WIDER Working Paper 2023/141

Financial inclusion and nutrition among rural households in Rwanda

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December 2023

United Nations University World Institute for Development Economics Research

wider.unu.edu

Abstract: We investigate if financial inclusion leads to improved nutrition in rural Rwanda, using Rwandan Integrated Household Living Conditions surveys (2013/14 and 2016/17). Our empirical evidence shows a robust positive impact of financial inclusion efforts undertaken by formal financial institutions, though informal institutions such as tontines are ineffective in improving food expenditure or nutrition. Furthermore, the study reveals heterogeneous marginal effects of financial inclusion in reducing the gender gap between the food demand and nutrition of female- and male-headed households. The study provides suggestive evidence that promoting formal financial inclusion will lead to wide-ranging welfare effects by improving food security, nutrition, and food demand, especially in rural communities.

Key words: financial inclusion, food security, nutrition, Sustainable Development Goals, Rwanda

JEL classification: D14, Q14, O16

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1   Introduction

Despite the efforts of the Rwandan government and development partners to ensure food security through programmes such as 'One cow per poor family', the Economic Development for Poverty Reduction Strategies (EDPRS I and II), and National Strategic Transformation (NST1), food security remains a major challenge for Rwanda. According to the Rwandan Ministry of Agriculture (MINAGRI et al. 2018), about 18.7 per cent of Rwandan households were food insecure in 2018 (17 per cent moderately, 1.7 per cent severely). With the intention of improving farm yields and food access, the Rwandan government has promoted financial inclusion programmes in recent years to modernize agriculture and improve efficiency and productivity. About 93 per cent of the population have access to formal or informal financial products and services (FinScope 2020). These financial inclusion programmes are expected to improve access to affordable financial services and products (payments, transactions, savings, credit, and insurance) for individuals and businesses and should be delivered responsibly and sustainably (AfDB 2013; Demirguc-Kunt et al. 2018; Singh 2017). The United Nations' Agenda 2030 recognizes financial inclusion as 'a powerful enabler to end hunger, achieve food security and enhance nutrition, and promote sustainable development' (SDG 2) (UNSGSA 2016).

In this paper, we explore if financial inclusion leads to increased food security and improved nutrition in rural Rwanda. First, we investigate if financial inclusion leads to improved household consumption expenditure. Second, we examine if financial inclusion improves the nutritional level of diets for rural households in Rwanda. Finally, we inspect if there are significant differences between female-headed and male-headed households.

The analyses are based on pooled data from Integrated Living Household Surveys (EICVs; Enquête Intégrale sur les Conditions de Vie des Ménages) for the periods 2013/14 and 2016/17. We employ the control function (CF) approach and extend it to pooled fixed-effects models to derive the impact of financial inclusion on food security (Papke and Wooldridge 2008).

Our evidence suggests that rural programmes that promote financial inclusion through formal financial institutions, such as Umurenge savings and credit cooperatives (SACCOs), microfinance institutions (MFIs), and commercial banks, lead to greater household food security. Furthermore, formal financial inclusion significantly improves the nutritional level of diets (in terms of proteins, fibres, and vitamins) among rural households. Similar results are not observed for informal financial institutions such as tontines. However, the heterogeneous marginal effects of financial inclusion (both formal and informal) show that female-headed households perform much better in terms of nutrition improvements compared with their male-headed counterparts. Our results indicate that policies that consistently allow access to formal financial services for rural households can provide a wide range of welfare effects in terms of improving food security and balanced diets.

The study makes several contributions to the literature. First, the evidence that financial inclusion significantly improves nutrition and diet in Rwanda adds to the literature on impact investment and sustainable finance. There has been growing interest in understanding the role of financial inclusion in promoting sustainable development (Bachas et al. 2018; Bharadwaj and Suri 2020; Demirguc-Kunt et al. 2018; FAO et al. 2013; Singh 2017; Triki and Faye 2013), consumption and income smoothing (Bali Swain and Floro 2012, 2014; Deaton 1992; Floro and Bali Swain 2013; Somville and Vandewalle 2019), financial stability and poverty (Bali Swain 2012; Bali Swain and Varghese 2009; Bruhn and Love 2014; Feghali et al. 2010; Pitt and Khandker 1998; Swamy 2014), and gender empowerment (Bali Swain and Wallentin 2009, 2012; Hendriks 2019; Siddik 2017; Swamy 2014). Yet very few studies (see for example Aung et al. 2018; Deaton 1992; Hoddinott

and Skoufias 2004; Islam et al. 2016; Lai et al. 2020; Somville and Vandewalle 2019) provide a robust analysis of the food consumption and nutrition effects of financial inclusion, at least in the African context.

Second, despite the high prevalence of malnutrition and food insecurity, literature on financial inclusion and food security in Sub-Saharan Africa has remained scant due to challenges associated with the causal identification of impacts and the availability of reliable data. We address this gap by using a living household survey (EICV5) on household food consumption and nutrition in Rwanda, to examine the effect of financial inclusion on household food diet and nutrition.

Third, the study contributes to the food security and gender inequality literature (Garawi et al. 2014; Kassie et al. 2014; Tibesigwa and Visser 2016; Tiwari 2013). Although the welfare implications of financial inclusion in developing countries are well established, little is known about the effects on food inequality, particularly along the lines of gender. Evidence from Tibesigwa and Visser (2016) on gender inequality in food security among smallholder farm households in South Africa indicates that male-headed households are more food-secure than female-headed households, with the latter depending more on agriculture to increase household food levels. Further, Kassie et al. (2014), in evaluating the driving forces of gender inequality in household food security in Kenya, find that the food security gap between male- and female-headed households is explained by their differences in observable and unobservable characteristics. Our evidence on a financial-inclusion-induced gender gap in improvements to nutrition thus provides a novel contribution to this literature.

The rest of this paper is organized as follows. Section 2 presents the state of food security and financial inclusion in Rwanda. The estimation strategy and data are discussed in Section 3. The results and discussion are presented in Section 4. The final section presents the conclusions.

2   Food security and financial inclusion in Rwanda

2.1   Food security in Rwanda

Even among the 81 per cent food-secure households in Rwanda, about 38.6 per cent are reportedly marginally food-secure. In 2018, about one-fourth of Rwandan households (23.8 per cent) had inadequate food consumption. Among them, 20 per cent consumed a borderline diet and 3.8 per cent were on a poor diet (MINAGRI et al. 2018). This is reflected in the high rates of stunting and child malnutrition in the country. About 38 per cent of children under the age of five are stunted, while about 17.8 per cent of those aged 6 to 23 months do not meet the minimum acceptable diet requirement (RoR 2018).

Shaw (2007) defines food security as a function of four distinct dimensions or indicators, namely availability, access, utilization, and stability (Adom 2014). Food availability and access are considered the two key determinants. Food availability is the amount of food physically available at micro or macro level, whereas food access is the physical and economic ability of households to acquire adequate amount of food on a regular basis (MINAGRI et al. 2018). Food availability encompasses domestic food production, imports, reserves, and food aid, whereas food access involves infrastructure such as road networks and markets, as well as households' ability in terms of their own production, exchange, or purchase of food. The third dimension of food security, food utilization, is an outcome indicator referring to the ability of the household to meet its dietary needs from food that it has access to. The fourth dimension, food stability, emphasizes the sustainability of food availability, access, and utilization (MINAGRI et al. 2018). All four

dimensions are critical in the long term (von Braun 2014) and work as a system of dynamic interactions between income, food, and energy prices, farm productivity, and climate change (Adom 2014; Kalkuhl et al. 2016; Laborde et al. 2016).

