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Gender differences and motivations in agricultural technology adoption

A study on Climate Smart Agriculture in northern Uganda

MSc Thesis

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Gender differences and motivations in agricultural technology adoption: A study on Climate Smart Agriculture in northern Uganda

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Abstract

One of the reasons behind the lagging agricultural productivity in Sub-Saharan Africa is the very low rate of agricultural technology adoption, especially among female farmers. Women often face more constraints regarding land, labour, information and credit than men, limiting technology adoption and productivity. Social networks are an important source of information for small-holder farmers, even more so in contexts where government extension is limited. Research by Yishay et al. (2015) showed that social learning from fellow farmers can increase knowledge and adoption of new agricultural practices in Malawi. They also showed that the gender of the communicating farmer matters for the effect on learning and adoption. The present study in northern Uganda builds upon these findings through analysing the effects of a social learning intervention on learning and adoption of Climate Smart Agricultural practices among male and female farmers separately. OLS regression results show that female farmers (1) are less likely to connect to communicator farmers, (2) gain less knowledge on CSA practices and (3) are less likely to adopt improved varieties of maize. I employ a Blinder-Oaxaca decomposition analysis to measure which factors contribute to this gender gap and find that the most important driver is a gender difference in prior experience with improved varieties. Furthermore, I complement these findings with a more qualitative analysis of farmers' motivations for (not) adopting different CSA practices. I find that there are very few gender differences in motivations and that most farmers strongly consider the expected effects on yield and the knowledge and labour requirements of a practice.

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Table of Contents

List of Tables

List of Graphs and Figures

Chapter 1: Introduction

Over the last decades, overall agricultural yields have remained low in Sub-Saharan Africa. A major cause for the region to lag behind in terms of yields, are the low adoption rates for technology that could increase agricultural productivity (World Bank, 2008). Relatively small and low-cost changes in farming methods and inputs can have major impacts on agricultural yields and farmers' welfare (e.g. Thierfelder, Matemba-Mutasa & Rusinamhodzi, 2015), its benefits increasing over time after adoption.

In Sub-Saharan Africa, an important reason for the low technology adoption rates is the lack of knowledge on such technologies among farmers (e.g. Yishay & Mobarak, 2014). Hence, with more effective agricultural extension methods to reach farmers, there is a lot to gain for productivity and food security. This holds even more for female farmers, since they tend to have a lower agricultural productivity and technology adoption compared to their male counterparts (Udry, 1996; Peterman et al., 2011).

Since people are social beings who use their relationships to exchange information, using social networks for spreading information can be very effective: Katungi, Edmeades & Smale (2006) find that informal mechanisms of knowledge exchange are the main sources of information for many Ugandan farmers. The concept of social learning – learning from peers in informal, practical settings – is already an important pillar in agricultural extension. Research in different countries and settings has explored some of the mechanisms behind it: farmers tend to adapt their practices according to experience of farmers similar to themselves (e.g. Conley & Udry, 2010 in Ghana). According to Yishay & Mobarak (2014) in the context of Malawi, agricultural comparability is particularly important for effectively communicating knowledge through social networks.

Yet, there is still scope for improving the reach and effectiveness of agricultural extension through social learning and existing social networks. Finding methods to inform and convince farmers about new technologies is necessary. These can be very relevant for governments and other agents that provide agricultural knowledge and seek to extend their scope and impact.

This research builds on the existing literature on social learning and agricultural technology adoption by including gender aspects. In the context of maize farmers in rural Malawi, Yishay et al. (2015) find that when employing social learning for technology adoption, the gender of the farmer communicating new knowledge about agricultural techniques to peers affects the eventual knowledge score and adoption rates among these peers. Specifically, they find that although female communicators perform equally well or better than male communicators, peer farmers (regardless of their gender) tend to pay significantly less attention to female communicators when they talk about agricultural technology. Peer farmers also view female communicators as less knowledgeable about agriculture, even though knowledge tests show otherwise. This perception translates into communicators' ability to convince others: in villages with a male communicator, peer farmers have significantly higher knowledge scores and adoption rates compared to villages with a female communicator.

The present study, conducted in rural northern Uganda, also looks into gender aspects of social learning for technology adoption, but focusses on the *receiving end* of the communication, i.e. the peer farmers instead of the communicators. Female farmers in developing countries are often observed to have lower rates of technology adoption than male farmers (e.g. Doss, 2001 and Lambrecht, Vanlauwe & Maertens, 2016). I specifically want to examine the impact *distribution* of social learning, through an experimental intervention with trainings on a range of Climate Smart Agricultural (CSA) technologies. Is the impact on knowledge levels and adoption decisions different for different groups of the population? Which farmer characteristics are important for the impact of social learning? In the analysis I specifically focus on gender differences, to examine differences in link formation (establishing of new social contacts regarding agricultural information), knowledge levels and adoption rates between male and female farmers, and the factors that account for these differences. Disaggregating impacts of social learning by gender is relevant given the differences in size and types of relations in the social networks of male versus female headed households in Uganda (Katungi et al., 2006). In many (developing country) settings, it was also found that female farmers tend to have a lower agricultural productivity than male farmers (e.g. Udry, 1996). Peterman et al. (2011) find that, for Uganda specifically, farm plots owned by females have the lowest productivity compared to male-owned plots, even when controlled for input levels and household characteristics. This gender gap highlights the relevance of analysing impacts of social learning on technology adoption rates for men and women separately, as women already have a disadvantage in agricultural productivity to start with.

Moreover, the research goes beyond measuring gender gaps in knowledge levels and adoption rates. In order to find underlying explanations of the hypothesized gender differences in technology adoption, farmers' motivations for technology adoption are also analysed. Exploring the most important motivations to adopt or not adopt a new technology and disaggregating them by gender can lead to important insights of the positions of men and women in social and agricultural networks of knowledge sharing. Furthermore, knowing these different motivations could help to specifically target women or men in agricultural extension to close the gaps between actual and potential productivity.

Outline

In chapter 2 of this study I will explain the research context in northern Uganda, the research set-up and the intervention that I use for my research. The chapter further explains the relevant literature on (barriers to) technology adoption, gender gaps in agricultural productivity and social learning. Chapter 3 contains the explanation of the three research questions discussed in this study, and the methodologies used to answer these questions. In chapter 4, I present the data used and the results of the regression and decomposition analyses related to the first research question on gender gaps. Chapter 5 deals with the results on the second and third research questions regarding farmers' motivations in adoption decisions. In chapter 6, I summarize and discuss the research results and present the most relevant conclusions, limitations and policy implications.

Chapter 2: Background & Literature

2.1 Research context

The research takes place in Uganda, a landlocked low-income country in eastern Africa. Throughout the past centuries, (civil) conflicts have scourged the country and its people, still leaving their imprints in current poverty rates and other development indicators. Especially the northern part of the country has been hit hard by decades of the horrific LRA insurgency, only to end in 2006, leaving millions of victims and displaced people. The area of this research is Nwoya district, which is located in this former conflict zone in the north, about 300 kilometres away from Kampala. Nwoya is a recently formed district, bordered by the river Nile in the south and west, Amuru district in the north and the major town of Gulu in the east. The district is predominantly inhabited by Acholi people. The landscape is rather flat and scarcely populated. The region has a distinct dry season between December and March, and shorter dry spells in June and July. Major crops cultivated by local farmers are cassava, maize, sorghum, millet, groundnuts and beans, while animal raising focusses on cattle, goats and chicken.

The agricultural sector is of major importance to Uganda, employing 66% of the working population (Ali et al., 2016), securing food and a livelihood for an even larger share. Despite the importance of agriculture and the rapidly growing population of Uganda, growth of the agricultural sector has been slow and lagging behind compared to other sectors in the country. Agriculture comprises largely of subsistence farming and use of agricultural technologies, such as fertilizers, improved varieties and pesticides, is very low compared to surrounding countries (e.g. Pan, Smith & Sulaiman, 2015). In order to help boost agricultural productivity and reduce poverty, the government of Uganda introduced the National Agricultural Advisory Services (NAADS) in 2001, which has been the focus point in agricultural development until 2009. As a new way of agricultural extension, the NAADS aimed to take away farmers' constraints to technology adoption and productivity by providing them with information, credit and creating farmer groups (Kasirye, 2013). According to Benin et al. (2011) however, the NAADS program achieved little measurable impact relative to its aims and costs. Despite government efforts, adoption of improved varieties and other technologies such as fertilizers remained very low and dropout (dis-adoption) rates are high (Kasirye, 2013). Besides ineffectiveness, the NAADS program was associated with corruption scandals, and the intended involvement of the private sector was doubtful. The program was therefore terminated by President Museveni in 2014, earlier than planned, when it practically became a part of the government program Operation Wealth Creation. Since then, some of the activities of the NAADS have been carried out by forces of the Ugandan Army, for example for distributing inputs. Other supporting services, for example regarding information provision, have not been continued or improved.

The research questions that will be addressed here are part of a larger study that is carried out by Kelvin Shikuku, PhD student at Wageningen University. The greater research project aims to analyse the impacts of social learning on agricultural technology adoption among smallholder farmers in northern Uganda, and find ways to improve the effectiveness of the mechanisms at play by studying the effect of incentives on social learning. The project is a randomized controlled trial with 132 randomly sampled sub-villages in Nwoya District, Northern Uganda. Like other studies on social learning in agriculture (e.g. Yishay & Mobarak, 2014), the project works with a *communicator* in each sampled sub-village, who received a training on the technologies to be disseminated. The technologies in case are a range of relatively low-tech Climate Smart Agriculture (CSA) techniques and improved varieties of maize that aim to improve crop productivity and farm resilience in the context of climate change. The communicators are male or female farmers, who are 'average' (e.g. in terms of literacy, wealth, agricultural practices, social status) relative to other farmers in their sub-village. These communicators have been asked to spread the knowledge they received in the training to other farmers in their sub-village. Per sub-village, 9 "peer farmers" are randomly selected to participate in the study. Before the communicator training in 2015, the communicators and peer farmers participated in an extensive baseline survey to collect data on CSA knowledge, use of improved varieties, social networks and many other household and farm characteristics. In early 2017 the same farmers and households were visited again to administer an endline survey on these same topics and several extra modules of questions. This way it is possible to make comparisons over time and study the impacts of social learning on agricultural technology adoption. The present study uses this research setup of having one trained communicator and nine random peer farmers for each of the 132 villages. This allows for analysing whether there are gender differences in the extent of knowledge dissemination and eventual technology adoption among peer farmers, and how peer farmer characteristics play a role in the process of connecting to other farmers, learning and adopting.

2.2 Climate Smart Agriculture

The agricultural knowledge introduced to communicator farmers in the studied communities are Climate Smart Agricultural (CSA) technologies. Climate Smart Agriculture is defined by the FAO (2013) as "agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances the achievement of national food security and development goals." (p. 548). CSA is promoted to enable farmers to adapt to a changing climate in which extreme weather events will occur more often, putting agriculture, farmers' livelihoods and food security at risk. A prime example of such climate risks in northern Uganda is the occurrence of droughts. Therefore, disseminating knowledge on CSA technologies is an important tool for improving agricultural productivity and food security in the region.

The CSA technologies and practices included in the communicator training in this research are:

- Improved crop varieties of maize and groundnuts
- Conservation farming basins
- Minimum tillage
- Crop rotation
- Crop residue retention
- Correct spacing
- Row planting
- Intercropping

Some of these practices were already common in the research area (e.g. crop rotation and intercropping), while others were not.

2.3 Barriers to technology adoption

Kasirye (2013) identifies key constraints and facilitators to agricultural technology adoption in Uganda, all of which he considers to influence (farmers' perceptions of) the level of risk involved in a technology. The author recognizes that in the context of Uganda, with rather insecure and dynamic land property rights, availability of land alone may be insufficient to encourage technology adoption. Instead, other factors such has availability of (adult) household labour and so-called ‘peer effects’ (i.e. social learning of technologies through friends or neighbours), and knowledge may be more important facilitators of technology adoption. Indeed, he finds that the number of adult household members increases likelihood of fertilizer use, as does farmers’ education attainment. Furthermore, peer effects and access to input markets turn out to be positively correlated to technology adoption. Knowledge scores on improved varieties are also shown to be a key determinant of adoption. Regarding dis-adoption of technologies, he finds that higher numbers of adults in the household and higher age of the household head increase the likelihood of dis-adoption (possibly pointing to life cycle effects), whereas peer effects decrease dis-adoption. Incidence of dis-adoption is also influenced by the country region.

Similarly, Shiferaw et al. (2015) studied the constraints to adoption of improved agricultural technologies (i.e. improved varieties) by groundnut farmers in Uganda. Apart from the often assumed lack of economic incentives as the reason for slow technology uptake, they identify three different types of constraints that farmers could face when they are interested in growing improved varieties: (1) information constraints, (2) seed supply constraints and (3) credit constraints. The authors find that proximity to agricultural centres, group membership, farm size and ownership of a bicycle positively influence the likelihood that a farmer has access to information. Farmers with experience in buying seed from extension agents, traders and informal seed systems were less likely to face constraints to seed access, while marketing and transportation assets like a bicycle further eased access to improved seeds. Group membership (social capital), ownership of productive assets and means of transport reduce farmers’ likelihood of facing capital constraints in order to buy seeds. Furthermore, in accordance with Kasirye (2013), it was found that demand for improved varieties was positively influenced by higher education, farm size, oxen ownership and past experience or knowledge on growing new varieties (Shiferaw et al., 2015). Besides initial technology adoption, they also considered the adoption intensity, i.e. the share of a farmer’s land planted with improved varieties. They found that membership of crop production groups, number of oxen owned and farm size increase adoption intensity. Interestingly, family labour endowment matters for the initial technology adoption, but not for the adoption intensity.

Like Kasirye (2013), Shiferaw et al. (2015) underline the importance of household labour availability, farmer’s knowledge (e.g. through knowledge scores, education attainment, experience with technology) and social learning from peers (e.g. also through group membership). The above is specifically about Uganda, but is also in accordance with the findings on barriers to technology adoption in developing countries in general in the extensive literature review by Jack (2013). She classifies the barriers under seven different types of market inefficiencies, which are often connected and reinforce each other. For this study context, labour market inefficiencies (e.g. related to human capital, markets for hired labour, seasonality of household labour constraints and differences between labour-saving and labour-intensive technologies) and informational inefficiencies (e.g. related to social learning, literacy and agricultural extension services) seem to be most relevant. Moreover, the author stresses the importance of inefficient input and output markets in many developing countries, particularly in remote rural areas with limited infrastructure and transportation possibilities. Lacking or malfunctioning markets for credit and risk are also identified as common barriers to technology adoption, especially among poor smallholder farmers who often lack the assets to use as collateral or for (self-)insurance (Jack, 2013). Since many of the CSA technologies included in this study are relatively low-tech, they may require relatively little up-front financial investments (except for improved seeds), which reduces several adoption constraints. On the other hand, many technologies only pay off on the longer term (for example through improved soil fertility) and may therefore be more sensitive to credit and risk market constraints, especially when the technology is also labour-intensive.

Gender gaps in agricultural productivity and technology adoption

Not only is agricultural productivity in Sub-Saharan Africa low and lagging, it is also unequal: female farmers are structurally found to be less productive than male farmers, even when controlled for input levels and household characteristics (e.g. Udry 1996, Peterman et al., 2011). This is important, given the fact that women comprise at least 50% of the agricultural labour force in most African countries, but the plots they manage are 20-30% less productive than those managed by male farmers (Ali et al., 2016). This gender gap in agriculture is an important issue, as it maintains the low agricultural productivity in general, contributes to gender inequality by itself and thereby forms part of a negative loop. In a study in Uganda, Ali et al. (2016) describe that Ugandan women generally have smaller plots, less access to extension services and grow different crops than men. The authors assess which factors are at play in the gender gap, thereby focussing on intra- rather than inter-household inequalities, given that differences between male-headed and female-headed households may be attributable to differences in household structures and endowments rather than gender alone. Earlier research by Kilic, Palacios-Lopez & Goldstein (2015) in Malawi finds that the productivity gap between female-managed and male-managed plots is primarily caused by higher levels of male labour and a preference for export crops by men (endowment gap), as well as differences in child dependency ratio and returns to male labour (structural gap). Ali et al. (2016) find a statistically significant productivity gap between male-managed and female-managed plots of 34.9% after including plot-level as well as household and community-level characteristics. Employing the Oaxaca-Blinder approach to disaggregate the gender productivity gap to the different factors at play, they find that the major contribution to the gap is the child dependency ratio, which affects women and men differently. This implies that caring for children constrains female farmers' agricultural work far more than it constrains male farmers. Despite the very low average input use in Uganda by men and women, Ali et al. (2016) find that female farmers even use significantly less inputs than men. Although this difference currently plays a very small role in the gender productivity gap, it may become important in the future if input use increases but gender inequality remains the same.

