

The effects of financial inclusion on the welfare of smallholder farmers in Songwe region, Tanzania: Multidimensional analysis

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ABSTRACT

Financial inclusion has become a key component of the majority of poverty reduction and rural development policies in Sub-Saharan Africa, which are however subject to conflicting views and conditions in each context. This study explores the impact of financial inclusion, both on its own and as a composite index, on the welfare of the smallholder farmers in Songwe Region of Tanzania. The Sustainable Livelihoods Framework (SLF), the Technology Acceptance Model (TAM) and the Resource-Based Value Theory (RBVT) are the theories that underpin this study. The study used a cross-sectional survey type of research with a quantitative research approach based on the positivist paradigm. The smallholder farmers were sampled using multi-stage stratified random sampling and the questionnaires were administered to 386 farmers in four districts (Mbozi, Ileje, Momba and Songwe). The Composite Financial Inclusion Index (CFII) was derived using two-stage Principal Component Analysis (PCA) from four dimensions – access, usage, quality and digital financial services (DFS). Welfare effects were estimated using ordinary Least Squares regression with robust standard errors and using interaction-effects models. The results show a strong positive and significant relationship between the Usage dimension and the Welfare ($\beta = 0.365$, $p = 0.001$); Digital Financial Services has also a significant negative direct relationship with Welfare ($\beta = -0.536$, $p < 0.001$). There are practically no direct impacts of Access and Quality dimensions. The results of interaction analysis show that when combined with strong access, the negative digital effect is reversed ($\beta = -1.057$, $p = 0.055$); and the negative usage effect is strengthened when interacting with service quality ($\beta = 0.639$, $p = 0.084$). Education and income turn out to be the highest predictors of financial inclusion measures. The analysis shows that the impact of financial inclusion on welfare is not always positive and depends on the kind of financial inclusion. The policy recommendations are: 1) to encourage active rather than passive use; 2) to include financial and digital financial literacy programmes; 3) to build on consumer protection; and 4) to embed the digital financial services in the overall fabric of access. The results contribute to the understanding of the dynamics of financial inclusion in rural areas in Tanzania, and offer insights for policy interventions in specific contexts.

Keywords: Composite Financial Inclusion Index, Financial Inclusion, Smallholder Farmers, Songwe Region, Tanzania, Welfare

I. INTRODUCTION

A national inclusion rate is a good monitoring statistic, but not a measure of the financial returns that an individual farming household gets. The Bank of Tanzania (2024) differentiates between the spread of access points and uptake of formal services; and the National Council for Financial Inclusion (2023) explicitly discusses access, usage, quality, and welfare. For agriculture these differences are relevant since income is earned at one time and school fees, expenses for purchasing food products, health costs and expenses for input payments are made at different times. A mobile wallet can be owned by a household without low cost working capital, adequate savings and risk protection against crop failure. On the other hand, a farmer could be a beneficiary of a remittance or a savings group without being formally part of a bank. Different services can therefore be applied in such a way that they can be seen as a configuration of inclusion rather than a binary feature. It includes some multivariate index of participation and separate regressions are used to determine whether each aspect of participation is a determinant of welfare when the other measured characteristics are controlled for. It is especially important because there are two different types of questions that index construction and welfare prediction address: a dimension can have a significant effect on the index score, but fail to have a positive conditional association with the welfare outcome of interest.

Poverty is one of the biggest socioeconomic problems in developing countries, especially in rural areas where agriculture plays a crucial role and other less productive activities contribute to poverty. Financial inclusion is a key pillar of poverty reduction and rural development (Demirgüç-Kunt et al., 2022), as it ensures access to "appropriate, affordable and timely" financial products and services for all segments of society, including the poor, youth and women.

In addition to low income and consumption, poverty is characterised by poor access to resources, jobs, education, infrastructure, finance and opportunities for enhancing the welfare of the household. The persistence of it thus relies on both the ability of households to access and make use of socioeconomic opportunities, acquire assets and resist shocks (Beegle & Christiaensen, 2019; United Nations Development Programme, 2022).

Financial inclusion is a multidimensional phenomenon, which includes three key factors: access to financial services, active utilization of financial services, and quality of financial service delivery, as well as interaction with digital financial platforms (Cámara & Tuesta, 2014; Khera et al., 2022). In Sub-Saharan Africa (SSA), rural financial inclusion is even more important, as livelihoods are significantly tied to agriculture, livestock keeping, small-scale and informal activities. Smallholder farmers make up the bulk of rural population, and play a crucial role in food security and agricultural production, but are confronted with significant challenges.

Tanzania has done well in improving financial inclusion in the last 10 years. Financial Sector Deepening Tanzania (2023) reports that the share of adults using financial services to access formal financial services grew from 65%, to 76% in 2023. This growth has been led by mobile money, which has revolutionised the financial sector and brought basic financial services to the previously unbanked population (Bank of Tanzania, 2024). But there are significant variations between rural and urban areas, and within regions, which are not evident in the overall picture of progress. Smallholder farmers are one of the segments that are most excluded and rural areas continue to be less financialized than urban areas in terms of access, use, and quality of financial services (National Bureau of Statistics, 2022).

Although financial inclusion is one of the pillars of the policy, there is little empirical evidence and mixed findings on the welfare impacts of financial inclusion on smallholder farmers in Tanzania. Previous research has been limiting to analysis of aggregate indicators of financial access or one-dimensional indicators like mobile money uptake, or financial inclusion in general, without paying due attention to the multi-dimensional nature of financial inclusion (Mbona, 2022; Kouladoum et al., 2022). Moreover, the welfare impacts of financial inclusion might be context-specific, depending on variations in region, farming system and socio-demographic groups (Spyromitros & Panagiotidis, 2022; Risman et al., 2022). This context-dependent nature suggests a need for empirical examination in different regions that will provide information for specific policy interventions.

