The Smallholder Financial Inclusion index: measuring access and usage of financial services in the Global South

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Highlights

- We propose the Smallholder Financial Inclusion Index (SFI) to measure access to and usage of financial services at the household, regional, and national levels.
- We estimate the SFI in Bangladesh, Uganda, Tanzania, Nigeria, and Ivory Coast at the household, regional, and national levels.
- We explore the key drivers of financial inclusion and shed light on the importance of information channels to increase households' financial inclusion.

Abstract

In the Global South, smallholder farmers are among the most financially excluded groups and appropriate indicators are essential to develop targeted support mechanisms. As financial inclusion is a complex and multidimensional phenomenon, we design a framework to link the concepts of access and usage of financial services and propose the Smallholder Financial Inclusion Index (SFI). We use Multiple Correspondence Analysis to identify 12 relevant indicators to measure financial inclusion and calculate weights. To demonstrate the applicability of the index, we use data from smallholders in Bangladesh, Uganda, Tanzania, Nigeria, and Ivory Coast to compare household, regional, and national financial inclusion. The results show Uganda has the highest SFI score at 35.45, followed by Bangladesh at 31.85, Tanzania at 22.49, Nigeria at 17.49, and Ivory Coast at 11.28. This index can be disaggregated to regional levels, allowing policymakers to identify vulnerable parts of the country and their specific financial needs (e.g., using bank accounts for saving and acquiring loans). For example, in Nigeria, farmers in the coastal regions report access to savings almost twice as large as in the central region. Lastly, we estimate a censored regression model using the household scores to understand factors driving household financial inclusion. We find that information channels are significantly associated with financial inclusion. The proposed index shows that a detailed understanding of financial inclusion can support policymakers in targeting excluded groups at the household and regional levels.

Keywords: Financial Inclusion; Composite indicator; Smallholder agriculture; Multiple Correspondence Analysis; Global South.

1. Introduction

Many rural households in developing countries have little or no access to financial services like bank accounts or loans (World Bank, 2014; 2017). An estimated 500 million smallholder households are among the most financially excluded due to high service costs for financial institutions to reach rural households (Anderson et al., 2019; Gomez et al., 2020). Furthermore, specific agricultural sector risks, including vulnerability to weather patterns, pests, price volatilities, and agriculture seasonality, make financial institutions hesitant to lend to farmers (Barry & Robison, 2001). Smallholders, in particular, often lack formal documentation on property, trade, and credit records or formalized land-use rights they could use as collateral, which limits their access to formal financial services (Villalba et al., 2023). However, access to finance is crucial for farmers to invest, enhance their productivity, buy equipment, and adopt new technologies.

Policymakers need appropriate indicators to understand financially excluded groups and create targeted policies. However, financial inclusion is a complex and multi-layered phenomenon where socioeconomic factors, regulatory frameworks, and cultural habits are key in determining individuals' use of financial services (Cámara & Tuesta, 2018). When measuring financial inclusion, encompassing different dimensions, such as access to and usage of various financial services, is essential to ensure a comprehensive and nuanced understanding of this phenomenon. This multidimensionality can be captured by a composite indicator such as an index. Several studies propose measurements of financial inclusion on the national and regional level (e.g., Amidžic et al., 2014; Arora, 2010; Sarma, 2008, 2015); however, methods to measure financial inclusion in the household have been less explored. Researchers often use proxy variables for finance (e.g., access to loans, access to ATMs, number of bank branches) to measure financial inclusion among households. In agriculture, farmers are considered financially included if they have an account registered in their name in a Financial Institution, or a mobile money account registered in their name (Anderson & Sobol, 2018). Nevertheless, these tend to neglect the multidimensionality of financial inclusion and do not offer any insights into the reasons why individuals fail to use formal financial services. Moreover, previous indices have not incorporated new technological developments, such as mobile banking, which are increasingly important and must be included (GSMA, 2019a, 2019b, 2021).

Against this backdrop, this study aims to answer two research questions: (i) Which indicators can better measure smallholder financial inclusion at the household level? and (ii) How does financial inclusion differ among agricultural households from different regions and countries in the Global South? To this end, we propose a framework to link the concepts of access and usage of financial services and develop the Smallholder Financial Inclusion Index (SFI). We use two-step Multiple Correspondence Analysis (MCA) for the index to identify 12 relevant indicators and their weights. Further, we compare financial inclusion at the household and regional levels in Uganda, Tanzania, Bangladesh, Ivory Coast, and Nigeria and use a censored regression model to explore the drivers of household financial inclusion.

The rest of the paper is structured as follows. Section 2 presents the conceptual framework for the Smallholder Financial Inclusion Index. Section 3 introduces the methodology and steps to estimate the index and explore financial inclusion drivers. In section 4, the results present the SFI at the national and regional levels and explain the key drivers of financial inclusion through the censored regression model. Finally, Section 5 discusses the main findings, and Section 6 presents our study's conclusion.

2. Conceptualizing the Smallholder Financial Inclusion Index

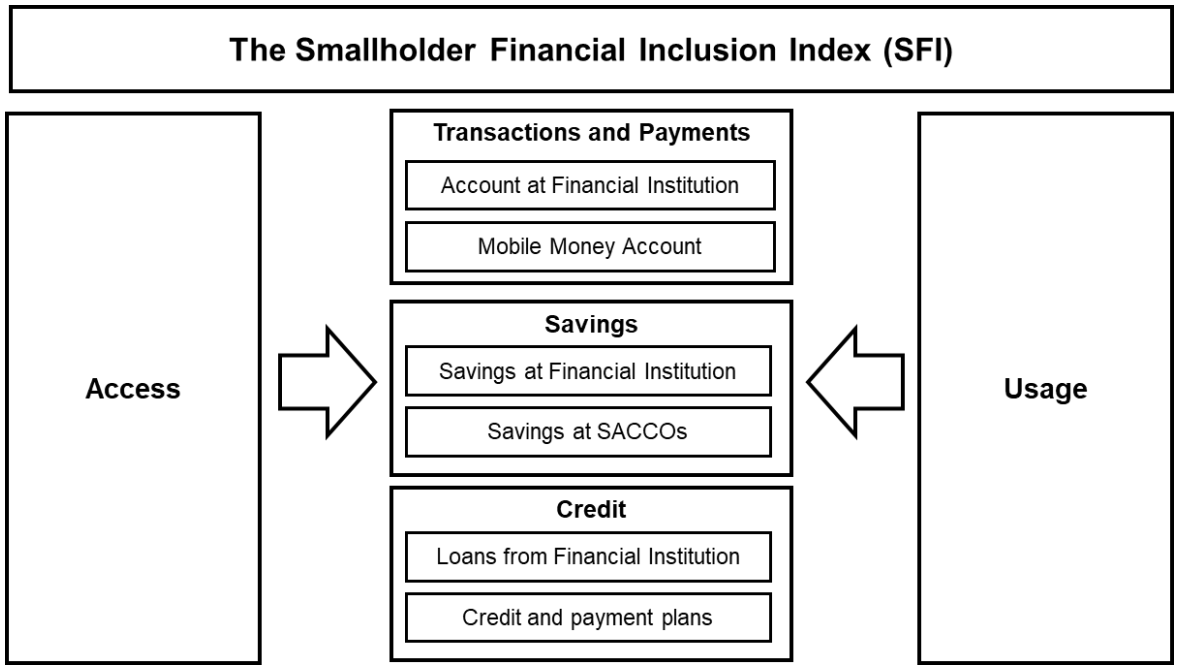
Financial Inclusion is the situation in which *"individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit, and insurance – delivered in a responsible and sustainable way"* (World Bank, 2018b). While financial inclusion is closely related to other concepts often used in the Global North, such as financial literacy (Lusardi et al., 2010; Lusardi & Mitchell, 2014), financial capability (Serido et al., 2013; von Stumm et al., 2013), and financial resilience (Salignac et al., 2019), it differs because of its holistic focus and practical implications for increasing financial products and service delivery. Financial literacy focuses on how individuals process economic information and make decisions (Lusardi et al., 2010), financial capability focuses on individuals' knowledge and confidence (Serido et al., 2013), and financial resilience focuses on how individuals recover from adverse financial events (Salignac et al., 2019). Further, the underlying assumption of these three concepts is that sufficient financial services are available, and individuals lack the knowledge, confidence, or skills to make sound

financial decisions. In contrast, financial inclusion looks into the structural and institutional insufficiencies of access to and usage of financial services.