The fact that female farmers in developing countries often also have lower rates of technology adoption compared to their male counterparts, is a part of the problem that is also recognized by many other scholars (e.g. Doss & Morris, 2001; Lambrecht et al., 2016). In a study on adoption of improved maize varieties in Ghana by Doss and Morris (2001), an important finding on the reasons behind this gender gap is that when controlling for other factors such as access to labour and land, adoption of improved varieties and fertilizers is not associated with the gender of the farmer. However, they find that the gender of the *household head* does matter: female farmers in male-headed households are more likely to adopt than are female farmers in female-headed households. Furthermore, when looking into the factors that are commonly associated with technology adoption, the authors do find relevant gender differences. Women are found to have significantly less access to land than men, but there were no significant differences between male and female farmers in availability of adult labour from the household. This does not mean that men and women also have the same access to and control over labour of other household members. Doss and Morris (2001) also find that female farmers have significantly lower education attainment compared to male farmers, and the same holds for female farmers in male-headed households compared to female-headed households. Importantly, women also reported significantly less contact with extension agents compared to men. These findings from Ghana are largely supported by Jack's (2013) literature review on barriers to technology adoption in developing countries in general. Jack (2013) also finds that female farmers are often disadvantaged by market inefficiencies and inequalities in access to land, labour (e.g. through time constraints and different valuation of male and female labour), credit and information. Such barriers also affect male farmers, but in many contexts hurt female farmers more and can thereby exacerbate existing gender inequalities that are prevalent in societies and households.

Social learning and technology adoption

Technology adoption remains low and slow in many developing country settings, while conventional ways of information provision and agricultural extension by governments often do not function adequately and efficiently, structurally failing to reach certain groups in society. Therefore, different approaches to agricultural extension are necessary to replace or support the conventional systems. Since people are social beings who use their relationships to exchange information, using social networks for spreading information can be very effective: Katungi et al. (2006) find that informal mechanisms of knowledge exchange are the main sources of information for many Ugandan farmers. The concept of social learning – learning from peers in informal, practical settings – is already an important pillar in agricultural extension. Research in different countries and settings has explored some of the mechanisms behind it: farmers tend to adapt their practices according to experience of farmers similar to themselves (e.g. Conley & Udry, 2010 in Ghana). According to Yishay & Mobarak (2014) in the context of Malawi, agricultural comparability is particularly important for effectively communicating knowledge through social networks.

In the field of social learning gender differences also play a role, affecting the process of knowledge dissemination and the resulting scope and impact on technology adoption. Magnan et al. (2014) find that agricultural extension agents often do not target women. According to the authors, differences in the type of social ties and network composition may affect men and women differently in terms of social learning and information exchange. For example, Katungi et al. (2006) also find that "among Ugandan banana cultivating farmers, men are more likely to only receive information through social networks than are women, whereas women are more likely to engage in two-way information sharing" (p. 25). On the other hand, in a research on the introduction of sunflower cultivation in rural Mozambique, heterogeneous effects of social learning on adoption decisions were shown by Bandiera and Rasul (2006), who found that female headed household were significantly more likely to adopt a new crop than male headed households. A potential explanation for this finding is that these female headed households were also poorer and had less other options for cultivation than male headed households. Although these findings may be highly contextual, they do confirm the complexity of the problem and the underlying causes.

It is already known that the gender of the communicator matters for knowledge growth and adoption rates of agricultural technologies (e.g. Yishay et al., 2015). Specifically, the authors find that, depending on the incentives provided, female communicators perform equally well or better than male communicators in terms of their own knowledge scores and technology adoption, their teaching efforts and the resulting yields in their villages. Female and male communicators are also equally 'visible' in their villages when it comes to social interactions with other farmers. However, both in formal and informal settings peer farmers (regardless of their gender) tend to pay significantly less attention to female communicators when they talk or teach about agricultural technology, compared to male communicators. Both female and male peer farmers also view female communicators as less knowledgeable about agriculture, even though the researchers' knowledge tests show otherwise. This perception translates in farmers' ability to convince others: in villages with a male communicator, peer farmers have significantly higher knowledge scores and adoption rates compared to villages with a female communicator. Intriguingly, the authors also find that the this difference is even more pronounced for female peer farmers, whose adoption rates are significantly higher when taught by male communicators compared to female communicators. Otherwise, their research does not analyse peer farmer characteristics and behaviour for significant differences between male and female peer farmers.

Hence, based on the literature available on agricultural technology adoption, social learning and gender gaps in Uganda as well as other developing countries, it is hypothesized that the following factors play a role in the gender differences in knowledge, link formation and technology adoption on CSA technology in northern Uganda:

Compared to men,

- women often have less and less secure access to (agricultural) land, which may constrain them in applying agricultural technology as well as acquiring credit, status or other assets.
- women often have less access to (hired and male) farm labour, have to divide their time over farming and household tasks and therefore are more constrained in time by high dependency ratios in households. These labour and time constraints may prevent women from engaging in social networks, learning about new technologies, applying them on farm (especially labour-intensive technologies) and acquiring (income for buying) the required inputs. On the other hand, it may also be an incentive for women to adopt accessible labour-saving technologies.
- women often face more income and credit constraints, which may constrain them from buying the required farm inputs or hire labour for certain technologies.
- women often have less access to information on agricultural technology through agricultural extension or social networks, which may constrain them from learning (actively or passively) about new technologies.
- women often have lower levels of literacy and educational attainment, which may constrain them further in accessing and properly using new information on agricultural technology.
- women often have less bargaining power and lower social status within and outside the household, even though men and women from the same household often cultivate separate plots on which they make their own decisions. This may result in less control over shared productive assets and (male) family labour for specific activities such as ploughing. It may also reduce the extent to which women can engage in and benefit from social ties that are relevant for obtaining agricultural information. These power inequalities form an underlying factor, causing or exacerbating other access inequalities such as land and labour constraints for female farmers.

Chapter 3: Research questions and methodology

3.1 Research Questions

This research builds on the findings of Yishay et al. (2015) by examining whether there are also gender differences on the *receiving* side of the communication, in the context of CSA technologies in northern Uganda. This corresponds to the first research question:

1. *Is there a difference in link formation, changes in CSA knowledge, and technology adoption rates between female and male peer farmers? If so, what factors account for this difference?*

The literature on gender gaps in agricultural productivity and technology adoption as mentioned above leads me to the following hypothesis:

a) *Female farmers have a lower probability of link formation, lower growth of CSA knowledge and lower technology adoption rates than male farmers.*

Here, link formation is defined by contact between the communicator farmer (CF) and the peer farmer whereby information on agricultural practices is exchanged. For the first research question, the focus is on the use of improved varieties of maize, since relevant data on improved groundnut knowledge and adoption were not available for this research. Therefore, technology adoption is defined as a dummy variable which equals one if a farmer has adopted any kind of improved maize in the last year, and zero otherwise. Adoption decisions on the other CSA practices dealt with in the communicator training are analysed in research questions 2 and 3. More details on the definition and measurement of the dependent and independent variables can be found in the data section in chapter 4.

The research goes beyond impacts on knowledge levels and adoption rates only by also including farmers' motivations for technology adoption according to men and women. Exploring motivations to adopt or not adopt a new technology and disaggregating them by gender can lead to important insights of the positions of men and women in social and agricultural networks of knowledge sharing. Furthermore, knowing these different motivations could help to specifically target women or men in agricultural extension to close the gaps between actual and potential productivity. Therefore the second and third research questions are as follows:

2. *What are the most important motivations for respondent farmers when they decide whether or not to adopt CSA technology?*

3. *Are there differences in the motivations for adopting or not adopting CSA technology between female and male respondent farmers?*

Motivations for technology adoption can be very situation-specific, so it is hard to in advance formulate a substantiated hypothesis on which motivations are most important to the peer farmers. Preliminary analysis of a survey module that was only included in at baseline shows that the most important *barriers* faced by farmers who already used CSA practices concern 'lack of skills', 'labour demanding' and 'lack of equipment'. These data provide relevant insights on farmers' potential motivations to not adopt CSA technology, but not on positive motivations to use a practice.

Based on the technology adoption literature, I expect the following motivations to play a role in deciding whether or not to adopt CSA technology:

- Expected effect on yields
- Expected effect on product selling price
- Expected effect on the costs of required inputs (e.g. herbicides, pesticides, seeds, equipment)
- Availability of land to implement this technology
- Availability of farm labour
- Level of knowledge on this technology
- Opinions of other household members on this technology
- Opinions of friends or neighbours on this technology
- Risk involved in using this technology

Moreover, since female and male farmers often have different responsibilities and constraints in their farm and household, my hypothesis is:

b) *There are differences in the motivations for whether or not to adopt CSA technology between female and male farmers, with availability of land and labour, knowledge levels and attitudes of other people towards the technology being more important to female farmers than to male farmers.*

3.2 Methodology

In order to answer the research questions mentioned above, I will make use of the research setup and data collection as carried out by Kelvin Shikuku for the overall research project. This includes a baseline and endline household survey, providing data on the total of 779 respondents in the 132 randomly sampled sub-villages. This includes one selected communicator farmer (CF) and nine randomly selected peer farmers per sub-village – only the peer farmers will be included in this study. The surveys contain an extensive list of detailed questions on household characteristics, farming practices, knowledge on CSA technology and social networks.

3.2.1 RQ 1: gender gap analysis

These survey data allow for answering research question 1. In order to do so, per dependent variable two equations need to be estimated: equation (1) for observations on female farmers and equation (2) for observations on male farmers.

$$y_{iv}^{female} = \alpha_v^{female} + \beta^{female} X_{iv} + \varepsilon_{iv}^{female} \quad (1)$$

$$y_{iv}^{male} = \alpha_v^{male} + \beta^{male} X_{iv} + \varepsilon_{iv}^{male} \quad (2)$$

Dependent variables:

y_{iv} represents the outcome of interest of farmer *i* in sub-village *v*., namely:

- link formation (represented by a dummy variable with value 1 if a link has established between the village CF and the respondent, and 0 otherwise),
- change in knowledge on CSA (represented by a continuous score),

- actual uptake of one or more improved maize varieties at endline (represented by a dummy variable with value 1 if farmer has used an improved variety in the last 12 months and 0 otherwise)

Explanatory variables:

X_{iv} represents a vector of respondent, household and farm characteristics of farmer *i* in sub-village *v*. This vector also includes:

- asset and welfare indices,
- indicators of labour availability,
- baseline indicators of respondent's sources of agricultural information
- baseline social network characteristics
- several indicators of comparability between respondent and CF, regarding age, education, maize area and (non)-agricultural assets, to control for social distance between farmer *i* and the CF in sub-village *v*,
- a variable capturing sub-village fixed effects
- When the dependent variable is knowledge change, link formation is included as an explanatory variable in this vector.
- When the dependent variable is adoption, link formation and endline knowledge score are included as explanatory variables in this vector.

This way β will capture the effect of farmer characteristics on the change in knowledge and adoption for male and female peer farmers separately. Equations (1) and (2) will be estimated in a linear probability model through OLS regression analysis.

Blinder-Oaxaca decomposition

I will use a decomposition approach to disaggregate outcomes on link formation, CSA knowledge growth and adoption rates. This will allow for measuring gender gaps in the dependent variables and analyse which factors account for these gender gaps. Since I estimate a linear probability model, I chose to use the Blinder-Oaxaca decomposition method (Oaxaca 1973, and Blinder 1973) for all three dependent variables, although link formation and adoption are not continuous variables. According to Jann (2008), this method estimates the overall gender gap in the dependent variable, as in equation (3):

$$D = E(Y_A) - E(Y_B) \qquad (3)$$

where D is the overall gender difference and $E(Y)$ indicates the estimated value of the dependent variable for groups A (men) and B (women). Given the estimated models in equations (1) and (2), D can also be described as

$$D = E(Y_A) - E(Y_B) = E(X_A)'\beta_A - E(X_B)'\beta_B \qquad (4)$$

where X_A and X_B are the vectors of explanatory variables and a constant in the male sample and female sample, respectively. β_A and β_B contain the slope parameters of the two samples. To estimate the contributions of gender differences in predictors to D, equation (4) can be rearranged to:

$$D = [E(X_A) - E(X_B)]'\beta_B + E(X_B)'(\beta_A - \beta_B) + [E(X_A) - E(X_B)]'(\beta_A - \beta_B) \qquad (5)$$

This way, outcome D is divided into three parts:

$$D = E + S + I$$

where

$$E = [E(X_A) - E(X_B)]'\beta_B$$

captures the extent to which gender differences in X_{iv} (i.e. in farmer characteristics) contribute to the total gender gap D in the dependent variable. This is the *endowment effect*. The second component:

$$S = E(X_B)'(\beta_A - \beta_B)$$

captures the extent to which gender differences in β_1 (i.e. in the regression coefficients) contribute to the total gender gap D in the dependent variable. This is the *structural effect*. The third component:

$$I = [E(X_A) - E(X_B)]'(\beta_A - \beta_B)$$

is an *interaction* term to capture the effect of endowment effects and structural effects existing simultaneously, thereby changing the effective overall gender gap D.

In decomposition (5), group B is the reference group. This means that the endowment effect measures the expected change in group B's dependent variable if group B had the characteristics of group A. Similarly, the structural effect measures the expected change in group B's dependent variable if group B had the coefficients of group A. In this study, female farmers are always the reference group.

For example, a gender gap in favour of men (e.g. men being more likely to adopt) could be explained partly by men *having more assets* than women (endowment gap), and/or men *having higher returns to assets* than women (structural gap). For each regression variable, coefficients are calculated which present the contribution of that variable to the endowment gap and the structural gap. A positive endowment coefficient means that this variable has a positive contribution to the endowment gap. It means that if the reference group (female farmers) would have the same values for X_{iv} as the other group, they would have a higher value of the dependent variable. A negative endowment coefficient indicates that if female farmers would have the characteristics of the male farmers, they would have a lower value of the dependent variable. The same holds for the structural coefficients.

3.2.2 RQ 2 and 3: analysis of farmers' motivations

In order to measure and analyse farmers' motivations, additional questions were added to the endline survey. These are mentioned below in table 1.

Table 1: Endline survey questions regarding farmers' motivations for technology adoption

1. Open question If the farmer indicates that s/he has heard about [practice]: *What was your main motivation when you decided whether or not to use [practice]?*					
2. Closed questions To what extent do you agree with the following statements? *When deciding whether or not to use [practice], I consider [motivation]*					
Motivation	**Level of agreement**				
	Strongly disagree (1)	**Moderately disagree (2)**	**Neutral (3)**	**Moderately agree (4)**	**Strongly agree (5)**
The effect of [practice] on yields					
The effect of [practice] on product selling price					
The effect of [practice] on the costs of required inputs (e.g. herbicides, pesticides, seeds, equipment)					
The availability of land to implement [practice]					
The availability of farm labour to implement [practice]					
The level of knowledge on [practice]					
Opinions of other household members on [practice]					
Opinions of friends or neighbours on [practice]					
Risk involved in using [practice]					

Answers to these questions will allow for answering research questions 2 and 3. Because several motivations may play a role for a farmer's decision at the same time, and because sub-groups according to the CSA practice, adoption (yes/no) of that particular practice, and gender of the farmer can be small, I will use a descriptive analysis of farmer motivations for CSA adoption. Answers to the open question on farmers' main motivations give qualitative insights, while the closed rating questions allow for a quantitative analysis of the most important motivations, as well as differences between adopters and non-adopters, female and male farmers. Details on the analysis and interpretation of the motivational data are presented in chapter 5.

