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GENDER DYNAMICS IN AGRICULTURAL EMPLOYMENT FOR FOOD SECURITY IN SUB-SAHARAN AFRICA

Afees Noah¹, Oladipo David², Wynand Grobler³, Moshood Alabi⁴

Abstract

Gender roles are socially constructed expectations defining the behavior, responsibilities, and opportunities of men and women, especially evident in agriculture, where specific tasks are traditionally assigned to each gender. Realizing these roles is vital for crafting efficient approaches to enhance food security. This study investigates the moderating role of gender employment in agriculture on the agricultural sector and food security nexus in 28 sub-Saharan African (SSA) nations. The study uses descriptive analysis, system generalized method of moments (SGMM), and panel-corrected standard error (PCSE) methodologies to analyze the secondary data on 28 SSA countries. The descriptive results reveal that, on average, women contribute over half (51%) of the agricultural labor force, highlighting women's important role in the agricultural sector. Empirical results also show that total agricultural employment has a positive short- and long-term impact on food security. In contrast, female employment exhibits a long-run impact, and male employment influences food security only in the short run. Also, the moderating effect of overall and male employment on agricultural output affects food security solely in the short run, while the impact of female employment occurs in both the short and long run. Considering the vital contribution of women in ensuring food security in SSA, it is recommended that efforts should be geared toward prioritizing gender-inclusive agricultural policies and addressing disparities in resource access and training. Addressing resource access and training disparities, and investments in

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agricultural infrastructure are also crucial to reducing post-harvest losses thereby improving food security in the region.

Key words: Agricultural labor force, food security, gender employment, static and dynamic panel analysis, sub-Saharan Africa.

JEL⁵: F5, Q18, O13

Introduction

Gender roles are socially constructed expectations defining the behavior, responsibilities, and opportunities of men and women, especially evident in agriculture, where specific tasks are traditionally assigned to each gender. Realizing these roles is vital for crafting efficient approaches to enhance food security (Tantoh et al., 2021). There is a prevalent understanding that agriculture serves as the principal employment sector for a considerable percentage of women in various regions, notably Oceania, Southern Asia, sub-Saharan Africa, and least-developed countries (UN, 2015). While certain discrepancies exist, with employment percentages in Niger and Uganda varying from 24% to 56%, or 37% at the national level in Nigeria, the sector's importance remains substantial (Palacios Lopez et al., 2017). Men perform a crucial task in household food security, while women contribute more to household food consumption. Reducing bias against women in agriculture could contribute to agricultural growth and enhance food security (Agarwal et al., 2022).

According to Mukasa and Salami (2016), gender equality and women's empowerment have become hot topics among stakeholders. Women in agriculture in particular face formidable obstacles that severely restrict their potential and imprison them in a gender productivity trap. Enhancing their access to agro-inputs (like land, agro-chemicals, or improved seeds), changing laws that discriminate against women in the land, and bridging the gaps between the women and technology, finance, human capital, or extension services could help African nations to achieve greater gender equality in their agricultural sector (Mukasa, Salami, 2016).

However, assessing the precise magnitude and nature of women's contributions to agriculture remains challenging, displaying significant variations across countries and regions (Mishra et al., 2022). Even though women in SSA have made significant contributions to the agriculture sector, as concerning trend emerges. There was a 4.3% rise in the gender gap in the region's food insecurity from 1.7% for men and women in 2019 and 2021 respectively. In 2022, concerning 2.4

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billion individuals, primarily women and those living in rural regions, struggled to obtain enough food that was safe, nourishing, and sufficient throughout the observed year (FAO, 2023).

Several questions arise, demanding answers: What part does agricultural output play in promoting food security in SSA? Does total employment in agriculture contribute to food security beyond food production? How does the gender differential in agricultural employment impact food security in SSA? And what is the relative contribution of gender differential in agricultural employment to food security across SSA regions?

