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The impacts of the microfinance multiplied approach on seasonal food insecurity: Evidence from a high-frequency panel survey in Uganda

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Working Paper Series**#2024-014****The impacts of the Microfinance Multiplied approach on seasonal food insecurity: Evidence from a high-frequency panel survey in Uganda****Ricardo Morel, Franziska Gassmann, Bruno Martorano, Nyasha Tirivayi and John Kamau**

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The impacts of the Microfinance Multiplied approach on seasonal food insecurity: Evidence from a high-frequency panel survey in Uganda

Ricardo Morel ^a, Franziska Gassmann ^b, Bruno Martorano ^b, Nyasha Tirivayi ^c, and John Kamau ^d

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Abstract

We study the impact of an innovative program that combines microfinance with farming extension services on food security outcomes in rural South-Western Uganda. For this purpose, we use experimental data and monthly panel data collected over two years to monitor seasonal changes. The results suggest that neither the combined approach of microfinance with farming extension services nor standalone microfinance demonstrated significant effectiveness in reducing food insecurity throughout seasons in the period of analysis. Households in both treatment groups experienced a reduction of dietary diversity mainly during land preparation approximately two years after the start of the interventions. Heterogeneous analysis revealed that households receiving MFM services and having better access to markets experienced occasional improvements in food security. Finally, households with higher food poverty levels in the MFM group experienced some improvements in food security, while those in the Microfinance group encountered sporadic negative outcomes in terms of dietary diversity.

JEL codes: G21, I3, Q16, Q18

Keywords: dietary diversity, food security, microfinance, agriculture

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1. Introduction

Rural populations in Sub-Saharan Africa face significant challenges due to weather and economic shocks associated with seasonal agrarian cycles, leading to variations in income, food access, and consumption. Seasonal poverty, particularly during the lean season, adversely affects food security, dietary intake, and nutritional status (Hoddinott and Yohannes 2002; Sen and Drèze 1989; Janvry et al. 2016). Addressing these issues is a critical policy priority for national governments and the international community, reflected in initiatives like the Sustainable Development Goals and the 'zero hunger' agenda (FAO et al. 2020; FAO 1996; United Nations 2017). Achieving food security requires consistent access to sufficient, safe, and nutritious food that meets dietary requirements and preferences while considering the challenges of seasonality (FAO 2002).

Using an experimental design, this study aims to measure the impact of an innovative approach that integrates Microfinance products with Agriculture, Poultry, and Livestock (APL) extension services on food security across farming seasons. This bundled approach, known as Microfinance Multiplied (MFM), posits that integrating programs addressing complementary outcomes can yield greater impacts than implementing them separately. MFM targets poor rural households that are grappling with seasonality constraints and can enhance household productivity through different mechanisms. Microfinance can improve seasonal income during the lean season, thereby increasing households' liquidity for investments and (food) spending as well as savings capacity, which helps to smoothen consumption over these seasonal shocks (Khandker et al. 2015; 2010). The APL program is directly linked to farming activities, and it offers agriculture, poultry, and livestock extension services, including training on modern farming methods in combination with distributing productive technologies, such as improved seeds or vaccines for chickens and livestock. Extension services can help boost the productivity and diversity of crops and animal products, and the surplus can be sold in the markets or saved for consumption in the lean season (Hawkes and Ruel 2006). While their mechanisms are different, both programs have the potential to complement each other to ensure food security. Cash liquidity can be used immediately to smooth consumption while learning modern farming practices and using improved productive inputs can increase productivity in the longer term. Additionally, credit can be injected into farming activities to boost productivity and commercialize products, which can lead to higher income, savings, and food to better cope with seasonal variations.

Despite the potential complementarity of these programs in ensuring food security, there is limited evidence regarding their synergies in smoothing consumption and mitigating the negative impacts of seasonal shocks. To fill this evidence gap, this study employs a factorial randomised design that compares the impact of the bundled MFM approach and standalone Microfinance to a control group. The aim is to evaluate how these interventions protect households from seasonal variations in food security. The research assesses trends in food security and dietary diversity using a rich panel dataset collected monthly over 24 months in rural South-Western Uganda, predominantly comprising smallholder farmers engaged in rain-fed agriculture.

Results suggest that neither the bundled MFM approach nor standalone microfinance showed significant effectiveness in reducing food insecurity across seasons in the short term. However, there were noticeable negative impacts on dietary diversity during the harvesting and land preparation seasons at the end of the study period. The lack of significant effects on food insecurity outcomes and the negative effects on dietary diversity could be due to institutional and socio-economic factors. The analysis shows that households that resided closer to markets and received MFM services experienced sporadic improvements in food security during harvesting, while dietary diversity remained unchanged. Households with higher food poverty levels in the MFM group experienced some improvements in terms of food security score in the first month and during land preparation phases in the second year, while those in the Microfinance group experienced a decrease in the dietary diversity score during one month of the second harvesting of year one.

This study addresses a gap in the literature by comprehensively examining the impact of bundling microfinance and extension services on food security across agricultural seasons. The existing evidence on the effectiveness of microfinance and farming programs in addressing seasonal food insecurity and dietary diversity is inconclusive, and there is a lack of research on the combined effects of these interventions. This paper makes a valuable contribution to the study of seasonal food security by conducting an in-depth analysis based on a comprehensive panel survey covering four planting and harvesting seasons. Unlike many impact evaluations in the field of development economics that rely on limited data points – usually, two or occasionally three if there is a midline survey – this unique panel of monthly survey rounds over 24 months allows for a thorough exploration of the potential benefits of combining microfinance and technology adoption programs in reducing seasonal food insecurity. Testing the disaggregated impacts of a bundled approach is another contribution of this paper. The factorial randomised design allows for differentiating effects of microfinance services and an integrated multiplied approach that adds on agriculture and livestock extension services. The findings highlight the importance of enhancing program design to incorporate food security and nutrition components at its core, strengthening and adapting microfinance services to rural populations and seasonality, and considering local market access and dynamics.

2. Literature review

Seasonality – understood as intra-annual, seasonal fluctuations in the agrarian cycle – is inherent to smallholder farming households and common in rural Sub-Saharan Africa. This dynamic means that income and consumption are prone to fluctuate depending on the season. In the growing season, when most of the food is produced, farm labour is in demand, food prices are cheaper, and, in general, more income is generated. This period is followed by the lean season when food stocks are depleted, labour is scarce, food prices are higher, and income tends to be lower. This seasonal variation, therefore, raises the opportunity cost of prices, labour, wages, and even migration patterns (Dercon and Krishnan 2007; Devereux, et al. 2011; Kaminski, et al. 2014; Stephens and Barrett 2011; Basu and Wong 2012; Bryan, et al. 2014). There is a large body of evidence that indicates that seasonal variation in household consumption is mainly due

to fluctuations in income, prices, labour, unreliable markets, and access to credit (Rosenzweig and Binswanger 1993; Chaudhuri and Paxson 2002; Paxson 1993). One of the most critical risks of this seasonal dynamic is that households that do not have the necessary coping mechanisms – for example, storing food, savings, assets, credit – will consume more calories and nutrients during the growing season but be unable to meet their an adequate dietary intake during the lean season, negatively affecting their food security and nutritional status, a key dimension of human wellbeing (Hoddinott and Yohannes 2002; Dercon and Krishnan 2007; Christian and Dillon 2016; Janvry et al. 2016).

Achieving effective consumption smoothing is challenging for many poor rural households due to limited resources and external factors such as price fluctuations, labour demand, and health and climate shocks. As a result, rural households use different risk mitigation mechanisms to smoothen consumption and ensure food security, complementing proactive strategies (before seasonal shocks occur) with reactive responses (after seasonal shocks occur). For example, households can store food, use savings, accumulate assets, borrow money, or engage in off-farm labour (Morduch 1995; Fink, Jack, and Masiye 2020; Chambers, et al. 1981; Dercon and Krishnan 2007; Collins et al. 2009). However, degrees of success vary because of the uncertainty of several external factors, such as food price fluctuation, availability of off-farm work, and even the incidence of health and climate shocks, duration of the lean season, among others (Christian and Dillon 2016). The literature also emphasizes that the poorest households are more vulnerable to seasonal deprivation as they cannot afford most of these mechanisms, such as livestock and grain storage, significant savings, or access to flexible credit. As a result, their methods for smoothening consumption are inadequate and inefficient (Khandker, et al. 2015). Even if expected, seasonal variations present constant challenges to poor rural households as they have to constantly save and borrow money to have enough food to eat during the year (Collins et al. 2009).

Certain interventions such as microfinance and farming extension services may have the potential to overcome these constraints and empower households to manage risks and shocks, enabling them to maintain food security and stabilize their consumption. The existent evidence related to these interventions is further discussed below.

Microfinance. Access to credit provides liquidity and can be a tool for consumption smoothening during seasonal shocks (Collins et al. 2009; Morduch 1995; Zeller and Sharma 2000; Angelucci, et al. 2015). Microfinance can also help promote off-farm income-generating activities (Bandiera, et al. 2022; Banerjee, et al. 2015). These activities are less volatile during seasonal shocks and, in principle, provide households with a steadier income during the lean season, allowing more spending on food and helping to smooth consumption during critical moments (Pitt and Khandker 2002; Zaman 1999; 2004; Khandker 2012). However, the evidence base does not convincingly support this claim. Several experimental studies in different contexts show null effects on income, savings, or consumption (Meager 2019; Bandiera, et al. 2022; Banerjee, et al. 2015; Dahal and Fiala 2020).¹ Scholars also point out that standard microfinance

¹ The analysis by Banerjee, Karlan, and Zinman covered Bosnia (Augsburg et al. 2015), Ethiopia (Tarozzi, Desai, and Johnson 2015), India (Banerjee, Karlan, and Zinman 2015), Mexico (Angelucci, Karlan, and Zinman 2015), Morocco (Crépon et al. 2015), and Mongolia (Attanasio et al. 2015) between 2003 and 2012. Meager's research (Meager 2019) included the same studies and added an RCT by Karlan and Zinman (2011) in the Philippines. Dahal and Fiala (2020), finally, added a study by Fiala (2018) in Uganda.

schemes, requiring regular repayments regardless of the income seasonality, can be detrimental to borrowers, for example, by leading to over-indebtedness (Morduch 1999; Schicks 2014; Rahman 1999). Microfinance institutions have started to tailor their products targeted to farmers to the seasonal variations of the agrarian cycle and the evidence, in general, shows that flexible products have more potential than the standard schemes (Field et al. 2013). Evidence of the impact of flexible credit products in Bangladesh and Zambia finds improvements in food security (Khandker, Khalily, and Samad 2015; Fink, et al. 2020), especially among the poorest. Loans are used as a mechanism for consumption smoothing during the lean season and then repaid in small instalments over the year when income and food access increase again (Berg and Emran 2020).

Farming extension services. Rural households in low-income settings face various challenges such as limited resources, high transaction costs, and market 'failures' like the lack of established credit and saving mechanisms. According to the agricultural household model theory, these households make decisions about their production and consumption that are interdependent, and non-separable from their resource allocation decisions (Janvry and Sadoulet 2006; Conceição et al. 2016; Jack 2013; Karlan et al. 2014; Morris et al. 2007; Muzari, et al. 2012; Udry 2010; Janvry et al. 2016).

