supply chain is the processor. In general, processors take the form of maize mills that remove the bran from the maize kernels and mill the maize into maize flour for direct consumption. Some processors also have packing facilities to produce maize flour for supermarkets or export. The smaller mills often provide milling as a service, whereby farmers come with bags of maize for milling against a fee.

There are again large differences between these processors. Some maize mills located in remote rural areas are diesel engine powered mills that are only able to produce low grade maize meal for home consumption. However, larger processors use machines powered by three phase electric power and mill multiple times to obtain fine export grade maize flour. In our sample, we find that about 57 percent of the millers use diesel powered mills, while 37 percent rely on three phase electric power. The quality of end product is indicated in grades, from highest (grade 1) to lowest (grade 3). The grade that can be obtained depends on a various factors, including the number of times the product is passed through the mill, the quality of the grain used and the type of mill. About 44 percent of processors indicate that they can also produce grade 1 flour. In our sample, we see that only 6.9 percent of processors are women.

2.4   Farmers

Central in our study are smallholder maize farmers, who buy inputs such as seed and fertilizer from agro-input dealers, sell to traders and/or use millers to process their maize for own consumption. These are generally small farmers, cultivating maize on one or two plots, corresponding to 1.81 acres. The average age of the farmers is 44.5 and 43 percent finished only primary education. The average distance of farmers' homestead to tarmac road is 6.54 km and to an all weather feeder road is 0.51 km.

About 53 percent of farmers used improved seed on their plot, while 21 percent used inorganic fertilizer. Yields in our sample amount to 468 kg/acre. More than 95 percent of farmers in our sample report that they took part of the maize they harvested to a miller. In terms of market participation, we find that 64 percent of farmers sold at least part of their crop. Those who reported selling sold on average 706 kg, which corresponds to about 55 percent of the total maize harvest. In our sample, 49 percent of the farmers are women.

3   Study hypotheses

This section describes the hypotheses that we will test, and the theory in which these hypotheses are grounded. We will test 5 hypotheses.

- Hypothesis 1: Self-ratings of dealers, traders and processors are higher than ratings given to them by farmers.

The first hypothesis revolves around how the agro-input dealers, processors and traders rate themselves as compared to the scores that are give to them by the farmers. A significant (positive) difference could mean that agro-input dealer systematically overestimate their own performance, perhaps as a result of an overconfidence effect. However, research has shown that agents are generally pretty good at assessing own performance (Clark and Friesen, 2008). At the same time, the difference can also increase if farmers systematically underestimate the performance of other value chain actors.

Perceptions in this regard may lead to inefficient value chains and slower value chain upgrading. If service and input providers perceive themselves to be performing better than they actually are, there may be no incentive to improve. Farmers rating input dealers, traders, and processors lower than their self-ratings indicate actors are not meeting the expectations of the farmers. Cheng et al. (2017) discusses that more favourable self-assessments can be a result of leniency in assessing self-performance. Such a leniency creates a gap between the input and service providers' perceived performance levels from the farmers and the perceived self-performance levels of the input and service providers. If farmers underestimate service quality of other value chain actors, this may lead to depressed demand for the services (Michelson et al., 2021).

- Hypothesis 2: Female farmers rate more favourable than male farmers.

In a second hypothesis, we test if female farmers rate input dealers, traders and processors systematically higher than male farmers do. There is some evidence that women generally rate more positive than men (Furnham, 2005; Winquist et al., 1998). More favourable ratings from female farmers may reflect that they received better services and inputs by the input dealers, maize processors and traders. Alternatively, there may be greater leniency from women while rating the service and input providers. However, the literature does not mention statistically significant presence of leniency for ratings provided by female raters (Thornton III et al., 2019).

Women who are more forgiving towards other value chain actors may backfire if these other value chain actors feel less compelled to live up to the standards. At the same time, relatively more positive feedback from women may mean that service providers also exert more effort when dealing with women. The fact that female farmers rate relatively higher also provides more scope for disappointment. This may lead to a higher likelihood of women exiting the value chain if reality does not match up with higher (perceived) quality of services and inputs.

- Hypothesis 3: Self-ratings from women are less favourable than self-ratings from men.

The third hypothesis compares the self-ratings given of female agro-input dealers, processors, and traders to the self-rating of their male counterparts. While we saw in hypothesis 1 that actors tend to overestimate own performance and in hypothesis 2 that women tend to rate others higher than men do, studies suggest that women generally tend to underrate themselves (relative to men). For instance, Patiar and Mia (2008) find that in the hotel industry, male department managers tend to hold inflated self-assessments, while the women assessed themselves lower. Similar patterns have consistently been found in a variety of contexts (eg.

Bengtsson et al., 2005; Beyer, 1990; Rosenkrantz et al., 1968). Not only that, Braddy et al. (2020) found that women tend to experience harsher consequences than men when they overrate themselves.

Lower self-ratings of women as compared to men may signal a lack of confidence which may hamper aspirations and refrain women from thriving in business. Cultural norms, societal expectations, and gender stereotyping will also be reflected in self-ratings. Such gendered ideas of self-assessment can thus be an important barrier to entry of women, leading to exclusive, male dominated value chains.

- Hypothesis 4: Male agro-input dealers, traders and processors receive more favourable ratings than their female counterparts.