Chapter 4: Gender gap analysis on linking, learning and adoption

4.1 Data

In order to answer research question 1 I used a panel dataset with data on link formation, CSA knowledge scores, adoption of improved maize varieties and a large set of control variables on respondent and household characteristics. Most variables were collected at baseline (2015) and endline (2017), but some were only included in the endline survey. The total number of observations in the panel dataset is 779, including 569 peer farmers and 120 communicator farmers (CFs). Table 2 below presents the gender balance in the peer farmer subset of this dataset, as well as descriptive statistics on the dependent and independent variables. The statistics presented are based on endline values and concern the situation in the year 2016, unless indicated otherwise in the variable description.

Definition of the dependent variables

During the endline survey, peer farmers were asked: 1) whether they had been contacted by another farmer in the sub-village about new farming methods and 2) whether they had heard about or attended an activity organized by another farmer in their sub-village to train co-villagers about farming. If they answered 'yes', follow up questions asked for the name of the contact or trainer and the content of the training. Existence of an information exchange link is defined as the dummy variable 'Link between farmer and CF', which is equal to one if a farmer had contact with or attended an activity organized by the CF in the respective sub-village and zero otherwise.

Other dependent variables are knowledge and adoption of improved varieties of maize. The variable 'knowledge score' is defined as a continuous variable measured using an exam about the trained CSA practices and improved varieties. These exams were administered in both the baseline and the endline survey. Such exams are an effective approach of assessing knowledge exposure by subjects (Kondylis et al., 2015). Because questions differ in difficulty and farmers differ in their ability to respond, the probability of answering a question correctly is generated, that is, $p = (q/Q)$ where q captures the number of people responding correctly to the question and Q is the total number of people. The inverse of the probability, that is, $1/p$ is then used as weight for a correct answer to that question. The final score is thus a summation of the weighted responses to all questions. This procedure ensures that difficult questions (those to which only a few farmers answer correctly) carry more weight in the final outcome. The difference in knowledge score between baseline and endline is one of the dependent variables in this analysis, for which the baseline score is subtracted from the endline score in order to measure knowledge gain (or loss). I use knowledge change as a dependent variable, because I am interested in the extent of (social) *learning* among men and women, and not merely in the final knowledge score. The endline knowledge score is used as a control variable in the regression analysis on adoption of improved varieties. In explaining adoption, I expect the final knowledge level of CSA to be more relevant in the adoption decision than knowledge gain over time.

'Adoption of improved maize variety' is defined as a dummy variable, which is equal to one if a respondent indicates that he/she has planted any type of improved variety of maize in the year 2016 (last 12 months before the endline survey). The variable equals zero otherwise. Since data on adoption intensity and intensity change over time were not available, I chose to use the endline adoption dummy variable as the dependent variable. I do use past experience with improved varieties (i.e. dummy variable for adoption at or before baseline) as a control variable, as explained below.

Explanation of several key explanatory and control variables

The dummy variable 'experience with improved varieties' equals one if the respondent has grown any type of improved variety before the baseline survey was administered, i.e. in 2015 or earlier. The variable 'final score in risk game' is a discrete variable with values ranging between 1 and 32, with 1 indicating extremely risk-averse and 32 indicating extremely risk-loving. The scores were measured through a risk game according to the staircase model described by Falk et al. (2016, pp. 43-48).

Several of the control variables are indices, such as the index for housing, agricultural assets and non-agricultural assets, indicating several aspects of welfare. The housing index is constructed based on questions about building materials and facilities present in the respondent's house. The agricultural and non-agricultural assets indices are constructed based on the type and number of (non-)agricultural tools that are owned by the household. The lower the indices, the lower the welfare score. It is striking that in this sample, the average housing index is negative, indicating poverty and very low household welfare in Nwoya district.

Respondents were also asked questions about which sources they used to get agricultural information, e.g. neighbours, farmer groups, government extension, friends. These questions translate to the four dummy variables 'agricultural info from…'. These variables equal one if the respondent uses this source, and zero otherwise. The respondents were also asked about other forms of social capital through listing the members of their various social networks in their village. Of these networks, the categories 'contacts for agricultural advice', 'friends' and 'kinship members' were included in this analysis. These variables take values between 0 and 5, indicating the number of persons in each of the networks. I chose to use the baseline values for the variables that measure respondent's agricultural information sources and social networks. Comparing the baseline and endline values of these variables shows that at endline, farmers reported significantly more social network ties and more often reported neighbours, friends and farmer groups as a source of information than at baseline. This network growth could partly be due to the research intervention and the activities of the CFs, which is also captured in the variable 'Link between farmer and CF'. In order to not capture this effect multiple times through different variables, I chose to use baseline values for information sources and social networks. Another form of social capital measured through the survey is group membership. This dummy variable equals one if any member of the household has been a member of some kind of group in the village, and zero if otherwise.

Lastly, the dataset includes variables on the comparability between the peer farmer and the CF in the corresponding sub-village. These dummy variables are described in panel C of table 2. They are measures of comparability and social distance between peer farmers and CFs, in terms of gender, age, education, maize area, agricultural assets and non-agricultural assets.

Table 2: Descriptive statistics of peer farmer sample

Panel A: gender balance in sample N = 659		**Male**	**Female**	
No. of respondents by gender		282	377	
% of total		*42.79*	*57.21*	
No. of respondents by gender of the household head		512	147	
% of total		*87.69*	*22.31*	
Panel B: peer farmer characteristics, by gender	**Pooled**	**Male**	**Female**	**Sig.**
Link between farmer and CF	0.144	0.174	0.122	*
	(0.014)	(0.023)	(0.017)	
Difference in knowledge score between baseline - endline	0.830	1.135	0.602	**
	(0.126)	(0.193)	(0.166)	
Knowledge score at endline	5.067	5.993	4.374	***
	(0.124)	(0.195)	(0.151)	
Adoption of improved maize variety (1=yes)	0.178	0.266	0.111	***
	(0.015)	(0.026)	(0.016)	
Age in years	43.490	42.291	44.387	*
	(0.593)	(0.878)	(0.799)	
Highest level of education (ranging 0-14)	4.498	6.351	3.111	***
	(0.134)	(0.180)	(0.158)	
Gender of household head (1=female)	0.223	0.007	0.385	***
	(0.016)	(0.005)	(0.025)	
Agriculture is primary activity of household head (1=yes)	0.958	0.986	0.936	***
	(0.008)	(0.007)	(0.013)	
Area planted with maize (ha)	0.478	0.540	0.431	*
	(0.031)	(0.058)	(0.032)	
Past experience with improved varieties (1=yes)	0.105	0.163	0.061	***
	(0.012)	(0.022)	(0.012)	
Risk attitude score (ranging 1-32)	12.541	13.502	11.821	*
	(0.430)	(0.667)	(0.560)	
Dependency ratio	0.562	0.528	0.587	***
	(0.008)	(0.013)	(0.010)	
Housing index	-0.687	-0.638	-0.724	**
	(0.017)	(0.028)	(0.022)	
Distance to main road (walking minutes)	12.464	13.989	11.324	*
	(0.724)	(1.152)	(0.924)	
Distance to agrodealer (km)	6.716	6.379	6.969	
	(0.221)	(0.300)	(0.315)	
No. of male agricultural workers in household	1.085	1.284	0.936	***
	(0.030)	(0.038)	(0.043)	
Household used hired labour (1=yes)	0.847	0.854	0.841	
	(0.014)	(0.021)	(0.019)	
Household received credit (1=yes)	0.528	0.461	0.578	***
	(0.019)	(0.030)	(0.025)	
Agricultural assets index	1.241	1.323	1.179	***
	(0.020)	(0.029)	(0.026)	
Non-agricultural assets index	0.831	0.988	0.714	***

	(0.026)	(0.039)	(0.033)	
Agricultural info from farmer group at baseline (1=yes)	0.053	0.043	0.061	
	(0.009)	(0.012)	(0.012)	
Agricultural info from friend at baseline (1=yes)	0.042	0.043	0.042	
	(0.008)	(0.012)	(0.010)	
Agricultural info from neighbour at baseline (1=yes)	0.161	0.138	0.178	
	(0.014)	(0.021)	(0.020)	
Agricultural info from government extension at baseline (1=yes)	0.023	0.021	0.024	
	(0.006)	(0.009)	(0.008)	
Group membership (1=yes)	0.804	0.762	0.836	**
	(0.015)	(0.025)	(0.019)	
No. of contacts for agricultural advice at baseline	0.804	1.057	0.615	***
	(0.046)	(0.078)	(0.054)	
No. of friends at baseline	2.042	2.181	1.939	***
	(0.037)	(0.056)	(0.050)	
No. of kin at baseline	1.756	2.007	1.568	***
	(0.042)	(0.062)	(0.055)	
Panel C: characteristics of farmer - CF comparability	**Pooled**	**Male**	**Female**	**Sig.**
Age CF > farmer (1=yes)	0.473	0.489	0.462	
	(0.019)	(0.030)	(0.026)	
Education CF < farmer (1=yes)	1.700	2.617	1.013	***
	(0.103)	(0.184)	(0.103)	
Maize area CF < farmer (1=yes)	0.254	0.260	0.249	
	(0.028)	(0.045)	(0.037)	
CF & farmer both have few agricultural assets (1=yes)	0.363	0.326	0.390	*
	(0.019)	(0.028)	(0.025)	
Agricultural assets CF < farmer (1=yes)	0.237	0.316	0.178	***
	(0.017)	(0.028)	(0.020)	
Agricultural assets CF > farmer (1=yes)	0.215	0.188	0.236	
	(0.016)	(0.023)	(0.022)	
CF & farmer both have few non-agricultural assets (1=yes)	0.387	0.323	0.435	***
	(0.019)	(0.028)	(0.026)	
Non-agricultural assets CF < farmer (1=yes)	0.208	0.270	0.162	***
	(0.016)	(0.026)	(0.019)	
Non-agricultural assets CF > farmer (1=yes)	0.228	0.184	0.260	**
	(0.016)	(0.023)	(0.023)	

*Notes: *** p<0.01, ** p<0.05, * p<0.1. T-test results shown are means, standard errors included in parentheses. Sample includes peer farmers only.*

4.2 Results

As described in the methodology section, for each of the three dependent variables (link formation, knowledge gain and adoption of improved maize), I first run an OLS regression by gender of the respondent, with a set of explanatory and control variables. After that I use the Blinder-Oaxaca decomposition approach to disaggregate the gender differences found into an endowment gap and a structural gap. Details on the meaning and interpretation of the decomposition exercises are explained in the methodology section as well as further below, along with the decomposition results on link formation. The analyses below are based on the peer farmer sample only (not CFs), and include endline variables concerning the situation in the year 2016, unless indicated otherwise in the variable description.

4.2.1 OLS regression on link formation

Firstly, the result of the OLS regression on link formation are presented below in table 3. The table presents the coefficients and standard errors for the male sample and female sample separately.

OLS regression results on probability of link formation between CF and peer farmer indicate various factors of influence. For male respondents, it appears that past experience (before baseline) with improved maize varieties strongly increases the probability of a link (0.293). Other important factors concern comparability between peer farmer and CF: if both farmer and CF have few agricultural assets, they are 12.2% more likely to form a link. On the other hand, when both have few *non-agricultural* assets, they are 15.5% *less* likely to form a link. Male farmers with more kinship members in their village are more likely to connect to the CF, as are farmers who get agricultural information from their neighbours. Moreover, there seems to be a substantial positive effect of a CF being older than the peer farmer. Lower social status or authority of younger men may play a role in this effect. Lastly, I find a small positive effect (0.021) of a CF being less educated than the farmer. This could be a side-effect of the selection procedure for CF's: a CF should be 'average' in his/her village in terms of wealth and education, not necessarily literate, and should be motivated to actively try and promote new farming methods. These criteria might result in a selection of CFs who are relatively low educated and whose effectiveness does not necessarily correlate with their education level.

In the female sample, past experience is also a substantial driver for link formation, but the effect is less strong than for male farmers. The importance of (non-)agricultural comparability disappears completely. Female farmers are more likely to form a link if they used to get agricultural information from government extension (0.197) and if the CF is also a woman (0.067). Farmer's resources seem to be more relevant for women then for men: access to credit and the area planted with maize both increase the probability of link formation substantially.

This could imply that for accessing new agricultural advice, female farmers are more dependent on their resources (land, credit) than are male farmers. Female farmers may be more likely to connect to people for information if the other is also a woman, while for male farmers agricultural comparability is more important than gender. The strong positive effect of government extension (albeit with weak evidence) among female but not among male farmers is surprising, as are the very limited effects of other information sources and social networks. A possible explanation of the importance of government extension among women, is that women have smaller social networks and/or do not gain as much agricultural information through these networks. However, government extension rarely reaches farmers in Nwoya district, so it is not immediately clear how it could contribute to link formation between farmers.

Table 3: OLS Regression results on link formation

	Male respondents N = 281 Adj R^2= 0.2167			Female respondents N = 375 Adj R^2 = 0.1071		
Dependent variable: Link between farmer and CF (1=yes)	**Coef.**	**SE**	**Sig.**	**Coef.**	**SE**	**Sig.**
Area planted with maize (ha)	-0.001	0.024		0.116	0.030	***
Past experience with improved varieties (1=yes)	0.293	0.061	***	0.169	0.072	**
Risk score (ranging 1-32)	0.005	0.002	**	-0.002	0.002	
Dependency ratio	0.157	0.108		-0.036	0.089	
Housing index	-0.067	0.050		-0.032	0.043	
Distance to main road (walking minutes)	-0.001	0.001		0.000	0.001	
Distance to agrodealer (km)	0.000	0.004		0.002	0.003	
No. of male agricultural workers in household	0.025	0.036		-0.004	0.021	
Household used hired labour (1=yes)	0.065	0.063		-0.017	0.048	
Household received credit (1=yes)	-0.011	0.047		0.103	0.037	***
Agricultural assets index	0.040	0.050		0.029	0.037	
Non-agricultural assets index	-0.002	0.040		-0.004	0.034	
Agricultural info from farmer group at baseline (1=yes)	-0.141	0.107		-0.021	0.069	
Agricultural info from friend at baseline (1=yes)	-0.032	0.108		0.077	0.089	
Agricultural info from neighbour at baseline (1=yes)	0.118	0.062	*	-0.021	0.045	
Agricultural info from government extension at baseline (1=yes)	0.057	0.146		0.197	0.109	*
No. of contacts agricultural advice at baseline	-0.018	0.017		0.014	0.016	
No. of friends at baseline	-0.001	0.026		0.023	0.018	
No. of kin at baseline	0.057	0.023	**	0.001	0.016	
CF gender (1=female)	0.058	0.051		0.067	0.036	*
Age CF > farmer (1=yes)	0.100	0.052	*	-0.024	0.044	
Education CF < farmer (1=yes)	0.021	0.010	**	0.011	0.012	
CF & farmer both have few agricultural assets (1=yes)	0.122	0.069	*	0.057	0.049	
CF & farmer both have few nonagricultural assets (1=yes)	-0.155	0.064	**	-0.074	0.058	

*Notes: *** p<0.01, ** p<0.05, * p<0.1. Results shown are from OLS estimation. Sample includes peer farmers only. Regressions include the following additional control variables: constant, sub-village indicator, respondent characteristics (education, gender, age), household characteristics (primary activity of the household head, group membership of at least one household member), additional dummy variables on social distance between CF and farmer (differences in maize area, agricultural assets and non-agricultural assets between CF and farmer).*

4.2.2 Blinder-Oaxaca decomposition on link formation

In the next step, I use the Blinder-Oaxaca decomposition method to see if there is a gender difference in link formation, and if so, to which factors this difference can be attributed. In panel A of table 4 below, the predicted values of probability of link formation for the male and female sample are presented, along with the estimated difference (overall gender gap). The results show that the average probability of link formation among male respondents is 0.174 and 0.123 for female respondents: a significant difference of 0.052. This difference is then decomposed into endowment differences and structural differences accounting for the gender gap. For example, a gender gap could be explained partly by men *having more assets* than women (endowment gap), and/or men *having higher returns* *to assets* than women (structural gap). For each regression variable, coefficients are calculated which present the contribution of that variable to the endowment gap and the structural gap. These coefficients are presented in panel B of table 4.

At the bottom of table 4, the total values of the endowment gap (0.034) and structural gap (-0.011) are presented. This is an important finding, implying that the endowment gap explains more than half of the overall gender gap, while the structural gap is negative. The overall positive endowment effect means that men have an endowment advantage and if women would have the same endowments as men, they would be more likely to form links. The negative structural effect implies that women have a small structural advantage, meaning that if women would the same *returns* to their characteristics or assets (i.e. asset *coefficients*) as men, they would be even less likely to form links.