To address this challenge, farming extension services offer training on modern farming techniques and access to highly productive technologies, such as improved seeds or animal vaccination, to diversify cropping systems and boost the productivity of smallholder farmers, developing, at the same time, their capacity to respond to shocks and risks by smoothing consumption and diversifying diets potential to fight food insecurity (Hawkes and Ruel 2006; Barrett, Reardon, and Webb 2001; Loison 2015). However, the empirical evidence is inconclusive and there is still an important gap in the effects of seasonality. A meta-analysis on the association between the diversification of crop production and diet diversity shows that, while findings tend to be generally positive, few studies report consistent results across indicators (Sibhatu and Qaim 2018). One of the challenges highlighted is the high numbers of additional crops or animal species required for production by smallholder farmers in order to achieve the desired levels of dietary diversity (Sibhatu and Qaim 2018). A systematic review of the effectiveness of agricultural programs on child nutrition in developing countries shows overall positive impacts on productivity and food consumption, however, these effects did not lead to a substantive improvement in the diet of poor households (Masset et al. 2012). However, a recent evaluation in Uganda shows that crop diversification increased household diet diversity and consumption (Tesfaye and Tirivayi 2020). Additionally, there is still little causal evidence of the link between extension services and food security. Researchers found that the adoption of technologies that require low upfront investments achieved food security in Uganda (Pan, et al. 2018). In Tanzania, researchers found that farmer field schools encouraged farmers to adopt technologies that helped smooth production over seasons (i.e., produced food across all seasons) and reduced hunger (Larsen and Bie Lilleør 2014). However, in Cameroon, an evaluation found that extension services did not improve the household dietary diversity score (Ngomi et al. 2020).

3. Uganda and the BRAC program

Description of the context. Uganda is particularly vulnerable to food security as agriculture is mainly rain-fed and thus, susceptible to seasonal and weather shocks (Tesfaye and Tirivayi 2020). Uganda ranks 95th out of 113 countries in the Global Food Security Index and, according to the Ugandan Bureau of Statistics, 37% of households are food-poor whereas rural households were as double as likely to be under this category (The Economist 2022). Agriculture accounts for the largest share of employment with nearly 40% of the working population, of which 43% reported that subsistence farming was their main source of income. However, the adoption of productive farming inputs and technologies remains low (Barua 2011; World Bank 2016; UBOS 2018). Access to credit was rapidly increasing at the time of the study, reaching approximately a quarter of households, but most of them in urban settings. The largest proportion of credit sources were still informal with exorbitant interest rates, particularly in rural areas (Chaia et al. 2009; FSD Uganda 2018; UBOS 2014; 2010; 2018).

The location of the study is in South-Western Uganda, in the districts of Kabale and Rukungiri (Figure 1, Panel A). This setting has a bimodal seasonal calendar, with two rainy seasons (usually between March and June and mid-August to December) and dry seasons in between (WFP 2013). This seasonality means that there are also two main agricultural seasons every year; the first is typically between January to July, and the second is from August to December. Each season includes periods for land preparation, crop cultivation, weeding, and harvesting. The first agricultural season of the year tends to be longer and, therefore, the peak lean season usually takes place around the middle of this period, that is from April to May.

Both Kabale and Rukungiri districts have agriculture as a main source of food and income, but they differ in the main crops they produce. In Kabale, the main crops are potatoes, sorghum, and beans, while in Rukungiri are bananas, beans, and cassava. Most households in both districts manage their food and cash needs during the planting and weeding period through a combination of strategies. They utilize their carry-over stocks from previous seasons, engage in livestock rearing, sell their labour either locally or by migrating to lowland areas, or seek support from relatives (Browne and Glaeser 2010). From 2011 to 2013, the region experienced generally positive patterns of agriculture and livestock production. During this time, bimodal areas in Uganda, including the South-West, overall experienced favourable rainfall, and above-average crop production, leading to replenished food stocks, stabilized prices, and no or minimal food insecurity. In 2014, the bimodal regions saw short dry spells and poor rainfall distribution across both rainy seasons, however, the overall harvests were close to average, and, in general, households were able to meet their food needs through market purchase and seasonal activities, such as crops sales, casual labour in harvest and post-handling activities, and petty trade. Throughout the period of this study, bimodal areas remained in Phase 1 of the Integrated Phase Classification (IPC),² indicating minimal acute food insecurity (FEWS NET 2023).

² The IPC system was developed by a consortium of international organizations including FAO, WFP, UNICEF, and WHO, among others.

Description of the intervention. The non-profit BRAC launched its Microfinance program in the districts of Kabale and Rukungiri in September 2012 while the Agriculture, Poultry, and Livestock (APL) extension program started in January 2013. The Microfinance program provides small loans between USD 200 to 400, equivalent to 30%-70% of per capita annual income, to local self-employed women, who are organised in groups of five that are responsible for each other's loans. Four or five of these groups conform to larger village groups that meet with credit officers weekly. The loan scheme follows the 'classic' or standard model, where borrowers need to repay the full amount in weekly instalments. Borrowers can only borrow additional amounts once they have fully repaid previous loans.

The agriculture extension services provided by the APL program specifically target female farmers and involve training sessions before the planting season. These sessions include both presentations and on-site demonstrations of good agricultural practices, namely crop rotation, intercropping line sowing, and zero tillage. Additionally, the program's model farmers sell improved seeds for both commercial crops, such as potato, eggplant, and cabbage, as well as for their own consumption, such as maize and beans. The poultry and livestock extension services provide advice on vaccination, disease control, and cattle breeding, and offer vaccination services for both cattle and chickens.

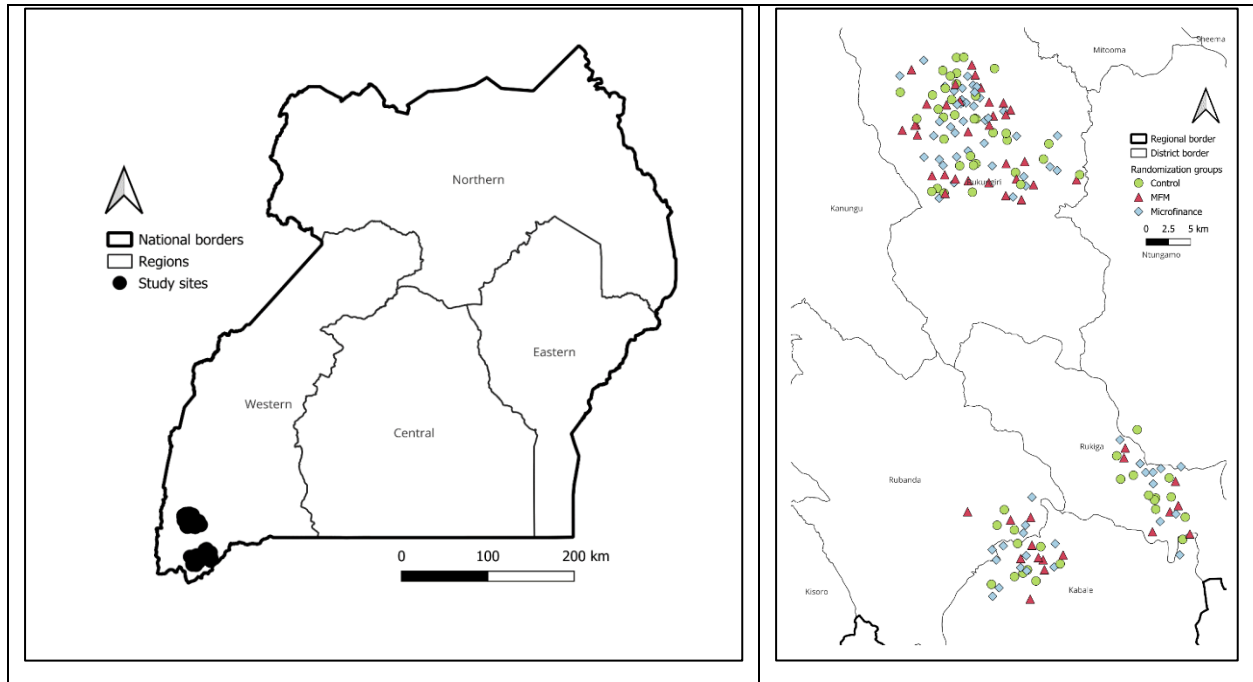
4. Data and methodology

4.1. Data

This study uses a monthly panel survey that collected data on income-generating activities, food security, and consumption at the individual and the household level. The same questionnaire was administered every month to each household in the sample, where the respondent was the main female of the household. The panel sample was drawn from a baseline dataset of 6,992 households across 173 communities³ randomly assigned to three groups, one which received access to MFM – that is a combination of Microfinance and APL programs (52 communities) – another which received access to microfinance only (62 communities), and a third which received neither of these programs, serving as the control group (59 communities). The random assignment was done by stratifying by branch, population size, proportion of farmers, and proximity to the nearest market (Figure 1, Panel B).

³ A 'community' is defined in this paper as a village or a group of villages. Villages were grouped into 'communities' if they shared a trading centre, market, school, church/mosque, health centre or were in the same valley or hillside. The villages were mapped in a census survey in the sub-counties of Kabale, Muhanga (Kabale district), Rukungiri, and Buyanja (Rukungiri district) in 2011, which covered 25,395 households.

Figure 1. Map of project sites (Panel A) and communities by groups (Panel B) – Uganda



Source: own elaboration.

These data, collected between May and July 2012 serve as a baseline for a series of randomised evaluations (Coppel and Sulaiman 2015; Bandiera, et al. 2022; Bandiera, et al. 2022), including this one. To build the panel for this study, five households were randomly sub-sampled from each community, obtaining a total sample of 865. The surveys were conducted from November 2012 to October 2014 and had a median of 855 completed interviews per month. Attrition is non-significant, losing only a median of two households each month. Descriptive statistics are reported in Table A1.

Table 1 also shows the calendar months, panel rounds, and corresponding seasons across the panel period. It is worth noting that the panel started a month after the Microfinance programme was launched. Balance checks between the treatment groups and the control group using data from the baseline and the first month of the panel confirm no major differences across treatment and control groups in the covariates used in the analysis, reassuring that the rollout of the programme did not result in significant differences that would limit the analysis (Table A2).

Table 1. Seasons by month

Panel month	Calendar month	Season	Panel month	Calendar month	Season
1	Nov-12	Lean	13	Nov-13	lean
2	Dec-12	Harvest	14	Dec-13	harvest
3	Jan-13	Harvest	15	Jan-14	harvest
4	Feb-13	land preparation	16	Feb-14	land preparation
5	Mar-13	land preparation	17	Mar-14	land preparation
6	Apr-13	land preparation	18	Apr-14	land preparation
7	May-,13	Lean	19	May-14	lean
8	Jun-13	Lean	20	Jun-14	lean
9	Jul-13	Harvest	21	Jul-14	harvest
10	Aug-13	Harvest	22	Aug-14	harvest
11	Sep-13	land preparation	23	Sep-14	land preparation
12	Oct-13	land preparation	24	Oct-14	land preparation

Source: own elaboration.

Main outcomes of interest. The scope of the analysis is centred on the outcomes of food security and dietary diversity. To measure food security, this work uses **Household Food Insecurity Access Scale (HFIAS)**, which captures food access in terms of quantity and quality while grasping behavioural and psychological manifestations of anxiety and uncertainty around food access. The HFIAS is a practical tool as it can easily be built in as a short survey module, containing only a few questions about food access with a recall period of 30 days, and can identify changes over time (Ballard et al. 2011; Coates, et al. 2007). The module consists of two sets of nine questions each, one about the ‘occurrence’ of an event and the other about the frequency of occurrence of that same event. Responses are given values depending on their severity obtaining a score that ranges from zero to 27, where the higher the score is, the higher food insecurity is. The descriptive statistics reveal a general decline in food insecurity over time, with minor average increases observed during periods of food scarcity (lean seasons). The average HFIAS score was 5.78 (Table A1).