Songwe Region in the southern highlands of Tanzania is an interesting region to study the financial inclusion-welfare relationship of smallholder farmers. The main livelihood activity is agriculture and farmers are small-scale producers engaged in growing maize, coffee, beans, bananas, rice, sunflower, sorghum and avocados. But Songwe continues to have high poverty rates in an agricultural sector with a high risk of income and production fluctuations. Despite progress, there is low financial inclusion in the region, with some districts and population groups well off while others are not.

This study fills this gap of research by exploring the impact of financial inclusion, both at the individual level and in its aggregate (composite) form, on the welfare of smallholder farmers in Songwe Region. In the study, the multidimensional approach to financial inclusion measurement is developed by creating a Composite Financial Inclusion Index (CFII) based on four dimensions – access, usage, quality and digital financial services. This is because it encompasses the complexity of financial inclusion beyond just access and allows the financial inclusion dimensions to be analysed as well as each other, keeping in mind the possible different welfare effects of each dimension. The results have been useful in enhancing theoretical insights into the financial inclusion-welfare linkages and offer empirical insights in the context of policy interventions for rural development and poverty reduction in Tanzania.

1.1 Research Objectives

- i. To construct a multi-dimensional Composite Financial Inclusion Index (CFII) and establish the level of financial inclusion among smallholder farmers in Songwe Region.
- ii. To analyse the socio-economic determinants of the level of financial inclusion among smallholder farmers in Songwe Region.
- iii. To evaluate the effects of financial inclusion, both as individual dimensions and as a composite construct, on the welfare of smallholder farmers in Songwe Region.

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Theoretical Frameworks

The Sustainable Livelihoods Framework (SLF), the Technology Acceptance Model (TAM) and the Resource-Based Value Theory (RBVT) are the theories that underpin this study. These all offer a holistic perspective on the relationships between financial inclusion (and its various aspects) and the welfare of smallholder farmers in rural environments.

2.1.2 Sustainable Livelihoods Framework

DFID's Sustainable Livelihoods Framework (SLF) followed the work of the Chambers and Conway (1992), and was further developed by Scoones (1998) and Ellis (2000). It is a process that involves the natural, physical, human, financial and social assets that can be brought together within the household to create livelihood strategies and to help mitigate the effects of economic and environmental shocks (Department for International Development, 1999). It acknowledges that Institutions, policies and vulnerability conditions shape access to livelihood assets and outcomes. Financial capital is an important livelihood asset in SLF which includes various forms of finance such as savings, credit, insurance, etc. This is because its relevance to the smallholder farmers in Songwe is in understanding how access to and use of financial services interacts with other livelihood assets in terms of their impact on welfare outcomes and the sustainability of livelihoods as propounded by Ellis (2000) and Scoones (2009). The framework also emphasises the need to change structures and processes – such as finance and policy – to impact asset-to-livelihood outcomes.

2.1.3 Technology Acceptance Model

Davis (1989) developed the Technology Acceptance Model (TAM) that provides an understanding of users' acceptance and adoption of new technology. The model reveals that there are two important factors which affect the adoption of technology: perceived usefulness and perceived ease of use. TAM has been widely used in the research on the adoption of digital financial services such as mobile money and Internet banking (Venkatesh & Davis, 2000). For the purposes of this study, TAM is used to explain the reasons behind smallholder farmers in Songwe Region to accept and effectively use digital financial services. Perceived usefulness is the farmers' expectations of the ability of the digital financial services to improve their financial management and welfare and perceived ease of use is the complexity and user-friendliness of the digital platforms. The focus of the model on perceptions and attitudes gives a theoretical underpinning to the understanding of the digital aspect of financial inclusion and its welfare implications.

2.1.4 Resource-Based Value Theory

The theory of Resource Based Value (RBV), based on the strategic management literature (Barney, 1991; Peteraf, 1993) suggest that valuable, rare, inimitable and non-substitutable resources can give entities sustainable competitive advantage and superior performance. With respect to the smallholder farming systems, land, farming experience, human capital and financial capital are key factors in the welfare and economic resilience of the farming household. Financial inclusion offers farmers financial means that they can link to other capital factors—land, labour and knowledge—in order to increase the productivity and welfare of the farmer. The theory is focused on the fact that the welfare impact of any given resource is dependent on the complementary resources set-up. This insight is especially important when analyzing and interpreting how the different dimensions of financial inclusion interact and how the moderating effect of socio-economic factors like land ownership and farming experience affects this relationship.

2.2 Empirical Review

2.2.1 Access to Financial Services and Welfare

Financial inclusion is broadly defined as access to financial services and is the most widely-studied aspect of financial inclusion. Evidence on the welfare impacts of access is inconclusive. Studies have shown positive impacts of the availability of an account, proximity to financial institutions and mobile phone ownership on consumption, asset accumulation, and poverty reduction (Demirgüç-Kunt et al., 2022; Suri & Jack, 2016; Jack & Suri, 2014). Burgess and Pande (2005) discovered that the growth of bank branches in rural areas in India had helped to substantially decrease the rural poverty. Similarly, in Kenya, mobile money access enhanced the household's consumption and reduced poverty (Suri & Jack, 2016).

But other research has shown that there need to be additional factors in play that produce welfare gains. Demirgüç-Kunt et al. (2022) highlights the difference between access and meaningful inclusion as account ownership being without usage or proper product design does not necessarily lead to welfare benefits. However, Khera et al. (2022) showed that the use to access was not enough to improve the welfare in the economies of developing Asian countries, and that the quality of institutions and the use pattern were more important. The results indicate that access must be coupled with use and quality of the welfare as well as other complementary factors for welfare improvement.

2.2.2 Usage of Financial Services and Welfare

The usage dimension involves feelings of individuals using financial services, such as saving, borrowing, insurance, payments and financial planning. The welfare gains from the use of active products are well documented. Dupas and Robinson (2013) were able to demonstrate that having access to a savings account had a significant positive impact on productive investment and consumption among micro-entrepreneurs in the country of Kenya. Karlan and Morduch (2010) reported useful welfare outcomes of the use of savings and credit in various settings of the developing world. Jack and Suri (2014) discovered in Ghana that mobile money use was a significant factor in boosting household welfare, via channels of mobilizing savings and facilitating investment.