In hypothesis 4, ratings received from farmers by female agro-input dealers, traders, and processors are compared to ratings received from farmers by their male counterparts. The fact that women are held to more stringent standards than men has been repeatedly established over time. Lyness and Heilman (2006) found that female managers received lower performance ratings compared to male managers. Basow and Silberg (1987) find that students rate female professors lower than male professors. Bias against female professors has been replicated numerous times (eg. Feldman, 1993; Mengel et al., 2018; Miller and Chamberlin, 2000). A recent study by Wu (2020) found that there is a gender bias in how women are perceived in professional circumstances, i.e., perceptions about women are generally lower in the professional sphere and higher in the domestic sphere or when physical appearance is judged. The fact that bias is more present in male dominated sectors suggests, at least in part, cultural factors play an important role in its creation.

In the context of this study, bias against women may again provide a barrier of entry for women in agro-input dealing, trading, and processing. When women are aware that they are perceived to be less capable for these business activities, they might not enter the sector in the first place to avoid criticisms and performance obstacles at a later stage. However, a bias in rating may also lead to actual differences in the quality of service, as women who are perceived to be inferior struggle to attract credit to invest in their activities or secure good locations to set up shop. More in general, the cultural context might limit women from performing better and being equally competitive as men. A study done on women entrepreneurs in Kigali, Rwanda by Nsengimana et al. (2017) reported many challenges for the success of women's businesses. Similarly, Guma (2015) discusses barriers faced by women entrepreneurs in Uganda. Some of the prominent issues faced by women are gender-related stereotypes (risk-taking behavior and lower aggressiveness), under-capitalization (credit access limits, availability of collateral), balance across multiple responsibilities (childcare, family responsibilities), inadequate skills and business knowledge, lack of respect from the male-dominated business community, time investment constraints, reputation and work credibility challenges. These can significantly impact the ratings received by the female input and service providers in the supply chain and can undermine their perceived performance in the sector.

- Hypothesis 5: Female farmers give higher ratings to female agro-input dealers, traders and processors.

Finally, in hypothesis 5 we test the interaction between the gender of the farmer and the other value chain actors in order to investigate if there is a significant impact of both being women on the ratings. This hypothesis is motivated by the literature on homophily in social networks. The homophily principle essentially

focuses on network ties based on relationships and characteristics of the actors involved. In the context of this study, gender homophily effects for women in rating would exist if ratings in female rater-ratee pairs (eg. female farmers rating female agro-input dealers, female traders, or female processors) are consistently higher than ratings in male-male or mixed gender rater-ratee linkages. McPherson et al. (2001) discusses the causes and consequences of such preferences like limitations in the social world, biased information, attitudes influenced by the characteristics of the ties formed and interactions limited to these homogeneous networks, arguing that gender based homophily can strongly divide personal environments.

Gender based homophily in food value chains may lead to several co-existing value chains aligned by gender. If a female farmer gives higher ratings to a female trader, she may always interact with traders of the same sex. The higher ratings and lower levels of competition enjoyed by dealers, trader and processors may reduce effort and delay innovations. However, recent research suggests that increased competition in value chains characterized by relational contracts is not always good (Macchiavello and Morjaria, 2020). Indeed, the increased trust in relationships mediated by gender homophily may make it easier for women to enter into business.

4 Data

This section explains sampling and data collection, how perceptions were measured and the variables constructed, and discusses reliability of the ratings.

4.1 Sample

We use survey data from 1,526 farming households, 78 agro-input dealer shops, 341 assembly traders and 174 processors operating in the maize growing districts of Iganga, Bugiri and Namutumba in eastern Uganda. Data was collected in July 2019. The farmer household sample was drawn from 63 villages in the three districts. The villages were selected through a process of stratified random sampling at sub-county level. In each of the three districts, the sub-counties from which the villages were sampled were purposely selected based on their distance (km) from the main district town, in the range of 10 kms, 20 kms and 30 kms from the main town. A map of the study area is given below (figure 1). In each selected village, a number of households was then randomly selected. The number of households was determined proportionate to the village population using the 2012 sampling frame of Uganda National Bureau of Statistics (UBoS). The input dealer shops, assembly traders and processors interviewed are those that were referred to by farmers, either because they have ever bought agro-inputs from these agro-input dealers, sold harvest to traders, or used processors to mill maize.