As a concept, financial inclusion at the country level has been useful for measuring links to poverty reduction, social inclusion, and growth and stability in developing countries (de Koker & Jentzsch, 2013; Soederberg, 2013). Previous studies have measured financial inclusion at the global and national level (Amidžić et al., 2014; Anwar et al., 2017; Cámara & Tuesta, 2017; Gupte et al., 2012; Huang & Zhang, 2020; Park & Mercado Jr, 2018; Sarma, 2008; Sethi & Sethy, 2018); however, there have been no frameworks proposed to assess financial inclusion at the household level. In empirical research, individual variables (e.g., taking a loan in the last year, owning a bank account, etc.) are commonly used to obtain a proxy measure of financial access. However, it is crucial to comprehend financial inclusion as a process that ensures and eases both the access and usage dimensions of the formal financial system.

In the Global South, understanding access and usage is critical to measuring financial inclusion. Although both terms are often used interchangeably, they have different meanings and implications (Chen & Jin, 2017). Access refers to the availability or supply of reasonable quality financial services at affordable costs, while usage refers to the actual consumption of financial services (Claessens, 2006; Hannig & Jansen, 2010). From a supply-demand perspective, access focuses on the supply of services, while usage is determined by the demand and supply (Chen & Jin, 2017; Claessens, 2006; Demirgüç-Kunt & Klapper, 2013). In the context of agricultural households, this suggests that farmers can face three types of scenarios of financial inclusion: (A) Farmers can have access and usage of financial services, (B) Farmers can have access but not do not want to use financial services (voluntary exclusion), and (C) Farmers do not have access and thus do not use financial services (involuntary exclusion) (Claessens, 2006). In South Africa, Bankable Frontier Associates (2009) shows that even when farmers have a bank account, these may become dormant over time. Further, Demirgüç-Kunt & Klapper (2013) find that even if access is granted, financial services can remain limited to groups that belong to the ethnic majority, have higher educational attainment, are male, or have higher income levels. Finally, financial institutions can also be reluctant to issue loans to low-income households as these are too small to be profitable (Johnston & Morduch, 2008).

Figure 1. A Framework for the Household Financial Inclusion Index: Dimensions of Access and Usage



To estimate the Smallholder Financial Inclusion Index, we account for the multidimensionality of financial inclusion of agricultural households in the Global South (Figure 1). Our framework includes indicators that measure the access to and usage of essential financial products and services, divided into three categories, as suggested by the World Bank[1]: (i) transactions and payments, (ii) savings, and (iii) credit.

Transactions and payments denote banking penetration and aim at fostering account ownership at a financial institution. As part of this category, we include two indicators: account at a financial institution and mobile money accounts. Having an account at a financial institution serves as an entry point into the formal financial sector as it facilitates the transfer of wages, remittances, and government payments. It also improves day-to-day financial operations, reducing the need for informal financing (Demirguc-Kunt et al., 2018; Sarma, 2008). For rural households, formal accounts can include accounts at different financial institutions (banks, microfinance institutions, cooperatives), mobile money accounts, and debit and prepaid debit cards (Adegbite & Machethe, 2020; Demirguc-Kunt et al., 2018). Further, mobile money (person-to-

[1] The original definition of the World Bank includes four categories: transactions and payments, savings, credit, and insurance. However, our dataset did not include accurate data to measure the access to and use of insurance products and thus was not included as part of this analysis.

person or business-to-person transfers from mobile wallets on mobile phones) has gained popularity in the last years for its potential to accelerate payments, decrease transaction costs and promote savings (Mcintosh & Mansini, 2018). In developing economies, development organizations have fostered mobile money and financial technologies to increase rural access to payments, savings, credit, and insurance (Walsham, 2012).

The second category refers to savings, which are a catalyst for capital creation and are crucial to allow farmers to encourage better cash management. Moreover, especially in small farms, they are indispensable as a risk management strategy against climatic events, and other social, economic, and environmental shocks (Demirgüç-Kunt & Singer, 2017; Karlan & Morduch, 2010; Zeller & Sharma, 2000). Savings are key for financial inclusion as they increase the household's resilience and smooth future consumption in the face of variable and unpredictable agricultural income (Wieliczko et al., 2020). In terms of formal savings, our framework includes two indicators for savings: savings at a financial institution (which includes banks, microfinance institutions, and post banks) and savings at Credit Cooperative Organisation or Societies (SACOOs).

Finally, credit is critical as borrowing from a financial institution shows benefits over borrowing from informal sources (friends, family, or an informal lender). When farmers borrow from family and friends, they are usually limited to the funds within their community; however, borrowing from a formal financial institution removes that constraint (Demirgüç-Kunt & Singer, 2017). Moreover, formal credit can offer them access to better credit terms than informal lenders. In terms of credit, our framework includes two indicators for credit, including loans from a financial institution (banks, microfinance institutions, and post banks) payment plans.

3. Data and Methodology

Our study aims to identify indicators that measure financial inclusion for smallholder farmers at the household level and explore how this measure varies among countries from the Global South. For this, we developed the Smallholder Financial Inclusion Index, which includes twelve indicators for access and usage of financial services.

3.1 Data

We used publicly available household survey data from the World Bank's Consultative Group to Assist the Poor (CGAP, 2015, 2016b)[2], which explored smallholder households' financial needs and behaviours in Bangladesh, Tanzania, Uganda, Nigeria, and the Ivory Coast. The survey focuses on small-scale farmers and sheds light on their agricultural and financial lives, covering agricultural and non-agricultural income sources, financial behaviours and tools, mobile phone usage, and a range of attitudes and perceptions. The surveys capture a nationally representative sample size of 3,000 (+/-) households identified through stratified sampling along administrative divisions (Anderson et al., 2016). After removing missing observations, our final dataset included 8,655 households.

Bangladesh

Agriculture plays a key role in Bangladesh's economy, employing 37 % of the labour force (World Bank, 2021b) and accounting for nearly half the poverty reduction between 2000 and 2010 (Gautam & Faruqee, 2016). The country is also a global leader in introducing and expanding the services of non-traditional finance providers, such as Microfinance Institutions. However, most smallholder farmers, who account for 98 % of total agricultural households (Palash & Bauer, 2017), still are not financially included and rely primarily on their communities to access financial information (Anderson & Sobol, 2018).

[2] Data sets can be accessed publicly under https://www.cgap.org/topics/collections/smallholder-families/demand-financial-services

Tanzania

Agriculture in Tanzania contributes to over 28 % of the GDP and employs 64 % of the national labour force (Rapsomanikis, 2015; World Bank, 2021b). Small farmers represent approximately 80 % of agricultural households. Although the country's public and private sectors have made significant investments in the financial infrastructure in recent years, credit, insurance, and payment facilities for smallholders are still lacking (Anderson & Sobol, 2018). Further, many smallholders in the country grow a limited number of crops, mainly maize, which increases their risk exposure due to the lack of insurance and financial mitigation products.

Uganda

More than 70% of people in Uganda work in agriculture, and the sector represents around 23 % of the country's GDP (FAO, 2023; World Bank, 2021b). The country has more than three and a half million family farms, and many of its smallholders are among the poorest people in the world (FAO, 2023). Many smallholder families depend on coffee production, one of the country's most significant exports. Similar to Tanzania, the public and private sectors have made recent investments in the country's financial infrastructure. While this has benefited the country, many financial services are not suited to the specific and unique financial needs of smallholders (Anderson & Sobol, 2018). Finally, many smallholder farmers have used mobile phones, and familiarity with mobile money is relatively high (Anderson & Sobol, 2018).

Nigeria

Nigeria has the largest population of all West African countries, and agriculture employs an estimated 70 % of the labour force (World Bank, 2021b). Further, 80 % of farmers are considered smallholders, owning less than 5 hectares of land (Mgbenka & Mbah, 2016). Agricultural activities are significantly diversified, with the average smallholder household growing six different crops. Saving is common, but mainly through informal methods, such as in cash, at home, or with friends. Moreover, cash is the prevalent form of payment among smallholders, as there are low levels of trust in financial institutions and a lack of perceived need for formal financial services (Anderson & Sobol, 2018).

Ivory Coast

Ivory Coast is the world's largest producer and exporter of cocoa beans and cashew nuts and a top exporter of coffee and palm oil. The agricultural sector supports approximately 70 % of the population, with an estimated 900,000 cocoa farmers, of whom 90% are smallholder farmers (International Labour Organization, 2018). As of 2021, only 21 % of adults in Ivory Coast had an account at a Financial Institution (World Bank, 2021a). Smallholders, even those in structured value chains, struggle to access formal financial institutions, which are highly concentrated in urban areas. Further, farmer households rely primarily on their financial resources or support from the local community as formal financial institutions play only a limited role in the Ivorian smallholder ecosystem (Anderson & Sobol, 2018).

