Social safety net programmes, repeated weather shocks, and household resilience to food insecurity in Malawi

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Executive summary

Extreme weather shocks manifested through the late onset of rains, prolonged dry spells, droughts, and floods have increased in frequency and intensity over the past decades in Malawi. The recent occurrence of El Nino-induced extreme weather events in 2015 and Cyclone Idai in 2019, coupled with high poverty rates, have had devastating consequences on Malawi's undiversified agricultural economy that is largely dependent on rain-fed farming. Over time social safety net programmes in Malawi have been used to assist households and communities protect themselves against shocks and risks. The paper aims at understanding the impacts of economic shocks and social safety net programmes on food security status and household resilience in Malawi. The study covers both spatial and temporal analysis, namely across geographical regions and over time, respectively.

Using four waves (2010, 2013, 2016 and 2019) of the Integrated Household Panel Survey (IHPS) data collected by the National Statistical Office (NSO), we analyzed the relationships between shocks and social safety net programmes and food security status and household resilience in Malawi. The study measures household resilience using the Food and Agriculture Organization (FAO) Resilience Index Measurement and Analysis (RIMA) methodology, which analyses household resilience as a function of four components, namely access to basic services, assets, social safety nets and adaptive capability. We use household food consumption score as the food security indicator.

The study shows that households' food security and resilience capacity have improved between 2010 and 2019. Furthermore, the study shows that assets and adaptive capacity are the most relevant pillars in determining household resilience in Malawi. Shocks including unusually high costs of food and agricultural inputs, floods, and irregular rains have a negative impact on resilience. Results show that cash transfers, improvements in education,

engagement in self-employment activities and access to savings have a positive impact on resilience and food consumption status suggesting the potential of these factors to protect people from getting into poverty because of adverse economic shocks and crises.

We track the resilience status of households between 2010 and 2019 across three categories classes of resilience, namely least, medium and most resilient. Our results show that about 78% of households that were most resilient in 2010 were still most resilient in 2019, while about a third of the households that were least resilient in 2010 improved and became medium resilient by 2019. Furthermore, about half of the households that were medium resilient in 2010 remained in the medium resilient category with a quarter and a fifth of the households moved into the least resilient and most resilient categories, respectively.

In terms of spatial patterns of RIMA resilience scores, our study shows that the Southern region districts have the largest scores of the social safety net pillar and access to basic services, reflecting the focus of most social-safety programs by the various actors including the Government, non-governmental organizations and faith-based organizations. On the other hand, Northern region districts have the highest scores for the adaptive capacity pillar and assets.

The results have several policy implications. Firstly, food security status and resilience should be enhanced through policy measures aimed at improving the ability of households to adapt to adverse shocks. The measures may include improvement of education (e.g., school enrolment and retention) which research has shown could have long-term positive resilience outcomes. Similarly, investments in self-employment activities and the use of financial products (e.g., savings and access to financing) could improve the resilience of households to adverse shocks through income diversification as shown in the literature Secondly, there is a need to scale up the adoption of climate-smart technologies (e.g., irrigation) and sustainable farming and water management practices (e.g., ridge alignment, box ridging, and vetiver grass) to mitigate against adverse climate-related shocks such as floods and irregular rains. These strategies could contribute to higher production and productivity resulting in higher incomes and uninterrupted access to food. Thirdly, considering their positive impact

on resilience to food insecurity and their potential to stimulate market activity through payments (e.g., school fees, food, farm inputs, or contributions to savings groups), cash transfers should be scaled up by example increasing the amount of cash transfers paid and the period of implementation of the programmes. Finally, the fact that the high costs of agricultural inputs have a negative impact on food security status and resilience capacity of households suggests that some continued support to improve agricultural productivity and smallholder profitability is warranted. However, the programmes should be strengthened to address issues of fertiliser use efficiency, targeting and other implementation challenges, such as implementation delays. This could include a combination of an improved subsidy programme that goes beyond inorganic fertiliser to address soil health concerns (e.g., supporting legume seeds, organic fertilizers, or agricultural lime) and programmes to improve agricultural research, development, and extension. Also, the use of local knowledge should be strengthened by encouraging bidirectional learning between extension agents and smallholder farmers.

1. Introduction

There is evidence that the frequency and intensity of climatic shocks and extreme weather events have increased across Africa over time (Diallo and Tapsoba 2022; Falco et al. 2022). Climatic shocks are commonly understood as unpredictable weather events such as floods, heat waves, droughts, and cyclones that affect the sustainability of community (Ha, et al., 2022; Vo et al., 2021). More generally, climatic shocks have been identified to contribute to worsening food insecurity and the inability to achieve sustained economic growth. As described by McCarthy et al. (2021), weather shocks reduce agricultural production and income among smallholder households which eventually leads to reduced food consumption and less diverse diets, among others. Research has shown that climatic shocks affect the livelihoods of households in Southern Africa and increased incidences of shocks are associated with reduced resilience (Ngoma, et al., 2023).

The concept of resilience broadly characterizes the capacity to resist and recover from shocks (Premand& Stoeffler, 2020). Governments are increasingly implementing various programmes aimed at promote the resilience of households by enhancing their ability to prepare and protect themselves against shocks. Social protection programmes or social safety nets have been widely utilised as policy instruments to improve the livelihoods of households (Otchere & Handa, 2022; Premand & Stoeffler, 2020; Abay, et al., 2022). The concepts of social protection and social safety net are closely related. However, while social safety net programs are aimed at protecting households from the impact of economic shocks, including natural disasters, and other crises, social protection is a broader term which seeks to not only aims at reducing the impact of shocks and improving coping, but also focuses on interventions for prevent shocks and building the long-term resilience of households. Thus, social protection is broader term that includes social safety nets (Adato, *et al.*, 2005).

This paper explores patterns in climatic shocks, social protection programs, and household resilience in Malawi over time. Malawi is well-suited to study these relationships, as it is particularly prone to droughts and floods, with more than 19 major floods and seven droughts experienced over the past 5 decades that are increasing in frequency, magnitude and scope (Government of Malawi, 2019). Recent occurrences of weather shocks were

experienced in the year 2018-2019 agricultural season (floods due to Cyclone Idai) and in the 2015-2016 agricultural season (late onset of rains, prolonged dry spells, and incidence of floods across the country, induced by El Nino) (Government of Malawi, 2018; Government of Malawi, 2019).

The increased frequency of shocks has affected the livelihoods of households, and Malawi may be particularly vulnerable because over half (50.7%) of the population lives below the poverty line while 20.5% are extremely poor (NSO, 2020). For example, the aftermath of the 2015 floods and dry spells resulted in a maize production decline of 30.2% and saw close to 3 million people in need of food assistance in Malawi (Malawi Government, 2015). The 2019 floods also affected the food security of 2.3 million farming households. In addition, the loss and damage in monetary cost of these weather-related shocks have been huge, with the cost of the 2015 and 2019 floods estimated at USD335 million and USD220.2 million, respectively (Government of Malawi, 2015; Government of Malawi, 2019).

To reduce poverty and vulnerability of the poor and the most vulnerable, the Malawi Government implements the National Social Support Policy (2012), which is operationalized through the Malawi National Social Support Programme (MNSSP) (2018-2023). Broadly, social support programs cover three areas of interventions namely productivity-enhancing safety nets (subsidies, free inputs, public works programs), direct welfare transfers (such as conditional and unconditional cash transfers) and market interventions (such as strategic grain reserves) (Devereux & Macauslan, 2006). Under the MNSSP II (2018-2023), the four main social support programs include the Social Cash Transfer Programme (SCTP), Public Works Programme (PWP), School Feeding Programme (SMP) and Savings and Loan Groups (SLGs). The MNSSP II also has a specific resilient livelihoods pillar that focuses on pathways for graduating households from poverty and facilitating access to and the use of essential services. The Malawi 2063, the country's long-term development plan, recognizes the role of social protection in building resilience for individuals, households and communities against shocks, economic crises, pandemics, and natural disasters. The long-term goal of the country is to reduce the number of people in need of social protection through the creation of wealth for all (National Planning Commission, 2020).

Studies on the welfare impacts of social protection programs in Malawi have produced mixed results. With special attention to the cash transfers programs, some studies have shown strong effects on food security, livelihood strengthening, human capital improvements (especially education) and children's well-being (Handa *et al.,* 2022; Premand and Stoeffler, 2021; UNICEF, 2020; Covarrubias et al., 2012). Further, Otchere and Handa (2022) applying the FAO Resilience Index Measurement and Analysis (RIMA) approach to measuring resilience and using a longitudinal and experimental data design, found that unconditional cash transfer significantly boosts household resilience in Malawi. On the contrary, an evaluation of the Malawi Social Action Fund (MASAF) showed no evidence of improved food security because of the program (Beegle *et al.,* 2017). There has also been concerns over targeting challenges of social cash transfer programs, wherein the current targeting approach some deserving vulnerable and eligible households are left out (UNICEF, 2020).

However, the impact of social safety nets in enhancing household resilience has not been adequately researched in Malawi. This paper makes an important contribution to the literature in two areas. Firstly, it conducts a spatial analysis of food security status and resilience capacity in Malawi. Secondly, it analyses the impacts of shocks and social safety net programme participation on food security status and household resilience.

The next section provides a summary of the data sources, and Section 3 describes the methods used for assessing household resilience. Results are presented in Section 4 and Section 5. Conclusions and policy recommendations are provided in Section 6.

2. Data Sources and Methods

2.1 Data

The study uses publicly-available panel data from the Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) collected using structured questionnaires by the National Statistical Office (NSO) with support from the World Bank. Specifically, four rounds of the Integrated Household Panel Survey data (IHPS) collected in 2010/11, 2013, 2016/17 and 2019/20 are utilized.