The total endowment effect and structural effect do not add up exactly to the total gender gap (0.057), because part of the gender gap is attributed to the *interaction* between the two effects. The endowment effect and structural effect are estimated separately from each other. The interaction term accounts for the fact that endowment effects and structural effects exist simultaneously (Jann, 2008), thereby changing the effective overall gender gap. The term is the difference between the overall gender gap on the one hand, and the sum of the total endowment and structural effects on the other hand. Hence, interaction effects can make the effective gender gap larger or smaller than predicted based on the estimated endowment and structural effects only. In the case of the decompositions in this study, the interaction effects are positive, but relatively small. Details about the interaction gap are complex to interpret and beyond the scope of this study. Therefore, they are not analysed or presented in this chapter.

When looking at the endowment differences explaining probability of link formation, only past experience and household credit have a significant contribution. The gender difference in past experience favours men (i.e. they have more experience) and explains about 32% of the total gender gap. The endowment coefficient for 'household received credit' is negative (-0.011), indicating a gender difference in credit in favour of women (i.e. households of female respondents more often received credit), thereby making the total gender gap smaller. When looking at the structural differences explaining probability of link formation (table 4 above, right column), risk score is striking, with a coefficient of 0.082. This implies that in terms of link formation, male farmers have higher returns to their (on average significantly higher) willingness to take risks compared to female farmers. Other important factors in the structural gap are the returns to maize area planted and the returns to credit, pointing to an advantage for female farmers (-0.051 and -0.066, respectively). This is in line with the hypothesis that female farmers are more dependent on their resources to make new connections. Inverse returns to area planted could also play a role in this structural difference. Furthermore, male farmers seem to have higher returns to their social contacts, in terms of getting information from neighbours and the kinship ties in the village.

Table 4: Blinder-Oaxaca Decomposition results on link formation

Y = Link between farmer and CF (1=yes)	**Coef.**	**SE**	**P>|z|**		**N = 656**	
Panel A: Differential						
Prediction_male sample	0.174	0.024	0.000			
Prediction_female sample	0.123	0.018	0.000			
Difference	0.052	0.030	0.080			
Panel B						
	Endowment gap			*Structural gap*		
	Coef.	SE	Sig.	Coef.	SE	Sig.
Area planted with maize (ha)	0.013	0.008		-0.051	0.017	***
Past experience with improved varieties (1=yes)	0.017	0.009	**	0.008	0.006	
Risk score (ranging 1-32)	-0.004	0.003		0.082	0.030	***
Dependency ratio	0.002	0.005		0.114	0.082	
Housing index	-0.003	0.004		0.025	0.048	
Distance to main road (walking minutes)	0.000	0.003		-0.015	0.017	
Distance to agrodealer (km)	-0.001	0.002		-0.010	0.036	
No. of male agricultural workers in household	-0.001	0.007		0.027	0.040	
Household used hired labour (1=yes)	0.000	0.001		0.069	0.067	
Household received credit (1=yes)	-0.012	0.006	**	-0.066	0.035	*
Agricultural assets index	0.004	0.005		0.013	0.074	
Non-agricultural assets index	-0.001	0.009		0.002	0.038	
Agricultural info from farmer group at baseline (1=yes)	0.000	0.001		-0.007	0.008	
Agricultural info from friend at baseline (1=yes)	0.000	0.001		-0.004	0.005	
Agricultural info from neighbour at baseline (1=yes)	0.001	0.002		0.025	0.014	*
Agricultural info from government extension at baseline (1=yes)	-0.001	0.002		-0.003	0.005	
No. of contacts agricultural advice at baseline	0.006	0.007		-0.020	0.014	
No. of friends at baseline	0.006	0.005		-0.046	0.061	
No. of kin at baseline	0.000	0.007		0.089	0.045	**
CF gender (1=female)	0.002	0.003		-0.005	0.032	
Age CF > farmer (1=yes)	-0.001	0.002		0.057	0.032	*
Education CF < farmer (1=yes)	0.018	0.019		0.010	0.016	
CF & farmer both have few agricultural assets (1=yes)	-0.004	0.004		0.025	0.033	
CF & farmer both have few nonagricultural assets (1=yes)	0.008	0.007		-0.035	0.038	
Total	0.034	0.030		-0.011	0.041	

*Notes: *** p<0.01, ** p<0.05, * p<0.1. Results shown are from Blinder-Oaxaca decomposition after OLS estimation. Sample includes peer farmers only. Regressions include the following additional control variables: constant, sub-village indicator, respondent characteristics (education, gender, age), household characteristics (primary activity of the household head, group membership of at least one household member), additional dummy variables on social distance between CF and farmer (differences in maize area, agricultural assets and non-agricultural assets between CF and farmer).*

4.2.3 OLS regression on CSA knowledge growth

In the second part of the analysis, I take the difference in CSA knowledge scores (endline score minus baseline score) as the dependent variable and add link formation as an independent variable. The regression results are presented in table 5 below. OLS regression shows that for male and female farmers alike, link formation and past experience have strong positive effects on knowledge gain. Among female farmers, the effect of past experience is by far the most important, and the effect is three times as large as for men. In the female sample, I also find positive effects of agricultural assets and, to a lower extent, of distance to the agrodealer. The latter is a surprising finding, as intuitively, one would reason that a farmer living closer to an agroshop (and potentially other shops or services) is more likely to access information and gain knowledge on CSA. An explanation for the opposite effect could be that farmers living further away from such shops and services are more inclined to connect to and learn from other sources of information (such as fellow farmers), since they have fewer alternatives to increase yield. This may count even stronger for female farmers as their time and resources tend to be more constrained. Moreover, agrodealers in Nwoya district are very few and dispersed, and they focus on providing products, but not information.

Table 5: OLS Regression results on CSA knowledge growth

Dependent variable: Difference in CSA knowledge score baseline - endline	**Male respondents N = 281 Adj R^2 = 0.1569**			**Female respondents N = 375 Adj R^2 = 0.2171**		
	Coef.	**SE**	**Sig.**	**Coef.**	**SE**	**Sig.**
Link between farmer and CF (1=yes)	2.030	0.562	***	2.312	0.498	***
Area planted with maize (ha)	0.406	0.214	*	0.185	0.278	
Past experience with improved varieties (1=yes)	1.317	0.564	**	3.977	0.666	***
Risk score (ranging 1-32)	0.017	0.017		-0.006	0.015	
Dependency ratio	0.911	0.954		-0.139	0.820	
Housing index	-0.315	0.443		0.002	0.395	
Distance to main road (walking minutes)	0.000	0.010		-0.001	0.009	
Distance to agrodealer (km)	0.002	0.038		0.081	0.025	***
No. of male agricultural workers in household	0.309	0.321		-0.332	0.197	*
Household used hired labour (1=yes)	-0.056	0.559		-0.230	0.440	
Household received credit (1=yes)	0.529	0.410		0.230	0.345	
Agricultural assets index	0.280	0.444		0.653	0.336	*
Non-agricultural assets index	0.742	0.355	**	0.191	0.314	
Agricultural info from farmer group at baseline (1=yes)	-1.278	0.947		-0.914	0.638	
Agricultural info from friend at baseline (1=yes)	0.448	0.952		0.384	0.819	
Agricultural info from neighbour at baseline (1=yes)	-0.770	0.554		-0.677	0.412	
Agricultural info from government extension at baseline (1=yes)	-0.830	1.287		-1.958	1.011	*
No. of contacts agricultural advice at baseline	-0.060	0.147		-0.257	0.148	*
No. of friends at baseline	-0.075	0.228		-0.047	0.162	
No. of kin at baseline	0.146	0.208		-0.308	0.149	**
CF gender (1=female)	-0.409	0.447		-0.054	0.336	
Age CF > farmer (1=yes)	0.514	0.465		-0.322	0.401	
Education CF < farmer (1=yes)	0.004	0.092		-0.053	0.108	
CF & farmer both have few agricultural assets (1=yes)	0.485	0.608		0.391	0.455	
CF & farmer both have few nonagricultural assets (1=yes)	0.167	0.573		-0.703	0.532	

*Notes: *** p<0.01, ** p<0.05, * p<0.1. Results shown are from OLS estimation. Sample includes peer farmers only. Regressions include the following additional control variables: constant, sub-village indicator, respondent characteristics (education, gender, age), household characteristics (primary activity of the household head, group membership of at least one household member), additional dummy variables on social distance between CF and farmer (differences in maize area, agricultural assets and non-agricultural assets between CF and farmer).*

Interestingly, among women, government extension had a positive effect on link formation but now has a substantial negative effect (-1.958) on knowledge change. I also find substantial negative effects of the number of male agricultural workers, contacts for agricultural advice and kinship ties. These negative effects on knowledge gain are hard to explain intuitively. Possibly, women who had more access to agricultural information, social ties and/or household labour at baseline also had higher knowledge scores at baseline. Therefore they had lower knowledge *growth* compared to other women.

These results imply that for gaining knowledge on CSA, having a link with a CF and past experience with improved varieties are very important, especially for women. At the same time, relying on other sources of information, like other farmers or government extension, reduces knowledge gain. This could be explained by conflicting information from different sources (e.g. government extension vs CF), or by farmers who rely on an external source of agricultural information being less likely to seek, trust and memorize information from a new connection such as a CF. However, a more obvious explanation might be that farmers who already used various sources of agricultural information had a higher knowledge score at baseline, and therefore had lower knowledge growth than relatively uninformed farmers.

Lastly, the positive effects of land and credit resources for female farmers that play a role in link formation, do not significantly contribute to knowledge change. In the male sample, however, I find physical resources positively affect knowledge growth. Men with a larger area of maize and more non-agricultural assets also experience higher knowledge growth.

4.2.4 Blinder-Oaxaca decomposition on CSA knowledge growth

The decomposition analysis on knowledge gain is presented in table 6 below and shows a significant difference of 0.537 points on knowledge gain to the advantage of male respondents (Panel A). This difference is almost entirely accounted for by endowment differences. Most importantly, male farmers are more likely to have past experience with improved varieties than female farmers. This endowment gap explains about 75% of the total gender gap in knowledge gain. However, female farmers seem have higher *returns* to their past experience, given the significant negative coefficient of -0.163 in the structural gap. Other structural differences are mostly in the advantage of male farmers. Men have significantly higher returns to male agricultural workers in their household (0.600), which may indicate gender inequality regarding control over household labour. In terms of knowledge gain, women report more kinship ties in the village than men (negative endowment coefficient), but they benefit *less* from these ties than do men (positive structural coefficient). The interpretation of the effect of kinship ties on knowledge *gain* is ambiguous, as explained above.

Lastly, men also have endowment advantages in terms of having a link with the CF and their agricultural assets, which contribute to their knowledge gain.

Hence, compared to the decomposition for link formation, more endowment differences and fewer structural differences are at play when it comes to knowledge gain. Differences in (returns to) land, credit and information sources seem to be relevant when it comes to contacting people for agricultural advice, but conditional on having a link with the CF, these factors do not contribute to the gender gap in CSA knowledge gain.

Table 6: Blinder-Oaxaca Decomposition results on CSA knowledge growth

Y = difference in CSA knowledge score baseline - endline	Coef.	SE	P>|z|	N = 656		
Panel A: Differential						
Prediction_male sample	1.153	0.202	0.000			
Prediction_female sample	0.616	0.172	0.000			
Difference	0.537	0.266	0.043			
Panel B						
	Endowment gap			*Structural gap*		
	Coef.	SE	Sig.	Coef.	SE	Sig.
Link between farmer and CF (1=yes)	0.120	0.070	*	-0.035	0.092	
Area planted with maize (ha)	0.020	0.033		0.095	0.152	
Past experience with improved varieties (1=yes)	0.407	0.122	***	-0.163	0.063	***
Risk score (ranging 1-32)	-0.010	0.025		0.271	0.269	
Dependency ratio	0.008	0.049		0.617	0.739	
Housing index	0.000	0.035		0.231	0.432	
Distance to main road (walking minutes)	-0.003	0.024		0.010	0.153	
Distance to agrodealer (km)	-0.048	0.038		-0.551	0.318	*
No. of male agricultural workers in household	-0.116	0.071		0.600	0.354	*
Household used hired labour (1=yes)	-0.003	0.008		0.146	0.599	
Household received credit (1=yes)	-0.027	0.042		0.174	0.312	
Agricultural assets index	0.093	0.054	*	-0.442	0.660	
Non-agricultural assets index	0.052	0.087		0.396	0.340	
Agricultural info from farmer group at baseline (1=yes)	0.017	0.020		-0.022	0.070	
Agricultural info from friend at baseline (1=yes)	0.002	0.007		0.002	0.047	
Agricultural info from neighbour at baseline (1=yes)	0.027	0.025		-0.017	0.123	
Agricultural info from government extension at baseline (1=yes)	0.005	0.023		0.027	0.040	
No. of contacts agricultural advice at baseline	-0.114	0.070		0.122	0.130	
No. of friends at baseline	-0.011	0.039		-0.054	0.544	
No. of kin at baseline	-0.131	0.068	*	0.714	0.403	*
CF gender (1=female)	-0.001	0.008		-0.181	0.285	
Age CF > farmer (1=yes)	-0.010	0.017		0.386	0.284	
Education CF < farmer (1=yes)	-0.085	0.176		0.056	0.143	
CF & farmer both have few agricultural assets (1=yes)	-0.026	0.033		0.036	0.296	
CF & farmer both have few nonagricultural assets (1=yes)	0.078	0.065		0.378	0.341	
Total	0.428	0.294		0.016	0.362	

*Notes: *** p<0.01, ** p<0.05, * p<0.1. Results shown are from Blinder-Oaxaca decomposition after OLS estimation. Sample includes peer farmers only. Regressions include the following additional control variables: constant, sub-village indicator, respondent characteristics (education, gender, age), household characteristics (primary activity of the household head, group membership of at least one household member), additional dummy variables on social distance between CF and farmer (differences in maize area, agricultural assets and non-agricultural assets between CF and farmer).*

4.2.5 OLS regression on improved maize adoption

In the third step of the analysis, adoption of an improved maize variety is introduced as the dependent variable of the OLS regression, while the endline knowledge score (not knowledge gain) is added as an explanatory variable. Results are presented in table 7 below. It is clear that again, past experience and link formation are by far the most important factors to increase the likeliness of adoption, among male and female farmers. The effect of link formation is stronger for men while experience is stronger for women. Maize area increases likeliness of adoption, but only among men. By itself, the positive effect of maize area on adoption of improved varieties is expected: maize area is measured after the farmer has decided whether or not to plant improved maize, so maize area is likely to be larger for farmers who have planted these types of maize. Moreover, farmers with a larger maize area might bare a smaller risk in trying new varieties than do farmers with less resources.