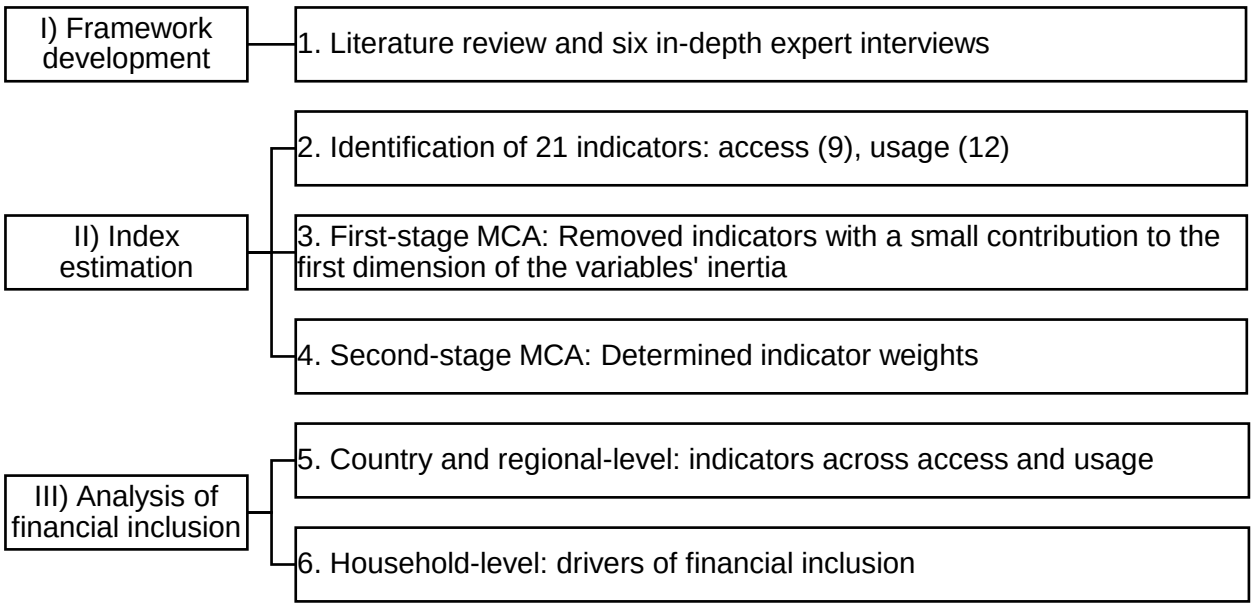
3.2 Smallholder Financial Inclusion Index Development

To develop the Smallholder Financial Inclusion Index, we performed three steps: (I) Framework Development, (II) Index Estimation, and (III) Analysis of Financial Inclusion (Figure 2).

(i) Framework Development

For step I, we conducted a literature review and six in-depth interviews with experts working on financial inclusion in agricultural households in the Global South. The interviewees included representatives from International Development Agencies, UN development projects, Agricultural Financial Consultants, Agricultural Banks, and Impact Investment Funds. We used these interviews to contrast information about smallholders' specific barriers, challenges, and financing needs and identify current indicators used by institutions to assess financial inclusion. All interviews were recorded and transcribed. The resulting framework is presented in Figure 1 in Section 1.

Figure 2. Overview of methodological approach



(ii) Index estimation

The index estimation was divided into three steps. First, we explored relevant variables to measure access and usage of financial services in the survey data. As part of our initial search, we included all variables referring to the access and usage of financial services available in the data. We created binary group indicators to transform these variables into similar indicators for all countries. These group indicators were given a value of 1 if the respondent presented access to or usage of one or several financial services. For example, variables related to access to accounts at Financial Institutions, including banks, microfinance institutions, post offices, or cooperatives, were combined into a group indicator named ‘Account at a Financial Institution.’ In total, we grouped variables into 21 group indicators for financial inclusion, among which 9 referred to access and 12 to usage (see Table A1 in the Appendix for more detail).

In the second step, we conducted Multiple Correspondence Analysis (MCA) to identify the most critical indicators for financial inclusion in the dataset. Benzécri & Benzécri (1980) introduced MCA to explore data and reveal correlation patterns among variables described by single components. Such principal components, or dimensions, are considered latent (unobserved) variables explaining most of the variance of a set of other variables (Ezzrari & Verme, 2013). The first principal component or dimension refers to the latent variable representing the largest variance across all observed

variables applied in the analysis. Other data-driven index approaches, such as Principle Component Analysis, require indicators based on aggregated, continuous data and are designed for multivariate normal distribution of variables, which does not exist with categorical variables (Booysen et al., 2008; Howe et al., 2008; Asselin, 2009). However, our dataset measured access and usage of financial services through categorical and binary data. Thus, MCA allowed for measuring a latent variable while applying categorical data and with fewer assumptions on the distribution of indicator variables (Asselin, 2009; Booysen et al., 2008).

The first MCA was conducted on the preliminary established indicators as listed in Table A1 by using the *mca* command in Stata17. This command produces an adjusted correspondence analysis using the preliminary indicators and adjusts the principal inertias (eigenvalues) by applying the method introduced by Benzécri & Benzécri (1980). In our study, the first dimension refers to the latent variable (in this study, financial inclusion) that accounts for the largest amount of variance across variables. The first dimension in our MCA represents 70,2% of the total inertia, and to avoid the complexity of interpretation, variables with column inertia less or equal to 0.187 or less (correlation values lie between 0 and 1) were dropped. This resulted in dropping four indicators: access to a debit card, usage of a debit card, usage of mobile savings, and usage of Western Union and Money Gram.

To develop an index using the access and usage of financial services, we regrouped the remaining indicators into 12 categories (Table 1). It is important to note that, following Claessens (2006), to estimate the index, we assume that farmers face three types of scenarios for financial inclusion: A) Farmers have access and usage of financial services, (B) Farmers have access but not do not want to use financial services (voluntary exclusion), and (C) Farmers do not have access and thus do not use financial services (involuntary exclusion). This also allowed us to ensure that the selected indicators presented both access and usage and that different types of instruments.

Table 1. Indicators to measure access and usage in the Smallholder Financial Inclusion Index

Dimensions of Financial Inclusion	Access	Usage
Transactions and Payments	1A. Account at Financial Institution (bank, MFI, cooperative)	1U. Account at Financial Institution (bank, MFI, cooperative)
	2A. Mobile Money Account	2U. Mobile Money Account
Savings	3A. Savings at bank	3U. Savings at bank
	4A. Savings at SACCOs	4U. Savings at SACCOs
Credit	5A. Formal loans	5U. Formal loans
	6A. Credit & Payment plans	6U. Credit & Payment plans

As presented in Table 1, for the access dimension, six relevant indicators were identified: (1A) Account at a Financial Institution, (2A) Mobile money account, (3A) Savings at a bank, (4A) Savings at Credit Cooperative Organisation or Societies (SACOOs), (5A) Access to formal loans, and (6A) Access to credit and payment plans. For the usage dimension, six relevant indicators were identified: (1U) Usage of an account at a Financial Institution, (2U) Usage of a mobile money account, (3U) Usage of savings at banks, (4U) Usage of savings at SACOOs, (5U) Usage of formal loans, and (6U) Usage of credit and payment plans.

In the last step, we conducted a second MCA to estimate the individual weights of the 12 selected indicators in the Smallholder Financial Inclusion Index. Following the method applied by Asselin (2009), the function for the SFI Index of a household i is written as:

$$SFI_i = \frac{1}{K}\sum_{k=1}^{K}\sum_{j_k=1}^{J_k} w_{j_k}^{k}\, I_{j_k}^{i_k} \quad (1)$$

Where K is the number of indicators with $k = (1, 2, \dots, K)$; J represents the number of categories of each indicator with $j = (0, 1, \dots, J_k)$, note that all indicators were coded as binary; I is the binary indicator of each category (0, 1); and w is the weight as estimated by the second MCA (factor score on the first dimension normalized by the eigenvalue λ_α of the first dimension α). After the second MCA was estimated on the final list of 12 indicators selected, the weights were further adjusted so the final index values would lie between 0 and 100. Hence, the Smallholder Financial Inclusion index gives each household a value between 0 and 100, which is the average across indicators of the weighted sum of each binary category of each indicator (Equation 1).

(iii) Analysis of financial inclusion

We used the computation of the index at the household level to explore drivers of financial inclusion in two sub-steps. In Step 5, we computed the %age of households that reported access or usage for each indicator in the dataset at the dimension and the national level (for more detail, see Table A2 in the Appendix). Then, in Step 6, we used a censored regression to uncover drivers of financial inclusion.