4.2 Ratings used to measure perceptions

This section focuses on the central indicators used in this study—the ratings. To obtain the ratings, each farmer was asked to rate between one and three of each of the three value chain actors (input dealers, traders, and processors). Farmer's perceptions about the other value chain actors and the other value chain actors' perceptions about themselves are derived from scores given on four dimensions: (1) location, where we asked to reflect on ease of reach of the actor; (2) quality, where we asked to rate the quality of the service rendered and/or product sold; (3) price, where we asked if the price charged for the service rendered or
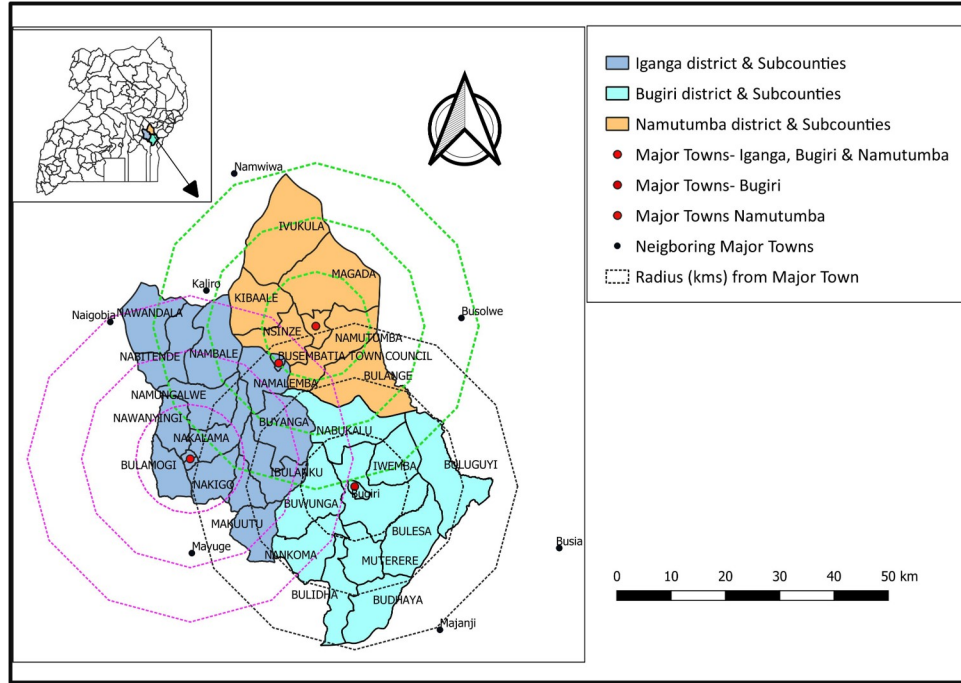
Figure 1: Map of the study area.

product sold was reasonable in relation to what others charged[2]; and (4) reputation, where we probe about how other farmers think about the actor that is being rated. The averages of these dimension-based ratings are obtained to get an overall rating.

Several methods have been proposed to measure perceptions, attitudes, or beliefs in social science research. Delavande et al. (2011) survey the literature on measurement of subjective beliefs in low- and middle-income countries and categorize possible methods into three groups: Likert style questions, elicitation of the 'most likely' outcome, and a full elicitation of the distribution of beliefs, most often conducted with visual aids. The ratings in this study reflect Likert style assessment where scores range from 1 to 5, 1 being the worst score and 5 being the best. This is the case for both farmer ratings and self-ratings from agro-input dealers, traders, and processors.

Table 1 presents ratings obtained from farmers. It shows average scores over all value chain actors (top panel), and average scores for each actor separately in each of the four dimensions. Farmers are generally positive about dealers, traders and processors. For example, only about 6 percent of all ratings that were given by farmers were the lowest score of one, while about 38 percent of ratings were a five. Interestingly, traders seem to get slightly better ratings than the other actors. The dimension that is always scored lowest is price competitiveness. Location is scored highest when actors are pooled, and this seems to be driven by the ease of access to traders. Judged by this table, the biggest constraint to the adoption of commercial seed and other purchased inputs is not related to quality, but rather price. It is also reassuring that all actors seem to score very well in terms of reputation.

Table 2 shows summary statistics for self-ratings from agro-input dealers, traders, and maize processors. These actors seem to be very confident about their reputation as among all the dimensions, the highest

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[2]Note that for input dealers and processors, price competitiveness would be rated higher if they charge lower prices to farmers. For traders, price competitiveness would be rated higher if they pay higher prices to farmers at the farm gate.

percentage give a self-score of five for reputation (59 percent). They seem to be the least confident about their price competitiveness as among all the dimensions, the highest percentage adhere to a score of at most 3 for this dimension.

4.3 Reliability of ratings

In this section we test whether the ratings are actually meaningful (as opposed to just noise). To do so, we look at intra-class correlation (ICC) coefficients determining the level of agreement between the ratings. We look at both inter-rater agreement and intra-rater agreement (Gwet, 2014). Inter-rater agreement looks at the correlation between ratings given by different farmers to a single actor, while intra-rater agreement is judged by the correlation between ratings received by different actors from a single farmer. Intra-class correlation coefficients range between zero and one, with zero being low agreement and one being total agreement. Only farmers who rated more than 6 times are considered for this analysis.

Table 3 presents the results for the ICC analysis. In the left panel, results for inter-rater agreement are shown. Judged by average ratings, farmer rate fairly consistent within actors. However, farmers disagree more with each other when quality is assessed, or when reputation needs to be rated. This is expected, as location and prices are observable factors and hence, ratings for these factors should be more similar compared to non-observable attributes like quality and reputation.

The right panel of Table 3 shows results for intra-rater agreement. Results also show that ratings for the different actors are consistent within farmers. The fact that intra-rater agreement is higher than inter-rater agreement may indicate some degree of assortative matching within the chain, whereby farmers who select better performing agro-input dealers also tend to go to better processors and sell to better traders. However, it could also be that ratings are determined more by farmer level characteristics (such as the education level of the farmer) than by actor level characteristics, leading farmers to rate different actors in a more consistent way. At the same time, as farmers rate different actors, it also seems reasonable that there is no complete intra-rater agreement.

5 Econometric analysis

We start the analysis with a descriptive section based on simple averages in subgroups of the data. This is followed by a section that presents more formal tests of the hypotheses. To test the first hypothesis, we use simple t-tests. The other hypotheses will be tested in a regression framework. In this section, we elaborate on the specifications we will estimate.

