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**Gender Implications of Agricultural Commercialization in Africa
Evidence from Farm Households in Ethiopia and Nigeria**

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Abstract

Agricultural commercialization is often pursued as an important driver of agricultural transformation in low-income countries. However, the implications it can have on gendered outcomes are less understood. While agricultural commercialization creates opportunities to increase income, this may come at the expense of change in women's decision-making agency and control over resources. Understanding the interactions between agricultural commercialization and gender outcomes is thus critical for policymakers aspiring to achieve agricultural transformation while promoting gender equity and the evidence on the links between the two in the context of Africa is scarce and mixed. We use three rounds of Ethiopia's and Nigeria's LSMS-ISA panel data to understand the implications of agricultural commercialization to gendered decision-making on crop harvest use, marketing, revenue control, asset ownership, and intrahousehold budget allocation. Results indicate commercialization is associated with decreases in women's participation in decision-making related to use of harvest, crop marketing, and control over revenue in Ethiopia, but only on harvest use and control over revenue in Nigeria. The association with land ownership is mixed: positive in Ethiopia but negative in Nigeria. Moreover, commercialization is associated with decreases in women's share of farm-workload but with increases in share of hired labor in Ethiopia. In Ethiopia we also find women's control over revenue is positively associated with increases in per capita consumption expenditures and dietary diversity, but men's control is negatively associated with increases in the share of expenditure on children's shoes and clothes. In Nigeria, women's control is positively associated with increases in the share of expenditure on women's shoes and clothes, food gap, and dietary diversity. In sum, we find suggestive evidence that commercialization may further marginalize women's decision-making agency in Ethiopia and Nigeria. However, conditional on women's control over proceeds, commercialization tends to improve women's as well as other members' welfare. We provide some policy recommendations and directions for future research.

Keywords: Gender, Agricultural commercialization, Income control, Ethiopia, Nigeria

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1. Introduction

Agricultural commercialization—defined as an increase in the share of marketed crop output—is an important outcome and a driver of the agriculture transformation process (e.g., von Braun, 1995, Ogutu and Qaim, 2019). Gender and gender relations, among others, play important roles in agriculture production, defining gendered labor allocations and control over resources in the household (Quisumbing and Doss, 2021)¹. While agricultural commercialization is pursued as an important milestone in the process of agricultural transformation in low-income countries (e.g., Tabe Ojong, 2022), its implications to gender relations, particularly on women’s decision-making agency and control over resources, are less understood. As agriculture transforms, the gendered allocation of tasks, decision-making or agency, and control over resources and income are subject to change (World Bank, 2012). The 2012 World Development Report on ‘gender equity and development’ points out that “women in agriculture have not experienced significant changes in decision-making capacity or agency as a result of commercialization and higher export orientation, even when typical ‘women’s crops’ are promoted”. Indeed, this may be the case when commercialization transforms women-dominated subsistence or semi-subsistence crops into men-dominated cash crops, leaving women disadvantaged; or else women may lack access to new technologies often associated with commercialization or have poor access to value chains and market opportunities. A growing literature documents the ways women often face constraints to participating in value chains, markets and business activities (Farnworth, 2011; Fischer and Qaim, 2012; Waithanji *et al.*, 2013; Quisumbing *et al.*, 2015; Damba *et al.*, 2021), and these constraints vary across different women groups (Andersson Djurfeldt *et al.*, 2018) and the nature of value chains (Rubin, Boonabaana, and Manfre, 2019). Thus, while agricultural commercialization creates opportunities to increase income via increased productivity and profitability, the increase may be captured by men who, in many instances, have greater access to these opportunities, often at the expense of women’s agency—including their control over income, assets, and decision-making authority (Clay and Zimmerer, 2020; Tavenner *et al.*, 2019; White and Haapala, 2019; Collins, 2018).

While these studies have certainly improved our understanding of the challenges women face in commercial-oriented agricultural value chains, most of them rely on qualitative analysis. Thus, empirical evidence on the links between agricultural commercialization and gendered

¹ While agricultural commercialization involves a wide range of production systems including livestock, this study focuses on commercialization of crops and uses both agriculture and crops interchangeably.

outcomes particularly in view of recent efforts to integrate agricultural commercialization as part of national strategies remains less well understood. Commercialization may further marginalize women's agency and control over resources or improve it depending on specific gender norms and evolving social and economic circumstances. Understanding the gendered implications of agricultural commercialization is critical for policymakers aspiring to achieve agriculture transformation while promoting gender outcomes.

To assess the gendered implications of agricultural commercialization on women's agency and subsequent economic outcomes in the household, we use three rounds of the LSMS-ISA panel data for Ethiopia and Nigeria in the last decade. Ethiopia and Nigeria present opportunities to study the evolving nature of gender equity because of their relatively recent progress in agricultural transformation and the diverse gender norms that exist in these contexts. Both countries have invested significantly, albeit at different scales, to improve agriculture productivity by transforming their subsistence farming into market-oriented production and commercialization. We investigate whether and to what extent agricultural commercialization is associated with intrahousehold decision-making on crop marketing, harvest use, control of revenue, intrahousehold budget allocation, and household welfare. Specifically, we focus on the following key questions: 1) How does agricultural commercialization correlate with woman's bargaining power (participation in household agricultural decision-making), resource rights (control over land, farm-workload, and market participation) and their control over proceeds from commercialization? 2) Conditional on women's or men's control of revenue, what are the implications of commercialization on women's wellbeing, primarily in terms of allocation of revenues to women's and other individual members' needs as well as household-level food expenditure, food security, and dietary diversity?

In the empirical analysis, we consider individual members of households in the LSMS-ISA sample that cultivated staple or cash crop in the previous season. Our empirical method exploits the panel nature of the data to address some (if not all) of the bias in parameter estimates due to time-invariant heterogeneities. We start by estimating a standard household fixed-effects model and its variant, the Correlated Random Effect (CRE) model. We also use panel Quintile Regression (QR) models to allow for nonlinear relationships in the outcome variable. In addition, depending on the nature of the outcome variables, we implement a variety of other empirical estimation methods discussed in the empirical estimation section.

Results show crop commercialization is associated with decreases in women's participation in decision-making on harvest use, crop marketing, and control over crop revenues in Ethiopia, and on harvest use and control over crop revenues in Nigeria. Specifically, a 10% increase in the marketed share of crops is associated with a decrease in women's participation in the decision-making by about 0.5–1.3 percentage points in Ethiopia and by about 1–1.7 percentage points in Nigeria. The association with ownership of land is mixed: positive in Ethiopia but negative in Nigeria. Crop commercialization is associated with decreases in women's share of farm-workload but with increases in share of hired labor in Ethiopia (and no statistically significant evidence of these in Nigeria). We also find women's sole or joint control over revenues in Ethiopia is positively associated with increases in per capita consumption expenditures and dietary diversity, but men's control is negatively associated with increases in the share of expenditure on children's shoes and clothes. In the case of Nigeria, women's control is positively associated with increases in the share expenditure on women's shoes and clothes, food gap, and dietary diversity, but the same is true of men's control. Overall, evidence suggests that agricultural commercialization may further marginalize women's decision-making agency in agriculture. However, conditional on women's control over proceeds, commercialization tends to improve the welfare of women, men, and children. We offer some recommendations and directions for future research.

The rest of the study proceeds as follows. Section 2 summarizes the key literature on gender and agricultural commercialization. Section 3, describes the data, characterizes the study contexts, and provides some descriptive evidence on broader crop production and commercialization as well as gendered decision-making on crop sales and implications to welfare. Section 4 provides a brief outline of the empirical method used and presents the key results. Section 5 concludes.

2. Review of existing evidence on gender and agricultural commercialization

The expanding literature on gender and development shows gender equality is not only a core development objective in its own right but is also critical to achieving other important development outcomes for current and future generations (World Bank, 2012). However, the development process itself has never been gender-neutral, often disfavoring women's access to economic opportunities, particularly at early stages of development, as in the case of structural changes from

agriculture to industrialized societies (Merouani and Perrin, 2022). Using DHS data from 28 sub-Saharan African countries, Gaddis *et al.* (2018) find that, despite substantial cross-country variations, men are more likely to own property than women in almost all sampled countries and that the gender gap in property ownership is less likely to improve with higher levels of income, suggesting economic growth may not necessarily reduce gender gaps in Africa.

Agricultural commercialization and the gender gap

Gender and gender relations are important in agricultural production—defining tasks men and women do on the farm, time allocation, and control over production and income (Quisumbing and Doss, 2021). As the agriculture sector transforms, however, these gendered allocations are subject to change. The implications of these changes to gender roles in agriculture and subsequent gender gap outcomes are however less understood.

This study focuses on understanding the gendered implications of agricultural commercialization focusing on control over the proceeds of crop sales—the last milestone in commercial-oriented value chains. Agricultural commercialization may involve changes in the gender relations and norms of agricultural production as well as control over income flows from crop revenues. In many contexts in sub-Saharan Africa, women play essential roles in agricultural production and rural livelihoods (Quisumbing *et al.*, 1995; Udry, 1996; Ibnouf, 2011), often controlling the income derived from subsistence and semi-subsistence crops (Njuki *et al.*, 2011). For example, Doss (2002) finds that women in Ghana are involved in the production and sale of all major crops, though cash crop production is predominantly in men’s domain. However, the commercialization of crop agriculture may change such gender roles (Quisumbing and Doss, 2021).

In many instances in Africa, as commercialization progresses, crops once situated within women’s domains may end up controlled by men along the value chains (Kasante *et al.*, 2001; Doss, 2001; Lilja and Sanders, 1998; Von Braun and Webb, 1989). Commercialization may shift subsistence crops to cash crops, thereby switching to men’s domain (World Bank, FAO, and IFAD, 2009). In Malawi, for example, women are less likely to cultivate cash crops like tobacco which are dominated by men (Campaign O.N.E, 2014). Women may also lack access to new technologies often associated with commercialization (von Braun and Webb, 1989; Sorensen, 1996; Doss, 2001; Negin *et al.*, 2009; FAO, 2011), access to output markets, transport assets, or market information, limiting their control over commercialized crops (Doss, 2001; Hill and Vigneri, 2011). Thus, while

agricultural commercialization creates opportunities to increase income, often this income is captured by men who have greater mobility and access to market opportunities. This may be exacerbated by time burdens and domestic responsibilities that impact both women's willingness and ability to commercialize as well as their ability to reap the gains of commercialization.

Other studies suggest that improving women's access to markets and enabling them to shift to high-value commercial crops have the potential to increase gender equity (Campaign O.N.E, 2014). In these instances, women are able to maintain control over the management of and income from commercialized crops. Saito *et al.* (1994), for example, documented the gender-specific nature of farming changes in response to evolving social and economic circumstances in favor of women controlling tasks traditionally performed by men². The World Bank (2014) also find that female farmers in Malawi, northern Nigeria, and Uganda enjoyed higher returns from commercial agriculture than male farmers. Carletto *et al.* (2017) find female farmers in Malawi, Tanzania, and Uganda sell larger shares of production under their control, although they appear to participate less in market activities. Hill and Vigneri (2011) report that as women acquire land rights through increased commercialization and individualization of land rights, men-dominated cocoa production in Ghana has become increasingly gender balanced where women are able to manage their farms and retain control of incomes generated.

Evidence of linkages between agricultural commercialization and gendered outcomes is thus mixed—depending on specific gender norms and evolving social and economic circumstances. As such, depending on these contexts, commercialization can either marginalize women's agency in agriculture, or improve it. The subsequent gendered outcomes following the reconfiguration of gender relations induced by agricultural commercialization are thus complex and unknown (Gironde *et al.*, 2022).

Agricultural commercialization, women's agency, and wellbeing

Improving women's participation in decision-making and control over resources is considered as an important milestone in improving women's bargaining power and empowerment (WB, 2011; Leigh *et al.*, 2017; Ihalainen *et al.*, 2021). A growing body of evidence shows strengthening women's share of earnings and property ownership can have positive impacts on, among others, women's bargaining and decision-making power (Fafchamps and Quisumbing, 2002; Melesse,

² For example, when men migrate in search of better remunerative activities elsewhere.

