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Mohamed PORGO

porgomohamed@gmail.com

Universite Thomas Sankara <https://orcid.org/0000-0002-7325-3610>

Pirénam Diane Kpatcha

Universite de Kara

Essossinam Ali

Universite de Kara

Pouwemdéou Tchila

Togolese Revenue Authority (OTR)

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Mohamed PORGO (Corresponding author)

Department of Economics, Thomas SANKARA University, Burkina Faso

porgomohamed@gmail.com

mohamed.porgo@uts.bf

ORCID: <https://orcid.org/0000-0002-7325-3610>

Pirénam Diane Kpatcha

Department of Economics, University of Kara, Kara, Togo

kpatchapirenamdiane@gmail.com

Essossinam Ali

Department of Economics, University of Kara, Kara, Togo

joachimali@hotmail.fr

e.joachimali@gmail.com

ORCID: <https://orcid.org/0000-0002-7614-7426>

Pouwemdéou Tchila

Togolese Revenue Authority (OTR), Lomé, Togo

Department of Economics, University of Kara, Kara, Togo

samuelson902@gmail.com

Statements & Declarations

Ethical approval and consent to participate: Ethical approval was obtained from the Afrobarometer's Ethics and Research Committee. All respondents provided informed consent to participate in the survey, from which the data were drawn for this study

Consent for publication: The authors of this manuscript consent to its publication

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Data Availability

The datasets generated during and/or analysed during the current study are available in the Afrobarometer repository, <https://www.afrobarometer.org/survey-resource/merged-round-8-data-34-countries-2022/>

From financial access to food resilience: A household-level analysis of gender and urban–rural disparities in Sub-Saharan Africa

Abstract

This study examines the impact of financial inclusion (FI) on household food insecurity in Sub-Saharan Africa (SSA), emphasizing gender and residential disparities. Using an ordered probit model with Copula approach to control for endogeneity and data from 45,683 households across 32 SSA countries, the findings reveal that expanding FI significantly reduces the probability of food insecurity. However, women and rural households face heightened vulnerability. Contributing factors include climatic shocks, conflicts, corruption, discrimination, and traditional land allocation practices. Conversely, access to healthcare and education mitigates food insecurity risks. Policymakers should enhance FI, especially for women and rural populations, through financial literacy programs, mobile banking, and tailored credit facilities. Addressing gender disparities requires empowering women via affordable credit, and entrepreneurial training. Investments in rural financial infrastructure, such as banking networks and digital payment systems, can improve service access. Systemic issues like corruption and inequitable land allocation must be tackled through policy reforms and conflict resolution. Strengthening education and healthcare infrastructure is also critical, as it boosts household productivity and enhances the efficacy of financial services in reducing food insecurity. By addressing these economic and structural barriers, policymakers can build a more inclusive financial ecosystem, fostering resilience and food security across SSA.

Keywords: Financial inclusion; Food insecurity; Gender; Urban-Rural households; SSA

1. Introduction

Food security is a complex and evolving challenge shaped by various elements, including international policies and community-level practices. Addressing it effectively typically demands a comprehensive strategy that not only meets current demands but also ensures long-term sustainability and adaptability. According to FAO (1996), food security refers to the access to enough safe and nutritious food, meeting people's dietary needs for a healthy life. Addressing food insecurity has become a priority in national development plans under the climate change stresses (Nordhaus, 2019; Ali and Bayale, 2024, Palmer et al., 2024). For instance, African heads of state established the Comprehensive African Agricultural Development Program (CAADP) in 2003 to allocate a minimum of 10% of their budgets to agricultural and rural development. In West Africa, the common agricultural policy is adopted to meet the food needs. Additionally, there have been efforts to strengthen the competitiveness and productivity of the agriculture sector in different regions, such as Central Africa. In East Africa, a policy has been designed to ensure sustainable agricultural development and food security.

Despite ongoing efforts, Sub-Saharan Africa remains deeply affected by food insecurity, exacerbated not only by climate change, but also other socio-economic characteristics. The Global Report on Food Crises (2022) noted that 193 million people in 53 countries faced food insecurity in 2021. The Global Food Security Index (2022) reported worsening global food security, with undernourishment in Africa rising from 16.5% to 19.7% between 2017 and 2022. Central Africa saw an increase from 23.7% to 29.1%, while Southern Africa, though below the Sub-Saharan average at 11.1%, is on the rise. East Africa's prevalence grew from 26.2% to

28.5%, and West Africa increased to 14.6%. Despite these challenges, FI is emerging as a vital tool to address food insecurity.

Beck et al. (2007) define financial inclusion (FI) as the ability for everyone to access a range of quality financial services affordably. The World Bank (2017) describes FI as having access to financial resources and formal accounts for transactions at reasonable costs. FI can boost agricultural production and household incomes by providing farmers with credit, enabling them to invest in inputs like improved seeds, equipment, and labor, thus enhancing food security (Soyemi et al., 2020). Additionally, digital financial products can streamline salary payments, social transfers, and subsidies, further improving farmers' productivity and market access. By facilitating investments and adopting innovative technologies, FI plays a vital role in strengthening food security and economic resilience (Ali, 2021).

The Sustainable Development Goals (SDGs) emphasize food security and FI. Goal 2 aims to end hunger, improve nutrition, and promote sustainable agriculture by enhancing production structures, boosting crop yields, adapting to climate change, and minimizing food waste. FI supports agricultural productivity by facilitating access to credit and financial services, which helps farmers improve their practices and economic resilience, ultimately increasing food production. According to the World Bank (2024), account ownership increased to 69% from 2011 to 2017. The FI index also grew from 0.559 in 2021 to 0.585 in 2022, a 4.45% rise in one year (BCEAO, 2023). The International Finance Corporation (IFC, 2018) notes that mobile money is a key driver of FI in Sub-Saharan Africa (SSA), with account ownership among adults rising from 34% in 2014 to 43% in 2017. Despite these advances, significant gender disparities in access to financial services persist, suggesting that the benefits of FI are not evenly distributed.

The impact of FI can differ across populations, with gender emerging as a key factor influencing access, utilization, and outcomes. Women, often more vulnerable, face significant disparities in accessing financial resources. Agarwal (2018) emphasizes that promoting gender equality in financial services is critical for food security. Adegbite and Machete (2020) highlight a pronounced FI gap between men and women in smallholder agriculture, calling for targeted interventions. While credit is intended to boost productivity, Baborska et al. (2020) and Adegbite and Machete (2020) note that it can inadvertently worsen food insecurity, as repayment pressures may divert funds from essential household needs. Small-scale farmers also contend with fluctuating yields, limited market access, and low financial literacy, which can undermine the effectiveness of credit programs. These findings stress the need for credit initiatives tailored to farmers' specific circumstances.