In addition to food security, the analysis focuses on household dietary diversity which refers to the variety of food groups consumed by a household within a specified time frame. It is a crucial measure of food security as it reflects the household’s ability to access a wide range of foods and its socioeconomic status. Studies have shown that a more diverse diet is linked to adequate nutrition status and a higher household income (Ruel 2003; Headey and Ecker 2013; Hoddinott and Yohannes 2002; Swindale and Bilinsky 2006; Drescher, et al. 2007; Ruel and Alderman 2013). Our study uses the **Household Dietary Diversity Score (HDDS)**, which assesses a household’s food access based on the foods consumed in the past 24 hours and is used as a proxy measure of household food access. The HDDS indicator

measures household dietary diversity by assigning a score of 1 for each of the 12 food groups⁴ that were consumed by the household over a given reference period, with the household score ranging from 0 to 12, which represents the total number of food groups consumed (Kennedy, et al. 2011). The descriptive statistics for HDDS suggest a general stable trend, with an average score of 6.59 (Table A1).

Intermediary outcomes. In addition to food security outcomes, the analysis examines intermediate outcomes related to the seasonal consumption smoothing to maintain food security. Specifically, the study considers access to credit from formal sources – which include banks, microfinance institutions, NGOs, Savings and Credit Cooperative Organizations (SACCO), and Rotating Savings and Credit Associations (ROSCA). On average, 27 percent of households report borrowing from formal sources and 78 percent of households reported maintaining some form of cash savings. Borrowing behaviour tended to increase after lean seasons while savings behaviour remained relatively stable over time and across groups. Another mechanism that is used to cope with seasonality is the shift in labour market participation, which includes salaried jobs in farm and off-farm settings as well as entrepreneurial activities. Specifically, we consider three different variables: salaried work on someone else’s farm; non-agricultural or livestock-related entrepreneurial activities; and non-farm wage work. Descriptive statistics about the intermediary outcomes are reported in Table A1.

4.2. *Empirical strategy*

The study is based on a randomised evaluation to assess the impacts of the programs based on Intention-to-Treat (ITT) estimates, which use data from all households originally assigned to the treatment groups, regardless of program uptake. The empirical strategy uses an OLS regression model with fixed effects to evaluate the impacts of each treatment group relative to the control group. The regression analysis outputs are produced using monthly time periods separately. In other words, for each month independently, from month 1 to month 24, the following model is estimated:

$$Y_{hc} = \alpha + \beta MFM_c + \beta MFI_c + X_{h0} + \delta_b + \varepsilon_c \quad (\text{Eq. 1})$$

Where Y_{hct} is the outcome of interest in household h in community c at a specific time period. MFM and MFI are binary variables for each treatment arm, namely MFM (communities that received both microfinance and agriculture and livestock services) and Microfinance (communities that only had access to microfinance but not farming services). X_{h0} represents the selected control variables at the household level h at baseline. Baseline control variables include the respondent’s age, marital status, completion of primary schooling, borrowing money in the last year, engagement in agriculture, livestock, or poultry activities in the last year at the individual level, and average number of meals per day

⁴ Cereals, roots and tubers, vegetables, fruits, meat, poultry, offal, eggs, fish and seafood, pulses, legumes, nuts, milk and milk products, oil/fats, sugar/honey, and miscellaneous.

and the number of rooms used for sleeping at the household level. δ_b includes branch-level fixed effects and ε represents the error term. Standard errors were clustered at the community level.

The cross-sectional analysis approach allows for the examination of individual time periods, facilitating the identification of potential variations and trends over time. This strategy was chosen considering that the available outcomes of interest start at a month after the Microfinance programme began, lacking a “month 0” or pure baseline period. As reported above, this did not affect the balancing property of our sample resulting in significant differences that would limit the analysis (Table A2). Further robustness checks show that results hold while using alternative empirical strategy (see Section 5).

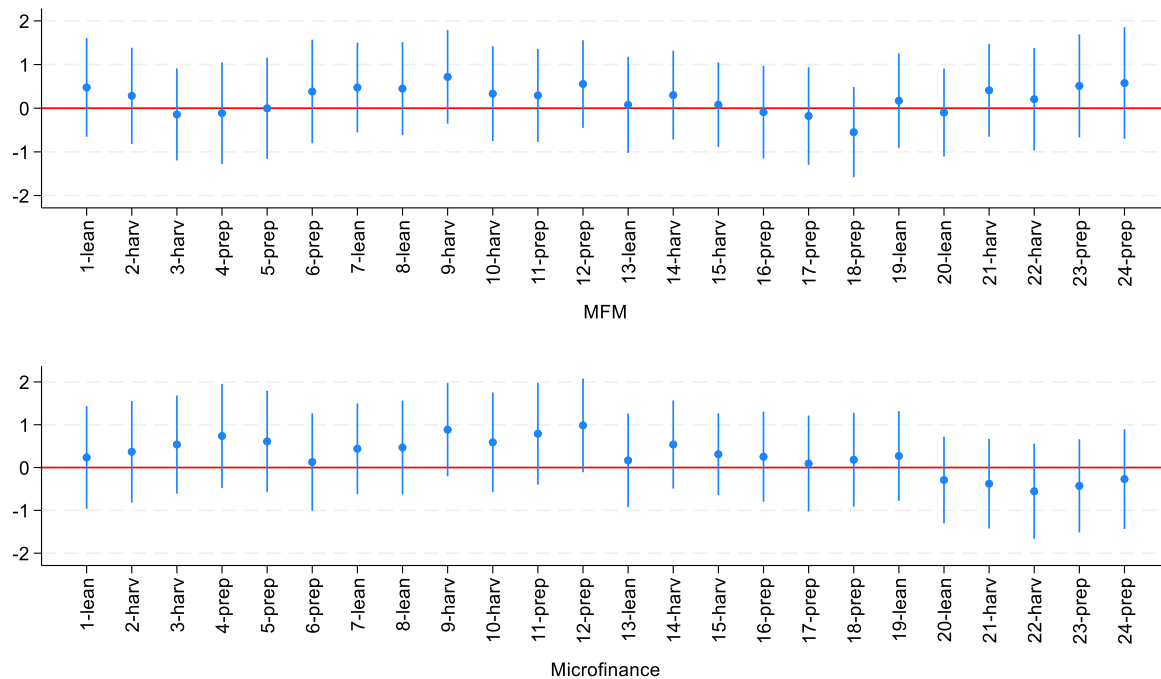
5. Results

This section reports the results of our analysis summarizing graphically the regression coefficients of the treatment effects across the 24 consecutive months in the panel survey. The corresponding tables are reported in the appendix. This dynamic analysis not only offers a clear snapshot of how treatment impacts vary over time but also facilitates a nuanced understanding of seasonal variations and significance, aiding in the interpretation of their policy implications.

5.1. Food Security and Dietary Diversity

Figures 2 and 3 report the results of our analysis looking at the impact of MFM and MFI interventions on food security and dietary diversity. Results on HFIAS show no significant effects of the interventions across seasons, meaning that neither microfinance nor MFM managed to successfully improve food security or food access among the targeted population (Figure 2, Table A3). The findings are not particularly surprising as the scarce existing evidence summarized above does not suggest that Microfinance leads to food security (Islam et al. 2016) nor does it increase household food consumption (Banerjee, et al. 2015; Meager 2019; Bandiera, et al. 2022; Dahal and Fiala 2020). It is worth noting that the microfinance product offered to households in the study sample was the standard model based on short repayment cycles. Lacking the flexibility to adapt to farming seasons and cycles could add liquidity constraints to households (Beaman et al. 2014; Khandker, et al. 2015; Berg and Emran 2020; Field et al. 2013; Morduch 1999; Schicks 2014; Karlan 2014; Rahman 1999). Moreover, another possible explanation from a programmatic perspective is that the interventions in question have primarily focused on improving productivity and economic aspects rather than directly targeting food access and security.

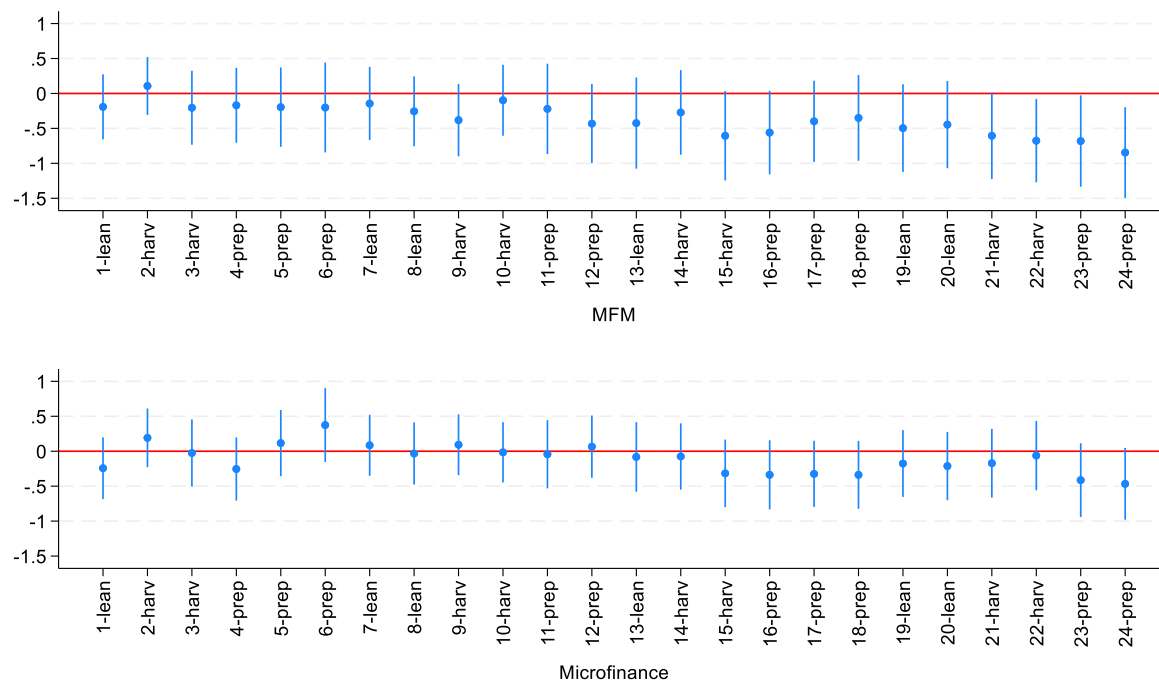
Figure 2. Household Food Insecurity Access Scale (HFIAS) score – OLS panel analysis by month



Note: Labels next to the x-axis in each figure refer to the month number and the season. "Lean" refers to the lean season; "harv" stands for harvesting; "prep" refers to land preparation.

The household dietary diversity score (HDDS), however, shows that households in the MFM group experienced, on average, significantly lower scores compared to the control group towards the end of the last harvesting season in the study period (month 22) and the subsequent two land preparation months (months 23 and 24) (Figure 3, Table A4). Our findings are in line with the existing literature discussed above showing that APL interventions do not effectively improve dietary diversity (Sibhatu and Qaim 2018, Masset et al. 2012, Ngomi et al. 2020). Related to the interpretation offered above, a possible explanation for these negative effects is that the theories of change of both Microfinance and APL interventions focus on productivity impacts rather than promoting a diverse and nutritious diet. Therefore, the programs may not have the right mechanisms built in to address dietary diversity outcomes effectively. Reflecting on the trade-offs that households make when allocating resources, households with access to MFM products and services may have prioritized investing in other income-generating activities, like entrepreneurial ventures, possibly at the expense of household dietary diversity (Pan, et al. 2018). This highlights the trade-offs that households may have made when allocating resources, which could have impacted their overall food security.

Figure 3. Household Dietary Diversity Score (HDDS) – OLS panel analysis by month



Note: Labels next to the x-axis in each figure refer to the month number and the season. "Lean" refers to the lean season; "harv" stands for harvesting; "prep" refers to land preparation.

Robustness check. Results on the main outcomes of interest are further explored using a difference-in-difference (DID) estimation. The DID model assesses effects of the treatment groups over time compared to the control group. The model compares the differences of month 1 with each of the subsequent months. In other words, the regression is repeated for the interaction on month 1 with each following month, starting from month 2 until month 24. This approach allows identify whether and how the treatments have an impact that varies across different time periods relative to the first month of the panel.