Dabissa, and Bulte, 2018; Meinzen-Dick *et al.*, 2019; Khalil and Mookerjee, 2019), consumption and human capital investments (Muchomba, 2017; Harari, 2019; Calvi, 2020; Milazzo and Van de Walle, 2021), improving children's nutrition outcomes (Allendorf, 2007; van der Meulen Rodgers and Kassens, 2018; Quisumbing *et al.*, 2020; Deininger *et al.*, 2021), and reducing domestic violence (Amaral, 2017; Peterman *et al.*, 2017). It follows that improving the gains women receive and their control over sources of income increases in the household, such as through the commercialization of agricultural production, can be an important source of improving women's bargaining power and empowerment. In fact, some studies suggest enabling women to switch from subsistence to commercial agriculture can help them increase their bargaining power and improve wellbeing (Campaign O.N.E, 2014; Lambrecht, 2017). However, first, it is unclear whether and how enabling participation in such market opportunities translates into improved bargaining power and empowerment (Said-Allsopp and Tallontire, 2014; Johnson *et al.*, 2018; Ihalainen *et al.*, 2021). Second, it is also unclear whether such policies are focused on solely women-headed households or if they also work in a typical male-headed household environment. Thus, while agricultural commercialization improves household income (e.g., Minot *et al.*, 2021), it is not clear how women fare in controlling the proceeds from such household-level income increases, or how it improves or exacerbates their time burden (Johnson *et al.*, 2018, p. 5).

Moreover, the effect of agricultural commercialization on other household-level outcomes is mixed³ and may also depend on how well women fare in controlling the revenues from crop sales. Some studies show overall household welfare, measured by consumption expenditures, food security, and improvements to nutritional outcomes once women are in control of the proceeds from commercialization (World Bank, FAO, and IFAD, 2009; Oduol *et al.*, 2017; Smith *et al.*, 2017). This may relate to a long-held view in the literature that women's control of income is positively correlated with household food expenditure and that women are more likely to spend income on basic household goods and on child investments (See e.g., Duflo and Udry, 2004; Hoddinott and Haddad, 1995; Quisumbing *et al.*, 1995). Moreover, when men take control over production, more food may be sold and the revenues may not be equitably distributed (Fischer and Qaim, 2012). However, it is also not clear whether such household-level welfare improvements

³ For instance, Minot *et al.*, (2021) find that commercialization improves household consumption expenditures while Carletto *et al.*, (2017) find no strong evidence on food consumption expenditures. Carletto *et al.*, (2017) for Malawi, Tanzania and Uganda find no strong relationship between overall increased commercialization and improved nutritional status. Ghebru and Girmachew, (2020) documents commercialization of agriculture can reduce tenure security of women and have nil or even negative implications for food and nutrition security

are achieved by redirecting women's hard-earned income away from improving their own bargaining positions (Ihalainen *et al.*, 2021).

In sum, understanding who controls the revenues from commercialization-induced crop sales is critical not only to understand the dynamic effects of the transition from subsistence to commercial farming on women's agency and bargaining power but also the derived household-level welfare gains (in terms of food consumption, food security, and nutritional outcomes) when women take control of household income. Using individually disaggregated household level data from Ethiopia and Nigeria, this study contributes to this evidence gap in the literature.

3. Data, study context, and descriptive results

3.1. Data

This study uses three rounds of the World Bank's Living Standards Measurement Study – Integrated Survey on Agriculture (LSMS-ISA) panel datasets for Ethiopia and Nigeria. These surveys were conducted in 2011/12, 2013/14, and 2015/16 in Ethiopia and 2010/11, 2012/13, and 2015/16 in Nigeria. These datasets are nationally representative in their respective countries, covering both rural and urban areas. However, since we focus on commercialization of crop production, our sample is limited to those households that cultivated land in the season prior to each survey round (hence, excludes the urban sub-sample). This gives a balanced panel (interviewed in the three rounds) of 2,542 farm households in Ethiopia and 2,449 in Nigeria where at least two individual adult female and male members in each household were interviewed. Overall, the sample attrition across the three rounds in both countries remained low. Table A1 in the Appendix provides the sample size used in our analysis for Ethiopia and Nigeria. A two-stage probability sampling strategy involving a random sampling of enumeration areas in the first stage and a random sampling of households from each sample's enumeration areas in the second stage was implemented.⁴

Uniform survey designs and instruments across countries means that the LSMS-ISA datasets are uniquely suitable to conduct cross-country studies on gender and agriculture at nationally representative levels, as opposed to most gender studies which focus on specific geographic locations and contexts. The LSMS-ISA surveys also uniquely collect extensive, nationally representative data on post-harvest crop disposition, including how much of the crops

⁴ For detail information on the LSMS-ISA surveys, including survey design, sampling method, and sample size, see <http://www.worldbank.org/lsmis>.

harvested are sold; consumed in the household; or given out as gifts, in-kind payments and transfers; who in the household makes these decisions; who transports crops to markets or makes decisions on sales; and who takes control of what to do with sales proceeds. These data are disaggregated by at least two male and female individual plot managers or “holders” in the household⁵. These features make it possible to study the gendered aspects of commercial-oriented agricultural production in the LSMS-ISA countries to understand the gendered effects of agricultural commercialization, specifically on who receives the proceeds from crop sales or who decides how they are used as well as the welfare implications of these decisions to women and the household at large. One caveat of these surveys is that they allow proxy reporting by “knowledgeable respondents” whenever targeted individuals were not available at the time of the interview, suggesting potential bias in our data to the extent that perceptions regarding who makes these decisions varies among women or men respondents⁶. That said, we note that Kilic *et al.* (2021) indicate that proxy respondents in the 2016 Nigeria LSMS-ISA data were used in only 21% of the female and 28% of the male samples, suggesting the bias due to proxy reporting may not be as large in Nigeria (evidence for Ethiopia is unavailable). Finally, we note that most of the gender-related questions, including who decides about household agricultural production and output use, who controls crop marketing and crop earnings, and who owns assets, were asked in the last two rounds (wave 2 and 3) of the LSMS-ISA surveys in Nigeria and Ethiopia. Thus, our analysis involving these outcomes is based on the last two rounds of the data.

3.2. Study context: Ethiopia and Nigeria

This study focuses on Ethiopia and Nigeria, two of Africa’s most populous countries and diverse socio-cultural contexts governing gender norms in agriculture. Ethiopia and Nigeria both host vast smallholder communities that have recently participated in commercialization where gender plays critical roles, but which are often blurred by socio-cultural norms and poorly defined property

⁵ The LSMS-ISA defines holders as persons that exercise management control over the operations of the agricultural holdings through ownership or management and makes major decisions regarding its utilization.

⁶ Using data from Bangladesh, Ambler *et al.*, (2021) study the implications of disagreements in household survey responses among men and women regarding asset ownership and decision-making and find that women are more likely than men to report that women own assets or make decisions and conclude that proxy responses based on a single spouse may not be sufficient to fully understand women’s bargaining power within the household. Similarly, in a study that assesses the effect of respondent selection to labor force and employment data using the LSMS-ISA data in Malawi, Kilic *et al.* (2022) also find that compared with direct individual interviews, ‘business-as-usual’ interviews using proxy respondents tend to under report wage and self-employment activities. These findings suggest that to the extent of use of proxy reporting on behalf of women respondents in our data, our estimates are likely underestimates of the true effects of agricultural commercialization on gender outcomes.

rights confining women to the domestic spheres (Oseni *et al.*, 2015). In terms of production systems, Ethiopia and Nigeria are known for rain-fed agriculture with fragmented household plots characterized by substantial variability across various climatic zones. Thus, both countries are characterized by a large subsistence farming families traditionally producing food crops solely for domestic consumption, but with some recent efforts to linking farmers with markets towards market-oriented production approaches. Major smallholder crops grown in Ethiopia include maize, wheat, teff, sorghum, barley, while Nigeria's include rice, cassava, yam, maize, sorghum, millet, and beans (See Figure A1). However, both countries are also known for slightly different sets of traditional cash crop sector (coffee, sesame, and root crops in Ethiopia and palm oils, cocoa, and rubber in Nigeria).

Women participate in a broad range of agriculture value chains in both contexts, with sometimes unclear distinction between women's and men's crops (Oseni *et al.*, 2021). However, the low level of women's agency and decision-making power prevalent in both contexts may work against their ability to benefit from proceeds of these value chains. The literature suggests such disadvantages of women may begin from the type of crops they grow or manage in the household. Figure A1 (see Appendix) summarizes participation of women and men in the management of main crops produced in Ethiopia and Nigeria by survey round. We note two important points from Figure A1. First, women in Ethiopia tend to participate in the management of all crops and in similar fashion in both rounds, but in Nigeria their participation appears to be limited to few crops (mainly in maize, yam, and cassava). Second, the management of crop production is clearly dominated by the joint decision-making of men and women in Ethiopia but solely by men in Nigeria. While this study mainly focuses on who benefits from the crop sales, we note that the reported low levels of women's participation in crop management, particularly in Nigeria, remains at the backdrop of women's decision-making and bargaining power in agriculture.

An important background to our study is the nature and structure of agricultural commercialization in both contexts and the roles played by recent policy processes in both countries. As part of the Comprehensive Africa Agriculture Development Programme (CAADP), an Africa-wide commitment to improve agriculture productivity, Ethiopia and Nigeria have in recent years implemented their respective national agricultural investment plans with the "aim of enhancing agricultural productivity through application of modern technology and diffusions of knowledge" albeit to varying degrees (Benin *et al.*, 2010). More recently, both have pursued their national agricultural transformation agenda through market-oriented smallholder agriculture

transformation with emphasis on commercialization of high-value crops, support to smallholder irrigation, and better use of groundwater. Moreover, both have registered increases in agricultural growth in recent years, specifically in the period 2004/05–2015/16 (Bachewe *et al.*, 2018; Berhane *et al.*, 2020; Owusu and Iscan, 2021). However, while Ethiopia’s agriculture growth is largely attributed to increases in smallholder agricultural productivity (Bachewe *et al.*, 2018), much of the recent growth in Nigeria is related to cultivated area expansion by commercial farms (Oseni *et al.*, 2015).

Household-level descriptive evidence on the link between commercialization and farm sizes also suggest commercialization is associated with farm size and volume of production—crop sales, and thus commercialization, increase alongside increases in farm sizes and volumes of harvest in both contexts but are more pronounced in Nigeria than in Ethiopia (see Figure A2, (a), (b) and (c)). This can be further elaborated as follows (see Figure A2). First, the majority of farm households in the Ethiopia sample (70%) participate in crop sales, and only a little more than half (58%) participate in Nigeria. However, the majority of participants in Ethiopia sell a small fraction of their crop harvest (only 12% sell above 50 percent of their harvests), but the same figure is modestly higher in Nigeria (about 21% sell above 50% of their harvests) (Figure A2 (c)). Second, taken by the size of land cultivated, the average value of crop sales for any given land size is higher in Nigeria than in Ethiopia (Figure A2 (b)). Taken together, these all may suggest the differences between the two countries with regards to the extent of smallholder market participation, crop commercialization, and associated implications to gendered outcomes in these contexts. We further discuss these in the following section and provide descriptive evidence with regards to implications to gender.

3.3 Descriptive results

Crop production, market participation, and commercialization in Ethiopia and Nigeria

In this section, we provide descriptive evidence related to gender implications of agricultural commercialization in Ethiopia and Nigeria. Table 1 presents value of crop production, market participation, sales, and commercialization—the latter measured by marketed share of value of crops harvested⁷—by gender of farm manager in Ethiopia and Nigeria. As indicated earlier, while

⁷“Marketed share” is also represented by ‘crop commercialization index’ (CCI), calculated as the ratio of gross value of crops sold to gross value of crops produced per season or year, multiplied by 100. CCI ranges between 0 (subsistence) and 100 (complete commercialization) (see e.g., Carletto *et al.*, 2017).

majority of households in Ethiopia (70 percent as opposed to 58 percent in Nigeria) participate in crop sales, the average values (in PPP terms) of crops produced and sold and the index level of commercialization are higher in Nigeria than in Ethiopia⁸. In terms of gender, although female managers participate in crop sales only about 10–20 percent less than male farm managers, female managers continue to produce and sale about 50–70 percent less than the average value of outputs produced and sold by male managers. Moreover, women are on par in terms of commercialization index in Nigeria and only 30 percent less in Ethiopia, suggesting once they participate in markets, women are more likely than men to sell larger shares of their produce.