In censored, truncated, or Tobit regression models, the range of the dependent variable is constrained in some way (Amemiya, 1984). As the SFI index value has upper and lower limits (0-100), we selected this model because it allows us to estimate the effect of each independent variable on SFI, considering the censoring. In our sample, continuous density cannot explain the conditional distribution of the SFI index given the independent variables because continuous density is inconsistent with the fact that there are several observations at zero (see Figure A1 in the Appendix). To estimate the censored regression model, we used four groups of independent variables that capture the context of the agricultural households: sociodemographic characteristics, information channels, economic characteristics, and farm-specific characteristics (Table 2). As suggested by Debebe (2022) and McDonald & Moffitt (1980), the Tobit model can be specified as follows:

$$Y_i = \begin{cases} Y_i^* \; if \;\; Y_i^* > 0 \\ 0 \; if \;\; Y_i^* \leq 0 \end{cases}, \qquad (2)$$

Where Y_i is the observed variable, and Y_i^* is the latent variable which is the SFI score. This implies that the observed SFI score $\mathrm{Y_i}$ takes the value of $\mathrm{Y_i^*}$ if $\mathrm{Y_i^*}$ is greater than zero, and it is censored at zero if $\mathrm{Y_i^*}$ is zero or negative. $\mathrm{Y_i^*}$ is explained by the following equation:

$$Y_i^* = X_i\beta + \mu_i \qquad (3)$$

Where X_i is a vector of independent variables (namely sociodemographic characteristics, information channels, economic characteristics, and farm-specific attributes), β is a vector of unknown coefficients, and μ_i is the independently distributed error term assumed to be normal with zero mean and constant variance σ^2.

4. Results

4.1 Descriptive statistics

The sample includes 8,655 households from Bangladesh, Tanzania, Uganda, Nigeria, and Ivory Coast. The sociodemographic characteristics of the households indicate that the average household head is 40, with 68% being male and 85% of the households living in rural areas. Further, 70.3% of the farmers reported no formal education, and only 19.6% had attended primary school. Regarding access to information channels, 82% of the farmers owned a mobile phone, 3% had access to financial advice, and 32% were part of a farmers' group. Regarding the economic characteristics of the households, 85% rely on agriculture as the primary source of income while 27% have a sales contract. Finally, the average land ownership is 7.5 Ha, with a crop diversity of 4.87 crops per farm and 95% producing staples.

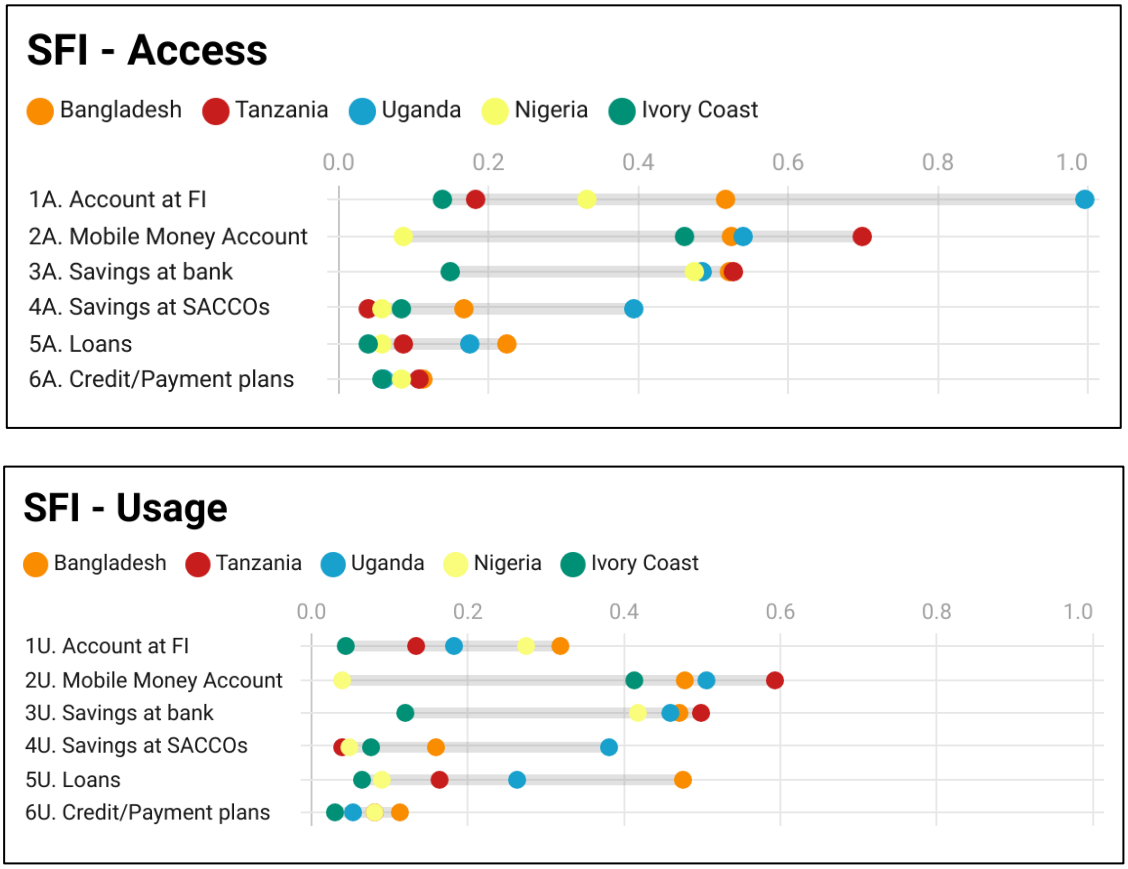
Table 2. Summary statistics of independent variables used for the censored regression model

Variables	Bangladesh	Tanzania	Uganda	Nigeria	Ivory Coast
Number of Households (N= 8,655)	1,748	1,657	1,392	1,690	2,168
Sociodemographic characteristics					
Age average (in years)	40.57	40.66	35.85	40.01	41.64
Male household heads (%)	85.5%	54.7%	63.5%	67.5%	67.3%
Population in Rural areas (%)	96.2%	70.6%	81.8%	90.1%	86.7%
Education (Finished primary school)	32.3%	10.1%	26.2%	33.6%	1.6%
Information channels					
Mobile Ownership (%)	91.7%	80.0%	67.9%	79.2%	87.8%
Access to Financial Advice (%)	4.7%	0.5%	4.8%	2.5%	2.0%
Member of a group (%)	14.6%	29.3%	35.4%	35.0%	42.5%
Economic characteristics					
Farm as primary source of income (%)	79.6%	86.7%	82.7%	82.1%	90.3%
Sales contract (%)	3.5%	96.1%	9.3%	16.1%	13.3%
Production characteristics					
Average land owned (in Ha)	1.17	10.15	1.86	6.19	15.20
Average total land (in Ha)	1.79	16.95	3.00	37.73	45.89
Number of crops produced on the farm	4.05	3.85	6.11	4.69	5.66
Producer of staples	98.6%	96.7%	98.4%	98.0%	84.5%

4.2 SFI at the dimension and indicator level

To offer a first glance at the indicators used to measure financial inclusion, we computed the %age of households that reported having access or usage for each of the twelve indicators at the national level (Figure 3). These indicators were validated by the expert interviews, who also referred to the importance of assessing the link between the available financial products and services and those that end up being used by farmers. For the first dimension, smallholders reported high access for (2A) Mobile money accounts at 46%, (3A) Savings at banks at 42%, and (1A) Accounts at financial institutions at 40%. However, the results denote a high variability across these indicators at the country level. For the second dimension, indicators (2U) Mobile money accounts at 40%, and (3U) Savings at banks at 38% report high usage. However, the rest of the indicators were reported below 20% (for more detail, see Table A2 in the Appendix).

Figure 3. Country-level indicators for access and usage of finance



Comparing access and usage, smallholder farmers, on average, report high and consistent levels of access and usage only for two indicators. Mobile money accounts are the most accessed (46%) and most used (40%) indicator. Moreover, savings at banks also show high access (42%) and usage (38%) by smallholder farmers. A second group of indicators is characterized by a small gap between access and usage but with low scores overall. For example, the gap between Savings and Credit Cooperatives' access (14%) and usage (13%) is small, but the scores show that their values are low across countries. A similar situation occurs for credit and payment plans, where access reaches 9% and usage 7%. Finally, for other indicators, there seem to be fundamental mismatches between access to and usage of finance at the national level. Accounts at financial institutions show a critical gap between the reported access (40%) and usage (19%). For example, in Nigeria, 33% of households report having access to an account at a financial institution, while 28% report using it; however, in Uganda, access is reported at 99% and usage at 18%.