The DID analysis yielded similar results to the OLS regression analysis in terms of the lack of significant impacts on the HFIAS score (Table A5). Regarding dietary diversity, the only impact observed in the DID analysis was a higher score during the first land preparation period, just before the lean season. This finding contrasts with the results of the OLS analysis, where negative significant effects were observed on adequate dietary diversity in the last three months of the panel, during the last land preparation season in the study period. While some differences were observed between the DID analysis and the main OLS analysis by panel month, the overall trends were not substantially different. These

findings provide additional robustness to the main results and support the conclusion that the interventions did not have significant impacts on food security and dietary diversity.

5.2 Intermediary Outcomes

Exploration of the impact on intermediary outcomes – namely borrowing, savings, and labour – do not show clear trends of significant differences between the treatment groups and the control (Table A6 to Table A10). The study findings show no significant changes in formal borrowing and savings over seasons, in line with the findings of multiple experimental studies in diverse contexts (Banerjee, et al. 2015; Meager 2019; Dahal and Fiala 2020; Bandiera, et al. 2022). The only exception are households in the MFM group who borrowed less, on average, than those in the control group during one month of the last harvest season (month 22), which coincides with the significant decrease in dietary diversity. As discussed in the interpretation of food security outcomes, structural and programmatic barriers, such as a standard repayment model that offered no flexibility to rural households may have reduced households' ability to engage (Morduch 1999; Schicks 2014; Rahman 1999). Additionally, there were no sustained changes in labour participation, but those in the microfinance group worked more on someone else's land during the lean weeding season (month 13) and increased entrepreneurial engagement during the first land preparation season (months 5 and 6).

6. Heterogenous analysis

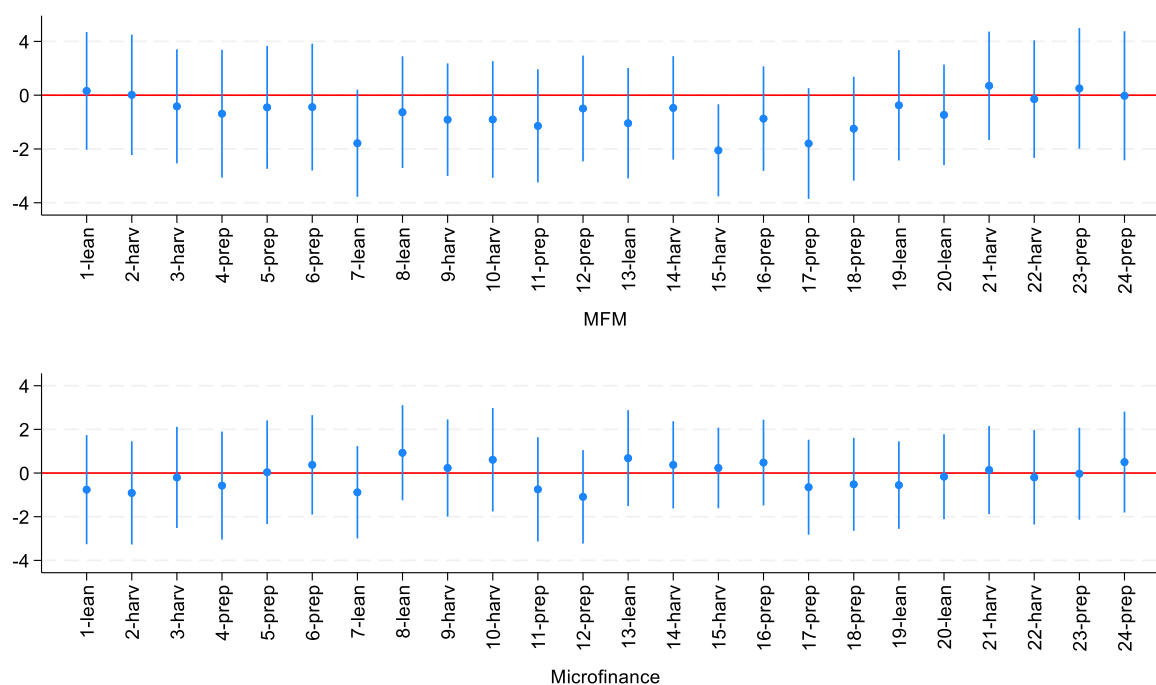
This section focuses into heterogenous treatment effects by examining the influence of distance to the nearest market and wealth. By considering these factors, the study aims to uncover nuanced insights into the varying impacts of the interventions on food security and dietary diversity among different subgroups within the study population.

6.1. Distance to the nearest market

Proximity to markets can shape opportunities and constraints for households as it provides opportunities to access productive inputs, financial products, commercial information as well as more and diverse foods. Households closer to markets may also be better positioned to access off-farm income sources, reducing agriculture dependence. Conversely, farther households face elevated transaction costs, diminishing market these opportunities (Suri 2011; Abay and Jensen 2020; Madzorera et al. 2021; Kuss, Gassmann, and Mugumya 2022). Therefore, analysing the impact of interventions such as microfinance and agriculture extension programs by distance to markets can provide insights into whether different households experience varying impacts, which is crucial for designing more targeted and effective development policies. The distance was calculated by asking respondents in the baseline survey for the time it took them to walk to the nearest trading centre or market. Using the median time at the community level, these were then divided into two groups based on their distance to the market, with the median distance serving as the cut-off point. We create a dummy variable with a value of one for households closer to markets (i.e. below the median reported distance) and interact this variable with the treatment variables to estimate the differential impact of the programs due to the distance to the nearest market.

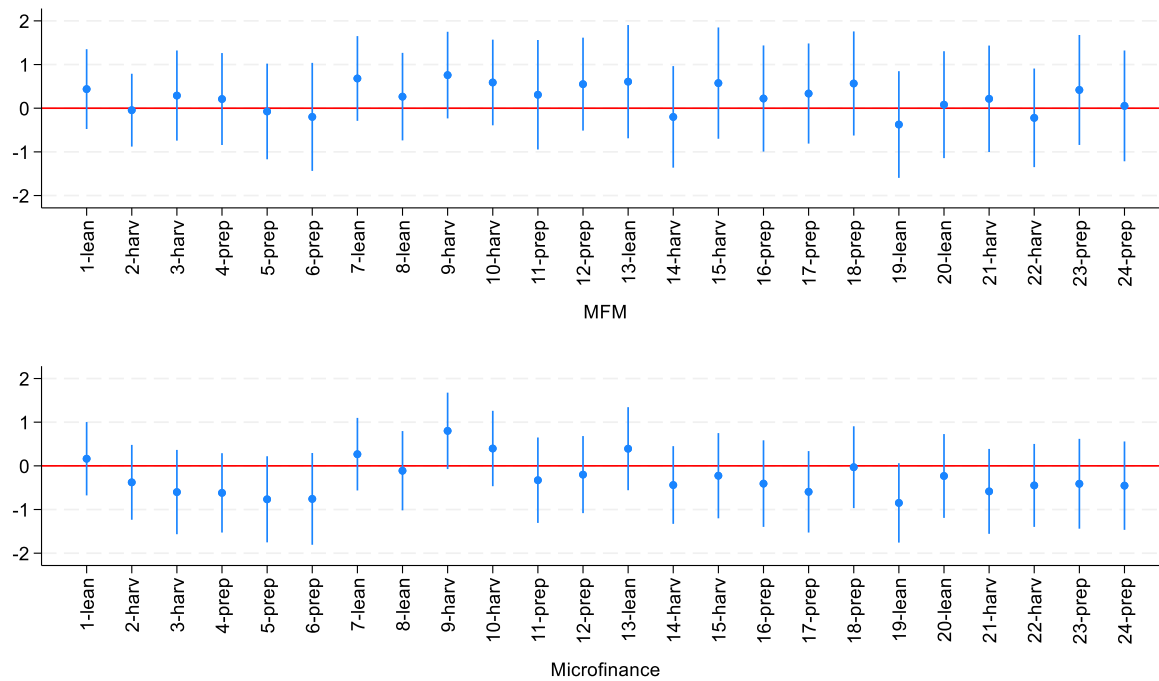
Results show that households closer to markets experience a significant decrease in the household food insecurity score in the MFM group during the first harvesting season of the second year (month 15) (Figure 4, Table A11). By contrast, the analysis of the dietary diversity score does not show significant changes based on the distance to markets (Figure 5, Table A12). Hence, the observed improvements in food security outcomes among households closer to markets in the MFM group seem to be sporadic, only appearing in specific months but hardly creating a clear trend.

Figure 4. Household Food Insecurity Access Scale (HFIAS) score by distance to market (Closer to the market)



Note: Labels next to the x-axis in each figure refer to the month number and the season. "Lean" refers to the lean season; "harv" stands for harvesting; "prep" refers to land preparation.

Figure 5. Household Dietary Diversity Score (HDDS) by distance to market (Closer to the market)



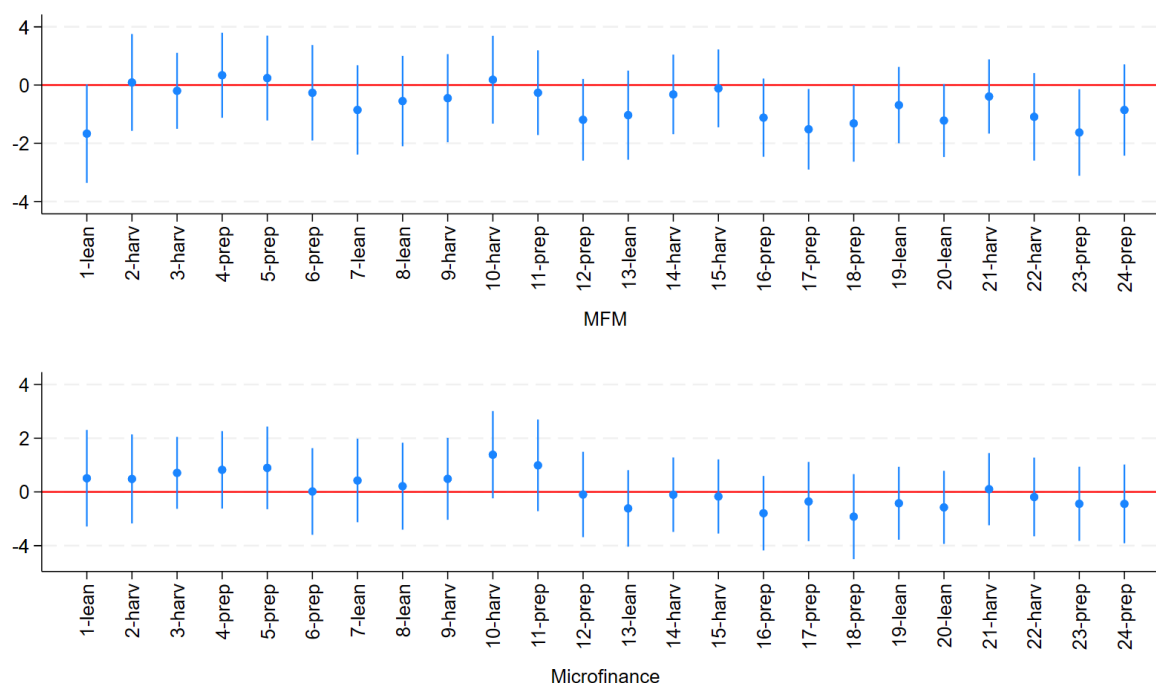
Note: Labels next to the x-axis in each figure refer to the month number and the season. "Lean" refers to the lean season; "harv" stands for harvesting; "prep" refers to land preparation.