Despite existing studies exploring the drivers of food security (Awoke et al., 2022; Worku, Terefe, 2023; Noah et al., 2024a), and the nexus between gender inequality and food security (Tayal, 2019; Obisesan, Awolola, 2021; Egah et al., 2023; Uduji, Okolo Obasi, 2023), others have also focused on food security and agriculture (David et al., 2016; Noah, Abidoye, 2019; Abdelhedi, Zouari, 2020; Ouko et al., 2020; Ukpe, 2024), but the limited emphasis has been given to the role of employment in agriculture to food security, particularly from a gender issues, in SSA. This is crucial in the context of empowering the poor and offering an alternative approach to addressing food insecurity.

Consequently, this study adds to the corpus of current information as previous research has employed a variety of indices for measuring food security, yet many have relied on just one or two indicators as proxies. Findings from these investigations underscore the variety of research concerns, giving rise to diverse sets of measures employed in categorization, leading to distinct typologies, and thus, different conclusions (Pawlak, Kołodziejczak, 2020; Noah et al., 2024b). Relying solely on one or two indicators while neglecting others may result in incomplete inferences. This limitation arises from the inability of a single indicator or a pair to fully represent or capture the complexity of food security. To address this challenge, the study enhances the current measurement scope of food security by aggregating several indicators, offering a broader perspective.

In addition, primary data used in earlier research on food security in SSA came from studies conducted in individual countries (Broussard, 2019; Dedehouanou, Araar, 2020; Funke et al., 2023). This study also adds to the little body of research on food security in Sub-Saharan Africa that relies on secondary data and related panel techniques. While micro studies have considered employment in agriculture as a determinant of food security, the limited macro studies on food security have predominantly used total employment as a determinant.

Additionally, the study explicitly looks into how agriculture employment influences food security, departing from the commonly used total employment in related previous studies. To our understanding, none of the existing studies investigated the differential effects of gender in agricultural employment on food security, most especially in SSA. Consequently, research contributes to the ongoing discourse on gender, agricultural employment, and food security, with the primary objective of investigating the effects of gender-inclusive agricultural employment on food security in SSA. Specifically, study examines the differential effects of male and female agricultural employment on food security and explores the moderating effects of total, male, and female agricultural employment on agricultural productivity and food security in SSA. Further details of this study are elaborated in the methods and materials, presentation and discussion of results, as well as conclusion and policy recommendations.

Methodology

The study is grounded in Malthus's (1789) Malthusian theory, which is implicit in the neo-classical theory. Malthus posits that the geometric trend of growing population outpaces the arithmetic rise in the production of food. This leads to a food crisis, termed a Malthusian tragedy if not adequately addressed. Effective population control can either decline food security or increase it (Scanlan, 2003). This implies that population growth result in food insecurity if not well-managed, and improve the food security if otherwise. Moreover, increased individual income is associated with better food security, supporting empirical and theoretical views linking economic growth to food security. Thus, economic growth positively influences food security. Although the gender factor adds diversity, employment in agriculture still significantly contribution to food security and outputs. Employment in agriculture influences food security by affecting the quality and volume of food people have access to. This also affect food security by generating income that can be used to access better food and nutrition (Doss et al., 2018).

In line with the economic dependency theory, the study recognizes the global dimension of food security while taking trade openness into account. But prudence is encouraged, stressing the significance of striking a balance between domestic and foreign production to avoid becoming overly dependent on the food supply of other nations, which can be harmful (Abdullah et al., 2021; Noah et al., 2024a). Ashraf and Javed (2023) highlighted the importance of capital stock, emphasizing how it raises living standards and productivity. Since capital stock includes items such as agricultural facilities that are necessary for effective food production, distribution, and preservation. All of which ultimately determine the availability and accessibility

of food. Thus, a higher capital stock corresponds to greater food security (Pawlak, Kolodziejczak, 2020). Food security in households can be greatly impacted by the efficient use of available lands, whereas both agriculture and food security are at risk from the loss of agricultural land (Bonye et al., 2021). Volatility in food prices is thought to be linked to food security, as seen by the relationship between rising food insecurity and food price inflation (Erokhin, Gao, 2020; Noah et al., 2024a).