Table 1. Crop production and commercialization by gender of farm managers

	Ethiopia				Nigeria			
	Male	Female	Joint	All	Male	Female	Joint	All
Value of crop production (PPP USD)	1157	606	1368	1223	1,978	670	1,502	1,701
Value of crops sold (PPP USD)	319	118	277	266	579	189	479	505
Crop seller households (%)	73	57	73	71	59	54	60	58
Crop commercialization index	23.1	16.2	18.8	19.4	23.3	22.9	24.5	23.5
No. of observations	1,146	652	3,286	5,084	3,277	695	946	4,918

Note: Monetary values are in real purchasing power parity in U.S. dollars (PPP USD).

Source: Authors' computation based on balanced panel of crop-farming households in all three rounds of the LSMS-ISA surveys in Ethiopia and Nigeria.

Women's decision-making, income control and intrahousehold welfare

This section discusses how we construct the gender and intrahousehold outcomes addressed in this study and provide key descriptive evidence on each of these outcomes, mainly i) women's participation in household agricultural decision-making; ii) women's crop marketing and income control; iii) women's asset ownership; iv) women's control and allocation of expenditures, and (v) intrahousehold allocation of income and farm-workloads. In addition, we examine the implication of agricultural commercialization on household-level welfare outcomes, including household consumption expenditure, food insecurity, and dietary diversity.

Women's participation in decision-making, earnings, and control over resources are important determinant of women's bargaining power and empowerment (see e.g., Doss, 2013; WB, 2011). In particular, women's participation, solely or jointly with men, in household decision-making, income control, and asset ownership are commonly used as a measure of bargaining

⁸These values have also slightly increased over the years on average (except in Ethiopia in the third year).

power and empowerment (Acosta *et al.*, 2020; Alkire *et al.*, 2013; Leigh *et al.*, 2017; Seymour & Peterman, 2018; WB, 2011). However, the way in which women’s decision-making, income control, and asset ownership are measured vary across surveys.⁹ In the LSMS-ISA surveys, questions about who makes agricultural decisions, who controls income, and who owns assets in the household were asked. For each question, the respondent was asked to name up to two household members as primary decision makers, those that control income and those that own assets in the household (see Table A2). As a result, it is possible to measure individual-level participation in each domain of decision-making, income control, and asset ownership by examining ‘who’ makes the specific decision and ‘who’ controls and owns the specific income and asset in the household.

We construct two types of binary indicator variables for each of these outcomes. First, we define a binary indicator that shows whether participation in decision-making, income control, and asset ownership in the household is dominated by male-only, female-only, and jointly (by male and female)¹⁰. Figure A4 depicts the gendered participation in agricultural decision-making, income control, and asset ownership in Ethiopia and Nigeria using these categorical variables. A striking result emerges from this figure: gender inequality exists in all domains but with differences across the domains considered and the two countries. In Ethiopia, all decision-making, crop marketing, revenue control, and asset ownership are characterized by joint participation of female and male members, while in Nigeria each of these domains are dominated by male only¹¹.

Second, to get a better sense of women’s participation, we aggregate the above binary indicator variables to indicate women’s participation in each domain of decision making, mainly women’s control over crop marketing, revenues from crop sales, and asset ownership. Each of these binary indicator variables take the value of 1 if any female household member participates in the considered domain either alone or jointly with male household members, and 0 otherwise. Specifically, we construct eight binary indicator variables, including: (1) women’s participation in output/harvest use decision; (2) women’s participation in crop marketing; (3) women’s crop

⁹ It is important to note that various surveys across the world including the WEAI, DHS, LSMS-ISA, use different survey instruments and approaches to construct and measure women empowerment indicators (see e.g., Acosta *et al.*, 2020).

¹⁰ It is common in the literature to put a linear ranking in women’s decision-making or resource control, and normatively to order women’s decision-making alone or resource control alone as the highest degree of women empowerment, followed by joint decision-making or joint resource control as second best, and women’s non-participation in decision-making or resource control as the worst gender outcome (see, e.g., Bernard *et al.*, 2020).

¹¹ The blue area at the bottom of Figure A4 (Panel (a) and (b)) represents the percentage of households who have joint participation, control and ownership of male and female household members in each of the domains.

income control; (4) women's land ownership; (5) women's land ownership based on formal land-certificate; (6) women's decision-making related to land rentals; (7) women's livestock ownership/management; and (8) women's mobile phone ownership. These are also the main binary outcome variables in our regression analysis regarding the gender implication of agricultural commercialization.¹²

Table 2 presents the descriptive trends of the key gender, intrahousehold and household-level welfare outcomes. Overall, women's participation in household crop harvest use decisions, crop marketing, crop revenue control, land ownership, and land rental market participation is substantially higher in Ethiopia with 93, 53, 62, 74, and 18 percent, respectively, compared to 45, 26, 24, 35, and 2 percent in Nigeria. Women's mobile phone ownership is lower in Ethiopia (14 percent) than in Nigeria (25 percent) but has risen slightly over the years (Table 2).

Other outcomes considered in our analysis include intrahousehold allocation of expenditures on shoes and cloths and intrahousehold allocation of farm-workloads, as well as household consumption expenditure, food insecurity, and dietary diversity outcomes. We measure consumption expenditure using real per capita consumption expenditure (in USD PPP). The food insecurity outcome is measured using the number of months the household reported was food insecure in the last 12 months. Dietary diversity is measured using the household dietary diversity score (HDDS) (Thompson and Amoroso, 2014).¹³

Regarding the intrahousehold allocation of expenditures on shoes and clothes, the share of women and men is relatively lower than the share of children in both countries. The overall shares for women, men, and children are about 27, 28, and 39 percent in Ethiopia, respectively, compared to 19, 18, and 37 percent in Nigeria. Further, the intrahousehold farm workload for women is relatively lower than men in both countries. The overall share of farm workload for women is 31 and 26 percent in Ethiopia and Nigeria, respectively, compared to 52 and 43 percent for men in Ethiopia and Nigeria, respectively. The share of hired labor is lower with about 6 and 14 percent of the farm workloads in Ethiopia and Nigeria, respectively. The household welfare outcomes, in terms of average per capita consumption expenditure and HDDS, are relatively higher in Nigeria with 995 (PPP USD) and 8.08, respectively, compared to 515 and 5.79 in Ethiopia. The average

¹² These variables are expected to capture women's involvement in the intrahousehold agricultural decision making, income control and asset ownership (Doss, 2013).

¹³ Individual disaggregated data on dietary diversity and other food security indicators is unavailable in our data.

number of months households face food insecurity is also lower in Nigeria (0.46 month) than Ethiopia (0.95 month).

Table 2. Trends in the gender- and household-level welfare outcomes for Ethiopia and Nigeria

	Ethiopia			Nigeria		
	2013	2015	Pooled	2012	2015	Pooled
Proportion of households in which women participate¹						
Harvest/output use decisions	94	92	93	47	43	45
Crop marketing	56	51	53	23	28	26
Crop revenues control	65	59	62	24	25	24
Land ownership	69	79	74	35	35	35
Land rental market	17	18	18	02	03	02
Mobile phone ownership	11	16	14	24	27	25
Intrahousehold allocation of expenditures on shoes/cloths:						
Women's share	29	29	29	26	26	26
Men's share	30	29	29	25	23	24
Children's share	41	42	42	49	51	50
Intrahousehold allocation of farm-workloads:²						
Women's share	30.9	30.37	31	32	19	26
Men's share	50.7	52.90	52	54	32	43
Hired-labor share	6.1	5.9	6	13	16	14
Household welfare outcomes						
Per capita consumption expenditure (PPP USD)	543	487	515	1,054	935	995
Number of food-insecurity months	0.98	0.92	0.95	0.52	0.41	0.46
Household Dietary Diversity Score (HDDS)	5.24	6.34	5.79	7.76	8.41	8.08
No. of observations	2,542	2,542	5,084	2,459	2,459	4,918

Source: Authors' computation based on balanced panel of crop-farming households round 2 and 3 of the LSMS-ISA surveys in Ethiopia and Nigeria.

Note: All monetary values are in real purchasing power parity in U.S. dollars (PPP USD).

¹ Each outcome indicator variables related to women's participation in agricultural decision and control—including participation in crop harvest use decision, crop marketing, crop income control, land ownership, land rental, and mobile phone ownership—takes a value of one if any female household member participate either solely or jointly with male household members, zero otherwise.

² The intrahousehold allocation of farm workloads in our analysis focuses on the share for women and men family members as well as hired labor (men and women) but the total workload used to compute these shares also include other workloads, including shared labor with other families.

Table 3 shows the distribution of the key outcome variables by quintiles of crop commercialization—measured by Crop Commercialization Index (CCI). These results help us discern an important trend regarding the extent of women's participation in agricultural decision-making as crop commercialization increases. Specifically, it shows that the percentage of women's participation in decision-making on crop production, use of harvest, marketing, and sales revenue, as well as land ownership, land market participation, and mobile phone ownership are decreasing across the quintiles of commercialization in Ethiopia. Similar trend is observed only in the domains

of crop harvest use decision, crop revenue control, and land rental market participation in Nigeria, and women's mobile ownership is increasing across the quintiles of crop commercialization in the case of Nigeria.

Table 3. Distribution of the gender and household welfare outcomes by quintiles of CCI

	Ethiopia						Nigeria					
	Quintiles of CCI						Quintiles of CCI					
	Non-sellers	Q1 (Lowest)	Q2	Q3	Q4 (Highest)	Total	Non-sellers	Q1 (Lowest)	Q2	Q3	Q4 (Highest)	Total
Proportion of women's participation in:												
Harvest use decision	94.4	95.3	93.3	93.5	92.0	93.8	46.9	42.3	36.3	38.4	42.5	42.8
Crop marketing control	-	79.4	62.2	71.4	77.3	72.5	-	47.1	35.3	41.0	47.4	42.8
Crop income control	-	92.0	85.7	86.5	89.3	88.4	-	42.1	36.1	38.6	41.0	39.5
Land ownership	84.0	82.3	86.7	83.1	82.7	83.8	36.8	32.6	31.4	37.7	38.2	35.7
Land rental market	79.2	75.7	80.8	73.0	67.7	76.2	39.0	26.9	24.1	16.2	24.7	28.1
Mobile phone ownership	42.8	36.7	28.4	30.7	24.8	33.3	44.4	45.2	34.3	46.7	51.8	44.7
Intrahousehold allocation of expenditures on shoes/cloths:												
Women's share	27.4	24.9	26.1	27.1	28.5	26.8	19.3	20.8	21.9	17.7	19.3	19.7
Men's share	25.5	28.1	29.4	29.2	31.7	28.5	18.1	18.5	16.4	19.8	17.1	18.0
Children's share	39.6	43.2	38.9	40.1	34.9	39.5	36.3	37.3	42.6	40.3	34.2	37.6
Intrahousehold allocation of farm-workloads (%)												
Women's share	34.6	29.2	28.2	27.1	24.1	29.1	25.0	24.5	22.0	24.2	23.9	24.2
Men's share	49.1	53.4	54.5	54.6	53.0	52.7	46.2	42.4	43.5	41.4	41.0	43.7
Hired-labors' share	4.2	4.0	6.0	7.8	12.2	6.5	13.9	13.1	15.2	16.8	16.9	14.9
Household welfare outcomes												
Real expenditure per capita (PPP USD)	523.5	493.1	484.4	496.0	483.1	497.8	992.3	967.4	853.8	994.4	1200.7	1002.0
Number of food-insecurity months	1.25	0.84	0.93	0.98	1.10	1.03	0.44	0.32	0.37	0.52	0.44	0.42
Household Dietary Diversity Score (HDDS)	5.67	5.83	5.69	5.98	5.84	5.80	7.87	8.03	8.24	8.46	8.68	8.16

Source: Authors' computation based on pooled sample of the balanced panel of crop-farming households in round 2 and 3 of the LSMS-ISA surveys in Ethiopia and Nigeria.

Note: All monetary values are in real purchasing power parity in U.S. dollars (PPP USD).

¹ Each outcome indicator variables related to women's participation in agricultural decision and control—including participation in crop harvest use decision, crop marketing, crop income control, land ownership, land rental, and mobile phone ownership—takes a value of one if any female household member participate either solely or jointly with male household members, zero otherwise.

