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Agricultural sales in Sub-Saharan Africa: Does farmers' gender matter?

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Agricultural sales in Sub-Saharan Africa: Does farmers' gender matter?

Wei Li¹ Kashi Kafle²

Abstract

This paper investigates the relationship between farmer's gender and agricultural sales in Ethiopia, Tanzania, and Nigeria, utilizing three rounds of the LSMS-ISA dataset. It uses panel data estimators to examine how a farmer's gender influences the decision to sell agricultural products and sales outcomes. The study identifies a difference between female and male farmers in market participation, sales value, and sales volume, which finds that female farmers are less likely to sell and sell less than male farmers. The results suggest that policy interventions that support market access for female farmers, which could help build a more complete market channel, enhance agricultural productivity, and ensure food security in Sub-Saharan Africa.

Keywords: agricultural sales, decision-making, farmer's gender

JEL codes: O12, O13, Q13.

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1. Introduction

In Sub-Saharan Africa (SSA), agriculture plays a central role in ensuring food security and reducing poverty, primarily among smallholders who traditionally practice subsistence farming to feed their families (Giller 2020; Conceição et al. 2016; Hilson 2016). The potential of these farmers is often constrained by limited production resources and poor market access, especially for female farmers. In recent years, with an increasing rate of male outmigration, more and more agricultural activities are led by female farmers (World Bank 2015). While female labor is critical in land preparation, planting, harvesting, and processing, they are believed to have unequal access to markets, compared to male farmers (Jc and Fn 2021; Maereka et al. 2023). It is also believed that female farmers in SSA sell primarily to local and informal markets only as they have poor access to formal regional markets. This gender disparity in market access could lead to inefficient resource allocation by different household members, which could result in suboptimal outcomes for the household. It also constrains female farmers' ability to influence household decisions that could improve their individual well-being and the household's collective well-being. Are female farmers less likely to sell agricultural products? Are they limited to local or informal markets only? We answer these questions using micro-household panel data from Ethiopia, Nigeria, and Tanzania.

Female farmers are actively engaged in post-harvest activities such as processing and packaging, which are essential for value addition and selling in the market. Despite their significant contributions to agricultural activities, female farmers still face significant challenges in accessing markets and selling agricultural products (Soneye 2022; Muhanji et al. 2011). Some of the challenges include limited control over household resources, poor access to markets, gender stereotypes, and lack of social networks essential for marketing. Cultural norms and social customs

also limit their ability to engage with traders and other market actors who are primarily males (Setini et al. 2020). The allocation of resources and agricultural sales are often influenced by intra-household decision-making power (Sell and Minot 2018; Nyakato, Rwabukwali and Kools 2020; Bertocchi, Brunetti and Torricelli 2014). When females are excluded from these processes, their specific needs and constraints may be overlooked, which further impacts their ability to participate in markets and optimize their agricultural sales.

Existing literature shows that the gender disparity in agricultural sales is a consequence of gender stereotypes in agriculture. For example, female farmers primarily cultivate cereal crops for subsistence but male farmers are involved more in cash crop cultivation ((Doss 2002). As such, male farmers are more likely to have a strong connection with the formal markets than female farmers. Agricultural sales are affected by factors such as the distance to markets, quality of road infrastructure, and transportation costs. If farmers have a higher cost of accessing the market, they are more likely to sell at a local or informal market (Kafle and Balasubramanya 2022). In many cases, males are more likely to sell agricultural produce to regional or formal markets (Gebre et al. 2021). This is no surprise as male farmers typically have greater access to resources such as land, credit, and technology, which can facilitate commercial farming. Female farmers have limited access to transportation and resources, which may confine sales to local and less profitable markets. As transaction cost affects the decision to sell and the point of sales (Woldie and Nuppenau 2011; Gong et al. 2007; Tilahun et al. 2023), it can also contribute to the gender differential in agricultural sales. Not only female farmers are more likely to face higher transaction costs than male farmers but also they lack opportunities to participate in agricultural value chains (Oduol et al. 2017; Kafle and Balasubramanya 2022).

Improving female farmers' access to markets is fundamental for achieving economic empowerment, enhancing agricultural productivity, and ensuring food security (Mobarok, Skevas and Thompson 2021; Alkire et al. 2013). It promotes gender equality by challenging traditional gender roles and enabling females to contribute significantly to household income and community development. This empowerment can lead to improved nutrition and health outcomes for their families as females typically reinvest a substantial portion of their earnings back into their households (Malapit and Quisumbing 2015). By enhancing female farmers' access to markets, they can achieve better prices for their products, invest in sustainable farming practices, and improve their overall economic stability and resilience to climate and economic shocks (R. Hariharan Et Al., and TJPRC 2020). Studies have shown that when women are empowered with market access, they are more likely to reinvest their earnings in their households and communities, leading to broader socioeconomic benefits (Rahman 2010; Glazebrook, Noll and Opoku 2020). However, it is less understood whether farmers' gender affects decisions to sell and where to sell.

We examine the gender effect on agricultural sales using micro-household longitudinal data from Ethiopia, Tanzania, and Nigeria. The data come from the Living Standards Measurement Study-Integrated Surveys in Agriculture (LSMS-ISA) database in these countries. The primary objective is to tease out the effects of farmer's gender on the decision to sell agricultural products and the point of sales (local vs. regional markets and formal vs. informal markets). This is explored at household level and individual level. First, we consider the unitary household model where a household is a single homogenous unit, and all agricultural sales decisions are made centrally by a member, primarily the household head. Empirically, we test this by regressing agricultural sales against household head's gender. Second, we consider the collective rationality model where each household member is allowed to make their own decision to maximize the collective household

utility. In this case, agricultural sales decisions are allowed to be made separately by different household members. We do this by regressing the plot manager's gender on sales of the crop from that plot.³

We contribute to the existing literature by examining the gender dimensions of household and individual decisions around agricultural sales in the context of sub-Saharan Africa. Empirical studies on the relationship between farmer's gender and crop sales are in short supply and existing studies focus primarily on a small region of a country for a single year or provide qualitative evidence. We push the literature by using longitudinal household and agricultural data for three different periods to analyze the relationship. By examining data over several years in three different countries, we observe changes and trends that may not be evident in cross-sectional studies. In addition to highlighting the existing gender differences in crop sales, we distinguish the gender disparities in the prevalence of crop sales, value and volume of sales, and the point of sales; the latter has been overlooked in the literature. Our findings help to identify potential gender-targeted policy interventions to promote market participation of female farmers and foster inclusive economic growth in Sub-Saharan Africa.