The households were tracked over time and administered multi-topic household and agricultural questionnaires which collected information on household characteristics, food consumption and security, shocks faced by households, coping strategies, social safety nets, assets, and non-farm self-employment. The panel data consists of 1,619 households interviewed in 2009/10; 1,990 households in 2012/13; 2,508 households in 2015/16 and 3,178 households in 2018/19. The number of households in the subsequent waves of the panel dataset is higher than in the first wave because some members of the original households graduated or split to start their own families.

Our analysis is based on a balanced panel of 1,017 households which were available in all four survey rounds, as shown in Table 1 below. Thus, the households that graduated from the original households have been excluded from the analysis. The households that graduated from the original households were identified by tracking household heads using a unique person identification code provided in the IHS data. The data consisted of the original 1,619 households; 1,017 households that remained intact in all the four waves; and 602 households that split into one or more households across the waves.

Table 1: Panel sample sizes by survey year

	Rural-urban areas		Regions of Malawi			
Year	**Rural**	**Urban**	**North**	**Centre**	**South**	**Total**
2010	728	289	126	441	450	1,017
2013	733	284	126	444	447	1,017
2016	748	269	126	441	450	1,017
2019	748	269	127	440	450	1,017

Source: Authors' computations using IHS data

Data in Table 1 shows that about 73% households lived in rural areas compared to 12% from urban areas. With respect to the regions, most of the households were from the Southern region (44%) followed by the Central region (43%) and the Northern region (12%).

2.2 Measurement of food security and resilience

The study utilized three main related indicators of food security and resilience, namely food consumption score (FCS), reduced strategy coping strategy index, and resilience capacity

index (RCI). These three indicators complement each other in providing an understanding of food security and resilience in our study. While, the FCS summaries the status of food consumption, the RCI indicates the strategies used during challenging times, and the RCI measures the overall ability of households to recover adverse events.

The FCS is a measure of dietary diversity and food security developed the World Food Programme in 2019. The methodology has been widely adopted in several studies across Africa and is probably the most used food security indicator (Adeyanju et al., 2023; Sileshi et al. 2023; Acheampong et al., 2022; Fite et al., 2022; Upton et al., 2022; Zoungrana, 2022). FCS is a composite score based on the dietary diversity, frequency of various foods consumed, and the relative nutritional importance of the various food groups consumed. A higher FCS indicates higher dietary diversity and higher frequency of food consumption. Using integrated household survey data, various food items were classified into nine food groups, with each food group assigned a weight reflecting its nutrient density. The food groups include cereals, grains and cereal products; roots, tubers, and plantains; nuts and pulses; vegetables; fish and animal products; fruits; milk/milk products; fats and oils; sugar/sugar products/honey; and spices/condiments. For each household, the FCS is calculated by multiplying each food group frequency by each food group weight and then summing these scores into one composite score. The following standard thresholds are then used to classify households as having poor food consumption (0 to 21), borderline (21.5 to 35) and acceptable consumption (> 35).

The Reduced Coping Strategy Index (rCSI) is another indicator for measuring household food insecurity. rCSI asks households to indicate the coping strategies that they employ in times of food shortage (Maxwell and Caldwell, 2008). The rCSI is an experience-based indicator which measures the behavior of households over the past seven days when they did not have enough food or money to purchase food. The integrated household data contains information on indicators such as if a household was worried that they would not have enough food, rely on less preferred and/or less expensive foods; limited portion size at meal-times; reduced the number of meals eaten in a day; restricted consumption by adults in order for small children to eat; and if a household borrowed food or relied on help from a friend or relative. Based on this data, a score was calculated for each strategy based on household answer using universal severity weight allocated for the coping strategy, and then summed to get the total rCSI score for the household.

Three main approaches have been developed to measure resilience, namely the Resilience Indicators for Measurement and Analysis (RIMA) method; Ciss'e and Barrett (C&B) method; and the TANGO method (Upton, et al., 2022). This study uses the RIMA approach to measure household resilience capacity in Malawi. While each of the three methods has its own merits and applied in different contexts, the RIMA approach is the most widely used method to the measurement of resilience according to the literature. One of the challenges identified with RIMA is that some of the factors associated with resilience are already used in the computation of the resilience capacity index. Nonetheless, the RIMA approach has been widely applied and tested in many contexts (e.g. Otchere, *et al.*, 2022; d'Errico, et al. 2020; Alinovi, et al., 2010) and is now the recommended approach for the under the Comprehensive Africa Agricultural Development Programme (CAADP) and the United Nations Organizations such as the Food and Agricultural Organization, World Food Programme, the United Nations Hilden's Fund, and the International Fund for Agricultural Development (Otchere, *et al.*, 2022; Upton, *et al.*, 2022).

The RIMA approach was developed by FAO and first used in 2008. It was later improved in 2016 by addressing a number of limitations that were identified (FAO, 2016; Otchere & Handa, 2022). The improved and updated methodology (RIMA-II) has four fundamental resilience pillars namely Access to Basic Services (ABS), Adaptive Capacity (AC), Assets (AST) and Social Safety Nets (SSN).

The RIMA-II approach estimation of the Resilience Capacity Index (RCI) is based on a two-stage procedure. In the first stage, the resilience pillars are estimated from observed variables through Factor Analysis (FA) while in the second stage, a single summary index of resilience capacity called the resilience capacity index (RCI) is computed from the pillars using the Multiple Indicators Multiple Causes (MIMIC) model. The RCI which reflects a household's resilience capacities can be used to rank households from the least to the most resilient and used to analyze the determinants of household resilience (FAO, 2016; Otchere & Handa, 2022). The RIMA model is mathematically presented in Equation 1 below:

$$RCI = f[(\beta_1, \beta_2 \dots \beta_n), (ABS, AC, AST, SSN)] \quad (1)$$

Where RCI is a function of the four pillars, namely Access to Basic Services (ABS), Adaptive Capacity (AC), Assets (AST) and Social Safety Nets (SSN), respectively, and the coefficients from calculating the pillars $\beta_1, \beta_2 \ldots \beta_n$. Thus, both the pillars and RCI are latent variables calculated from a set of observable variables.

Table 2 provides the description of the RIMA pillars and the set of typical variables used to construct the pillars and subsequently RCI. FAO (2016) makes some recommendations regarding the variables to be included in each of the pillars. Our estimation of RIMA is based on pooled sample, motivated by d'Errico *et al.* (2020) and Upton et al. (2022) who estimated RCI using pooled survey round data, thus fixing the weights over time and only allowing the variables making up the RIMA components to vary over time so that the changes in the RCI are due to changes in the variable values.

Table 2: Description of RIMA pillars

No	Pillar	Description
1	Access to Basic services	The pillar captures access to basic services, namely the distance that need to be covered to reach facilities such as schools, hospitals, markets, roads, water facilities, etc.
2	Adaptability	The pillar indicates the ability of a household to absorb, adapt and transform livelihood strategies in order to offset the negative impacts of a shock (both actual or anticipated).
3	Assets	This captures access by a household to both productive (e.g., land, livestock, etc.) and non-productive or durable assets (e.g., house, car, motorcycle, bicycle, table, etc.).
4	Social Safety Nets	The pillar captures the ability of a given household to access help from relatives and friends, charities, government, non-governmental organizations and other sources.

Source: Compiled from FAO (2016)

2.3 Descriptive Analysis

We provide a descriptive analysis of food consumption and resilience over time and a comparative analysis by male and female headed households; rural and urban locations and

across the three regions of Malawi, namely North, Centre and South. This includes an analysis of household, demographic and socio-economic characteristics by survey year.

2.4 Econometric Analysis

In line with the objectives of the study, two sets of fixed effects regression models are implemented, namely analyses on the impacts of economic shocks and social protection programmes on food security status (Model 2) and analyses the effects of shocks and social protection programmes on resilience (Model 3).

$$FCS_{it} = \alpha_0 + \alpha_1 S_{it} + \alpha_2 SP_{it} + \alpha_3 X_{it} + \alpha_4 RCI_{it-1} + u_{it} \quad (2)$$

$$RCI_{it} = \beta_0 + \beta_1 S_{it} + \beta_2 SP_{it} + \beta_{31} X_{it} + \epsilon_{it} \quad (3)$$

Where FCS_{it} and RCI_{it} respectively represent the outcome variables, namely food consumption score (FCS) and RIMA resilience capacity index (RCI) for household i at time t for $T = 1,2,3,4$; X_{it} represents a set of household and socio-economic factors (age of household head, education, assets, access to basic services, etc.); RCI_{it-1} represents lagged resilience scores for a given household included in the mode to analyze if past resilient status is associated with current food consumption status. The inclusion of past resilience status is based on empirical evidence which concludes that resilience capacity improves food security status and reduces the probability of households suffering from poor food security status in the presence of shocks (Egamberdiev, et al., 2023; Haile, et al., 2022). S_{it} represents adverse shocks that households reported to have faced in the past 12 months and SP_{it} represents household participation in various social protection programmes (such as cash transfers, school feeding programmes and public works programmes) in the past 12 months.

We assume u_{it} and ϵ_{it} to be a composite error terms made of two components, namely $u_{it} = n_i + v_{it}$ and $\epsilon_{it} = c_i + \theta_{it}$, respectively. Each of n_i and c_i is the time constant unobserved heterogeneity and does not vary with time but correlated with x_{it} while v_{it} or θ_{it} is the idiosyncratic error or time-varying unobserved heterogeneity but uncorrelated with x_{it}. If the exogeneity assumption does not hold, namely $E(x_{it} n_i \neq 0)$ and $E(x_{it} c_i \neq 0)$, estimation of our model by ordinary least squares regression (OLS) will result in biased results. However, fixed effects estimation is used to obtain unbiased estimates of β by controlling for unobserved

individual time invariant heterogeneity and this strategy reduces the magnitude of bias even when the unobserved correlated effect is not time invariant (see Wooldridge, 2002).