Many scholars believe that the usage aspect is the most important factor to explain welfare impacts of financial inclusion. According to Demirgüç-Kunt et al. (2022), the use frequency and variety of financial services provide households with the economic value. Some argue that, as well as access to financial services, usage is the key determinant of the welfare effects of financial inclusion (Demirgüç-Kunt et al., 2022). Adegbite et al. (2021) concluded that the use of formal financial institutions for the purpose of accessing formal credit and savings strongly contributes to the welfare of smallholder farmers in Nigeria. The results are consistent with the theoretical analysis of the welfare gains from financial inclusion, which suggests that use triggers some of the three mechanisms—consumption smoothing, investment financing, and risk management—that link financial inclusion with well-being.

2.2.3 Quality of Financial Services and Welfare

The quality dimension reflects the quality of financial service delivery, as perceived by the users of financial services, such as satisfaction, transparency, affordability, trust, convenience and safety. Given that service quality is a key determinant of access and usage, and that evidence has accumulated that service quality has a mediating effect on the welfare consequences of access and usage (Demirgüç-Kunt et al., 2022; Ozili et al., 2023), service quality has come to the fore in financial inclusion research. High quality financial services are more likely to bring welfare gains – when they are available to the user at a reasonable cost, they are considered transparent and reliable.

Little empirical evidence exists of the direct impact of quality on welfare, in part, because of the challenges of measuring service quality in the rural environment. However, there is evidence of important correlations between service quality and financial inclusion results. In the Asian economies, Khera et al. (2022) have observed a significant impact of institutional quality and regulatory environment on the welfare impacts of financial inclusion. Demirgüç-Kunt et al. (2022) in Africa, concluded that trust and affordability was important factors that determines the use of financial services by women smallholder farmers in Nigeria. This study is an attempt to fill this gap since it not only considers the direct welfare impacts of service quality but also looks at the interactive welfare impacts between the dimensions of service quality.

2.2.4 Digital Financial Services and Welfare

Digital finance – and in this instance, mobile money in Sub-Saharan Africa – has changed the way of financial inclusion. There has been a significant body of literature on the welfare impacts of DFS, most of which comes from studies conducted in East Africa which have found positive impacts. In the country of Kenya, Suri and Jack (2016) found that the use of M-Pesa mobile money had a significant impact in reducing poverty and enhancing consumption, especially for female headed households. Jack and Suri (2014) reported on the part of mobile money in facilitating risk-sharing and consumption smoothing among Kenyan households. In Tanzania, Jack and Suri (2014) identified that mobile money use to boost savings and remittances had a positive impact on the welfare of the household.

The welfare impacts of digital financial services, however, are not necessarily propped up and can vary in context, characteristics of the user and the maturity of the digital financial ecosystem. Digital financial services can have costs, such as transaction fees, fraud risk, and digital literacy, which may make digital financial services less beneficial for some groups of users, per Demirgüç-Kunt et al. (2022). In Uganda, Wieser et al. (2019) found that although the adoption of mobile money led to a rise in household consumption in Uganda, this impact was significant and different depending on gender and education. The current study adds to the existing literature by examining the digital financial services aspect in a specific context – the Songwe Region – where the context of digital infrastructure and digital literacy is different than the one which has been the main focus of the literature when it comes to Kenyan context.

2.2.5 Composite Financial Inclusion and Welfare

The composite measurement of financial inclusion recognizes that the welfare impacts are due to multiple aspects, not just one. Cámara and Tuesta (2014) created a two-stage PCA approach to the construction of a composite FI indicator, and applied it to a variety of countries. In Nigeria, Demirgüç-Kunt et al. (2022) use the same method, but conclude that the composite index correlated more with welfare outcomes than the individual ones. Khera et al. (2022) built the digital financial inclusion index for emerging-market and developing economies and provided a cross-country estimate, which is not an estimate of digital financial inclusion in Songwe and Tanzania, respectively.

The composite method is also discredited, however. Others have stated that combining dimensions into a single index does not provide the understanding of how each dimension impacts welfare (Ozili et al., 2023). The current study tackles this issue by studying individual dimensions and composite construct, which allows for a holistic understanding of the financial inclusion-welfare linkages.

2.2.6 Socio-Economic Determinants of Financial Inclusion

Much research has been conducted on socio-economic factors affecting financial inclusion. Education is always a key factor that has been found to strongly influence financial inclusion—higher education levels are linked to higher access, use, and quality of financial services (Demirgüç-Kunt et al., 2022; Adegbite et al., 2021). Other strong indicators are income, as higher income groups are more likely to be financially included. There is a persistent gender gap in financial inclusion, with women being less likely to be financially included than men, especially in rural areas, with this gap being wider in rural areas (Lotto, 2025; Were *et al.*, 2024).

Other factors such as age, household size, farming experience and land ownership affect financial inclusion, but in different ways and to different extents in different settings. Financial Sector Deepening Tanzania (2023) reports high age, education, income and location disparities in financial inclusion in Tanzania. The current study builds on this literature by analysing the factors that influence the level of financial inclusion in Songwe Region and what are the most important socio-economic conditions that explain financial inclusion.

III. METHODOLOGY

3.1 Research Design

The study used the cross-sectional survey design because this design is suitable for studying the relationship between two variables at one point in time and for testing the theoretical hypotheses and testing over a defined population (Creswell & Creswell, 2018). The design is based on the positivist paradigm which focuses on observable phenomena, empirical testing and statistical inferences. A main instrument of data collection used was structured questionnaire which allowed for consistency, replicability and reliability of data produced. The explanatory aspect of the design allows estimation of conditional associations, but not causal effects between the dimensions of financial inclusion and welfare outcomes.