4.3 SFI at the National and regional level

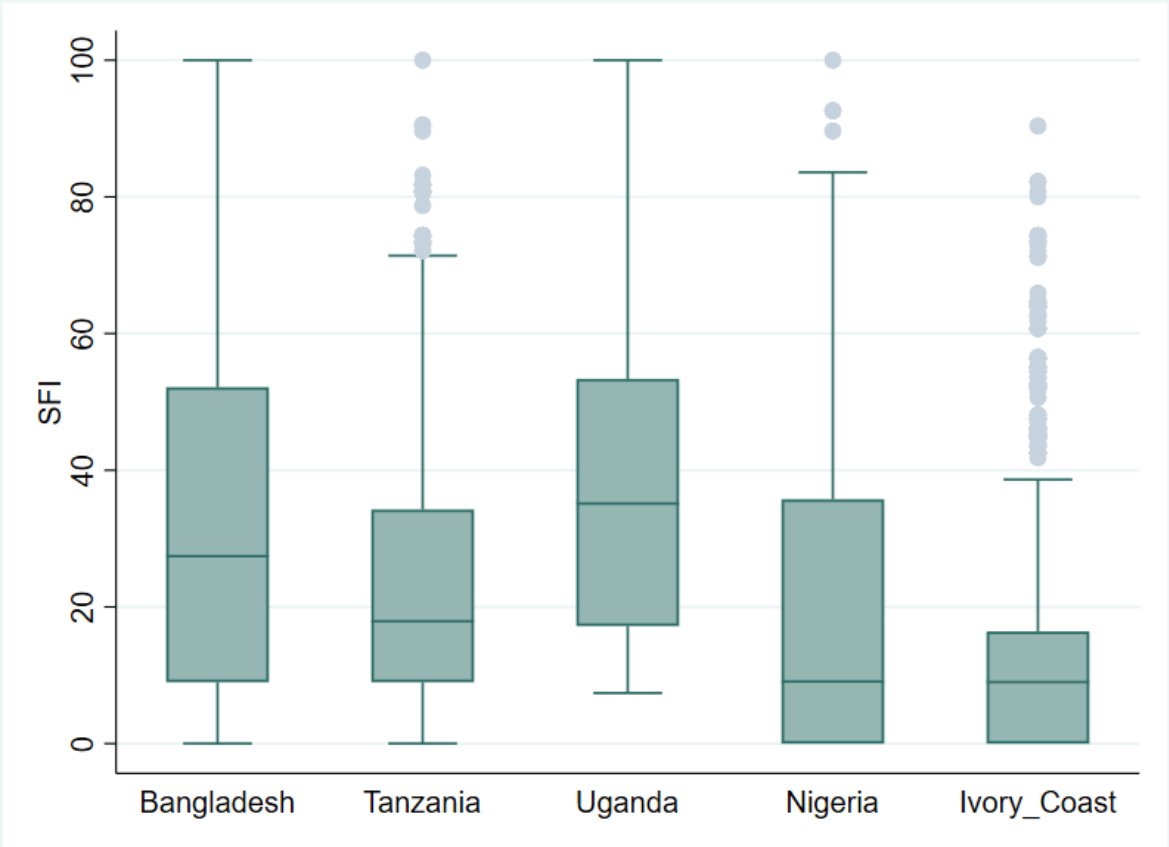
We computed the Smallholder Financial Inclusion index for 8,655 households. Table 3 shows the SFI mean for smallholder households across countries, which is 22.74 out of 100. Uganda has the highest mean SFI score at 35.45, followed by Bangladesh with a score of 31.85. Tanzania, Nigeria, and Ivory Coast reported scores under the sample mean with values of 22.49, 17.79, and 11.28, respectively. Further, 45.6% of the households are ranked in the lowest decile.

Table 3. Smallholder Financial Inclusion Index per Country

Country	Observations	Mean	Std. dev.	Median	SFI=0 (%)
Bangladesh	1,748	31.85	24.91	27.42	14%
Tanzania	1,657	22.49	19.99	17.89	17%
Uganda	1,392	35.45	21.76	35.12	0%
Nigeria	1,690	17.79	20.12	9.07	46%
Ivory Coast	2,168	11.28	15.84	9.00	44%
TOTAL	**8,655**	**22.74**	**22.36**	**17.22**	**26%**

The distribution of the SFI at the national level (Figure 4) shows that in Bangladesh, 73% of the households reported a score under 50 points, out of which 14% had an SFI score of 0. In Tanzania, 88% of the households reported an SFI under 50 points and 17% a score of 0. In Uganda, 72% of the households displayed a score below 50 points; however, the minimum score was estimated to be 7 points. The distribution of the index values in the dataset also shows that 26% of the observations have a score of 0 (Figure A1 in the Appendix), which can be attributed to a lack of financial services or incomplete survey responses. This share is higher for Nigeria and the Ivory Coast, with 46% and 44% of the households, respectively. When we removed zero values, the sample was reduced to 6,409 households, and the mean SFI score increased to 30.71, while the minimum SFI score was 4.57, and the maximum was 100.

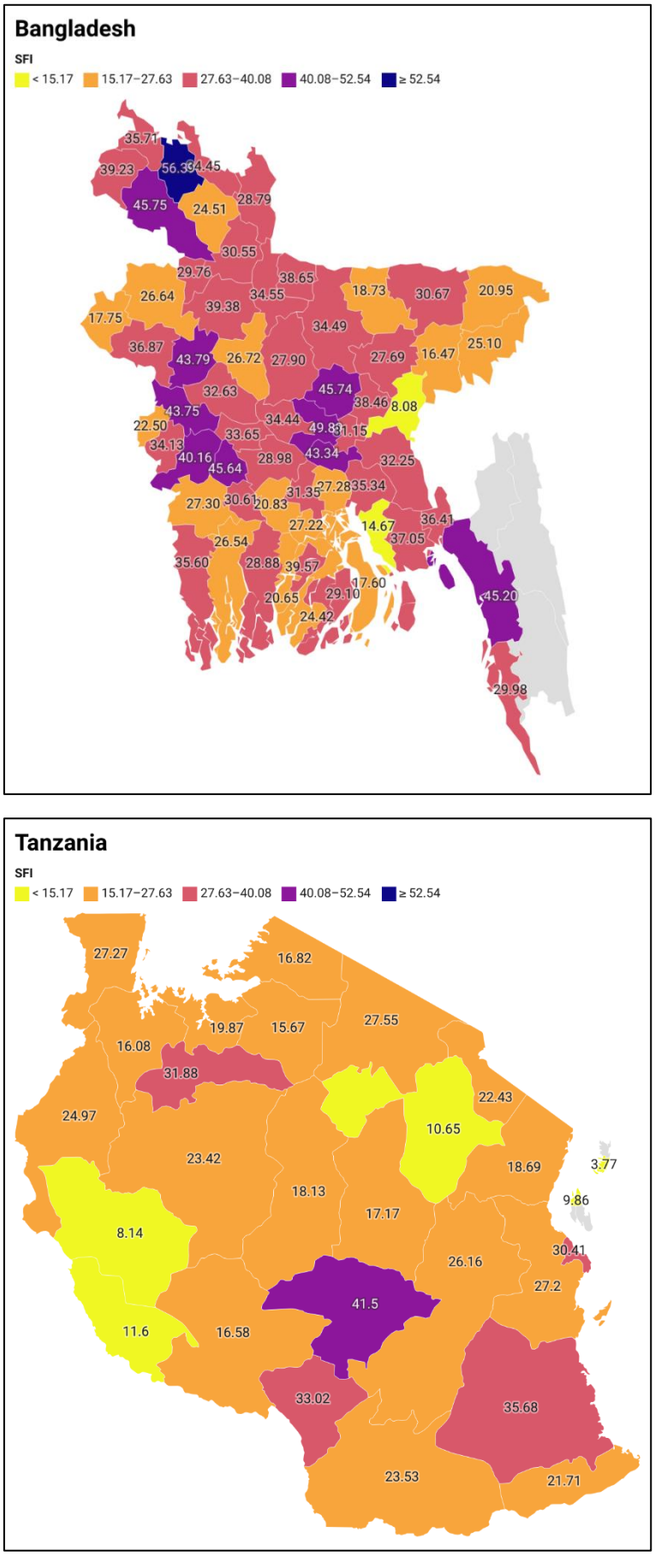
Figure 4. SFI distribution at the national level