3. Study Findings

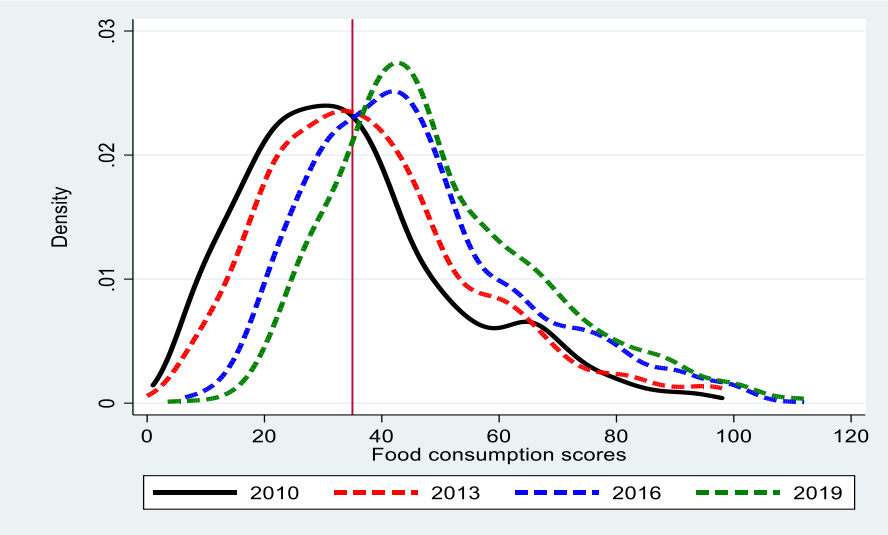
3.1 Descriptive Results

This section provides a descriptive analyses results for our study focusing on the outcome variable and selected household demographic and socio-economic characteristics such as age, education, asset ownership and access to basic services.

3.1.1 Food consumption status and resilience capacity over time

Figure 1 shows an outward shift in the distribution of food consumption status in each of the subsequent waves, indicating an improvement in the food security situation between 2010 and 2019. Results for the comparisons between rural and urban households; male-headed and female-headed households; and across the Northern, Central and Southern regions are provided in the appendix (see Figures A1 to A13 and Tables A1 and A2). Despite exhibiting some variations over the years, the patterns in food consumption score distributions are broadly similar for male-headed and female-headed households, urban and rural households as well as across regions of Malawi.

Figure 1: Distribution of food consumption status by survey

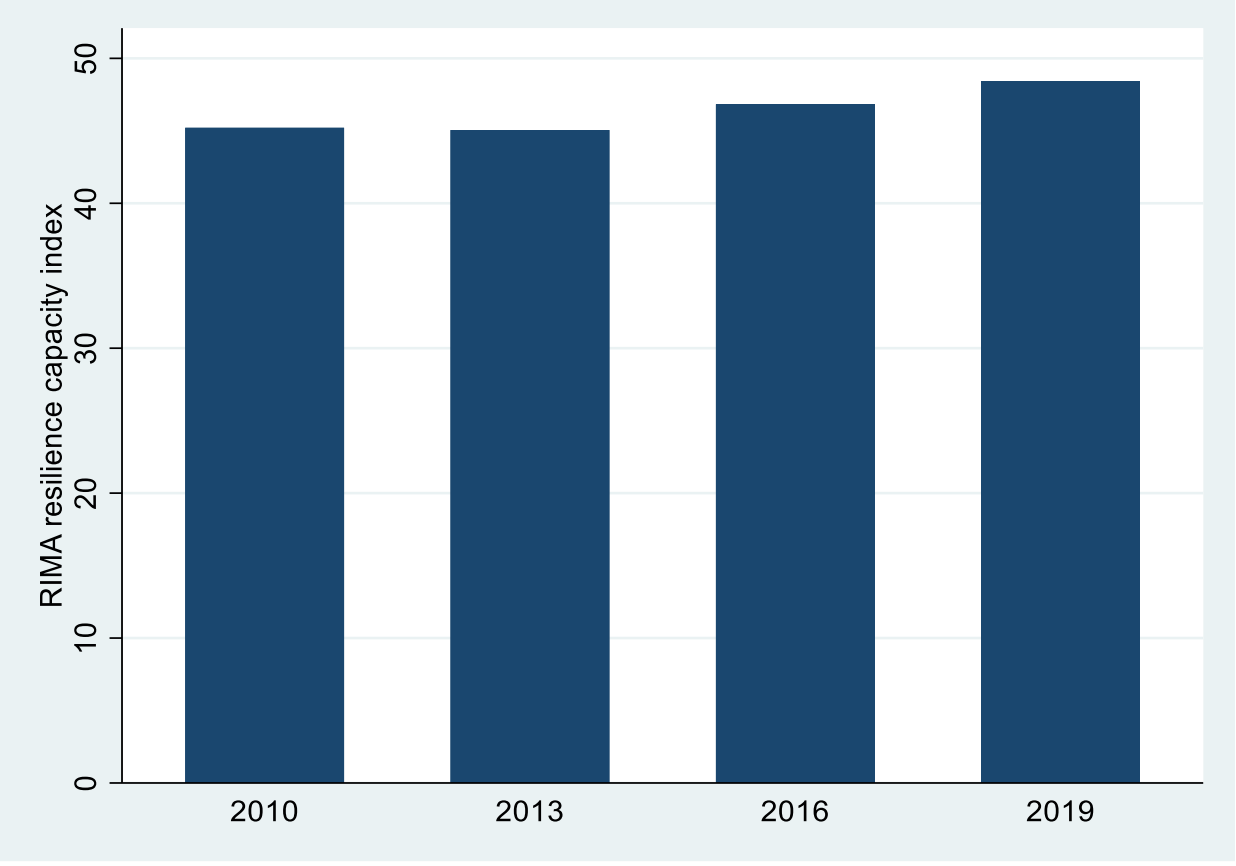


Source: Authors' computation using IHS data

The increases in the food consumption scores are particularly notable for households in the lower part of the distribution (below the vertical line representing acceptable consumption score threshold of 35) where no overlaps are noted in the k-density curves compared to the upper end of the distributions (acceptable consumption score threshold of greater than 35) where the curves cross especially for food consumption scores above 60.

Similarly, Figure 2 shows the RIMA resilience capacity of households has increased consistently between 2010 and 2019. The RIMA resilience scores are scaled from a minimum of 0 to a maximum of 100. The t-tests between a pair of any two years show that except for 2010 and 2013, the resilience scores are significantly different from each other. Graphical comparisons across regions, rural-urban areas and sex of the household head are shown in Figures A6, A7 and A8 in the appendix.

Figure 2: Resilience capacity index between 2010 and 2019



Source: Own computations using IHS data

3.1.2 Structure and components of resilience in Malawi

This Section discusses the structure and components of resilience in Malawi by focusing on the relative contributions of the various pillars of resilience. This is done in three steps. First, we identify the list of variables to be used in the analysis of each pillar. Second, we summarize the factor loadings based on factor analysis of the variables making up the pillars of the RCI: Access to Basic Services, Assets, Social safety nets and adaptive capacity (Table 3). Third, we analyze the relative importance of the components to resilience through pairwise correlations (Table 4).

The factor loadings measure the extent to which a factor is related to the latent component or pillar. For example, the correlation between the inverse distance to the nearest road (km) and the component is 0.28. The higher the loading is the higher the correlation to the component. Thus, for the ABS pillar, distance to the nearest road has the greatest strength while access to agricultural land shows the greatest association with the AST pillar; for the SSNs pillar, receiving help from relatives or friends has the greatest association and finally for the AC pillar, the share of household members who are literate has the largest association.

Table 3: Factor loadings of resilience components (N=1,017; pooled sample)

Variable	Coefficient
Access to basic services (ABS)	
Inverse distance to nearest road	0.279
Inverse distance to nearest Tobacco market	0.109
Inverse distance to nearest ADMARC market	0.079
Inverse distance to boma	0.238
Assets (AST)	
Access to agricultural land	-0.337
Productive asset index	0.231
Durable asset index	0.143
Social safety nets (SSN)	
Cash transfer Government	0.057
Cash transfer other	0.095

Food/cash for work	0.067
Gifts/transfers	0.210
School feeding	-0.012
Supplementary feeding	0.049
Help from relatives/friends	0.227
Adaptive capacity (AC)	
Engaged in self-employment	0.129
Households with literate members	0.441
Members with primary education	0.146
Members with JCE	0.174
Members with secondary education	0.206
Members with chronic illness	0.006

Source: Authors' computations using IHS data

Our descriptive analysis based on pair correlations of the outcome variables, namely RIMA resilience capacity index (RCI) and food consumption score (FCS) suggests that, overall, the assets pillar and adaptability pillar are the most important dimension of resilience and food consumption status followed by the access to basic services pillar and finally the social safety nets pillar (see Table 4). The correlation coefficient between RCI and FCS is also positive and statistically significant as expected.