Fowowe (2023) identifies financial exclusion and gender inequality as key barriers to agricultural productivity. Koomson et al. (2022) report that FI reduces food insecurity more effectively for men than women, whereas Kairiza et al. (2021) show that credit access supports female-headed households in managing food insecurity. Overall, the benefits of FI remain uneven across gender and location. Demirgüç-Kunt et al. (2018) further highlight persistent disparities between genders and regions despite global gains in FI. Evidence also suggests FI enhances rural food security. Koomson et al. (2022) and Murendo et al. (2020) find that FI improves food consumption and dietary diversity among rural households. Zhang et al. (2022) link mobile payments to better food consumption, while Nakasone and Torero (2016) and Parlasca et al. (2020) report that mobile phone use supports agricultural production and dietary

diversity. Conversely, Zezza and Tasciotti (2010) observe that urban households benefit more from FI in coping with food insecurity than rural households.

Afrobarometer survey data from 2022 shows that in Sub-Saharan Africa, 52.64% of men have bank accounts, compared to 46.01% of women. Internet access, which supports various digital financial services, also reveals gender disparities: 46.46% of men have internet access compared to 36.64% of women. Mobile phones, which are crucial for financial services, show a similar trend with 91.26% of men owning phones versus 88.06% of women. These disparities in internet access, phone ownership, and bank account possession exacerbate gender inequalities, particularly in food security. Women face higher food insecurity rates (54.61%) compared to men (52.83%), highlighting how limited access to financial and digital resources deepens their vulnerability. Additionally, these inequalities can be influenced by geographic location, revealing further regional disparities.

Data shows that urban areas are better served by financial infrastructure (65.35%) compared to rural areas (31.5%), which enhances access to banking services and encourages account ownership. In urban areas, 67.57% of residents have bank accounts, while only 35.83% do in rural areas. Internet access also favors urban areas (60.43%) over rural ones (27.59%) due to more advanced communication infrastructure in cities. Additionally, 95.83% of urban residents own phones compared to 85.06% in rural areas. These disparities in financial and digital access contribute to higher food insecurity in rural areas, with 57.14% of rural residents facing food insecurity compared to 49.09% in urban areas.

Examining how FI affects household food insecurity in SSA is crucial, especially considering gender and location. The added value of this work lies firstly in the choice of the study area, where such research is so rare with the use of cross-sectional data that can lead to adequate economic policies. The choice of the sub-Saharan African region is particularly relevant because of its socio-economic diversity, its specific challenges in terms of food insecurity and pronounced gender inequalities, and its precarious access to financial services, especially in rural areas. These different characteristics make it possible to examine how the FI can meet varied and critical needs, thus offering robust and applicable conclusions for effective public policies. Unlike previous studies (Ajefu et al., 2024; Chowdhury and Chowdhury, 2023; Abdul-Rahaman and Abdulai, 2022; Koomson, et al., 2022; Atakli and Agbenyo, 2020), this research uses a comprehensive FI index based on five indicators: mobile phone ownership, internet access, bank account ownership, the presence of a financial network, and the availability of local banking services such as money transfer points, mobile banking services, or ATMs.

The findings highlight that advancing financial inclusion can significantly reduce food insecurity in SSA, especially among women and rural households who face disproportionate challenges. This underscores the importance of targeted financial policies to address systemic inequities and expand access to essential services. Policy interventions aimed at underserved areas, such as rural communities, can enhance food security, while empowering women through financial inclusion may reduce gender disparities. Integrating these strategies with broader development initiatives—like agricultural credit access, smallholder market linkages, and financial literacy programs—can strengthen household resilience, boost economic participation, and promote inclusive, sustainable development. The paper is structured as follows: Section 2 reviews the literature, Section 3 outlines methodology, Section 4 presents results and discussion, and Section 5 provides conclusions and recommendations.

2. Financial inclusion and food insecurity, a controversial relationship in the economic literature

Equitable access to financial services can enhance economic and social development, particularly in reducing food insecurity linked to poverty, gender inequality, and rural-urban gaps. FI supports agricultural growth by improving access to credit, savings, and insurance. For example, low-interest loans enable investment in inputs and mechanization (Hussain & Thapa, 2012). Mobile money platforms further strengthen food security by facilitating agricultural purchases and improving household resilience (Abdul-Rahaman & Abdulai, 2022; Ajefu et al., 2024). FI also reduces geographic barriers to finance (Koomson et al., 2022) and, through digital tools, provides farmers with climate and market information, narrowing knowledge gaps (Liu & Ren, 2023).

Despite these benefits, FI can undermine food security. Credit expansion in 88 low- and middle-income countries has been linked to higher food insecurity risks (Baborska et al., 2020). Farmers often face debt burdens when borrowing for costly inputs or off-farm ventures without assured returns, and failed harvests can force asset sales, worsening vulnerability. Information asymmetry in lending may also produce adverse selection and moral hazard (Akerlof, 1970).

FI can indirectly increase food prices when actors speculate in markets or store grain for profit, heightening volatility. Shifts toward non-agricultural activities may weaken local food production if ventures fail. Furthermore, exposure to financial shocks—such as currency depreciation or rising interest rates—can reduce credit access while increasing costs. Credit availability may also drive land consolidation, marginalizing smallholders, limiting crop diversity, and prioritizing cash crops. Overreliance on inputs financed through credit can degrade natural resources, further threatening long-term food security. Thus, while FI holds promise for boosting productivity and resilience, its impacts vary across gender, geography, and institutional contexts. Careful policy design is essential to ensure that financial access supports rather than undermines food security.

Addressing gender in the relationship between FI and food security is crucial. Studies show that female-headed households face higher food insecurity risks than male-headed ones, largely due to lower earnings, restricted access to resources, and heavy caregiving responsibilities (Atakli & Agbenyo, 2020; Kyeremateng et al., 2024). Limited land ownership, credit, agricultural inputs, and education further constrain women's roles in food production, while cultural norms in Sub-Saharan Africa often disadvantage women in household food allocation. These structural inequalities intensify women's vulnerability to food insecurity.

Access to financial services can mitigate these challenges. Kairiza et al. (2021) found that credit enables women to manage food insecurity by supporting income-generating activities. Informal savings groups play a key role in women's access to credit. However, credit is not universally beneficial. Adegbite and Machethe (2020) caution that loans for small farms may increase financial risk and widen gender gaps, especially when women face barriers such as lack of collateral or discriminatory norms.

Broader evidence suggests that FI improves household resilience against food-related shocks. Khandker and Koolwal (2016), Murendo et al. (2020), and Parlasca et al. (2020) show that FI enhances food security by facilitating financial planning and diversifying food access, with mobile phones playing a significant role. Yet, limited and costly credit access, especially in rural

areas, restricts agricultural productivity (Balana & Oyeyemi, 2022). High transaction costs, information gaps, and risk aversion further complicate access.

