The interplay of gender norms and education in male farmers' adoption of index-based insurance in Mali

by Kirchner, E., Sarfo, Y. and Musshoff, O.

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Abstract

Agricultural index-based insurance helps farmers to mitigate the adverse effects of climate change. However, adoption rates remain low in developing countries which are particularly affected by climate change. A number of reasons such as basis risk, high insurance premium, and lack of trust in insurance providers have been cited for the low adoption among farmers. Additional influence factors could be the characteristics of the insurance agent who sells insurance policies to farmers. In this study, we examine whether the gender of the insurance agent influences male farmers' adoption of index-based insurance, disaggregated by the educational level of farmers. We run probit regressions on a sample of 783 male farmers producing maize in Mali which was collected in fall 2021. Our results show that male farmers are less likely to adopt index-based insurance if the insurance agent is a female rather than a male. Disaggregated by education level, we find that the higher the education level of the farmer, the more irrelevant the gender of the agent becomes for the purchase decision. Our study highlights the need to take local gender norms into account and shows that formal education is an important facilitator of balanced gender perceptions. We contribute to the discussion about farmers' low adoption rate of index-based insurance, particularly in Mali.

Keywords: Index-based insurance; Insurance adoption; Gender of the insurance agent; Mali; Smallholder farmers

JEL classification – G21, G22, Q14

1. Introduction

With climate change intensifying, agricultural production risk is increasing (IPCC, 2022) and necessitates adequate risk management responses, particularly among smallholder farmers who largely rely on agriculture for a living. Among the variety of available risk management approaches, agricultural index insurance emerged as a promising financial tool that overcomes limitations of indemnity-based insurance. In index insurance, payouts are not dependent on individually incurred losses but rather linked to an objectively measurable, predefined index that is highly correlated with crop losses (Barnett and Mahul, 2007). This reduces the transaction costs for crop insurance delivery and largely eliminates the problems of adverse selection and moral hazard, thereby paving the way to offer agricultural insurance to smallholders in remote areas.

Although index insurance has positive ex-ante and ex-post effects on farmers' production decision and welfare (Hill *et al.,* 2019; Janzen and Carter, 2019), adoption rates in developing countries remain surprisingly low (Platteau *et al.*, 2017; Kramer *et al.*, 2022; Lichtenberg and Iglesias, 2022). As index insurance can only realize its welfare enhancing potential when adopted by the target group, it is crucial to understand barriers to adoption. Frequently cited adoption barriers include high basis risk (Kramer *et al.*, 2022; Lichtenberg and Iglesias, 2022), high insurance premium (Matsuda and Kurosaki, 2019; Stoeffler and Opuz, 2022; Kramer *et al.*, 2022), lack of trust in insurance providers (Cai *et al.*, 2015; Moritz *et al.*, 2024), and a lack of insurance understanding among farmers (Lampe and Würtenberger, 2020; Stoeffler and Opuz, 2022).

In addition to product and individual farmer characteristics, distribution and marketing efforts affect insurance uptake decisions as they not only determine accessibility but also shape the process of taking the adoption decision (Jensen et al., 2024). Insurance agents who travel into villages are often the central point of contact linking farmers and the insurance provider. In

direct conversations, they can provide information, answer questions, and actively convince farmers about the advantages of the product. Jensen et al. (2024) observed a large heterogeneity in the agents' capability and efforts to supply an insurance scheme when studying a livestock insurance scheme in Kenya and Ethiopia. Nonetheless, it remains unclear which agent characteristics translate into which insurance uptake outcome.

We contribute to closing this knowledge gap by investigating whether the gender of an insurance agent influences male farmers' adoption of index-based insurance. If so, we will further examine whether the gender bias persists across all educational levels of the farmers. For this purpose, we use primary data collected in the fall 2021 from 783 male maize producers in Southern Mali. This study focusses on OKO Mali SaRL (hereafter OKO), a commercial insurance provider offering a weather index-based insurance tailored to maize production that triggers payouts in case of droughts and floods.

This study contributes to two main strands of literature. First, we add insights on the insurance agent's role for insurance adoption. Until now, little is known about the role of insurance agents in farmers' adoption of index-based insurance. DeLay *et al.* (2020) investigated how competition among insurance agents influences farmers' crop insurance coverage decisions in the US market. Given the differences in agricultural and societal conditions between the US and low-income countries, we consider the previously mentioned findings by Jensen *et al.* (2024) most relevant to our study. They found that the agents' ability and effort to sell the insurance varied across regions. Agents were more likely to visit areas with lower premium rates, favorable index realizations in the preceding season, and active external marketing campaigns. In contrast to their study, our data allows us to link individual producer decisions and agents which enables us to provide first insights on the effect of the insurance agent's gender on the adoption decision.

Second, by taking a gender perspective, we contribute to highlighting the importance of a gender lens for the insurance sector and evaluate whether previous findings from the microcredit sector apply to the microinsurance sector as well. For microlending interactions there is evidence for a gender bias between clients and loan officers. Chamboko *et al.* (2021) find that clients of microfinance institutions (MFI) in the Democratic Republic of Congo and in Senegal prefer agents of their own gender. They attribute this observed homophily to gender-based trust because the preference for same gender agents increased with higher risk transactions. Their findings are in line with Beck *et al.* (2018) who analyze MFI data from Albania and observe that clients assigned to opposite-gender loan officers are less likely to take up a second loan after repayment of the first as they receive inferior loan terms. Beck et al. (2018) could trace such inferior terms back to loan officers who had little experience with opposite-gender customers and who faced a low level of competition in the credit market. The assessment whether similar biases can be observed for the insurance sector contributes to the body of knowledge on gender preferences related to insurance.