Table 4: Correlations between predicted resilience and resilience pillars (N=1,017, pooled)

	RCI	FCS	ABS	Assets	SSN	AC
RCI	1					
FCS	0.46***	1				
ABS	0.30***	0.14***	1			
Assets	0.90***	0.36***	0.14***	1		
SSN	0.01	0.04***	0.01	-0.00	1	
AC	0.71***	0.42***	0.12***	0.36***	0.02	1

*** denotes significance at 5% level

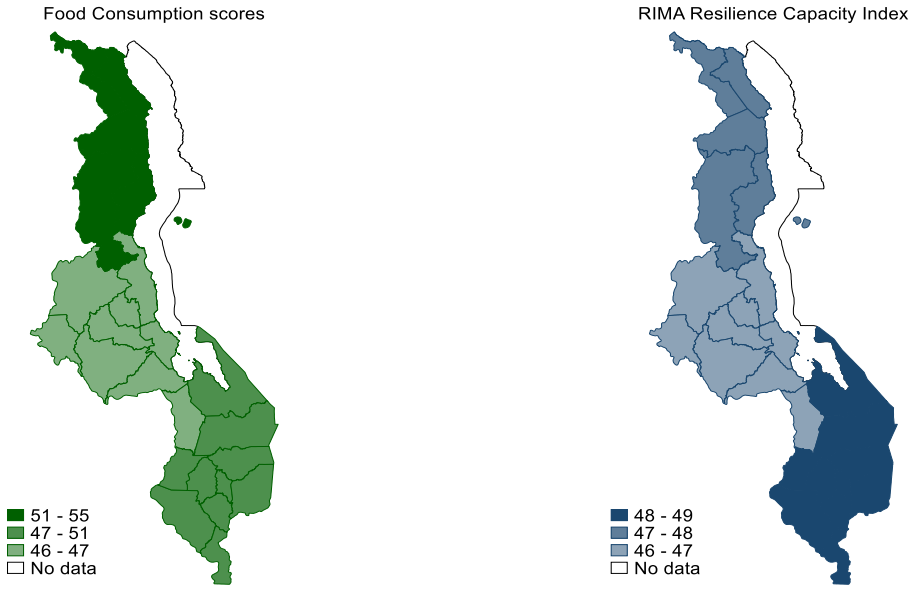
Source: Authors' computations using IHS data; level of significance in italics

3.1.3 Spatial comparisons of food security status and resilience index

This section discusses spatial disparities of food security status, resilience capacity and resilience structure across the three regions of Malawi, namely North, Centre and South (see Figures 3 and 4).

Darker shades correspond to the higher mean scores while the unshaded areas reflect Lake Malawi which has no data. Our results presented in Figure 3 show that in the year 2019, the average food consumption scores were highest in the Northern region, followed by the Southern region. Overall, for all three regions, the average food consumption scores were above the acceptable threshold of 35 indicating that households generally had good food security status. Furthermore, the scores are higher than the baseline averages of around 34 as shown earlier in Figure 1 and Figure A1 in the appendix. With respect to the resilience capacity index, the results presented in Figure 3 shows that the Southern region ranked first followed by the Northern region. However, this captures the overall resilience capacity of households when all the components of RIMA are combined not disaggregated as is the case in Figure 4 which shows spatial comparisons of the various pillars of the RIMA, namely access to basic services, assets, social safety nets and adaptability.

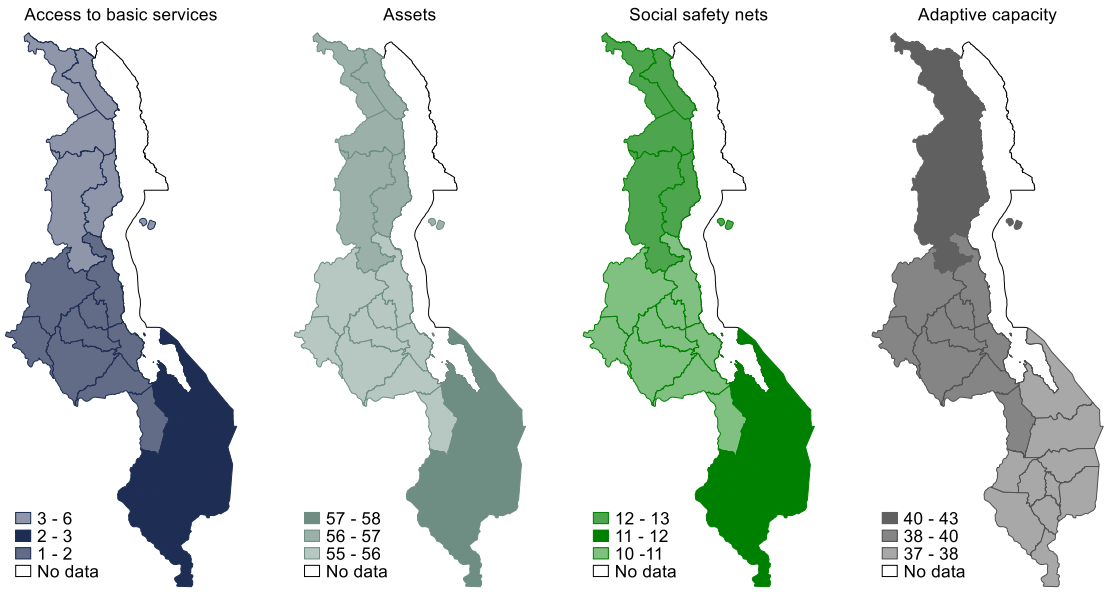
Figure 3: Regional disparities of food consumption scores and resilience capacity (2019)



Source: Authors' computations using IHS data

Higher values of access to basic services observed in the Southern region are largely driven by shorter distances to basic services such roads and agricultural markets. Assets are driven by access to agricultural land and a list of 31 durable goods (such as bed, radio, bicycle, etc.) and 24 agricultural goods (such as farm implements, machinery, and structures) used to construct the asset index. Stronger patterns in social safety nets observed in the Southern region reflect the concentration of the various social protection programmes implemented by both the Government and non-government actors. Greater resilience capacity with respect to adaptability observed in the Northern region is driven by better historical outcomes in education and engagement on non-farm employment opportunities.

Figure 4: Spatial patterns of RIMA pillars (2019)



Source: Authors' computations using IHS data

Over the years, the individual RIMA components have registered growth between 2010 and 2019 as shown in Table 5. Despite declining between 2013 and 2019, the ABS pillar has increased overall between 2010 and 2019. The ASS pillar has registered a small change as anticipated considering that assets which make up the ASS pillar are generally slow-changing variables. However, the SSN and AC pillar have registered steady increases between 2010 and 2019, with the AC pillar registering a larger increase between the two pillars in percentage terms.

Table 5: Changes in RIMA pillars between 2010 and 2019

	ABS pillar		ASS pillar		SSN pillar		AC pillar	
Year	Mean	SD	Mean	SD	Mean	SD	Mean	SD
2010	0.3	0.9	55.9	7.0	30.4	22.2	6.9	11.5
2013	4.2	11.5	54.7	5.7	33.0	21.3	8.1	12.8
2016	3.2	8.3	56.4	9.7	35.0	20.8	9.8	14.9
2019	3.8	12.9	56.9	10.1	40.1	20.7	11.4	15.4

Source: Authors' computations using IHS data

3.1.4 Resilience dynamics

We employ transition matrices to understand how the resilience capacity of households in Malawi has changed over time between 2010 and 2019 (see Table 6). This was done in two steps. First, we categorized households into three tercile groups of the resilience index, namely least resilient, medium resilient and most resilient. Second, we computed shares of households that remain, move out or move in of the three classes of resilience capacity identified in the first step. Our results indicate that while the most resilient households in 2010 stayed resilient in 2019, about a third of the households that were least resilient in 2010 improved and became more resilient by the year 2019. About half of the households that were medium resilient in 2010 stayed medium resilient, about a quarter of the households became least resilient in 2019 and about a fifth of the households moved upwards. Overall, our results suggest that households in the medium-resilient category are more likely to worsen (move downwards) compared to the households that are least and most resilient.

Our results show that about 6.6% of the households that were in the least resilient status in 2010 became most resilient in 2019, while about 31.4% of the least resilient in 2010 became medium resilient in 2019 and 62.1% of the households that were least resilient in 2010 remained least resilient in 2019.

Table 6: Transition matrices between 2010 and 2019

Description	Least resilient in 2019	Medium resilient in 2019	Most resilient in 2019	Total
Least resilient in 2010	62.1	31.4	6.6	100
Medium resilient in 2010	25.7	52.5	21.8	100
Most resilient in 2010	7.2	15.3	77.5	100

Source: Authors' computation using IHS data

Similarly, about 25.7% of the households that were medium resilient in 2010 became least resilient in 2019 while 21.8% of the medium resilient households in 2010 became most resilient in 2019 and about 52.5% of the households remained in the medium resilient status.

With respect to the most resilient households in 2010, about 7.2% of the households that were most resilient in 2010 became the least resilient in 2019, while 15.3% of the most resilient households became medium resilient in 2019 and about 77.5% of the households remained in the most resilient category in both 2010 and 2019.

3.2 Econometric analysis

This section discusses results from an analysis of the determinants of household food consumption status (based on FCS) and resilience (based on RIMA resilience capacity index). The estimations are based on fixed effects regression analysis which controls for time-invariant variables that have been omitted in the analysis but that affect the outcome variables. We carried out the Hausman test to help us decide on the appropriate model between fixed and random effects. The diagnostic test results showed that the fixed effects model was the appropriate model. A variance inflation factor (VIF) analysis was carried out to check for the level of collinearity in the variables. Our overall VIF statistics for the results shown in Tables 7 and 8, were respectively 1.23 and 1.30, well below the most commonly used threshold of 10 considered worrisome and signifying high correlation (O'brien, 2007).

3.2.1 Determinants of household food consumption

Table 7 shows results based on three sets of fixed effects regression analyses. Model 1 is based on economic shock variables while also controlling for household characteristics explanatory variables. Model 2 includes coping mechanisms and social safety net programmes while Model 3 includes controls for urban-rural areas and year-fixed effects to control for changes over time. We use different models to check if the results consistently hold across different specifications and to also isolate and analyse the individual effects of different variables under different contexts.

In Model 1, our analysis shows that that food consumption is positively associated with resilience scores of the previous survey, while high cost of agricultural inputs (such as fertiliser and seeds) and high cost of food are negatively associated with food consumption status outcomes (namely diversity and frequency of consumption). Research has shown that high cost of inputs affects production which in turn leads to higher food insecurity Komarek et al., 2017; Hebebrand & Debucquet, 2023). Results from the household characteristics show that food consumption is positively associated with changes in the size of the household and age of the household head between the survey years. This implies that households with higher resilience scores in the past survey year, larger households and with older household heads had more diverse consumption and higher consumption frequency of the food items included in the calculation of the food consumption scores, namely cereals, tubers, pulses, vegetables, fruit, meat, fish, milk, sugar, and oils.