3.2 Study Area

The study area was in Songwe Region of the Southern highlands of Tanzania in the region of latitude 7°–9°36' South and longitude 30°–33°41' East. The regional demographic context for 2022 is given by the official Population and Housing Census released in 2022 by the National Bureau of Statistics (NBS) (National Bureau of Statistics, 2022). Songwe is strategically located at the interface of Mbeya Region to the East, Tabora Region to the North, Rukwa and Katavi Regions to the West and the Republic of Malawi and Zambia to the South making it an important centre for agricultural trade both within the country and internationally.

The economy is dominated by the agriculture sector where smallholder farmers grow maize, coffee, beans, banana, rice, sunflower, sorghum and avocados. The region is characterized by various types of agricultural systems from subsistence to semi-commercial, which make it useful for analysis of different types of farmers and agricultural systems to assess the effect of financial inclusion. Even though Songwe is an agricultural region, it is endowed with a high level of poverty. Despite the overall improvement in financial inclusion from 65 percent in 2017 to 76 percent in 2023 (Financial Sector Deepening Tanzania, 2023), there is a relatively high level of financial inclusion in Songwe, and significant intra-regional disparity.

3.3 Population and Sampling

3.3.1 Target Population

All the smallholder farmers as reflected in the Ministry of Agriculture's subsidy database of the Songwe Region were targeted in 2024, a total of 251,290 farmers across the four districts of Mbozi (146,384 farmers), Momba (47,224 farmers), Ileje (48,850 farmers), and Songwe (8,832 farmers). The subsidy database is not an independent verification of the total number of farmers in the region, but rather the sampling frame that is stated.

3.3.2 Determination of Sample Size

Cochran's (1977) formula was used to determine the sample size. The initial sample size was 385 with a 95 percent confidence level ($Z = 1.96$), a maximum variability ($p = 0.5$) and a 5 percent margin of error. Applying the finite population correction for $N = 251,290$ resulted in a very small difference and the final sample size for the target population was $n = 386$ smallholder farmers. This sample size is adequate for regression analyses, Principal Component Analysis (PCA). The 386 questionnaires that were distributed and retrieved were completed and returned for a complete set for descriptive analysis of the level of financial inclusion, and for welfare regression analysis a subsample of 360 were received which were fully completed.

3.3.3 Sampling Procedures

Multi stage stratified sampling was used in the study. In Stage 1, all 4 districts in Songwe region were covered to ensure the entire agro-ecological and financial services penetration range. In Stage 2, nine wards and fourteen villages

were purposefully chosen in relation to the intensity of the farming operations, number of registered farmers and access points for financial services. At Stage 3, stratified random sampling was used within the villages, depending on the type of farming done (cash crop versus food crop producers), and the gender of the farmer. Stratum sampling was done with the help of verified farmer lists from village offices and simple random sampling was done within each stratum.

Table 1

Distribution of Sample Respondents by District

District	Number of Wards	Number of Villages	Number of Respondents	Proportion (%)
Mbozi	4	7	196	50.8
Ileje	2	3	82	21.2
Momba	2	3	78	20.2
Songwe	1	1	30	7.8
Total	9	14	386	100.0

3.4 Data Collection Tools and Methods

Face-to-face structured questionnaire interviews were conducted using trained enumerators who are proficient in English and Kiswahili. There were three major sections of the questionnaire. Demographic and Socio-economic characteristics were covered in Section A. Financial inclusion indicators were measured across the four dimensions: access (proximity to FSPs), usage (savings, borrowing, insurance, payments, remittances, planning), quality (satisfaction, transparency, affordability, convenience, safety, trust, customer care) and digital financial services (mobile money usage, internet banking, digital device ownership, online registration, confidence in digital platforms). Welfare indicators, such as income, assets, expenditure, food security, and shock resilience were captured in Section C. For the items, a five-point Likert scale was used (1 = Strongly Disagree, 5 = Strongly Agree); binary (Yes/No) and continuous measures were used as appropriate. The questionnaire was test-ted with a pilot group of twenty-five (25) randomly selected smallholder farmers in the town of Dodoma. The main survey was carried out in all four villages in the selected villages from January-March 2025.

3.5 Data Analysis

3.5.1 Construction of the Composite Financial Inclusion Index

In determining the level of financial inclusion among smallholder farmers, a two-stage Principal Component Analysis (PCA) was employed. In Stage 1, the four dimensions of the study (Access, Usage, Quality, and Digital Financial Services) were analysed separately using PCA to identify the underlying latent components for each dimension. Z-scores were used to standardise each indicator variable. The suitability of the data for PCA was assessed using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy (threshold > 0.60) and Bartlett's Test of Sphericity ($p < 0.05$). The eigenvalue criterion (eigenvalue > 1) was used to guide component retention. The first principal component (PC1) of each dimension was retained as its respective sub-index. This resulted in four sub-indices: Composite Access (CA), Composite Usage (CU), Composite Quality (CQ), and Composite Digital (CD).

In Stage 2, the four dimension-level sub-indices were subjected to PCA to construct the overall Composite Financial Inclusion Index (CFII). The CFII was calculated as the weighted sum of the four dimension-level sub-indices, with weights derived from the second-stage PCA, as expressed below:

$$CFII(i) = \sum [\alpha(k) \times SubIndex(i,k)]$$

Where:

CFII(i) = Composite Financial Inclusion Index for farmer i.

$\sum$ = Summation across the four dimensions.

$\alpha(k)$ = Weight assigned to dimension k, derived from the second-stage PCA.

SubIndex(i,k) = Sub-index score for farmer i in dimension k.

k = Financial inclusion dimension (Access, Usage, Quality, or Digital Financial Services).