There is also a clear increase in men's share of expenditure and farm workloads of hired labor in Ethiopia. We further investigate these relationships using a multivariate regression framework in the next section. Finally, as background to the empirical analysis, the rest of this section provides descriptive statistics of the main variables used in the analysis in the next sections. Table 4 reports these statistics by gender of decision-making or crop managers for Ethiopia and Nigeria. We note

that most of these variables reveal important differences between the two contexts. For example, women and men crop managers in Ethiopia are relatively younger than those in Nigeria with average ages of 46 and 50 years for Ethiopia and 51 and 59 years in Nigeria—majority of women are illiterate in Ethiopia (only 12 percent can read or write), compared to 38 percent in Nigeria. We also note that the vast majority of the sample households are male-headed in both countries with only 12 and 19 percent of female-headed households in Ethiopia and Nigeria, respectively. While mean land size owned by the household in terms of gender is somewhat larger in Nigeria (1.64 hectares in Nigeria and 1.44 hectares in Ethiopia), mean land size is slightly higher for women in Ethiopia (0.78 hectare) than in Nigeria (0.58 hectare) and mean livestock holding for women in Ethiopia is 1.54 tropical livestock units (TLU) and 0.32 TLU in Nigeria.

Table 4. Descriptive statistics of key variables used in analysis by gender of farm managers

	Ethiopia				Nigeria			
	Male	Female	Joint	All	Male	Female	Joint	All
Male headed household (male=1, female=0)	0.98 (0.14)	0.04 (0.20)	0.89 (0.31)	0.80 (0.40)	0.98 (0.15)	0.27 (0.44)	0.92 (0.27)	0.87 (0.34)
Age of household head (year)	45.56 (15.43)	50.39 (14.71)	46.97 (14.22)	47.09 (14.63)	50.96 (14.26)	58.94 (13.81)	55.02 (13.96)	52.87 (14.44)
Literate household head (1=literate, 0=illiterate)	0.41 (0.49)	0.12 (0.32)	0.44 (0.50)	0.39 (0.49)	0.53 (0.50)	0.38 (0.49)	0.64 (0.48)	0.53 (0.50)
Number of adult members (ages 14 – 65)	2.81 (1.42)	1.83 (1.29)	3.00 (1.39)	2.81 (1.44)	3.49 (1.92)	2.44 (1.82)	3.43 (1.90)	3.33 (1.94)
Number of children (age < 14)	2.68 (1.81)	1.88 (1.60)	2.77 (1.73)	2.63 (1.76)	3.19 (2.38)	1.32 (1.67)	2.42 (1.96)	2.78 (2.32)
Number of older members (age > 65)	0.85 (1.35)	0.93 (1.20)	0.81 (1.25)	0.83 (1.27)	1.02 (1.47)	1.45 (1.44)	1.19 (1.54)	1.11 (1.49)
Farm size (ha)	1.39 (1.52)	0.78 (1.21)	1.58 (1.56)	1.44 (1.54)	1.94 (2.56)	0.52 (1.06)	1.40 (2.47)	1.64 (2.44)
Livestock holdings in TLU (Tropical Livestock Units)	2.86 (3.29)	1.54 (1.89)	3.00 (8.25)	2.78 (6.87)	1.93 (5.66)	0.32 (1.09)	0.59 (2.27)	1.45 (4.79)
Access to extension (yes=1, no=0)	0.40 (0.49)	0.33 (0.47)	0.50 (0.50)	0.46 (0.50)	0.09 (0.29)	0.02 (0.14)	0.03 (0.17)	0.07 (0.26)
Access to finance (yes=1, no=0)	0.13 (0.33)	0.13 (0.33)	0.20 (0.40)	0.17 (0.38)	0.18 (0.39)	0.29 (0.46)	0.31 (0.46)	0.22 (0.42)
Inorganic fertilizer use (yes=1, no=0)	0.46 (0.50)	0.41 (0.49)	0.58 (0.49)	0.53 (0.50)	0.52 (0.50)	0.25 (0.44)	0.28 (0.45)	0.43 (0.50)
Access to irrigation (yes=1, no=0)	0.12 (0.32)	0.10 (0.30)	0.12 (0.32)	0.11 (0.32)	0.03 (0.17)	0.00 (0.04)	0.00 (0.06)	0.02 (0.14)
Distance to nearest market (km)	68.20 (51.09)	65.79 (46.15)	65.98 (47.11)	66.46 (47.92)	76.84 (38.93)	58.22 (31.54)	70.81 (39.22)	73.05 (38.56)
Long-term average rainfall (mm)	942.62 (266.33)	931.10 (267.30)	922.88 (276.66)	928.38 (273.24)	1091.72 (392.14)	1635.54 (321.18)	1593.96 (389.72)	1265.18 (454.36)
No. of observations	1,146	652	3,286	5,084	3,277	695	946	4,918

Source: Authors' computation based on balanced panel of crop-farming households in all three rounds of the LSMS-ISA surveys in Ethiopia and Nigeria.

Note: Standard errors are in parentheses. All monetary values are expressed in terms of real purchasing power parity in U.S. dollars (PPP USD). Tropical Livestock Units (TLU) is a convenient measure of different species of livestock holding that takes relative animal biomass into account (e.g., an average camel is equivalent to 1 TLU and average cattle 0.7TLU)

Overall, access to extension services, irrigation, and fertilizer use are higher in Ethiopia with 43, 12, and 50 percent, respectively, compared to only 8, 3, and 43 percent in Nigeria. Access to financial services, however, is higher in Nigeria with 21 percent, compared to 15 percent in Ethiopia. Another variation between the two countries is related to geospatial variables such as distance to the nearest market and long-term average rainfall. The average distance to the nearest market is 66.5km in Ethiopia and 73.1km in Nigeria, and the long-term average rainfall is 913 and 1273mm in Ethiopia and Nigeria, respectively.

4. Estimation method

In this section, we briefly describe the empirical method adopted to test the set of research questions outlined in Section 2. Given the longitudinal nature of our data, we exploit panel data regression techniques, mainly the household (or individual) Fixed-Effects (FE) and Correlated Random Effects (CRE) to minimize some of the potential endogeneity biases on our estimates. The FE model does this by removing potential biases due to time-invariant unobserved characteristics. However, it may also remove important variables of interest that do not vary with time such as gender of the head. The CRE model also removes time-invariant unobserved heterogeneities but has the advantage of enabling the estimation of observed time-invariant variables of interest (e.g., gender). Results based on these two specifications remain consistent across outcome variables and thus, unless specifically mentioned, we interpret the FE estimates.

In addition, we perform additional triangulation using alternative regression methods, e.g., panel Quintile Regression (QR) methods that allow us to understand nonlinear relationships (other than the mean) of the outcome variable. For example, in Table 5, we use Panel QR to understand whether commercialization varies by quintiles of crop commercialization index (CCI). To check for robustness, we also run additional estimations on other outcomes to address specific econometric problems (e.g., bias due to selection into crop selling) in our setting and find that our FE estimates remain robust (these results are not presented here and available upon request). However, despite these efforts, our estimates may not represent clean causal impacts. Thus, we interpret our findings cautiously. That said, the strong associational results remain important to inform our understanding about the implications of agricultural commercialization—an important step in the process of smallholder agricultural transformation—to gendered welfare outcomes in Africa and contributes to the scarce empirical evidence regarding how women fare in the face of agriculture transformation.

5. Results and discussion

This section presents the main results based on the empirical approaches outlined in Section 4. We first discuss results on the determinants of crop commercialization—highlighting, among others, the association between household gender headship and agricultural commercialization. We then discuss results on the implications of crop commercialization on the gendered, intrahousehold, and household-level welfare outcomes described in section 3, mainly (1) women’s participation in decision-making on use of agricultural produce; (2) women’s control of crop marketing and

revenues; (3) women's asset ownership; (4) the allocation of expenditures on women's and children's shoes and clothes as proxies of intrahousehold allocation of income; (5) intrahousehold allocation of farm-workloads and women's workload; and (6) implications to household-level welfare outcomes and (7) women's control over crop revenues and intrahousehold welfare.

5.1 Determinants of crop commercialization in Ethiopia and Nigeria

To provide context to our gender implications of agricultural commercialization, we first examine what determines crop commercialization, and more specifically, whether the gender of the household head matters for commercialization. We use both the binary indicator for crop sales and quintiles of levels of CCI. Table 5 reports the results based on the FE and panel data QR models described in section 4. Columns (1-5) report for Ethiopia and columns (6-10) report for Nigeria. The dependent variable in columns 1 and 6 is binary variable indicating whether the household has sold any crops; columns 2 and 7 report for using CCI, and columns (3-5) and (8-10) are based on the quintiles of CCI for Ethiopia and Nigeria, respectively.

Results in Table 5 show that based on all measures, gender of the household head is a strong predictor of agricultural commercialization in Ethiopia, with male-headed households more likely (9 percentage points higher) to sell crops than female-headed households and their crop commercialization rate is 4 percentage points higher than female-headed households (columns (1-5)). Further, the results in columns (3-5) suggest that gender (of head) difference in crop commercialization increases across CCI quintiles—with crop commercialization rate of the male-headed increasingly higher than the female-headed (increasing from 0.2 percentage points higher at the lower, to 3 percentage points higher at the median, and 7 percentage points higher at the upper quintile). These results corroborate findings from other studies, e.g., Hill and Vigneri, 2011, that indicate scale of produce for sale is important for commercialization with smaller quantities being less preferred.

Table 5. Panel data estimates of the determinants of crop commercialization

	Ethiopia					Nigeria				
	FE estimates		Panel quintile estimates			FE estimates		Panel quintile estimates		
	Sold crop (1)	CCI (2)	Q.25 (3)	Q.50 (4)	Q.75 (5)	Sold crop (6)	CCI (7)	Q.25 (8)	Q.50 (9)	Q.75 (10)
Male-headed household (yes=1)	0.090** (0.041)	4.152** (1.903)	0.191*** (0.021)	3.012*** (1.084)	6.485** (3.110)	-0.040 (0.041)	-2.373 (2.252)	0.000 (0.000)	0.330 (1.209)	-3.853** (1.927)
Age of household head	-0.000 (0.001)	-0.111* (0.063)	-0.003*** (0.000)	-0.109*** (0.029)	-0.094*** (0.023)	-0.002 (0.001)	-0.112* (0.067)	-0.000*** (0.000)	-0.111*** (0.027)	-0.110*** (0.017)
Literate household head	-0.054*** (0.019)	-2.126** (1.076)	-0.119*** (0.015)	-2.523*** (0.621)	0.357 (1.139)	0.009 (0.017)	0.266 (0.999)	-0.000 (0.000)	-0.461 (0.285)	1.858 (1.258)
No. adult members	0.023** (0.009)	0.212 (0.545)	0.018*** (0.005)	0.747*** (0.164)	0.130 (0.242)	-0.007 (0.009)	-0.560 (0.489)	-0.000*** (0.000)	-0.392*** (0.076)	-1.114** (0.442)
No. children	0.008 (0.007)	0.147 (0.428)	0.024*** (0.005)	0.524*** (0.166)	0.324* (0.194)	-0.001 (0.008)	-0.230 (0.398)	-0.000*** (0.000)	-0.314*** (0.061)	-0.950** (0.407)
No. older members	0.008 (0.008)	-0.439 (0.495)	-0.005 (0.007)	0.028 (0.165)	-0.896** (0.444)	-0.010 (0.009)	-0.282 (0.500)	-0.000*** (0.000)	0.109 (0.314)	0.109 (0.341)
Farm size (ha)	0.014*** (0.005)	0.171 (0.290)	0.284*** (0.004)	1.178*** (0.085)	1.144*** (0.341)	0.017*** (0.003)	0.498*** (0.144)	0.000*** (0.000)	1.205*** (0.148)	0.722*** (0.218)
Livestock holding (TLU)	0.001 (0.001)	-0.041 (0.026)	-0.019*** (0.001)	-0.531*** (0.019)	-0.896*** (0.092)	-0.000 (0.000)	-0.022** (0.010)	0.000*** (0.000)	-0.006*** (0.002)	-0.030* (0.017)
Access to extension	0.030* (0.016)	0.217 (0.839)	-0.012* (0.006)	-0.887* (0.457)	-2.236*** (0.643)	0.134*** (0.026)	5.864*** (1.551)	0.000*** (0.000)	16.062*** (0.781)	14.851*** (1.197)
Access to finance	0.017 (0.017)	-1.152 (0.854)	-0.047 (0.030)	-0.692*** (0.238)	-3.118*** (1.165)	0.034 (0.022)	-0.929 (1.321)	0.000* (0.000)	-0.348 (0.306)	-3.487** (1.379)
Inorganic fertilizer use	0.061*** (0.018)	-0.596 (0.989)	0.443*** (0.013)	1.609*** (0.513)	-1.497 (0.984)	0.031* (0.017)	2.927*** (0.897)	0.000*** (0.000)	2.762*** (0.408)	2.502*** (0.840)
Access to irrigation	0.068*** (0.023)	2.723** (1.119)	2.735*** (0.008)	5.077*** (0.727)	8.866*** (2.676)	0.128** (0.051)	10.491*** (3.335)	0.000*** (0.000)	18.893*** (1.986)	17.883*** (1.639)
Average rainfall (mm)	0.000 (0.000)	0.010 (0.014)	0.001*** (0.000)	0.008*** (0.001)	0.003 (0.004)	-0.000 (0.000)	-0.022 (0.016)	0.000*** (0.000)	0.006*** (0.001)	0.015*** (0.001)
Round 2	0.043** (0.018)	-2.390** (1.012)	0.088*** (0.014)	-2.083*** (0.407)	-1.450 (1.456)	-0.025* (0.014)	0.900 (0.778)	-0.000*** (0.000)	4.913** (2.436)	2.480 (3.032)
Round 3	-0.030* (0.017)	-2.344** (0.973)	-0.114*** (0.010)	-3.587*** (0.936)	1.592 (4.740)	0.085*** (0.020)	2.208* (1.165)	0.000*** (0.000)	9.211*** (0.668)	3.398 (2.748)
Constant	0.422* (0.219)	14.336 (12.516)				0.983*** (0.288)	58.114*** (20.308)			
R2	0.03	0.01				0.03	0.02			
No. of observations	7626	7626	7626	7626	7626	7377	7377	7377	7377	7377