Our results are relevant for insurance schemes operating in similar market and development contexts. However, given that Mali is among the least developed countries, the primary importance of these findings remains within the Malian context. Nonetheless, our results could stimulate similar research in other countries in the Global South. The findings of the study help agricultural insurance providers and policy makers in the region to design appropriate strategies to increase index-based insurance adoption among smallholder farmers.

The remainder of the paper is organized as follows: In Section 2, we describe the study setting. This is followed by the description of the data and methods used for the study in Section 3. In Section 4, we present and discuss the empirical results. Section 5 concludes the paper.

2. Case study context

This study analyses the adoption decision of an insurance scheme provided to maize producers in Mali, a landlocked country in West Africa. Mali is one of the least developed countries in the world and relies heavily on the agricultural sector in terms of employment (World Bank, 2024b), GDP contribution (World Bank, 2024a) and contribution to livelihoods (FAO, 2017). As the north of the country is mainly characterized by drought and desertification (FAO, 2017), most of the agricultural production takes place in the southern half of Mali. Increased climatic variability such as the frequent occurrence of droughts and floods in recent years (World Bank and GFDRR, 2019), coupled with the limited availability of irrigation infrastructure, make farmers in Mali vulnerable to production risks, exacerbating food insecurity and poverty.

In this context, OKO offers index-based crop insurance in the regions Bamako, Kayes, Koulikoro, Segou, and Sikasso. The insurance is designed to mitigate shocks related to droughts and floods with strike levels tailored to specific crops, phenological stages and the location of the insured site. Premiums are set by zone, with each zone defined mainly by historical weather patterns and factors like elevation, terrain, and proximity to water bodies; the premium rate of each individual farmer depends on the zone in which the farm is located. OKO started large scale operations in 2020 for maize producers and has since successfully expanded its product portfolio, increased its client base to more than 27,000 farmers, and reached a total of USD 482,000 paid in claims (as of February 2025; OKO, 2025). At the time of the study, OKO was – to the best of our knowledge – one of only two commercial crop insurance providers in Mali[1]. Thereby, OKO not only contributes to expanding insurance offerings in African countries but also highlights the limited number of providers. Despite rapid growth since the early 2000s,

[1] Before OKO's large-scale operational launch, PlaNet Guarantee (now Inclusive Guarantee) had introduced index-based insurance products in Mali in collaboration with various agencies (Index Insurance Forum, 2017). In 2024, four years after the purchase decision analyzed in this study, Pula initiated its own insurance program focused on cotton production in only two regions in Mali (ILO, 2024). This list is not intended to be comprehensive or exhaustive, as the situation may evolve rapidly over time.

agricultural insurance penetration in African countries remains low, with premiums reaching less than 10% of agricultural GDP, reflecting the early stage of market development compared to other regions such as Asia, Latin America, and the Caribbean (Hazell *et al.*, 2021).

OKO's insurance is mainly promoted and distributed by agents who travel to villages. Regional managers oversee a team of agents and assign them to specific areas, rather than allowing farmers to choose their agent, in order to ensure efficiency of travel routes and coverage. The insurance agents work towards maximizing enrolment rates, as an initial subscription allows farmers to experience and learn about the product, potentially increasing coverage in subsequent seasons. Agents conduct individual consultations with farmers and village heads and hold informational sessions for groups or cooperatives. During these interactions, the agent provides a detailed explanation of the product, registers interested farmers, generates a personalized quote, and facilitates the subscription process for those who choose to enroll. In addition to this in-person sales process, OKO offers various digitized options to take out their insurance product remotely, including a web-app, a mobile application, and a call center (OKO, 2025). Although OKO is well-known for its digital service offerings (Raithatha and Priebe, 2020), the digital options are mostly relevant to farmers who have been insured with OKO in previous seasons and seek to renew their policy. In this study, we focus on first time adopters for whom remote insurance consultations are a rare exception. Hence, the insurance agent plays a primary role in influencing the purchase decision.

Given that we focus on the influence of female and male agents, women's representation in the business context as well as the general societal perception of gender are important aspects to consider in the context of this study. In Mali, strong gender norms prevail and heavily influence roles of women and men in a variety of sectors, including the agricultural sector (Beaman and Dillon, 2018, Singbo *et al.*, 2021). Distinct gender norms translate into large general gender inequalities and the under-representation of women in business contexts. In the gender

inequality index, Mali ranked 155th out of 191 countries in 2021 (UNDP, 2023) and only 17.4% of the managerial positions in Mali are held by women (UN Women, 2024).

3. Data and methods

3.1 Data for main analysis

The primary dataset on Malian maize producers was collected in October and November 2021 in cooperation with OKO and centers on the insurance adoption decision for the crop season in 2020. In 2020, OKO first issued their maize insurance product on a large scale. A total of 4,913 farmers registered with the insurance company to receive an individualized quote using their mobile phone number. Among them, 1,815 proceeded to purchase maize insurance for the main cropping season in 2020, meaning they not only registered and received a quote but also paid the insurance premium. Because of the nearly two-year gap between registration and the survey, many of the originally targeted farmers under a stratified sampling approach could not be reached – due to migration, changes in phone numbers, or unavailability – requiring us to adopt a convenience sampling approach. We do not expect systematic differences between farmers we could and could not reach. The study is based on a convenience sample of 842 smallholders drawn from the full list of the 4,913 initially registered farmers, including both farmers who took out insurance for 2020 and farmers who did not.

For the present analysis we limited the dataset to male farmers leading to a final sample of 783 respondents.[2] Maize is typically cultivated by men in Mali which, in turn, also explains the small share of women in the initial dataset. Given the societal circumstances and the limited decision-making power of women, the insurance subscription decision of the household is largely determined by a male. Out of the 59 female respondents, only 12 indicated to be the

[2] The large share of male respondents was expected given the prevailing gender inequality in Mali. However, as demographic details from the full list of 4,913 initially registered were not disclosed to us for privacy reasons, we cannot verify whether the gender distribution in our sample is representative of the full registry.

sole decision-maker in the household and 22 claimed to take decisions jointly with their male spouse.[3] Hence, we restrict our analysis to only male farmers in the study context.