We start from the following multivariate regression model:

$$y_{f,a} = \alpha + \beta_1 g_f^F + \beta_2 g_a^A + \beta_3 g_f^F * g_a^A + \gamma X_{f,a} + \varepsilon_{f,a} \tag{1}$$

Here, $y_{f,a}$ is the primary outcome variable, which will be the rating that farmer i gave to actor a (hypotheses 2, 4 and 5). We will run separate regressions for the ratings for the different dimensions, and also a regression where $y_{f,a}$ is the average of the ratings of the four dimensions that farmer i gave to actor a.[3] The main variables of interest are the sex of the farmer (g_f^F, a dummy variable which takes the value

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[3]When we look at ratings on a particular dimension, this will be an integer number ranging between 1 and 5. When we look at average ratings, this can also be a rational number. While we agree that the outcome variable is likely to be non-normal, we nevertheless proceed with Ordinary Least Squares, as this gives the conditional mean under minimal assumptions.

of 1 if the farmer is a woman and 0 otherwise), which varies at the farmer level f, and sex of the actor (g_a^A, a dummy variable taking the value of 1 for female actors and 0 otherwise), which varies at the actor level a. $X_{f,a}$ is a vector of control variables, some of which vary at the farmer level, like farmer's age (in years), dummy variable indicating if the farmer has finished primary education, distance of farmer's homestead to tarmac and feeder roads (in km) and marital status. Other control variables included in $X_{f,a}$ vary at the level of the actor, like age, education (if primary education is finished) and dummy variable for marital status of the dealer, trader or processor. The error term in the model is $\varepsilon_{f,a}$. As the number of women in some actor categories are very low, we decided to run the analysis on the pooled dataset and include three fixed effects for the actor type (dealer, trader, processor). We use the approach proposed by Cameron et al. (2011) to allow for two-way non-nested clustering at the farmer and the actor level.

The coefficients of interest in these models are β_1, β_2 and β_3. In particular, finding that $\beta_1 > 0$ would confirm hypothesis 2, while finding that $\beta_2 < 0$ would confirm 4. Gender homophily among women would mean that $\beta_3 > 0$ (hypothesis 5).

To test hypothesis 3, a regression that only uses self-rating data of the actors is used:

$$y_a = \alpha + \beta_1 g_a^A + \gamma X_a + \varepsilon_a \tag{2}$$

Here, the primary outcome variable is the self-rating y_a of actor a which is regressed on the sex of the actor $\left(g_a^A\right)$. Finding that $\beta_1 < 0$ would confirm hypothesis 3. Also here, we include a range of control variables (X_a), including fixed effects for the type of actor (dealer, trader or processor). The error term in this model is ε_a.

As we rely on observational data, we control for confounding bias through the inclusion of exogenous control variables. Men are likely to be better educated than women. Better levels of education and knowledge will probably mean that farmers have a better understanding of what to expect from service and input providers, and so, may rate more or less favourably, as scores given will be better informed. One has to control for this impact pathway, as otherwise the gender and education effects will be conflated. The age of the farmer may also affect ratings in some way. In our sample of farm households, women are likely to be younger than men (Jensen and Thornton, 2003), so age effects need to be purged from the model.

Marital status of the person interviewed may also be correlated with ratings. It may be that single household heads are more likely to interact with lower rated agents (for instance, predatory traders who target households with only one head). At the same time, the women we interviewed in our sample are also more likely to be unmarried, so we need to control for the effect of marital status on ratings that works through gender. Distance to murram and tarmac roads are proxies of remoteness. In remote areas, input and service providers face many challenges such as larger transaction costs and poor access to services such as power. For instance, in semi-urban areas, mills often run on 3-phase electricity, while in remote areas, combustion engines are used to power the mills. The latter produce inferior quality maize products. If women are also more likely to reside in remote areas, this may lead to biased coefficient estimates.

Similar arguments can be made for the gender of the dealers, traders and processors. Since men are likely to be more educated than women, the education and knowledge might define what kind of service and inputs they provide to their customers. This would lead to more or less favourable ratings from farmers, so we need to control for education to disentangle the effect of actor gender and actor education levels. Men are likely to be older because of longer active periods in service providing and input dealing. Older individuals

might have better experience in the business, which can impact the ratings. Controlling for marital status of input dealers, trader and processors is necessary, as female value chain actors may be more likely to be single.

6   Results

6.1   Average ratings

In this section, we provide a descriptive account of the hypotheses outlined in Section 3 based on subgroup averages reported in Table 4. The table shows scores aggregated over all input dealers (first three columns on the left), but also for each actor type separately (columns 4-6 for agro-input dealers, columns 7-9 for traders, and columns 10-12 for processors). We further differentiate between scores received by male and female actors.

The rows represent the different dimensions on which actors were scored (or were asked to rate themselves). We again start with an overall rating (rows 1-4) and then provide separate ratings for location (5-8), quality (9-12), and reputation (rows 13-16). We also differentiate between the gender of the farmer, and also add a line for self-ratings.

In line with hypothesis 1, Table 4 shows that the mean overall self-rating given by the actors (4.22) is substantially higher than the mean overall rating that farmers give to actors (3.6). This pattern is consistent across all the different rating dimensions. Looking at individual groups of input dealers, traders, and processors in Table 4, self-ratings are also always higher.

In line with hypothesis 2, we find that the mean overall rating provided by female farmers is 3.62 which is slightly higher than the mean overall rating given by male farmers (3.58). We similarly see that location-, price- and reputation-based ratings are higher among female farmers than among male farmers. However, for quality-based rating, male farmers give a higher rating.

Looking across actor types, for average ratings we again find that women consistently rate higher than men, but the margin is small. For traders, women rate more favourable in all dimensions. For processors, women also generally rate more favorable, except for reputation where ratings between men and women are virtually the same. Female farmers rate dealers lower on both reputation and price competitiveness than male farmers. In all, out of 20 comparisons, 16 are in line with hypothesis 2.