Note: Results in columns 1-2 and 5-6 come from Heckman two-step model for Ethiopia and Nigeria, respectively; while columns 3-4 and 7-8 report results from FE regression model for Ethiopia and Nigeria, respectively. The dependent variable in columns 1, 3, 5, 7 is dummy variable of crop selling and columns 2, 4, 6, and 8 is marketed share of crops. The sample in the Heckman two-step regression contains full sample of crop-farming households in all rounds, while the FE regressions contain the balanced panel of crop producing households in all rounds. Standard errors, clustered at the household-level are given in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors are in parentheses. Source: Authors' computation based on the LSMS-ISA surveys in Ethiopia and Nigeria.

In contrast, the estimation results for Nigeria show inconsistent results with the coefficient for male-headed household being statistically insignificant in columns (6-9), suggesting no significant gender difference in the probability of crop selling and levels of crop commercialization between male-headed and female-headed households, but negative and significant at the higher quantile suggesting female-headed households fare better when the rate of commercialization is highest. This may be consistent with evidence from Ghana and Nigeria where women are found to be involved in growing high-value crops, breaking the gender-specific nature of farming in Africa (e.g., Saito *et al.*, 1994, Hill and Vigneri, 2011). This finding may also suggest the need for

a regionally disaggregated analysis given Nigeria's sheer size and broad socio-economic diversity (e.g., Campaign O.N.E, 2014). While the latter case may be an exceptional scenario, the lower commercialization result for female-headed households may be in line with findings from other studies in Africa, e.g., Djurfeldt *et al.* (2018) who document women have generally less access to cash crops in Ghana, Kenya, Malawi, Mozambique, Tanzania, and Zambia.

Other important predictors of commercialization (Table 5) include the number of adult and child members of the household, younger age of head, farm size, use of inorganic fertilizers, access to irrigation, and long-term average rainfall, all positively contributing to commercialization in Ethiopia. But contrary to our expected livestock asset (TLU), access to extension services and finance are negatively associated with commercialization, particularly, in the panel quintile regression results in columns 3-5, while most of these variables appear statistically insignificant in column 2. These variables are also expected to have modest within-household variation across the rounds, and this could explain the insignificance as well as counter-intuitive results on the variables. These results are mostly similar with Nigeria except that the variables for number of adult and child members are negatively associated with commercialization, and access to extension services is positively associated with commercialization, and household head's literacy is insignificant in Nigeria¹⁴.

5.2 Gender implications of agricultural commercialization in Ethiopia and Nigeria

With the background on gender implications of agricultural commercialization in the previous section, we now turn to our main research question of interest in this study: How does agricultural commercialization interact with women's agency and control over resources in the household? Does commercialization contribute to increasing male control over crop production and revenues and reduce women's decision-making agency in the household?

Table 6 summarizes the main estimation results of the implications of agricultural commercialization on women's participation in agricultural decision-making, crop marketing, control of revenue, and asset ownership based on the FE method described in section 4.

¹⁴ In Ethiopia, extension services are solely focused on the delivery and adoption of modern agricultural inputs and have limited roles on crop commercialization (Berhane *et al.*, 2018). Nigeria's smallholder agriculture on the other hand is underserved by the extension system and existing services tend to focus on better off farmers (Khalid *et al.*, 2021).

Table 6. Agricultural commercialization, women’s decision-making and income control

	Dependent variable: Binary indicator for women’s participation in:					
	Women’s decision-making and income control			Women’s asset ownership		
	Harvest use decisions (2)	Control over crop marketing (3)	Control over sales revenues (4)	Land ownership (5)	Land rentals (6)	Mobile phone (7)
Panel-A: Ethiopia						
Marketed share of crop	-0.049* (0.026)	-0.109** (0.049)	-0.127*** (0.043)	0.075* (0.045)	-0.003 (0.028)	0.020 (0.031)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.02	0.01	0.02	0.04	0.02	0.02
No. observation	5084	3611	3611	5084	5084	5084
Panel-B: Nigeria						
Marketed share of crop	-0.095*** (0.031)	-0.080 (0.049)	-0.169*** (0.055)	-0.077*** (0.030)	0.015 (0.015)	0.046 (0.033)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.02	0.02	0.05	0.01	0.01	0.02
No. Observation	4918	2867	2867	4918	4918	4918

Source: Authors' calculations based on Nigeria LSMS-ISA panel data.

Standard errors clustered at household-level reported in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

The first two columns of Table 6 report results for women’s participation in decision-making related to crop production and harvest use decisions and columns 3-4 show results for women’s participation in crop marketing and revenue control, while columns 5-7 show results for women’s land ownership, land rental market participation, and ownership of mobile phones often acquired following income increases from commercialization. The dependent variables in Table 6 are thus dummy variables that indicate women’s participation in each of these domains. Panel A reports results for Ethiopia and Panel B results for Nigeria.

Three important findings emerge regarding the gender implications of crop commercialization in both countries. First, crop commercialization statistically significantly associated with decreases in women’s participation in households’ agricultural decision-making regarding use of harvest (i.e., allocation of harvest among competing household needs), while its association with women’s participation in decision-making related to crop production appears to be statistically insignificant in both countries (columns 1 and 2). Specifically, results (Column 2) show that a 10 percent increase in marketed share of crop production is associated with a decrease in women’s participation in harvest use decisions by about 0.5 and 1 percentage points in Ethiopia and Nigeria, respectively. In short, agricultural commercialization significantly decreases the involvement of women in the households’ harvest use decision-making, including decisions concerning how much of the harvest to use or allocate for home consumption, how much for sales, how much for other purposes and the like.

Second, crop commercialization is also statistically negatively associated with women's participation in crop marketing and control over the revenues generated from crop sales. In Ethiopia, conditional on crop selling, a 10 percent increase in the marketed share of crop is associated with a 1.1 and 1.3 percentage points decreases in women's participation of crop marketing and control over sales revenues (Panel A, columns 3 and 4). Similarly, in Nigeria, conditional on crop selling, a 10 percent increase in the marketed share of crop production is associated with about 0.8 and 2 percentage points decreases, respectively, in women's participation of crop marketing and control over sales revenues, but the coefficient for crop marketing is not significant for Nigeria (Panel B, columns 3 and 4). In sum, in both countries, commercialization is strongly associated with declines in women's control over crop income. These results are consistent with recent findings from value-chain studies that indicate commercialization can have both empowering and disempowering effects (Ihalainen *et al.*, 2021), or there may not be a correlation between women's participation in value chains and their control over generated income (Loconto, 2015; Limuwa and Synnevag, 2018).

Third, the implication of crop commercialization on women's asset ownership is mixed. While crop commercialization is positively associated with women's land ownership in Ethiopia, it is negatively associated in Nigeria, and the association with women's land rental market participation and mobile phone ownership is statistically insignificant in both countries (Columns 5-7). Specifically, the result on women's land ownership suggests that a 10 percent increase in marketed share of crops increases women's land ownership by about 0.8 percentage points in Ethiopia, while it decreases women's land ownership by about 0.8 percentage points in Nigeria. We note that crop commercialization is strongly associated with irrigation (Table 5), and we also know that irrigation land is associated with stronger ownership certification in Ethiopia. This may suggest that irrigation and hence commercialization increases women's land ownership in the Ethiopia context. However, this may not be the case in Nigeria.

5.3 Agricultural commercialization, women's farm-workload, and intrahousehold expenditures.

The previous section has presented evidence on increases in the share of agriculture produce for markets (i.e., increased commercialization of agriculture) may come at the expense of reduced women's decision-making power in the household. The implications of agricultural commercialization on women's decision-making agency can also be manifested in the form of

changes in observed outcomes as the nature of share of women’s farm workload, the actual allocation of income within the household, or even more subtly, via changes in the intrahousehold allocation of budgets on clothing, food consumption, and diet quality.

Table 7. Agricultural commercialization, gendered expenditure and farm-workload shares, and household welfare.

	<u>Share of expenditures on shoes and cloths:</u>			<u>Share of farm-workloads:</u>			<u>Household welfare outcomes:</u>		
	<u>Women</u>	<u>Men</u>	<u>Children</u>	<u>Women</u>	<u>Men</u>	<u>Hired-labor</u>	<u>Per capita consumption expenditure (PPP USD)</u>	<u>Food gap (months)</u>	<u>HHDS</u>
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Ethiopia									
Marketed share of crop	0.484 (2.529)	0.919 (2.525)	2.196 (2.665)	-5.127*** (1.950)	0.665 (2.224)	3.739** (1.514)	68.417* (40.485)	-0.076 (0.179)	0.143 (0.153)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.005	0.017	0.011	0.019	0.022	0.012	0.033	0.014	0.282
No. observation	5084	5084	5084	5084	5084	5084	5084	5084	5084
Panel B: Nigeria									
Marketed share of crop	0.350 (2.218)	1.397 (2.141)	-3.145 (2.927)	0.605 (1.494)	-0.666 (1.669)	-0.156 (1.375)	79.874 (54.075)	0.197** (0.093)	0.329*** (0.113)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.013	0.013	0.044	0.265	0.416	0.029	0.024	0.016	0.151
No. observation	4918	4918	4918	4918	4918	4918	4918	4918	4918

Note: Household FE estimates of effect of crop commercialization on intrahousehold allocation of expenditures, farm workload, and household welfare outcomes. The dependent variables in Columns (1-3), (4-6), and (7-9) are share of expenditures on cloth and shoes for women, men, and children, respectively. Other controls include household characteristics (age of head, education, household structure, land size, TLU, fertilizer use, and access to extension, finance and irrigation) and EA-level long-term average rainfall. Standard errors clustered at household-level reported in parenthesis (*** p<0.01, ** p<0.05, * p<0.1). Source: Authors' calculations based on LSMS-ISA surveys in Ethiopia and Nigeria.