The rest of the paper proceeds as follows. Section 2 provides a background on gender dynamics and market access in Sub-Saharan Africa. Section 3-4 presents the data, models, and hypothesis. Section 5 provides descriptive analysis and econometric results. Section 6 presents robustness checks and section 7 concludes.

2. Background

³ LSMS-ISA data records plot manager's gender but does not record crops sales at the plot level. Crops sales are reported at household-crop level only. Therefore, we use only the major crop cultivated in the country, keep only the plots that cultivate the crop, and estimate the relationship between plot manager's gender and sales of the crop.

Ethiopia's agriculture is essential not only for food production but also for employment, as it employs the majority of the population, particularly in rural areas. This sector is characterized by small-scale subsistence farming, with a diverse range of climatic and soil conditions contributing to the variety of crops produced. Markets for these agricultural products are both local and international. Locally, crops are sold in village markets and to traders who may supply regional or national markets. Internationally, Ethiopian products such as coffee, oilseeds, and flowers are exported to markets around the world. It is actively working to expand its agricultural exports, with a focus on increasing productivity, sustainability, and value addition. This includes improving infrastructure, such as roads and market facilities, and adopting new agricultural technologies.

Despite the fast-growing economy, it remains one of the most impoverished in the world. Female farmers are integral to agricultural labor, performing up to 75% of farm work and producing 70% of household food. However, they face many challenges, producing significantly less than male farmers due to limited access to resources such as extension services, seeds, and fertilizer. Initiatives like those from USAID and the Relief Society of Tigray (REST) aim to empower female farmers by improving access to irrigation water, thus boosting their productivity and economic opportunities. With the assistance of programs by USAID and REST, they are able to diversify their crops and sell some of their produce in the market. These initiatives have empowered female farmers by reducing labor time and allowing them to invest in community savings cooperatives, which in turn helps to protect their assets and increase their economic opportunities.

Regarding women's access to markets, females in Tanzania actively participate in crop cultivation. Females are at the heart of Tanzania's agricultural transformation strategy. Tanzania's new agricultural transformation strategy, known as Agenda 10/30, aims to increase the sectors'

growth to 10 percent per year by 2030. To achieve this target, the government plans to increase the number of workers employed in the sector by 3 million in mainland Tanzania and 300,000 in Zanzibar, to be made up mostly of females and youth. However, gender disparities and cultural norms can limit their access to markets and resources. The government and NGOs have been running various programs aimed at empowering women in agriculture. These programs often provide training and support to help women increase their agricultural productivity and income.

Nigeria has a diverse agricultural landscape, with typical crops including cassava, yam, maize, and rice. Crop markets in Nigeria are also diverse, ranging from small local markets to large commercial markets. The challenge of market access for female farmers in Nigeria, as in many other regions of SSA, involves several issues that hinder their ability to sell their agricultural produce effectively. In many rural areas of Nigeria, inadequate transportation infrastructure and high transportation costs can pose significant challenges for female farmers in reaching markets, especially distant ones. Nigeria has initiated the National Development Plan (2021-2025) to address these issues. This plan emphasizes food security, infrastructure development, and climate change adaptation as key areas for growth and development.

Female farmers play a crucial role in Nigeria's agriculture sector, constituting about 37% of the agricultural labor force and being pivotal in food production, processing, marketing, and preservation. Few females hold rights over the land they farm, and many work without pay or a say in financial decisions. Efforts are being made to enhance the role of women in agriculture to improve food security and alleviate poverty. For instance, USAID, in partnership with Feed the Future and the Nigerian-based Trade Hub, is providing tools, knowledge, and resources to female farmers. Programs like the Argungu Outgrower Expansion Program focus on training women in

rice farming, aiming to increase yields by 50 to 100%, thereby enhancing income and financial security for their families and communities.

Ethiopia, Tanzania, and Nigeria share similar agricultural backgrounds, and female farmers in these countries encounter comparable challenges when it comes to accessing markets. In order to address these challenges and enhance women's access to markets, it is essential for local governments and non-governmental organizations (NGOs) to collaborate effectively. This collaborative effort should focus on distributing market information, providing value addition training, and implementing initiatives that connect female farmers with markets and buyers.

3. Data

The data come from the World Bank's LSMS-ISA database for Tanzania, Ethiopia, and Nigeria. For each country, data on household demographics, sales activities, crop characteristics, financial conditions, and agricultural activities are available for three different periods between 2010 and 2016. Gender information is available for each household member. Major crop sales data are provided at the plot level, but we aggregate them annually for different crop managers. All other information is also available at the household level and crop level.

Table 1 presents the details of the cross-sectional sample size for all three countries. Although the number of respondents surveyed and the timeframe covered differs across the three countries, the methodology and questions used in the surveys are comparable. In this case, cross-country analysis could be done. Furthermore, all of the data sets encompass both household and agricultural information, with standardization applied wherever feasible.