The chosen determinants of food security are justified based on their theoretical significance and related studies such as (Tayal, 2019), informing the formulated model for food security as follows:

$$FOS_i = \alpha_0 + \alpha_1 POP_i + \beta_2 X_i + \varepsilon_i \dots\dots\dots(1)$$

Where, *FOS* is food security (food security index), *POP* is population growth and *X* represents the variable of interest-employment in agriculture (*EMA* - total employment in agriculture), and further disaggregated into male (*MEA*) and female employment (*FEA*). Other control variables include agricultural output (*AGO* - agricultural sector value-added), economic growth (*GDP* - GDP per capita), food trade openness (*FTO* - total of food import and export, percent of GDP), agricultural land (*AGL* - agricultural land, percent of land area), physical capital stock (*PCS* - gross fixed capital formation in fishing, forestry, and agriculture), food inflation (*FIN*). It is anticipated that *FIN* will be negative, while *AGO*, *GDP*, *AGL*, *FTO*, and *PCS* will all be positive based *a priori* expectations.

Additionally, dynamic panel regression is incorporated into the analysis to mitigate any bias due to the endogeneity of particular regressors. Next equation illustrates the applied model as:

$$FOS_{it} = \delta_0 + \delta_{1t} FOS_{it-1} + \theta_{1t} \delta + \eta_{it} \dots\dots\dots(2)$$

where FOS_{it-1} represents the first lag of food security, the explanatory variables with a dimension of $1 \times k$ are represented by Θ_{it} . Using the previous equation's first difference to illustrate the models' objectivity and reliability:

$$\Delta FOS_{it} = \delta_0 + \delta_{1t} \Delta FOS_{it-1} + \Delta \theta_{1t} \delta + \eta_{it} \dots\dots\dots(3)$$

Analytical techniques

The statistical methods encompass descriptive analysis, and panel regression analysis. The study used panel-corrected standard error (PCSE) to estimate panel static regressions. Considering the characteristics of our datasets, the PCSE approach yields the most accurate and dependable estimate. Most significantly, it enables us to account for autocorrelation, heteroscedasticity, and cross-sectional dependency

(Beck, Katz 1995; Reed, Webb 2010) Furthermore, the study incorporates the SGMM technique for dynamic panel regression, considering the characteristics of the micro panel data being examined. According to theories and empirical evidence, endogeneity may result from bidirectional causality between food security and its drivers. To estimate the model, the study uses the system generalized method of moments (SGMM). When there is a correlation between the lagged dependent variables and the unobserved panel-level effects, SGMM is a reliable estimator for the model's parameters. Additionally, it is better suited for panel datasets with a larger country dimension and a shorter time dimension, like the one used in this study, and performs better when endogeneity, heteroscedasticity, and autocorrelation are present. We employ the first lagged level of the dependent variable, which is produced automatically by the over-identifying restriction technique, as an instrument during the estimate process. The over-identifying limitations would change depending on how many instruments were used (Roodman, 2009). For this reason, we perform the Arellano Bond and Sargan tests to verify the validity of the instruments and the dependability of the estimates.

Data sources

This study relied on secondary data collected from 28 SSA countries. Following the accessibility of data and the effort to achieve the SDGs' second goal, this analysis covers the years 2012-2022, the temporal scope of earlier studies on the subject is likewise expanded by this timeframe. Additionally, this period broadens the chronological span of earlier studies on the subject. The Economist Impact's GFSI (Global Food Security Index) provided data on food security, while the WDI (World Bank's World Development Indicator) included data on population and economic growth, agricultural employment, and land. FAOSTAT (Food and Agriculture Organization (FAO) Statistics) provided data on inflation, food trade openness, physical capital stock, and agricultural output.