Furthermore, in this model, the results show that households affected by irregular rains had higher food consumption scores. This may be capturing the effects of humanitarian assistance from both state and non-state actors to households faced with negative economic shocks such as floods, cyclones, and droughts. As shown in Figure 4, social safety nets are concentrated in the southern region. In addition, the observed higher food consumption scores could also be as a result of better access to services in the southern region districts of Malawi (see also Figure 4).

For model 2, results show that reducing coping strategy index exhibits a negative significant relationship with food consumption scores as expected given that the index is an indicator that captures the hardship faced by households due to shortage of food and the negative coping mechanisms employed such as limiting portions and skipping meals, for example. Factors associated with higher food diversity and frequency of consumption include engagement in self-employment activities, access to own savings, receiving cash transfers, and benefiting from a secondary school scholarship programme.

In model 3 which includes controls for urban-rural areas and year-fixed effects, our analysis shows that households that migrated to urban areas between the survey rounds have higher food consumption scores compared to those located in rural areas. This is corroborated by the graphical results presented in Figure A2 in the appendix where while both rural areas and urban areas have registered growth in food consumption scores between 2010 and 2019, the scores and growth rates are much larger and significant for urban areas. With respect to survey years, data shows food consumption scores are significantly higher for 2016 and 2019 above the 2013 levels. This is in line with the observed growth in food consumption scores over time presented in Figures 1, and Figures A1 to A4 in the appendix.

Table 7: Determinants of food consumption score (Fixed effects regression results)

Explanatory variable	Model 1	Model 2	Model 3
Lagged values of resilience score	3.936***	3.693**	2.154
	(2.70)	(2.55)	(1.53)
High cost of agricultural inputs	-2.483***	-2.964***	-1.426*
	(-3.20)	(-3.83)	(-1.87)
High cost of food prices	-1.025	-1.086	0.066
	(-1.38)	(-1.46)	(0.09)
Illness or injury in the HH	2.017	2.633**	1.271
	(1.61)	(2.11)	(1.04)
Affected by floods	1.517	1.28	0.871
	(1.59)	(1.35)	(0.92)
Affected by drought	0.293	0.386	-0.257
	(0.41)	(0.55)	(-0.37)
Affected by irregular rains	1.509**	1.716**	0.75

	(2.17)	(2.48)	(1.09)
Affected by landslides	1.755	1.884	0.382
	(0.96)	(1.05)	(0.22)
Affected by death of member	1.155	0.851	0.43
	(0.93)	(0.69)	(0.36)
End of regular assistance	1.053	1.246	1.779
	(0.85)	(1.01)	(1.49)
Household size	1.133**	1.290***	1.253***
	(2.30)	(2.63)	(2.64)
Age of household head	0.971***	0.897***	-0.099
	(10.83)	(9.83)	(-0.79)
Household head PSLCE	4.187*	3.933*	3.556*
	(1.89)	(1.79)	(1.66)
Household head JCE	-0.283	0.515	1.555
	(-0.10)	(0.18)	(0.57)
Household head MSCE	-0.61	-0.566	-1.593
	(-0.18)	(-0.17)	(-0.48)
Household received cash transfers		3.741***	3.162***
		(4.82)	(4.20)
Household received free food		-0.818	-0.808
		(-1.02)	(-1.03)
Participation in MASAF programme		-0.247	1.25
		(-0.22)	(1.14)
Scholarship for tertiary education		-1.809	-5.172
		(-0.20)	(-0.61)
Scholarship for secondary education		8.206**	7.400**
		(2.20)	(2.05)
Received subsidized coupon		-0.788	-0.286
		(-1.11)	(-0.41)
Reduced coping strategy index		-0.231***	-0.290***
		(-4.78)	(-6.13)
Engaged in self-employment		2.523***	1.955**
		(3.20)	(2.55)
Household has savings		0.569	1.204*
		(0.88)	(1.92)

Urban households			5.508**
			(2.45)
2016			8.005***
			(10.37)
2019			11.322***
			(11.04)
Constant	-5.79	-3.00	36.970***
	(-1.21)	(-0.62)	(6.14)
Number of observations	3051	3051	3051
Number of households	1017	1017	1017

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.2.2 Shocks, social safety nets and household resilience

Table 8 presents results on the determinants of household resilience based on fixed effects regression analysis, where the focus is on shocks and social safety nets, while controlling for household characteristics. The outcome variable is the RIMA resilience capacity index estimated on a number of control variables added to the model in phases, namely Model 4, Model 5 and Model 6.

Model 4 includes shocks faced by households over the past 12 months and household characteristics, Model 5 includes participation in the various social safety net programmes, and finally, Model 6 adds the location of households (rural-urban areas) and survey year as additional controls.

The results show that generally shocks have a negative impact on welfare and these include high costs of agricultural inputs, floods, and irregular rains. The high cost of agricultural inputs is one of the most significant economic shocks, faced by at least 49% of the households in the sample. Over the years, for purposes of national food self-sufficiency, the Government of Malawi has been implementing a national wide Farm Input Subsidy Programme aimed at providing smallholder farmers with access to cheaper seed and fertiliser (Government of Malawi, 2019). Due to the increase in the intensity and frequency of climate related shocks such as floods and irregular rains, the Government of Malawi through the National Social

Support Policy and National Resilience Strategy is leading the implementation of a shock-sensitive social protection programme aimed at reducing vulnerability while increasing the resilience and recovery from shocks (Government of Malawi, 2019).

Our results further show that engagement in non-farm employment activities, participation in cash transfer programmes, access to own savings, improvements in education, age of household, and the end of regular assistance are positively correlated with household resilience. This suggests that households with these characteristics are likely to be more resilient. For example, as noted in the MW2063 agenda, education has the likelihood of pulling people out of vulnerabilities through the creation of access to opportunities (National Planning Commission, 2020). Other variables with positive impact include age of household head, and households migrating to urban locations. With respect to year, our analysis shows higher resilience capacity in 2013, 2016 and 2019 compared to the levels observed in baseline year (2010).

Table 8: Determinants of household resilience (Fixed effects regression results)

Explanatory variable	Model 4	Model 5	Model 6
High cost of agricultural inputs	-0.025***	-0.025***	-0.017*
	(-2.62)	(-2.62)	(-1.76)
High cost of food prices	0.008	0.001	0.004
	(0.94)	(0.10)	(0.41)
Illness or injury in the HH	0.009	0.012	0.004
	(0.60)	(0.75)	(0.25)
Affected by floods	-0.014	-0.018	-0.024*
	(-1.11)	(-1.45)	(-1.91)
Affected by drought	-0.004	-0.002	0.000
	(-0.45)	(-0.18)	(0.01)
Affected by irregular rains	-0.026***	-0.027***	-0.042***
	(-2.89)	(-3.04)	(-4.28)
Affected by landslides	0.032	0.037	0.025
	(1.24)	(1.44)	(1.00)
Affected by death of member	-0.019	-0.014	-0.017
	(-1.22)	(-0.90)	(-1.07)

End of regular assistance	0.029*	0.032*	0.037**
	(1.74)	(1.91)	(2.24)
Household size	-0.010*	-0.011*	-0.011*
	(-1.65)	(-1.91)	(-1.89)
Age of household head	0.013***	0.012***	0.005***
	(14.09)	(12.58)	(3.18)
Household head PSLCE	0.299***	0.293***	0.285***
	(11.22)	(11.14)	(10.85)
Household head JCE	0.295***	0.301***	0.310***
	(9.04)	(9.35)	(9.71)
Household head MSCE	0.295***	0.301***	0.298***
	(6.97)	(7.21)	(7.18)
Household received cash transfers		0.016	0.011
		(1.61)	(1.11)
Household received free food		-0.001	-0.001
		(-0.11)	(-0.06)
Participation in MASAF programme		-0.002	0.007
		(-0.11)	(0.45)
Scholarship for tertiary education		0.014	-0.004
		(0.14)	(-0.04)
Scholarship for secondary education		-0.032	-0.037
		(-0.69)	(-0.78)
Received subsidized coupon		-0.007	-0.002
		(-0.88)	(-0.27)
Reduced coping strategy index		0.000	-0.001
		(-0.53)	(-1.13)
Engaged in self-employment		0.092***	0.087***
		(10.03)	(9.58)
Household has savings		0.013	0.015*
		(1.57)	(1.80)
Urban households			0.077***
			(2.81)
2013			0.011
			(0.84)
2016			0.070***

			(4.68)
2019			0.096***
			(5.49)
Constant	-0.615***	-0.579***	-0.305***
	(-13.69)	(-12.72)	(-4.77)
Number of observations	4068	4068	4068
Number of households	1017	1017	1017

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

3.2.3 Discussion of econometric results

Our findings show some positive associations of some social protection programmes (e.g., cash transfers and scholarship programmes), savings and self-employment activities with resilience and food security. Our findings are consistent with other studies from the SSA region. For example, Daidone *et al.* (2019) observed that that cash transfers in Ghana, Kenya, Lesotho and Zambia increase resilience to shocks through increased income generation and productivity, and eventually improving the likelihood of household graduation from social safety nets programs. Similar results are reported by Handa *et al.* (2019) who notes that cash transfer programs have significant impacts on consumption and food security, in addition to productivity impacts. There is also evidence of increased resilience capacity emanating from household savings (Do, 2023; Gash and Gray, 2016). Households that save tend to have uninterrupted consumption in times of shocks. Further, income diversification is also key in improving resilience. In an agrarian economy like Malawi's, participation in non-farm employment is one way of diversifying income sources, and cushioning against shocks. Studies have shown that households that have multiple income sources tend to be resilient (Lwanga-Ntale and Owino, 2020; Wan *et al.* 2016; Gash and Gray, 2016).

Furthermore, our findings on the effects of shocks on welfare collaborate research from other countries where recent evidence shows that increasing intensity of climatic shocks has negative implications on household welfare. In Zambia and Ghana, for example, studies have found that rainfall shocks tend to worsen households' welfare and food security (Boansi *et al.* 2021; Asfaw *et al.* 2017). In Vietnam and Thailand, extreme weather shocks such as floods and droughts were found to have a negative impact on household income, consumption and poverty (Nguyen *et al.* 2020).