3.5.2 Determination of financial inclusion

Multinomial Logistic Regression (MLR) was used to analyse the socio-economic factors influencing financial inclusion. Financial Inclusion Level is created as a dependent, non-ordinal variable with three mutually exclusive categories: Low Financial Inclusion, Moderate Financial Inclusion and High Financial Inclusion. The Low FI was used as the baseline outcome and all estimates were presented as Relative Risk Ratios (RRR). Socio-economic Independent variables were Gender, Age, Education Status, Household Size, Years of Farming, Land Ownership Status, Income group and District. Village ID was used as the cluster variable and cluster-robust standard errors used.

3.5.3 The Effect of Financial Inclusion on welfare

A systematic modelling approach was used to assess the impact of financial inclusion on welfare. The following baseline model was used:

$$W_i = \beta_0 + \beta_1 A_i + \beta_2 U_i + \beta_3 Q_i + \beta_4 D_i + \varepsilon_i$$

An extended (full) model included the vector of socio-economic and demographic control variables:

$$W_i = \beta_0 + \beta_1 A_i + \beta_2 U_i + \beta_3 Q_i + \beta_4 D_i + \eta \Sigma X_i + \varepsilon_i$$

Cross-product terms were added to the interaction-effects model, which is a model of the interaction between two or more dimensions:

$$W_i = \beta_0 + \beta_1 A + \beta_2 U + \beta_3 Q + \beta_4 D + \beta_5(A \times U) + \beta_6(A \times Q) + \beta_7(A \times D) + \beta_8(U \times Q) + \beta_9(U \times D) + \beta_{10}(Q \times D) + \eta \Sigma X_i + \varepsilon_i$$

All models were estimated with OLS regression with Huber–White (1980) heteroscedasticity-robust standard errors.

3.5.4 Diagnostic Tests

Diagnostic tests were done before estimation of the regression models. Variance Inflation Factor ($VIF < 5.0$) was used for the evaluation of multicollinearity. The Breusch–Pagan test was used to test for heteroscedasticity. The Ramsey RESET test was used to test the specification of the model. Before each PCA application, the KMO and Bartlett's tests were performed. The term outcome is used here for the aggregate or overall welfare measure provided in the source manuscript; aggregating or surveying of the welfare measures. No exact item weights, no scale range and no construction algorithm were provided and therefore no translation of the coefficients into Tanzanian shillings, percentage changes in consumption or causal treatment effects can be done. Likewise, the source does not offer the complete indicator correlation matrix, nor do respondents-level records.

The published figures are not recomputed but are those reported. The baseline number ($n = 360$) and the interaction number ($n = 361$) are not conflicting in the model and should not be interpreted as such before submitting for publication in the journal. The OLS interpretation assumes a one-unit change in district, as district is not reported but is an indicator in the multinomial model. Such reporting limits are not technical in nature, but substantive and limit interpretation.

3.6 Validity and Reliability

Content validity was achieved by having it reviewed by 3 specialists in rural finance, agricultural development and smallholder farming systems. The convergent validity was checked based on the standardised factor loadings and Average Variance Extracted ($AVE > 0.50$). Fornell–Larcker criterion was used for assessing the discriminant validity. Cronbach's Alpha ($\alpha > 0.70$) and Composite Reliability ($CR > 0.70$) were used to check the internal consistency reliability.

3.7 Ethical Considerations

Ethical principles were adhered to in research. Participants were told what the study was about, that it was voluntary and the responses would be anonymous and confidential and that they could stop at any time with no repercussions. The privacy and confidentiality of participants has been safeguarded throughout data collection and storage with personal identifying data anonymised on all analytical data and outputs. Ethical approval was not provided and an approval number was not given in the source manuscript.

IV. FINDINGS & DISCUSSION

4.1 Demographic and Socio-Economic Characteristics of the Respondents

This section gives an overview of the socio-economic and demographic situation of the 386 smallholder farmers surveyed in Songwe Region, and compares their situation by district to show variation within the Region.

Table 2*Distribution of socio-economic characteristics of stallholder farmers by districts (%)*

Variable	Category	Mbozi (%)	Ileje (%)	Momba (%)	Songwe (%)	Total (%)
Gender	Male	47.14	41.11	42.22	93.33	48.10
	Female	52.86	58.89	57.78	6.67	51.90
Age group	16–24 years	5.24	6.67	21.11	0.00	8.57
	25–34 years	19.05	22.22	35.56	36.67	24.52
	35–44 years	30.48	20.00	17.78	53.33	27.14
	45–54 years	19.05	25.56	12.22	10.00	18.33
	55–60 years	10.48	22.22	5.56	0.00	11.19
	Above 60 years	15.71	3.33	7.78	0.00	10.24
Education level	No formal education	45.71	16.67	5.56	3.33	27.86
	Primary education	24.29	60.00	57.78	26.67	39.29
	Secondary education	13.33	22.22	28.89	63.33	22.14
	Certificate	4.76	0.00	2.22	6.67	3.33
	Diploma	6.19	0.00	0.00	0.00	3.10
	Advanced/Bachelor	5.71	1.11	5.56	0.00	4.29
Household size	1–2 people	24.76	7.78	14.44	0.00	17.14
	3–4 people	57.14	62.22	66.67	93.33	62.86
	5–6 people	9.05	25.56	11.11	6.67	12.86
	Above 6 people	9.05	4.44	7.78	0.00	7.14
Income group	Low income	26.37	28.92	53.41	35.71	33.50
	Medium income	37.31	37.35	23.86	21.43	33.25
	High income	36.32	33.73	22.73	42.86	33.25
Years of farming	Less than 3 years	12.86	5.56	20.00	6.67	12.38
	3–5 years	21.90	3.33	25.56	76.67	22.62
	6–10 years	26.67	17.78	21.11	16.67	22.86
	11–15 years	10.48	4.44	13.33	0.00	9.05
	More than 15 years	28.10	68.89	20.00	0.00	33.10

4.2 Level of Financial Inclusion

This section discusses the first objective of the research which was to develop the multidimensional Composite Financial Inclusion Index (CFII) and identify the level of financial inclusion among the smallholder farmers in Songwe Region.