These outcomes are important to triangulate our results on decision-making roles based on reported data given women often choose to report to survey questions strategically consistent with social norms. A nice feature of the LSMS-ISA surveys is that they gather individual-level expenditure data on shoes, clothing, and farm workload as well as on household-level food consumption, food gap, and dietary diversity¹⁵. Table 7 presents the summary of the results of the implications of marketed share of crops on shares of gendered farm-workload and expenditures on shoes and clothing. It also presents implications to household-level outcomes as per capita consumption expenditures, number of months the household has been unable to satisfy food needs

¹⁵ The LSMS-ISA data lacks individual-level information on dietary diversity and food gap, and we rely on these household-level outcomes to see the implications of commercialization on these outcomes via changes in overall women’s decision-making agency as women are often in charge of consumption and diet related decisions in the household.

(food gap, hereafter), and household-level dietary diversity (HDDS). Columns 1-3 of Table 7 report results for the share of expenditures on shoes and clothes for women, men, and children; columns 4-6 report results for the share of farm-workloads for women, men, and hired-labor; and columns 7-9 report results for the household-level welfare outcomes in terms of per capita consumption expenditure, food gap, and HDDS. Panel A presents results for Ethiopia and Panel B for Nigeria.

The results for the intrahousehold allocation of expenditures on shoes and clothes suggest that there is not statistically significant link between intrahousehold expenditure allocations and crop commercialization in both countries (Table 7, columns 1-3). The parameter coefficients for marketed share of crops on expenditure shares of women, men, and children although largely positive are statistically insignificant. An interesting finding emerges with the link between commercialization and intrahousehold allocation of farm-workload for Ethiopia: women's share of farm-workload decreases with crop commercialization while the share of hired labor increases with crop commercialization, but there is no statistically significant change to men's shares of farm-workload, although the coefficient is positive (Table 7, Panel A, columns 3-4). A one percent increase in the marketed share of crops is associated with a decrease in share of farm-workloads for women by about 0.05 percentage points and with an increase in share of farm-workloads for hired labor by about 0.04 percentage points. It is worth noting that the associated decrease in women's share of farm-workloads in Ethiopia can be explained by the increase in the share of hired labors, and hence the result suggests that agricultural commercialization may partly substitute women's work burden on the farm with hired labor. An important follow-up question for future research is whether such reduction in farm-workload is met by an increase in women's household chores given increased labor use (including via hire) may mean feeding more mouths working on the farm (as hiring farm labor in Ethiopia often includes food). The result for Nigeria, however, shows no statistically significant association between intrahousehold allocation of farm-workloads and crop commercialization.

Regarding the link between commercialization and household-level welfare outcomes, there is statistically significant evidence that crop commercialization is positively associated with household per capita consumption expenditures in Ethiopia and dietary diversity score in Nigeria (but not per capita consumption expenditure in Nigeria and dietary diversity score in Ethiopia). In short, a 10 percent increase in the marketed share of crops is associated with an increase in per capita annual consumption expenditure in Ethiopia by 6.8 USD (in PPP terms) and an

improvement in HDDS in Nigeria by 0.03 points. We also find a positive and statistically significant association between crop commercialization and food gap in Nigeria—a 10 percent increase in marketed shares is associated with an increase in food gap by about 6 days a year (= 0.02 months of food gap \times 30 days). A tentative interpretation of this result is that an increase in commercialization may have weakened women's control over income and hence reduces food gap (while still increasing diet diversity as indicated above).

5.4 Welfare implications of gender differences in crop revenue control

The previous sections have dealt with whether and to what extent agricultural commercialization affects women's decision-making agency and control over revenues, and the implications to gendered as well as household-level welfare. In this section, conditional on crop sales, we investigate to what extent men's or women's control over revenues affect intrahousehold allocation of expenditures and household welfare. We use the same estimation method described above and regress men's or women's sole or joint decision-making roles on crop revenues over intrahousehold share of expenditures and household per capita consumption expenditures, food security, and dietary diversity.

To do this, we construct three binary indicator variables, identifying three groups of farm households, mainly (1) households in which women solely or jointly control crop revenues where the revenues from the crop sales are controlled by female household members either solely or jointly with other male household members, (2) households in which men solely control crop revenues in which case the revenues from crop sales are controlled completely by male household member only, and thus typically represent patriarchal households, and (3) those that did not have crop sales and thus no one in the household controls crop revenues. The last group is the base household group in our estimation.

Table 8. Men’s and women’s control over revenues and implications to intrahousehold allocation of expenditures and welfare

	Share of expenditures on shoes/cloths for:			Household welfare outcomes:		
	Women (1)	Men (2)	Children (3)	Per capita consumption expenditure (PPP USD) (4)	Food gap (months) (5)	HDDS (6)
Panel A: Ethiopia						
Women solely or jointly control revenues	-0.130 (1.246)	0.469 (1.236)	-1.300 (1.465)	35.293** (17.744)	-0.028 (0.091)	0.198*** (0.067)
Men solely control revenues	0.018 (1.903)	2.970 (1.980)	-6.038*** (2.209)	20.941 (28.841)	-0.034 (0.127)	0.053 (0.110)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.01	0.02	0.01	0.03	0.01	0.28
N	5084	5084	5084	5084	5084	5084
Panel B: Nigeria						
Women solely or jointly control revenues	3.817** (1.687)	1.057 (1.392)	-2.448 (2.119)	19.770 (37.872)	0.113* (0.068)	0.190*** (0.073)
Men solely control revenues	1.536 (1.370)	1.778 (1.401)	-2.804 (1.821)	91.697** (36.779)	0.094** (0.043)	0.297*** (0.070)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.02	0.01	0.04	0.03	0.02	0.15
N	4918	4918	4918	4918	4918	4918

Note: The dependent variables in Columns (1-3), (4-6), and (7-9) are share of expenditures on cloth and shoes for women, men, and children, respectively. The reference category includes those with no crop sales. Other controls include household characteristics (age of head, education, household structure, land size, TLU, fertilizer use, and access to extension, finance and irrigation) and EA-level long-term average rainfall. Standard errors clustered at household-level reported in parenthesis (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). Source: Authors' calculations based on LSMS-ISA surveys in Ethiopia and Nigeria.

Table 8 presents estimation results of the role of crop revenues controlled solely or jointly (with men) by women and those solely controlled by men, compared to the base group of crop non-seller households. The first three columns of Table 8 reports results for the share of expenditures on shoes and clothes for women, men, and children; and columns 4-6 reports results for the household per capita consumption expenditure, food gap, and HDDS. The results in Panel A and B are, respectively, for Ethiopia and Nigeria.

The results for Ethiopia clearly show that women’s revenue control significantly increases household per capita consumption expenditure and dietary diversity, while men’s sole control over crop revenue significantly decreases the share of expenditure on children. Keeping other things constant, women’s control over crop revenues increases both per capita consumption expenditure and dietary diversity score by 35.3 USD (in PPP terms) and 0.2 points, respectively. In contrast, holding other things constant, men’s revenue control decreases the share of expenditures on shoes and clothes for children by 6 percent. The result that women’s revenue control increases

consumption expenditure and dietary diversity in Ethiopia is consistent with the literature that documents women's income control increases household consumption and dietary diversity (e.g., Hoddinott and Haddad, 1995).

Further, women's revenue control in Nigeria appears to be statistically significantly (positively) associated with increases in the share of expenditures on shoes and clothes and household dietary diversity score, while also slightly increase the food gap. Men's revenue control also appears to be significantly associated with increases in household per capita consumption expenditure, dietary diversity, and food gap. Specifically, women's control over revenues increases both the share of expenditures on shoes and clothes for women and household dietary diversity score by 4 percent and 0.2 points, respectively. Men's revenue control in Nigeria also increases both per capita consumption expenditure and dietary diversity score by 91.7 PPP USD and 0.3 points, respectively. In addition, contrary to expectations, revenues controlled by both men and women appear to increase household food gap by about 0.1 months each.

Lastly, as discussed earlier, the indicator variable for women's revenue control is defined as control by female household members, either solely or jointly with male members. But women's joint control over revenues may not be equal with women's independent revenue control. Several studies that implemented similar proxy variables typically equate women's independent decision-making and control of resources with highest degree of women empowerment (e.g., Bernard *et al.*, 2020). It is also common to put a linear ranking in women's resource control and decision-making, and normatively order woman's resource control alone as the highest degree of women empowerment, followed by joint control as second best, and women's non-participation in resource control as the worst (Bernard *et al.*, 2020)¹⁶. However, there is no strong evidence that shows the extent to which women's joint income/resource control is different from women's independent control of income/resource, and thus it is not always clear whether such ranking works practically (Acosta *et al.*, 2019; Bernard *et al.*, 2020; Peterman *et al.*, 2021; Seymour & Peterman, 2018).

¹⁶ Using five different decision-making typologies, Bernard *et al.*, (2020) find a link between the rationale for decision-making and household outcomes but underline understanding why a certain person in the household (or the couple) make decisions rather than who makes decisions can provide more insights into the intrahousehold dynamics.

Table 9. Implications of crop revenue control by women and men solely and jointly

	Share of expenditures on shoes/cloths for:			Household welfare outcomes:		
	Women	Men	Children	Per capita consumption expenditure (PPP USD)	Food gap (months)	HDDS
Panel A: Ethiopia						
Women solely control revenues	0.095 (2.692)	-1.965 (2.255)	-0.637 (2.859)	26.128 (31.997)	-0.167 (0.163)	0.225* (0.121)
Men solely control revenues	-0.004 (1.901)	3.201 (1.988)	-6.101*** (2.218)	21.811 (29.002)	-0.020 (0.127)	0.051 (0.111)
Jointly control revenues	-0.170 (1.247)	0.897 (1.282)	-1.417 (1.488)	36.903** (18.117)	-0.004 (0.093)	0.194*** (0.071)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.01	0.02	0.01	0.03	0.02	0.28
N	5084	5084	5084	5084	5084	5084
Panel B: Nigeria						
Women solely control revenues	6.695** (3.043)	-0.921 (2.042)	-2.814 (3.625)	58.789 (65.574)	-0.069 (0.114)	0.102 (0.097)
Men solely control revenues	1.321 (1.364)	1.925 (1.414)	-2.777 (1.827)	88.785** (37.062)	0.108** (0.043)	0.304*** (0.070)
Jointly control revenues	2.593 (1.809)	1.897 (1.671)	-2.293 (2.353)	3.185 (41.275)	0.191** (0.075)	0.227*** (0.085)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.02	0.01	0.04	0.03	0.02	0.15
N	4918	4918	4918	4918	4918	4918

Note: The dependent variables in Columns (1-3), (4-6), and (7-9) are share of expenditures on cloth and shoes for women, men, and children, respectively. Other controls include household characteristics (age of head, education, household structure, land size, TLU, fertilizer use, and access to extension, finance and irrigation) and EA-level long-term average rainfall. Standard errors clustered at household-level reported in parenthesis (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Authors' calculations based on LSMS-ISA surveys in Ethiopia and Nigeria.

If women's sole control over crop revenues is stronger than their joint control with men, then our estimates based on the joint control (i.e., solely or jointly) is weaker than the sole control as compared to the men's sole control. We probe this by splitting the women control variable constructed from sole and joint control into two groups which separately include women's sole revenue control and joint control for women and men.¹⁷ Table 9 reports the estimation results based on this new definition of crop revenue control. With few changes on the magnitude and significance of the coefficients, most of the significant results for both countries are consistent with those in Table 8, confirming the robustness of our main results.

¹⁷ Thus, we have now four groups of farm households in our analysis: (1) households in which women solely control crop revenues, (2) households in which women and men jointly control crop revenues, (3) households in which men solely control crop revenues, and (4) the base group of crop non-seller households.

In sum, these results suggest that women’s crop revenue control, be it jointly or alone, are positively associated with most of the intrahousehold and household-level welfare outcomes compared to men’s control over revenues.

6. Conclusions and implications

This study has assessed how aspects of the gender gap in agriculture, namely women’s agency and control over income fared in the process of agricultural commercialization in Ethiopia and Nigeria—two of Africa’s most populous and diverse contexts of gender relations and norms.

Four important findings emerge from our empirical analysis that use two rounds of the LSMS-ISA panel data from Ethiopia and Nigeria. First, we find that women’s participation in overall agricultural decision-making is among the lowest in these two countries and is more pronounced in Nigeria than in Ethiopia. Further, we find evidence that commercialization is negatively associated with the likelihood that women participate in household decision-making regarding ‘use of harvest’ (for home consumption, sales, or other purposes), crop marketing, and control over crop income or revenues from crop sales in Ethiopia, but only on harvest use and control over crop income or revenues in Nigeria. Clearly, while the participation of women in decision-making is already limited, we find evidence that commercialization may further erode their bargaining power through reducing their control over income gains.