----------Figure 1 here ----------

A local team of enumerators carried out in-person interviews. The interviews were conducted mostly in Bambara, the local language, or in French, the official language, following the preference of the respondent. The questionnaire included questions on the farmer's household, farm information, knowledge of crop insurance, and insurance adoption among others. A map of the interview locations is provided in figure 1.

The survey data were matched with OKO's data records based on the client identifier. Hence, the final dataset also contains data on the premium paid as well as the name of the insurance agent who was responsible for the farmer. We determine the gender of the agent based on the name provided in the dataset. Farmers who participated in the survey were contacted by 99 different agents whereof 15 were female. For data protection reasons, the dataset does not include any further details on the insurance agent except for their name. We do not have information on the education attainments or on the professional career of the agents. The locations of the interviews and the corresponding agent information for each respondent show that each agent tends to operate within a specific region, but these regions may overlap so that some areas are served by multiple agents. This regional distribution does not differ by gender: both female and male agents were active across the study region, with no apparent gender-specific clustering near urban centers (see figure 1).

3.2 Separate dataset on agent characteristics

To identify the association of the agent's gender with the likelihood to take out insurance, other confounding factors need to be ruled out. If – for instance – male agents were systematically

[3] Conducting a separate subsample analysis on this group of respondents was not meaningful as the small number of observations also implies a lower number of agents, particularly only four female agents.

more experienced in selling insurance, the coefficient for the agent's gender would be inflated as it would also capture the effect of the difference in experience between male and female agents. Our main dataset lacks information to control for these aspects. However, the insurance provider OKO kindly provided a separate dataset on their insurance sales agents for the season 2022 (i.e., two years after the analysed adoption decision). This separate dataset includes more comprehensive information, namely age, gender, educational level and professional sector, for 93 agents. While it was impossible to merge the survey data with the separate dataset, it allowed us to check for such differences between male and female agents, thereby following a similar procedure as Chamboko *et al.* (2021) in their study on the effects of agent's gender in microlending.

We compare the female and the male agents with regards to their age, their highest educational level and their professional background. Comparative statistics are presented in Table 1. We do not find a statistically significant difference in terms of age between female and male agents. Female insurance agents reported higher levels of education while a larger share of the male agents reported to have either worked in agriculture previously or currently alongside their role as an insurance agent. While the higher degree of education could give female agents an advantage in conveying product information, the higher level of agricultural experience may allow male agents to establish stronger rapport with farmers through shared professional experience.

----------Table 1 here ----------

Based on the available information from the main dataset and this separate agent dataset, we have no reason to assume that the agent characteristics differ between the two. We therefore

acknowledge that differences in education and agricultural experience between female and male agents likely exist in the main dataset too, although we cannot quantify or control for them in the main analysis. This limitation needs to be taken into account when interpreting the results.

3.3 Econometric approach

The purpose of this study is to investigate the relationship between farmers' index-based insurance adoption and the gender of the insurance agent in southern Mali. We treat farmers' index-based insurance adoption as a binary decision. An alternative approach would be to consider the share of land each farmer insures. However, since the insurance product is designed specifically for maize production and the exact extent of maize cultivation is unknown, this measure could introduce measurement errors. The approach of using a binary outcome of insurance adoption is also in line with previous studies (e.g. Casaburi and Willis, 2018; Lampe and Würtenberger, 2020).

The outcome variable y_i takes one if a smallholder farmer i adopted index-based insurance for the 2020 crop season and zero otherwise. We specify a probit model of the following form:

$$P(y_i = 1 \,|G_i, X'_i) = \Phi(\alpha + \beta G_i + \lambda X'_i) \qquad (1)$$

where P is the probability that a farmer takes out the insurance product conditional on G_i and X'_i. Let Φ denote the cumulative distribution function of the standard normal distribution. The variable G_i is the main variable of interest in this study and takes one if the gender of the insurance agent for farmer i is female and zero otherwise. The vector X'_i includes explanatory variables that have been shown to influence the adoption decision of index insurance products, and α, β, and λ are the parameters to be estimated.

The additional explanatory variables in X'_i include the premium per hectare (ha) as one of the classical determinants for demand. In addition, we include socioeconomic variables like the farmer's age in years and the educational level in years of schooling. The binary variable whether the farmer is a beneficiary of the national social protection program, Jigisemejiri

together with the binary variable whether a household had experienced a situation with insufficient income prior to the interview are used as an approximation for wealth. To control for differences in terms of vulnerability and risk diversification strategies, the cultivated area in ha, the number of income generating activities and the binary variable whether a household generates off-farm income are included in the probit model. We also include the expected frequency of severe harvest losses in the next ten years to capture the risk perception of the respondent. The frequency of mobile money use is included in the regression because the payout is transferred in mobile money. Lastly, a binary variable whether the household of the respondent received remittances during the past year is also part of the explanatory variables as remittances may serve as a substitute to insurance.

Furthermore, to investigate whether the influence of the agents' gender is stable across all educational levels of the farmers in the study area, we categorize the respondents into three groups based on their educational level and re-estimate equation (1). The first group comprises farmers who have no formal education or have only literacy education. The second group includes farmers who have primary and/or Koranic education[4], and the third group includes farmers who have beyond primary education including middle school, high school, and tertiary education.