Next, we focus on the comparison of self-ratings from female and male value chain actors (hypothesis 3). For overall average self-rating, female actors rate themselves lower than how male actors rate themselves (4.16 vs. 4.23). We also find women rate themselves lower on location and reputation dimensions. However, for quality and price, men self-assess themselves worse than how women self-assess themselves.

There is also no clear pattern when we look at the different actors. While female traders assess themselves higher than their male counterparts, male input dealers rate themselves higher than female dealers. When looking at the four dimensions, we find that for agro-input dealers, men rate themselves higher on three of the four dimensions. For processors, it is the other way around. For traders, women consistently rate themselves higher. However, due to the small number of female traders, this result needs to be interpreted with caution. Overall, we see that from the 20 comparisons, 9 are in line with hypothesis 3, indicating that the hypothesis is likely to be false.

In hypothesis 4, we test if the gender of the actor leads to systematically different ratings from farmers. Judged from the overall score, male value chain actors receive lower scores than female actors, but the difference is negligible (3.59 vs. 3.61). When all actors are pooled, we see that male actors are scored higher on location and price competitiveness, while they are scored lower on the dimensions of quality and reputation.

When we look at the different actors more in detail, we find no systematic difference in the overall ratings between men and women. As is the case when all actors are pooled, women dealers are viewed more favorably for quality and reputation, while male dealers get higher scores for location and price. For traders, women consistently receive higher scores than men, but again, these results need to be interpreted with care given the very few female traders we have in the sample. For processors, men seem to get somewhat higher ratings, except perhaps on the quality dimension. In all, the descriptive analysis provides little support for hypothesis 4.

Finally, we look for indications of female gender homophily (hypothesis 5). Aggregating over actors and dimensions, we see that female farmers score female actors higher (3.63) than any other gender combination. But if we look at the different dimensions, there are no signs of female gender homophily effects. For location and price competitiveness, female farmers score male actors highest; for quality, male farmers score female actors highest. For reputation, male and female farmers give the same score to female actors. When looking at dealers, traders and processors separately, we only find signs of female gender homophily effects for traders. But again, these results are likely to suffer from a small sample size. For other actors, there also seems to be no indication of female gender homophily effects, leading us to reject hypothesis 5.

6.2 Regressions

To test hypothesis 1 formally, we test if the difference between an actor's self-rating and the rating of the actor provided by the farmer is significantly larger than zero. Table 5 shows that we reject the null hypothesis that the difference is equal to zero in favour of the alternative hypothesis that actors rate themselves systematically higher than farmers do.

Formally testing hypotheses 2, 4 and 5 is done by estimating regression model 1 outlined in Section 5, the results of which are reported in Table 6. Taking overall ratings as the dependent variable in column (1), we can not reject the null that the sex of the farmers does not affect the rating given (hypothesis 2). However, if we look at the different components of the rating index, we see that female farmers rate actors significantly higher when asked to assess location and price competitiveness (columns (2) and (4)).

The gender of the actor that is being rated does not seem to be significantly correlated with ratings given by the farmer. As such, we do not find evidence for hypothesis 4 in our data.[4] Looking at the interaction between the gender of the farmer and the gender of the actor, we also do not find any significant correlation, suggesting there is no female gender homophily effect (hypothesis 5).

Formally testing hypothesis 3 is done by estimating regression model 2 outlined in Section 5, the results of which are reported in Table 7. While women actors seem to rate themselves somewhat higher on the quality dimension, the difference with men is not significant. We certainly do not find that men rate themselves higher than women, leading us to reject hypothesis 3.

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[4]In fact, there are some indications that women score higher on quality and reputation, which runs against hypothesis 4, but differences are not significant.

We also ran an additional regression similar to equation 1 outlined in Section 5, but used the difference between actor self-ratings and farmer ratings as the dependent variable. Results are in Table 8. This provides an alternative way to test hypothesis 1 by looking at the significance of the constant in equation 1. Interestingly, in a regression framework that controls for a range of farmer and actor level characteristics, there is no significant difference anymore between actor ratings and farmer ratings for the location dimension. This seems plausible, as location can be easily observed by both farmer and actor. The table also shows that the gender of the farmer now also becomes significantly negative, which makes sense as women rate more positive (hypothesis 2), making the gap between actor and farmer rating smaller.

The impact of the sex of the actor, although often not statistically significant, is also interesting. The differences in ratings increase substantially for quality and price if the actor is a woman, while the difference reduces in the case of reputation-based ratings. Women rate themselves higher on quality, while farmer ratings on quality are not dependent on the sex of the actor being rated. On price, the coefficient of the sex of the actor is also positive for self-ratings, but here the lower rating from the farmers of female actors seems to make the gap larger. For reputation, women actors are too modest: the combination of a negative gender effect on self-ratings and a positive gender effect on the farmer ratings significantly reduces the gap.

7   Conclusion

In informal food supply chains, perceptions about the quality of services of value chain actors such as agro-input dealers, traders and processors are an important input in the decision making processes underlying the structure, conduct and performance of the value chain. We thus investigated perceptions of maize farmers about the input and service providers in informal maize value chains; and the perceptions of these input and service providers about themselves. We were particularly interested in gender-based heterogeneity in these perceptions. Perceptions were captured through ratings given on dimensions like ease of access, quality of service, price competitiveness, and reputation.