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

3.1 Agricultural sales

The definition of agricultural sales includes three parts: the binary variable of sales (whether a household engages in sales activities or not) and the total sales value and the volume of the major crops sold. This primary focus aims to determine the presence or absence of sales transactions within a household. The second component, “the total value of sales” is the total economic value of agriculture crop sales. It represents not only the value of goods sold but also reflects the market price and the bargaining power of the farmer. Since the sales decisions are often made at the household level, both are at the household level. The volume of sales is the total quantity of the major crops sold. Major crops typically represent a significant portion of agricultural production and sales within a country. By narrowing the focus to these major crops, we can explore how gender factors influence their sales volume.

3.2 Farmer’s gender

The gender of farmers is defined at two levels: household level and individual level. At the household level, the focus is on the gender of the household head. The household head is often considered the primary decision-maker who controls resources, makes financial decisions, and sets priorities for the household. By comparing sales outcomes between households led by males and those led by females, we can identify potential differences and barriers that female-headed households may face. It also provides evidence that policies may need to be tailored to address specific barriers faced by female-headed households. While in reality decision-making power can be distributed among multiple individuals within a household, it is also essential to analyze gender at the individual crop manager level. Crop managers often have significant authority over critical decisions such as crop selection, planting schedules, resource allocation. The gender of crop managers can influence access to resources like seeds, fertilizers, technology, and financial

services. This level of analysis provides insights into the specific constraints and opportunities faced by male and female crop managers, which can directly impact agricultural sales outcomes.

Combining these two levels provides a more complete perspective, which could help policymakers design targeted interventions that address gender-specific barriers at both the household and individual levels.

3.3 Market access

Market access in the LSMS-ISA survey was elicited by asking the primary point of crop harvest sales (where farmers sold their products, primarily). We further identify major buyers who purchase most of the household's sales or determine the primary market where the household sells the majority of their agricultural produce. In this case, market access will only be analyzed at the household level. Formal markets include local markets, regional traders, cooperatives, etc. Informal markets include street vendors, friends, neighbors, relatives, etc. If the point of sale is located within the town or near the town, it is considered a local market, otherwise, it is considered a regional market. Each household is divided into four groups according to where they primarily sell their agricultural products. It means that each household is categorized as selling in formal/informal markets and local/regional markets. This classification helps to understand the spatial dynamics of agricultural sales and how they align with market accessibility and infrastructure.

4. Household level analysis

We consider a household as a unit to examine the relationship between a household head's gender and three key dependent variables: a binary variable indicating agricultural sales, the total value of agricultural sales, and the point of sale (local, regional, informal, and formal buyers). It examines how the gender of the household head might influence agricultural sales. As the same

households are observed over time, a Two-Way Mundlak Regression (Wooldridge 2021) will be used to control for unobservable characteristics of farming households that may influence their market behavior and decisions regarding agricultural sales. The Two-Way Mundlak estimator is equivalent to the Two-Way Fixed Effect estimator, but it is more efficient and allows for the estimation of the time-invariant variables. Equation (1) provides a mathematical representation of the relationship between agricultural sales and household head's gender.

$$Sale_{it} = \alpha_0 + \alpha_1 Gender_i + \beta_1 X_{it} + \beta_2 \bar{X}_i + \beta_3 \bar{X}_t + \varepsilon_{it} \quad (1)$$

where $Sale_{it}$ denotes whether a household sold agricultural produce, or the value of sales by household i at time t , $Gender_i$ denotes the household head's gender in household i , and X_{it} denotes the vector of control variables that might affect the sales outcome for household i at time t , such as household size, dependent ratio, and land size, etc. We use a uniform set of control variables across three countries to ensure that any differences observed in the outcomes across countries can be attributed more confidently to differences in the treatment variables rather than differences in the types of variables controlled for. This makes the comparative analysis more robust. The gender of the household head is considered a time-invariant variable since there is not much variation across the three survey periods.

5. Results

5.1 Descriptive statistics

In this section, we first present descriptive results followed by results from regression analysis. Robustness checks are provided in section 6.

We present a summary of household demographic characteristics, household head's demographic characteristics, and sales variables for each of the three countries considered in this analysis.

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

Table 2 provides an overview of household characteristics and economic indicators across three waves of surveys conducted in Ethiopia, Nigeria, and Tanzania. It includes household size, which shows a general increase over the survey periods in all countries. The dependency ratio in these countries remains above 1.5, which indicates a higher number of dependents per working-age adult. The demographic data indicates a stable but increasing number of economically active adults (15–64 years). Economic data shows variations in total consumption expenditure both in local currency and USD, which is deflated by the base year 2003 for all three countries. Access to loans and irrigation remains low across all countries, which reflects persistent challenges in financial access and agricultural infrastructure. The data on climatic shocks indicates varying levels of exposure, which could influence agricultural productivity and economic stability.

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

Table 3 presents the demographic and educational characteristics of household heads across three survey waves in Ethiopia, Nigeria, and Tanzania. It highlights a steady presence of female household heads with slight increases over time, particularly in Nigeria where the percentage rose from 12% to 14%. The age of household heads generally increased across the surveys, indicating an aging leadership in households. Marital status shows a modest decline in the proportion of married individuals, particularly in Ethiopia and Tanzania. A considerable

number of household heads in Ethiopia and Tanzania have never attended school, with around 63% and 25% respectively, whereas Nigeria shows improvement in educational attainment over time.

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

Table 4 provides a detailed view of household sales characteristics across Ethiopia, Nigeria, and Tanzania over three survey waves, which captures sales value in local currency and USD, access to transportation, transportation costs, and the distance to major markets. Sales values show a general upward trend in all three countries. Access to transportation has seen mixed changes, with Ethiopia showing slight improvements, Nigeria making significant strides from 28% to 42%, and Tanzania experiencing a minor decline. Transportation costs have fluctuated, while distances to major markets have slightly increased in Ethiopia, decreased in Nigeria, and remained stable in Tanzania.