Table 7: OLS Regression results on adoption

	Male respondents N = 281 Adj R^2 = 0.3825			Female respondents N = 375 Adj R^2 = 0.3789		
Dependent variable: Adoption of improved maize variety (yes=1)	**Coef.**	**SE**	**Sig.**	**Coef.**	**SE**	**Sig.**
CSA Knowledge score	0.044	0.009	***	0.032	0.006	***
Link between farmer and CF (1=yes)	0.206	0.069	***	0.130	0.046	***
Area planted with maize (ha)	0.067	0.025	***	0.006	0.024	
Past experience with improved varieties (1=yes)	0.251	0.069	***	0.470	0.063	***
Risk score (ranging 1-32)	0.003	0.002		0.001	0.001	
Dependency ratio	-0.095	0.112		0.059	0.072	
Housing index	-0.002	0.052		0.006	0.034	
Distance to main road (walking minutes)	0.000	0.001		-0.001	0.001	
Distance to agrodealer (km)	0.002	0.004		-0.004	0.002	
No. of male agricultural workers in household	0.030	0.038		0.027	0.017	
Household used hired labour (1=yes)	0.052	0.066		-0.021	0.038	
Household received credit (1=yes)	0.024	0.049		-0.048	0.030	
Agricultural assets index	-0.013	0.052		0.020	0.029	
Non-agricultural assets index	0.037	0.042		-0.045	0.027	
Agricultural info from farmer group at baseline (1=yes)	-0.090	0.111		0.177	0.056	***
Agricultural info from friend at baseline (1=yes)	0.115	0.112		0.006	0.072	
Agricultural info from neighbour at baseline (1=yes)	0.033	0.065		-0.008	0.036	
Agricultural info from government extension at baseline (1=yes)	0.010	0.151		-0.180	0.088	**
No. of contacts agricultural advice at baseline	0.026	0.017		0.011	0.013	
No. of friends at baseline	-0.027	0.027		0.007	0.014	
No. of kin at baseline	-0.014	0.025		0.009	0.013	
CF gender (1=female)	-0.010	0.053		-0.027	0.029	
Age CF > farmer (1=yes)	0.066	0.055		0.053	0.035	
Education CF < farmer (1=yes)	0.004	0.011		-0.017	0.009	*
CF & farmer both have few agricultural assets (1=yes)	0.012	0.071		-0.026	0.040	
CF & farmer both have few nonagricultural assets (1=yes)	0.041	0.067		-0.022	0.046	

*Notes: *** p<0.01, ** p<0.05, * p<0.1. Results shown are from OLS estimation. Sample includes peer farmers only. Regressions include the following additional control variables: constant, sub-village indicator, respondent characteristics (education, gender, age), household characteristics (primary activity of the household head, group membership of at least one household member), additional dummy variables on social distance between CF and farmer (differences in maize area, agricultural assets and non-agricultural assets between CF and farmer).*

In both samples I find smaller but significant positive effects of endline knowledge score. The regression results also show that for female farmers, getting agricultural information from farmer groups has a substantial positive effect on adoption: female farmers are 17.7% more likely to adopt an improved variety if they use this source of information. On the contrary, I find evidence for a substantial *negative* effect of government extension as a source of information on the likeliness of adoption among women. This could confirm the hypothesis of conflicting information from different sources and/or of farmers relying on government extension being less open to other sources of information. Alternatively, this could be explained by the very low rate of effective government extension in Nwoya district. Farmers who rely on these services might therefore have a disadvantage in information access.

Comparing to the previous analyses on link formation and knowledge gain, kinship ties, access to credit and (agricultural) comparability between CF and peer farmers become less important when it comes to adoption, both for men and women. One explanation for the lower number significant contributors could be that these factors are already partly accounted for in the analysis by including link and knowledge as explanatory variables.

4.2.6 Blinder-Oaxaca decomposition on improved maize adoption

The decomposition analysis on adoption as presented in table 8 below, shows a significant probability difference of 0.155, again in the advantage of male farmers. This gap is accounted for partly by male endowment advantages in knowledge score and past experience, together explaining 65% of the total gender gap regarding adoption. On the other hand, female farmers seem to have a small advantage in terms of returns to past experience (structural coefficient of -0.013). They also benefit more from farmer groups as an information source than male farmers. These structural advantages are almost entirely offset by a structural disadvantage regarding returns to maize area.

Overall, the total endowment difference (0.128) explains a far larger share of the gender difference in adoption than does the structural gap (0.027). This is similar to the decomposition results for link formation and knowledge gain.

It is plausible that decisions regarding adoption of maize varieties are not taken by the respondents alone, but are taken by the household head or by household members together. Therefore, I also carried out an OLS regression and Blinder-Oaxaca decomposition exercise on improved maize adoption by gender of the household head (see results in Appendix 1). The results were similar to the ones based on respondent's gender, albeit with some differences. Most notably, the positive effects of link formation and farmer groups disappear in the female sample. For female household heads, past experience and knowledge level are the most important enablers of adoption.

Table 8: Blinder-Oaxaca Decomposition results on adoption

Dependent variable: Adoption of improved maize variety (yes=1)	Coef.	SE	P>|z|	N = 656		
Panel A: Differential						
Prediction_male sample	0.267	0.027	0.000			
Prediction_female sample	0.112	0.017	0.000			
Difference	0.155	0.032	0.000			
Panel B						
	Endowment gap			*Structural gap*		
	Coef.	SE	Sig.	Coef.	SE	Sig.
CSA Knowledge score	0.053	0.012	***	0.052	0.045	
Link between farmer and CF (1=yes)	0.007	0.004		0.009	0.010	
Area planted with maize (ha)	0.001	0.003		0.026	0.015	*
Past experience with improved varieties (1=yes)	0.048	0.014	***	-0.013	0.006	**
Risk score (ranging 1-32)	0.002	0.002		0.018	0.028	
Dependency ratio	-0.004	0.004		-0.091	0.078	
Housing index	0.001	0.003		0.006	0.046	
Distance to main road (walking minutes)	-0.002	0.002		0.009	0.016	
Distance to agrodealer (km)	0.002	0.002		0.038	0.035	
No. of male agricultural workers in household	0.010	0.006		0.003	0.039	
Household used hired labour (1=yes)	0.000	0.001		0.062	0.064	
Household received credit (1=yes)	0.006	0.004		0.042	0.033	
Agricultural assets index	0.003	0.004		-0.039	0.071	
Non-agricultural assets index	-0.012	0.008		0.058	0.036	
Agricultural info from farmer group at baseline (1=yes)	-0.003	0.003		-0.016	0.008	**
Agricultural info from friend at baseline (1=yes)	0.000	0.000		0.004	0.005	
Agricultural info from neighbour at baseline (1=yes)	0.000	0.001		0.007	0.013	
Agricultural info from government extension at baseline (1=yes)	0.000	0.002		0.005	0.004	
No. of contacts agricultural advice at baseline	0.005	0.006		0.009	0.013	
No. of friends at baseline	0.002	0.003		-0.065	0.059	
No. of kin at baseline	0.004	0.006		-0.036	0.044	
CF gender (1=female)	-0.001	0.001		0.009	0.031	
Age CF > farmer (1=yes)	0.002	0.002		0.006	0.030	
Education CF < farmer (1=yes)	-0.027	0.016	*	0.021	0.015	
CF & farmer both have few agricultural assets (1=yes)	0.002	0.003		0.015	0.032	
CF & farmer both have few nonagricultural assets (1=yes)	0.002	0.005		0.027	0.036	
Total	0.128	0.029	***	0.027	0.041	

*Notes: *** p<0.01, ** p<0.05, * p<0.1. Results shown are from Blinder-Oaxaca decomposition after OLS estimation. Sample includes peer farmers only. Regressions include the following additional control variables: constant, sub-village indicator, respondent characteristics (education, gender, age), household characteristics (primary activity of the household head, group membership of at least one household member), additional dummy variables on social distance between CF and farmer (differences in maize area, agricultural assets and non-agricultural assets between CF and farmer).*

Chapter 5: Motivations for (not) adopting CSA

5.1: Data and survey questions

For the analysis on farmers' motivations for technology adoptions, two types of questions were included in the survey. For each CSA practice separately, respondents were first asked an open question: what was your main motivation when deciding whether or not to use [practice]? The enumerators were specifically instructed not to guide the answer in any direction and to report the response without changing the phrasing. The answers to these open questions enable a more qualitative analysis of farmer motivations and allow for respondents to mention unexpected and specific motivations.

Later on in the survey, the respondents were also asked a series of closed questions about factors considered in their adoption decisions on each practice. They were asked to what extent they agreed that they consider [factor x] when deciding whether or not to use [practice]. Farmers were asked about nine pre-determined factors, namely: (1) expected effect on yield, (2) expected effect on product selling price, (3) expected effect on input costs (e.g. seeds, equipment, pesticides, fertilizers...) (4) availability of land, (5) availability of labour, (6) level of knowledge on this practice, (7) opinions of other household members, (8) opinion of peers like friends and neighbours and (9) risk involved. For each of the factors, respondents could indicate to what extent they agreed, using scores ranging from 1 (strongly disagree) to 5 (strongly agree).

Due to an error in the design of the survey tool, no open questions were asked about the adoption of improved varieties, while no closed questions were asked about the adoption of conservation farming basins.

Hypotheses on farmer motivations

Based on the literature review and the baseline data on barriers to adoption (as described in chapters 2 and 3), I expected farmers' decisions on technology adoption to be motivated mostly by yield, labour requirements, land availability, input costs and knowledge requirements. In terms of gender differences in motivations, I expected female farmers to report labour and land as important motivations more often than male farmers. Furthermore, considering the generally lower social status of women I expected women to consider the opinion of their spouse and other household members more strongly than men. Lastly, since female farmers on average had a lower level of knowledge on CSA (see section x on research question 1), my hypothesis was that female farmers would indicate (lack of) knowledge as an important reason for not adopting a practice more often than male farmers.

5.2 Analysis of main motivations reported in open questions

At the start of the analysis of the open questions, the responses were scanned and grouped into the most common categories as much as possible. The final categories are explained in table 9 below.

This categorization exercise resulted in categories that partly overlap the nine predetermined factors used in the closed questions, but the open questions lead to more and more specific categories. Arguably, categories like 'soil' and 'crop health' ultimately contribute to crop yield, but it is striking how often they were mentioned as a specific motivation. Therefore, they were included separately.

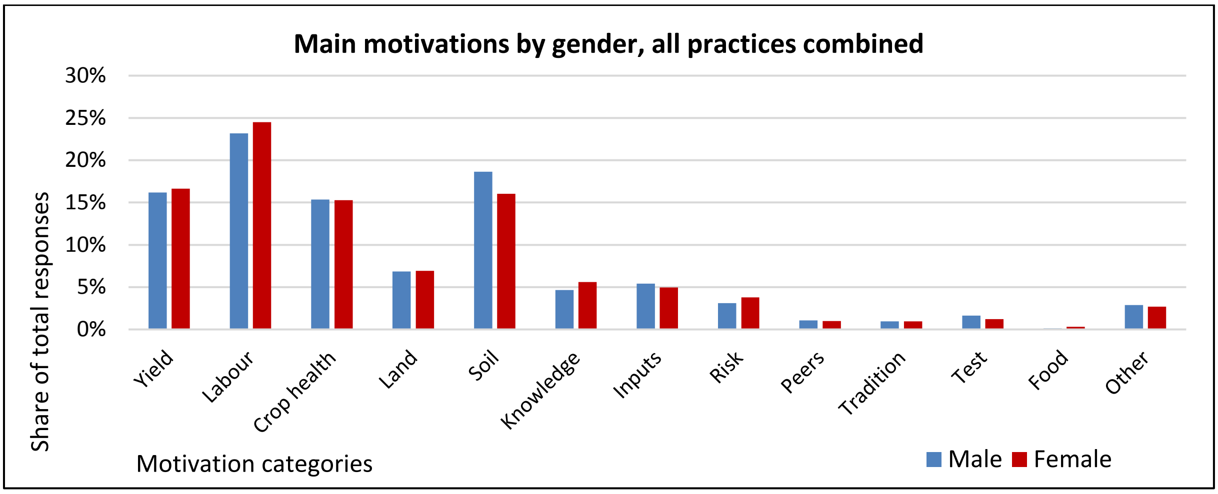
The categorization exercise is rather rough and does not respond to all nuance and details in phrasing, but results in a relevant general classification of motivations. [1]

Table 9: Categorization of responses to open questions on motivations

Category	Example key words	Examples of responses
Yield	Yield, harvest, more crops	"high yields", "harvest more than one crop from the same field"
Labour	Labour, time, ease, weeding	"time consuming", "requires more labour", "easy to weed"
Knowledge	Know, skill, understand, hear	"I don't know much about this", "I heard about it", "it requires more skills", "limited knowledge"
Soil	Soil, fertile, moist, humus	"it improves soil fertility", "to add humus", "to keep the soil moist"
Inputs	Seed, herbicide, plough, available, cost, sprays	"seeds were not available", "lack of herbicides", "seed and spray costs", "it's expensive to use", "it brings out quality seeds"
Land	Land, garden, utilisation of plots	"limited land", "it requires a bigger garden", "bad quality land", "we have enough land"
Crop health	Weeds, pest, disease, drought, health, stunt, sun light	"it controls the weeds", "to reduce pests and diseases", "crops grow healthier", "afraid of stunting", "crops get enough sun light", "crops mature quickly", "drought resistance"
Risk	Risk, rely, failure, depend, sure	"I fear taking risks", "in case of failure there is another crop", "to not depend on one crop"
Peers	Neighbours, other people, farmers, friend, spouse	"the neighbours don't use this", "other farmers also use it", "my friend was using it"
Tradition	Tradition, parents, common practice, elders, culture	"it's just how it's done here", "we saw it from our fore fathers", "I'm not used to this way", "it's not common practice here"
Test	Try, trial, test, experiment	"I just wanted to try it," "I made a trial to see if it works", "I wanted to see how this method can benefit"
Food	Food, consumption	"to have a variety of foods", "more crops for consumption"
Other	All uncategorized responses	"I have no idea", "It looks nice", "I just don't like it"

Graph 1 below shows how often each type of motivation was mentioned overall, without disaggregating by practice. It shows that overall labour is the motivation mentioned most often, followed by motivations concerning soil, yield and crop health. The trend is very similar for male and female farmers, with only small differences, in labour and soil mostly.

[1] A limitation of this method is that there is a lot of room for noise in between respondent and researcher to complicate categorization and interpretation. Firstly, the enumerator must explain the question clear enough, then translate and report the respondent's answer correctly without shortening or changing the meaning. Quite some responses were phrased ambiguously, however, thereby requiring interpretation by the researcher in order to categorize and analyse the data. For example, a response like "this method is very hard", was now categorized as a labour-related motivation (hard work), but could also be interpreted as a knowledge-related motivation (hard to understand). Furthermore, the categorization method was not very specific and some responses contained several motivations, causing some responses to be counted in different categories.



Graph 1: Main motivations in adoption decision by gender, all practices combined

Table 10 shows the motivation mentioned most often for each practice and for male and female adopters and non-adopters of that specific practice, separately. Note that if a motivation is mentioned most often in absolute terms, this does not necessarily mean that it is *significantly* more important than the other motivations. The table confirms that there seem to be few differences between male and female farmers, while logically more so between adopters and non-adopters.

Table 10: Main motivations in adoption decision, mentioned in open questions

	Non-Adopters		Adopters	
Practice	**Male**	**Female**	**Male**	**Female**
Conservation farming basins	Labour	Labour	Test	Yield/Knowledge/Test
Minimum Tillage	Labour	Knowledge	Labour	Labour
Crop Rotation	Soil	Soil	Yield	Yield
Crop Residue Retention	Labour	Labour	Soil	Soil
Intercropping	Yield	Yield	Yield	Yield
Correct Spacing	Labour	Labour	Labour	Labour
Row Planting	Labour	Labour	Labour	Labour

Reading note: the table presents the motivation category that was mentioned most frequently by the respondent group in case (male/female, adopters/non-adopters), for each CSA practice separately.

5.2.1 Open questions - Non-adopters

The interpretation of motivational data from non-adopters turned out to be problematic for some of the practices. Many respondents reported motivations *in favour* of the practice they were asked about, as a reason for *not* adopting the practice.[2] This might indicate that the questions were not well

[2] For example for intercropping, non-adopters most often report yield-related motivations. This suggests that farmers expect lower yields (per crop) if they use intercropping. When looking at the phrasing of the answers to the open question in this category, this seems to be indeed the case (e.g. "reduced yield of the second crop"). However, it also shows that in this sub-sample (i.e. farmers who are familiar with intercropping but report NOT to use it), many farmers mentioned motivations that seem to be in favour of intercropping (e.g. "much yield", "more harvest from one plot"). This might indicate that this question was not understood well by the respondents, or that they did not report intercropping when actually they do use intercropping.

understood or that the respondents did not report adopting a practice when they were actually using it. It does not appear for all practices, and of course it is possible that certain benefits of a practice were indeed perceived as a disadvantage by some farmers. Given the high frequency of this type of responses, however, this does not seem likely.

In general, I find that among non-adopters, labour restrictions seem to be the decisive argument for most of the practices. Indeed, applying conservation farming basins, correct spacing and row planting are relatively labour-intensive at the time of planting, e.g. compared to broadcasting seeds. The only gender difference among non-adopters appearing from this analysis, is that regarding minimum tillage, male farmers consider labour requirements as their main motivation to not adopt, while female farmers consider knowledge requirements the most important. Labour requirements as a motivation to not adopt minimum tillage may seem counterintuitive at first sight, since minimum tillage should in fact require less soil preparation. However, a common practice in the research area is to burn the field in order to clear and prepare land, which is also not labour-intensive. Moreover, it could be that farmers experience or expect a higher workload from weeding throughout the season, or that these survey questions were misunderstood, as discussed above.