4. Results and discussion

4.1 Summary statistics

Table 2 shows descriptive statistics of the sample, also differentiated by educational level of the respondents and by gender of the insurance agents. The mean age of the farmers in our sample is about 47 years and the respondents received on average four years of education, with

[4] Koranic education refers to Islamic religious schools which can take a variety of different forms. They are usually private schools, use Arabic as the language of instruction and often teach reciting and memorizing the Qur'an. Islamic religious schools are of high importance in Mali. In 2010, 16% of all schools were medersas which is a particular form of Islamic religious school that is officially registered and adheres to the government curriculum (Boyle, 2014).

less than 20% of the sample having attained secondary or tertiary education. While these characteristics closely align with those of typical agricultural household heads in Mali, the average household size in this sample is larger, with more than 20 members compared to the average of 11 members according to Malian Agricultural statistics from 2017 (CPS/SDR and World Bank, 2019). The cultivated area averages around 15 ha in the sample, exceeding the regional average of 7 to 10 ha in southern Mali (CPS/SDR and World Bank, 2019). It is important to note, however, that the cultivated land area varies substantially with standard deviations of roughly 10 ha, primarily driven by a few large outliers. Only a small share of respondents (less than 15%) engage in income generating off-farm activities, but the large majority of farmers diversifies on-farm activities (e.g., by also engaging in animal or vegetable production). This income diversification among agricultural households is also confirmed by the Malian agricultural report, indicating that agricultural households in Mali derive 80% of their income from various agriculture related activities (CPS/SDR and World Bank, 2019).

The average respondent in our sample uses a mobile phone at least 4 times a day. This suggests that the respondents are familiar with mobile phone usage which is important as the premium payment needs to be done via mobile money. Additionally, we notice from Table 2 that about a third of the sampled farmers received remittances during the past 12 months. As remittances were discussed as a potential substituting risk management tool to insurance this is an important aspect to consider.

When looking at insurance adoption, 79% of the sampled farmers purchased an insurance policy for the 2020 crop season. Among farmers who have no formal education, the adoption rate is lower (76%) than in the farmer groups with higher education, an observation which hints at a potential importance of farmers' educational level for index-based insurance adoption in the study area. Also, insurance adoption is higher for male farmers who were contacted by a male insurance agent (about 81%) compared to male farmers who were contacted by a female

insurance agent (about 73%). The insurance premium per ha for the crop season under consideration is on average about CFA 6,413 (approximately EUR 10). Given that the average cultivated area comprises about 15 ha, the amount of premium required to insure the whole cultivated area would correspond to roughly 4% of the average yearly household expenditure of a Malian farming household[5]. Most farmers, however, insure only parts of their cultivated land given that the insurance is specifically tailored to maize.

----------Table 2 here ----------

4.2 Determinants of farmers' adoption of index-based insurance

Table 3 presents the estimation results of the probit model (see equation (1)) on male farmers' adoption of index-based insurance in southern Mali. The corresponding marginal effects are presented in Table 4.

In model (1), we investigate what affects male farmers' adoption of index-based insurance using all observations in the sample (N = 783) and including the gender of the insurance agent as the independent variable of interest. Being advised by a female insurance agent is negatively associated with the likelihood of male farmers adopting the insurance scheme. The marginal effect indicates that a female agent decreases the likelihood of a male farmer taking out insurance by 7%. This finding aligns with the gender preferences observed among micro-finance clients, who also tend to favor agents of the same gender (Beck *et al.*, 2018; Chamboko *et al.*, 2021). Possible explanations are manifold. First, the preference for same gender could be purely taste-based. If so, it would be driven by homophily - the tendency for people to associate

[5] To calculate this figure, we used the Mali EHCVM (Enquête Harmonisée sur le Conditions de Vie des Ménages) from 2021/22 provided by the World Bank (INSTAT 2024). We filtered the data for households who reported that at least one household member cultivated a field in the growing season prior to the survey. We multiply the average premium per ha by the average cultivated area reported in our sample and divide the product by the average yearly household expenditure indicated in the EHCVM data.

with those who are similar to themselves - as also suggested by Chamboko *et al.* (2021). Homophily may not only relate to the gender but also to aspects such as agricultural experience which was, on average, higher among male agents than female agents (see Section 3.2) and may potentially be captured in the coefficient for the agent's gender. Second, it could also be based on prejudices and gender roles. Male farmers may perceive female agents as less knowledgeable or trustworthy, which is plausible given the prevailing gender norms in Mali. Yet, objectively, this perception is unfounded as female agents are on average better educated as shown in Table 1. Third, male farmers may engage differently with male agents compared to female agents, potentially asking different questions and discussing varying topics. Consequently, the sales interactions could vary in length or content between male and female agents. From model (1), we can neither confirm nor rule out any of these explanations.

Another important determinant for the adoption of the insurance scheme is the insurance premium. With an increase in premium per ha of CFA 1,000 (which equals about EUR 1.50), the likelihood to take out insurance cover decreased by 21%. Such an increase in premium would be quite drastic, but even when considering price changes in the magnitude of one standard deviation (i.e., CFA 340), the change in likelihood to adopt the insurance remains relevant. Assuming rational economic behaviour, this relation is to be expected and also in line with previous literature on the adoption of insurance (e.g., Hill *et al.*, 2016; Stoeffler and Opuz, 2022).

In addition, the results show that a frequent use of a mobile phone is positively associated with the likelihood to subscribe to the insurance. The studied insurance scheme has to be taken out via a mobile phone. Despite the fact that the insurance agent's task is also to facilitate the process and support farmers, including farmers with low levels of mobile phone use, the effect size for a frequent use of a mobile phone remains large.

Furthermore, we observe statistically significant associations between risk management aspects and insurance adoption. They are, however, rather minor in terms of magnitude. A higher expectation for harvest losses in the future is associated with an increased likelihood to take out insurance. In contrast, a higher number of income generating activities, which serves as a proxy for risk diversification here, is negatively associated with the likelihood to adopt insurance. We also controlled for socioeconomic characteristics, and the effect sizes are close to zero for most control variables.