FI's benefits are therefore conditional. While it can enhance productivity, investments, and food storage (Koomson et al., 2022; Zezza & Tasciotti, 2010), poorly managed credit may worsen debt and food insecurity (Nepal & Neupane, 2022). Thus, FI supports food security most effectively when paired with supportive infrastructure, training, and equitable access for women.

3. Methodology

3.1 Theoretical framework

The theoretical foundation of the link between financial inclusion and food insecurity in economics derive from Sen (1981, 1999) entitlement and capability frameworks. According to Sen (1981), food insecurity is driven by restricted economic and social access rather than a simple deficit supply, because of limited entitlements by which individuals acquire food through income, production, or transfers. Financial inclusion is a powerful tool to strengthen these entitlements by expanding access to credit, savings, and insurance, enabling households to smooth consumption and invest in productive activities. Sen (1999) emphasizes this linkage, through the capability approach, by arguing that financial access enhances individuals' real freedoms to achieve well-being, including capabilities to secure food.

From a welfare economics perspective, financial inclusion acts as a corrective mechanism for relaxing failures in credit and insurance markets (Stiglitz & Weiss, 1981). By lowering transaction costs and information asymmetries, it improves resource allocation and household welfare including food security. Yunus (1999) and Morduch (1999) further support this view in microfinance literature by showing that access to small-scale financial services can stabilize consumption and reduce hunger among low-income populations.

3.2 Empirical strategy

The empirical strategy relies on the theoretical insights from Sen's entitlement and capacity framework, and welfare economics, to build the relationship between financial inclusion and food insecurity by specifying measurable variables and testing their effects through an ordered probit model.

Let $Y_i^* = X_i\beta + \alpha FI_i + \lambda_i + \varepsilon_i$ a latent variable representing an unobserved severity of food insecurity index for a household i , with FI the financial inclusion index, X a vector of control variables including households' socio-economic characteristics and institutional variables such as education, economic inequality, ethnic and religious discrimination, market and healthcare access, gender, age of household head, perceptions of government anti-corruption efforts, traditional land allocation, asset ownership (vehicles, radios, TVs), and climatic shocks, λ is the country specific fixed- effect, α and β are parameter to be estimated, and ε is the error term which is assumed to follow a standard normal distribution. The observed food insecurity status of the household is captured through the variable Y expressed as follows:

$$Y_i = \begin{cases} 0 & \text{if } Y_i^* < \delta_1 \text{ (Food security)} \\ 1 & \text{if } \delta_1 \leq Y_i^* < \delta_2 \text{ (Moderate food insecurity)} \\ 2 & \text{if } \delta_2 \leq Y_i^* < \delta_3 \text{ (Severe food insecurity)} \\ 3 & \text{if } Y_i^* \geq \delta_3 \text{ (Chronic food insecurity)} \end{cases}$$

Following Dungey et al. (2018) and Reis (2022), the variable of interest, FI, is computed using the Multiple Correspondence Analysis. It is scaled between 0 and 1 using OECD framework (OECD, 2022). This index incorporates five indicators: mobile phone ownership, internet access, bank account ownership, the presence of a financial network, and the availability of local banking services such as money transfer points, mobile banking services, or ATMs.

According to Bali Swain and Nsabimana (2024), analyzing the effect of FI on food security is challenging due to an endogeneity issue arising from unobservable factors that affect FI and may depend on the same attributes that determine a household's food insecurity. This call for an instrumental variable to address this econometric challenge. However, given the constraints imposed by data limitation, finding a valid instrument may pose challenges. To address the endogeneity of FI without an external instrument, the empirical strategy relies on the instrument-free Gaussian Copula approach proposed by Park and Gupta (2012). Specifically, a two-stage semi-parametric Control Function (CF) estimator is implemented as method of estimation. In the first stage, the empirical cumulative distribution function (ECDF) of the endogenous FI is inverted into standard normal space to construct the Copula correction term. In the second stage, this Copula correction term is included as an auxiliary regressor in the Ordered Probit model to absorb the endogeneity bias. To account for the generated Copula correction term, standard errors are fully corrected using a non-parametric bootstrap approach. If the parameter of Copula Correction term is statistically significant after estimation, it implies FI was endogenous and failing to control this would have yield biased estimates. At the reverse, a non-significance of Copula correction terms indicate there is no statistical evidence of FI and a simple ordered probit model would have yield consistent estimates.

3.3 The data

This study utilizes 2022 Afrobarometer Household Survey data, encompassing 45,683 households across 32 Sub-Saharan African countries. Findings show that 53.73% of respondents experience food insecurity, with about 56% residing in rural areas (Table 1).

Table 1 : Descriptive statistics of the variables

Variables	Descriptions	Mean	Standard deviation
Financial inclusion	Index based on OECD framework (OECD, 2022)	0.6511	0.259
Area of resident	Binary (0=Urban, 1=Rural)	0.5591	0.4965
Gender	Binary (0=Female, 1=Male)	0.5001	0.5000
Access market	Binary (0=non-access, 1=Access)	0.633	0.482

Food insecurity	Binary (0=Security, 1=Insecurity)	0.5373	0.4986
Perception flawed democracy	Binary (0=No, 1=Yes)	0.1406	0.3476
Economic discrimination	Binary (0=No, 1=Yes)	0.3427	0.4746
Ethnic discrimination	Binary (0=No, 1=Yes)	0.219	0.4136
Religious discrimination	Binary (0=No, 1=Yes)	0.1823	0.3861
Education	Binary (0=Primary and below, 1=Secondary and above)	0.5229	0.4995
Conflicts	Binary (0=Absence, 1=Presence)	0.4907	0.4999
Climatic shocks	Binary (0=Absence of disasters, 1=Disasters occurrence)	0.3928	0.4884
Lack income	Binary (0= Never, 1=Always)	0.6767	0.4678
Perception of corruption	Binary (0=Fighting, 1=Highly)	0.864	0.3428
Influence of traditional leaders in land allocation	Binary (0=No, 1=Yes)	0.6673	0.4712
Access to health	Binary (0=No, 1=Yes)	0.4611	0.4985
Age	Number of years	36.8585	14.7439
Owning vehicle	Binary (0=No, 1=Yes)	0.1905	0.3927
Owning TV	Binary (0=No, 1=Yes)	0.4327	0.4955
Owning radio	Binary (0=No, 1=Yes)	0.7493	0.4334

278

279 Discrimination—economic, ethnic, or religious—affects access to resources critical for food
280 production, such as land and agricultural inputs, thereby exacerbating food insecurity (Heiman,
281 Gordon, & Zilberman, 2019). About 34.27% reported economic discrimination, 21.9% ethnic
282 discrimination, and 18.23% religious discrimination. Climate shocks threaten agricultural
283 livelihoods, with 60.72% of respondents experiencing climate-related disasters (Nordhaus,
284 2019). Conflicts further heighten vulnerability, affecting 49.07% of households. Limited
285 income restricts the ability to purchase adequate nutritious food, intensifying food insecurity.
286 Collectively, these factors—discrimination, climate shocks, conflict, and low income—interact
287 to deepen household vulnerability to inadequate food access across Sub-Saharan Africa.