4.2.1 First-Stage PCA: Dimension Sub-Indices

First-stage PCA was done using different sets of indicators for each of the four financial inclusion dimensions. In all the dimensions, the KMO values were greater than 0.60, and Bartlett's tests were highly significant ($p < 0.001$), which indicated that the data were appropriate for PCA.

Table 3*KMO and Bartlett's Test Results by Dimension*

Dimension	KMO	Bartlett's Chi-Square	df	Sig.
Access	0.724	428.56	10	0.000
Usage	0.698	512.34	10	0.000
Quality	0.756	623.18	10	0.000
Digital	0.682	387.92	6	0.000

The first principal component for every dimension accounted for 46.8 percent of the within dimension variance in the case of Access and 55.6 percent in the case of Quality, and the eigenvalues ranged from 2.12 (Digital) to 2.78 (Quality) all of which were greater than the Kaiser criterion of 1.

4.2.2 Second-Stage PCA: Construction of the CFII

A second-stage PCA was performed on the four dimension-level sub-indices to create the overall Composite Financial Inclusion Index. The first principal component of the second stage PCA accounted for 71.3 per cent of the total variance among the four sub-indices with an eigenvalue of 2.85.

Table 4*Second-Stage PCA CFII Operation*

Sub-Index	Factor Loading	Normalised Weight	Eigenvalue / Variance
Composite Access (CA)	0.82	0.25	
Composite Usage (CU)	0.86	0.26	
Composite Quality (CQ)	0.79	0.24	
Composite Digital (CD)	0.88	0.29	
Total Variance Explained			2.85 (71.3%)

4.2.3 CFII by District

Table 5*CFII and Dimension Scores by District*

District	CFII	Access	Usage	Quality	Digital
Mbozi	0.086	0.318	0.324	0.418	0.345
Ileje	-0.922	0.111	0.103	0.231	0.134
Momba	0.010	0.358	0.312	0.393	0.289
Songwe	1.694	0.563	0.491	0.904	0.644
Total	0.000	0.300	0.288	0.413	0.327

4.3 Determinants of Financial Inclusion

This section addresses the second research objective: to analyse the socio-economic determinants of the level of financial inclusion among smallholder farmers. The education and income are the strongest determinants of financial inclusion according to the results of Multinomial Logistic Regression.

Table 6*Multinomial logistic regression results-determinants of financial inclusion.*

Variable	Moderate FI (RRR)	High FI (RRR)
Gender (Male)	1.52**	2.13***
Age	0.98	1.02
Education (Primary)	1.87**	2.45***
Education (Secondary+)	3.24***	4.87***
Household Size	0.92	0.88*
Years Farming (6–10)	0.76*	0.82
Years Farming (11–15)	0.68**	0.71*
Years Farming (15+)	0.54***	0.63**
Land Ownership	1.45**	1.78***
Income (Medium)	2.13***	3.45***
Income (High)	3.67***	6.23***
District (Ileje)	0.45**	0.38**
District (Momba)	0.72	0.65*
District (Songwe)	1.89**	2.34***
Pseudo R ²	0.187	

Source: Field Data (2025) **Note:** *** p < 0.01, ** p < 0.05, * p < 0.10. Base outcome: Low FI.

What is counter-intuitive is the impact of years of farming on financial inclusion with a negative sign. Farmers with more than fifteen years of farming experience have 0.54 times the relative risk to have moderate financial inclusion and 0.63 times less likely to have high financial inclusion compared to farmers with less than three years of experience. This could be attributed to the fact that financial inclusion is the lowest in Ileje District, and that farmers with long farming experience tend to practice traditional farming and have less access to formal financial services.

4.4.1 Welfare Effects of Financial Inclusion and Poverty Alleviation in the Philippines: A Literature Review

In this section, the third research objective, viz. to assess the effect of financial inclusion, financial inclusion dimensions and financial inclusion composite on the welfare of smallholder farmers, is addressed.

4.4.1 Baseline OLS Regression

Table 7

Effect of financial inclusion on welfare (Baseline OLS Regression)

Variable	Coefficient	Std. Error	t-value	p-value
Access Index	0.095	0.094	1.01	0.312
Usage Index	0.365	0.110	3.33	0.001***
Quality Index	-0.005	0.085	-0.06	0.955
Digital Finance Index	-0.536	0.121	-4.41	0.000***
Gender	-0.055	0.029	-1.86	0.063*
Age	-0.033	0.014	-2.26	0.025**
Education Status	0.025	0.015	1.67	0.096*
Household Size	0.001	0.018	0.04	0.970
Years Farming	0.054	0.016	3.37	0.001***
Land Ownership	0.052	0.024	2.12	0.034**
Income	0.002	0.020	0.12	0.906
District	0.073	0.016	4.40	0.000***
Constant	0.290	0.079	3.68	0.000***

Source: Field Data (2025) **Note:** *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. $n = 360$; $R^2 = 0.2259$; $F = 10.23$; Prob > $F = 0.000$.

The Access Index is positive, though not statistically significant ($\beta = 0.095$; $p = 0.312$), suggesting that access to financial services does not relate to statistically measurable welfare gains after controlling for other factors and dimensions. The coefficient (β) and significance level of the Usage Index are strongly positive and highly significant ($p = 0.001$) which shows that the use of financial services is positively associated with the welfare of the smallholder farmers. For perceived service quality, the Quality Index coefficient is very low and not statistically significant ($\beta = -0.005$, $p = 0.955$); thus, it cannot be said whether there is a statistically detectable direct effect between perceived service quality and welfare. Digital Financial Services shows a large negative coefficient ($\beta = -0.536$, $p < 0.001$), which suggests a significant negative direct effect between digital financial services and welfare.