Even when changing the number of covariates included in the probit model, the effect sizes remain stable. An overview of the robustness check is presented in the Appendix in Table A.1.

In an attempt to gain additional insights on the relation between the agent's gender and the insurance adoption decision, we tested whether the negative gender bias towards female insurance agents persists across all educational levels. The models on subsamples disaggregated by educational levels (models (2)-(4)) show that the gender of the insurance agent loses importance with increasing levels of education. For farmers without education or with only primary education (models (2) and (3)), the gender of the insurance agent (female insurance agent) is negatively and statistically significantly associated with their index-based insurance adoption. They are about 10% less likely to adopt index-based insurance if their insurance agent is a female compared to their fellow male farmers without formal education whose insurance agent is a male. In contrast, the marginal effect of the agent's gender on the purchase decision of farmers with more than primary education is close to zero and not statistically significant. Hence, higher-educated farmers do not consider the agent's gender when making the insurance adoption decision.

These observations offer additional insights into the previously discussed explanations for the observed gender bias in model (1). They suggest that the importance of the agent's gender on male farmers' insurance adoption, as seen in model (1), is not exclusively attributable to a

preference for agents of the same gender. We assume that such a preference would be independent of educational level. Instead, this result supports the second explanation: that biases, prejudices and expectations towards female agents may be at play in model (1). The belief in substantial differences between the capabilities of men and women might diminish with increasing formal education. However, we cannot rule out that other explanations are at play here. It is, for instance, also possible that with higher levels of formal education, other, more product-related factors may outweigh the effect of a gender bias on the insurance purchase decision.

Furthermore, it is observed in Table 3 and Table 4 that the marginal effects in the models (2) to (4) also vary across the three samples with regards to risk diversification and experience. While farmers without formal education tend to take out insurance more often if they have off-farm income, this is not observed for farmers who received education. Those respondents with higher education (model 4), in turn, are 14% more likely to subscribe to the insurance when they experienced a situation where their income was insufficient to cover household expenses. We also observe that the effect of mobile phone use seems to be largely driven by those who are least educated.

----------Table 3 here ----------

----------Table 4 here ----------

4.3 Limitations and Future Research Outlook

This study offers valuable insights into the role of the insurance agent's gender in the adoption decision, but we need to acknowledge a few limitations of our study, primarily related to data availability. As we assess an index insurance which is tailored to maize and maize, in turn, is

primarily cultivated by men in Mali, our analysis is based on a sample including only male farmers. Hence, we cannot derive conclusions regarding the preferences of female farmers as many other gender-related aspects may come into play. Female farmers tend to have a lower demand for insurance. Timu *et al.* (2023) find that women as compared to men purchase a lower insurance coverage of an index-based livestock insurance in Ethiopia. Furthermore, in an experimental setting in Bangladesh, Akter *et al.* (2016) even observe that women have a general aversion against insurance. For a livestock insurance program in Ethiopia, in contrast, Bageant and Barrett (2016) do not observe differences in insurance demand between male and female pastoralists. Summarizing current evidence regarding the gendered aspects of index insurance, Timu and Kramer (2023) state that – despite differences in gender dynamics that are likely to be attributed to the context – existing insurance schemes are often neither gender-inclusive (i.e., they do not actually reach women) nor gender-responsive (i.e., delivering benefits to men and women). They discuss various product related aspects on how to increase the reach and benefits to women. Previous studies on extension services draw a mixed picture with some finding that female agents increase adoption rates among female participants (Ahmed *et al.*, 2023, Lecoutere *et al.*, 2023) while others do not observe statistically significant effects of transferring information by women to women (Kondylis *et al.*, 2016, Medendorp *et al.*, 2022). Thus, the question whether female farmers would be more inclined to adopt insurance when assisted by a female agent warrants further investigation in future research to further advance knowledge regarding insurance reach towards women.

Moreover, we refrain from claiming a causal relationship between the agent's gender and the adoption decision. Using another, separate dataset (see Section 3.2), we find differences in education and professional activity between female and male agents working for OKO in 2022, and we assume that this also applies to the sales period assessed in this study. As we cannot control for these characteristics in our main analysis, the extent to which they affect the

insurance sales process remain uncertain, representing an important caveat to this analysis. Future research on the role of agents should ideally control for a broader range of agent characteristics, particularly educational attainments and relevant professional experience. In the microcredit context, for instance, Beck *et al.* (2018) found that increased sales experience with opposite-gender clients mitigates the typically observed gender bias. Whether similar effects of agent characteristics have an influence on the observed gender bias in insurance sales remains an open question for future investigation.

Lastly, our study abstracts from potential heterogeneity in the insurance distribution channels. Jensen *et al.* (2024) observed that insurance agents were more likely to visit areas where the insurance firm conducted marketing campaigns. In this study, we believe that farmers were equally likely to receive marketing information as the marketing was largely done via radio broadcasts, which are not limited to urban centers. However, Jensen *et al.* (2024) also noted that agents are more likely to visit locations that had a relatively better previous season and are less likely to reach out to farmers in areas where the insurance premium is high. We hypothesize that this effect may be more pronounced for female agents, who might face greater mobility challenges than their male counterparts. This could create an implicit mechanism through which differences in agents' sales behavior indirectly contribute to the observed gender bias among male farmers. Even without considering the gender aspect, the findings by Jensen *et al.* (2024) suggest variations in sales behavior and discussions. To avoid confounding factors, future studies should aim at controlling for these variations.

5. Conclusion

Agricultural insurance, in particular index-based insurance, presents an opportunity for farmers to mitigate the adverse effects of climate change. However, adoption rates remain low. This has been attributed to a number of factors including, but not limited to, basis risk, high insurance premium and lack of trust in insurance providers by farmers (Platteau *et al.*, 2017). We add to

this literature by investigating the relationship between male maize farmers' index-based insurance adoption and the gender of the insurance agent in southern Mali while considering the educational level of farmers.