The Government of Malawi is implementing various social protection programmes aimed at supporting vulnerable poor households, improving their production, productivity, incomes, and increasing participation in employment activities (Government of Malawi, 2019). With respect to improving self-employment activities and savings, the Government is supporting the scaling up of village savings and loans and improved access to microfinance services (Government of Malawi, 2017; Government of Malawi, 2019). Furthermore, the Government of Malawi is implementing the Social Cash Transfer Programme targeting households that are ultra-poor and labour-constrained with the aim of improving access to basic services (e.g., food, shelter, health and education) and reducing poverty and hunger (Government of Malawi, 2019). Furthermore, the Government and the various actors are implementing various programmes such as school feeding programme for school going children including education in nutrition aimed at improving educational outcomes.

While the various social protection programmes (including social safety nets and farm input subsidies) have helped to cushion households against adverse economic shocks and high cost of food and agricultural costs, research has shown that the programmes should be strengthened to address targeting issues and other implementation challenges such as delays in reaching beneficiaries and cases of households benefiting from multiple programmes (Gondwe, *et al.,* 2023; Nyondo, *et al.,* 2022).

4. Summary and conclusions

This paper makes an important contribution to the literature by assessing the impact of shocks and the various social safety net programmes on food security status and household resilience using a panel data set (2010-2019). The study also analyses the resilience status of households over time, namely how households move in and out of resilience classes between 2010 and 2019. In addition to a temporal analysis, the study conducts a spatial analysis of food security status and resilience capacity across the regions of Malawi.

While the resilience capacity of households has been improving since 2010, the changes are largely correlated with positive changes in the Social Safety Nets (comprising of cash transfers, gifts, remittances and food) and Adaptive (comprising of self-employment, literacy, education and illness) components of the RIMA index over time. Compared to other regions,

our results show that households located in the Southern region have better access to basic services, assets and social safety nets while households located in the Northern region have a better ability to adapt to new situations and livelihoods when faced with negative economic shocks. Our analysis shows that while some households improved their resilience status, other households became worse off between 2010 and 2019, suggesting the importance of tracking the welfare status of households over time.

The results also show that adverse economic shocks such as high cost of agricultural inputs, high food prices and floods have a negative impact on food security status and resilience capacity of households and this is exacerbated by the fact that households face multiple and repeated shocks, averaging about 3 shocks per annum. Social safety net programmes have been implemented to help households mitigate against the shocks. Our study shows that cash transfers has improved household's food security. Residing in urban areas, engagement in self-employment activities, access to savings, and improvements in education also have a positive impact on food security status and the resilience of households.

The findings highlight valuable lessons for program interventions. Firstly, strategies for improvements in education (e.g., enrolment, retention, etc.) could have long-term human capital development benefits that complement household resilience. These could be complemented by access to support financing for investments in self-employment activities (including business skills) and access to savings. Secondly, considering their positive impact on resilience, social safety nets especially cash transfers should be reinforced, scaled up and amounts increased to increase benefits. Thirdly, the susceptibility and vulnerability of the agricultural sector to climatic and weather-related shocks such as floods, drought and irregular rains suggest the need for continued investments and promotion of more sustainable farming and water management practices such as irrigation, gully reclamation, vetiver grass, box ridging, and ridge realignment. Finally, the fact that the high costs of agricultural inputs have a negative impact on food security status and resilience capacity of households suggests that some continued support to improve agricultural productivity and smallholder profitability is warranted. However, the programmes should be strengthened to address issues of fertiliser

use efficiency, targeting and other implementation challenges, such as implementation delays. This could include a combination of an improved subsidy programme that goes beyond inorganic fertiliser to address soil health concerns (e.g., supporting legume seeds, organic fertilisers, or agricultural lime) and programmes to improve agricultural research, development, and extension. Also, the use of local knowledge should be strengthened by encouraging bidirectional learning between extension agents and smallholder farmers.

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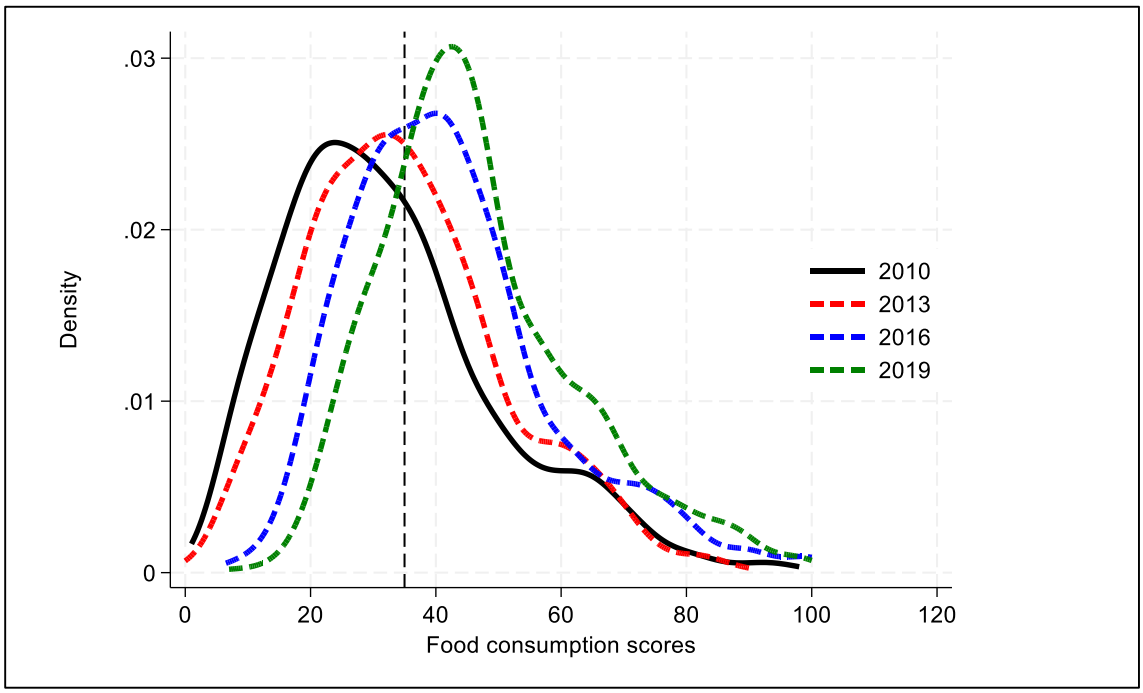
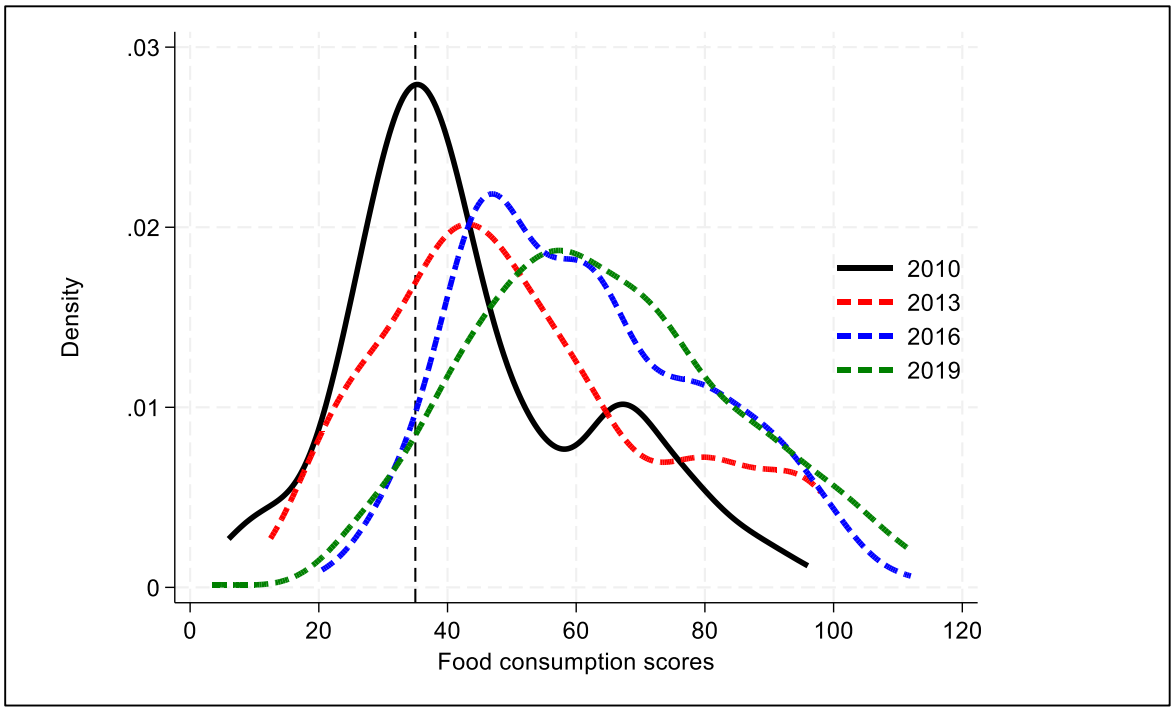
Appendices

Figure A1: Distribution of food consumption status for rural areas (2010-2019)