5.2.2 Open questions - Adopters

Comparing non-adopters to adopters, it seems that adopters are generally motivated by similar factors as non-adopters. Conservation farming basins are an exception, in the sense that the majority of the adopters (which were only 37 farmers in total) decided to use the technology because they wanted to test or experiment with it.

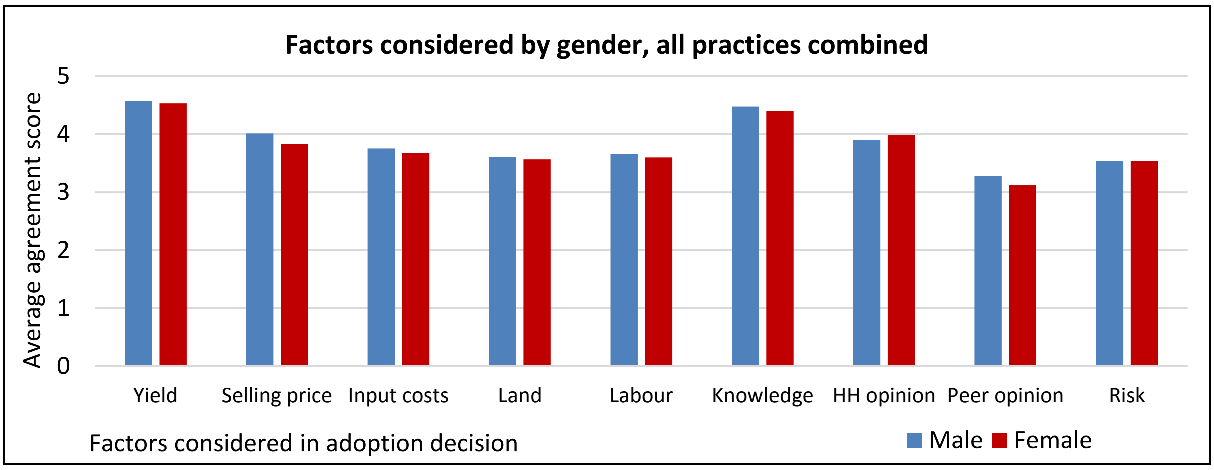
As for non-adopters, labour requirements play an important role in the decisions of adopters regarding minimum tillage, correct spacing and row planting. This similarity can be explained since minimum tillage generally is labour-saving in soil preparation, but might require more labour in planting and weeding. At the same time, correct spacing and row planting may be relatively labour-intensive in soil preparation and planting, but can save time in weeding at later stages. Indeed, "easier weeding" is a motivation that is often mentioned among farmers who use correct spacing and row planting. Hence, it seems that for these technologies, both adopters and non-adopters are motivated by the estimated labour requirements, but they may base their estimations on a different phase in the season.

Most adopters of crop rotation indicate that they are mainly motivated by an increase in yields resulting from this practice, while farmers using crop residue retention are more often motivated by enhanced soil quality. Lastly, farmers who use intercropping seem to be mainly motivated by higher yields from the same plot.

5.3 Analysis of decision factors rated through closed questions

A similar analysis was conducted based on the answers to the closed questions. Graph 2 below shows the average agreement scores for male and female farmers for each of the factors, combining all the practices. It shows that all factors score between 3 and 4,5 on average. This implies that generally, all of the factors are considered to some extent. Yet, the expected effect on yields and the level of knowledge of a practice are clearly the most considered, followed opinions of household members.

Another interesting conclusion drawn from this analysis is that there seem to be no big differences between men and women when it comes to these factors.



Graph 2: Factors considered in adoption decision by gender, all practices combined

Table 11 below again shows the factors with the highest agreement score per practice, separately for male and female farmers and adopers and non-adopters. Again, note here that factors with the highest agreement score in their sub-group do not necessarily have a *significantly* higher score than other factors. The rating of different factors is often very close together. These results confirm the complexity of adoption decisions, in which many different factors play a role. This is also illustrated by the rating score graphs per practice in Appendix 2. The graphs show some differences between men and women, adopters and non-adopters and between practices, but more clearly confirm the similarity of the patterns. Comparing the graphs also shows that for most practices, the product selling price is the least considered factor, together with peers' opinions and risk. For more details on the exact scores for each factor and practice, see table X in Appendix 3.

Strikingly, table 11 below shows that knowledge and yield are the motivations with the highest rating *for each practice*, again with few differences between men and women.

Table 11: Factor most considered in adoption decision, measured through agreement scores

	Non-Adopters		Adopters	
Practice	**Male**	**Female**	**Male**	**Female**
Improved varieties	Knowledge	Yield	Yield	Yield
Minimum Tillage	Knowledge	Knowledge	Knowledge/Yield	Knowledge
Crop Rotation	Yield	Yield	Yield	Yield
Crop Residue Retention	Yield	Knowledge	Yield	Yield
Intercropping	Yield	Yield	Knowledge	Knowledge
Correct Spacing	Knowledge	Knowledge	Yield	Yield
Row Planting	Yield	Yield	Yield	Yield

Reading note: the table presents the motivation category that was mentioned most frequently by the respondent group in case (male/female, adopters/non-adopters), for each CSA practice separately.

5.3.1 Closed questions - Non-adopters

Among non-adopters of minimum tillage and correct spacing, most men and women strongly considered their (lack of) knowledge in their decision. In the case of correct spacing, this probably has to do with not knowing the advised spacing for different crops, while for minimum tillage it could indicate that many farmers are not informed about this practice in general, or about how to manage weeds and pests without tillage. Among non-adopters of crop rotation, intercropping and row planting, most men and women strongly considered the effect on yields of these practices when deciding not to use it. This is suprising, since it would imply that farmers expect these practices to have a *negative* effect on their yields, or no effect at all. Another explanation for this finding is that these survey questions were not well understood by the respondents, or that they indeed strongly considered yield but that in practice other factors were decisive.

T-test analysis on the different motivations per practice (i.e. not just the single most important one) allows for more nuance, but still shows that there are only few significant differences between male and female farmers. Detailed analysis results are included in Appendix 3. Regarding improved varieties and crop rotation, male farmers consider peer opinions more strongly than do females. They also consider knowledge more strongly for minimum tillage and crop rotation, while for crop residue retention women consider knowledge more strongly. For crop rotation and row planting, male farmers consider opinions of household members more strongly than do female farmers, and for minimum tillage they consider input costs more. Lastly, for correct spacing women seem to take land availability more into account then men. Although most differences in rating are rather small and not consistent throughout the practices, these findings are surprising because overall, they do not confirm the hypotheses on gender differences in motivations. I expected knowledge, land, labour and opinions to be more important for women than for men, but if anything these findings seem to confirm the opposite: knowledge and opinions are more important to men.

5.3.2 Closed questions – Adopters

Looking at the adopters, it seems that for most farmers and for most practices, yields is the factor most strongly cosidered when deciding to use it. Interestingly, knowledge also seems to play an important role here, particularly for minimum tillage and intercropping. This implies that (lack of) knowledge can not only be a decisive inhibiting factor in technology adoption (i.e. “I do not know enough about this practice, so I will not use it”), but may also be a decisive promoting factor (i.e. “I have learned about this practice, so I will use it”).

T-test analysis per motivation and practice again shows few significant gender differences. The exceptions are that female farmers consider opinions of household members more strongly then do men when it comes to adopting improved varieties and correct spacing. This is in line with my hypothesis. Regarding crop rotation, intercropping and row planting, the male farmers consider knowledge more strongly than the female farmers. Lastly, male farmers also consider input costs more strongly regarding intercropping, and for correct spacing men consider the product selling price more strongly than do women.

5.4 Conclusions

The hypotheses on gender differences are not confirmed by this analysis: overall there are only very small differences between men and women when it comes to their motivations for (not) using a technology. Land does not seem to be a decisive factor for women nor men. Even in a more detailed analysis of the factors at play (i.e. not only comparing the *most* important motivations), only few significant differences between men and women emerge, but not consistenly throughout the practices and if anything, these differences suggest that knowledge and other people's opinions play a more prominent role in men's decisions compared to women's. This is the opposite of what I expected to find.

Although I did not find the gender differences that I expected, the main factors in CSA adoption decisions are not suprising. Female and male farmers report that they strongly consider yield, knowledge and labour. It is interesting that labour is frequently mentioned as the main motivation for (not) adopting a practice in the open questions, but it is not one of the highest rated factors in the closed questions. Moreover, the importance of labour did not strongly come to the fore in the regression and decomposition analysis, so this is an interesting nuance from qualitative analysis.

Chapter 6: Discussion & Conclusion

6.1 Gender gap analysis

When looking for connections within and implications of the results, it is useful to have an overview of the different steps and factors that came into play in the analysis. Figures 1 and 2 below are a visual overview of the complex web of contributing and inhibiting factors, based on the outcomes of the OLS regression results of research question 1 as presented in chapter 4. Figure 1 concerns the factors that influence link formation, CSA knowledge gain and improved maize adoption in the male sample, while figure 2 corresponds to the female sample. The green arrows indicate positive effects, the red arrows indicate negative effects. The thicker the lines, the larger the relative effect on the dependent variables. The arrow between CSA knowledge *gain* and CSA knowledge *score* is dashed since the effect of knowledge gain on adoption was not measured directly, but the effect of knowledge score was.

The figures indicate that for both men and women, past experience with improved varieties is the most important factor throughout the three steps in the learning and adoption process. Experienced farmers are more likely to connect to the CF in their village, gain more CSA knowledge and are more likely to adopt improved maize later on. These effects also reinforce each other, as link formation positively affects knowledge (gain), which again positively affects the likelihood of adoption. For men, other important contributing factors in this process are (non-)agricultural comparability to the CF and neighbours as a source of agricultural information.

For women, the picture becomes more complex with more different factors coming into play, but past experience and link formation are still important enablers throughout the process. Female farmers are more likely to connect to the CF they have more resources (maize area, credit) and if the CF is also a woman. This could be an indication of the importance of social distance in information sharing. Kinship ties, contacts for agricultural advice and male household labour all reduce knowledge gain among women. An explanation for this could be that women who use these social resources also had higher knowledge scores at baseline and therefore less knowledge *gain*. Government extension plays an ambiguous role throughout the learning and adoption process for female farmers; boosting link formation, but reducing knowledge gain and adoption probability. Since agricultural extension is rare in Nwoya district, it is possible that farmers who only rely on this source of agricultural information have a relative information disadvantage. Lastly, female farmers who share agricultural information through farmer groups are substantially more likely to adopt improved maize varieties.

Figure 1: Factors of influence in linking, learning and adoption – male sample

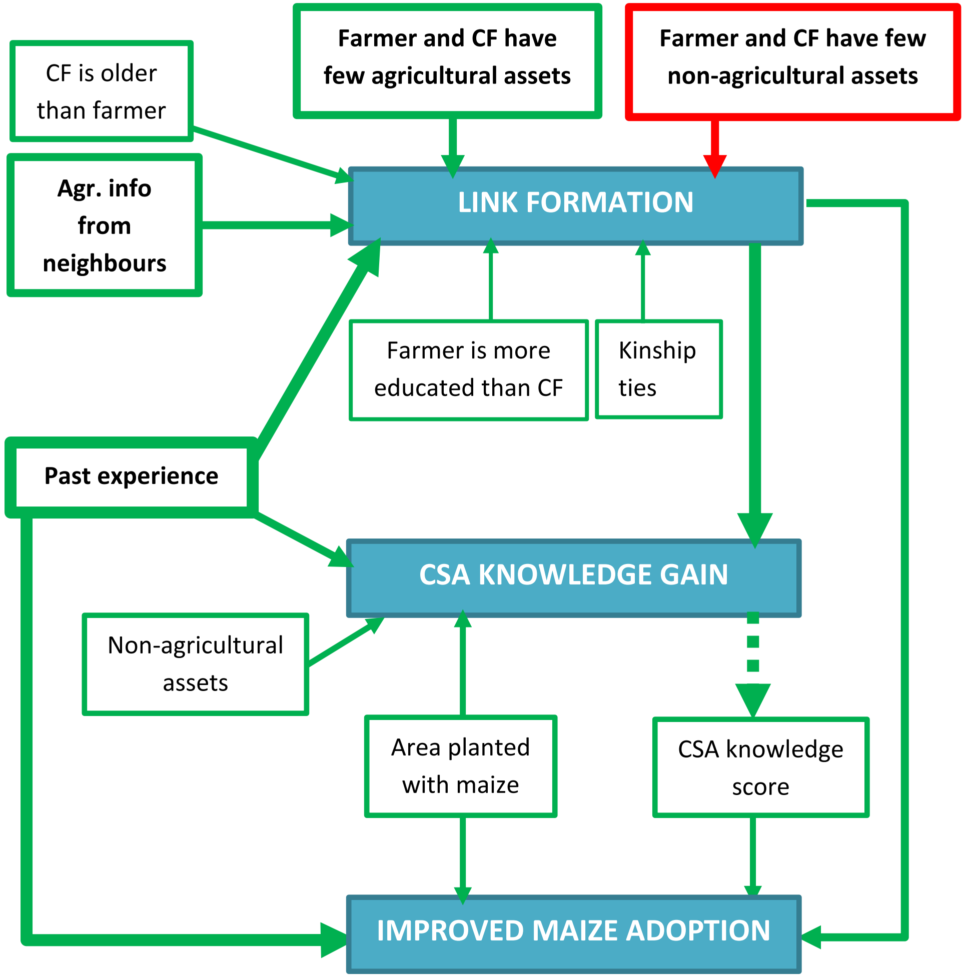
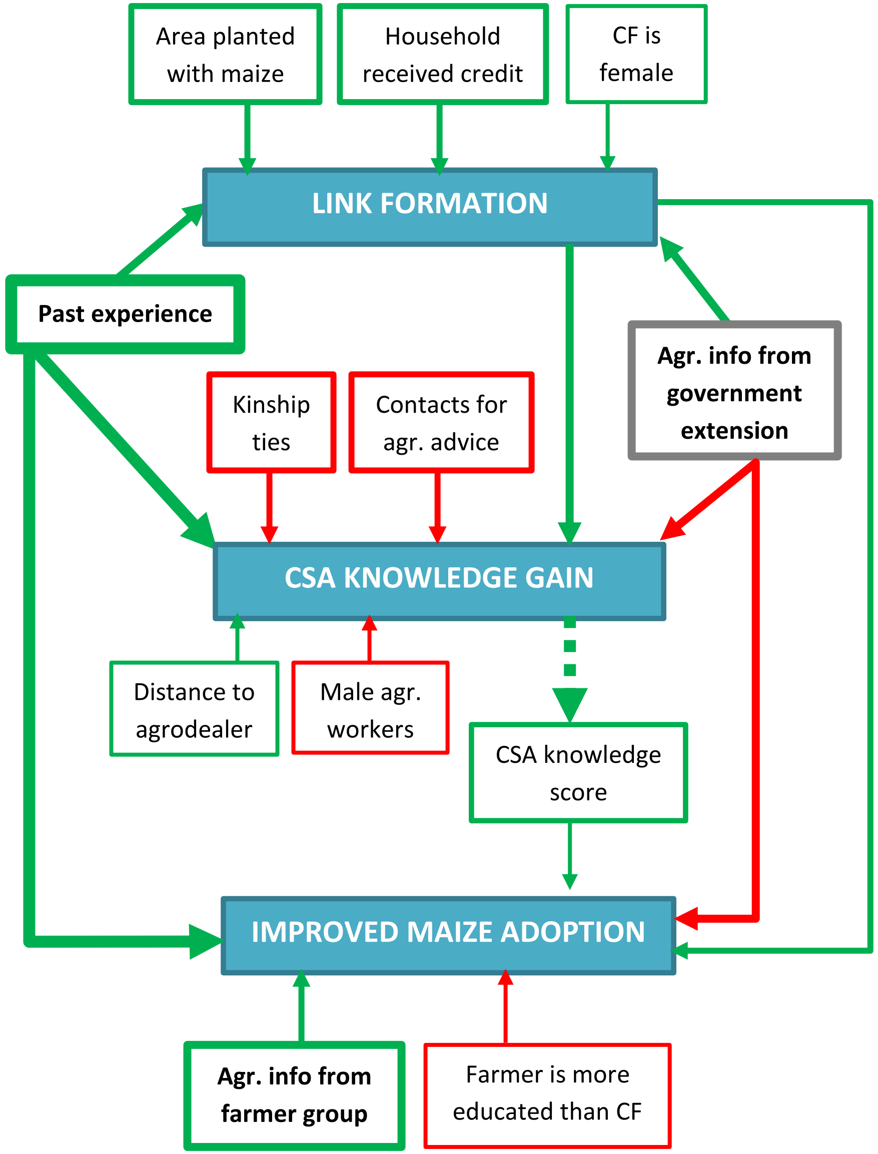


Figure 2: Factors of influence in linking, learning and adoption – female farmers



The decomposition analyses confirm the hypothesis that indeed male farmers are more likely to form a link with the CF, gain more CSA knowledge and are more likely to adopt improved varieties. These gender differences are reinforcing and mostly attributable to endowment differences, as opposed to structural differences. The finding that women are less likely to connect to the CF and also have lower returns kinship ties and information from neighbours, confirms the hypothesis that female farmers have smaller social networks and/or benefit less from informal information sharing. However, they are more likely to share and benefit from information through farmer groups regarding adoption.