Our results show that male maize farmers are less likely to adopt index-based insurance if the insurance agent is a female compared to a male agent. However, with increasing levels of formal education, the influence of the agent's gender on the adoption decision decreases. Male farmers who have beyond primary education take their insurance adoption decision independent of the gender of the insurance agent. We hypothesize that the initial and overall negative gender bias towards female agents can be attributed to gender-based expectations and prejudices which can be altered through formal education. Determining whether a similar same-gender preference holds among female farmers constitutes an important avenue for future research.

A key implication of this study is the need to promote education, as a higher level of education among the farmers was linked to a neutral perception of the insurance agent's gender in the insurance adoption decisions. This suggests that education can play a crucial role in fostering gender equality. Because higher educational attainments only encompass the current and future school aged generation, policy makers may also want to consider additional initiatives such as information campaigns on gender equality. These efforts would reach not only the young generation in schools but also farmers of all ages. Additional research on such educational programs and campaigns is needed to determine their effectiveness.

Regardless of farmers' education levels, our results underscore the importance of considering local gender roles and perceptions when distributing insurance products. In doing so, we contribute to existing research on customer-agent relationships in the microcredit sector by demonstrating that gender norms also play a significant role in insurance sales. Within the given study context, insurance companies may benefit from assigning male agents to advise male farmers. However, our findings also raise the question of how to overcome the negative bias

towards female agents among male farmers. One possible approach could be to implement certification programs for insurance agents. If both male and female agents hold the same certifications – indicating an equivalent level of knowledge and training – it could reduce uncertainty about their competencies and help mitigate gender-based biases.

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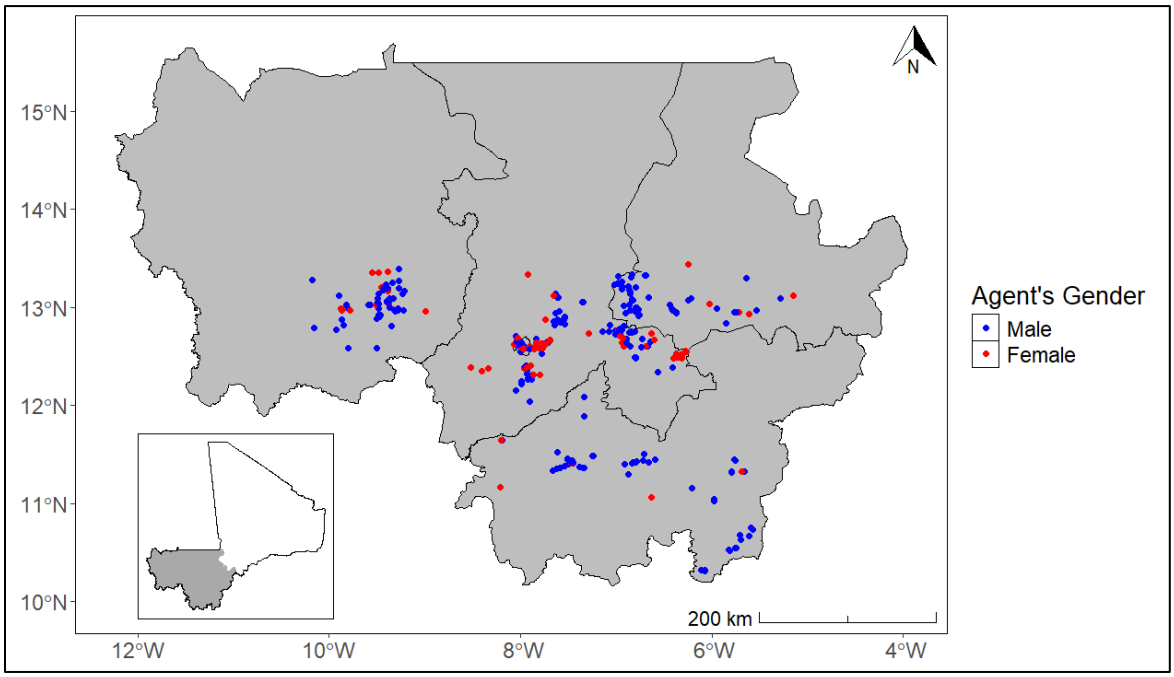
Figure 1. Geographic distribution of interview locations across the study region.



Note: The grey-shaded areas represent the regions in Mali where OKO operates, specifically Bamako, Kayes, Koulikoro, Ségou, and Sikasso. Farmer interviews were conducted at the locations marked by dots (N = 783). More than half of all the interviews were conducted at the farmer's house (N = 454), while the rest took place near the fields, at cooperatives, or in other spaces (most likely village centers, though not explicitly identified). The dots are coloured according to the gender of the insurance agent that the respondent interacted with.
Source: Authors own work based on administrative divisions from GADM (2022).

Table 1. Comparison of key characteristics between female and male agents in a separate dataset on agent characteristics.

	Total	Female	Male
Age (years)	34.47	31.37	35.27
Education			
No education [a]	0.06	0.00	0.08
Primary school or Koranic education [a]	0.14	0.11	0.15
Middle and/or Highschool [a]	0.27	0.16	0.30
Higher education [a]	0.53	0.74	0.47
Field of profession activity [b]			
Agriculture [a]	0.45	0.21	0.51
Employment (public or private sector) [a]	0.05	0.05	0.05
Teaching [a]	0.04	0.16	0.01
Merchant [a]	0.09	0.21	0.05
Other sectors [a]	0.37	0.37	0.37
N	93	19	74

Note: a) Binary variable that takes 1 if the category applies. b) The field of professional activity may refer to the agent's prior background or any current pursuits beyond their role as an insurance agent.
Source: Authors own work.