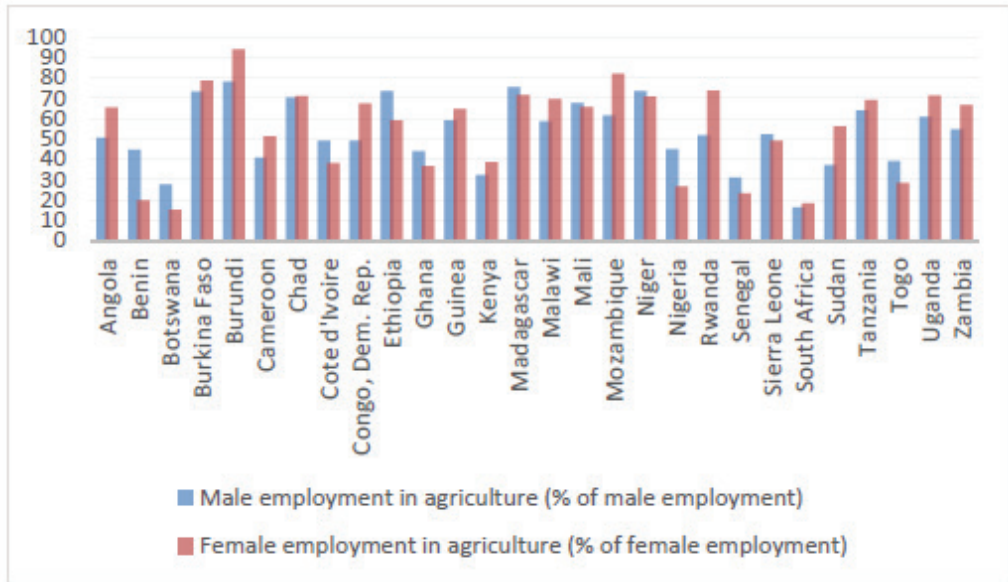
Results and Discussion

Gender perspective of employment in agriculture among SSA countries

The detailed analysis presented in Figure 1. reveals that, on average, females are more actively involved in agricultural employment than their male counterparts in SSA. However, this trend varies among individual countries. For instance, Figure 1. illustrates that out of the 28 countries, 15 exhibit higher female engagement in agricultural employment. Notably, Burundi tops the list with the highest rate at 93.88%, followed by Mozambique at 81.81%, and Burkina Faso, Rwanda, and Uganda securing the third, fourth, and fifth positions with rates of 78.50%, 73.64%,

and 71.06%, respectively. On the flip side, the remaining 13 countries portray a higher prevalence of male employment in agriculture compared to their female counterparts. This group includes Madagascar, Niger, Ethiopia, Mali, and Sierra Leone, with rates of 75.28%, 73.50%, 73.26%, 67.53%, and 52.13%, respectively.

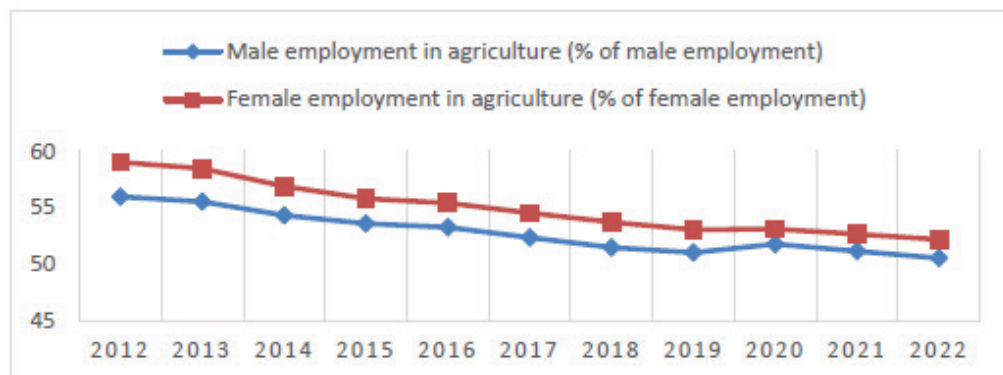
Figure 1. Average gender employment in agriculture among SSA countries



Source: Authors processing based on World Bank's World Development Indicator (WB, 2023).