6.2 Food poverty

Food poverty is measured by a dummy variable based on the number of types of food consumed at baseline. Households who consume less than the average number of food types, indicating higher food poverty, get a value of one. We interact this variable with the treatment variables to estimate the differential impact of the programs due to their level of food poverty.

The analysis reveals that food-poor households in the MFM group experience a significant decrease in the **food insecurity** score in the first month and during the land preparation phase in the second year (months 17 and 23), (Figure 6, Table A13). However, significant changes are not consistent over time and, therefore, levels of food consumption do not seem to have substantial and sustained impacts in food security outcomes.

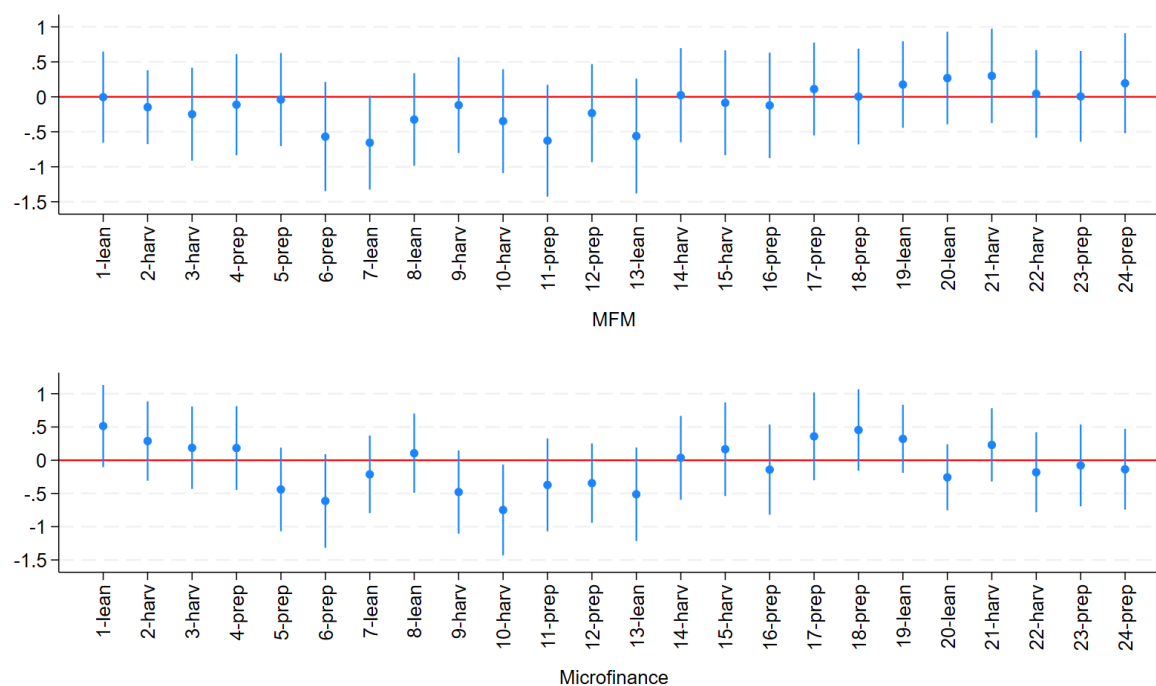
Figure 6. Household Food Insecurity Access Scale (HFIAS) score by food consumption (Food poverty)



Notes: Labels next to the x-axis in each figure refer to the month number and the season. "Lean" refers to the lean season; "harv" stands for harvesting; "prep" refers to land preparation.

Results also indicate a decrease in the **dietary diversity** score among food-poor households in the Microfinance group during the second harvesting of year one (month 10) (Figure 7, Table A14). The observed decreases in dietary diversity among food-poor households are scattered and inconclusive. A possible interpretation of these changes, however, could be attributed to the fact that these households faced limitations in accessing a variety of foods due to their financial constraints. Despite the provision of microfinance, the available financial resources may still be insufficient to support diverse food purchases. Moreover, asset-poor households may have limited access to markets and may be constrained by higher food prices and limited availability of diverse food items. It is important to note that while microfinance interventions may improve access to financial resources, additional focused support activities on enhancing food access and nutrition education may be necessary to address the specific challenges faced by asset-poor households in improving their dietary diversity.

Figure 7. Household Dietary Diversity Score (HDDS) by food consumption (Food poverty)



Note: Labels next to the x-axis in each figure refer to the month number and the season. "Lean" refers to the lean season; "harv" stands for harvesting; "prep" refers to land preparation.

7. Conclusions

The study implements a randomised evaluation to examine the impacts of Microfinance and an integrated approach that combines Microfinance with Agriculture, Poultry, and Livestock extension programs on food security outcomes and dietary diversity over farming seasons. The results indicate that the interventions did not have significant effects on food security outcomes, as measured by the Household Food Insecurity Access Scale (HFIAS). Moreover, the analysis on dietary diversity indicates that households in both the MFM approach and the standalone Microfinance program experienced a significantly lower Households Dietary Diversity Score (HDDS) during the last harvesting season and subsequent land preparation months in the study period. Heterogeneous analysis employing distance to markets and levels of food poverty produced interesting results. The analysis reveals that households closer to markets in the MFM group experienced positive food security outcomes, particularly during the first harvesting season of the second year. Moreover, households with higher food poverty levels in the MFM group experienced some improvements in terms of

food security in the first month and during land preparation phases in the second year; however, households with higher food poverty in the Microfinance group experienced sporadic negative outcomes in terms of dietary diversity.

The findings of this study provide valuable insights for policymakers and practitioners aiming to enhance the effectiveness of financial inclusion interventions in addressing food security and dietary diversity. One key takeaway is the importance to enhance the design of financial inclusion programs by building in components that explicitly target food security and nutrition outcomes. It is not enough to simply bundle it with another program – in this case, APL services – if it does not integrate mechanisms that directly enhance the intake of diverse and nutritious foods into the program design. In other words, the recommendation is to take a comprehensive stand by focusing not only on income generation and productivity but also on engraining other dimensions in the program design, such as food-related aspects that can more effectively contribute to improving food security and nutritional well-being among vulnerable populations. Additionally, it is crucial to tailor microfinance products and services to the specific needs of households, particularly for rural households with volatile income due to agricultural seasons (e.g., including flexible repayment terms) while taking into consideration the dynamics of local markets. More granular findings also suggest that proximity and access to markets can play a crucial role in mitigating food insecurity. Moreover, targeting poorer sections of the population is relevant to tackle food security-related outcomes.

These recommendations can contribute to the improvement of financial inclusion interventions in addressing food security and dietary diversity. By enhancing program design, strengthening microfinance services, considering local market dynamics, effectively targeting less-wealthy populations, and prioritizing long-term measurement, policymakers and practitioners can refine interventions and promote sustainable improvements in food security and nutritional well-being among vulnerable populations.

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Appendix

Table A1. Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
<i><u>Final outcomes</u></i>					
HFIAS score	19,515	5.78	4.14	0	27
HDDS score	19,868	6.59	1.94	0	12
<i><u>Intermediate outcomes</u></i>					
Borrowed from formal sources last month	20,443	0.27	0.44	0	1
Saved last month (any amount)	20,443	0.78	0.41	0	1
Laborer on someone else's land (wages)	20,443	0.14	0.35	0	1
No farm labour (self-employed)	20,443	0.25	0.43	0	1
No farm labour (wages)	20,443	0.04	0.20	0	1
<i><u>Control variables</u></i>					
Age of respondent	20,366	43.12	16.97	18	98
Marital status	20,271	1.89	1.46	1	6
Primary education completed	19,960	.20	.40	0	1
Borrowed from formal sources in the last year	20,443	.53	.50	0	1
Engaged in agriculture or livestock in the last year	20,443	.91	.29	0	1
Number of sleeping rooms in the house	20,030	3.02	1.86	1	8
Average number of meals per day	19,694	2.26	.69	1	5

Table A2. Balance check at baseline

Variables	(1) All treatments	(2) MFM	(3) Microfinance
Age of respondent	0.00182 (0.00133)	-0.00109 (0.00122)	0.00291* (0.00128)
Marital status	-0.0149 (0.0144)	-0.00120 (0.0126)	-0.0137 (0.0143)
Primary education completed	-0.0285 (0.0519)	-0.000315 (0.0525)	-0.0281 (0.0512)
Borrowed from formal sources in the last year	-0.00583 (0.0372)	0.0211 (0.0403)	-0.0270 (0.0359)
Engaged in agriculture or livestock in the last year	-0.0506 (0.0740)	0.0118 (0.0780)	-0.0624 (0.0811)
Number of sleeping rooms in the house	-0.0161 (0.0194)	0.00786 (0.0189)	-0.0240 (0.0205)
Average number of meals per day	0.0220 (0.0288)	0.0190 (0.0281)	0.00299 (0.0310)
Kept cash savings in the last year	-0.0985 (0.0725)	-0.0487 (0.0665)	-0.0498 (0.0709)
Worked in someone else's farm (wages)	0.0765 (0.0799)	0.0558 (0.0799)	0.0207 (0.0868)
Worked off-farm (self-employed)	0.101* (0.0506)	-0.00536 (0.0468)	0.107 (0.0578)
Worked off-farm (wages)	-0.0239 (0.0890)	-0.0540 (0.0755)	0.0301 (0.0924)
Prevalence of household food insecurity access (based on HFIAS)	-0.0835 (0.0680)	0.0391 (0.0592)	-0.123 (0.0681)
Insufficient food access (based on HFIAS)	0.0146 (0.0549)	0.0474 (0.0562)	-0.0328 (0.0512)
Inadequate dietary diversity (based on HDDS)	-0.00149 (0.0836)	0.0209 (0.0923)	-0.0224 (0.0829)
Constant	0.779** (0.152)	0.237* (0.118)	0.542** (0.155)
Observations	792	792	792
R-squared	0.007	0.013	0.019

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A3. HFIAS: Household Food Insecurity Scale Score (0-27) – OLS panel analysis by month

Month	Season	MFM	[S.E.]	Mfinance	[S.E.]	Obs	R ²	Control avg	MFM avg	Mfi avg
month 1	weeding	0.4766	[0.5730]	0.2364	[0.6072]	774	0.112	7.516	7.794	7.607
month 2	harvest	0.2834	[0.5583]	0.3688	[0.6000]	771	0.104	7.115	7.408	7.527
month 3	harvest	-0.1426	[0.5338]	0.5384	[0.5800]	754	0.112	6.107	5.885	6.688
month 4	preparation	-0.1140	[0.5890]	0.7379	[0.6152]	738	0.099	6.126	5.906	6.917
month 5	preparation	-0.0023	[0.5875]	0.6106	[0.5982]	715	0.095	6.228	6.192	6.793
month 6	preparation	0.3827	[0.6012]	0.1288	[0.5759]	706	0.094	6.251	6.597	6.469
month 7	lean	0.4740	[0.5210]	0.4393	[0.5367]	712	0.079	6.093	6.529	6.645
month 8	lean	0.4484	[0.5396]	0.4685	[0.5555]	751	0.119	5.834	6.169	6.323
month 9	harvest	0.7185	[0.5438]	0.8833	[0.5515]	773	0.152	5.099	5.684	5.905
month 10	harvest	0.3333	[0.5493]	0.5894	[0.5890]	764	0.178	5.364	5.601	5.916
month 11	preparation	0.2936	[0.5388]	0.7895	[0.6009]	768	0.191	5.046	5.178	5.714
month 12	preparation	0.5538	[0.5083]	0.9846	[0.5545]	767	0.199	4.850	5.167	5.644
month 13	lean	0.0784	[0.5568]	0.1677	[0.5528]	627	0.147	5.797	5.797	6.057
month 14	harvest	0.2996	[0.5154]	0.5392	[0.5215]	772	0.113	5.267	5.526	5.763
month 15	harvest	0.0793	[0.4902]	0.3116	[0.4835]	778	0.103	4.830	4.926	5.162
month 16	preparation	-0.0900	[0.5374]	0.2540	[0.5328]	778	0.112	5.003	4.912	5.234
month 17	preparation	-0.1775	[0.5662]	0.0941	[0.5669]	768	0.146	5.245	5.072	5.387
month 18	preparation	-0.5490	[0.5231]	0.1829	[0.5556]	776	0.117	5.475	4.898	5.579
month 19	lean	0.1713	[0.5495]	0.2697	[0.5319]	759	0.141	5.777	5.813	5.943
month 20	lean	-0.0993	[0.5100]	-0.2906	[0.5113]	782	0.105	5.372	5.327	5.076
month 21	harvest	0.4086	[0.5374]	-0.3767	[0.5311]	780	0.126	5.303	5.728	4.917
month 22	harvest	0.2058	[0.5944]	-0.5532	[0.5633]	780	0.097	5.339	5.492	4.649
month 23	preparation	0.5110	[0.5970]	-0.4276	[0.5507]	772	0.139	5.589	5.988	5.023
month 24	preparation	0.5752	[0.6466]	-0.2698	[0.5894]	687	0.174	5.353	5.511	4.767