A majority (80 per cent) of Rwandan households are rural and primarily dependent on agriculture. Rwanda has low food availability due to low agricultural yields, resulting from subsistence agriculture and traditional technology and practices (MINAGRI et al. 2018). Other causes of low food availability include a low propensity to import due to limited national income, cross-border trade issues, and lack of infrastructure (markets, roads, transportation, etc.) (Lascano Galarza 2020;). To increase productivity, the National Agricultural Policy implements policies to promote an enabling environment and responsive institutions, technological upgrading and skills development, productivity and sustainability, and inclusive markets and off-farm opportunities (RoR 2018). However, increased population pressure is leading to accelerating land fragmentation, which is an obstacle to the adoption of modern farm technologies.

2.2 Financial inclusion in Rwanda

Financial inclusion has been considered a key element in rural transformation and hence in the socioeconomic development of Rwanda, given its potential to improve the agricultural productivity and livelihoods of rural populations, enhancing entrepreneurship and employment opportunities, particularly for youth and women. In 2006, Rwanda initiated the Rwandan Financial Sector Development Programme (FSDP) to improve the livelihoods of Rwandans by enhancing access to secure saving facilities and other financial services for all (AFR 2012). To achieve this objective, the focus is on rural financial inclusion through the adoption of different savings mobilization strategies, including Umurenge SACCOs, MFIs, tontines, and commercial banking.

Umurenge SACCOs were initiated by Rwanda in 2009 in light of the low level of domestic savings and alarming financial exclusion, particularly in rural areas (MINECOFIN 2013). The idea was to establish at least one SACCO at each administrative sector (Umurenge) level, with a mission to give previously unbanked people (in rural areas) access to financial services at a low transactional cost (AFI 2014). Umurenge SACCOs are user-owned savings and credit co-operatives with an overall goal of enhancing livelihoods through boosting rural savings and credit facilities. Moreover, Umurenge SACCOs promote the social welfare of their members by providing them with financial literacy as well as assuring co-operation among members. Rwanda has a total of 416 Umurenge SACCOs, collectively serving about 2 million citizens (AFR 2016). Umurenge SACCOs remain the primary provider of financial services in all provinces of Rwanda except for Kigali city (AMIR 2015). They play a crucial role in agricultural growth through delivering savings and credit services to farmers. FinScope (2016) finds that about 41 per cent and 34 per cent of commercial farmers and farm workers respectively are members of Umurenge SACCOs.

Microfinance was introduced in Rwanda around 1975 with the creation of the first Banque Populaire in Nkamba. However, the microfinance sector in Rwanda experienced fast growth only after the 1994 genocide against the Tutsi. This was due to the support of international non-governmental organizations (NGOs) and humanitarian aid organizations (USAID Rwanda Nguriza Nshore Project 2018). Several NGOs evolved into MFIs; some transformed into microfinance banks while others remained non-bank MFIs. MFIs are categorized into two groups based on their legal status: those registered in the form of corporations and those registered as SACCOs. The first category comprises two main subcategories: those that evolved into or were set up as microfinance banks and those that have not yet obtained the status of banks (AMIR 2015). However, unlike the SACCOs, MFIs in form of corporations are relatively few, and hence their contribution to rural financial inclusion is limited.

Tontines (Ibimina) are informal MFIs formed by small voluntary groups of people, where members mobilize savings and mutually invest to enhance their livelihoods (AMIR 2015). The overall objective of tontines is to provide low-income individuals who have difficulties accessing formal loans with the opportunity to raise more capital for their economic activities. Every member contributes a fixed sum of money over a fixed period. One of the members receives a fixed part of the pooled amount in rotation until all members have received it once. Other variants of tontines consist of using the remaining part of the pooled money to offer loans to members for interest or to invest in collective businesses or assets. Consequently, tontines allow their members to pursue their activities, particularly farm and livestock activities in rural areas, and provide significant support to micro, small, and medium-sized enterprises (MSMEs).

Commercial banks are a part of the formal financial infrastructure. The banking sector has seen a very low rate of growth in Rwanda, but since 2008 it has experienced significant growth. This is mainly due to the divestiture or partial divestiture of the government from major banks such as Bank of Kigali (BK) and I&M Bank (formerly Banque Commerciale du Rwanda) as well as the entrance of new foreign banks (USAID Rwanda Nguriza Nshore Project 2018). Despite the contribution of commercial banks to economic development, their role in rural financial inclusion is still limited. FinScope (2016) reveals that in 2016, only 20 per cent of rural residents were banked while 42 per cent were using other formal non-bank financial services and products.

3   Methods and data

This section elucidates the methods and data employed in the analyses. We provide the identification and estimation strategy used to gauge the impact of financial inclusion on rural households' nutrition and diet. This is followed by a discussion on the measurement of food security and the data and descriptive statistics.

3.1   Estimation strategy

Assessing the impact of financial inclusion programmes on food security is challenging due to the presence of selection bias, arising mainly from unobservable factors. The decision to participate in financial inclusion programmes may depend on the same attributes that determine a household's food security. Our main explanatory variables (proxies for financial access, namely tontine membership, ownership of a savings account) are potentially endogenous. In other words, any assumption that variations in access to financial inclusion are orthogonal to economic outcomes such as food access is unlikely to be valid. To mitigate this endogeneity issue, we employ the control function (CF) approach, which uses control variables to capture the endogeneity and isolate the exogenous variation in the endogenous variable. The control variables are typically observed variables that are correlated with the endogenous variable.

A two-stage least square (2SLS), CF method (Wooldridge 2010) is adopted. First, the CF method provides a direct exogeneity test for endogenous variables (Wooldridge 2010). Second, it can easily be combined with Chamberlain-Mundlak methods for handling unobserved heterogeneity (Wooldridge 2015). The estimation process involves regressing the endogenous variables on the instruments and other exogenous variables. The resulting residual from the reduced form is then added to the structural model in the second step. A significant coefficient value for the residuals in the second stage makes it possible to reject the hypothesis of absence of endogeneity (see Papke and Wooldridge 2008, Wooldridge 2015, and Woldeyohanes et al. 2017 for further details).

However, the Rwandan EICV surveys are reported at the district level and do not contain spatial information such as household geo-co-ordinates that could be merged with other relevant exogenous variables in other data such as local infrastructure or climate information. To deal with such issue, we employ the CF method and use the information on local infrastructure as a control variable for financial inclusion (see Section 3.2 for further discussion on this). From the first-stage reduced-form model, we specify the structural equation as follows:

$$y_{hdt} = \beta_0 + \lambda_1 FI_{hdt} + \rho_1 \hat{v}_{hdt} + \alpha_1 X_{hdt} + \varepsilon_{1hdt} \qquad (1)$$

where the subscripts denote household h living in district d and surveyed in year t. y_{hdt} denotes the vector of outcomes (indicators of food diversity and nutritional level of diet among rural Rwandan households). These include family expenditure on food categories that represent food diversity in households (proteins, fibres, fats, carbohydrates, and vitamins). FI_{hdt} represents the financial inclusion indicators while $\hat{v}_{hdt}$ are the residuals from the reduced form that address the endogeneity issue in our variable of interest. X_{hdt} stands for a vector of other household and demographic control variables, including age and education of the household head and spouse, household size, and business type in the household. These controls are critical to avoiding spurious results when deriving the effect of financial inclusion on a nutritious food diet. λ_1, ρ_1, and α_1 are the parameters to be estimated, and finally, ε_{hdt} is an unobservable random disturbance term which is assumed to have a zero mean.