Second, the association between commercialization with land ownership is mixed: positive in Ethiopia (perhaps mirroring the strong gender-specific land certification implemented in the last decades in Ethiopia) but negative in Nigeria (suggesting commercialization reduces chances that women stay in control of their land at least at the lower crop sales quintiles). Third, we also find that agricultural commercialization is associated with reduction in women’s relative role in farming activities while also associated with increases in the relative role of hired labor in Ethiopia—suggesting substitution of women’s labor by hired labor (and no statistically significant evidence of these for Nigeria). Fourth, we also find, conditional on crop sales, women’s sole or joint control over revenue in Ethiopia is positively associated with increases in per capita consumption expenditures and dietary diversity, but men’s control is negatively associated with increases in the share of expenditure on children’s shoes and clothes. In the case of Nigeria, women’s control is positively associated with increases in the share of expenditure on women’s shoes and clothes, food gap, and dietary diversity. However, in Nigeria, men’s control is also positively associated with per capita expenditure, food gap, and dietary diversity.

Overall, the evidence suggests that commercialization may further marginalize women's decision-making agency in agriculture in Ethiopia and Nigeria. Interestingly, such reduced income gains from commercialization for women seems to arise even if their participation in production remains the same, which suggests that participation at the production end of the value chain may not necessarily guarantee the gains from harvest. However, when women have control over proceeds, commercialization tends to improve women's, as well as other household members', welfare. Nonetheless, it is not clear whether such household-level welfare improvements come at the cost of redirecting their income shares away from improving their empowerment positions. Moreover, while reduction of women's time burden and workload in agriculture is a welcome outcome, it may well be that their labor share is moved to "hidden labor" in the household and, as such, may contribute to reduction in women's bargaining power on revenue sharing. Future research may shed light on understanding these important questions. We note also that the results are more mixed for Nigeria than for Ethiopia, and regionally disaggregated data may be warranted to dissect the mixed results in Nigeria. It also follows that a more systematic individualized data collection on the income sharing end of the value chain is critical to understand the full effects of commercialization on gender outcomes. And, overall, women's participation in production and access to productive inputs may not be sufficient to address the gender gaps in agriculture or gender equity. It is imperative that efforts to reduce the gender gaps in agriculture include the last milestone in agriculture value chains, namely who benefits from harvests. Policymakers seeking to achieve productivity gains through commercialization also need to consider potential gender imbalances that may arise from such exercises. Moreover, it is important for future research to focus on understanding not just whether women participate but also what it means for them to (not) participate in decision-making in terms of access to incomes earned.

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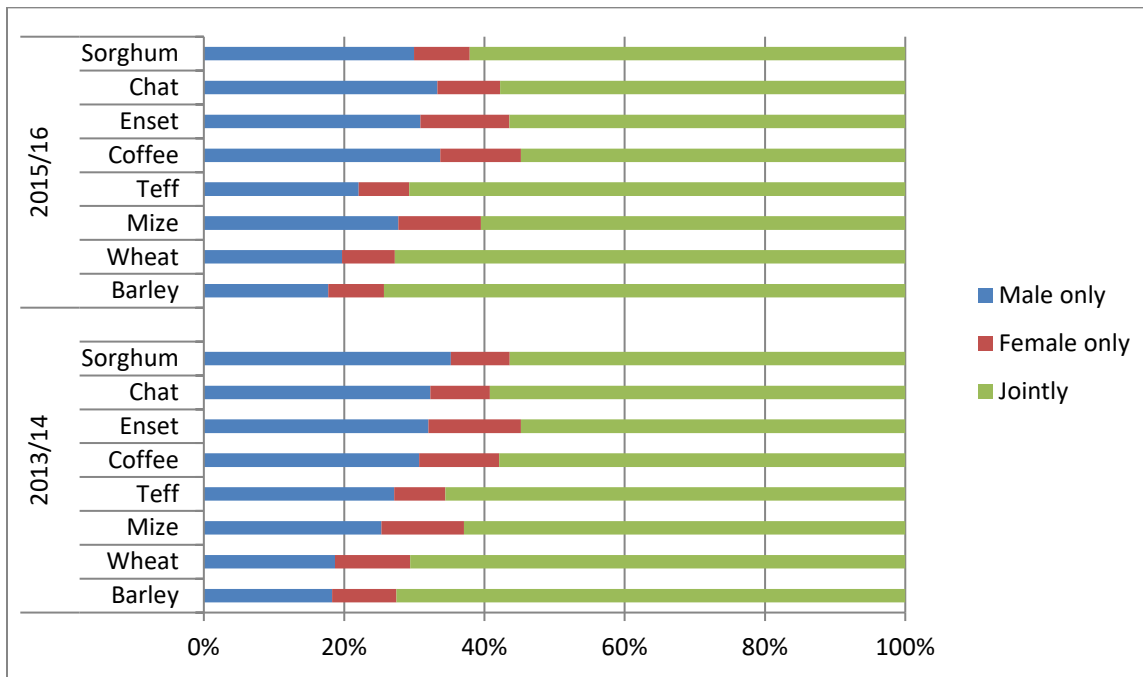
Appendix

Table A1 The LSMS-ISA sample households used in our analysis

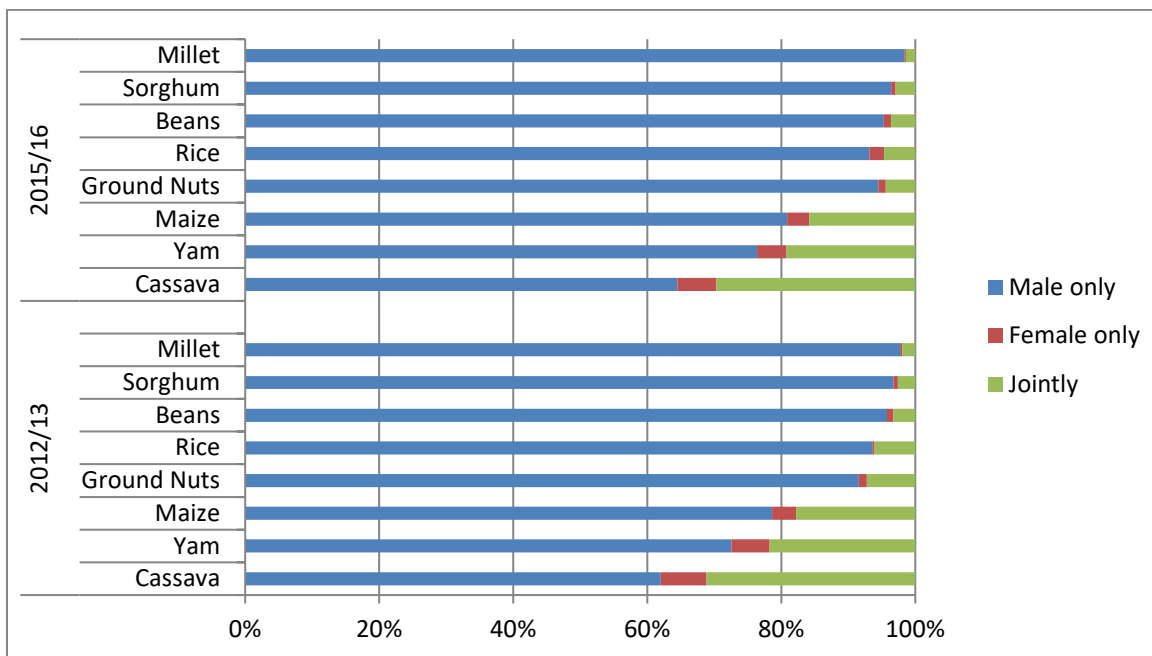
Sample size/year	Ethiopia			Nigeria		
	2011/12	2013/14	2015/16	2010/11	2012/13	2015/ 16
Total households interviewed	3,969	5,262	4,967	4,916	4,716	4,582
Farming households	2,805	3,158	3,054	3,082	2,987	2,861
Balance panel of farming households	2,542	2,542	2,542	2,449	2,449	2,449

Figure A1. Main crops produced in Ethiopia and Nigeria, by gender of farm managers and round

(a) Ethiopia



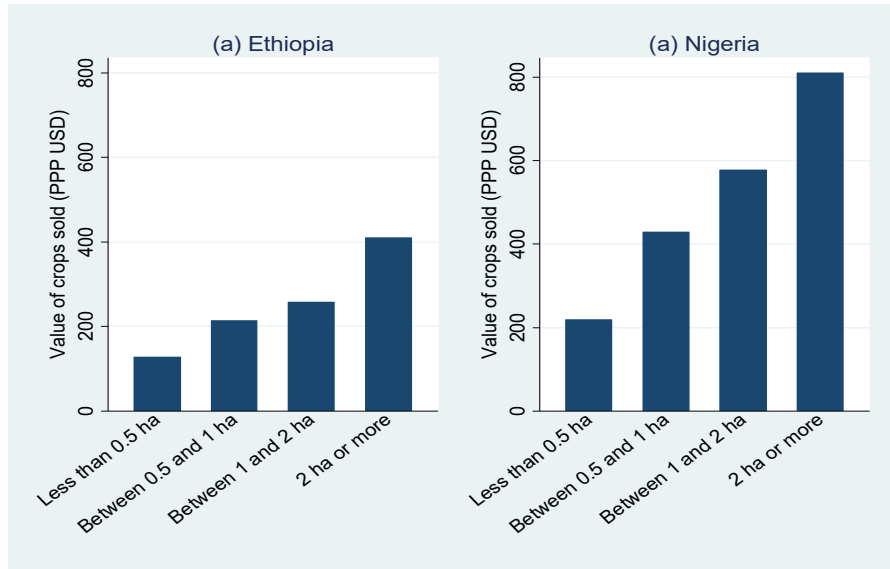
(b) Nigeria



Source: Authors' computation based on Ethiopia and Nigeria LSMS-ISA panel data.

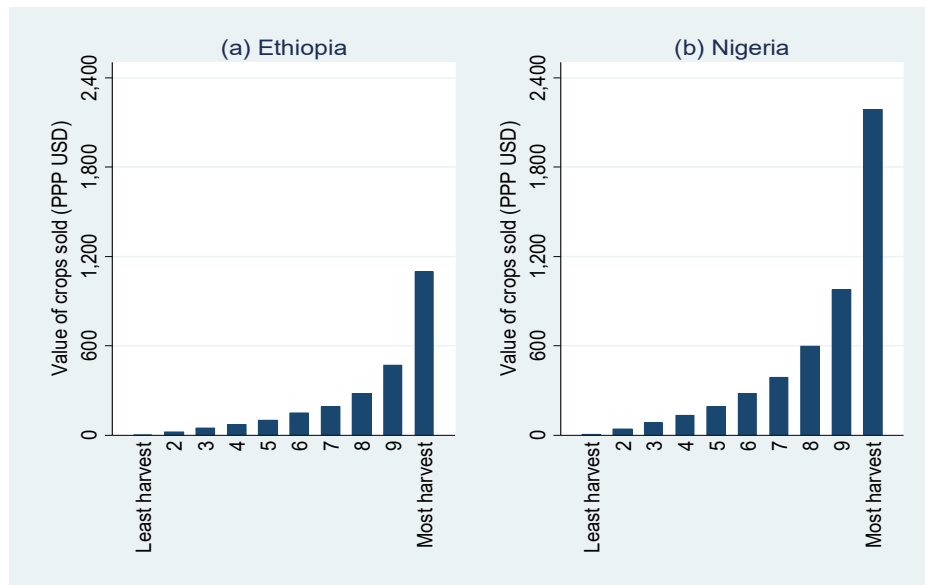
Figure A2. Average values of crop sales by land size, volume of production, and the distribution of share of households by marketed share of crop output in Ethiopia and Nigeria.