We find that agro-input dealers, traders and processors consistently rate themselves higher than how farmers rate them, except for one attribute that is easily observable by both those who rate and those who get rated. We do not find that gender plays a significant role in self-assessments, except perhaps for the fact that women seem to rate themselves somewhat higher on the quality dimension. The sex of the actor being rated does not affect the rating that they receive and we find no signs of gender-based homophily for women in the ratings. There is some evidence that female farmers rate more favorably than male farmers, but only in some dimensions. Taken together, women actors rate themselves relatively higher and/or farmers rate female actors relatively lower when price and quality considerations are concerned. Female actors may also be too modest with respect to the reputation they have.

In terms of policy implications, it is reassuring to find that one of the key hypotheses in this study, namely that female agro-input dealers, traders and processors are systematically rated lower than male actors, was not supported by the data. Still, given an extensive literature that does find discrimination in a variety of contexts (eg. Mengel et al., 2018; Mitchell and Martin, 2018; Lyness and Heilman, 2006), we caution against sweeping conclusions. Heterogeneous effects between actors may suffer from low sample size and limited variation in the gender of the actor. For instance, we do find that male agro-input dealers get higher scores for location than women, and this effect may become significant if the sample size grows.

The fact that self-assessments are always larger than farmer rating may either mean that actors are overconfident or farmers are overcritical. Overconfidence of value chain actors may delay innovations within

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the chain as actors do not see the need to improve. Farmers that expect more from value chain actors are likely to demand less services from these actors. As such, policy interventions aimed at reducing the gap between actor self-assessments and farmer ratings are likely to increase efficiency in value chains. Examples of such policy interventions include certification by independent agency or non-centralized clearing house mechanisms based on crowd sourcing (Reimers and Waldfogel, 2021; Hasanain et al., 2019).

Even though we did not find that farmers rate female agents differently, gender may still affect inclusiveness of value chains. For instance, the tendency of female farmers to rate more favourably may result in input and service providers treating women farmers differently.[5] The fact that female farmers rate higher also means that the gap between self-assessments of actors and ratings of female farmers is smaller than the gap between self-assessments of actors and ratings of male farmers. This may lead to differences in the efficiency of the chain conditional on the gender of the farmers.

Finally, judged by farmer perceptions, there seem to be issues related to price competitiveness within the maize value chain, as agro-input dealers, traders and processors are consistently scored lowest. Quality, on the other hand, seems to be rated fairly good. Input dealers, for example, are perceived to be performing poorly in terms of price competitiveness but get highest scores for quality. This seems to contradict recent studies that blame poor quality of inputs as the root cause for low adoption by farmers (Bold et al., 2017). Rather, policies that encourage market entry and competition between agro-input dealers, traders and processors are likely increase price competitiveness of value chain actors.

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[5]The leniency of female farmer may mean actors are not compelled to provide high quality inputs or services. Alternatively, positive feedback may encourage actors to provide higher quality inputs and services.

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Tables

Table 1: Summary Statistics of the variables related to the farmers.

	Summary Statistics (Farmers)					
	Mean	Standard Deviation	Minimum	Maximum	First Quartile	Third Quartile
Overall rating (all actors)	3.6	0.77	1	5	3.2	4.2
Location rating (all actors)	3.88	1.17	1	5	3	5
Quality rating (all actors)	3.5	1.1	1	5	3	4
Price rating (all actors)	3.04	1.08	1	5	2	4
Reputation rating (all actors)	3.83	1.02	1	5	3	5
Overall rating (dealers)	3.59	0.74	1	5	3.2	4
Location rating (dealers)	3.65	1.27	1	5	3	5
Quality rating (dealers)	3.64	1.02	1	5	3	4
Price rating (dealers)	2.99	1.08	1	5	2	4
Reputation rating (dealers)	3.84	0.96	1	5	3	5
Overall rating (traders)	3.67	0.8	1	5	3.2	4.2
Location rating (traders)	4.09	1.02	1	5	4	5
Quality rating (traders)	3.54	1.01	1	5	3	4
Price rating (traders)	3.07	1.05	1	5	2	4
Reputation rating (traders)	3.84	1.04	1	5	3	5
Overall rating (processors)	3.54	0.75	1	5	3	4
Location rating (processors)	3.8	1.21	1	5	3	5
Quality rating (processors)	3.41	1.19	1	5	3	4
Price rating (processors)	3.02	1.11	1	5	2	4
Reputation rating (processors)	3.82	1.03	1	5	3	5

Table 2: Summary Statistics of the variables related to dealers, traders, and processors.

	Self-ratings of value chain actors					
	Agro-Input Dealers					
	Mean	Standard Deviation	Minimum	Maximum	First Quartile	Third Quartile
Overall self-ratings	4.13	0.43	2.8	5	3.85	4.4
Location self-ratings	4.22	0.88	2	5	4	5
Quality self-ratings	4.58	0.61	3	5	4	5
Price self-ratings	4.05	0.82	2	5	3	5
Reputation self-ratings	4.4	0.86	1	5	4	5
	Assembly Traders					
Overall self-ratings	4.29	0.5	2.2	5	4	4.6
Location self-ratings	4.11	0.85	1	5	4	5
Quality self-ratings	4.33	0.77	1	5	4	5
Price self-ratings	3.91	0.83	1	5	3	5
Reputation self-ratings	4.45	0.77	2	5	4	5
	Processors					
Overall self-ratings	4.18	0.52	3	5	3.8	4.6
Location self-ratings	3.99	0.97	1	5	3	5
Quality self-ratings	4.16	0.84	2	5	4	5
Price self-ratings	3.84	0.95	1	5	3	5
Reputation self-ratings	4.5	0.69	2	5	4	5

Table 3: ICC coefficients for inter-rater reliability and intra-rater reliability.