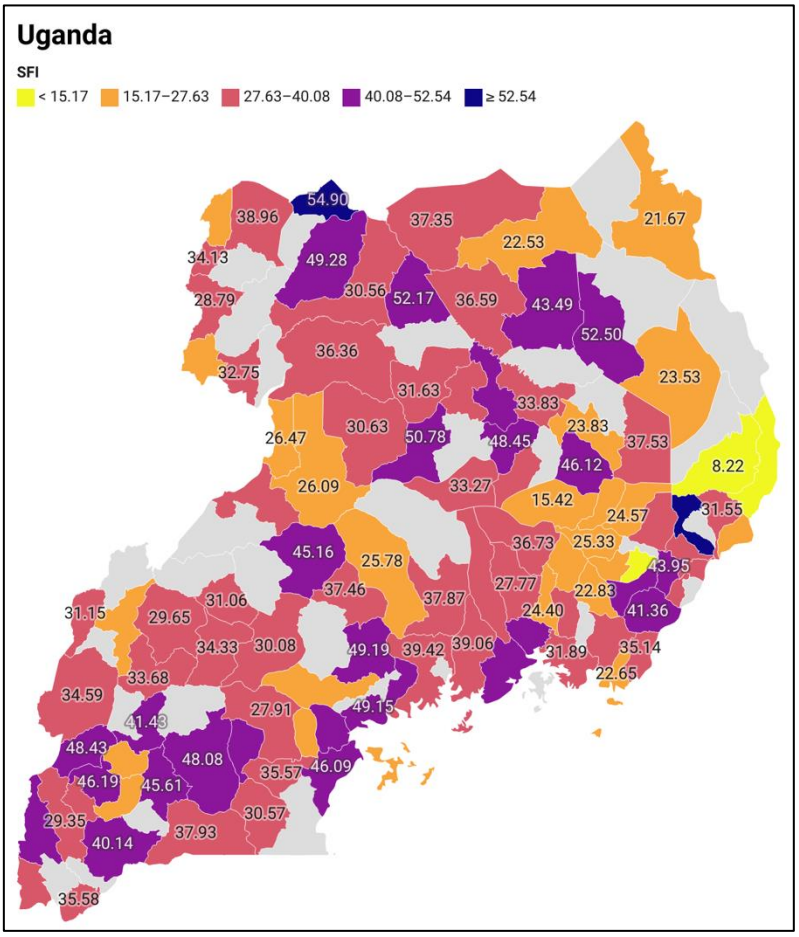


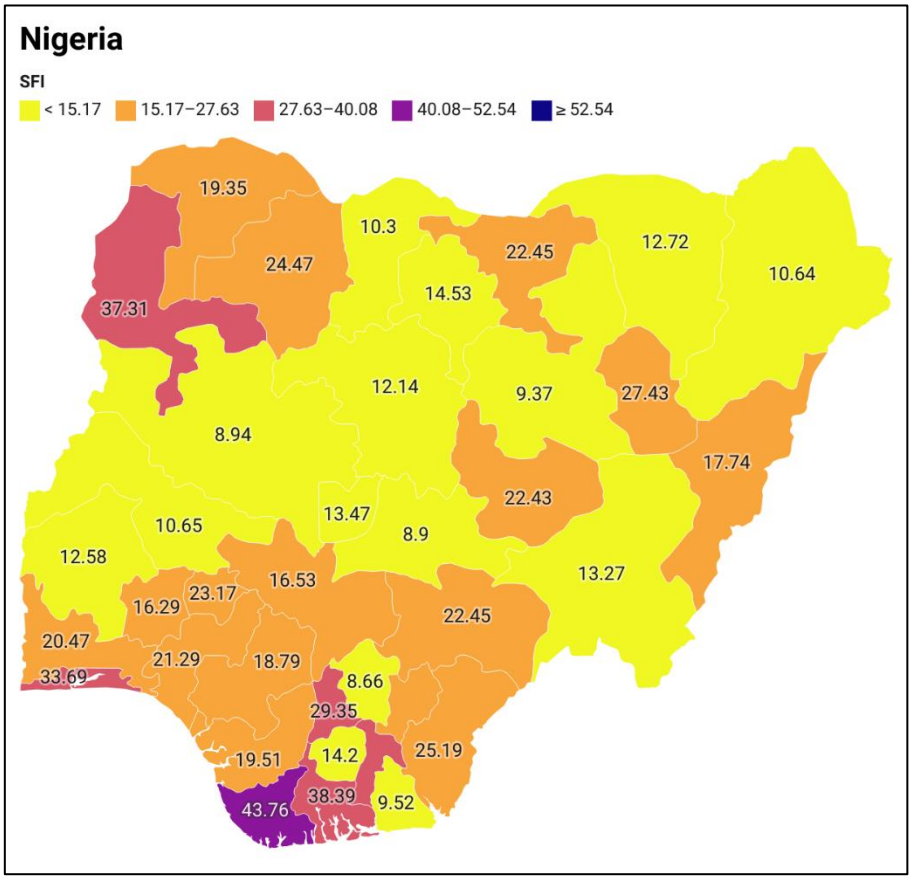
Estimating the SFI at the household level also allows aggregating Financial Inclusion scores at the regional level for 261 districts across the five countries. In Bangladesh, the SFI results show that most districts report low and intermediate levels of financial

inclusion. Of the 61 districts included in the sample, 28% are depicted in orange (SFI score between 15.17 and 27.63) and 52% in red (SFI score between 27.63 and 40.08). Extremely low levels of financial inclusion were reported only in 2 districts (yellow colour), and Nilphamari reported the highest SFI score at 56.4 (blue colour). In Tanzania, 60% of the 28 regions in the sample show low financial inclusion levels. This group had an SFI score between 15.17 and 27.63, depicted in orange. Moreover, extremely low levels of financial inclusion were found in 7 districts, depicted in yellow, with Kusini Pemba scoring the lowest at 3.77 points. Only one district scored higher than 40 points, namely Iringa, at 41.5 (purple colour). In contrast, in Uganda, the map shows more nuanced scores for financial inclusion at the regional level. Of the 103 districts included in the sample, 24% belong to the orange group, 46% to the red group, and 25% to the purple group. Extremely low SFI scores were reported only in 3 districts, with Amudat being the lowest at 8.22.

Figure 5. SFI estimation at the regional (district) level




Uganda
SFI
< 15.17
15.17–27.63
27.63–40.08
40.08–52.54
≥ 52.54
54.90
38.96
37.35
21.67
22.53
34.13
49.28
28.79
30.56
52.17
36.59
43.49
52.50
36.36
32.75
23.53
31.63
33.83
26.47
30.63
50.78
48.45
23.83
37.53
46.12
8.22
26.09
33.27
15.42
24.57
31.55
45.16
25.78
36.73
25.33
43.95
37.46
37.87
27.77
22.83
31.15
31.06
29.65
24.40
41.36
34.33
30.08
49.19
39.42
39.06
31.89
35.14
33.68
22.65
34.59
27.91
49.15
41.43
48.43
48.08
35.57
46.09
46.19
45.61
30.57
29.35
37.93
40.14
35.58


Nigeria
SFI
< 15.17
15.17–27.63
27.63–40.08
40.08–52.54
≥ 52.54
19.35
10.3
22.45
12.72
10.64
24.47
14.53
37.31
12.14
9.37
27.43
8.94
17.74
22.43
13.47
10.65
8.9
12.58
13.27
16.53
23.17
16.29
22.45
20.47
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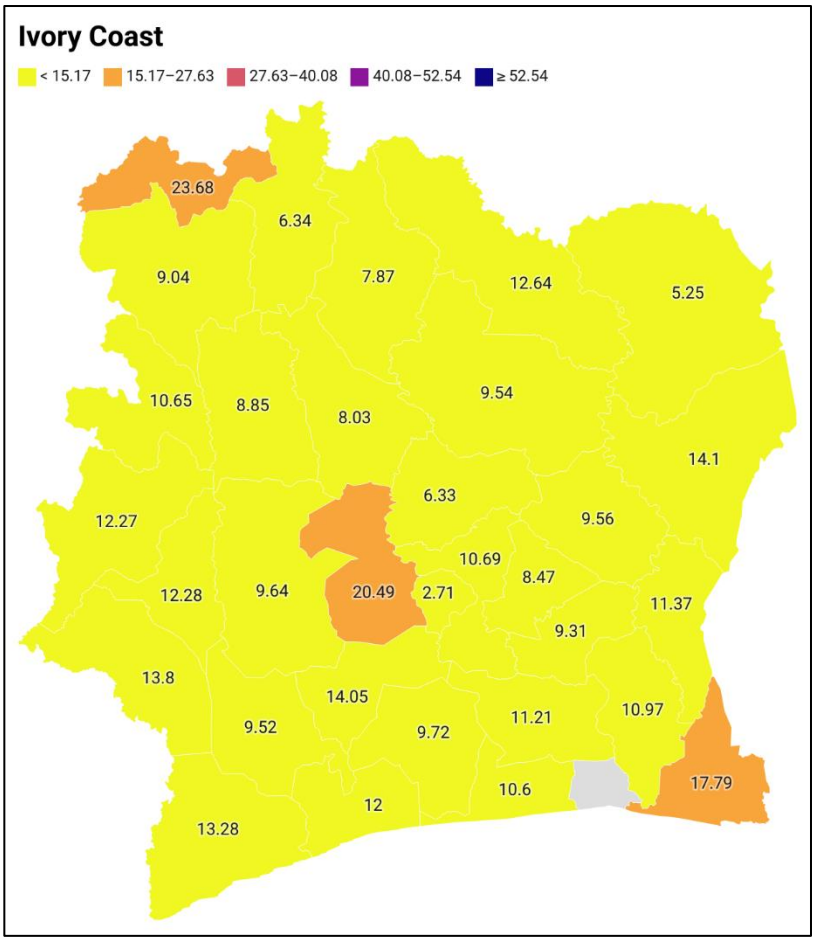
25.19
38.39
9.52
43.76



Nigeria and Ivory Coast report lower levels of financial inclusion at the regional level. In Nigeria, the least financially included (yellow) group is mostly found in the country's central area and represents 41% of the 36 states. SFI scores are higher in the South, with Bayelsa scoring the highest SFI score at 44.98. In Ivory Coast, 62% of the 31 regions show very low scores for financial inclusion. Only three regions, namely Sud-Comoé, Marahoué, and Folon are depicted in orange, indicating a score higher than 15 points.