5.2 Econometric results

Table 5 shows the t-tests for significance of mean differences in accessing various agricultural resources between male and female-headed households in Ethiopia, Nigeria, and Tanzania. Male-headed households, with better access to essential agricultural inputs such as irrigation, pesticides, and fertilizers, together with larger land holdings and greater labor resources, are likely to achieve higher yields and produce better quality goods, which could enhance their market competitiveness and sales potential. Conversely, female-headed households face systemic barriers that limit their access to these crucial resources, resulting in lower productivity and reduced market participation. This not only impacts their economic stability but also perpetuates a cycle of reduced market access and financial insecurity.

-----Table 5 about here-----

Table 6 presents the results of a Two-Way Mundlak Regression looking at the effect of the gender of the farmer (whether the household head is female or not) on the decision to sell household products in three different countries: Ethiopia, Nigeria, and Tanzania. The dependent variable is whether sales occurred (1 for yes and 0 for no). The coefficient for a female head of household is negative in all three countries, which suggests that households headed by females are less likely to engage in sales activities compared to those headed by males.

-----Table 6 about here-----

In Ethiopia, households with a female head are approximately 7% less likely to sell than those with a male head. The situation is similar in Nigeria, with a significant reduction of around 6%. However, in Tanzania, the reduction is smaller and not statistically significant which suggests that the gender of the household head may not have a clear influence on sales decisions there.

-----Table 7 about here-----

In Ethiopia and Nigeria, households with female heads show a lower sales value compared to those with male heads, by approximately 24% and 26% respectively. This indicates that gender differences in control over resources or market participation could be influencing these outcomes. The analysis does not show a significant relationship in Tanzania, which suggests the effect of the household head's gender on sale values.

5.3 Channels

-----Table 8 about here-----

Table 8 represents the household sales and the impact of the head of household's gender across different consumption expenditure distributions in Ethiopia, Nigeria, and Tanzania. In all three countries, female-headed households in the middle 40% of the consumption expenditure distribution have statistically significantly lower sales compared to their male counterparts. The effect is most significant in the middle consumption expenditure group in Ethiopia, where the sales value is 35% lower for female-headed households at a five-percent significant level. However, the relationship is not consistent across all countries. For instance, in Tanzania, the difference is not statistically significant across the board, and in the bottom 40% of Nigeria, female-headed households show higher log sales values, although this is not statistically significant.

-----Table 9 about here-----

Table 9 presents insights into the impact of gender on household sales across different plot number distributions within Ethiopia, Nigeria, and Tanzania. The data suggests that female-headed households in the bottom 40% of plot numbers in Ethiopia and Nigeria are associated with significantly lower sales. Specifically, in Ethiopia, female-headed households show an 11% decrease in sales, which is quite a substantial difference given the scale. When it comes to the sales values, the impact of having a female head of household is starkly negative in the bottom 40% for Ethiopia and moderately for Nigeria, both being statistically significant. Tanzania, however, shows a positive but not significant association in the top 20%, which suggests that female heads may fare better in terms of sales value at this distribution level.

5.4 Market access

-----Table 10 about here-----

Table 10 illustrates how gender roles within households intersect with market economies in three countries. In Ethiopia, households with female heads show a slight disadvantage in local markets, but interestingly, they seem to have an advantage in regional markets. However, this advantage turns into a slight disadvantage in informal markets and then flips back to an advantage in formal markets.

Moving to Tanzania, the figures show an even more diverse impact. Female heads of household seem to benefit significantly in local markets, though this is not statistically significant due to the large standard error. In contrast, they are at a significant disadvantage in regional markets. The informal and formal market effects are positive but not statistically significant, which may imply some benefits that are not as pronounced or consistent. In Nigeria, female heads of household appear to do remarkably well in local markets. There is also a notable and significant negative coefficient for regional markets. The pattern of significant positive influence returns in informal markets, suggesting that female heads are adept at leveraging the flexibility of less structured markets. However, they face challenges in formal markets, as indicated by a significant negative coefficient.

These numbers indicate that female household heads may face different challenges and opportunities depending on the market's structure and scale. This could stem from various factors, including but not limited to social norms, market access, resources, or networks that are available to them.

5.5 Heterogeneity analysis

-----Table 11 about here-----

-----Table 12 about here-----

Table 11 and Table 12 display a cross-sectional analysis of how the gender of household heads and other factors influence sales in Ethiopia, Nigeria, and Tanzania.

Table 11 suggests that having a female head of household generally negatively correlates with sales across most categories and countries, particularly under conditions of lower education and climatic shocks. In rural households, the negative impact is consistently significant across all three countries. Table 12 shows mixed results when it comes to sales values: female-headed households in Ethiopia and Tanzania sometimes positively influence sales, especially in secondary education and urban settings. However, the impact remains predominantly negative in Nigeria and in situations of climatic stability and rural environments.

6. Robustness checks

We find that female-headed households are less likely to sell consistently across three study countries. We employ two different approaches to assess the robustness of the findings.

6.1 Pooled analysis

First, we pooled the data from all three countries together and estimated the relative gender–sales relationship with the metadata. Pooling the data across countries may create cross-variable inconsistencies and incomparability, but the results add to the literature that the farmer’s gender and agricultural sales relationship holds in both individual countries and the Sub-Saharan Africa region irrespective of the country. Results from the pooled analysis are presented in Table A1. Households headed by females are 5.7% less likely to sell their agricultural products compared to households headed by males. They also tend to have lower sales values when they do sell. The value of sales for female-headed households are approximately 27% lower than those of male-headed households.