288 The data reveal that 46.11% of respondents have access to healthcare services, while 66.73%
289 report that traditional leaders significantly influence land allocation. These findings have
290 important implications for food insecurity, as both access to healthcare and land governance are
291 critical factors shaping household resilience and agricultural productivity.

4. Results and discussion

4.1. Descriptive results

The results indicate that there is diversity in FI between men and women (Table 2). The data indicate that men in SSA have achieved slightly higher levels of financial inclusion compared to women, who also experience disproportionately higher levels of food insecurity.

Table 2: Mean comparison test by gender

Variables	Women (1)	Men (2)	Difference (1)-(2)
Financial inclusion	0.6305	0.6715	-0.041***
Food insecurity	0.5460	0.5285	0.018***
Access market	0.6330	0.633	0.0005
Perception flawed democracy	0.1305	0.151	-0.0205***
Economic discrimination	0.3280	0.3575	-0.0295***
Ethnic discrimination	0.2090	0.229	-0.02***
Religious discrimination	0.1775	0.187	-0.0095**
Education	0.4775	0.5685	-0.091***
Conflicts	0.4890	0.4925	-0.004
Climatic shocks	0.4500	0.3355	0.1145***
Lack of income	0.6815	0.672	0.0095**
Perception of corruption	0.8540	0.8735	-0.0195***
Influence of traditional leaders in land allocation	0.6595	0.675	-0.016***
Access health	0.4580	0.464	-0.0055
Owning vehicle	0.1175	0.263	-0.1455***
Owning TV	0.3965	0.469	-0.0725***
Owning radio	0.7095	0.789	-0.079***

*** p<0.01, ** p<0.05, * p<0.1

This dual disparity underscores the intertwined challenges of gender inequality in financial access and the structural vulnerabilities that heighten women's risk of food insecurity. Men's marginal advantage in financial inclusion reflects persistent gender-based barriers in the financial sector. Women in SSA often face limited access to formal financial services due to lower asset ownership, income disparities, and sociocultural norms favoring men's economic participation. Without access to savings or credit, women struggle to manage risks, invest in income-generating activities, or build financial resilience, which are critical for addressing food insecurity.

307 The link between financial exclusion and food insecurity is particularly pronounced for women,
 308 who are often primary caregivers and household nutrition managers. Exclusion from financial
 309 opportunities restricts their access to essential resources, such as agricultural inputs, reducing
 310 productivity and household food stability. Consequently, lower financial inclusion exacerbates
 311 food insecurity, perpetuating cycles of poverty and malnutrition and undermining efforts toward
 312 sustainable development and gender equity in SSA. Men's relatively higher education levels
 313 often enable better employment and income stability, whereas women face economic and ethnic
 314 discrimination that limits food security.

315 Conflicts and climate shocks also influence food security, disproportionately affecting men,
 316 while economic downturns tend to impact women more severely. Residential location further
 317 shapes these disparities: urban households generally experience better food security than rural
 318 ones (Table 3). Mean comparison tests indicate that rural populations are more food insecure,
 319 consistent with Balana and Oyeyemi (2022), who studied agricultural credit constraints in
 320 Nigeria, though Szabo (2015) found urban populations more vulnerable. Rural food insecurity
 321 is partly linked to lower employment rates compared to urban areas (Haapanen & Tervo, 2010).
 322 Households in rural areas of SSA are disproportionately impacted by climatic shocks, with 43%
 323 reporting adverse effects compared to 33% of urban households. Conversely, urban households
 324 face heightened vulnerability to conflicts, with 52% experiencing their detrimental
 325 consequences. These contrasting vulnerabilities highlight the differing risk profiles of rural and
 326 urban communities, both of which contribute to food insecurity through distinct pathways. The
 327 data show also that urban residents generally have higher education levels, thanks to better
 328 infrastructure and resources, leading to better job prospects and greater parental investment in
 329 education.

330 Table 3: Mean comparison test of variables by household location

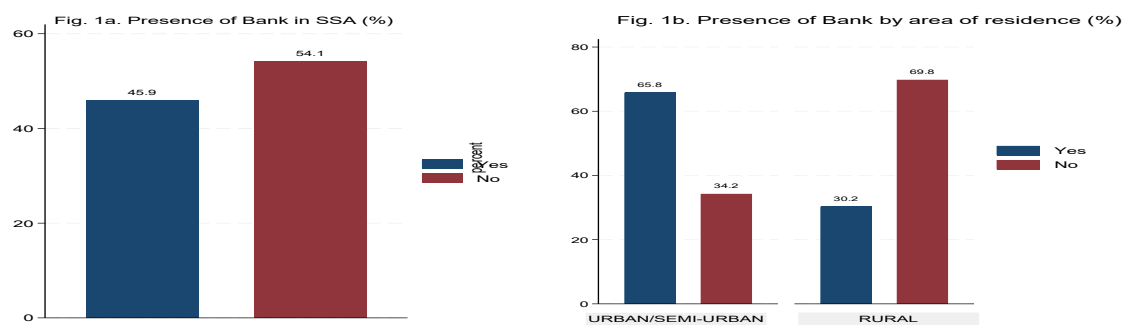
Variables	Urban (1)	Rural (2)	Difference (1)-(2)
Financial inclusion	0.7820	0.5475	0.2345***
Food insecurity	0.4920	0.573	-0.0805***
Access market	0.7725	0.523	0.2495***
Perception flawed democracy	0.1500	0.133	0.017***
Economic discrimination	0.3600	0.329	0.031***
Ethnic discrimination	0.2430	0.200	0.043***
Religious discrimination	0.2005	0.168	0.0325***
Education	0.6990	0.384	0.3155***
Conflicts	0.5190	0.4685	0.05***
Climatic shocks	0.3335	0.4395	-0.106***
Lack income	0.6040	0.734	-0.1305***
Perception of corruption	0.8790	0.8525	0.0265***

Influence of traditional leaders in land allocation	0.6225	0.703	-0.0805***
Access health	0.4380	0.4795	-0.0415***
Owning vehicle	0.2265	0.162	0.064***
Owning TV	0.6435	0.2665	0.3775***
Owning radio	0.8000	0.7095	0.0905***

*** p<0.01, ** p<0.05, * p<0.1

The presence of a bank, a money transfer point, mobile banking services, or an ATM in an environment attracts individuals to join these financial structures. These different services and institutions allow residents to have access to financial services. The proximity of these structures reduces costs and geographical obstacles, thus making these services more accessible, especially for rural populations. However, we observe that these financial structures are more present in urban areas than in rural areas, thus limiting the access of rural populations to financial services. The light is shed on the unequal distribution of the presence of banks or microfinance between rural and urban areas, revealing a predominance of services in urban areas (Figure 1).