Since men have an endowment advantage in terms of past experience with improved varieties and knowledge of CSA, this confirms the hypothesis that male farmers are less constrained by a lack of knowledge than female farmers. Strikingly, the expectation that female farmers would face more land and labour constraints (e.g. through a structural disadvantage from dependency ratio) is not confirmed by the regressions nor the decomposition analysis. I do find that maize are and access to credit increase the probability of link formation among women, and women also have higher returns to these assets than men.

6.2 Conclusions

Firstly, the regression analysis shows that social learning as a tool to stimulate technology adoption works. I find that exchanging agricultural information with a trained peer farmer (i.e. link formation) is an important driver for knowledge gain and adoption of improved varieties. In fact, informal sources of information, such as neighbours, kinship ties, farmer groups and communicator farmers, are contribute more the learning and adoption process than formal sources of information, such as government extension. This is particularly true for male farmers. The research thereby confirms the findings of Katungi et al. (2006) in that social learning is a very important and effective source of agricultural information for (Ugandan) smallholder farmers. It also confirms the findings of Yishay & Mobarak (2014) in highlighting the importance of agricultural comparability and social distance between farmers for effective learning.

Secondly, I find that learning by doing is a key factor in stimulating technology adoption. Farmers who have past experience with growing an improved variety are much more likely to retain knowledge and plant an improved variety later. The roles of experience and knowledge as key adoption enablers was also mentioned by Kasirye (2013) and Shiferaw et al. (2015), among others.

Although these enablers concern male and female farmers, I also find gender gaps throughout the adoption process of linking, learning and adopting. Female farmers are less likely to form a link with the CF and have less past CSA experience, causing them to benefit less from social learning and learning by doing than male farmers. The present study confirms the importance of knowledge and information constraints which affect women more than men, as mentioned by Jack (2013). Moreover, I find that regarding link formation, access to credit is an enabling factor for women but not for men.

Throughout the learning process, past experience is the dominant driver of the gender gaps in technology adoption. Male farmers are more experienced with improved varieties, which makes them more likely to link, learn and adopt than female farmers. Men are also have higher knowledge levels, but this gender difference can largely be traced back to the difference in experience. The male advantage of a higher probability of link formation is also relevant, but does not play a significant role in the explanation of the adoption gender gap.

Based on the analysis of farmer motivations, I conclude that in their decision on using CSA technologies, farmers mostly consider expected yield and knowledge requirements. Many farmers also indicate labour as an important motivation: among adopters it is a reason to save time (for example in weeding), and for non-adopters it is a reason not to adopt a labour-intensive practice.

Strikingly, I find very few gender differences regarding farmers' motivations. Hence, the data do not confirm my hypothesis that female farmers would more strongly consider labour and land availability, knowledge requirements and people's opinions.

6.3 Limitations

Firstly, regression and decomposition analysis were carried out based on the gender of the respondent, but some variables (e.g. asset indices) were measured at household level. Inclusion of intra-household divisions of labour, land and other resources in the analysis would have provided more nuanced insights into constraints that women and men face. This was not possible for the present study, since not all the relevant variables were reliably available on intra-household level.

Secondly, in the motivational analysis, there is a lot of room for noise in the interpretation of the findings, especially regarding the open questions. Responses regarding main motivations were often phrased ambiguously, making it difficult to categorize into type of motivation. Moreover, it seems that some motivational survey questions were misunderstood by the respondents, especially among non-adopters. For some CSA practices, non-adopters mentioned main motivations that were actually *in favour* of adopting the practice. Therefore it became harder to interpret whether they indeed used the practice and which motivation was decisive. Phrasing the survey questions more specifically per practice and decision could help to prevent this problem (e.g. "Why did you not use crop residue retention this year?"). This was not done in the present study for the sake of simplicity in designing and operating the survey tool, but it clearly has its trade-offs. Furthermore, complementing the survey with qualitative focus group discussions on motivations would also benefit the interpretation of the survey questions.

6.4 Policy implications

An important policy implication of this research is that social learning can be used as an effective tool to stimulate knowledge dissemination and technology adoption among smallholder farmers, complementing or taking the role of government extension. Farmers indicate that their main motivations concern the effect on yield, knowledge requirements and labour requirements. Therefore, for stimulating technology adoption it is important to not only inform farmers so they meet the knowledge requirements, but also highlight the ways in which new practices improve yields and save labour throughout the season.

I find that women face more constraints to link, learn and adopt than men. A lack of experience among female farmers is the most important driver of this gender gap. Therefore, it seems relevant to specifically target female farmers in order to improve awareness and knowledge of and particularly *experience with* agricultural practices. Participatory training on demonstration plots or communal land could be a tool increase learning by doing. Furthermore, women could also benefit if (small amounts of) seeds or other inputs were made easily available so they have fewer constraints to test a new practice and become acquainted. I also find that women are more likely to adopt improved maize when they share information through farmers groups. Therefore, including or targeting female farmer groups in agricultural extension, trainings and social learning strategies could be an effective way to disseminate information and convince women.

Appendix 1: Improved maize adoption disaggregated by gender of the household head

Table 12: OLS Regression results on adoption by gender of the household head

	Male HHH			Female HHH		
	N = 510			N = 146		
	Adj R^2 = 0.3830			Adj R^2 = 0.3862		
Dependent variable: Adoption of improved maize variety (yes=1)	**Coef.**	**SE**	**Sig.**	**Coef.**	**SE**	**Sig.**
CSA Knowledge score	0.044	0.006	***	0.026	0.009	***
Link between farmer and CF (1=yes)	0.164	0.045	***	0.075	0.083	
Area planted with maize (ha)	0.045	0.018	**	-0.011	0.055	
Past experience with improved varieties (1=yes)	0.300	0.051	***	0.507	0.105	***
Risk score (ranging 1-32)	0.002	0.001	*	0.002	0.002	
Dependency ratio	-0.030	0.081		0.056	0.083	
Housing index	0.015	0.035		-0.075	0.054	
Distance to main road (walking minutes)	0.000	0.001		-0.001	0.001	
Distance to agrodealer (km)	0.000	0.003		-0.005	0.004	
No. of male agricultural workers in household	0.043	0.024	*	0.003	0.030	
Household used hired labour (1=yes)	0.023	0.044		-0.002	0.049	
Household received credit (1=yes)	-0.012	0.032		-0.006	0.042	
Agricultural assets index	0.013	0.034		-0.026	0.038	
Non-agricultural assets index	-0.018	0.028		-0.040	0.045	
Agricultural info from farmer group at baseline (1=yes)	0.056	0.066		0.089	0.089	
Agricultural info from friend at baseline (1=yes)	0.073	0.086		0.062	0.075	
Agricultural info from neighbour at baseline (1=yes)	0.034	0.042		-0.010	0.047	
Agricultural info from government extension at baseline (1=yes)	-0.052	0.097		-0.196	0.137	
No. of contacts agricultural advice at baseline	0.034	0.013	***	-0.020	0.017	
No. of friends at baseline	-0.018	0.017		0.012	0.019	
No. of kin at baseline	-0.003	0.014		0.013	0.019	
CF gender (1=female)	-0.013	0.033		-0.038	0.041	
Age CF > farmer (1=yes)	0.052	0.036		0.015	0.058	
Education CF < farmer (1=yes)	-0.001	0.007		-0.009	0.018	
CF & farmer both have few agricultural assets (1=yes)	0.001	0.045		-0.096	0.062	
CF & farmer both have few nonagricultural assets (1=yes)	0.006	0.045		-0.046	0.127	

*Notes: *** p<0.01, ** p<0.05, * p<0.1. Results shown are from OLS estimation. Sample includes peer farmers only. Regressions include the following additional control variables: constant, sub-village indicator, respondent characteristics (education, gender, age), household characteristics (primary activity of the household head, group membership of at least one household member), additional dummy variables on social distance between CF and farmer (differences in maize area, agricultural assets and non-agricultural assets between CF and farmer).*

Table 13: Blinder-Oaxaca Decomposition results on adoption, by gender of the household head

Dependent variable: **Adoption of improved maize variety (yes=1)**	**Coef.**	**SE**	**P>|z|**		**N = 656**	
Panel A: Differential						
Prediction_male sample	0.210	0.018	0.000			
Prediction_female sample	0.068	0.023	0.002			
Difference	0.141	0.029	0.000			
Panel B						
	Endowment gap			*Structural gap*		
	Coef.	SE	Sig.	Coef.	SE	Sig.
CSA Knowledge score	0.040	0.015	**	0.071	0.042	*
Link between farmer and CF (1=yes)	0.005	0.006		0.008	0.009	
Area planted with maize (ha)	-0.003	0.013		0.016	0.017	
Past experience with improved varieties (1=yes)	0.037	0.014	***	-0.010	0.007	
Risk score (ranging 1-32)	0.007	0.009		0.007	0.023	
Dependency ratio	-0.004	0.006		-0.053	0.071	
Housing index	-0.005	0.005		-0.067	0.048	
Distance to main road (walking minutes)	-0.001	0.002		0.009	0.016	
Distance to agrodealer (km)	-0.002	0.003		0.031	0.030	
No. of male agricultural workers in household	0.002	0.027		0.016	0.015	
Household used hired labour (1=yes)	0.000	0.003		0.020	0.052	
Household received credit (1=yes)	0.000	0.001		-0.003	0.028	
Agricultural assets index	-0.007	0.010		0.040	0.054	
Non-agricultural assets index	-0.022	0.026		0.009	0.021	
Agricultural info from farmer group at baseline (1=yes)	0.000	0.002		-0.002	0.006	
Agricultural info from friend at baseline (1=yes)	-0.002	0.003		0.001	0.008	
Agricultural info from neighbour at baseline (1=yes)	0.001	0.003		0.009	0.013	
Agricultural info from government extension at baseline (1=yes)	-0.001	0.003		0.003	0.004	
No. of contacts agricultural advice at baseline	-0.004	0.004		0.035	0.015	**
No. of friends at baseline	0.001	0.002		-0.059	0.051	
No. of kin at baseline	0.002	0.003		-0.026	0.040	
CF gender (1=female)	-0.001	0.002		0.012	0.026	
Age CF > farmer (1=yes)	0.004	0.015		0.010	0.018	
Education CF < farmer (1=yes)	-0.013	0.025		0.005	0.012	
CF & farmer both have few agricultural assets (1=yes)	0.015	0.010		0.046	0.037	
CF & farmer both have few nonagricultural assets (1=yes)	0.012	0.033		0.031	0.079	
Total	0.115	0.053		-0.041	0.044	

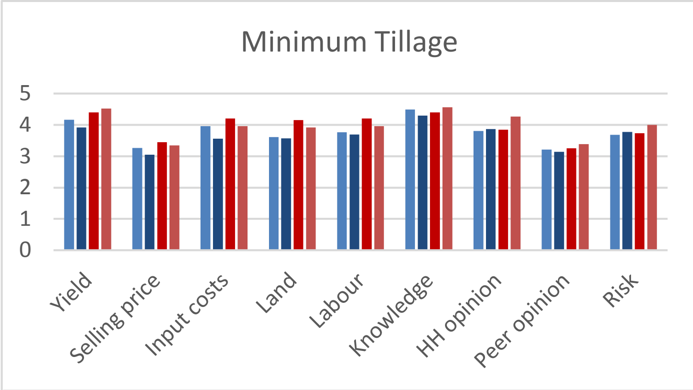
*Notes: *** p<0.01, ** p<0.05, * p<0.1. Results shown are from Blinder-Oaxaca decomposition after OLS estimation. Sample includes peer farmers only. Regressions include the following additional control variables: constant, sub-village indicator, respondent characteristics (education, gender, age), household characteristics (primary activity of the household head, group membership of at least one household member), additional dummy variables on social distance between CF and farmer (differences in maize area, agricultural assets and non-agricultural assets between CF and farmer).*

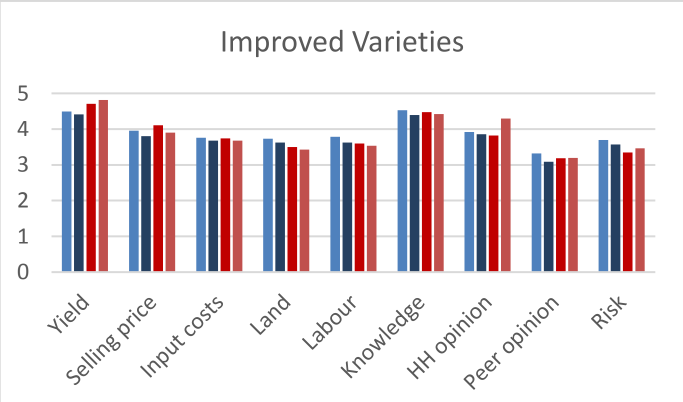
Appendix 2: Motivation rating scores per practice

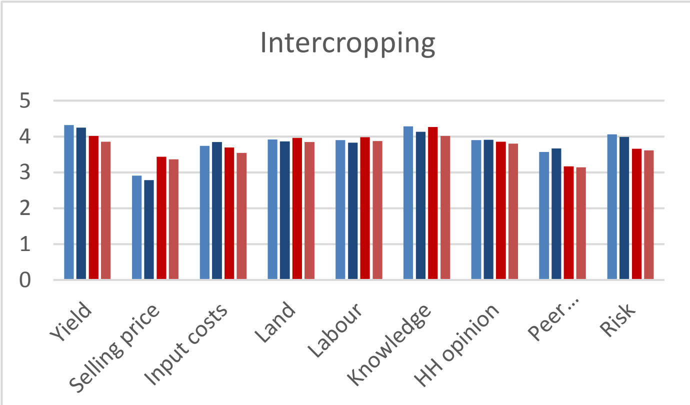
Y-axes: average agreement score per factor considered in adoption decision

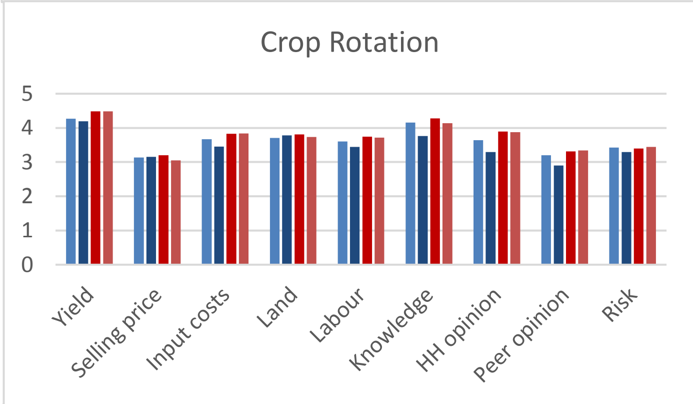
X-axes: factors considered

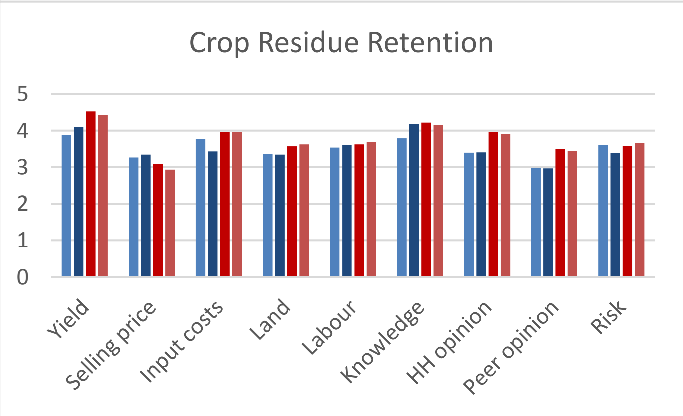
■ Non-adopters Male ■ Non-adopters Female ■ Adopters Male ■ Adopters Female