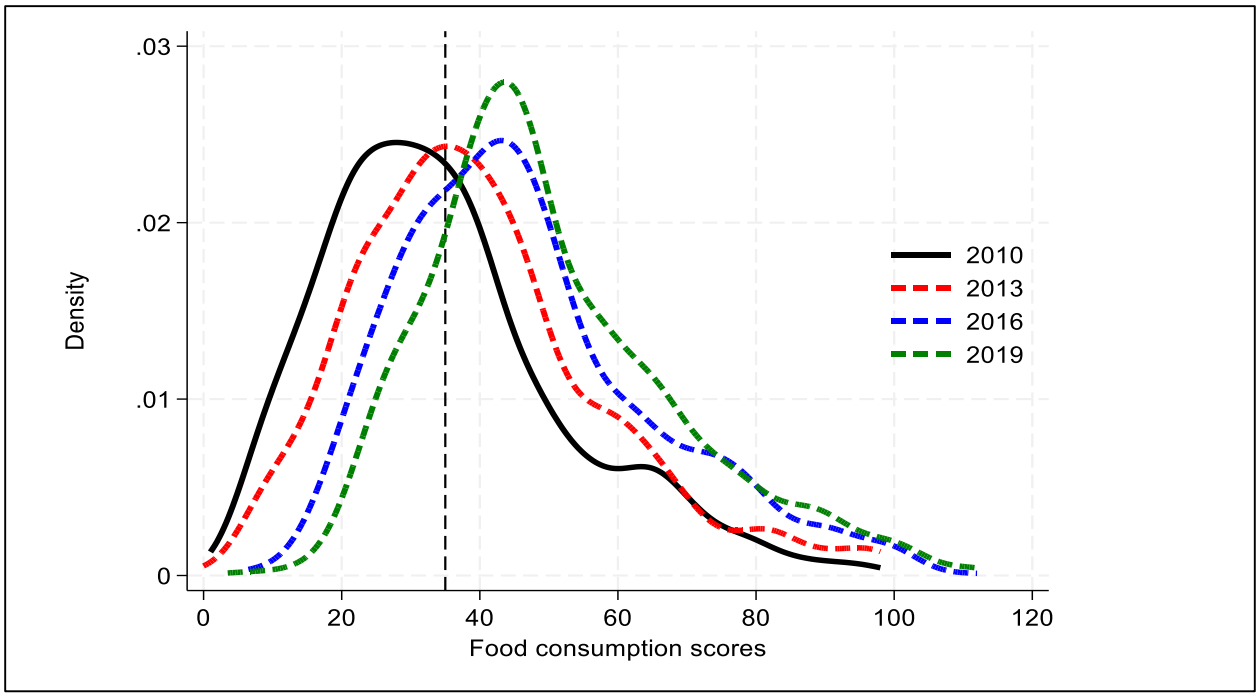
Source: Authors' computation using IHS data

Figure A2: Distribution of food consumption status for urban areas (2010-2019



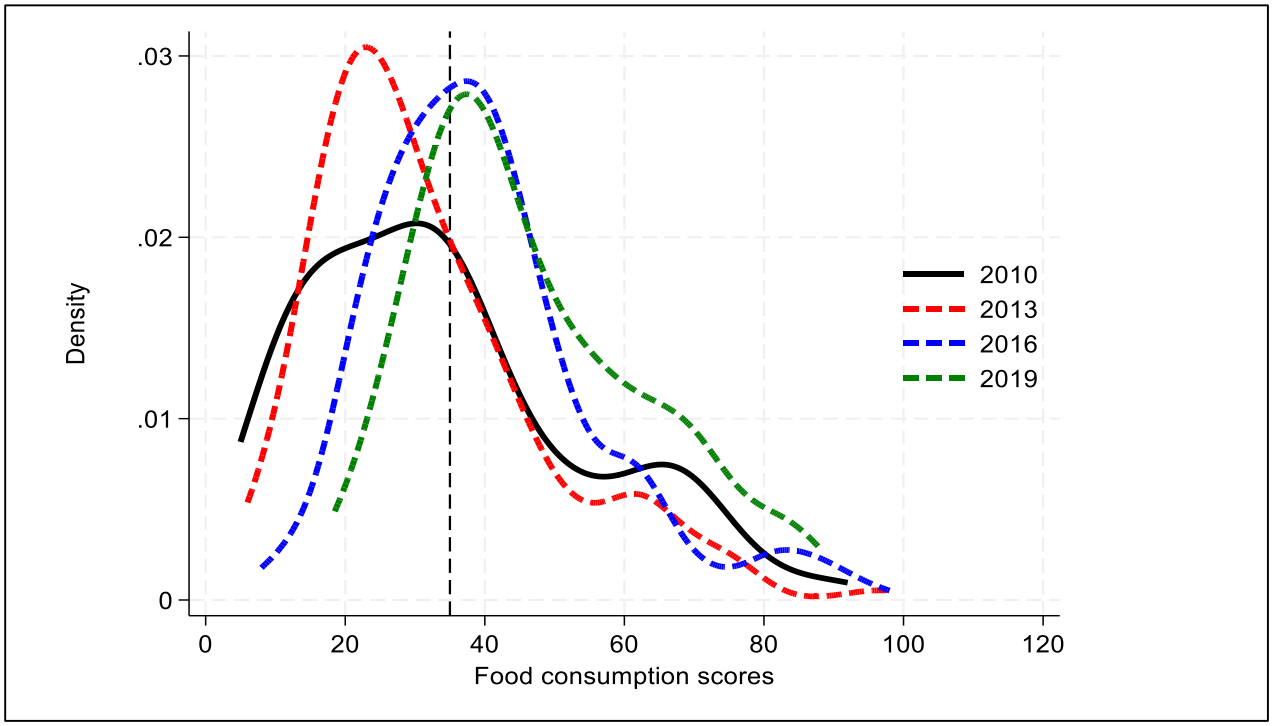
Source: Authors' computation using IHS data

Figure A3: Distribution of food consumption status for male headed households (2010-2019



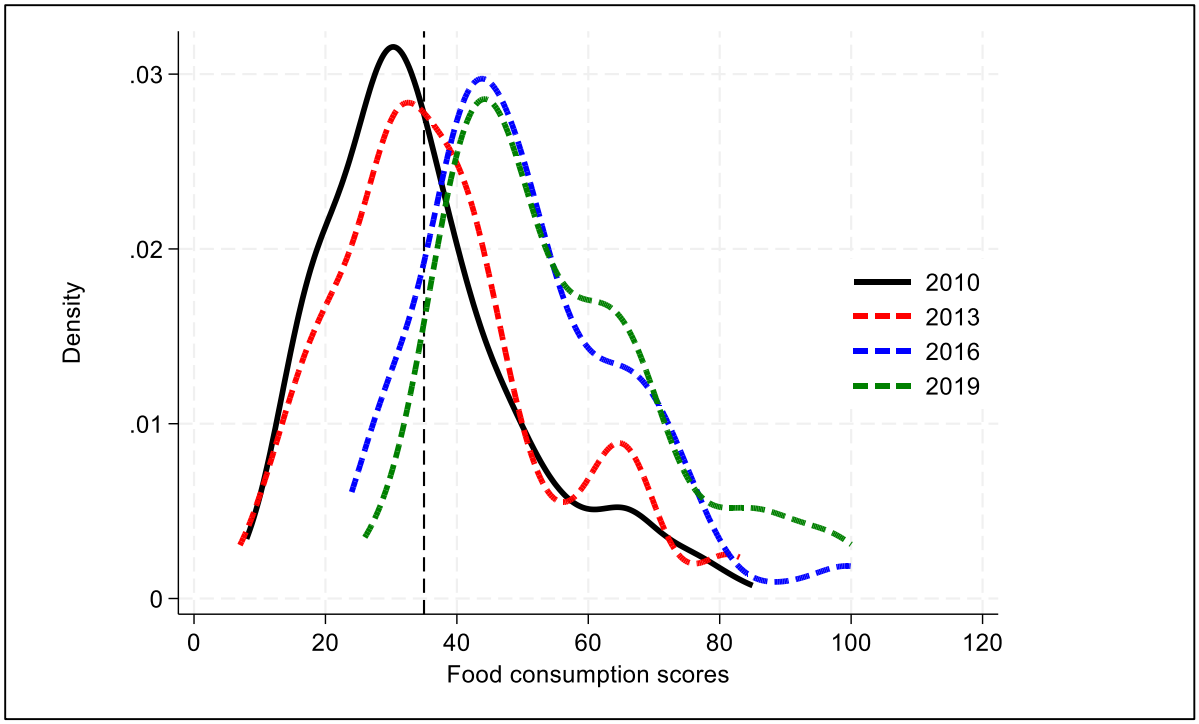
Source: Authors' computation using IHS data

Figure A4: Distribution of food consumption status for female-headed households (2010-2019



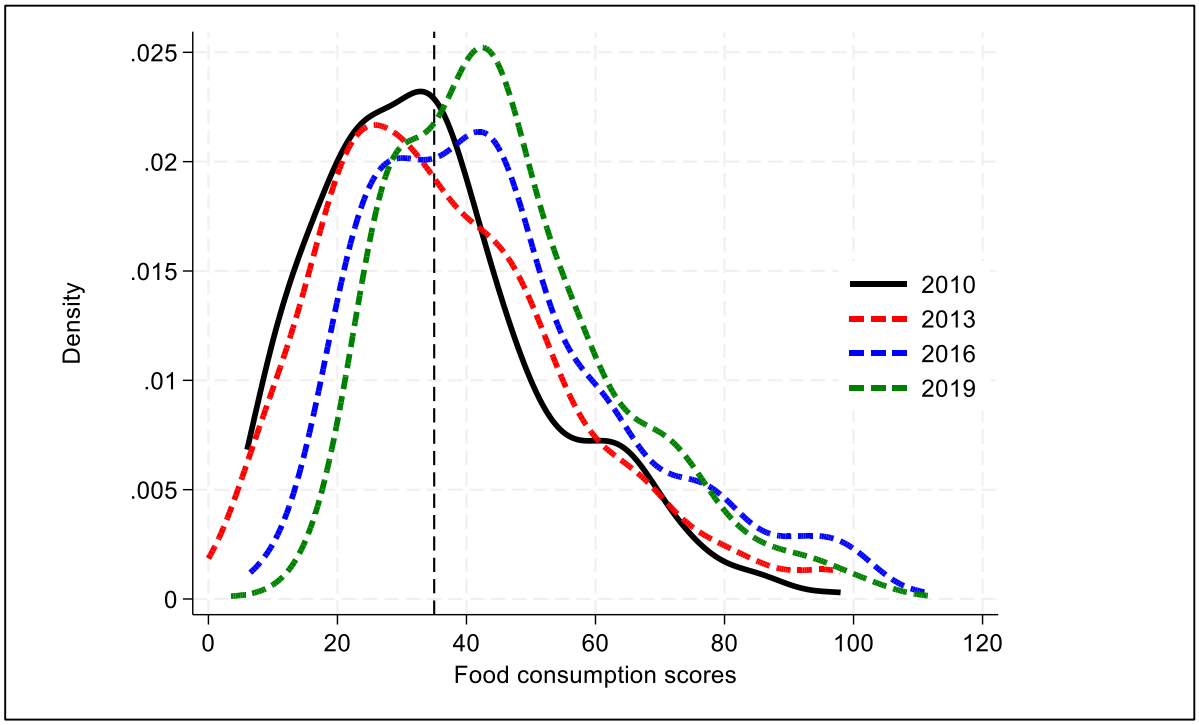
Source: Authors' computation using IHS data