To derive the effect of financial inclusion on a nutritious food diet, we also control for other potential confounders that may lead to biased and inconsistent estimates, by including a set of different fixed effects—district fixed effect, household income category, and year of survey—to account for the unobserved factors that are common across those groups as expressed in the following equation:

$$y_{hdt} = \beta_1 + \lambda_2 FI_{hdt} + \rho_2 \hat{v}_{hdt} + \alpha_2 X_{hdt} + \sigma_d + \omega_{ub} + K_t + \varepsilon_{2hdt} \qquad (2)$$

where σ_d, ω_{ub}, and K_t represent district, Ubudehe 'household income category', and year of household survey fixed effects respectively, to control for the unobserved common factors in district, income categories, and survey year. District fixed effects σ_d absorb time-invariant differences across districts in Rwanda and also absorb the district-specific contemporaneous shocks. The Ubudehe 'household income category' ω_{ub} is used to account for differences in households' assets and properties that may correlate with household nutrition, and finally the year of the survey K_t is included to absorb contemporaneous shocks that may be correlated with household food consumption decisions during the survey period. In addition, the survey year fixed effects account for agricultural seasonality that may correlate with household consumption.

3.2   Data

The analysis in this study is based on data from the Rwandan Integrated Household Living Conditions surveys, EICV4 (2013/14) and EICV5 (2016/17), conducted by the National Institute of Statistics for Rwanda (NISR). The surveys were conducted over a period of 12 months: October 2013 to October 2014 and October 2016 to October 2017 for EICV4 and EICV5 respectively. They are designed to represent the household-based population in the country. The NISR uses the national master sampling frame to randomly select sample villages in each district. In both cases, the master sample was based on the 2012 Rwanda census frame. The surveys provide information on household welfare indicators, including poverty, household income, employment, education, health, housing conditions, and household consumption patterns. In addition, the surveys contain detailed information on household financial services, including use of banks,

tontines, etc. They also provide detailed one-week recalls on household food consumption patterns. The 2013/14 and the 2016/17 surveys include 14,172 and 14,580 households respectively. The focus of our analysis is on rural Rwanda. Deleting the urban households, we are left with data on 11,824 and 11,670 rural households respectively in the two consecutive waves.

As mentioned in the previous section, the EICV data suffer from some limitations. The data lack information on anthropometric measures (especially height and weight) of individual households. Such measures are usually collected as part of Demographic and Household Survey datasets, but the latter does not contain other comprehensive household attributes, hence the restriction of its use to health-related studies. In Rwanda, the EICVs collect neither anthropometric measures for member households nor coordinates information. The latter is important for spatial analysis (for instance, considering climate and other spatial elements).

Finally, the available datasets collected under EICVs are mostly of cross-sectional data across the waves, making it even more difficult to obtain information on the same household over time. This is critical, especially in a country like Rwanda, with numerous development (national) programmes that need to be evaluated empirically. This has implications for the selection of the control variable(s). In this study, we use 'distance from the household to the nearest main business markets' as a control variable in our CF approach. In rural Rwanda, these main markets are the hub for business activities, the location of financial institutions, and the centre for local administrative entities such as sector offices, which provide most of the public administrative services to local citizens.

Financial inclusion is proxied by having a savings account and being a member of a tontine, having access to SACCOs or MFIs, or using formal banks. To deal with differences in household attributes, we employ the following variables: age of household head, household size, share of adult members in the household, education level of household head and spouse, whether the household has a non-farm business or not, whether the household has wage/ salary and the household food expenditure.

To measure the potential welfare effects (measured as the nutritional level of household diet) of financial inclusion, we use household expenditures on protein, fibres, fats, carbohydrates, and vitamin intake. We construct five food categories using household consumption data. The data include information on how much each household spent on all food and non-food items over the previous week and previous month. This information is used to define the different food categories (protein, fibres, fats, carbohydrates, and vitamins) and compute household expenditures for each.[1] All of the numerical outcome values were converted into logarithms based on the inverse hyperbolic sine transformation, following Bellemare and Wichman (2020). Note that not all households spend on all food categories. Therefore, some food categories show up with zeros against household expenditure, leading to the existence of corner solutions. The reasons for these zero expenditure values might be related to non-preference, non-affordability, non-availability, infrequent purchases, etc. Failure to account for these missing values in the estimation procedures could lead to biased estimates (Park et al. 1996). We thus replace zero values with missing value. This leads to unbalanced observations across estimations, as can be observed in the number of observations in Appendix Tables A1–A2. The data were also winsorized from the upper bound to solve the issue of extreme outliers in reported expenditures.

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[1] We constructed the food categories based on the different nutritional content of each of the food items as listed in the questionnaire and based on the nutritional values for common foods and products provided at www.nutritionvalue.org.

Descriptive statistics are presented in Table 1. The statistics show a decline in tontine membership among rural households from 54 to 35 per cent between 2013 to 2017. This could be associated with the introduction of the Access to Rural Finance Policy in Rwanda, the main goals of which include: expanding access to finance among rural households using formal financial services such as SACCOs and other MFIs; supporting financial institutions to set up specialized agriculture finance units in rural areas; promoting financial inclusion for youth through financial education; and facilitating payment services for smallholder farmers in partnership with telecoms companies such as MTN and TIGO, in collaboration with local financial institutions.[2]

The reduction in tontine membership is also explained by a 33.3 per cent decrease in the per capita household annual return from membership. On other hand, while there is decrease in tontine membership, Table 1 shows an increase in access to SACCOs and MFIs, from 53 to 86 and 5 to 7 per cent respectively. Therefore, the increase in access to SACCOs and other MFIs in rural areas may have contributed to the reduction of tontine membership in Rwanda. Approximately 20 per cent of rural households possess bank accounts. It is crucial to acknowledge that these households might engage with various financial institutions for distinct financial services and may hold memberships with multiple financial entities.

To mitigate the potential influence of heterogeneity in household decision-making, we incorporate variables such as age, education level, and gender of household head into our analytical framework. Female-headed households are under-represented in the two waves. The prevalence of lack of formal education among household heads has declined across the two observed data waves. Adult equivalence within households remains relatively consistent when comparing the two waves. Also, it is important to highlight an increase in household size is expected to be positively associated with greater levels of food consumption and expenditure (Jacobson et al. 2010). An additional control that serves to elucidate the determinants of patterns of spending on various dietary items among rural households is ownership of non-farm businesses. Table 1 shows that the proportion of households running non-farm businesses stagnated (47 per cent) between the two surveys.

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[2] Further details on the Rwandan Access to Rural Finance Policy can be accessed at https://afr.rw/who-we-are/our-history.

Table 1: Demographics and household (hh) characteristics in rural Rwanda (descriptive statistics)

	EICV4 (2013/14)		EICV5 (2016/17)	
	Mean	Std Dev.	Mean	Std Dev.
Demographics and household attributes in rural Rwanda				
Real value of food expenditure (RWF)	206,376	129,543	185,643	107,105
Real value annual hh expenditure (RWF)	495,565	349,935	694,692	467,919
Hh incurred environmental shocks	0.22	0.42	0.15	0.36
Distance (km) to main markets	4.37	3.96	5.39	3.96
Distance (km) to sector office	5.80	4.61	5.75	3.88
Household adult equivalence (size)	4.58	2.05	4.46	2.05
Share of adults in household	0.84	0.17	0.84	0.17
Female head household	0.26	0.44	0.12	0.33
Age of household head	45.88	16.18	46.22	15.80
Husband with primary education	0.27	0.44	0.28	0.45
Spouse with primary education	0.19	0.39	0.20	0.40
Non-farm business household	0.47	0.50	0.47	0.50
Household with wage/salary	0.55	0.50	0.60	0.49
Non-food share expenditure in hh	0.35	0.15	0.30	0.11
Food share expenditure in hh	0.65	0.15	0.70	0.11
Proxies of financial inclusion				
Tontine membership	0.54	0.50	0.35	0.48
Having account in SACCO	0.53	0.50	0.86	0.35
Having account in other MFI	0.05	0.22	0.07	0.25
Having account in formal bank	0.20	0.40	0.21	0.40
Real value of annual savings	31,759	40,359	73,614	192,940
Real value of return from tontine	26,435	20,195	17,615	18,135
Location				
South province	0.30	0.46	0.30	0.46
West province	0.25	0.43	0.25	0.43
North province	0.19	0.39	0.19	0.39
East province	0.26	0.44	0.27	0.44
Observations	11,824		11,670	

Note: RWF = Rwandan francs.