Figure 2. illustrates a declining trend in both male and female agricultural employment in SSA over the entire period. Notably, the average female agricultural employment surpasses that of their male counterparts consistently throughout the period. The overall average employment in agriculture for the entire period stands at 52.83% for males and 54.99% for females. This suggests that, on average, female employment in agriculture exceeds that of males within the considered timeframe.

This result supports the widely held perception that women comprise a larger proportion of the agricultural labor force in SSA than men. However, it is noteworthy that this figure (51%) is marginally lower than the commonly acknowledged belief that women in SSA account for 60-80% of the agricultural workforce (UN, 2015). This finding also contradicts assertions that women contribute less than half of the agricultural labor in the region (Palacios Lopez et al., 2017). These reveal that, on average, women constitute more than half (51%) of the agricultural labor force in SSA, while men contribute 49%.

Figure 2. Average gender employment in agriculture in SSA (period 2012-2022.)

Source: Authors processing based on WB, 2023.

Discussion of PCSE and SGMM estimates

Table 1. displays the outcomes of the analysis on the influence of total employment in agriculture and gender-specific (male and female) employment in agriculture, along with other variables, on food security in Models 1 and 2, respectively. Additionally, Table 2. illustrates the findings regarding the interactive effects of agricultural output and total agricultural employment, agricultural output, and female agricultural employment, as well as agricultural output and male employment in agriculture in Models 3, 4, and 5, respectively. The empirical findings of the pre-estimation tests support the PCSE and SGMM for the long- and short-run estimations, respectively.

Empirical results from the PCSE estimation in Model 1 show the results of the impact of total employment in the agricultural sector on food security. This reveals that the coefficients of economic growth, physical capital stock, and total employment in the agricultural sector are all positive and statistically significant. In contrast, the coefficients of population growth, food inflation, and trade openness are negative yet statistically significant. This suggests that physical capital stock, economic growth, and total employment in the agricultural sector have positive effects on food security, while population growth, food inflation, and trade openness exert negative effects.

Table 1. Total and gender effects of employment in agriculture on food security

Variables	Model 1			Model 2		
	FEM	PCSE	SGMM	FEM	PCSE	SGMM
GDP	0.130*** (0.008)	0.001*** (0.000)	0.029 (0.452)	0.002 (0.233)	0.001*** (0.000)	0.045 (0.345)
AGO	-0.013 (0.539)	-0.006 (0.730)	-0.014 (0.385)	-0.125** (0.012)	-0.022 (0.212)	-0.007 (0.693)
AGL	0.764*** (0.000)	-0.007 (0.574)	0.064 (0.343)	0.308** (0.022)	-0.002 (0.848)	-0.002 (0.980)
POP	-0.053* (0.077)	-2.484*** (0.000)	0.016*** (0.005)	-1.078 (0.134)	-2.346*** (0.000)	0.084 (0.235)
FIN	0.001 (0.304)	-0.052*** (0.008)	-0.001 (0.120)	0.007 (0.530)	-0.045** (0.021)	-0.001 (0.329)
FTO	0.025*** (0.008)	-8.034*** (0.000)	0.002 (0.778)	-1.203 (0.477)	-7.527*** (0.000)	-0.005 (0.709)
PCS	0.025** (0.029)	0.001*** (0.000)	0.011** (0.022)	0.001 (0.735)	0.001*** (0.000)	0.013*** (0.005)
EMA	0.162*** (0.001)	0.045*** (0.003)	0.157*** (0.000)			
FEA				0.520*** (0.000)	0.057*** (0.002)	0.047 (0.290)
MEA				0.301*** (0.004)	0.021 (0.277)	0.059 (0.647)
FOS ₋₁			0.594*** (0.000)			0.650*** (0.000)
Constant	0.922 (0.239)	54.624*** (0.000)	2.132*** (0.000)	46.735*** (0.000)	54.037*** (0.000)	1.860* (0.053)
F-statistics /Wald χ^2	15.48*** (0.000)	971.25*** (0.000)	1246.81 (0.000)	13.64*** (0.000)	1145.61*** (0.000)	1140.69*** (0.000)
F-test	23.33*** (0.000)			20.27*** (0.000)		
Hausman test	4.32** (0.038)			48.10*** (0.000)		
CSD test	7.593*** (0.000)			18.534*** (0.000)		
Autocorrelation	30.861*** (0.000)			36.870*** (0.000)		-1.447 (0.651)
Multicollinearity (Mean VIF)	2.10			3.88		
Sargan test						19.082 (1.000)
R ²	0.313	0.478		0.312	0.484	