4.4 Identifying drivers of financial inclusion

We estimated a censored regression model to understand the driving factors of financial inclusion. We considered all the observations in the dataset for the first censored regression and for the second one, only those above zero (Table 4). We include country dummy variables with Uganda as the baseline. The first model shows that Uganda displays the highest levels of financial inclusion, while in the second one, the SFI index gap between Uganda and other countries is reduced. Notably, in the

case of Nigeria, the gap is reduced to 4.5 points. Further, in this model, Bangladesh surpasses Uganda's SFI score by 2.7 points.

Table 4. Results of censored regression model for SFI

Independent variable **SFI**	**First Model** Censored regression (all values)	**Second Model** Censored regression for SFI>0
Country		
Bangladesh	-3.562**	2.670**
	(1.062)	(0.858)
Tanzania	-12.751***	-7.297***
	(1.408)	(1.177)
Nigeria	-24.821***	-4.498***
	(1.120)	(0.958)
Ivory Coast	-31.449***	-16.533***
	(1.208)	(1.034)
Sociodemographic characteristics		
Age	0.048**	0.026
	(0.020)	(0.018)
Male	1.254**	0.134
	(0.630)	(0.553)
Rural	-4.840***	-3.178***
	(0.767)	(0.698)
Education	4.966***	2.542***
	(0.449)	(0.367)
Information channels		
Mobile	12.045***	6.002***
	(0.807)	(0.746)
Financial Advice	14.867***	10.062***
	(1.645)	(1.307)
Member group	14.549***	11.110***
	(0.613)	(0.528)
Economic characteristics		
Farming	-9.260***	-4.921***
	(0.788)	(0.651)
Contract	- 1.617*	0.328
	(-0.968)	(0.851)
Production characteristics		
Land owned	- 0.031*	0.003
	(0.016)	(0.015)
Total land	0.008	-0.001
	(0.008)	(0.007)
Crops produced	0.402***	0.292***
	(0.098)	(0.084)
Staples	-1.488	-0.557
	(1.327)	(1.189)
Cons	25.234***	29.618***
	(2.034)	(1.745)
Log-likelihood	-28,640	-25,368

Note: a) The first model included 8,655 observations, and the second one 6,409. b) For the first model, coefficients were estimated using censored regression with a lower bound of 0 and an upper bound of 100. For the second model, coefficients were estimated using a lower bound of 1 and an upper bound of 100. c) Standard errors are in parentheses. *, **, and *** denote significance levels at 0.10, 0.05, and 0.01, respectively. d) We explored interaction terms between information channels, sociodemographic characteristics, and economic characteristics with coefficients that were not statistically significant.

Among the sociodemographic characteristics of the households, location (rural) and education have a significant positive association with financial inclusion. However, other characteristics such as gender (whether the household head is male) and age are only significant in the first model. Table 4 shows that information channels (mobile phone, group membership, formal financial advice) represent critical drivers of financial inclusion based on their significant positive association with financial inclusion scores and high magnitudes. Mobile phone ownership is associated with a significantly higher financial inclusion score of 12 points. Similarly, households who receive formal financial advice from banks or extension agents display, on average, 14.87 points higher in the SFI index. Finally, group or association membership is associated with an increase of 14.55 points in the index. These results change in magnitude with the second model but remain statistically significant.

Regarding production characteristics, farming as the primary economic activity has a significant negative association with financial inclusion, with a reduction of the SFI by 9.2 points in the first model and 4.9 points in the second. However, the results also show that diversity in production is related to higher SFI scores. With each additional crop the farmers grow, the SFI score increases by 0.40 points and 0.29. The remaining dependent variables selected, namely contract, land owned, total land, and staple production, show no significant associations with financial inclusion.

5. Discussion

Access to finance is an important bottleneck for smallholders' technology adoption, adaptation to climate change, and improved high-value market access (Barry & Robison, 2001). However, there are limited indicators for financial inclusion among rural agricultural households in the Global South. Appropriate indicators are crucial for understanding financially excluded groups' needs and creating targeted policies. Here, we focus on several important features of our index and the specific policy recommendations based on our case studies.

5.1 Important features of the SFI

In selecting indicators, we addressed the definition of financial inclusion: access to useful and affordable financial products and services that meet users' needs and are delivered responsibly and sustainably (World Bank, 2018b). Our index makes an

important distinction between the access and usage of finance, which is crucial for identifying true finance needs (de Koker & Jentzsch, 2013). For example, in our sample, only mobile money accounts and savings at banks reported consistency for access and usage in agricultural households. Hence, measuring both dimensions would allow policymakers to select and prioritize financial instruments with a larger impact and potential in specific contexts.

The distinction between access and usage allows policymakers to identify better areas that need extension and training related to financial services, particularly as we find evidence of high access but low usage. This is further confirmed by our exploration of drivers of financial inclusion: our results suggest that information channels such as mobile phone ownership, group membership and financial advice play the most significant role in increasing financial inclusion among smallholder farmers. Although previous literature has explored the nature of the links between farmers and advisor, the impact of advisor services tends to be associated only with their contribution to agricultural production, while their role in financial management is usually neglected (Hilkens et al., 2018). This could be attributed to the fact that in some contexts, discussing financing openly is considered taboo, and being good at financial management is not regarded as a priority by many farmers (Hilkens et al., 2018). As a result, many farmers still seek informal sources, such as relatives, friends, and co-farmers, to obtain financial advice (Elahi et al., 2018). Financial advice seems to be an inflection point for financial inclusion among smallholder farmers, but its understanding and outreach in many contexts are still limited. In our sample, only 2.8% of the households reported having access to financial advice. Hence, with the flourishing of both offline and ICT-based financing platforms for farmers, customized financial advice could play a significant role in increasing financial inclusion and potentially closing the gap between access and usage of financial products.

The second important feature of multidimensional indicators is the ability to disaggregate them. While previous measures of financial inclusion presented indicators at the national level (Amidžić et al., 2014; Anwar et al., 2017; Cámara & Tuesta, 2017; Gupte et al., 2012; Huang & Zhang, 2020; Park & Mercado Jr, 2018; Sarma, 2008; Sethi & Sethy, 2018), this index can be disaggregated to the regional and household level. This offers a tool for identifying and visualizing regions where farmers are financially excluded. It can be used to develop targeted policies specific to

their financing needs (e.g., support using mobile money accounts). We find differences between access and usage, which demonstrates a disconnect between being able to access a service (e.g., open an account) and having the skills or knowledge to harness its potential.

Notably, our index excludes access to informal sources of credit. We omit informal finance indicators because they capture a wide range of activities and do not represent a stable option. While many informal loans receive immediate approval and a flexible amount of money, the loan conditions are heterogeneous (Dalla Pellegrina, 2011) and informal lending is associated with multiple dimensions of discrimination, which is driven by social institutions such as caste, class, and location (Guérin et al., 2013). For example, in India, several studies have shown debt fragmentation among castes, with middle/upper caste lenders refusing to lend to castes considered below them. Although informal lending is a reality of finance in the Global South, we do not believe it can be characterized as financial inclusion, which should be fair, equitable, and regulated.

5.2 Policy Implications

We compare financial inclusion in five countries to demonstrate how the index can be useful for comparing indicators, households, regions, and countries. By disaggregating to the regional level, we can identify target districts within each country that are weakly linked to financial services.

Financial inclusion among smallholders in Bangladesh varies significantly by region. In low inclusion districts (depicted in yellow), like Brahmanbaria and Lakshmipur, access to financial institution accounts is notably low at 15% and 20%, with account-holders reporting zero percent usage. In districts with low-middle Social Financial Index (SFI) scores (depicted in orange), average access to accounts is higher at 52%, with a 33% reported usage. Despite these differences, mobile money access and usage patterns are similar, averaging 58% and 51% for access and 49% and 48% for usage in low and low-middle SFI districts, respectively. Policies for financial inclusion should prioritize the already high mobile money access and usage for introducing new financial products like savings and credit.