Figure 1: Bank presence by area of residence in SSA



Banks are more concentrated in urban areas (65.8%) than in rural areas (30.2%). Bank accounts offer access to financial services like savings, loans, and insurance, helping individuals prepare for unexpected needs. The data reveal that more men than women have bank accounts, and urban households use them more frequently than rural ones (Figure 2).

Figure 2: Bank account ownership by gender and place of residence in SSA

Fig. 2a. Ownership of a Bank account in SSA (%)

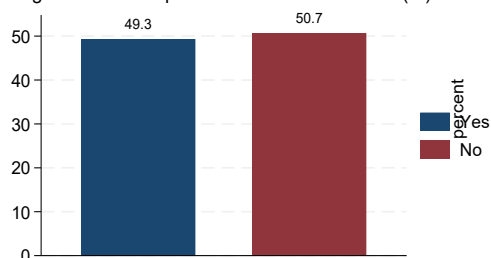


Fig. 2b. Ownership of Bank account by gender (%)

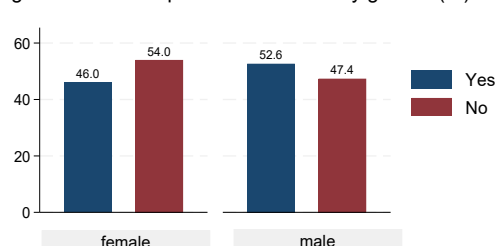
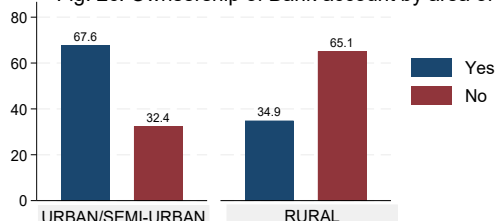


Fig. 2c. Ownership of Bank account by area of residence (%)



348

349 In Sub-Saharan Africa, about 50.7% of people lack bank accounts. Women face significant
 350 barriers to financial services due to cultural norms, lack of legal documentation, and lower
 351 education levels. The data show that 52.6% of men and 46 % of women have bank accounts. In
 352 urban areas, 67.6% of respondents have accounts compared to 35% in rural areas. Internet
 353 access offers a chance for digital financial services, especially in areas without traditional
 354 banking. Internet access allows for the use of online services and mobile payment applications,
 355 thereby facilitating financial transactions. However, internet access remains unevenly
 356 distributed between genders and residential areas (Figure 3).

357 Figure 3: Access to Internet by gender and area of residence in SSA

Fig. 3a. Access to internet in SSA (%)

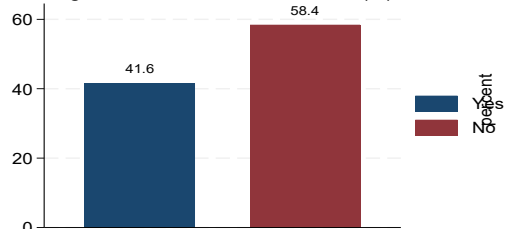


Fig. 3b. Access to internet by gender (%)

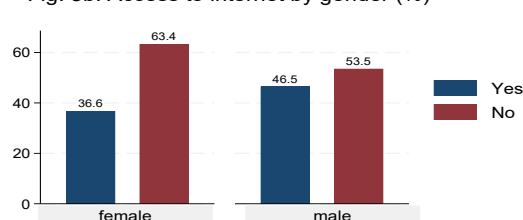
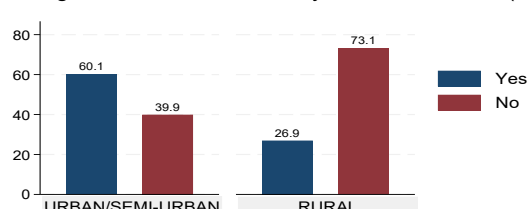


Fig. 3c. Access to internet by area of residence (%)

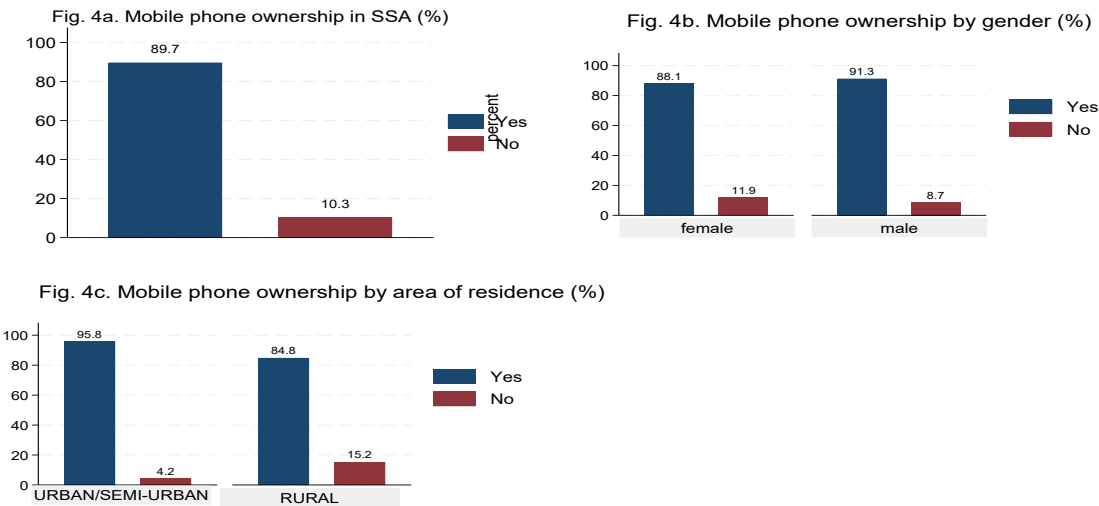


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359 Approximately 58.4% of households report a lack of internet access. Among genders, 46.5% of
 360 men have internet access compared to 36.6% of women. Urban respondents have greater
 361 internet access (60.1%) compared to their rural counterparts (27%). These disparities highlight
 362 the need for enhanced digitalization policies, which are crucial for advancing financial services

and *FI* in developing countries. Furthermore, mobile phone ownership significantly contributes to *FI*, particularly in areas where traditional financial services are scarce. Mobile phones enable access to various financial services, including electronic payments, money transfers, and digital savings, which are especially valuable in regions with inadequate banking infrastructure. As per the data gathered, 89.7% of people in sub-Saharan Africa possess a mobile phone (Figure 4).

Figure 4: Mobile phone ownership by gender and area of residence in SSA



A higher percentage of men (91.3%) own a phone compared to 88.1% of women. Similarly, there is inequality in the use of phones depending on the area of residence. More people in urban areas (95.8%) own a phone compared to 84.8% in rural areas.