Source: authors' construction based on EICV data.

We also provide the distribution of household food consumption annual budget share among rural households in Rwanda: see Table 2. The table shows that in 2016/17 rural households in the country spent around 75 per cent of their annual food expenditure on roots and tubers, cereals, fruits, vegetables, legumes, and edible oil. Expenditure on proteins (such as meat, fish and eggs) was relatively small. This explains malnutrition in the country.

Table 2: Food consumption budget shares of rural households

	EICV4 (2013/14)		EICV5 (2016/17)	
	Mean	Std Dev.	Mean	Std Dev.
Cereals	0.092	0.133	0.080	0.140
Cereal flours	0.107	0.165	0.049	0.099
Bread	0.032	0.075	0.045	0.081
Meat products	0.014	0.057	0.030	0.086
Egg	0.000	0.007	0.001	0.008
Fish	0.025	0.058	0.034	0.067
Dairy products	0.007	0.040	0.011	0.050
Edible oil	0.087	0.106	0.113	0.118
Fruits	0.060	0.093	0.050	0.096
Legumes	0.184	0.177	0.155	0.181
Vegetables	0.206	0.220	0.104	0.106
Roots and tubers	0.110	0.162	0.198	0.213
Sugar	0.065	0.112	0.038	0.072
Other food items	0.002	0.011	0.088	0.124
Observations	11,824		11,670	

Source: authors' construction based on EICV data.

Another important aspect to explain in the two surveys is the distribution of food and non-food in rural households' expenditure. Figure 1 provides the distribution of food and non-food shares according in both waves among male- and female-headed rural households. The figure shows an increase in the expenditure share of food between the two study periods for both male- and female-headed households. We also report the distribution of the food and non-food shares by household tontine membership, as indicated in the Figure 2. The figure shows that the percentage of food expenditure is slightly higher for households with tontine membership than for their non-member counterparts.

Figure 1: Food and non-food share distribution in EICV4 and EICV5
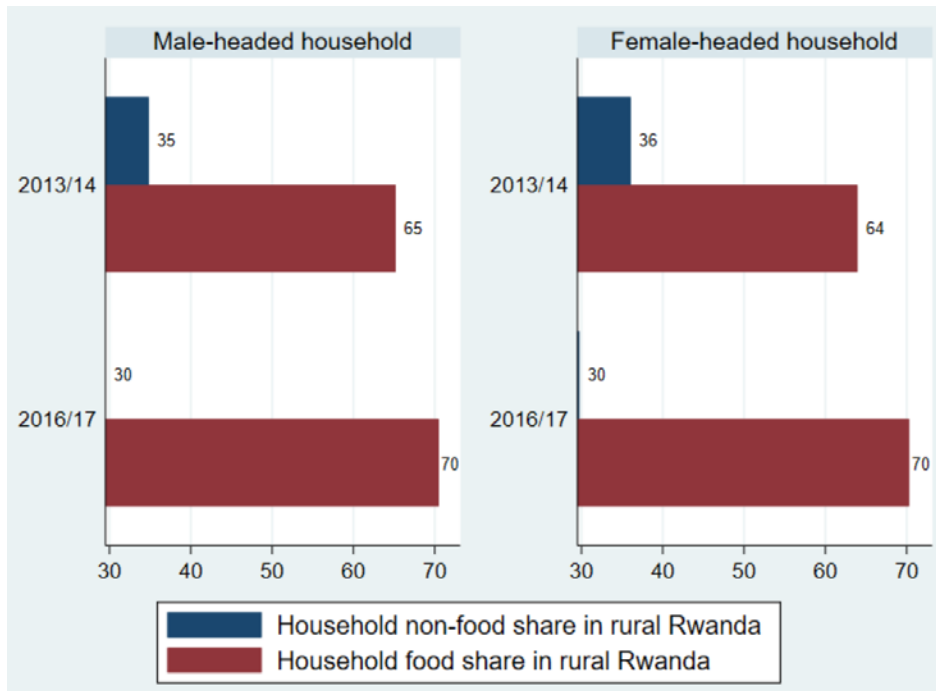
Source: authors' illustration based on EICV data.

Figure 2: Food and non-food share distribution and tontine membership
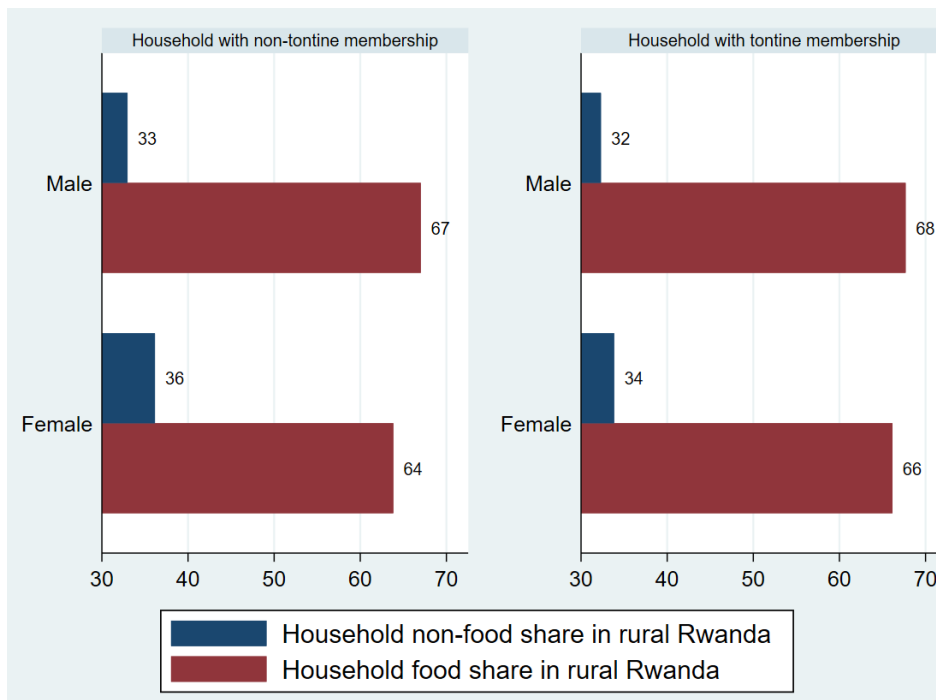
Source: authors' illustration based on EICV data.

The EAT-Lancet targets are widely applied in the literature to identify the most affordable food categories across individuals or regions (Hirvonen et al. 2020; Vanham et al. 2020). Appendix Figure A1 presents the most affordable foods in relation to meeting EAT-Lancet targets among rural Rwandan households across the 27 districts.[3] It reports the distributions of the EAT-Lancet reference diets in terms of the median cost of nutrient adequacy across the rural households. The size of each box indicates the interquartile range of diet expenditure. Each vertical bar inside the box indicates the annual median value for the expenditure per capita in each respective district. In the majority of Rwandan rural households, expenditures on fruits, vegetables, fish, and meat are relatively minimal, with carbohydrates accounting for the main expenditure. Exceptions to this trend are observed in the Rubavu and Rusizi districts, where a relatively higher number of households exhibit median expenditure values that surpass the norm.