-----Table A1 about here-----

6.2 Collective household model

The analysis so far assumes a single decision-maker within the household. This is consistent with the majority of empirical studies on farmer-market linkages as they are based on patriarchal theories that assume a unitary household model (Chiappori et al. 1993). However, the collective rationality model presents several advantages over the traditional unitary model, especially in the context of agricultural sales. The collective model recognizes that decisions within households are not made by a single individual but are the result of interactions among multiple members. This is particularly relevant for farming households where decisions about production and sales often involve negotiations between spouses and sometimes children and extended family members. Using a collective model can help highlight the role of female farmers in agricultural households, which is often underrepresented in unitary models. Females play crucial roles in the production, processing, and marketing of agricultural products, but their influence and contributions might be overlooked if the analysis assumes a single decision-maker on sales decisions of every crop. We test the collective rationality model by estimating the relationship between crop sales and the gender of the plot manager, as shown in Equation (2):

$$Sale_{htcp} = X_{htcp}\beta + \gamma Gender_{htcp} + \lambda_{htc} + \varepsilon_{htcp} \quad (2)$$

where X_{htcp} is a vector of characteristics of crop c at time t by a member of the household; $Sale_{htcp}$ is the sales outcomes on that crop; $Gender_{htcp}$ is the gender of the individual who controls the crop; λ_{htc} is a household-year-crop fixed effect; ε_{htcp} is an error term that summarizes the effects of unobserved crop quality variation and crop-specific production shocks on sales.

7. Conclusion

Using longitudinal data from integrated household and agriculture surveys from three countries in Sub-Saharan Africa (Ethiopia, Nigeria, and Tanzania), we estimate the effects of the farmer's gender on agricultural sales at the household level and individual level. We find that female-headed households face significant disadvantages in agricultural sales and market participation compared to male-headed households, in all three countries. We find that female-headed households are less likely to engage in sales activities (7% less likely in Ethiopia, 6% less in Nigeria, 3% less in Tanzania) and have lower sales values when they do sell (around 24% lower in Ethiopia, 26% lower in Nigeria), compared to male-headed households. This negative impact is most significant for households in the middle consumption expenditure distribution in Ethiopia and Nigeria and those with fewer plots of land. The effects vary across different market types, with female household heads facing disadvantages in some markets but advantages in others depending on the market structure and scale. The results persist across various categories like lower education, weather shocks, and rural settings. Even in the three-country pooled analysis, female-headed households are 5.7% less likely to sell agricultural products with 27% lower sales values than male-headed households. The results match with previous literature that male-headed households have better access to crucial agricultural resources like irrigation, fertilizers, and larger land holdings.

These findings on gender differences in agricultural sales and market participation across Sub-Saharan Africa have insightful policy implications, especially when considering the effects of gender inequality on decision-making and market participation. The consistent disadvantages faced by female farmers in accessing markets and maximizing agricultural sales emphasize the need for targeted interventions to address systemic barriers. Policymakers should prioritize

initiatives that improve access to essential agricultural resources like land, irrigation, fertilizers, and pesticides for female farmers. This can boost productivity and enable female farmers to produce higher quality goods that are more competitive in the market. Additionally, policies focused on bridging the education gap and promoting skills development can empower female farmers with the knowledge and expertise required for effective agricultural decision-making and market engagement.

Our analysis underscores the importance of farmer's gender differences in accessing agricultural markets. Policies that support market access for female farmers are essential to mitigate gender disparities that limit the economic potential of the agricultural sector. By empowering female farmers, who are central to agricultural labor and production, these policies not only promote fairness but also contribute to broader economic development and food security goals.

Addressing market access challenges for female farmers is also a critical area for policymakers. Facilitating their integration into formal and informal agricultural markets requires improving basic infrastructure like rural roads and transportation links that connect them to urban centers. But going beyond physical connectivity, policies must also focus on building gender-inclusive market networks and value chains. This could involve supporting females' cooperatives, providing market information systems tailored to their needs, and ensuring their representation in agricultural marketing boards and decision-making bodies. The key is to adopt a gendered approach that accounts for and accommodates the unique constraints and challenges female entrepreneurs face in male-dominated agricultural supply chains.

Dismantling barriers facing female farmers requires a policy push on equitable resource

allocation. Female farmers need to get secure access and ownership over critical assets like land, water, farm inputs, credit, and extension services that social norms often deny them. Redistributive reforms to strengthen females' land tenure, gender-targeted input subsidies, and agricultural credit are crucial steps. However, resource allocation must go beyond just agricultural inputs. Investing in rural infrastructure and labor-saving technologies tailored to female farmers' needs can ease their work burdens.

This study suggests a pressing need for a reevaluation of current agricultural and economic development policies to include a gender-focused perspective, ensuring that the benefits of development are equitably shared among all members of the household. This shift is essential for achieving true economic empowerment and sustainable development in Sub-Saharan Africa.

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Tables

Table 1. Sample Size

Country	Wave 1	Sample Size	Wave 2	Sample Size	Wave 3	Sample Size	Panel Size
Ethiopia	2011/12	2603	2013/14	3057	2015/16	3105	2603
Tanzania	2008/09	1932	2010/11	2038	2012/13	2594	1932
Nigeria	2010/11	2809	2012/13	2972	2015/16	2829	2809

Notes: All waves represent nationally except the first wave of Ethiopian panel is representative of rural and small town areas only.