In Tanzania, 60% of smallholder farmers belong to the low-middle financial inclusion segment, with scores slightly rising in the central and southern regions. The country displays the highest access and usage rates of mobile money in the sample at 69%

and 58%, respectively. Further, Tanzania has the highest rate of female household heads in the sample at 45%; nevertheless, it also displays the lowest access to financial advice (0.5%). Thus, programs that offer a combination of mobile-based financial products with financial advice and that focus on female users could play a critical role in enhancing financial inclusion for smallholders.

The SFI results show that, similarly to Bangladesh, financial inclusion among smallholders varies significantly by district in Uganda. While the country is at the forefront of access to accounts due to recent public and private sector investments, many farmers declare not to use them. Low usage could be attributed to accounts not being suited to the specific financial needs of smallholders. Further, they are not complemented with other financial products, such as savings, credits, and loans. While the results suggest financial inclusion levels in Uganda are higher than in other regions, these results need to be treated with caution as they are mainly attributed to the high access rates for accounts. Nonetheless, attention should be given to the complementarity of different financial products and their suitability to farmers' needs.

In Nigeria, we identify significant financial inclusion discrepancies between regions near the coast and the central and northern regions. This is particularly related to limited access and usage of accounts and savings. Regions near the coast (South), such as Delta and Edo, report average access to savings at financial institutions at 0.40 and 0.56, while Kwara and Nasarawa (in the central region) report account access at 0.22 and 0.29, respectively. Further, mobile money usage is the lowest in the sample, with regions in the lower segment reporting only 9% access and 4% usage. We recommend that policymakers prioritize financial inclusion efforts in the country's central region and explore the drivers behind the low levels of mobile money adoption.

Finally, Ivory Coast shows the lowest levels of financial inclusion in the sample, which are mainly attributed to low access and usage rates of accounts and savings at financial institutions compared to other countries. The indicators of the SFI allow us to identify that this gap is 26% for accounts and 27% for savings compared to the cross-country average. Financial Inclusion scores are low even in the leading cocoa producer regions from the southwest, such as San Pedro, Cavally, and Nawa. Thus, programs could focus on closing gaps in account and savings access, particularly in the leading cocoa producer regions.

6. Conclusion

Financial inclusion is a multidimensional phenomenon and we develop an index to measure financial inclusion for smallholder farmers. To address smallholders' financial needs, it is key to assess their level of financial inclusion, identify their financing needs, and foster important drivers of financial inclusion, particularly related to financial advice and training.

In this paper, we present a conceptual contribution to understanding financial inclusion for agricultural households in the Global South. We develop a framework to capture the multidimensionality of financial inclusion at the household level by considering the access and usage dimensions and accounting for three categories of financial services: transactions and payments, savings, and credit. Furthermore, we present a methodological contribution by developing the Smallholder Financial Inclusion Index to measure financial inclusion for agricultural households. The index is based on 12 indicators that assess the access and usage of financial services particularly available to smallholders in the Global South.

Finally, our empirical contribution is twofold. First, we test the index using household data from Bangladesh, Tanzania, Uganda, Nigeria, and Ivory Coast and rank households based on financial inclusion. Further, through a censored regression model, we identify the critical drivers of financial inclusion at the household level and determine the crucial role played by information channels, such as mobile ownership, access to financial advice, and group membership. The empirical results suggest that information channels, particularly financial advice, are critical drivers for smallholders' financial inclusion.

The findings offer policymakers a tool to correctly identify financially excluded smallholders. Moreover, by measuring both the access and usage dimensions, we aim to present a more comprehensive understanding of financial inclusion at the household and regional level. In particular, this can support targeted financial training (e.g. through extension) in terms of content and target group.

7. Appendix

Table A1. List of preliminary indicators for financial inclusion

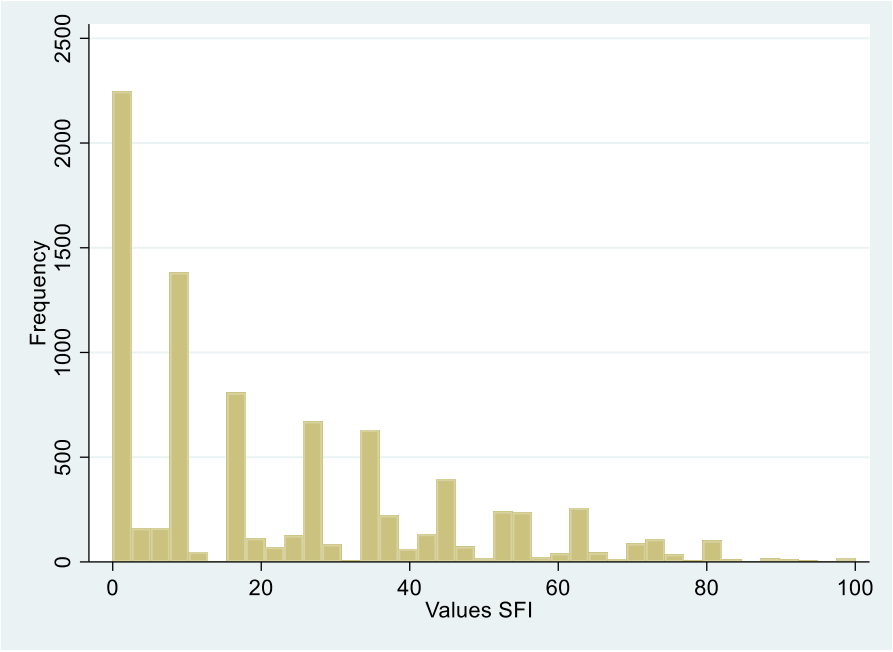
Dimension	Subdimension	Indicator	Description
Access	*Accounts/ Cards*	**Account Access**	Account at Bank, MFI, Post Office or Cooperative
		Mobile Money Account	Mobile Money Account at Registered Providers
		Formal Debit Card	(Prepaid) Debit Card Holder
	Financial Advice	**Formal Financial Advice**	Financial Advice by Bank or Extension Agent
	Savings Availability	**Formal Savings Availability**	Availability of Savings, Transfer, Insurance or Investment at Bank/MFI or Postbank
		Group Savings Availability	Savings Account via Trade Union, Cooperative or Savings and Credit Group
	Loans / Credit Availability	**Formal Loan Availability**	Availability of Loans at Bank or MFI
		Group Loan Availability	Availability of Loans via Savings and Credit Group, Cooperative or Trade Union
		Credit Availability via Group	Possibility to Buy on Credit via Group
Usage	*Formal Account Usage*	**Usage Formal Account**	Regular Financial Payments or Withdrawals or Deposits During Last 90 Days via Account at Bank, MFI or Post Office
		ATM Usage	Regular ATM Usage
		Mobile Money Usage	Last 90 Days Financial Mobile Transaction, Deposit or Withdrawal
		Formal Debit Card Usage	Regular Usage Prepaid Debit Card
	Loans / Credit usage	**Formal Loan Usage**	Loan from Financial Institution in Last 12 Months
		Usage Payment Plan for Inputs	Payment Plan Last 90 Days
	Investment Usage	**Usage Investment**	Investment Currently
	Savings Usage	**Formal Savings Usage**	Savings or Savings Plan Within Last 12 Months with Bank or MFI
		Usage Mobile Money Savings	Has Used Mobile Money Savings in Last 12 Months
		Group Savings Usage	Savings Last 12 Months with Savings and Credit Group, or Cooperative
	Western Union / Money Gram	**Western Union and Money Gram Usage**	Used Western Union or Money Gram to Send or Receive Money in Last 12 Months
	Insurance	**Usage Insurance**	Insurance Plan or Coverage in Last 12 Months

Table A2. Indicator and country-level scores for Financial Inclusion

ACCESS						
Country	**Account at FI**	**Mobile Money Account**	**Savings at bank**	**Savings at SACCOs**	**Loans**	**Credit/Payment plans**
Bangladesh	0,517	0,526	0,523	0,168	0,225	0,113
Tanzania	0,185	0,699	0,528	0,042	0,088	0,108
Uganda	0,997	0,542	0,486	0,395	0,176	0,062
Nigeria	0,332	0,088	0,476	0,059	0,058	0,086
Ivory Coast	0,139	0,462	0,150	0,084	0,042	0,060
All countries	0,400	0,460	0,416	0,138	0,113	0,085

USAGE						
Country	**Account at FI**	**Mobile Money Account**	**Savings at bank**	**Savings at SACCOs**	**Loans**	**Credit/Payment plans**
Bangladesh	0,320	0,478	0,471	0,161	0,477	0,113
Tanzania	0,135	0,593	0,500	0,040	0,165	0,081
Uganda	0,184	0,506	0,460	0,381	0,263	0,055
Nigeria	0,275	0,040	0,418	0,050	0,091	0,082
Ivory Coast	0,046	0,414	0,122	0,077	0,066	0,031
All countries	0,185	0,403	0,377	0,131	0,205	0,071

Figure A1. Distribution of the Smallholder Financial Inclusion Index (all values)



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