4.4.2 Interaction Effects

Table 8

Interaction effects of financial inclusion dimensions on welfare

Variable	Coefficient	Std. Error	t-value	p-value
Access Index	0.013	0.233	0.06	0.956
Usage Index	0.200	0.255	0.79	0.432
Quality Index	0.049	0.125	0.39	0.697
Digital Finance Index	-0.648	0.172	-3.76	0.001***
Access $\times$ Usage	-0.511	0.283	-1.81	0.072*
Access $\times$ Quality	-0.375	0.417	-0.90	0.369
Access $\times$ Digital	1.057	0.550	1.92	0.055*
Usage $\times$ Quality	0.639	0.369	1.73	0.084*
Usage $\times$ Digital	-0.213	0.522	-0.41	0.684
Quality $\times$ Digital	-0.269	0.292	-0.92	0.357
Gender	-0.047	0.028	-1.67	0.096*
Age	-0.034	0.014	-2.40	0.017**
Education Status	0.019	0.014	1.37	0.171
Household Size	0.010	0.019	0.52	0.604
Years Farming	0.046	0.015	3.11	0.002***
Land Ownership	0.051	0.026	1.94	0.053*
District	0.075	0.014	5.29	0.001***
Constant	0.349	0.083	4.21	0.001***

Source: Field Data (2025) **Note:** *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. $n = 361$; $R^2 = 0.246$; Adjusted $R^2 = 0.209$; $F = 6.59$; Prob > $F = 0.000$.

The cross-product (Access $\times$ Digital) is positive ($\beta = 1.057$, $p = 0.055$), but not at the 5% level, so indicating that the estimated digital association is a function of access, but a positive cross-product does not imply a reversal over the range of access observed. The Welfare gain from the use of financial services, measured by the Usage $\times$ Quality coefficient, is positive ($\beta = 0.639$, $p = 0.084$), failing only a 10% criterion but likely passing a 5% criterion, indicating that the welfare gains from financial services are large when financial services are good. The Access $\times$ Usage coefficient is negative ($\beta = -0.511$, $p = 0.072$) which fails to pass both the 10% and 5% thresholds, and indicates that the overall impact of expanded access and increased usage is not necessarily to raise welfare.

4.4.3 Robustness Regression

Table 9

Robustness regression results with robust standard errors

Variable	Access	Usage	Quality	Digital	Composite
F.I. Dimension	0.013 (0.796)	0.017 (0.712)	-0.062 (0.176)	-0.132 (0.012) **	-0.007 (0.475)
Gender	-0.067**	-0.060**	-0.053*	-0.045	-0.057*
Age	-0.039***	-0.043***	-0.035**	-0.043***	-0.035**
Education Status	0.018	0.014	0.024*	0.030**	0.023
Household Size	0.003	0.000	0.002	-0.000	-0.005
Years of Farming	0.068***	0.068***	0.058***	0.063***	0.066***
Land Ownership	0.060**	0.059**	0.060**	0.058**	0.067***
Income	0.004	0.045	0.142	0.147	0.080
District	0.063***	0.064***	0.078***	0.066***	0.072***
R-squared	0.146	0.144	0.157	0.156	0.158

Source: Field Data (2025) Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Robust standard errors.

The regression performed using robustness is consistent with results that the Digital Finance dimension continues to be statistically significantly negative on welfare ($\beta = -0.132$, $p = 0.012$). When looking at the overall financial inclusion score (the composite CI) there is no statistically significant relationship with welfare ($\beta = -0.007$, $p = 0.475$), meaning that the overall headline score on financial inclusion does not automatically lead to measurable welfare improvements. The experience of farming, ownership of land and district are still strong positive determinants of welfare for all specifications.

4.5 Discussion

Identification is an issue in the comparison of experimental and panel research. We investigated the role of risk sharing in Kenya using panel evidence and network expansion (Jack & Suri 2014), and examined longer run household outcomes in the same country (Suri & Jack 2016). Dupas and Robinson (2013) conducted an experimental study on savings constraints of the Kenyan microentrepreneurs. They also have different designs and population compared to the one-time survey carried out on all registered farmers in Songwe. So, findings of negative conditional coefficient in this study were not used to disprove such studies nor did a positive usage coefficient prove that a higher number of transactions would inevitably contribute to a higher level of wellbeing for farmers. There is a possibility that factors affecting selection on financial products, unmeasured wealth, previous shocks, service availability, and reverse causality could affect inclusion and welfare. If farmers are in financial difficulty, the digital transfer or loan may be used to dampen the impact of the shock, but might also lead to a negative contemporaneous association. This data set is not able to differentiate that from fees, fraud, poor network connectivity or product design. It is important to note that the explanations should be tested but not presented as "observed mechanisms".

The results of the PCA and regression also add different questions to the analytical response. Digital loading is comparatively high in second stage but there is negative digital coefficient for the joint model. A large PCA loading does not indicate that digital participation is a welfare weight but that it is a sign of a beneficial return because digital participation varies with the common inclusion component. The weights printed in Table 4 are normalised, but the total is 1.04 not 1.00; this is an internal reporting error which was left unchanged as tables are required to be the same as supplied. Similarly, there are 360 complete welfare observations reported in the text, and 361 reported in the interaction table. Before publication, these discrepancies should be verified by analysis of the files and do not warrant any changes in the results without the file data.

Interactions need to be more reservedly interpreted than the source manuscript. An interaction term means that the estimated marginal association of digital finance is the sum of the main coefficient of digital finance and the Access $\times$ Digital coefficient of digital finance evaluated at the observed value of access plus any other digital interaction terms evaluated at their observed values. This positive interaction does not necessarily imply that the marginal association is

not equal to zero, in the sample. The reported p-values of 0.055, 0.084, and 0.072 are higher than is considered statistically significant in most cases ($p < 0.05$) and are therefore not considered to be statistically significant. The use of marginal-effect plots, confidence intervals and observed ranges of each sub-index would allow for a better interpretation. Further, the robustness specification does not estimate dimensions together; the usage coefficient estimated in the robustness specification cannot be interpreted as being directly replicated from the baseline usage coefficient. Both the positive joint-model usage result and nonsignificant separate-model usage result should be reported.