Table 2. Summary Statistics of Household Variables

	Ethiopia			Nigeria			Tanzania		
	Wave1 2010/11	Wave 2 2013/14	Wave 3 2015/16	Wave1 2010/11	Wave 2 2012/13	Wave 3 2015/16	Wave 1 2008/09	Wave 2 2010/11	Wave 3 2012/13
<i>Household characteristics</i>									
Household size	5.33 (0.041)	5.94 (0.041)	6.48 (0.043)	6.22 (0.058)	6.71 (0.059)	7.60 (0.065)	5.49 (0.066)	5.62 (0.064)	5.46 (0.055)
Number of children, 0–14	2.59 (0.033)	2.83 (0.032)	3.57 (0.036)	2.83 (0.042)	2.76 (0.042)	2.82 (0.046)	2.58 (0.045)	2.59 (0.044)	2.49 (0.038)
Number of youths, 15–34	1.57 (0.020)	1.87 (0.021)	1.61 (0.021)	1.08 (0.023)	1.16 (0.024)	1.22 (0.025)	0.99 (0.027)	1.06 (0.027)	1.04 (0.023)
Number of adults, 35–64	0.98 (0.015)	1.02 (0.014)	1.09 (0.014)	2.01 (0.020)	2.08 (0.022)	2.09 (0.021)	1.65 (0.020)	1.69 (0.019)	1.66 (0.017)
Number of elderly, 64+	0.18 (0.008)	0.22 (0.008)	0.22 (0.009)	0.3 (0.010)	0.71 (0.021)	1.47 (0.031)	0.28 (0.013)	0.28 (0.012)	0.27 (0.011)
Dependency ratio	1.59 (0.044)	1.57 (0.040)	2.11 (0.047)	2.40 (0.060)	2.63 (0.065)	2.94 (0.064)	1.84 (0.067)	1.86 (0.068)	1.83 (0.061)
Rural residence (1 = Yes, 0 = No)	0.98 (0.003)	0.96 (0.003)	0.97 (0.003)	0.85 (0.007)	0.86 (0.007)	0.87 (0.007)	0.91 (0.007)	0.86 (0.008)	0.85 (0.007)
Total consumption expenditure (capita, annual, local currency)	4927.50 (111.800)	4912.50 (61.200)	5360.00 (68.900)	91372.00 (1256.900)	88839.60 (2142.800)	91632.90 (1689.200)	535461.20 (8325.000)	612091.20 (9805.700)	846618.70 (12669.000)

Total consumption expenditure (USD)	[261.16]	[260.36]	[284.08]	[580.21]	[564.13]	[581.87]	[334.66]	[382.56]	[529.14]
Climatic Shocks (1 = Yes, 0 = No)	0.17 (0.007)	0.11 (0.006)	0.29 (0.008)	0.11 (0.006)	0.15 (0.007)	0.09 (0.006)	0.48 (0.011)	0.45 (0.011)	0.41 (0.010)
Access to loan (1 = Yes, 0 = No)	0.28 (0.009)	0.33 (0.008)	0.25 (0.008)	0.20 (0.007)	0.20 (0.008)	0.18 (0.008)	0.07 (0.006)	0.09 (0.006)	0.10 (0.006)
Number of plots	12.10 (0.140)	11.20 (0.120)	11.60 (0.130)	1.90 (0.020)	1.95 (0.020)	2.02 (0.021)	2.36 (0.029)	2.42 (0.030)	2.35 (0.028)
Plot size (Ha.)	0.15 (0.007)	0.19 (0.016)	0.13 (0.005)	0.63 (0.035)	0.52 (0.017)	0.51 (0.017)	1.25 (0.150)	1.02 (0.049)	0.54 (0.039)
Land size (Ha.)	1.69 (0.086)	1.86 (0.096)	1.80 (0.180)	0.97 (0.041)	0.81 (0.023)	0.82 (0.024)	2.45 (0.170)	2.13 (0.082)	2.00 (0.089)
Access to irrigation (1 = Yes, 0 = No)	0.09 (0.006)	0.09 (0.005)	0.09 (0.005)	0.04 (0.004)	0.03 (0.003)	0.03 (0.003)	0.04 (0.005)	0.04 (0.004)	0.04 (0.004)
Sales (1 = Yes, 0 = No)	0.47 (0.010)	0.50 (0.009)	0.46 (0.009)	0.56 (0.009)	0.52 (0.009)	0.64 (0.009)	0.60 (0.011)	0.61 (0.011)	0.56 (0.010)
Observations	2603	3057	2809	2972	2829	2680	1932	2038	2594

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Table 3. Summary Statistics of Household Head Variables

	Ethiopia			Nigeria			Tanzania		
	Wave1 2010/11	Wave 2 2013/14	Wave 3 2015/16	Wave1 2010/11	Wave 2 2012/13	Wave 3 2015/16	Wave 1 2008/09	Wave 2 2010/11	Wave 3 2012/13
<i>Household head's characteristics</i>									
Female Household Head (1 = Yes , 0 = No)	0.17 (0.007)	0.20 (0.007)	0.20 (0.007)	0.12 (0.006)	0.12 (0.006)	0.14 (0.007)	0.24 (0.010)	0.25 (0.010)	0.25 (0.009)
Age	44.80 (0.290)	46.40 (0.270)	47.80 (0.270)	50.90 (0.280)	52.60 (0.280)	53.50 (0.280)	47.70 (0.360)	49.20 (0.340)	49.40 (0.310)
Marital status (1 = Married, 0 = else)	0.84 (0.007)	0.80 (0.007)	0.80 (0.007)	0.85 (0.007)	0.85 (0.007)	0.82 (0.007)	0.75 (0.010)	0.75 (0.010)	0.74 (0.009)
Education level-Never attended school	0.65 (0.009)	0.63 (0.009)	0.63 (0.009)	0.51 (0.009)	0.45 (0.009)	0.41 (0.010)	0.28 (0.010)	0.29 (0.010)	0.25 (0.009)
Education level-primary or lower	0.32 (0.009)	0.32 (0.008)	0.32 (0.008)	0.21 (0.008)	0.46 (0.009)	0.24 (0.008)	0.66 (0.011)	0.64 (0.011)	0.67 (0.009)
Education level-secondary or higher	0.03 (0.004)	0.04 (0.004)	0.05 (0.004)	0.28 (0.008)	0.08 (0.005)	0.34 (0.009)	0.06 (0.005)	0.06 (0.005)	0.06 (0.005)
<i>Observations</i>	2603	3057	2809	2972	2829	2680	1932	2038	2594