4   Results and discussion

In this study, we test the food Engel curve hypothesis for different types of financial institutions among rural households. We provide empirical evidence regarding the influence of tontine membership and ownership of savings accounts (banks, SACCOs, or other MFIs) on diverse dietary consumption patterns. We further demonstrate that financial access within rural areas may exert heterogeneous effects on overall household expenditure patterns. All specifications consider the role of gender and demographic characteristics in household financial decisions. Each estimation is further augmented by a set of fixed or time-invariant variables (such as district of household location, year of survey, and income category), which may be correlated with household financial access.

Figure 3 presents the effects of tontine membership on rural households' intake of proteins, fibres, fats, carbohydrates, and vitamins (see also Table A1). The results show large negative impacts of tontine membership on household food expenditure on foods rich in fibres, fats, and vitamin. The impacts on expenditure on proteins and carbohydrates are negative but statistically insignificant. We also interact the gender (female-headed household) with tontine membership to find out whether there is a statistical difference between female versus male headed households regarding the food consumption patterns when both have tontine membership. Figure 3 shows a statistically significant difference, albeit small in magnitude, in household expenditure on food between female and male headed household when they both have tontine membership. Specifically, we find that a female-headed household with a 1 per cent increase in the amount received from tontines will increase annual spending on fibres and vitamins (proteins) by 0.05 per cent relative to male-headed households. Fats and carbohydrates also see a similar percentage increase of about 0.07 and 0.03 respectively. As cited earlier in the paper, this may be because women are more focused than men on the nutrition of their households.

Figure 3 also indicates that having an account in a formal bank increases spending on proteins, fibres, vitamins, fats, and carbohydrates by 1.16, 0.3, 0.3, 0.6, and 0.5 per cent respectively. Thus, access to formal banks leads to a considerable increase in the spending of rural households on proteins (such as meat, eggs, and milk) and fats (such as cooking oil). Being an MFI beneficiary also leads to a statistically significant economic impact on consumption of all food categories.

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[3] Rwanda consists of 30 districts, including three in Kigali city. For this study, we excluded all urban households in both Kigali and other cities.

Figure 3: Effect of tontine membership on nutritious diets

Financial access and nutritious diets in rural Rwanda
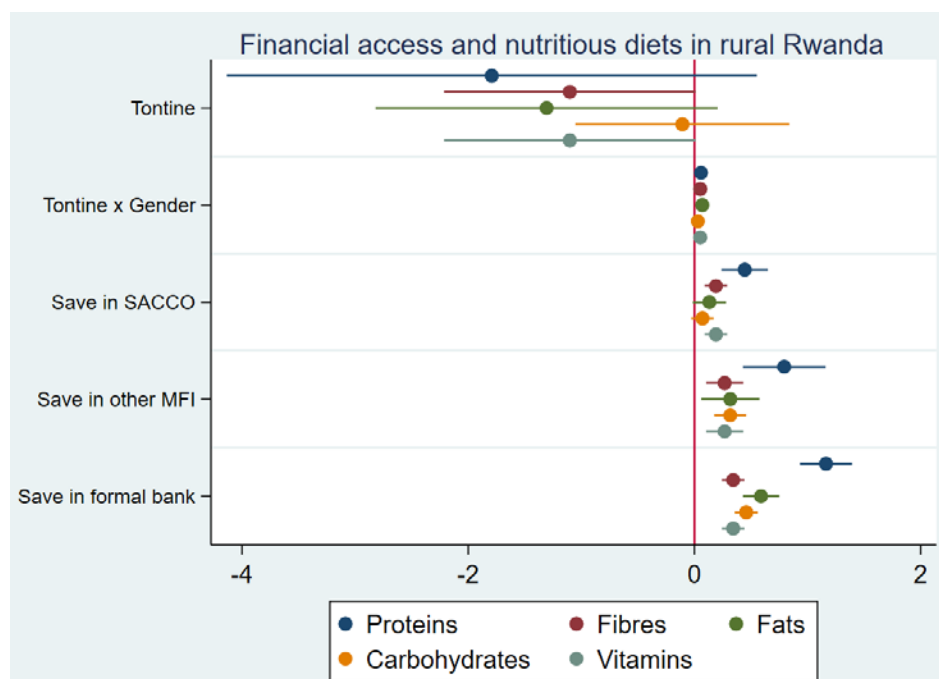
Source: authors' illustration based on EICV.

We investigate more deeply the effect of formal financial inclusion on rural nutrition consumption patterns. Figure 4 presents the evidence on the impact of annual formal household savings on the nutritional level of rural households' diet (see also Table A2). We find a positive and statistically significant robust effect of annual formal household saving on expenditure in all food categories. The figure indicates that an increase in annual household savings in formal institutions will increase annual spending on protein, fats, and carbohydrates by nine, nine, and three percentage points respectively. The increase in protein and fat expenditures may be attributed to the fact that an increased saving amount implies increased financial ability of households. The slighter increase in carbohydrate expenditure may be explained by the fact that in rural areas of Rwanda, carbohydrates are considered a necessity, hence their demand is not elastic. Further, relative to the previous figure, we see that the effect of formal households saving is positive and considerably larger than the effect of tontine membership. An increase in rural financial inclusion due to the adoption of various savings mobilization strategies, especially through Umurenge SACCOs, MFIs, and commercial banks has resulted in easier access and greater affordability.

Figure 4: Effect of financial savings on nutritional level of diets
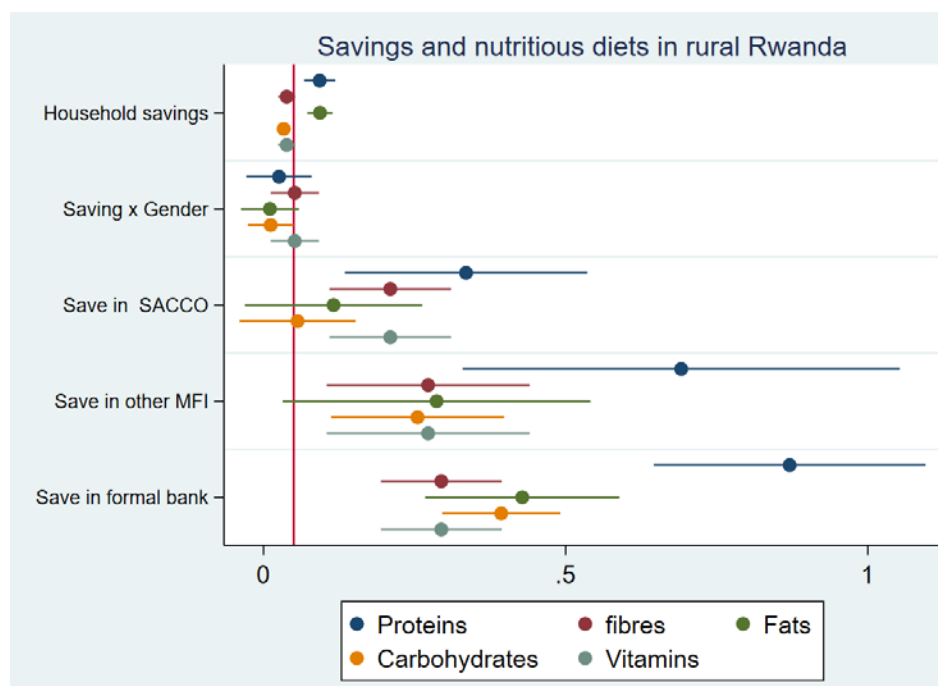
Source: authors' illustration based on EICV.