4.2 Econometric results and discussion

The results of the estimation the ordered probit model with Gaussian Copula correction is presented in the table 4. The significance of Copula correction term confirms the endogeneity of *FI* and failing to account for this would have yield biased estimates. The results reveal that deepening *FI* significantly reduce food insecurity in SSA, enabling households to transit from chronic food insecurity status to food-secured status. (Table 4). As households gain better access to financial services, they can secure credit and savings for both productive investment and consumption. *FI* plays a role of safety net against economic shocks, thereby reducing the risk of chronic food insecurity. Consequently, as households' financial security improves, their food security also stabilizes and strengthens, contributing to better transition toward sustainable food security. Loans can assist households in diversifying their income sources by investing in additional income-generating activities and, therefore, reducing food insecurity. The results are consistent with micro-level evidence from Rwanda (Bali Swain and Nsabimana, 2024) and Nigeria (Ayinde et al., 2023) and align more broadly with macro-level findings from developing countries using panel data (Arshad, 2022), suggesting that *FI* could be a powerful policy instrument for promoting food security in SSA. Effective financial management enables families to plan for the long term, optimize their expenditures, and invest in resources that reduce vulnerability to food insecurity ..

The findings indicate a positive correlation between the age of the household head and food insecurity, suggesting that older household heads are more likely to face chronic food insecurity in SSA. This can be explained by the heightened vulnerability of older persons in many SSA African countries because of weak social protection systems (Barrientos et al., 2003) . Conversely, higher levels of education, particularly secondary education and beyond, are associated with a significant reduction in food insecurity. These outcomes remain consistent across varying degrees of food insecurity, underscoring the critical need for targeted interventions. Improving access to education is essential, as it equips individuals with the skills and knowledge necessary to enhance livelihoods and resilience. Additionally, policies must prioritize the protection of vulnerable populations, including elderly individuals, who may face unique challenges in maintaining food security due to age-related constraints or limited resources. This approach can foster more inclusive and sustainable solutions to address food insecurity in Sub-Saharan Africa.

Table 4: Effect of financial inclusion on food insecurity in SSA

Variable	Food insecurity (Dependent variable)				
	Whole sample	By gender		By area of residence	
		Female	Male	Urban/semi-urban	Rural
Financial inclusion	-0.3640*** (0.090)	-0.4702*** (0.130)	-0.2830** (0.127)	-0.4319*** (0.123)	-0.3422** (0.146)
Age	0.0022*** (0.000)	0.0021*** (0.001)	0.0022*** (0.001)	0.0021*** (0.001)	0.0020*** (0.001)
Education (Secondary and above=1)	-0.1318*** (0.014)	-0.1564*** (0.021)	-0.1122*** (0.020)	-0.1402*** (0.022)	- (0.018) 0.1227***
Economic discrimination (Yes=1)	0.2485*** (0.012)	0.2380*** (0.018)	0.2601*** (0.019)	0.2499*** (0.019)	0.2459*** (0.018)
Ethnic discrimination (Yes=1)	0.0516*** (0.016)	0.0448* (0.025)	0.0598*** (0.022)	0.0184 (0.024)	0.0778*** (0.021)
Religious discrimination (Yes=1)	0.0952*** (0.016)	0.1002*** (0.024)	0.0886*** (0.024)	0.0910*** (0.025)	0.0948*** (0.023)
Access market (Yes=1)	-0.0180 (0.012)	-0.0261 (0.020)	-0.0101 (0.018)	0.0162 (0.021)	- (0.016) 0.0497***
Conflicts as major concern to be addressed (Yes=1)	0.0787*** (0.013)	0.0703*** (0.018)	0.0877*** (0.017)	0.0852*** (0.019)	0.0724*** (0.018)
Climatic shocks (Disasters occurrence=1)	0.0632*** (0.012)	0.0632*** (0.017)	0.0608*** (0.018)	0.0502** (0.020)	0.0789*** (0.015)
Perception flawed democracy (Yes=1)	0.1371***	0.1039***	0.1676***	0.1462***	0.1270***

	(0.015)	(0.023)	(0.022)	(0.023)	(0.023)
Perception of Corruption (Yes=1)	0.0167	0.0089	0.0247	0.0361	0.0021
	(0.017)	(0.023)	(0.026)	(0.027)	(0.022)
Lack of income (Highly =1)	0.8302***	0.8440***	0.8169***	0.8461***	0.8054***
	(0.014)	(0.020)	(0.020)	(0.021)	(0.020)
Influence of traditional leaders in land allocation (Yes=1)	0.0167	-0.0079	0.0422**	0.0311*	0.0064
	(0.014)	(0.019)	(0.018)	(0.018)	(0.018)
Access to Health (Yes=1)	-0.1127***	-0.0900***	-0.1331***	-0.1261***	-
					0.1092***
	(0.011)	(0.017)	(0.017)	(0.019)	(0.015)
Owning Vehicle (Yes=1)	-0.1356***	-0.1363***	-0.1350***	-0.1680***	-
					0.0996***
	(0.017)	(0.026)	(0.021)	(0.022)	(0.022)
Owning TV (Yes=1)	-0.0633***	-0.0348*	-0.0904***	-0.0237	-
					0.1204***
	(0.013)	(0.020)	(0.019)	(0.019)	(0.019)
Owning Radio (Yes=1)	-0.0890***	-0.0803***	-0.0973***	-0.0815***	-
					0.1001***
	(0.013)	(0.018)	(0.020)	(0.021)	(0.017)
Main activity of the household head (reference=Civil servants)					
1.No job	0.0780***	0.0800**	0.0702	0.1667***	0.0384
	(0.030)	(0.040)	(0.046)	(0.048)	(0.039)

Table 4: Effect of financial inclusion on food insecurity in SSA (continued)

Variable	Food insecurity (Dependent variable)				
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	Whole sample	By gender		By area of residence	
		Female	Male	Urban/semi-urban	Rural
2.Homemaker	-0.0354 (0.039)	-0.0225 (0.050)	-0.0461 (0.067)	0.0500 (0.054)	-0.1073** (0.049)
3.Farmers	-0.0472*** (0.016)	-0.0423** (0.021)	-0.0393 (0.029)	-0.0699* (0.038)	- (0.018) 0.0468***
4.Trader	-0.0064 (0.023)	-0.0186 (0.028)	0.0391 (0.043)	-0.0229 (0.030)	0.0071 (0.032)
5.Retail	0.0125 (0.043)	0.0209 (0.051)	-0.0129 (0.075)	0.0692 (0.054)	-0.0669 (0.068)
6.Unskill manual workers	0.0803*** (0.027)	0.1111*** (0.034)	-0.0333 (0.051)	0.0315 (0.037)	0.1454*** (0.041)
/cut1	-0.0178 (0.069)	-0.0768 (0.088)	0.0232 (0.092)	-0.0994 (0.093)	0.1061 (0.106)
/cut2	0.4886*** (0.069)	0.4187*** (0.088)	0.5420*** (0.093)	0.4312*** (0.093)	0.5988*** (0.106)
/cut3	1.2714*** (0.069)	1.2054*** (0.087)	1.3227*** (0.093)	1.2422*** (0.094)	1.3693*** (0.106)
/cut4	2.1963*** (0.071)	2.1425*** (0.088)	2.2365*** (0.095)	2.1302*** (0.095)	2.3237*** (0.107)
Observations	45,683	22,838	22,845	20,143	25,540
Wald-chi2	12260***	7764***	6623***	6683	7392
Copula correction term	-0.0444*	-0.0080	-0.0743**	-0.0392	-0.0416
Country fixed-effects	Yes	Yes	Yes	Yes	Yes