Table 2: Summary statistics of male farmer respondents.

		Pooled sample		Sample split by education						Sample split by gender of the agent			
				No formal education[d]		Koranic/ Primary education		Beyond primary education [d]		Contacted by a male insurance agent		Contacted by a female insurance agent	
Variable	Unit	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	Years	46.98	12.68	50.17	11.90	45.68	12.31	40.41	12.68	47.12	12.71	46.50	12.62
Beneficiary of Jigisemejiri (social protection program, yes=1)	1/0 [b]	0.12	-	0.11	-	0.14	-	0.13	-	0.11	-	0.16	-
Cultivated area	ha	14.90	12.79	17.12	15.10	13.70	10.13	10.87	8.16	15.48***	13.51	12.87	9.67
Educational level (yes = 1)	1/0												
No education		0.27	-	-	-	-	-	-	-	0.30***	-	0.15	-
Literacy school		0.23	-	-	-	-	-	-	-	0.21	-	0.27	-
Primary school		0.19	-	-	-	-	-	-	-	0.19	-	0.22	-
Koranic education		0.14	-	-	-	-	-	-	-	0.14	-	0.14	-
Secondary school		0.15	-	-	-	-	-	-	-	0.13	-	0.18	-
Higher (tertiary) education		0.03	-	-	-	-	-	-	-	0.02	-	0.04	-
Education	Years	4.14	4.16	-	-	-	-	-	-	3.93***	4.11	4.87	4.29
Expectation of yield loss in the next 10 years due to drought (at least 25% of total expected harvest)	Number	2.01	1.43	2.03	1.42	2.05	1.49	1.87	1.36	1.96*	1.43	2.19	1.43
Experienced situation with insufficient household income (yes=1)	1/0[b]	0.69	-	0.70	-	0.71	-	0.64	-	0.67***	-	0.79	-
Frequency of mobile phone use	Scale[a]	3.50	0.68	3.42	0.71	3.53	0.68	3.67	0.56	3.55***	0.65	3.35	0.76
Gender of insurance agent (female=1)	1/0[b]	0.22	-	0.19	-	0.24	-	0.29	-	0.00	-	1.00	-
Household size	Members	21.68	14.64	22.45	14.98	22.40	15.31	18.09	11.55	22.39***	15.57	19.25	10.48
Insurance cover for crop season (yes=1)	1/0[b]	0.79	-	0.76	-	0.82	-	0.83	-	0.81**	-	0.73	-
Insurance premium per ha for crop season	1k CFA [c]	6.41	0.35	6.42	0.36	6.40	0.33	6.42	0.34	6.42	0.36	6.39	0.27
Number of income-generating activities	Number	2.00	0.99	2.01	0.99	1.95	0.97	2.10	1.03	1.93***	0.97	2.27	1.00
Off-farm income during the past 12 months (yes=1)	1/0 [b]	0.14	-	0.11	-	0.11	-	0.30	-	0.14	-	0.14	-
Remittance during the past 12 months (yes=1)	1/0 [b]	0.32	-	0.28	-	0.34	-	0.36	-	0.32	-	0.32	-
N		783		386		262		135		608		175	

Note: [a] Measured at a 4-level scale where 1 indicates "never", 2 means "a few times per week", 3 indicates "1-3 times a day", and 4 means "at least 4 times a day".
[b] Mean values for dummy variables (1/0) indicate ratios. [c] CFA: CFA-Franc BCEAO. 1€ = 655 CFA-Franc BCEAO. d) "No formal education" comprises farmers who have no education or literacy education, and "Beyond primary education" comprises farmers who have middle school education, high school education or tertiary education.
***, **, and * indicates statistical significance at the 1%, 5% and 10% levels, respectively. Significance level is for the difference in means between farmers who were contacted by male and female insurance agents.
Source: Authors own work.

Table 3. Probit estimates for farmers' adoption of index-based insurance.

	Pooled sample	Sample split by education		
		No formal education	Primary/ Koranic education	Beyond primary education
Model	(1)	(2)	(3)	(4)
Gender of the insurance agent (female = 1)	-0.28**	-0.32*	-0.44*	-0.00
	[0.13]	[0.19]	[0.23]	[0.35]
Age (years)	0.01**	0.01*	0.01	0.03**
	[0.00]	[0.01]	[0.01]	[0.01]
Beneficiary of Jigisemejiri (yes = 1)	0.25	0.05	0.56*	0.36
	[0.17]	[0.24]	[0.34]	[0.49]
Cultivated area (ha)	0.01**	0.01	0.02**	0.03
	[0.01]	[0.01]	[0.01]	[0.02]
Education (years)	0.03**	-	-	-
	[0.01]			
Expected frequency of severe harvest losses	0.08**	0.07	0.12*	0.06
	[0.04]	[0.05]	[0.07]	[0.11]
Experienced situation with insufficient income (yes = 1)	0.18	0.13	0.12	0.71**
	[0.12]	[0.17]	[0.24]	[0.33]
Frequency of mobile phone use (categorical)	0.23***	0.27**	0.23	-0.36
	[0.08]	[0.11]	[0.15]	[0.31]
Insurance premium (per ha in 1,000 CFA)	-0.80***	-0.57***	-1.13***	-1.08***
	[0.15]	[0.20]	[0.30]	[0.40]
Number of income-generating activities	-0.12**	-0.20**	0.07	-0.07
	[0.06]	[0.08]	[0.12]	[0.16]
Off-farm income (yes = 1)	0.23	0.60**	-0.21	0.08
	[0.17]	[0.28]	[0.32]	[0.35]
Remittances received during past 12 months (yes = 1)	0.13	0.31*	-0.23	0.45
	[0.12]	[0.18]	[0.21]	[0.35]
Constant	4.38***	2.83*	6.27***	7.15**
	[1.08]	[1.46]	[2.15]	[2.93]
Pseudo R-squared	0.106	0.116	0.154	0.208
Log likelihood	-359.15	-189.44	-104.26	-48.82
AIC	744.30	402.87	232.53	121.64
BIC	804.92	450.34	275.35	156.51
N	783	386	262	135

Note: Standard errors in brackets, * p<.1, ** p<.05, *** p<.01. CFA: CFA-Franc BCEAO. 1€=655 CFA-Franc BCEAO. "No formal education" comprises farmers who have no education or literacy education, and "Beyond primary education" includes farmers who have middle school education, high school education or tertiary education.