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Table 4. Summary Statistics of Sales Variables

	Ethiopia			Nigeria			Tanzania		
	Wave1 2010/11	Wave 2 2013/14	Wave 3 2015/16	Wave1 2010/11	Wave 2 2012/13	Wave 3 2015/16	Wave 1 2008/09	Wave 2 2010/11	Wave 3 2012/13
<i>Household sales' characteristics</i>									
Sales Value (local currency)	1550.10 (98.800)	2289.40 (130.400)	2461.00 (125.100)	66940.30 (2815.200)	93257.90 (4527.800)	111515.60 (6908.600)	247704.30 (15351.400)	376064.30 (23100.100)	627038.20 (102939.000)
Sales Value (USD)	[82.16]	[121.34]	[130.43]	[425.07]	[592.19]	[708.12]	[154.82]	[235.04]	[391.90]
Access to transportation (1 = Yes, 0 = No)	0.65 (0.015)	0.63 (0.013)	0.69 (0.013)	0.28 (0.011)	0.32 (0.012)	0.42 (0.011)	0.44 (0.015)	0.38 (0.014)	0.35 (0.013)
Transportation cost (local currency)	18.20 (2.040)	10.40 (1.490)	24.70 (6.440)	1514.00 (279.200)	1038.40 (90.600)	888.60 (110.500)	2795.80 (530.600)	4288.90 (1096.000)	4006.10 (725.800)
Transportation cost (USD)	[0.96]	[0.55]	[1.31]	[9.61]	[6.59]	[5.64]	[1.75]	[2.68]	[2.50]
Distance to major market (KM)	58.9 (1.170)	62.9 (1.150)	66.4 (1.260)	75.8 (1.010)	72.6 (1.100)	70.4 (0.940)	80.5 (1.540)	79.4 (1.490)	78.6 (1.410)
Observations	1058	1376	1183	1675	1472	1908	1083	1172	1340

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Table 5. Differences in Resources Access Between Male and Female-Headed Households

	Ethiopia	Nigeria	Tanzania
Access to irrigation (1 = Yes, 0 = No)	0.038*** (0.009)	0.026*** (0.005)	0.0077 (0.005)
Access to pesticides (1 = Yes, 0 = No)	0.042*** (0.013)	0.28*** (0.016)	0.052*** (0.010)
Access to fertilizer (1 = Yes, 0 = No)	0.069*** (0.012)	0.24*** (0.016)	0.062*** (0.013)
Land size (Ha.)	0.83*** (0.180)	0.63*** (0.056)	0.91*** (0.159)
Number of plots	2.34*** (0.190)	0.20*** (0.036)	0.34*** (0.039)
Number of home workforce availability	0.77*** (0.038)	1.07*** (0.061)	0.75*** (0.049)
Access to hired labor force (1 = Yes, 0 = No)	0.033*** (0.011)	0.11*** (0.016)	0.064*** (0.014)
Access to loan (1 = Yes, 0 = No)	0.064*** (0.012)	0.016 (0.013)	0.008 (0.008)
Observations	7699	8299	6519

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Table 6. The effect of household head's gender on household sales decision

Dependent variable: Sales (Yes=1, No=0)			
Model: Two-Way Mundlak Logit Regression			
Variables	Ethiopia	Nigeria	Tanzania
Female head (1 = Yes, 0 = No)	-0.071*** (0.021)	-0.006** (0.124)	-0.039* (0.022)
Control	Yes	Yes	Yes
Observations	7699	8299	6519

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Control covariates include land size (Ha.), household consumption expenditure, climatic shocks, transportation cost, household head's characteristics (age, marital status, education), household agricultural characteristics (access to irrigation, fertilizer, pesticide), household demographics (household size, number of children/youth/adults, access to loan).

Table 7. The effect of household head's gender on crop sales value

Dependent variable: Log (Sales value)			
Model: Two-Way Mundlak Logit Regression			
Variables	Ethiopia	Nigeria	Tanzania
Female head (1 = Yes, 0 = No)	-0.240** (0.096)	-0.260** (0.116)	-0.11 (0.084)
Control	Yes	Yes	Yes
Observations	3462	4752	3569

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Control covariates include land size (Ha.), household consumption expenditure, climatic shocks, transportation cost, household head's characteristics (age, marital status, education), household agricultural characteristics (access to irrigation, fertilizer, pesticide), household demographics (household size, number of children/youth/adults, access to loan).

Table 8. Crop sales and head's gender across the consumption expenditure distribution

	Sales (Yes=1, No=0)									Log (Sales value)								
	Bottom 40%			Middle 40%			Top 20%			Bottom 40%			Middle 40%			Top 20%		
	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania
Female head (1 = Yes, 0 = No)	-0.09***	-0.04	-0.01	-0.064**	-0.093**	-0.072**	-0.05	-0.01	-0.01	-0.10	0.16	-0.04	-0.350**	-0.27	-0.06	-0.12	-0.18	0.00
	(0.035)	(0.079)	(0.034)	(0.032)	(0.047)	(0.036)	(0.041)	(0.043)	(0.046)	(0.154)	(0.329)	(0.123)	(0.143)	(0.182)	(0.141)	(0.215)	(0.195)	(0.203)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3080	3260	2608	3081	3261	2608	1538	1630	1303	1493	1828	1485	1405	1898	1443	564	961	641

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Control covariates include land size (Ha.), household consumption expenditure, climatic shocks, transportation cost, household head's characteristics (age, marital status, education), household agricultural characteristics (access to irrigation, fertilizer, pesticide), household demographics (household size, number of children/youth/adults, access to loan).