The interaction effect of annual formal household savings and gender on the nutritional level of rural household diets is significant. By interacting gender (female-headed household) with saving we aim to explore to whether there is statistical difference between female and male headed households regarding the food consumption patterns when both of them have saving account in formal financial institutions. Annual formal household savings have a positive significant impact on consumption of fibres and vitamins, and that a 100 per cent increase in female-headed households' annual savings in a formal institution will increase annual spending on both fibres and vitamins by 5.33 per cent as compared with the spending in male-headed households.[4]

To deal with the endogeneity problem in our estimates, we estimate the augmented CF model. The reduced-form results on the distance from the household to the nearest main business markets and the financial inclusion indicators are reported in Table 3. The outcome variables are tontine membership (columns 1 and 2) and the log of annual household savings (columns 3 and 4). The estimated standard errors are clustered at the household level, with bootstraps of 1,000 replications to ensure quality standard errors and confidence intervals. The results for the outcome variables' specifications (and their alternative) show that a decrease in the distance to the nearest main business markets leads to an increase in financial inclusion. The F-test values are sufficiently high, indicating strong instrument validity.

Table 4 presents the effect of tontine membership on households' food expenditure and total annual expenditure. Food expenditure and equivalized total household expenditure are not significantly different between households with and without tontine membership. The benefits of tontine membership for female-headed households are greater than those for male-headed households. Other forms of financial inclusion show a positive significant impact on food household expenditure. Households with an account in a SACCO, MFIs, or formal bank show an

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[4] From Table A2, on the interaction term the parameter estimates for fibres and vitamins are 0.052; hence, the percentage change is computed by $((exp)^{0.052} - 1)x\ 100 = 5.33$.

increase of 10, 15, and 21 per cent respectively in food household expenditures. We observe similar patterns in total annual household expenditure. Informal MFIs such as tontines are not necessarily effective in improving the nutritional level of diets among rural households in Rwanda.

Table 4: CF estimates for tontine membership and household expenditure

Variables	Log of household food expenditures	Log of (total) annual household expenditure
Tontine membership	0.050	−0.102
	(0.098)	(0.107)
Tontine x female head	0.017***	0.010***
	(0.003)	(0.002)
Household with account in SACCO	0.099***	0.127***
	(0.011)	(0.011)
Household with account in MFI	0.159***	0.198***
	(0.018)	(0.019)
Household with account in formal bank	0.210***	0.291***
	(0.012)	(0.013)
Household incurs environmental shocks	0.006	0.014
	(0.011)	(0.011)
Predicted residuals from first stage	−0.017	0.150
	(0.097)	(0.106)
Distance to main market	−0.000	−0.003**
	(0.001)	(0.001)
Equivalized household members (size)	0.127***	−0.090***
	(0.002)	(0.003)
Share of adult in household	0.184***	0.033
	(0.029)	(0.029)
Household head is female	−0.278***	−0.120***
	(0.026)	(0.024)
Age of household head	0.000	0.001***
	(0.000)	(0.000)
Household head with at least primary education	0.058***	0.076***
	(0.009)	(0.010)
Spouse with at least primary education	0.058***	0.066***
	(0.010)	(0.011)
Non-farm business household	0.028***	0.047***
	(0.009)	(0.009)
Household with salary/wage	−0.222***	−0.297***
	(0.009)	(0.009)
Constant	13.026***	13.154***
	(0.051)	(0.055)
Observations	23,494	23,494
R-squared	0.509	0.360
District fixed effects	Yes	Yes
Ubudehe fixed effects	Yes	Yes
Wave fixed effects	Yes	Yes

Note: districts, Ubudehe (income) categories, and year of survey fixed effects included in all regressions; the inverse hyperbolic sine transformation is applied to the continuous outcome values to credibly approximate log values while taking zero-valued observations into account (Bellemare and Wichman 2020); outcome variables are log of household food expenditures and log of (total) annual household expenditure; all estimations weighted at household level; robust standard errors reported in parentheses; *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Source: authors' construction based on EICV data.

Table 5: CF estimates for household savings and expenditure

Variables	Log of household food expenditures	Log of (total) annual household expenditure
Annual household savings (log)	0.027***	0.030***
	(0.001)	(0.001)
Household saving x female head	0.003	−0.002
	(0.004)	(0.003)
Household with account in SACCO	0.070***	0.063***
	(0.011)	(0.011)
Household with account in MFI	0.122***	0.134***
	(0.017)	(0.018)
Household with account in formal bank	0.157***	0.212***
	(0.012)	(0.012)
Household incurs environmental shocks	0.006	0.019*
	(0.010)	(0.010)
Predicted residuals from first stage	−0.032***	0.022**
	(0.009)	(0.009)
Distance to main market	0.001	−0.002**
	(0.001)	(0.001)
Equivalized household members (size)	0.128***	−0.095***
	(0.002)	(0.002)
Share of adult in household	0.198***	0.043
	(0.028)	(0.027)
Household head is female	−0.175***	−0.016
	(0.043)	(0.037)
Age of household head	−0.000	0.001***
	(0.000)	(0.000)
Household head with at least primary education	0.047***	0.065***
	(0.009)	(0.009)
Spouse with at least primary education	0.047***	0.054***
	(0.010)	(0.010)
Non-farm business household	0.012	0.025***
	(0.008)	(0.008)
Household with salary/wage	−0.192***	−0.276***
	(0.009)	(0.009)
Constant	12.795***	12.855***
	(0.030)	(0.029)
Observations	23,494	23,494
R-squared	0.500	0.386
District fixed effects	Yes	Yes
Ubudehe fixed effects	Yes	Yes
wave fixed effects	Yes	Yes

Note: districts, Ubudehe (income) categories, and year of survey fixed effects included in all regressions; the inverse hyperbolic sine transformation is applied to the continuous outcome values to credibly approximate log values while taking zero-valued observations into account (Bellemare and Wichman 2020); outcome variables are log of household food expenditures and log of (total) annual household expenditure; all estimations weighted at household level; robust standard errors reported in parentheses; *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Source: authors' construction based on EICV data.

Table 5 presents the results of the analysis of impact of annual formal savings on household food expenditure (and total expenditure). The results show that annual formal savings have a positive (3 per cent) and statistically significant impact on households' food expenditure. No gender differential was found. Financial inclusion through SACCOs, MFIs, and formal banks has a significant 7 to 16 (6 to 21) per cent impact on the food (total) expenditure of households.

5   Conclusions and policy implications

Accelerated population growth and rural poverty have made the food security of households in Rwanda a growing concern, given the government's commitment to food security and to delivering on the Sustainable Development Goals (SDGs). The food security and nutrition of rural households in Rwanda take on a new urgency given the impending economic hardships and plausible increase of malnourishment following the COVID-19 pandemic. This paper investigates if financial inclusion leads to increased food security and improved nutrition in Rwanda. Financial inclusion via informal MFIs (tontines) and formal institutions (Umurenge SACCOs, MFIs, and formal banks) are explored. First, we examine the impact of financial inclusion on dietary nutrition patterns in rural Rwanda. Second, we investigate the impact of tontine membership and annual household formal savings on food and total household expenditure, while controlling for endogeneity using the CF method. Finally, we examine the interactive impact of financial inclusion and gender, to isolate the differential impact between female- and male-headed households. The analyses are based on data from rural households in the Rwandan Integrated Living Household Surveys (EICVs) for the periods 2013/14 and 2016/17.