Source: Authors own work.

Table 4. Marginal effects of the probit models on male farmers' adoption of index-based insurance.

	Pooled sample	Sample split by education		
		No formal education	Primary/ Koranic education	Beyond primary education
Model	(1)	(2)	(3)	(4)
Gender of the insurance agent (female = 1)	-0.07**	-0.09*	-0.10*	-0.00
	[0.03]	[0.05]	[0.05]	[0.07]
Age (years)	0.00**	0.00*	0.00	0.01**
	[0.00]	[0.00]	[0.00]	[0.00]
Beneficiary of Jigisemejiri (yes = 1)	0.06	0.01	0.12*	0.07
	[0.04]	[0.07]	[0.07]	[0.10]
Cultivated area (ha)	0.00**	0.00*	0.00**	0.01
	[0.00]	[0.00]	[0.00]	[0.00]
Education (years)	0.01**	-	-	-
	[0.00]			
Expected frequency of severe harvest losses	0.02**	0.02	0.03*	0.01
	[0.01]	[0.01]	[0.02]	[0.02]
Experienced situation with insufficient income	0.05	0.04	0.03	0.14**
(yes = 1)	[0.03]	[0.05]	[0.05]	[0.06]
Frequency of mobile phone use (categorical)	0.06***	0.08***	0.05	-0.07
	[0.02]	[0.03]	[0.03]	[0.06]
Insurance premium (per ha in 1,000 CFA)	-0.21***	-0.16***	-0.25***	-0.21***
	[0.04]	[0.05]	[0.06]	[0.07]
Off-farm income (yes = 1)	0.06	0.17**	-0.05	0.02
	[0.04]	[0.08]	[0.07]	[0.07]
Number of income-generating activities	-0.03**	-0.06**	0.02	-0.01
	[0.01]	[0.02]	[0.03]	[0.03]
Remittances received during past 12 months	0.03	0.09*	-0.05	0.09
(yes = 1)	[0.03]	[0.05]	[0.05]	[0.07]
N	783	386	262	135

Note: Standard errors in brackets, * p<.1, ** p<.05, *** p<.01. CFA: CFA-Franc BCEAO. 1€=655 CFA-Franc BCEAO. "No formal education" comprises farmers who have no education or literacy education, and "Beyond primary education" includes farmers who have middle school education, high school education or tertiary education.

Source: Authors own work.

Table A.1. Probit estimates for various model specifications for male farmers' adoption of index-based insurance (N=783).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gender of the insurance agent (female = 1)	-0.28**			-0.33***	-0.29**	-0.32***	-0.27**
	[0.13]			[0.12]	[0.12]	[0.12]	[0.12]
Insurance premium (per ha in 1,000 CFA)	-0.80***	-0.79***		-0.86***	-0.89***	-0.83***	-0.89***
	[0.15]	[0.15]		[0.14]	[0.14]	[0.15]	[0.14]
Age (years)	0.01**	0.01**	0.01***	0.01**			
	[0.00]	[0.00]	[0.00]	[0.00]			
Education (years)	0.03**	0.03*	0.03**	0.03**			
	[0.01]	[0.01]	[0.01]	[0.01]			
Expected frequency of severe harvest losses	0.08**	0.07*	0.07*		0.08**		
	[0.04]	[0.04]	[0.04]		[0.04]		
Number of income-generating activities	-0.12**	-0.14**	-0.12**		-0.12**		
	[0.06]	[0.06]	[0.06]		[0.05]		
Off-farm income (yes = 1)	0.23	0.26	0.30*		0.24		
	[0.17]	[0.17]	[0.17]		[0.16]		
Beneficiary of Jigisemejiri (yes = 1)	0.25	0.23	0.24			0.20	
	[0.17]	[0.17]	[0.17]			[0.17]	
Cultivated area (ha)	0.01**	0.01**	0.01**			0.01**	
	[0.01]	[0.01]	[0.01]			[0.01]	
Experienced situation with insufficient income (yes = 1)	0.18	0.14	0.28**			0.26**	
	[0.12]	[0.12]	[0.11]			[0.12]	
Remittances received during past 12 months (yes = 1)	0.13	0.12	0.18			0.15	
	[0.12]	[0.12]	[0.12]			[0.12]	
Frequency of mobile phone use (categorical)	0.23***	0.24***	0.24***				0.24***
	[0.08]	[0.08]	[0.08]				[0.07]
Constant	4.38***	4.25***	-1.09***	5.86***	6.65***	5.82***	5.77***
	[1.08]	[1.07]	[0.39]	[0.98]	[0.94]	[0.98]	[0.96]
Pseudo R-squared	0.106	0.101	0.065	0.066	0.070	0.074	0.069
Log likelihood	-359.15	-361.43	-375.81	-375.41	-373.89	-372.27	-374.17
AIC	744.30	746.87	773.63	760.82	759.78	758.54	756.33
BIC	804.92	802.83	824.92	784.14	787.75	791.18	774.99

Note: Standard errors in brackets; * p<.1, ** p<.05, *** p<.01.
Source: Authors own work.