A) Average values of crop sales by land size



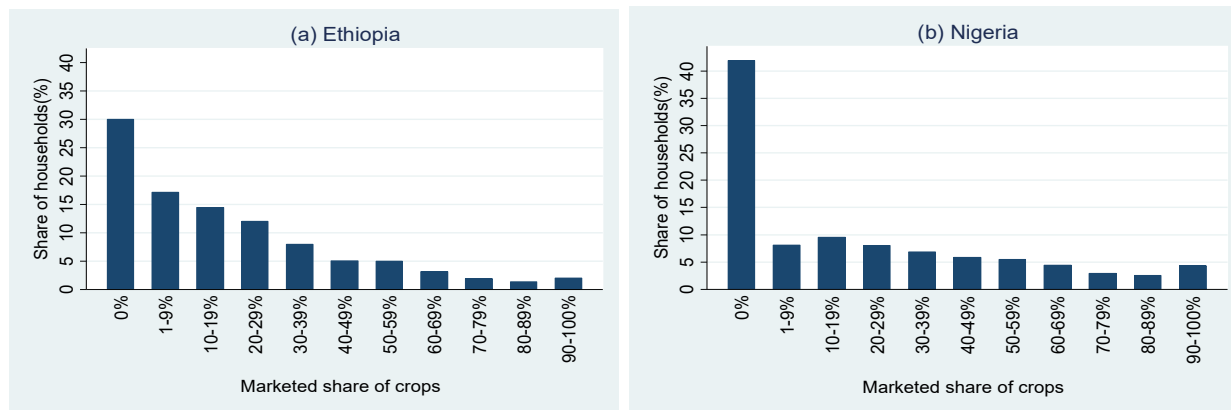
Source: Authors' computation based on LSMS-ISA surveys in Ethiopia and Nigeria.

B) Average values of deciles of volume of production



Source: Authors' computation based on LSMS-ISA surveys in Ethiopia and Nigeria.

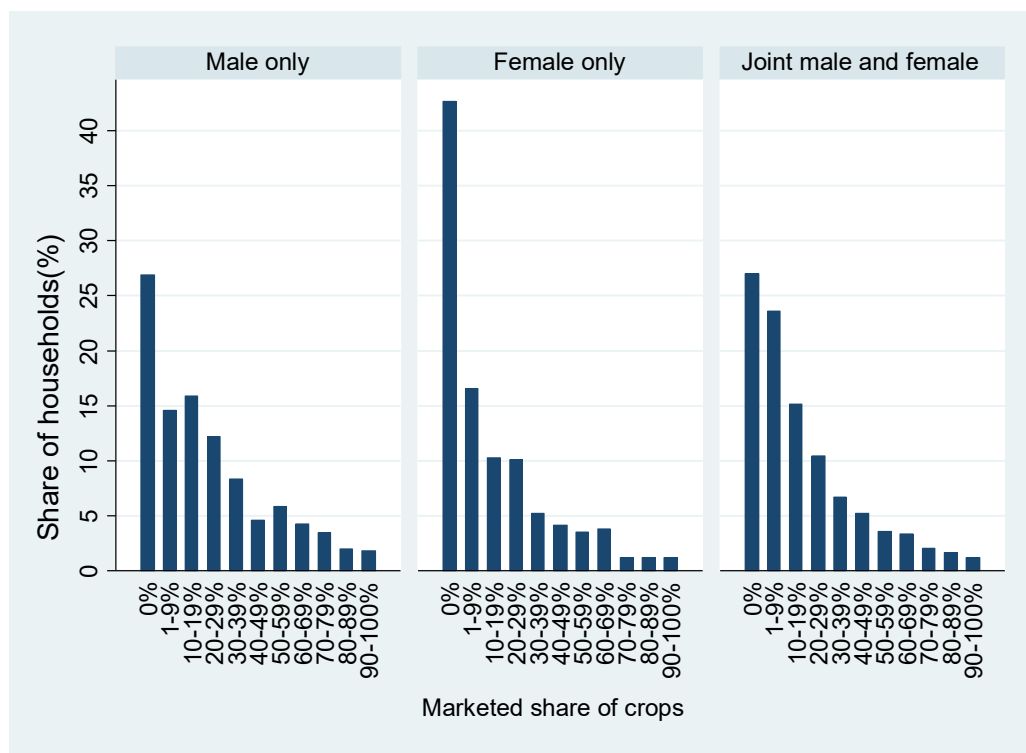
(c) Distribution of share of households by crop commercialization



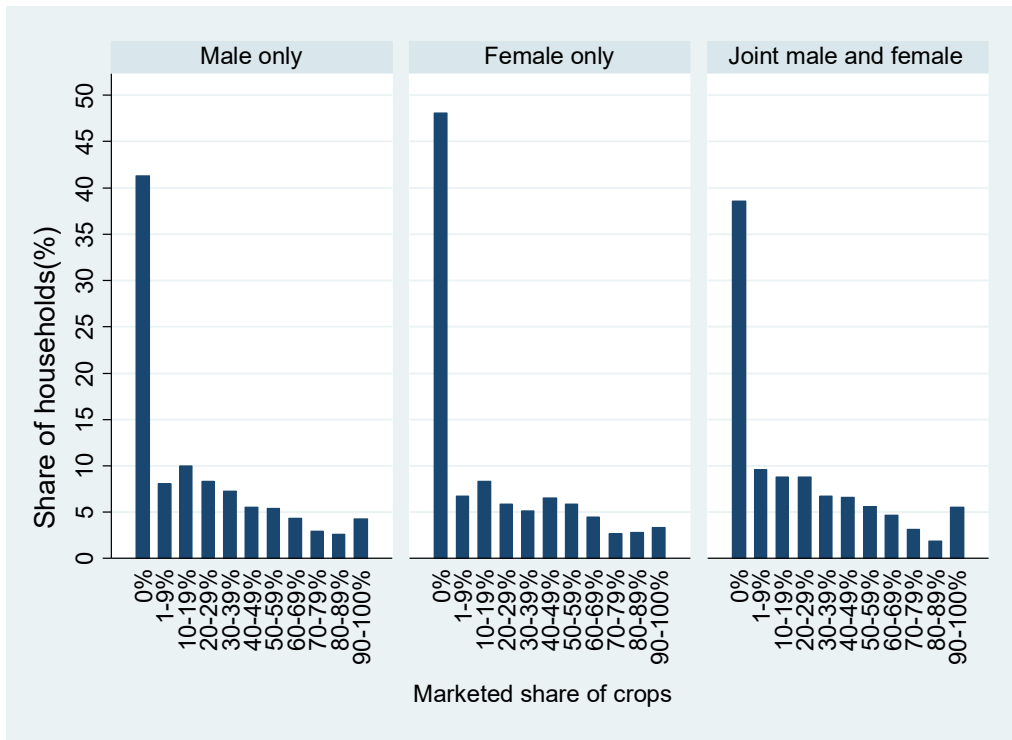
Source: Authors' computation based on Ethiopia and Nigeria LSMS-ISA panel data.

Figure A3. Distribution of marketed share of crops by gender of crop managers in Ethiopia and Nigeria

(a) Ethiopia



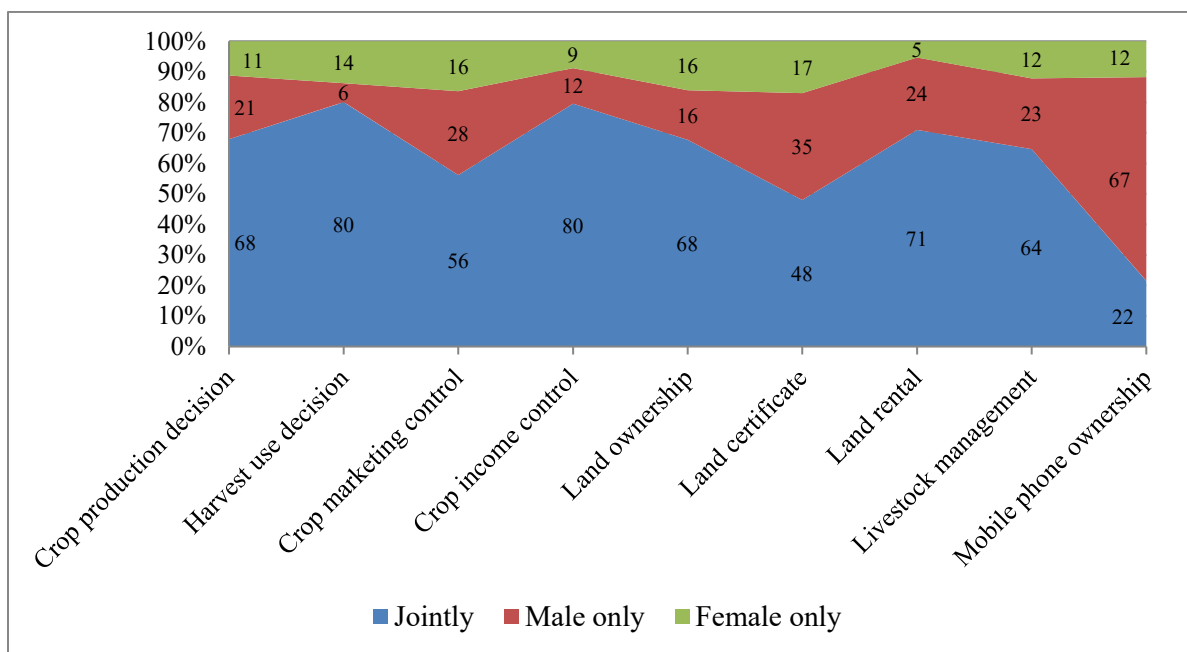
(b) Nigeria



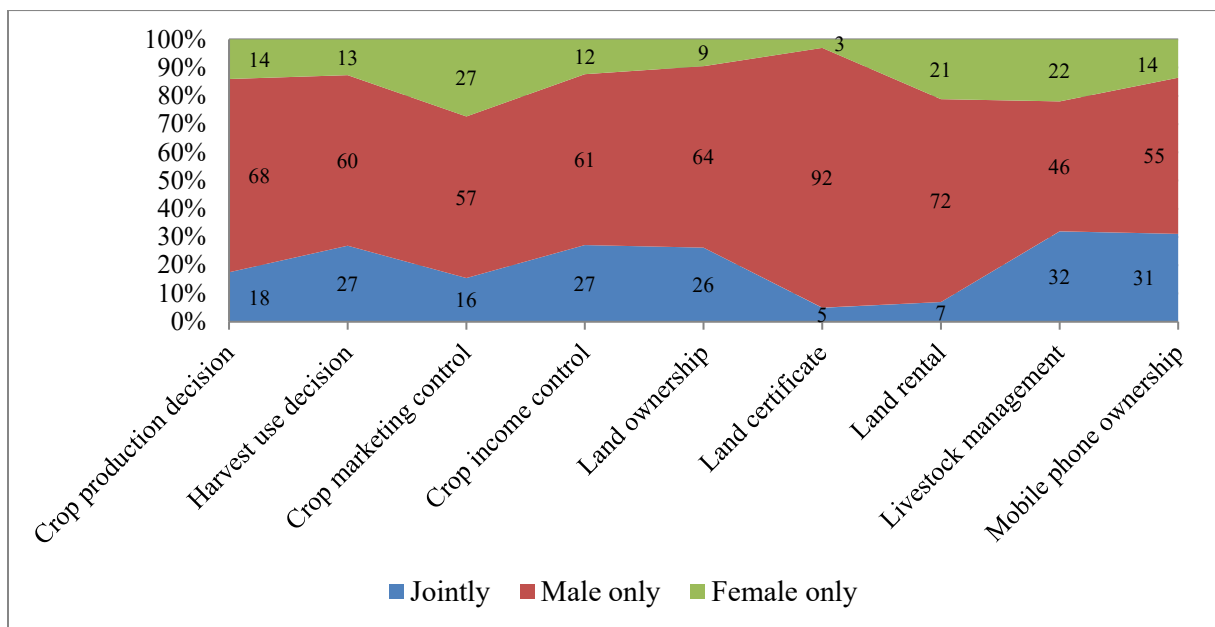
Source: Authors' computation based on Ethiopia and Nigeria LSMS-ISA panel data.

Figure A4. Participation in agricultural decision-making, income control, and asset ownership, by gender of crop manager

(a) Ethiopia



(b) Nigeria



Source: Authors' computation based on the LSMS-ISA surveys in Ethiopia and Nigeria.

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