Source: Authors processing based on WB, 2023, Economist Impact (GFSI, 2023), and FAO (2023).

Note: The p-value is the number enclosed in parenthesis (). *, **, and *** stand for significance levels at 10%, 5%, and 1%, respectively. Food security – FOS, economic growth – GDP, agricultural output – AGO, agricultural land – AGL, total agricultural employment – EMA, population growth – POP, food inflation – FIN, food trade openness – FTO, female agricultural employment – FEA, and male agricultural employment – MEA.

Specifically, a 1 % rise in physical capital stock, economic growth, and total employment in the agricultural sector leads to an approximately 0.001, 0.001, and 0.045% rise in food security among SSA countries in the long run. In contrast, food security increases by 2.484, 0.052, and 8.034% for every one percent drop in population growth, food inflation, and food trade openness, respectively. Observed effects are in line with prior research by Ashraf and Javed (2023), and Scanlan (2003), and they also match *a priori* expectations. However, the observed insignificance of agricultural output and land usage contradicts *a priori* expectations and related studies, possibly due to unpredictable climate patterns leading to environmental challenges, conflicts, and land degradation in many SSA countries. Insignificance of agricultural land usage could be attributed to the growing demand for residential and commercial land, which comes at the expense of agricultural land, as suggested by Bonye et al., 2021.

Additionally, the empirical results from the SGMM in Model 1. show that the coefficients of the one-period lag of food security, population growth, physical capital stock, and total employment in agriculture are positive and statistically significant. However, trade openness, economic growth, food inflation, agricultural output, and land use, are found to be statistically insignificant. This implies that the one-period lag of food security, population growth, physical capital stock, and total agricultural employment positively influence food security in the short run. That is, a one percent rise in the one-period lag of food security, population growth, physical capital stock, and total employment in agriculture leads to an approximate rise of 0.594, 0.016, 0.011, and 0.157%, respectively, in food security among SSA nations.

The observed impacts align with earlier studies by Doss et al. (2018), Erokhin and Gao (2020), and Noah et al. (2024a) except for the insignificance of economic growth, which contradicts these findings. The implications of these is that a population that is well-nourished because of improved food security in the previous periods can lead to increase labor productivity and health outcomes in the present period. Population growth also result improved food security if effectively-managed. This increases the consumer base and labor force, which boosts economic and demand activities. In a similar vein, improvement in agricultural employment increases rural economies, lowers poverty, and promotes long-term sustainability in food production.

Table 2. Moderating effects of total and gender employment in agriculture on food security