406 Bootstrap standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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The results shows that conflicts worsen food insecurity, with increased instability leading to higher food insecurity levels, as reported by Nga Ndjoko (2023). Conflict can cause sudden shifts in inflation, commodity prices, and agricultural inputs, disrupting production and the overall economy. This, in turn, raises the risk of income loss for households. During periods of severe or chronic food insecurity, economic instability intensifies the vulnerability of already struggling households. Conflicts and terrorism often lead leaders to prioritize military spending over agricultural investment, worsening food insecurity (Bayale and Gado, 2023; Bayale and Kouassi, 2022; Brück and d'Errico, 2019; Ali and Adj, 2023; Parigi, 2023). Moreover, the perception of flawed democratic governance significantly exacerbates food insecurity, suggesting strengthening democratic institutions can create enabling environment for effective food security interventions.

Economic discrimination occurs when individuals are treated differently based on their economic status (wealth or poverty status). Ethnic discrimination occurs when a person is treated unpleasantly by reference to his/her ethnic origin. The results show that the coefficients of the economic and ethnic discrimination variables, and the high lack of income are positive and significant with the likelihood of being in chronic food insecurity. These results suggest that discrimination, whether economic or ethnic, is a catalyst for food insecurity in SSA. Using the ordinary least squares method with living standards survey data from Ghana, Koomson and Churchill (2021) found similar results. Indeed, in societies where ethnic discrimination is on the rise, discriminated groups may have limited access to employment and even farmland reducing the ability of households to increase their income or agricultural production to cope with food insecurity. Discrimination also leads to the exclusion of marginalized groups from policies and programs aimed at ensuring food security. The same results are found when considering different levels of food insecurity. Good social cohesion can be a source of success for the implementation of agricultural policies and a guarantee of sustainable food security.

Climate shocks not only have a direct effect on food production but are also a source of conflict, with negative consequences on food security. Climate shocks lead to resource scarcity, which can be a source of conflict, as described in Hardin's (1968) economic theory of the tragedy of the commons. Climatic hazards such as droughts, floods, and high temperatures destroy crops, degrade soils, reduce agricultural yields including livestock, and consequently aggravate food insecurity. Natural resources such as water and agricultural land, often shared by several users, will be overexploited and poorly managed as a result of the accentuation of the climate change phenomenon (Ostrom, 2010). Without regulation, individuals, driven by the quest for maximum profit, use common resources in an unsustainable way, leading to their degradation.

Limited healthcare access adversely affects food security through multiple channels. Poor health reduces individuals' capacity for agricultural labor and income-generating activities, lowering household productivity and earnings (Spitzer et al., 2020). High medical costs can also divert resources from food purchases, worsening food insecurity. Conversely, households with better healthcare access can manage illness more effectively and maintain consistent participation in economic activities that can foster households' food security. The results support that access to health improve the likelihood of being in food security in SSA. Strengthening healthcare infrastructure and ensuring equitable access can thereby improve food security outcomes. Ownership of assets such as vehicles, radios, or televisions also significantly mitigates food insecurity. These assets enable households to access markets, obtain commodity-price information, and adopt new agricultural technologies, enhancing

productivity and food availability. By facilitating informed decision-making and innovation adoption, such assets strengthen household resilience. Regarding the main activity of the head of households, the results indicate that households headed by unemployed or unskilled persons are likely to be in food insecurity than those headed by civil servants. At the reverse, being in a household headed by farmers increase the likelihood of being food secured, suggesting that agriculture sector is strong pathway for promoting food security in SSA.

Gender disparities further influence food insecurity outcomes, as men and women experience different effects, highlighting the need for targeted interventions (Table 4). The findings reveal that FI significantly reduces food insecurity in both male- and female-headed households in SSA. However, the magnitude of this effect is notably higher for male-headed households compared to their female counterparts. This disparity may stem from the differing priorities and economic constraints faced by women. Female household heads often allocate financial resources toward urgent needs such as healthcare and children's education, which can limit their capacity to address food security directly. Additionally, women typically have lower and less stable incomes than men, making it more challenging to maintain consistent food access, especially during economic shocks.

Another critical factor is asset ownership. Female-headed households often possess fewer assets, such as land or property, which can be used as collateral for loans. This lack of collateral restricts their ability to access credit under favorable terms, sometimes forcing them to rely on high-interest loans that exacerbate financial strain and food insecurity. Furthermore, cultural norms and systemic barriers in some SSA contexts hinder women's economic opportunities, even when financial services are accessible. These challenges underscore the need for more nuanced approaches to financial inclusion that address the specific vulnerabilities of female-headed households. Education emerges as a key factor in mitigating food insecurity, particularly for women. The findings indicate that higher levels of education significantly reduce the likelihood of food insecurity for female-headed households, with a more pronounced effect compared to male-headed households. Research by Wegenast and Beck (2020) highlights that education beyond primary school has a stronger impact on improving food security for women than for men. Educated women are better equipped to diversify their income sources, enhance financial independence, and manage household budgets effectively, thereby improving their ability to secure food for their families.

Interestingly, female-headed households experiencing chronic food insecurity may derive greater long-term benefits from financial inclusion than male-headed households. While educated men may possess better skills for immediate food procurement in severe food insecurity situations, women tend to exhibit greater adaptability in chronic crises due to their central role in household resource management. Women are often highly motivated to stabilize their family's food situation during prolonged crises. However, the interplay between gender, food insecurity, and external shocks is complex. Women are more vulnerable to climate shocks, which disproportionately affect their livelihoods and exacerbate food insecurity. On the other hand, men face heightened food insecurity during conflict-related disruptions, as widespread displacement and destruction undermine food production and availability (Bapolisi et al., 2021). These findings emphasize the need for gender-sensitive policies that integrate financial inclusion with broader strategies addressing education, asset ownership, and resilience to shocks, ensuring equitable and sustainable food security outcomes for all.