Our results show that financial inclusion (FI) through formal institutions such as SACCOs, MFIs, and commercial banks significantly improves households' consumption expenditure. We also find that FI leads to significant improvements in the nutrition levels of diets (proteins, fibres, and vitamins) among rural households. Informal MFIs such as tontines do not show a statistically significant impact on either members' nutrition patterns or their household food expenditure. Female-headed households perform better in improving nutrition levels, compared with male-headed households. This result is robust for both formal financial institutions and tontine membership. Based on our empirical results, we strongly argue for formal FI policies that provide access to financial services to all rural households. The evidence provided in this paper shows that FI creates a wide range of welfare effects for households in rural Rwanda, accruing particularly in terms of better food security and more nutritional diets.

The majority of the Rwandan population is rurally based and relies primarily on subsistence farming for livelihood, with a substantial proportion having limited food security. Our results suggest that financial inclusion programmes such as Umurenge SACCOs create substantial opportunities to provide wide-ranging welfare effects in terms of improving food security and balanced diets. The study shows that use of formal financial institutions like Umurenge SACCOs, MFIs, and banks increases consumption expenditure on nutritious food diets (proteins, fibres, and vitamins) among rural households. The study further suggests that effective policies on FI can improve the food security and nutrition of rural households, especially for female-headed households.

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Appendix

Table A1: Tontine membership and level of nutrition of household diets in rural Rwanda

Variables	Proteins	Fibres	Fats	Carbs	Vitamins
Tontine membership	−1.792	−1.101*	−1.307*	−0.107	−1.101*
	(1.195)	(0.567)	(0.772)	(0.482)	(0.567)
Tontine x female head	0.058***	0.052***	0.070***	0.031**	0.052***
	(0.022)	(0.013)	(0.017)	(0.015)	(0.013)
Household with account in SACCO	0.445***	0.190***	0.133*	0.071	0.190***
	(0.105)	(0.051)	(0.075)	(0.051)	(0.051)
Household with account in MFI	0.794***	0.267***	0.317**	0.316***	0.267***
	(0.186)	(0.084)	(0.132)	(0.072)	(0.084)
Household with account in formal bank	1.163***	0.343***	0.589***	0.458***	0.343***
	(0.117)	(0.051)	(0.082)	(0.052)	(0.051)
Household incurs environmental shocks	0.090	−0.064	−0.069	−0.083	−0.064
	(0.101)	(0.052)	(0.075)	(0.052)	(0.052)
Predicted residuals from first stage	1.872	1.081*	1.335*	0.175	1.081*
	(1.190)	(0.565)	(0.765)	(0.481)	(0.565)
Distance to main market	−0.039***	−0.057***	−0.029***	−0.028***	−0.057***
	(0.012)	(0.007)	(0.009)	(0.006)	(0.007)
Equivalized household members (size)	0.035	0.127***	0.163***	0.173***	0.127***
	(0.022)	(0.011)	(0.017)	(0.011)	(0.011)
Share of adult in household	−1.560***	−0.426***	−0.165	−0.759***	−0.426***
	(0.278)	(0.136)	(0.200)	(0.128)	(0.136)
Household head is female	−0.558***	−0.437***	−0.744***	−0.459***	−0.437***
	(0.209)	(0.134)	(0.172)	(0.148)	(0.134)
Age of household head	−0.028***	−0.013***	−0.021***	−0.015***	−0.013***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
House hold head with at least primary education	0.173*	0.045	0.179***	0.125***	0.045
	(0.094)	(0.045)	(0.068)	(0.043)	(0.045)
Spouse with at least primary education	0.550***	0.115**	0.460***	0.032	0.115**
	(0.104)	(0.048)	(0.071)	(0.047)	(0.048)
Non-farm business household	0.187**	0.331***	0.181***	0.194***	0.331***
	(0.084)	(0.041)	(0.060)	(0.039)	(0.041)
Household with salary/wage	−1.103***	−0.011	−0.551***	−0.093**	−0.011
	(0.089)	(0.044)	(0.064)	(0.044)	(0.044)
Constant	8.525***	10.767***	9.293***	10.818***	10.767***
	(0.591)	(0.271)	(0.394)	(0.234)	(0.271)
Observations	23,494	23,494	23,494	23,494	23,494
R-squared	0.172	0.129	0.149	0.147	0.129
District fixed effects	Yes	Yes	Yes	Yes	Yes
Ubudehe fixed effects	Yes	Yes	Yes	Yes	Yes
Wave fixed effects	Yes	Yes	Yes	Yes	Yes

Note: districts, Ubudehe (income) categories, and year of survey fixed effects included in all regressions; the inverse hyperbolic sine transformation is applied to the continuous outcome values to credibly approximate log values while taking zero-valued observations into account (Bellemare Wichman 2020); outcome variables are expenditures on proteins, fibres, fats, carbohydrates, and vitamins; all estimations weighted at household level; robust standard errors reported in parentheses; *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

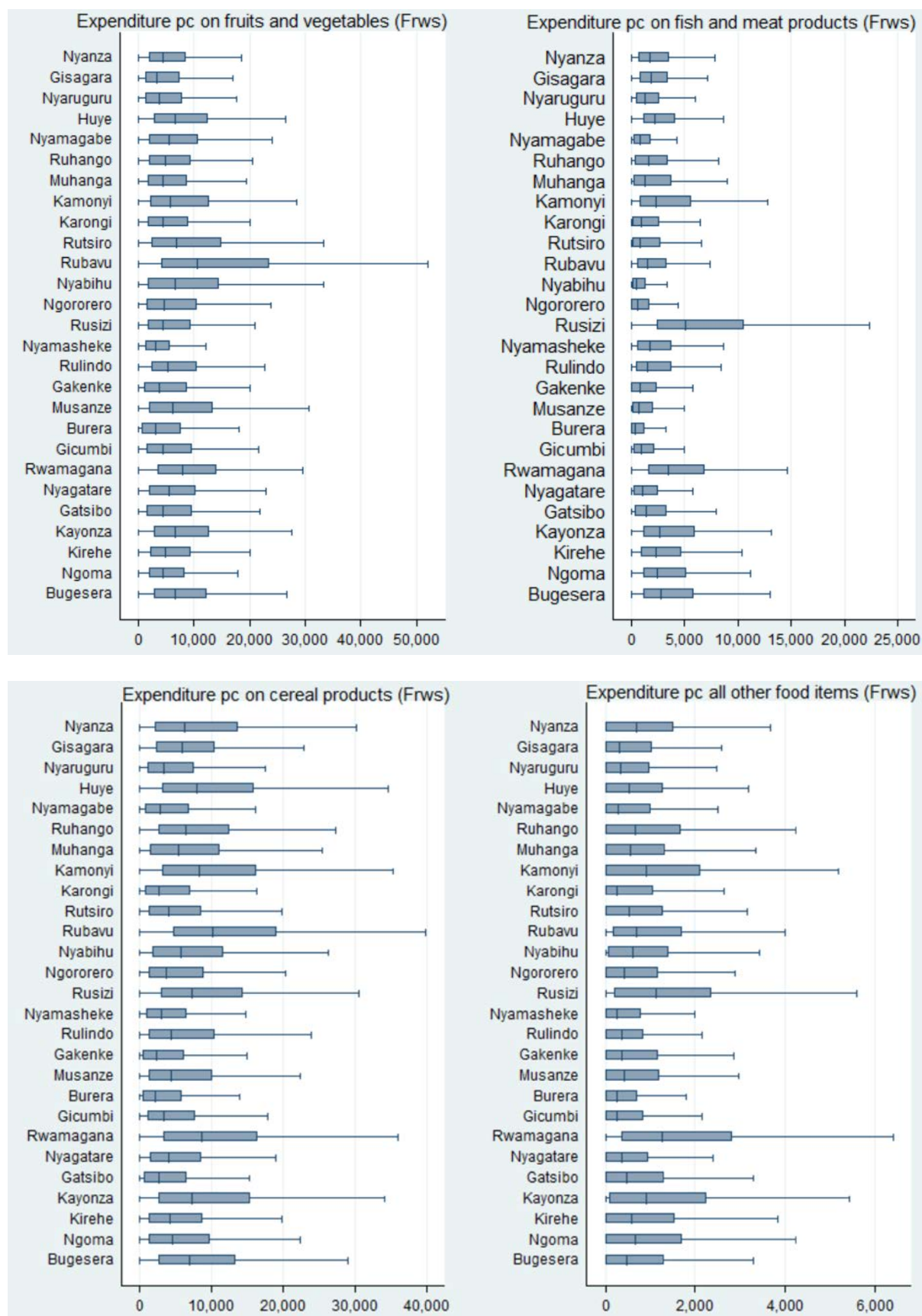Source: authors' construction based on EICV data.