	Intraclass correlation coefficients	
	Inter-Rater Reliability (Agreement)	*Intra-Rater Reliability (Agreement)*
Overall	0.54	0.64
Location	0.47	0.62
Quality	0.15	0.31
Price	0.43	0.43
Reputation	0.24	0.68

Table 4: Average ratings (all dimensions) from farmers and average self-ratings (all dimensions) from dealers, traders, and processors, grouped by gender.

	Average Ratings (Mean)											
	All actors			Agro-Input Dealers			Assembly Traders			Millers		
	Men	Women	All	Men	Women	All	Men	Women	All	Men	Women	All
Overall Average (All Dimensions)												
Farmer is male	3.58	3.61	3.58	3.59	3.57	3.58	3.64	3.92	3.65	3.51	3.59	3.52
Farmer is female	3.62	3.63	3.62	3.6	3.64	3.61	3.68	4.09	3.69	3.58	3.44	3.57
Farmer is either male or female	3.59	3.61	3.6	3.59	3.59	3.59	3.66	4	3.66	3.54	3.53	3.54
Self-ratings	4.23	4.16	4.22	4.06	4.02	4.05	4.28	4.53	4.28	4.23	4.29	4.24
Location												
Farmer is male	3.85	3.54	3.83	3.61	3.33	3.53	4.05	4.41	4.06	3.76	3.74	3.76
Farmer is female	3.98	3.82	3.97	3.93	3.77	3.89	4.13	4.4	4.13	3.87	3.67	3.86
Farmer is either male or female	3.91	3.64	3.88	3.72	3.46	3.65	4.08	4.41	4.09	3.81	3.71	3.8
Self-ratings	4.11	4.07	4.11	4.08	4.01	4.06	4.1	4.97	4.12	4.12	3.91	4.11
Quality												
Farmer is male	3.49	3.7	3.51	3.71	3.65	3.69	3.53	3.82	3.54	3.37	3.77	3.39
Farmer is female	3.47	3.65	3.49	3.48	3.64	3.52	3.54	3.93	3.55	3.41	3.56	3.42
Farmer is either male or female	3.48	3.68	3.5	3.63	3.65	3.64	3.53	3.88	3.54	3.39	3.69	3.41
Self-ratings	4.24	4.68	4.28	4.48	4.62	4.52	4.3	4.88	4.31	4.12	4.71	4.16
Price												
Farmer is male	3.01	2.95	3	2.96	2.92	2.95	3.05	3.24	3.05	2.99	2.93	2.98
Farmer is female	3.1	3	3.09	3.08	3.09	3.08	3.09	3.47	3.1	3.1	2.69	3.08
Farmer is either male or female	3.04	2.97	3.04	3	2.97	2.99	3.07	3.34	3.07	3.04	2.83	3.02
Self-ratings	3.9	4.06	3.92	3.82	4.05	3.88	3.93	3.94	3.93	3.91	4.14	3.92
Reputation												
Farmer is male	3.82	3.93	3.83	3.82	3.96	3.86	3.81	4.06	3.82	3.83	3.84	3.83
Farmer is female	3.83	3.93	3.84	3.78	3.89	3.81	3.85	4.4	3.87	3.82	3.79	3.82
Farmer is either male or female	3.82	3.93	3.83	3.81	3.94	3.84	3.83	4.22	3.84	3.83	3.82	3.82
Self-ratings	4.48	4.34	4.47	4.53	4.4	4.49	4.38	4	4.37	4.55	4.33	4.54

Table 5: T-test results for differences between the self-ratings and the farmer ratings.

	T-tests: Differences between self-ratings and farmer ratings > 0		
	Self-ratings	Farmer ratings	P-value
Overall	4.22	3.596	<0.001
Location	4.106	3.884	<0.001
Price	3.917	3.036	<0.001
Quality	4.282	3.499	<0.001
Reputation	4.467	3.833	<0.001

Note: The average self-ratings for each dimension are mentioned in the first column and the average farmer ratings for each dimension are mentioned in the second column. The p-value indicating the significance of each t-test is also presented. The alternative hypothesis is that the differences between the self-ratings and the farmer ratings are greater than 0.

Table 6: Regression results for the impact of farmer's and actor's gender on the ratings given by the farmers to the actors.