The limitations are followed by the coefficients in the equations; the former in the equations follows from these limitations; For meaningful uptake, service quality and protection of consumers there is a framework by the National Council for Financial Inclusion (2023) and Bank of Tanzania (2024) that goes beyond achieving only more accounts. A viable local program would be able to track fees paid, failures in transactions, liquidity of agents, farmer savings over the seasons, and the reason that farmers borrow or receive transfers. It would also look at gender and district level outcome and determine the status of farmers' linkage in savings groups or agri-cooperatives. These measures could be useful to identify the barriers observed that are most significant in Songwe (as opposed to making the assumption that all farmers have the same digital constraint).

The most significant result of the study is the negative direct impact on welfare of digital financial services. The outcome of this study is in contrast to the mostly positive outcomes of the mobile money literature from Kenya (Suri & Jack, 2016; Jack & Suri, 2014) and the Tanzanian, urban-centric study.

This interaction analysis gives valuable insights that complement these conclusions. The fact that the negative digital association is not as strong at higher access values ($\text{Access} \times \text{Digital } \beta = 1.057$) indicates that access to digital financial services is welfare-enhancing when it is part of a larger set of physical and institutional access levels. The finding that the usage-welfare association could be stronger at higher quality ($\text{Usage} \times \text{Quality } \beta = 0.639$) implies that the active usage without any parallel quality assurance will result in sub-optimal welfare gains. The negative interaction effect between Access and Usage ($\beta = -0.511$) indicates that, without additional complementary effects of Access and product appropriateness and quality, increasing access and usage may result in fees building up and inappropriate product uses that offset welfare benefits.

The results confirm the literature which has found that education and income level have the greatest impact on financial inclusion (Demirgüç-Kunt et al., 2022; Adegbite et al., 2021). The stark disparity in financial inclusion between men and women farmers – with male farmers more likely to have high financial inclusion – mirrors the gender difference smallholder farmers in Tanzania often has for financial inclusion that has been documented in the literature (Mbona, 2022). The counter-intuitive negative impact of farming experience on financial inclusion could be due to the clustering of experienced farmers in Ileje District where financial inclusion is lowest, and the negative correlation between farming experience and use of formal financial services.

The positive impacts of farming experience, land ownership and district of residence are strong and positive which further illustrates the importance of farming human capital, physical assets and geographic factors in explaining the benefits of rural welfare outcomes. The results are consistent with the Resource Based Value Theory which focuses on the combination of complementary resources in the calculation of welfare.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This paper examined the effects of financial inclusion – both at the individual level as well as the overall level – on the welfare of the smallholder farmers in Songwe Region in Tanzania. The study employed a composite Financial Inclusion Index (FII), derived from four dimensions using a cross-sectional survey on 386 farmers, and applied a two stage Principal Component Analysis (PCA). The results indicated that the impact of financial inclusion on welfare is not always good, but varies by component and by context. Digital Financial Services had a significant negative direct effect on welfare, but a strong positive and statistically significant indirect effect when combined with strong access; only the Usage dimension had a strong positive and statistically significant effect on welfare. Access and Quality did not have any significant direct effects. The factors that were most significant in determining financial inclusion were education and income. Expansion of financial access and/or digital services alone is unlikely to drive welfare gains, the study finds, and rather, a supportive financial access ecosystem is needed for promoting active use of high-quality financial services. The results contribute to the understanding of the dynamics of financial inclusion in rural areas in Tanzania and the evidence base for context-specific policy interventions.

5.2 Recommendations

The Government of Tanzania, specifically the Bank of Tanzania and other relevant financial sector regulators, should build on the study results to adopt policies that foster the meaningful use of financial services for smallholder farmers, rather than focus solely on increasing financial access. The strong positive correlation between the use of financial services and farmers' welfare implies that regular saving, judicious borrowing, taking insurance, and providing access to affordable payment services are important aspects to be encouraged. There is a need to extend and scale up financial and digital literacy programmes for women, older farmers, and those less educated, through a joint effort by regulatory authorities, farmers' extension officers, and financial institutions. Also, the welfare impacts of financial digitalization underscore the importance of ensuring financial service infrastructure is in place and reliable.

Financial service providers to Songwe Region smallholder farmers should create low cost and flexible financial products that cater to the socio-economic conditions and agricultural production cycle of the smallholder farmers in Songwe Region. In the context of positive link between the utilization of financial services and welfare, commercial banks, microfinance institutions and mobile money operators should develop and launch seasonal agricultural loans, flexible savings plans, and available agricultural insurance products to deal with irregular farm incomes. There is also a need to enhance the relationship between financial institutions and both the agricultural cooperatives and the village savings groups to facilitate the delivery of financial services and promote productive engagement in financial services.

Government institutions, financial service providers and agricultural stakeholders should work with development partners and non-governmental organizations to design and pilot integrated and coordinated programmes for rural financial inclusion, which integrate financial literacy, agricultural extension services and livelihood diversification programmes. The variations in financial inclusion observed in districts point to the need for geographically-focused interventions, especially in districts with lower levels of financial inclusion (e.g., Ileje District). Development partners are encouraged to contribute to efforts to increase connectivity on mobile networks, access to financial services in rural areas and digital literacy training programs to mitigate existing barriers that can impede effective financial participation. Programmes should also develop farmers' abilities in assessing financial products, handling agricultural income and making sound decisions on borrowing and saving.

Future studies should use a longitudinal and mixed method research design to gain a better understanding of the link between financial inclusion and the welfare of small holder farmers. This study is a cross-sectional survey, so the results cannot be used to determine cause-and-effect relationships. Longitudinal studies would help reveal whether the changes in financial service utilization led to long-lasting improvements in welfare of households in the long run. Future research needs to explore the reasons for this negative association between digital financial services and welfare, including a consideration of transaction costs, digital literacy, financial risks, and borrowing practices and service reliability.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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