Customary land tenure systems, often governed by traditional leaders, play a pivotal role in Sub-Saharan Africa. While these systems can facilitate land access for some, they may perpetuate inequalities and limit opportunities for marginalized groups. Insecure and inequitable land distribution reduces incentives for sustainable investment, undermining food security. The results indicate that influence of traditional leaders on land allocation negatively affect food security of male headed households but does not have effect on female headed households. This may be surprising but could be explained by the fact that traditional leaders' control over land allocation in SSA often disadvantages male-headed households because men are the primary claimants under customary systems while female-headed households are frequently excluded from formal land rights, so their reliance on informal access strategies can help them to avoid exposure to direct negative effects. Reforming land governance to balance traditional authority with inclusive, transparent mechanisms can improve equitable access. Policies ensuring secure tenure and empowering marginalized groups in decision-making are essential for sustainable food security.

The findings reveal a significant negative correlation between FI and food insecurity in both rural and urban areas (Table 4). While FI substantially reduces food insecurity in both settings, its impact is more pronounced in urban areas. This may be attributed to the greater accessibility and utilization of financial services in urban environments, where such services are often better integrated into daily economic activities. Expanding access to financial services and decentralizing financial systems can play a crucial role in mitigating food insecurity, aligning with the objectives of Sustainable Development Goal 2, "Zero Hunger." To maximize the effectiveness of FI in rural areas, improvements in both physical and financial infrastructure, as well as education, are essential. Enhanced rural infrastructure can facilitate access to markets, reduce transaction costs, and improve the delivery of financial services, while education empowers households to better utilize financial tools to address food security challenges.

Unlike Penne and Goedemé (2020), the results indicate that rural households face higher levels of food insecurity compared to urban households. In cases of severe or chronic food insecurity, urban households with limited income and restricted access to financial services face distinct challenges. High living costs and reliance on market-purchased food leave them particularly vulnerable during economic shocks or price fluctuations. In contrast, rural households, despite experiencing greater baseline food insecurity, benefit from access to natural resources such as land and water, which can provide a buffer during periods of acute food scarcity. These findings underscore the importance of context-specific strategies to enhance the impact of FI. Urban-focused interventions should prioritize improving the affordability and accessibility of financial tools for low-income households, while rural initiatives should emphasize infrastructure development, education, and targeted financial products that address the unique needs of rural communities.

Climate shocks, such as droughts and floods, affect both urban and rural households in SSA, but rural areas suffer more due to their dependence on agriculture. These shocks can damage crops and reduce productivity, leading to losses in income and food supply. The study underscores that deteriorating economic conditions or a lack of stable income substantially increase the risk of food insecurity, particularly among urban households. While rural households are also vulnerable, the impact is notably more severe in urban areas due to the

higher cost of living, encompassing housing, utilities, and goods. These financial pressures leave urban households more exposed to economic fluctuations.

Job insecurity further compounds the issue, with urban workers, often employed in precarious or informal sectors, facing heightened risks of income loss during economic crises. This instability intensifies food insecurity, as urban households primarily depend on market purchases for their food supply. In contrast, rural households, despite their economic challenges, are often able to mitigate food insecurity through subsistence farming and access to natural resources, providing a buffer against external shocks. Unskilled manual laborers in rural areas also face significant challenges, as limited income opportunities restrict their ability to purchase necessary goods. However, the capacity for food self-production in rural settings provides a critical advantage over urban households, who lack similar alternatives. Consequently, economic downturns disproportionately exacerbate food insecurity in urban areas, highlighting the need for targeted interventions to improve income stability, reduce living costs, and enhance food access for vulnerable urban populations.

6 Conclusion and recommendations

The digitalization and decentralization of financial services significantly influence households' ability to secure sufficient and nutritious food by enhancing access to essential financial resources. However, disparities in access to these financial services can impede the achievement of sustainable development goals (SDGs), particularly SDGs 2, 4, 5, 10, and 13, which are crucial in SSA where, food security remains a critical issue amidst climate change stresses. This study explores the effect of FI on food insecurity in SSA, with particular attention to gender and households' residence. We use probit model applied to country fixed-effect and cross-sectional data from 45,684 households across 32 SSA countries. These fixed effects are instrumental in controlling for potential heterogeneity across countries, which may influence financial inclusion or food insecurity outcomes. Unlike previous research, this study employs a financial inclusion index that includes five key components: mobile phone ownership, internet access, possession of a bank account, and the availability of mobile banking services or ATMs. The research illustrates the region's socio-economic diversity, the specific food security challenges faced, and notable gender and regional disparities in accessing financial resources.

The findings show that increased FI is associated with a significant decrease in household food insecurity in SSA. However, the benefits of financial inclusion are often undermined by factors such as climate shocks and conflicts. Extreme weather events, such as prolonged droughts, can severely impact agricultural productivity and, by extension, food security. Conflicts disrupt labor markets, damage infrastructure, and deplete agricultural resources, contributing to price instability and worsening food insecurity. Furthermore, issues like and flawed democracy in the country, corruption, economic, ethnic and religious discriminations, Corruption, through practices such as embezzlement and unfair resource distribution, exacerbates food insecurity. Discrimination, whether based on gender, ethnicity, or other factors, undermines the effectiveness of agricultural policies and further deteriorates food security. Moreover, the role of traditional leaders in land allocation appears to exacerbate food insecurity in SSA. Inequitable or inefficient land distribution practices can limit households' access to productive land, undermining their ability to achieve food security. In contrast, improving access to healthcare emerges as a critical strategy for mitigating food insecurity. Healthier individuals

are better equipped to engage in productive activities, enhancing their capacity to secure sufficient food for their households.

To effectively address food insecurity in SSA, it is essential for governments and financial institutions to implement policies that ensure equitable access to financial services, with a particular focus on women and rural populations. The integration of mobile and digital technologies into the financial sector can play a pivotal role in reaching the most remote and vulnerable communities. FI strategies should also incorporate mechanisms to reduce barriers for women, as improving women's access to financial resources can significantly enhance food security. Moreover, targeted FI should address gender disparities, regional differences, and challenges such as corruption and conflict. Efforts to combat climate change should include improving access to advanced seeds, agricultural inputs, and innovative technologies. Strengthening institutions, establishing robust control mechanisms, and promoting integrity are crucial steps to mitigate corruption and ensure the effective development and implementation of agricultural policies. Additionally, governments and stakeholders should promote transparent and equitable land allocation processes, reducing the influence of traditional leaders where such practices hinder access to resources. Simultaneously, investments in healthcare infrastructure and services are essential to support healthier, more resilient populations capable of sustaining food security.

While this research provides valuable insights into the relationship between FI and food insecurity at a specific point in time, it does not allow for an exploration of causality or changes over time. The reliance on cross-sectional data limits the ability to account for temporal dynamics and potential lagged effects of financial inclusion on food security outcomes. Future research could address these limitations by utilizing the most recent datasets or employing panel data to track households over time. Such approaches could help identify long-term trends and the persistence of food insecurity, offering deeper insights into the mechanisms at play.

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