	Dependent variable: Ratings from Farmers				
	Overall	Location	Quality	Price	Reputation
	(1)	(2)	(3)	(4)	(5)
Constant	3.535	3.878	3.238	3.064	3.83
	(0.101)	(0.186)	(0.178)	(0.148)	(0.119)
Farmer is female	0.034	0.113**	−0.034	0.07*	−0.011
	(0.03)	(0.05)	(0.048)	(0.04)	(0.04)
Actor is female	0.039	−0.174	0.138	−0.034	0.122
	(0.07)	(0.147)	(0.106)	(0.089)	(0.092)
Farmer has finished	−0.003	0.01	−0.039	0.011	−0.003
primary education	(0.031)	(0.046)	(0.042)	(0.039)	(0.038)
Farmer's age	0	0.001	−0.001	0	−0.001
(in years)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)
Farmer's distance to	−0.002	−0.002	−0.006*	−0.004	0.001
tarmac road (in km)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
Farmer's distance to	−0.016*	−0.028*	−0.002	−0.013	0.005
murram road (in km)	(0.009)	(0.016)	(0.014)	(0.013)	(0.014)
Farmer is married	−0.064	−0.068	−0.035	−0.089	−0.085
	(0.044)	(0.074)	(0.062)	(0.07)	(0.056)
Actor's age	0.003	0.001	0.006**	0.002	0.003
(in years)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Actor is married	−0.117**	−0.134	−0.146	−0.136**	−0.083
	(0.059)	(0.114)	(0.106)	(0.068)	(0.07)
Actor has finished	0.089**	−0.022	0.295***	0.106*	0.057
primary education	(0.04)	(0.072)	(0.068)	(0.054)	(0.047)
Actor is a dealer	0.019	−0.124	0.123	−0.05	−0.03
	(0.046)	(0.112)	(0.078)	(0.067)	(0.052)
Actor is a trader	0.156***	0.304***	0.192***	0.081	0.032
	(0.044)	(0.066)	(0.073)	(0.055)	(0.053)
Interaction: Farmer is female*	−0.014	0.156	0.001	−0.049	−0.021
Actor is female	(0.096)	(0.172)	(0.138)	(0.13)	(0.126)
Number of obs.	3588	3588	3588	3588	3588

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Note: Standard errors are clustered at the actor level (agro-input dealers, traders, and processors) and the farmer level.

Table 7: Regression results looking at the impact of actor's gender on their self-ratings.

| | Dependent variable: Self-ratings by dealers, traders, and millers | | | | |
| | Overall | Location | Quality | Price | Reputation |
	(1)	(2)	(3)	(4)	(5)
Constant	4.063	3.708	3.883	3.843	4.441
	(0.092)	(0.163)	(0.142)	(0.16)	(0.14)
Actor is female	0.003	−0.107	0.216	0.153	−0.105
	(0.086)	(0.153)	(0.133)	(0.15)	(0.131)
Actor's age	0	0.008**	−0.001	−0.001	−0.002
(in years)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Actor is married	0.036	−0.154	0.21*	−0.021	0.158
	(0.073)	(0.129)	(0.113)	(0.127)	(0.111)
Actor has finished	0.107**	0.182**	0.172**	0.043	0.016
primary education	(0.044)	(0.078)	(0.068)	(0.076)	(0.067)
Actor is a dealer	−0.067	0.203	0.354***	0.164	−0.07
	(0.071)	(0.126)	(0.11)	(0.124)	(0.108)
Actor is a trader	0.118**	0.144*	0.168**	0.076	−0.079
	(0.048)	(0.085)	(0.074)	(0.083)	(0.073)
Number of obs.	592	592	592	592	592

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Note: Dependent variable is the self-rating given by the actors.

Table 8: Regression results for the impact of farmer's and actor's gender on the differences between actor self-ratings and farmer ratings.

| | Dependent variable: Differences between actor self-ratings and farmer ratings | | | | |
| | Overall | Location | Quality | Price | Reputation |
	(1)	(2)	(3)	(4)	(5)
Constant	0.546***	−0.115	0.909***	0.671**	0.656**
	(0.159)	(0.326)	(0.299)	(0.278)	(0.278)
Farmer is female	−0.094**	−0.173**	−0.135**	−0.005	−0.053
	(0.042)	(0.076)	(0.056)	(0.054)	(0.054)
Actor is female	−0.069	0.085	0.284	0.194	−0.347**
	(0.113)	(0.318)	(0.185)	(0.14)	(0.14)
Farmer has finished	0.005	−0.019	−0.059	0.094*	−0.018
primary education	(0.038)	(0.066)	(0.052)	(0.051)	(0.051)
Farmer's age	0	0	−0.001	0.002	0
(in years)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Farmer's distance to	0.003	0.005	−0.003	0.006	−0.003
tarmac road (in km)	(0.003)	(0.007)	(0.005)	(0.005)	(0.005)
Farmer's distance to	0.011	0.043*	0.01	−0.01	−0.014
murram road (in km)	(0.012)	(0.024)	(0.021)	(0.019)	(0.019)
Farmer is married	0.093*	0.142*	0.074	0.002	0.114*
	(0.052)	(0.08)	(0.075)	(0.064)	(0.064)
Actor's age	0	0.007	0.004	−0.006	−0.001
(in years)	(0.003)	(0.006)	(0.005)	(0.006)	(0.006)
Actor is married	0.067	−0.149	0.085	0.251	0.071
	(0.117)	(0.251)	(0.232)	(0.18)	(0.18)
Actor has finished	0.025	0.262*	−0.268**	−0.106	0.018
primary education	(0.082)	(0.158)	(0.112)	(0.127)	(0.127)
Actor is a dealer	−0.245**	−0.014	−0.031	0.141	0.009
	(0.098)	(0.259)	(0.176)	(0.145)	(0.145)
Actor is a trader	−0.096	−0.236*	−0.074	−0.021	−0.199
	(0.076)	(0.137)	(0.125)	(0.133)	(0.133)
Interaction: Farmer is female*	0.147	−0.086	0.022	0.107	0.13
Actor is female	(0.103)	(0.261)	(0.165)	(0.137)	(0.137)
Number of obs.	3588	3588	3588	3588	3588

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

Note: Standard errors are clustered at the actor (agro-input dealers, traders, and processors) and farmer level.