Table A2: Annual savings and level of nutrition of household diets in rural Rwanda

Variables	Proteins	Fibres	Fats	Carbs	Vitamins
Annual household savings (log)	0.093***	0.038***	0.093***	0.033***	0.038***
	(0.013)	(0.007)	(0.011)	(0.006)	(0.007)
Household saving x female head	0.026	0.052**	0.011	0.012	0.052**
	(0.028)	(0.020)	(0.024)	(0.019)	(0.020)
Household with account in SACCO	0.335***	0.210***	0.116	0.056	0.210***
	(0.102)	(0.051)	(0.075)	(0.049)	(0.051)
Household with account in MFI	0.691***	0.272***	0.286**	0.255***	0.272***
	(0.185)	(0.086)	(0.130)	(0.073)	(0.086)
Household with account in formal bank	0.871***	0.294***	0.428***	0.393***	0.294***
	(0.115)	(0.051)	(0.082)	(0.050)	(0.051)
Household incurs environmental shocks	0.102	−0.042	−0.032	−0.067	−0.042
	(0.095)	(0.049)	(0.073)	(0.048)	(0.049)
Predicted residuals from first stage	−0.056	−0.116**	−0.154**	−0.104**	−0.116**
	(0.091)	(0.046)	(0.070)	(0.042)	(0.046)
Distance to main market	−0.029**	−0.054***	−0.020**	−0.023***	−0.054***
	(0.012)	(0.006)	(0.009)	(0.005)	(0.006)
Equivalized household members (size)	0.040*	0.128***	0.173***	0.181***	0.128***
	(0.021)	(0.011)	(0.016)	(0.011)	(0.011)
Share of adult in household	−1.622***	−0.493***	−0.298	−0.767***	−0.493***
	(0.261)	(0.127)	(0.194)	(0.119)	(0.127)
Household head is female	−0.355	−0.607***	−0.325	−0.351	−0.607***
	(0.305)	(0.234)	(0.274)	(0.215)	(0.234)
Age of household head	−0.029***	−0.013***	−0.021***	−0.014***	−0.013***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Household head with at least primary education	0.117	0.048	0.147**	0.103**	0.048
	(0.088)	(0.043)	(0.065)	(0.040)	(0.043)
Spouse with at least primary education	0.516***	0.097**	0.423***	0.010	0.097**
	(0.099)	(0.046)	(0.070)	(0.044)	(0.046)
Non-farm business household	0.088	0.283***	0.128**	0.149***	0.283***
	(0.079)	(0.039)	(0.058)	(0.036)	(0.039)
Household with salary/wage	−0.947***	0.039	−0.494***	−0.059	0.039
	(0.083)	(0.043)	(0.063)	(0.041)	(0.043)
Constant	6.799***	9.982***	7.686***	10.422***	9.982***
	(0.284)	(0.138)	(0.211)	(0.117)	(0.138)
Observations	13,495	13,495	13,495	13,495	13,495
R-squared	0.170	0.119	0.154	0.146	0.119
District fixed effects	Yes	Yes	Yes	Yes	Yes
Ubudehe fixed effects	Yes	Yes	Yes	Yes	Yes
Wave fixed effects	Yes	Yes	Yes	Yes	Yes

Note: districts, Ubudehe (income) categories, and year of survey fixed effects included in all regressions; the inverse hyperbolic sine transformation is applied to the continuous outcome values to credibly approximate log values while taking zero-valued observations into account (Bellemare Wichman 2020); outcome variables are expenditures on proteins, fibres, fats, carbohydrates, and vitamins; all estimations weighted at household level; robust standard errors reported in parentheses; *** significant at 1% level, ** significant at 5% level, * significant at 10% level.
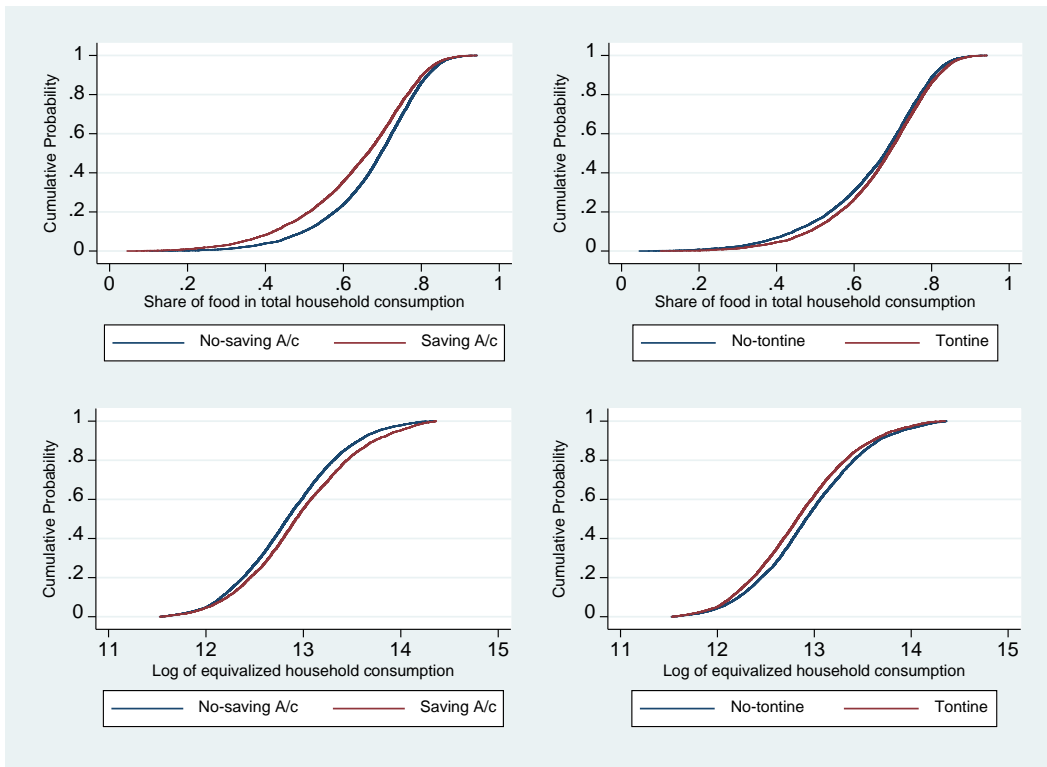
Source: authors' construction based on EICV data.

Figure A1: Distribution of cost of EAT-Lancet diet in 2014 (in Rwandan francs), by district

Source: authors' illustration based on EICV data.

Figure A2: CDF-food share and consumption by household financial access

Note: CDF = cumulative density function.

Source: authors' illustration based on EICV data.