Table 9. Crop sales and head's gender across the plot numbers distribution

	Sales (Yes=1, No=0)									Log (Sales value)								
	Bottom 40%			Middle 40%			Top 20%			Bottom 40%			Middle 40%			Top 20%		
	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania	Ethiopia	Nigeria	Tanzania
Female head (1 = Yes, 0 = No)	-0.110***	-0.071**	-0.020	-0.030	-0.007	-0.062	0.037	-0.027	0.001	-0.560***	-0.30**	-0.082	0.035	0.070	0.230	-0.079	-0.260	-0.310*
	(0.027)	(0.033)	(0.027)	(0.038)	(0.083)	(0.050)	(0.054)	-0.11	(0.053)	(0.163)	(0.135)	(0.110)	(0.154)	(0.287)	(0.190)	(0.175)	(0.414)	(0.180)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3221	6070	4072	3058	1344	1390	1420	737	1057	1074	3261	2003	1569	884	828	819	542	738

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Control covariates include land size (Ha.), household consumption expenditure, climatic shocks, transportation cost, household head's characteristics (age, marital status, education), household agricultural characteristics (access to irrigation, fertilizer, pesticide), household demographics (household size, number of children/youth/adults, access to loan).

Table 10. The effect of household head's gender on different types of markets

Dependent variables:	Ethiopia				Tanzania				Nigeria			
	Local Market	Regional Market	Informal Market	Formal Market	Local Market	Regional Market	Informal Market	Formal Market	Local Market	Regional Market	Informal Market	Formal Market
Female head (1 = Yes, 0 = No)	-0.039 (0.030)	0.050* (0.028)	-0.054 (0.036)	0.060* (0.036)	0.14 (0.264)	-0.16 (0.282)	0.056 (0.139)	0.073 (0.139)	0.62** (0.302)	-0.54* (0.325)	0.50** (0.227)	-0.47** (0.234)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3281	3281	3281	3281	2986	2986	2986	2986	4189	4189	4189	4189

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Control covariates include land size (Ha.), household consumption expenditure, climatic shocks, transportation cost, household head's characteristics (age, marital status, education), household agricultural characteristics (access to irrigation, fertilizer, pesticide), household demographics (household size, number of children/youth/adults, access to loan).

Table 11. Effects of household head's gender on sales on crop sales decision across demographic groups

	Sales (Yes=1, No=0)		
	Ethiopia	Nigeria	Tanzania
<i>Education level (secondary+)</i>			
Female head (1 = Yes, 0 = No)	-0.16 (0.122)	-0.03 (0.065)	0.084 (0.091)
Observations	296	1937	564
<i>Education level (secondary-)</i>			
Female head (1 = Yes, 0 = No)	-0.073*** (0.021)	-0.14** (0.034)	-0.041* (0.022)
Observations	7403	6214	5955
<i>Climatic shock (yes)</i>			
Female head (1 = Yes, 0 = No)	-0.0068 (0.042)	-0.21* (0.114)	-0.060* (0.033)
Observations	1644	930	2861
<i>Climatic shock (no)</i>			
Female head (1 = Yes, 0 = No)	-0.085*** (0.024)	-0.052* (0.030)	-0.015 (0.029)
Observations	6055	7221	3658
<i>Rural households</i>			
Female head (1 = Yes, 0 = No)	-0.066*** (0.022)	-0.15** (0.076)	-0.051** (0.023)
Observations	7378	7171	5518
<i>Urban households</i>			
Female head (1 = Yes, 0 = No)	-0.025 (0.067)	-0.043 (0.031)	0.11* (0.060)
Control	Yes	Yes	Yes
Observations	321	980	1001

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Table 12. Effects of household head's gender on sales value across demographic groups

	Log (Sales value)		
	Ethiopia	Nigeria	Tanzania
<i>Education level (secondary+)</i>			
Female head (1 = Yes, 0 = No)	1.31 (1.130)	-0.35 (0.240)	1.05** (0.530)
Observations	98	1133	206
<i>Education level (secondary-)</i>			
Female head (1 = Yes, 0 = No)	-0.25*** (0.094)	-0.11 (0.139)	-0.11 (0.085)
Observations	3364	3554	3363
<i>Climatic shock (yes)</i>			
Female head (1 = Yes, 0 = No)	-0.16 (0.185)	-0.13 (0.127)	-0.084 (0.530)
Observations	668	521	1574
<i>Climatic shock (no)</i>			
Female head (1 = Yes, 0 = No)	-0.24** (0.109)	-0.26** (0.120)	-0.079 (0.113)
Observations	2794	4166	1995
<i>Rural households</i>			
Female head (1 = Yes, 0 = No)	-0.23** (0.095)	-0.28** (0.124)	-0.059 (0.089)
Observations	3413	4197	3150
<i>Urban households</i>			
Female head (1 = Yes, 0 = No)	1.56 (1.275)	-0.051 (0.317)	0.095 (0.272)
Control	Yes	Yes	Yes
Observations	49	490	419

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Table A1. Metadata: Effects of gender of household head on agricultural sales

	Model: Two-Way Mundlak Logit Regression	
	Sales (Yes=1, No=0)	Log (Sales Value)
Female head (1 = Yes, 0 = No)	-0.057*** (0.013)	-0.32*** (0.052)
Control	Yes	Yes
Observations	22264	11682

Notes: Standard errors are in parentheses. Level of significance *p < .10, **p < .05, ***p < .01.

Control covariates include land size (Ha.), household consumption expenditure, climatic shocks, transportation cost, household head's characteristics (age, marital status, education), household agricultural characteristics (access to irrigation, fertilizer, pesticide), household demographics (household size, number of children/youth/adults, access to loan).