Variable	Model 3		Model 4		Model 5	
	PCSE	SGMM	PCSE	SGMM	PCSE	SGMM
GDP	0.002*** (0.000)	0.053 (0.139)	0.002*** (0.000)	0.060* (0.097)	0.002*** (0.000)	0.052 (0.136)
AGL	-0.016 (0.182)	0.057** (0.028)	-0.012 (0.311)	0.060** (0.038)	-0.017 (0.153)	0.047* (0.079)
POP	-3.061*** (0.000)	0.022*** (0.000)	-2.964*** (0.000)	0.022*** (0.000)	-3.084*** (0.000)	0.023*** (0.000)
FIN	-0.051*** (0.008)	-0.001* (0.099)	-0.052*** (0.007)	-0.001 (0.139)	-0.051*** (0.010)	-0.001* (0.087)
FTO	-8.588*** (0.000)	-0.007 (0.000)	-6.935*** (0.000)	-0.008 (0.400)	-9.425*** (0.000)	-0.007 (0.370)
PCS	0.001*** (0.000)	0.013*** (0.003)	0.001*** (0.000)	0.015*** (0.001)	0.001*** (0.000)	0.013*** (0.003)
AGO*EMA	0.001 (0.620)	0.035*** (0.009)				
AGO*FEA			0.001* (0.084)	0.039*** (0.003)		
AGO*MEA					0.001 (0.819)	0.033*** (0.010)
FOS ₋₁		0.667*** (0.000)		0.651*** (0.000)		0.677*** (0.000)
Constant	53.915*** (0.000)	1.472*** (0.000)	54.037*** (0.000)	1.573*** (0.000)	53.742*** (0.000)	1.451*** (0.000)
Wald χ^2	864.66*** (0.000)	748.15*** (0.000)	878.34*** (0.000)	1094.24*** (0.000)	874.47*** (0.000)	1090.17*** (0.000)
Autocorrelation		-1.531 (0.126)		-1.541 (0.123)		-1.528 (0.127)
Sargan test	308	20.563 (1.000)	308	20.484 (1.000)	308	20.620 (1.000)
Observations	308	280	308	280	308	280
R-squared	0.468		0.470		0.468	

Source: Authors processing based on World Bank's World Development Indicator (WB, 2023), Economist Impact (GFSI, 2023), and FAO (2023).

The p-value is the number enclosed in parenthesis (). *, **, and *** stand for significance levels at 10%, 5%, and 1%, respectively. Interacting agricultural output with total employment in agriculture – AGO*EMA, interacting agricultural output with male employment in agriculture – AGO*MEA, and, interacting agricultural output with female employment in agriculture – AGO*FEA.

Concerning the differential effects of gender employment in the agricultural sector on food security in Model 2., the empirical findings from the PCSE and SGMM estimations reveal that the coefficient of female agricultural employment is statistically significant and positive only in the long run, while the coefficient of male agricultural employment is also statistically insignificant in the short and long-run. This suggests that female employment in the agricultural sector positively impacts food security, while male agricultural employment does not affect food security. In particular,

food security in SSA nations increases by about 0.057% over time for every 1% increase in female employment in the agricultural sector. This supports the findings of earlier research by Agarwal et al. (2022). However, the observed insignificance of male employment in agriculture contradicts expectations and existing literature. This disparity may be explained by the growing number of individuals relocating to cities from rural regions in pursuit of greater employment possibilities. This movement reduces the number of men working in agriculture and affects overall food production (Tayal, 2019; Mishra et al., 2022).

Moving to Model 3, which looks at the moderating impact of total employment in agriculture on the link between food security and agricultural output. The empirical findings from the PCSE and SGMM estimations indicate that the coefficient of the moderating role of total agricultural employment with agricultural output is statistically significant and positive only in the short run. This suggests that the moderating role of total employment in agriculture with agricultural output positively influences food security only in the short run, while it does not influence in the long run. Specifically, a 1% increase in the moderating role of total employment in agriculture with agricultural output causes an approximate rise of 0.035% in food security among SSA nations in the short run. This finding aligns with *a priori* expectation, even though none of the previous studies has considered this interacting effect. However, the observed insignificance of the interaction variable of total agricultural employment with agricultural output, in the long run, could be attributed to the low productivity of the total agricultural labor force in the region, resulting in overall low food production and food security (Carletto et al., 2017).

Analyzing Model 4, which explores the moderating influence of female employment in agriculture on the connection between food security and agricultural output. Drawing from the PCSE and SGMM estimates, the empirical results show that there is statistically significant and positive correlation between the moderating role of female agricultural employment and agricultural output over both the short and long term. This suggests that the long- and short-term benefits of female agricultural employment with agricultural output strengthen food security. Specifically, a 1% increase in the moderating role of female employment in agriculture with agricultural output led to a rise in food security among SSA countries by approximately 0.001 and 0.039% in the long and short run respectively.