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A4. HDDS: Household Dietary Diversity Score (0-12) – OLS panel analysis by month

Month	Season	MFM	[S.E.]	Mfinance	[S.E.]	Obs	R ²	Control avg	MFM avg	Mfi avg
month 1	weeding	-0.1916	[0.2358]	-0.2434	[0.2231]	791	0.068	5.782	5.651	5.545
month 2	harvest	0.1072	[0.2096]	0.1914	[0.2126]	788	0.101	6.301	6.463	6.466
month 3	harvest	-0.2044	[0.2681]	-0.0251	[0.2436]	789	0.100	6.752	6.665	6.805
month 4	preparation	-0.1692	[0.2716]	-0.2545	[0.2287]	782	0.101	6.418	6.395	6.295
month 5	preparation	-0.1961	[0.2874]	0.1164	[0.2397]	774	0.119	6.436	6.293	6.560
month 6	preparation	-0.2019	[0.3254]	0.3741	[0.2675]	779	0.122	6.372	6.260	6.839
month 7	lean	-0.1442	[0.2651]	0.0851	[0.2210]	765	0.085	6.242	6.207	6.392
month 8	lean	-0.2558	[0.2532]	-0.0327	[0.2253]	775	0.093	6.493	6.341	6.530
month 9	harvest	-0.3817	[0.2622]	0.0925	[0.2203]	774	0.140	6.741	6.456	6.846
month 10	harvest	-0.0976	[0.2574]	-0.0155	[0.2184]	763	0.108	6.543	6.448	6.444
month 11	preparation	-0.2208	[0.3274]	-0.0434	[0.2473]	768	0.103	6.755	6.530	6.744
month 12	preparation	-0.4317	[0.2866]	0.0656	[0.2259]	767	0.135	6.686	6.299	6.832
month 13	lean	-0.4242	[0.3298]	-0.0815	[0.2516]	627	0.160	6.356	5.934	6.295
month 14	harvest	-0.2721	[0.3064]	-0.0748	[0.2402]	772	0.156	6.719	6.455	6.662
month 15	harvest	-0.6054	[0.3238]	-0.3163	[0.2445]	778	0.134	7.018	6.527	6.812
month 16	preparation	-0.5595	[0.3033]	-0.3377	[0.2502]	778	0.126	7.028	6.458	6.734
month 17	preparation	-0.3983	[0.2939]	-0.3239	[0.2394]	768	0.128	6.918	6.618	6.693
month 18	preparation	-0.3503	[0.3106]	-0.3378	[0.2463]	776	0.171	6.975	6.675	6.675
month 19	lean	-0.4961	[0.3176]	-0.1758	[0.2419]	759	0.157	6.652	6.217	6.582
month 20	lean	-0.4459	[0.3162]	-0.2123	[0.2473]	782	0.125	6.872	6.512	6.747
month 21	harvest	-0.6055	[0.3136]	-0.1719	[0.2489]	780	0.161	6.952	6.461	6.890
month 22	harvest	-0.6756*	[0.3015]	-0.0620	[0.2509]	780	0.169	7.014	6.417	7.010
month 23	preparation	-0.6811*	[0.3308]	-0.4134	[0.2672]	772	0.157	7.354	6.797	7.066
month 24	preparation	-0.8456*	[0.3285]	-0.4661	[0.2601]	687	0.177	7.378	6.689	7.030

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A5. Food security indicators – DID analysis

	Group		HFIAS Score	HDD Score
rvest	MFM	month_2	-0.2271 [0.5508]	0.2691 [0.1944]
	Mfi	month_2	0.1327 [0.5499]	0.4071 [0.2129]
	MFM	month_3	-0.6325 [0.5967]	-0.0470 [0.2479]
	Mfi	month_3	0.2808 [0.6102]	0.2224 [0.2345]
	MFM	month_4	-0.6349 [0.6307]	-0.0098 [0.2719]
	Mfi	month_4	0.5503 [0.6361]	-0.0116 [0.2652]
Preparation	MFM	month_5	-0.5301 [0.6151]	-0.0378 [0.2874]
	Mfi	month_5	0.4334 [0.6026]	0.3680 [0.2494]
	MFM	month_6	-0.1043 [0.6202]	-0.0376 [0.3203]
	Mfi	month_6	-0.0684 [0.5758]	0.6323* [0.2849]
	MFM	month_7	-0.0806 [0.6426]	0.0110 [0.3027]
	Mfi	month_7	0.2017 [0.6120]	0.3153 [0.2928]
Lean	MFM	month_8	-0.0784 [0.6820]	-0.0797 [0.3033]
	Mfi	month_8	0.2512 [0.6497]	0.1960 [0.3017]
	MFM	month_9	0.1552 [0.7126]	-0.2069 [0.3214]
	Mfi	month_9	0.6045 [0.6502]	0.3230 [0.3046]
Harvest	MFM	month_10	-0.2501 [0.7272]	0.0647 [0.3021]
	Mfi	month_10	0.3281 [0.6697]	0.2133 [0.2765]
	MFM	month_11	-0.2579 [0.6959]	-0.0796 [0.3676]
	Mfi	month_11	0.5669 [0.6488]	0.1753 [0.3038]
Preparation	MFM	month_12	0.0127 [0.6590]	-0.2751 [0.3370]
	Mfi	month_12	0.6862 [0.6891]	0.2934 [0.2954]
	MFM	month_13	-0.4851 [0.7589]	-0.2594 [0.3859]
	Mfi	month_13	-0.0345 [0.7901]	0.1476 [0.3200]
Harvest	MFM	month_14	-0.2703 [0.7208]	-0.1340 [0.3705]
	Mfi	month_14	0.2675 [0.7158]	0.1815 [0.3149]
	MFM	month_15	-0.4836 [0.7136]	-0.4534 [0.3785]
	Mfi	month_15	0.0473 [0.7215]	-0.0582 [0.3138]

	Group		HFIAS Score	HDD Score
Preparation	MFM	month_16	-0.6278 [0.7017]	-0.3833 [0.3649]
	Mfi	month_16	0.0106 [0.6987]	-0.0745 [0.3329]
	MFM	month_17	-0.7468 [0.7838]	-0.2327 [0.3552]
	Mfi	month_17	-0.1742 [0.7459]	-0.0612 [0.3166]
	MFM	month_18	-1.1088 [0.7352]	-0.1904 [0.3625]
	Mfi	month_18	-0.1166 [0.7471]	-0.0773 [0.3099]
Lean	MFM	month_19	-0.3748 [0.7336]	-0.3383 [0.3886]
	Mfi	month_19	-0.0028 [0.7759]	0.0731 [0.3362]
	MFM	month_20	-0.6302 [0.6906]	-0.2975 [0.4099]
	Mfi	month_20	-0.5354 [0.7318]	0.0313 [0.3491]
Harvest	MFM	month_21	-0.1329 [0.7291]	-0.4444 [0.3853]
	Mfi	month_21	-0.6518 [0.7571]	0.0904 [0.3264]
	MFM	month_22	-0.3371 [0.7561]	-0.5195 [0.3763]
	Mfi	month_22	-0.8044 [0.7959]	0.1803 [0.3321]
Preparation	APL	month_23	-0.0810 [0.7745]	-0.5207 [0.3802]
	MFM	month_23	-0.6836 [0.7843]	-0.1512 [0.3178]
	Mfi	month_24	0.0251 [0.7956]	-0.6817 [0.3919]
	MFM	month_24	-0.5673 [0.8388]	-0.1969 [0.3243]

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A6. Borrowing from formal sources – OLS panel analysis by month

Month	Season	MFM	[S.E.]	Mfinance	[S.E.]	Obs	R ²	Control avg	MFM avg	Mfi avg
month 1	weeding	-0.0337	[0.0445]	-0.0841	[0.0451]	792	0.071	0.364	0.337	0.292
month 2	harvest	-0.0411	[0.0421]	-0.0818	[0.0423]	792	0.097	0.309	0.267	0.224
month 3	harvest	-0.0014	[0.0368]	-0.0341	[0.0373]	791	0.093	0.213	0.191	0.175
month 4	preparation	-0.0113	[0.0380]	-0.0251	[0.0371]	792	0.075	0.220	0.194	0.185
month 5	preparation	-0.0125	[0.0431]	-0.0601	[0.0392]	790	0.078	0.275	0.242	0.205
month 6	preparation	0.0051	[0.0397]	-0.0131	[0.0372]	791	0.089	0.224	0.218	0.198
month 7	lean	-0.0073	[0.0476]	-0.0455	[0.0396]	791	0.045	0.248	0.249	0.195
month 8	lean	0.0656	[0.0471]	-0.0244	[0.0376]	791	0.087	0.245	0.315	0.218
month 9	harvest	0.0554	[0.0467]	0.0037	[0.0405]	790	0.123	0.263	0.315	0.260
month 10	harvest	0.0518	[0.0501]	-0.0344	[0.0438]	791	0.095	0.307	0.354	0.256
month 11	preparation	0.0418	[0.0491]	-0.0553	[0.0443]	790	0.089	0.297	0.340	0.237
month 12	preparation	0.0289	[0.0468]	-0.0712	[0.0445]	791	0.083	0.293	0.319	0.224
month 13	lean	-0.0390	[0.0447]	-0.0690	[0.0443]	791	0.116	0.269	0.230	0.198
month 14	harvest	-0.0774	[0.0438]	-0.0398	[0.0484]	789	0.073	0.343	0.254	0.289
month 15	harvest	0.0080	[0.0429]	0.0465	[0.0444]	791	0.061	0.259	0.265	0.289
month 16	preparation	-0.0019	[0.0414]	0.0253	[0.0434]	791	0.043	0.269	0.265	0.273
month 17	preparation	-0.0072	[0.0443]	0.0188	[0.0438]	791	0.052	0.290	0.280	0.286
month 18	preparation	-0.0301	[0.0452]	0.0165	[0.0467]	790	0.079	0.324	0.292	0.306
month 19	lean	-0.0509	[0.0439]	-0.0524	[0.0443]	791	0.086	0.309	0.272	0.257
month 20	lean	-0.0590	[0.0436]	-0.0304	[0.0476]	791	0.096	0.326	0.276	0.300
month 21	harvest	-0.0450	[0.0417]	-0.0359	[0.0447]	791	0.094	0.326	0.276	0.293
month 22	harvest	-0.0808*	[0.0404]	-0.0287	[0.0451]	790	0.093	0.334	0.249	0.300
month 23	preparation	-0.0443	[0.0379]	0.0028	[0.0453]	786	0.081	0.284	0.240	0.280
month 24	preparation	-0.0690	[0.0409]	0.0024	[0.0456]	721	0.107	0.269	0.191	0.258