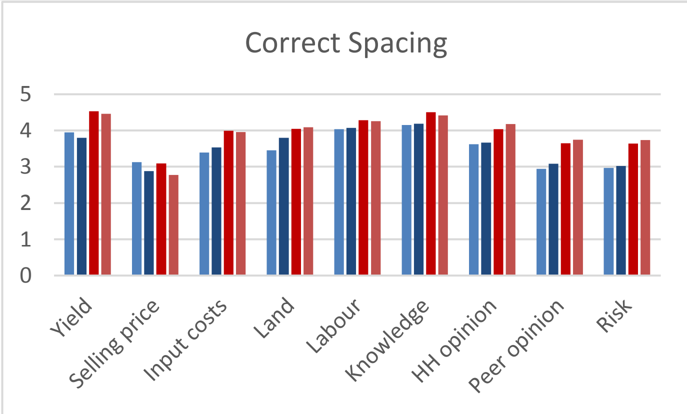


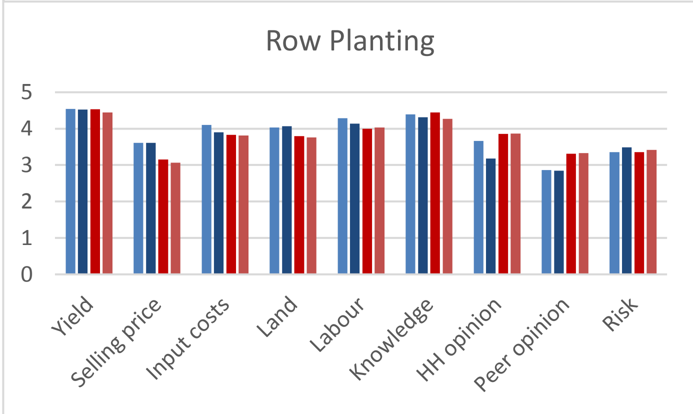












Appendix 3: T-test analysis on motivations

Table 14: Average agreement rate per factor considered, per CSA practice (based on closed questions)

	Non-adopters			Adopters		
Motivations by practice	**Male**	**Female**	**Sig.**	**Male**	**Female**	**Sig.**
Practice: Improved Varieties						
Yield	4.497	**4.414**		**4.704**	**4.817**	
	(0.075)	(0.085)		(0.070)	(0.078)	
Product selling price	3.955	3.805		4.104	3.901	
	(0.095)	(0.097)		(0.095)	(0.164)	
Input costs (e.g. seeds, equipment, pesticides)	3.760	3.678		3.741	3.676	
	(0.084)	(0.088)		(0.096)	(0.144)	
Availability of land	3.732	3.626		3.496	3.423	
	(0.098)	(0.107)		(0.133)	(0.181)	
Availability of labour	3.781	3.626		3.593	3.535	
	(0.097)	(0.102)		(0.121)	(0.176)	
Level of knowledge	**4.531**	4.391		4.474	4.423	
	(0.065)	(0.067)		(0.074)	(0.116)	
Opinion of household members	3.922	3.856		3.822	4.296	***
	(0.086)	(0.091)		(0.110)	(0.121)	
Opinion of peers (e.g. friends, neighbours)	3.318	3.086	*	3.185	3.197	
	(0.089)	(0.094)		(0.108)	(0.141)	
Risk involved	3.693	3.569		3.348	3.465	
	(0.099)	(0.090)		(0.116)	(0.166)	
Practice: Minimum Tillage						
Yield	4.164	3.921		**4.400**	4.522	
	(0.093)	(0.119)		(0.275)	(0.226)	
Product selling price	3.261	3.050		3.450	3.348	
	(0.111)	(0.126)		(0.352)	(0.292)	
Input costs (e.g. seeds, equipment, pesticides)	3.962	3.561	***	4.200	3.957	
	(0.074)	(0.105)		(0.186)	(0.213)	
Availability of land	3.614	3.568		4.150	3.913	
	(0.101)	(0.114)		(0.233)	(0.266)	
Availability of labour	3.766	3.691		4.200	3.957	
	(0.091)	(0.113)		(0.156)	(0.247)	
Level of knowledge	**4.495**	**4.295**	*	**4.400**	**4.565**	
	(0.067)	(0.086)		(0.210)	(0.187)	
Opinion of household members	3.804	3.871		3.850	4.261	
	(0.089)	(0.099)		(0.284)	(0.191)	
Opinion of peers (e.g. friends, neighbours)	3.207	3.145		3.250	3.391	
	(0.087)	(0.108)		(0.307)	(0.272)	
Risk involved	3.679	3.772		3.733	4.000	
	(0.100)	(0.110)		(0.371)	(0.195)	

Practice: Crop Rotation						
Yield	**4.268**	**4.194**		**4.484**	**4.480**	
	(0.111)	(0.109)		(0.054)	(0.045)	
Product selling price	3.134	3.155		3.201	3.052	
	(0.132)	(0.129)		(0.077)	(0.074)	
Input costs (e.g. seeds, equipment, pesticides)	3.670	3.456		3.824	3.838	
	(0.098)	(0.110)		(0.057)	(0.049)	
Availability of land	3.711	3.777		3.806	3.736	
	(0.128)	(0.116)		(0.065)	(0.061)	
Availability of labour	3.608	3.447		3.744	3.715	
	(0.109)	(0.127)		(0.067)	(0.060)	
Level of knowledge	4.155	3.767	**	4.279	4.136	*
	(0.106)	(0.109)		(0.054)	(0.050)	
Opinion of household members	3.639	3.291	**	3.894	3.880	
	(0.102)	(0.107)		(0.060)	(0.055)	
Opinion of peers (e.g. friends, neighbours)	3.200	2.898	*	3.312	3.345	
	(0.127)	(0.123)		(0.063)	(0.056)	
Risk involved	3.427	3.296		3.399	3.441	
	(0.154)	(0.150)		(0.078)	(0.071)	
Practice: Crop Residue Retention						
Yield	**3.889**	4.101		**4.526**	**4.423**	
	(0.196)	(0.167)		(0.048)	(0.054)	
Product selling price	3.270	3.348		3.087	2.931	
	(0.188)	(0.170)		(0.080)	(0.090)	
Input costs (e.g. seeds, equipment, pesticides)	3.762	3.435		3.955	3.953	
	(0.144)	(0.139)		(0.055)	(0.060)	
Availability of land	3.365	3.348		3.568	3.628	
	(0.177)	(0.173)		(0.072)	(0.077)	
Availability of labour	3.540	3.609		3.628	3.686	
	(0.171)	(0.158)		(0.067)	(0.075)	
Level of knowledge	3.794	**4.174**	*	4.216	4.150	
	(0.170)	(0.126)		(0.049)	(0.058)	
Opinion of household members	3.397	3.406		3.955	3.916	
	(0.170)	(0.151)		(0.055)	(0.063)	
Opinion of peers (e.g. friends, neighbours)	2.984	2.971		3.495	3.438	
	(0.170)	(0.153)		(0.057)	(0.067)	
Risk involved	3.609	3.386		3.583	3.663	
	(0.172)	(0.164)		(0.068)	(0.073)	
Practice: Intercropping						
Yield	**4.316**	**4.250**		4.013	3.853	
	(0.088)	(0.083)		(0.072)	(0.067)	
Product selling price	2.910	2.779		3.438	3.364	
	(0.119)	(0.122)		(0.075)	(0.067)	
Input costs (e.g. seeds, equipment, pesticides)	3.737	3.846		3.690	3.546	*
	(0.079)	(0.067)		(0.059)	(0.057)	

Availability of land	3.917	3.865		3.962	3.845	
	(0.083)	(0.082)		(0.068)	(0.064)	
Availability of labour	3.902	3.827		3.978	3.870	
	(0.072)	(0.077)		(0.065)	(0.062)	
Level of knowledge	4.278	4.135		**4.268**	**4.015**	***
	(0.075)	(0.079)		(0.056)	(0.056)	
Opinion of household members	3.895	3.904		3.850	3.796	
	(0.079)	(0.070)		(0.063)	(0.056)	
Opinion of peers (e.g. friends, neighbours)	3.564	3.663		3.169	3.140	
	(0.078)	(0.074)		(0.067)	(0.059)	
Risk involved	4.057	3.990		3.654	3.617	
	(0.085)	(0.086)		(0.072)	(0.062)	
Practice: Correct Spacing						
Yield	3.946	3.800		**4.529**	**4.459**	
	(0.145)	(0.152)		(0.048)	(0.040)	
Product selling price	3.125	2.878		3.095	2.776	**
	(0.142)	(0.143)		(0.089)	(0.099)	
Input costs (e.g. seeds, equipment, pesticides)	3.393	3.530		3.992	3.954	
	(0.128)	(0.129)		(0.051)	(0.049)	
Availability of land	3.455	3.800	*	4.049	4.087	
	(0.146)	(0.129)		(0.057)	(0.054)	
Availability of labour	4.036	4.070		4.280	4.260	
	(0.125)	(0.122)		(0.044)	(0.043)	
Level of knowledge	**4.152**	**4.191**		4.504	4.418	
	(0.124)	(0.116)		(0.039)	(0.043)	
Opinion of household members	3.625	3.670		4.038	4.179	*
	(0.135)	(0.132)		(0.055)	(0.053)	
Opinion of peers (e.g. friends, neighbours)	2.946	3.087		3.648	3.750	
	(0.126)	(0.126)		(0.058)	(0.062)	
Risk involved	2.973	3.026		3.640	3.733	
	(0.133)	(0.138)		(0.076)	(0.080)	
Practice: Row Planting						
Yield	**4.542**	**4.521**		**4.533**	**4.443**	
	(0.114)	(0.071)		(0.047)	(0.043)	
Product selling price	3.610	3.608		3.153	3.067	
	(0.166)	(0.136)		(0.081)	(0.072)	
Input costs (e.g. seeds, equipment, pesticides)	4.102	3.904		3.833	3.816	
	(0.134)	(0.104)		(0.050)	(0.049)	
Availability of land	4.034	4.068		3.793	3.759	
	(0.162)	(0.116)		(0.064)	(0.058)	
Availability of labour	4.288	4.137		4.000	4.032	
	(0.126)	(0.100)		(0.056)	(0.048)	
Level of knowledge	4.390	4.315		4.450	4.273	***
	(0.121)	(0.097)		(0.042)	(0.041)	
Opinion of household members	3.661	3.178	**	3.853	3.868	
	(0.152)	(0.137)		(0.059)	(0.052)	

Opinion of peers (e.g. friends, neighbours)	2.864	2.849	3.312	3.326
	(0.173)	(0.157)	(0.059)	(0.055)
Risk involved	3.358	3.485	3.358	3.418
	(0.185)	(0.150)	(0.077)	(0.066)

*Notes: *** p<0.01, ** p<0.05, * p<0.1. T-test results shown are means, standard errors included in parentheses. Figures in **bold** indicate the motivation with the highest agreement score per sub-group.*

References

Ali, D.A., Bowen, D., Deininger, K., & Duponchel, M. (2016). Investigating the gender gap in agricultural productivity: evidence from Uganda. *World Development, 87*, 152-170.

Bandiera, O., & Rasul, I. (2006). Social networks and technology adoption in northern Mozambique. *The Economic Journal*, *116*(514), 869-902.

Benin, S., Nkonya, E., Okecho, G., Kato, E., Randriamamonjy, J., Lubade, G., Kyotalimye, M. & Byekwaso, F. (2011). *Impact of Uganda's National Agricultural Advisory Services Program.* International Food Policy Research Institute, Washington, DC.

Blinder, A. S. (1973). Wage discrimination: reduced form and structural estimates. *Journal of Human resources*, 436-455.

Conley, T. G., & Udry, C. R. (2010). Learning about a new technology: Pineapple in Ghana. *The American Economic Review*, *100*(1), 35-69.

Doss, C. R. (2001). Designing agricultural technology for African women farmers: Lessons from 25 years of experience. *World development*, *29*(12), 2075-2092.

Doss, C. R., & Morris, M. L. (2001). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agricultural Economics, 25*(1), 27-39.

Fairlie, R. W. (2005). An extension of the Blinder-Oaxaca decomposition technique to logit and probit models. *Journal of economic and social measurement*, *30*(4), 305-316.

FAO (2013). *Climate-smart agriculture sourcebook.* Retrieved 25 November 2016 from http://www.fao.org/docrep/018/i3325e/i3325e.pdf

Jann, B. (2008). The Blinder-Oaxaca decomposition for linear regression models. *The Stata Journal,* 8(4): 453-479.

Kasirye, I. (2013). Constraints to Agricultural Technology Adoption in Uganda: Evidence from the 2005/06-2009/10 Uganda National Panel Survey. *African Journal of Agricultural and Resource Economics,* 8(2), 90-107.

Katungi, E., Edmeades, S., & Smale, M. (2006*). Gender, Social Capital and Information Exchange in Rural Uganda* (CAPRi Working Paper No. 59). Retrieved 15 December 2016 from *http://ageconsearch.umn.edu/bitstream/50070/2/capriwp59.pdf*

Kelsey, J. (2013). *Constraints on the adoption of agricultural technologies in developing countries.* Literature review, Agricultural Technology Adoption Initiative, J-PAL (MIT) and CEGA (UC Berkeley).

Kilic, T., Palacios-Lopez, A., & Goldstein, M. (2015). Caught in a productivity trap: A distributional perspective on gender differences in Malawian agriculture. *World Development, 70*, 416–463.

Kondylis F., Mueller V. & Zhu S. (2015). Measuring agricultural knowledge and adoption. *Agricultural Economics, 46*, 449–462.

Lambrecht, I., Vanlauwe, B., & Maertens, M. (2016). Agricultural extension in Eastern Democratic Republic of Congo: does gender matter?. *European Review of Agricultural Economics*, 1-33

Magnan, N., Gulati, K., Lybbert, T. J., & Spielman, D. J. (2014). Gender dimensions of social networks and technology adoption in eastern Uttar Pradesh, India.

Oaxaca, R. (1973). Male-female wage differentials in urban labor markets. *International economic review*, *9,* 693-709.

Pan, Y., Smith, S. C., & Sulaiman, M. (2015). Agricultural extension and technology adoption for food security: Evidence from Uganda. IZA Discussion Paper No. 9206.

Peterman, A., Quisumbing, A., Behrman J. & Nkonya, E. (2011). Understanding the Complexities Surrounding Gender Differences in Agricultural Productivity in Nigeria and Uganda. *The Journal of Development Studies, 47*(10), 1482-1509

Shiferaw, B., Kebede, T., Kassie, M., & Fisher, M. (2015). Market imperfections, access to information and technology adoption in Uganda: Challenges of overcoming multiple constraints. *Agricultural Economics, 46*(4), 475–488.

Thierfelder, C., Matemba-Mutasa, R., & Rusinamhodzi, L. (2015). Yield response of maize (Zea mays L.) to conservation agriculture cropping system in Southern Africa. *Soil and Tillage Research*, *146*, 230-242.

Udry, C. (1996). Gender, Agricultural Production, and the Theory of the Household. *Journal of Political Economy, 104*(5), 1010-1046.

World Bank (2008). *World Development Report 2008: Agriculture for Development* (No. E14 231). Washington, DC: The World Bank.

Yishay, A.B. & Mobarak, A.M. (2014). *Social learning and communication* (NBER Working Series, 277 Working Paper 20139). Retrieved 30 November 2016 from http://www.nber.org/papers/w20139.

Yishay, A.B., Jones, M., Kondylis, F., & Mobarak, A. M. (2015). *Are gender differences in performance innate or socially mediated?* (No. 7689). The World Bank.