This finding also aligns with *a priori* expectation and supports conclusions drawn in related earlier studies, such as those by Agarwal et al. (2022), and United Nations (UN, 2015). This implies that through increased productivity, economic resilience, and household nutrition, female employment in agriculture offers a critical role in boosting agricultural outputs on food security in Africa. This can also be as a result of

the fact that female farmers are more inclined to devote funds to household nutrition and education.

Analyzing Model 5, which explores the moderating effect of male employment in agriculture on the link between food security and agricultural output, the PCSE and SGMM estimates reveal that the coefficient of the moderating role of male agricultural employment with agricultural output is statistically significant and positive only in the short run. This indicates that the moderating role of male employment in agriculture with agricultural output positively influences food security only in the short run, while it has no influence in the long run. Specifically, a 1% increase in the moderating role of male employment in agriculture with agricultural output causes an approximate rise of 0.033 % in food security among SSA countries in the short run. This also shows that male employment in agriculture plays an essential role in strengthening the impact of agricultural outputs on food security by supplying labor for large-scale farming, market-oriented production, and mechanized operations.

The overall significance of the regressors in explaining food security is assessed via the Wald χ^2 which is statistically significant at 1% significance level throughout the models. This demonstrates that the models possess substantial explanatory power and aptly fit the data. In essence, all explanatory variables emerge as robust food security determinants in SSA. Additionally, the outcomes of the SGMM diagnostic tests, such as the Sargan test of over-identifying instruments and serial correlation, lend credence to the validity and exogenousness of the food security model's instruments.

Conclusions

The descriptive analysis revealed that on average, women contribute more than half (51%) to the agricultural labor force in sub-Saharan Africa (SSA), while their male counterparts contribute 49%. Evidence from the empirical results also reveals that total employment in agriculture exhibits positive impacts on food security both in the short and long run. Meanwhile, female employment in agriculture demonstrates an impact solely on food security in the long run, while male employment in agriculture only has an impact on food security in the short run. The PCSE and SGMM estimates show that there is statistically significant and positive correlation between the moderating role of female agricultural employment and agricultural output over both the short and long term. This suggests that the long- and short-term benefits of female agricultural employment with agricultural output strengthen food security.

Moreover, the preceding level of food security economic growth, physical capital stock in agriculture, food inflation, population growth, and openness are identified as significant factors influencing food security in SSA. The study therefore recommends

that the creation and application of gender-inclusive agricultural policies have to be given top priority by policymakers, and ensure that women have equitable use of the resources that will enhance their productivity. In addition, given that the region's overall employment rate significantly affects food security, efforts should be focused on encouraging positive gender roles in agriculture. Improving investments in agricultural infrastructure, and the success of these efforts hinges on establishing robust monitoring and evaluation systems.

Achieving these goals will require policymakers to give attention to the creation and execution of gender-inclusive agricultural policies that guarantee that women have sufficient access to land, credit, training, and agricultural inputs, which can be achieved through targeted subsidies, capacity-building programs, and legal reforms. Policies that foster women and youth participation in agriculture, such as offering incentives for female-led farming cooperatives and aiding agribusiness initiatives, are also necessary to promote positive gender roles in the sector. To improve food security, governments must increase investments in agro-infrastructure, as are systems for irrigation and storage facilities, or rural roads, to boost productivity and market access. The success of these initiatives hinges on the establishment of strong monitoring and evaluation systems that provide accountability, track progress, and identify obstacles.

To establish a resilient and accessible agricultural system, this can be accomplished by utilizing digital technology, fortifying institutional frameworks, and involving stakeholders, such as local communities and private sector partners. Despite the contributions of the present study to the subject matter, efforts can be made in future research to look at the gender effects on food security from the youth perspective. The direction of the causality among the variables can also be considered.

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