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A7. Kept cash savings – OLS panel analysis by month

Month	Season	MFM	[S.E.]	Mfinance	[S.E.]	Obs	R ²	Control avg	MFM avg	Mfi avg
month 1	weeding	-0.0325	[0.0591]	-0.0494	[0.0606]	792	0.047	0.787	0.764	0.734
month 2	harvest	0.0794	[0.0552]	0.0362	[0.0549]	792	0.052	0.753	0.837	0.795
month 3	harvest	0.0290	[0.0470]	0.0007	[0.0480]	791	0.070	0.825	0.856	0.805
month 4	preparation	0.0025	[0.0524]	-0.0111	[0.0506]	792	0.063	0.770	0.779	0.750
month 5	preparation	-0.0627	[0.0542]	-0.0189	[0.0554]	790	0.067	0.780	0.719	0.747
month 6	preparation	-0.0129	[0.0548]	-0.0196	[0.0549]	791	0.050	0.790	0.798	0.766
month 7	lean	0.0022	[0.0553]	-0.0170	[0.0588]	791	0.051	0.766	0.770	0.734
month 8	lean	0.0275	[0.0458]	0.0066	[0.0442]	791	0.079	0.790	0.813	0.786
month 9	harvest	-0.0221	[0.0526]	-0.0245	[0.0469]	790	0.060	0.779	0.755	0.747
month 10	harvest	0.0110	[0.0497]	0.0526	[0.0425]	791	0.102	0.762	0.774	0.805
month 11	preparation	-0.0439	[0.0498]	0.0452	[0.0425]	790	0.092	0.803	0.762	0.834
month 12	preparation	-0.0515	[0.0514]	0.0216	[0.0460]	791	0.065	0.790	0.739	0.802
month 13	lean	-0.0716	[0.0380]	-0.0494	[0.0308]	791	0.533	0.707	0.611	0.640
month 14	harvest	-0.0271	[0.0489]	0.0227	[0.0413]	789	0.099	0.782	0.766	0.818
month 15	harvest	-0.0215	[0.0467]	0.0048	[0.0433]	791	0.090	0.797	0.786	0.805
month 16	preparation	0.0072	[0.0402]	0.0507	[0.0393]	791	0.092	0.814	0.813	0.851
month 17	preparation	-0.0279	[0.0488]	0.0289	[0.0440]	791	0.064	0.793	0.770	0.825
month 18	preparation	0.0337	[0.0441]	-0.0182	[0.0440]	790	0.123	0.797	0.856	0.805
month 19	lean	-0.0678	[0.0566]	-0.0230	[0.0548]	791	0.036	0.790	0.747	0.785
month 20	lean	-0.0553	[0.0471]	0.0067	[0.0435]	791	0.117	0.804	0.770	0.824
month 21	harvest	-0.0393	[0.0444]	0.0097	[0.0432]	791	0.183	0.777	0.759	0.798
month 22	harvest	-0.0518	[0.0463]	0.0130	[0.0429]	790	0.152	0.779	0.751	0.798
month 23	preparation	0.0127	[0.0450]	0.0331	[0.0433]	786	0.157	0.765	0.768	0.788
month 24	preparation	-0.0090	[0.0549]	0.0488	[0.0478]	721	0.097	0.762	0.753	0.801

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A8. Worked on someone else's land (wages) – OLS panel analysis by month

Month	Season	MFM	[S.E.]	Mfinance	[S.E.]	Obs	R ²	Control avg	MFM avg	Mfi avg
month 1	weeding	0.0121	[0.0316]	-0.0046	[0.0304]	792	0.058	0.0859	0.105	0.0779
month 2	harvest	0.0188	[0.0275]	0.0394	[0.0298]	792	0.054	0.0687	0.0891	0.104
month 3	harvest	-0.0143	[0.0338]	-0.0041	[0.0357]	791	0.042	0.117	0.0973	0.0974
month 4	preparation	-0.0144	[0.0327]	-0.0159	[0.0343]	792	0.053	0.124	0.112	0.0974
month 5	preparation	-0.0072	[0.0323]	-0.0016	[0.0333]	790	0.060	0.127	0.121	0.107
month 6	preparation	-0.0028	[0.0339]	-0.0194	[0.0333]	791	0.070	0.131	0.136	0.101
month 7	lean	0.0520	[0.0324]	0.0186	[0.0329]	791	0.058	0.124	0.171	0.130
month 8	lean	-0.0304	[0.0359]	0.0277	[0.0441]	791	0.060	0.159	0.132	0.179
month 9	harvest	0.0050	[0.0341]	0.0345	[0.0397]	790	0.038	0.107	0.113	0.133
month 10	harvest	-0.0196	[0.0356]	0.0657	[0.0436]	791	0.067	0.128	0.105	0.175
month 11	preparation	0.0238	[0.0286]	0.0450	[0.0338]	790	0.051	0.107	0.133	0.143
month 12	preparation	-0.0073	[0.0351]	0.0449	[0.0396]	791	0.066	0.155	0.152	0.179
month 13	lean	-0.0282	[0.0315]	0.0779*	[0.0376]	791	0.107	0.145	0.117	0.201
month 14	harvest	-0.0084	[0.0361]	0.0422	[0.0405]	789	0.057	0.166	0.156	0.182
month 15	harvest	-0.0091	[0.0337]	0.0436	[0.0401]	791	0.045	0.152	0.136	0.172
month 16	preparation	-0.0212	[0.0312]	0.0311	[0.0371]	791	0.060	0.172	0.144	0.172
month 17	preparation	-0.0146	[0.0374]	-0.0098	[0.0374]	791	0.066	0.186	0.167	0.156
month 18	preparation	-0.0502	[0.0346]	0.0025	[0.0371]	790	0.075	0.210	0.160	0.189
month 19	lean	-0.0316	[0.0380]	-0.0292	[0.0372]	791	0.069	0.206	0.183	0.153
month 20	lean	-0.0206	[0.0352]	-0.0148	[0.0363]	791	0.071	0.168	0.148	0.134
month 21	harvest	-0.0076	[0.0357]	-0.0391	[0.0356]	791	0.046	0.172	0.167	0.111
month 22	harvest	-0.0190	[0.0367]	-0.0264	[0.0350]	790	0.061	0.159	0.148	0.114
month 23	preparation	-0.0318	[0.0380]	-0.0262	[0.0374]	786	0.077	0.176	0.146	0.134
month 24	preparation	-0.0565	[0.0396]	-0.0404	[0.0395]	721	0.078	0.185	0.119	0.122

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A9. Worked off-farm (self-employed) – OLS panel analysis by month

Month	Season	MFM	[S.E.]	Mfinance	[S.E.]	Obs	R ²	Control avg	MFM avg	Mfi avg
month 1	weeding	0.0329	[0.0338]	0.0862*	[0.0427]	792	0.172	0.206	0.256	0.315
month 2	harvest	0.0199	[0.0349]	0.0739	[0.0446]	792	0.172	0.223	0.252	0.289
month 3	harvest	0.0360	[0.0345]	0.0750	[0.0414]	791	0.165	0.210	0.261	0.299
month 4	preparation	0.0196	[0.0378]	0.0716	[0.0408]	792	0.145	0.227	0.256	0.308
month 5	preparation	0.0210	[0.0359]	0.0959*	[0.0415]	790	0.161	0.206	0.230	0.315
month 6	preparation	0.0475	[0.0366]	0.1133**	[0.0420]	791	0.132	0.190	0.233	0.308
month 7	lean	-0.0130	[0.0351]	0.0076	[0.0381]	791	0.141	0.228	0.218	0.240
month 8	lean	0.0235	[0.0361]	0.0046	[0.0382]	791	0.167	0.224	0.249	0.237
month 9	harvest	0.0246	[0.0367]	0.0210	[0.0372]	790	0.142	0.215	0.245	0.240
month 10	harvest	0.0175	[0.0403]	0.0233	[0.0404]	791	0.148	0.224	0.257	0.256
month 11	preparation	-0.0027	[0.0400]	0.0157	[0.0386]	790	0.155	0.238	0.238	0.263
month 12	preparation	0.0094	[0.0377]	0.0288	[0.0376]	791	0.166	0.221	0.226	0.260
month 13	lean	-0.0163	[0.0324]	0.0154	[0.0344]	791	0.120	0.179	0.152	0.192
month 14	harvest	0.0039	[0.0393]	0.0404	[0.0404]	789	0.148	0.225	0.227	0.269
month 15	harvest	0.0056	[0.0405]	0.0342	[0.0423]	791	0.136	0.234	0.233	0.276
month 16	preparation	-0.0089	[0.0418]	0.0428	[0.0417]	791	0.140	0.241	0.226	0.286
month 17	preparation	-0.0125	[0.0384]	0.0604	[0.0410]	791	0.134	0.228	0.206	0.292
month 18	preparation	-0.0071	[0.0397]	0.0477	[0.0419]	790	0.148	0.238	0.222	0.287
month 19	lean	-0.0317	[0.0422]	0.0228	[0.0440]	791	0.140	0.247	0.210	0.267
month 20	lean	-0.0274	[0.0406]	0.0596	[0.0433]	791	0.154	0.251	0.218	0.303
month 21	harvest	-0.0207	[0.0407]	0.0433	[0.0435]	791	0.152	0.258	0.230	0.300
month 22	harvest	-0.0363	[0.0407]	0.0335	[0.0456]	790	0.141	0.266	0.226	0.300
month 23	preparation	-0.0237	[0.0407]	0.0367	[0.0442]	786	0.144	0.263	0.236	0.300
month 24	preparation	-0.0563	[0.0423]	0.0355	[0.0447]	721	0.140	0.265	0.217	0.310

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A10. Worked off-farm (wages) – OLS panel analysis by month

Month	Season	MFM	[S.E.]	Mfinance	[S.E.]	Obs	R ²	Control avg	MFM avg	Mfi avg
month 1	weeding	-0.0235	[0.0233]	-0.0129	[0.0241]	792	0.060	0.0722	0.0543	0.0584
month 2	harvest	0.0019	[0.0245]	-0.0003	[0.0240]	792	0.027	0.0584	0.0659	0.0617
month 3	harvest	0.0088	[0.0185]	0.0373	[0.0224]	791	0.055	0.0309	0.0428	0.0747
month 4	preparation	-0.0170	[0.0173]	0.0027	[0.0224]	792	0.054	0.0447	0.0349	0.0584
month 5	preparation	-0.0255	[0.0148]	-0.0061	[0.0207]	790	0.071	0.0447	0.0195	0.0422
month 6	preparation	-0.0312	[0.0174]	0.0060	[0.0230]	791	0.060	0.0552	0.0272	0.0714
month 7	lean	-0.0342	[0.0190]	-0.0117	[0.0218]	791	0.049	0.0586	0.0272	0.0487
month 8	lean	-0.0197	[0.0149]	0.0049	[0.0218]	791	0.064	0.0414	0.0233	0.0487
month 9	harvest	0.0073	[0.0162]	0.0107	[0.0194]	790	0.064	0.0311	0.0350	0.0455
month 10	harvest	-0.0179	[0.0164]	-0.0181	[0.0173]	791	0.054	0.0448	0.0272	0.0325
month 11	preparation	0.0045	[0.0173]	-0.0039	[0.0189]	790	0.067	0.0414	0.0391	0.0390
month 12	preparation	-0.0150	[0.0208]	-0.0182	[0.0211]	791	0.073	0.0552	0.0350	0.0390
month 13	lean	-0.0146	[0.0155]	-0.0206	[0.0158]	791	0.075	0.0379	0.0195	0.0227
month 14	harvest	0.0053	[0.0174]	0.0097	[0.0186]	789	0.085	0.0311	0.0391	0.0455
month 15	harvest	-0.0167	[0.0175]	-0.0010	[0.0206]	791	0.090	0.0414	0.0311	0.0487
month 16	preparation	-0.0043	[0.0154]	0.0102	[0.0186]	791	0.090	0.0310	0.0311	0.0455
month 17	preparation	0.0016	[0.0173]	0.0026	[0.0174]	791	0.076	0.0345	0.0389	0.0487
month 18	preparation	0.0006	[0.0172]	0.0060	[0.0172]	790	0.086	0.0310	0.0389	0.0554
month 19	lean	0.0022	[0.0164]	0.0142	[0.0177]	791	0.075	0.0275	0.0350	0.0554
month 20	lean	-0.0009	[0.0165]	0.0068	[0.0180]	791	0.075	0.0344	0.0350	0.0521
month 21	harvest	-0.0200	[0.0173]	-0.0006	[0.0187]	791	0.093	0.0447	0.0272	0.0489
month 22	harvest	-0.0243	[0.0177]	-0.0041	[0.0189]	790	0.091	0.0483	0.0272	0.0489
month 23	preparation	-0.0135	[0.0176]	0.0033	[0.0188]	786	0.094	0.0415	0.0315	0.0489
month 24	preparation	-0.0069	[0.0167]	0.0033	[0.0186]	721	0.081	0.0346	0.0340	0.0453

* p<0.05, ** p<0.1 Robust standard errors in parentheses.

Table A11. HFIAS Score by distance to market – OLS panel analysis by month

Month	Season	(Distance to market dummy, 1=below median)				Obs	R ²
		MFM	[S.E.]	Mfinance	[S.E.]		
month 1	weeding	0.1585	[1.1099]	-0.7592	[1.2659]	774	0.114
month 2	harvest	0.0129	[1.1338]	-0.9110	[1.1961]	771	0.107
month 3	harvest	-0.4164	[1.0742]	-0.2009	[1.1730]	754	0.112
month 4	preparation	-0.6895	[1.2048]	-0.5736	[1.2530]	738	0.105
month 5	preparation	-0.4520	[1.1578]	0.0385	[1.2026]	715	0.096
month 6	preparation	-0.4434	[1.1943]	0.3754	[1.1538]	706	0.095
month 7	lean	-1.7861	[1.0105]	-0.8806	[1.0714]	712	0.097
month 8	lean	-0.6323	[1.0529]	0.9289	[1.1040]	751	0.132
month 9	harvest	-0.9103	[1.0597]	0.2332	[1.1266]	773	0.166
month 10	harvest	-0.9042	[1.0990]	0.6084	[1.2003]	764	0.185
month 11	preparation	-1.1427	[1.0660]	-0.7460	[1.2104]	768	0.201
month 12	preparation	-0.4944	[0.9964]	-1.0880	[1.0841]	767	0.207
month 13	lean	-1.0420	[1.0382]	0.6821	[1.1109]	627	0.168
month 14	harvest	-0.4731	[0.9747]	0.3760	[1.0122]	772	0.118
month 15	harvest	-2.0513*	[0.8672]	0.2341	[0.9346]	778	0.130
month 16	preparation	-0.8729	[0.9852]	0.4811	[0.9946]	778	0.126
month 17	preparation	-1.7972	[1.0423]	-0.6482	[1.1022]	768	0.167
month 18	preparation	-1.2450	[0.9791]	-0.5149	[1.0785]	776	0.139
month 19	lean	-0.3753	[1.0402]	-0.5522	[1.0152]	759	0.144
month 20	lean	-0.7313	[0.9475]	-0.1639	[0.9864]	782	0.107
month 21	harvest	0.3498	[1.0212]	0.1416	[1.0219]	780	0.126
month 22	harvest	-0.1459	[1.1080]	-0.1958	[1.0951]	780	0.097
month 23	preparation	0.2534	[1.1357]	-0.0295	[1.0668]	772	0.140
month 24	preparation	-0.0224	[1.2158]	0.5024	[1.1713]	687	0.175

*p<0.05, **p<0.1 Robust standard errors in parentheses.

Table A12. HDDS by distance to market – OLS panel analysis by month

Month	Season	(Distance to market dummy, 1=below median)				Obs	R ²
		MFM	[S.E.]	Mfinance	[S.E.]		
month 1	weeding	0.4375	[0.4628]	0.1631	[0.4256]	791	0.082
month 2	harvest	-0.0453	[0.4225]	-0.3773	[0.4341]	788	0.104
month 3	harvest	0.2897	[0.5227]	-0.6002	[0.4889]	789	0.109
month 4	preparation	0.2104	[0.5331]	-0.6184	[0.4602]	782	0.111
month 5	preparation	-0.0748	[0.5546]	-0.7660	[0.4995]	774	0.127
month 6	preparation	-0.1989	[0.6264]	-0.7563	[0.5323]	779	0.128
month 7	lean	0.6814	[0.4913]	0.2675	[0.4209]	765	0.090
month 8	lean	0.2649	[0.5078]	-0.1111	[0.4598]	775	0.098
month 9	harvest	0.7586	[0.5025]	0.8021	[0.4433]	774	0.156
month 10	harvest	0.5892	[0.4968]	0.3975	[0.4376]	763	0.114
month 11	preparation	0.3082	[0.6351]	-0.3286	[0.4957]	768	0.110
month 12	preparation	0.5516	[0.5391]	-0.2003	[0.4470]	767	0.155
month 13	lean	0.6079	[0.6560]	0.3928	[0.4809]	627	0.171
month 14	harvest	-0.1989	[0.5892]	-0.4385	[0.4507]	772	0.185
month 15	harvest	0.5750	[0.6455]	-0.2254	[0.4944]	778	0.151
month 16	preparation	0.2220	[0.6155]	-0.4066	[0.5022]	778	0.141
month 17	preparation	0.3362	[0.5807]	-0.5945	[0.4723]	768	0.153
month 18	preparation	0.5665	[0.6039]	-0.0305	[0.4748]	776	0.182
month 19	lean	-0.3737	[0.6190]	-0.8485	[0.4605]	759	0.188
month 20	lean	0.0807	[0.6200]	-0.2319	[0.4863]	782	0.155
month 21	harvest	0.2155	[0.6173]	-0.5841	[0.4925]	780	0.180
month 22	harvest	-0.2205	[0.5720]	-0.4475	[0.4813]	780	0.173
month 23	preparation	0.4179	[0.6379]	-0.4105	[0.5211]	772	0.170
month 24	preparation	0.0534	[0.6425]	-0.4536	[0.5123]	687	0.190

*p<0.05, **p<0.1 Robust standard errors in parentheses.

Table A13. HFIAS Score by level of food consumption – OLS panel analysis by month

Month	Season	(Food poor dummy, 1= higher food poverty)				Obs	R ²
		MFM	[S.E.]	Mfinance	[S.E.]		
month 1	weeding	-1.6688*	[0.8565]	0.5094	[0.9104]	774	0.142
month 2	harvest	0.0895	[0.8422]	0.4841	[0.8394]	771	0.114
month 3	harvest	-0.1991	[0.6611]	0.7093	[0.6781]	754	0.120
month 4	preparation	0.3363	[0.7399]	0.8220	[0.7308]	738	0.105
month 5	preparation	0.2404	[0.7383]	0.8951	[0.7797]	715	0.107
month 6	preparation	-0.2653	[0.8304]	0.0165	[0.8173]	706	0.100
month 7	lean	-0.8545	[0.7773]	0.4258	[0.7876]	712	0.095
month 8	lean	-0.5510	[0.7864]	0.2126	[0.8198]	751	0.126
month 9	harvest	-0.4505	[0.7663]	0.4870	[0.7728]	773	0.160
month 10	harvest	0.1831	[0.7645]	1.3859	[0.8233]	764	0.186
month 11	preparation	-0.2622	[0.7369]	0.9886	[0.8645]	768	0.197
month 12	preparation	-1.1938	[0.7107]	-0.0955	[0.8049]	767	0.207
month 13	lean	-1.0345	[0.7737]	-0.6145	[0.7205]	627	0.150
month 14	harvest	-0.3219	[0.6926]	-0.1041	[0.7018]	772	0.119
month 15	harvest	-0.1143	[0.6770]	-0.1699	[0.6995]	778	0.106
month 16	preparation	-1.1201	[0.6809]	-0.7919	[0.7023]	778	0.118
month 17	preparation	-1.5189*	[0.7014]	-0.3576	[0.7470]	768	0.152
month 18	preparation	-1.3164	[0.6671]	-0.9202	[0.8022]	776	0.123
month 19	lean	-0.6885	[0.6639]	-0.4223	[0.6879]	759	0.143
month 20	lean	-1.2201	[0.6347]	-0.5753	[0.6892]	782	0.109
month 21	harvest	-0.3926	[0.6456]	0.1021	[0.6810]	780	0.127
month 22	harvest	-1.0915	[0.7611]	-0.1884	[0.7422]	780	0.101
month 23	preparation	-1.6293*	[0.7534]	-0.4427	[0.6999]	772	0.146
month 24	preparation	-0.8568	[0.7941]	-0.4465	[0.7422]	687	0.176

*p<0.05, **p<0.1 Robust standard errors in parentheses.

Table A14. HDDS by level of food consumption – OLS panel analysis by month

Month	Season	(Food poor dummy, 1=higher food poverty)				Obs	R ²
		MFM	[S.E.]	Mfinance	[S.E.]		
month 1	weeding	-0.0039	[0.3302]	0.5142	[0.3125]	791	0.075
month 2	harvest	-0.1473	[0.2673]	0.2888	[0.3023]	788	0.110
month 3	harvest	-0.2481	[0.3367]	0.1875	[0.3141]	789	0.105
month 4	preparation	-0.1116	[0.3660]	0.1834	[0.3190]	782	0.107
month 5	preparation	-0.0385	[0.3371]	-0.4397	[0.3186]	774	0.132
month 6	preparation	-0.5674	[0.3951]	-0.6129	[0.3565]	779	0.138
month 7	lean	-0.6547	[0.3401]	-0.2122	[0.2957]	765	0.094
month 8	lean	-0.3241	[0.3357]	0.1059	[0.3019]	775	0.106
month 9	harvest	-0.1180	[0.3471]	-0.4782	[0.3173]	774	0.160
month 10	harvest	-0.3468	[0.3759]	-0.7482*	[0.3462]	763	0.132
month 11	preparation	-0.6268	[0.4055]	-0.3714	[0.3541]	768	0.130
month 12	preparation	-0.2332	[0.3551]	-0.3446	[0.3023]	767	0.154
month 13	lean	-0.5604	[0.4148]	-0.5126	[0.3555]	627	0.171
month 14	harvest	0.0239	[0.3407]	0.0358	[0.3196]	772	0.168
month 15	harvest	-0.0850	[0.3800]	0.1654	[0.3565]	778	0.144
month 16	preparation	-0.1222	[0.3819]	-0.1419	[0.3438]	778	0.142
month 17	preparation	0.1120	[0.3365]	0.3591	[0.3347]	768	0.136
month 18	preparation	0.0045	[0.3468]	0.4548	[0.3102]	776	0.176
month 19	lean	0.1763	[0.3137]	0.3217	[0.2593]	759	0.163
month 20	lean	0.2687	[0.3352]	-0.2572	[0.2515]	782	0.137
month 21	harvest	0.3000	[0.3415]	0.2308	[0.2790]	780	0.170
month 22	harvest	0.0430	[0.3177]	-0.1806	[0.3050]	780	0.179
month 23	preparation	0.0065	[0.3289]	-0.0777	[0.3116]	772	0.162
month 24	preparation	0.1950	[0.3616]	-0.1359	[0.3077]	687	0.189

*p<0.05, **p<0.1 Robust standard errors in parentheses.

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