Figure A5: Distribution of food consumption status for Northern region (2010-2019



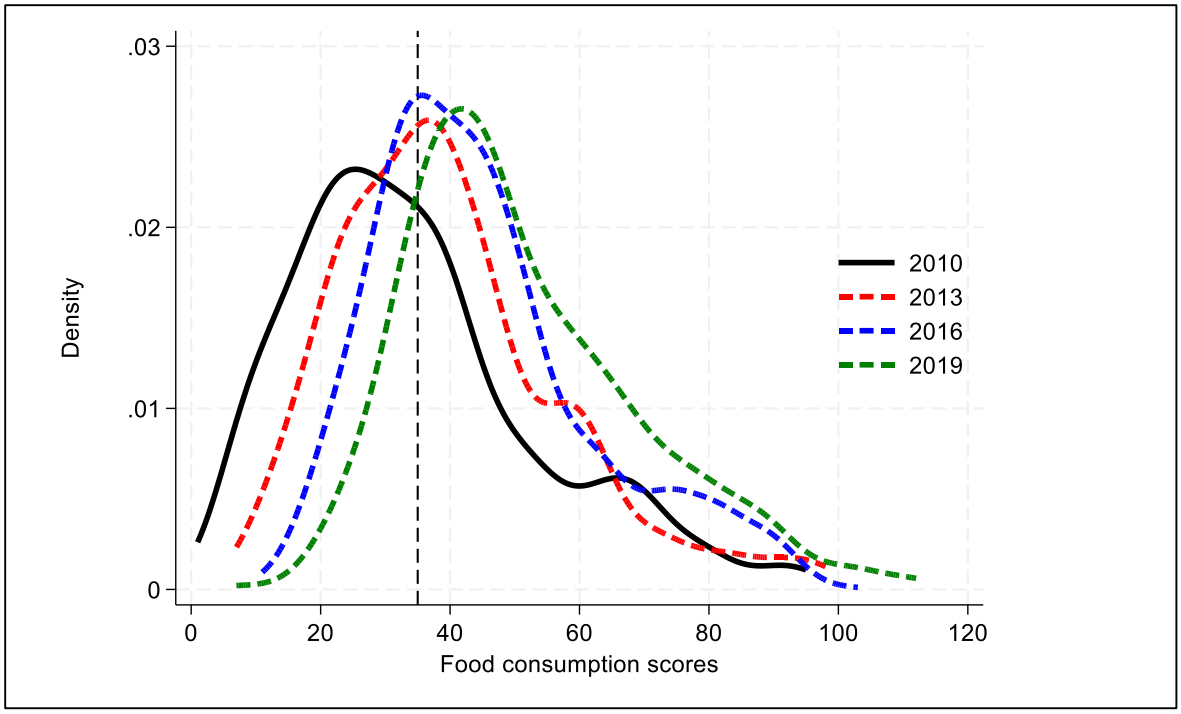
Source: Authors' computation using IHS data

Figure A6: Distribution of food consumption status for Central region (2010-2019



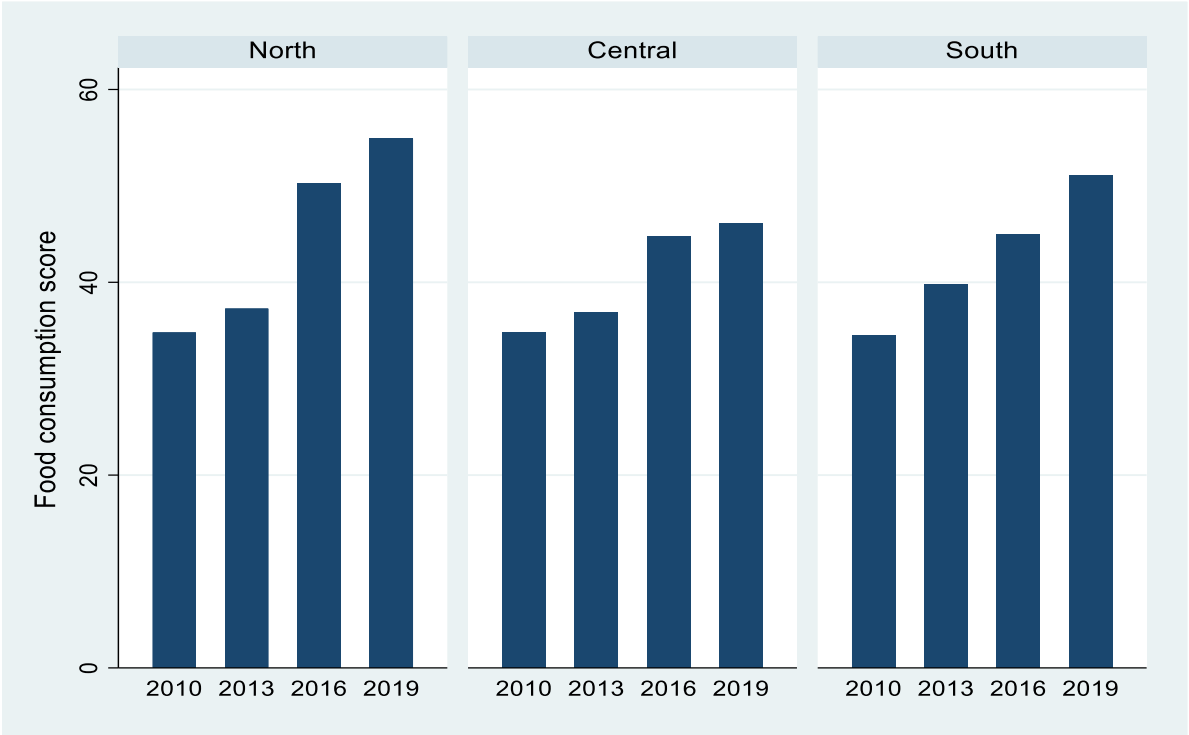
Source: Authors' computation using IHS data

Figure A7: Distribution of food consumption status for Southern region (2010-2019



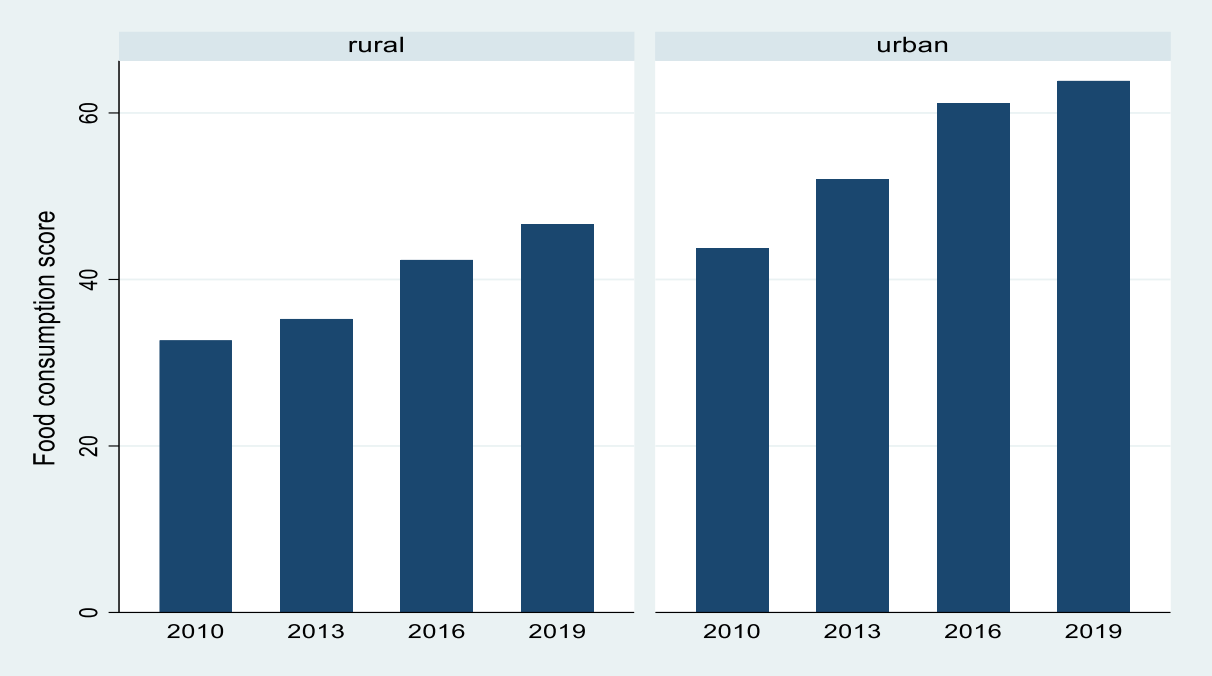
Source: Authors' computation using IHS data

Figure A8: Food Consumption Scores by year and region



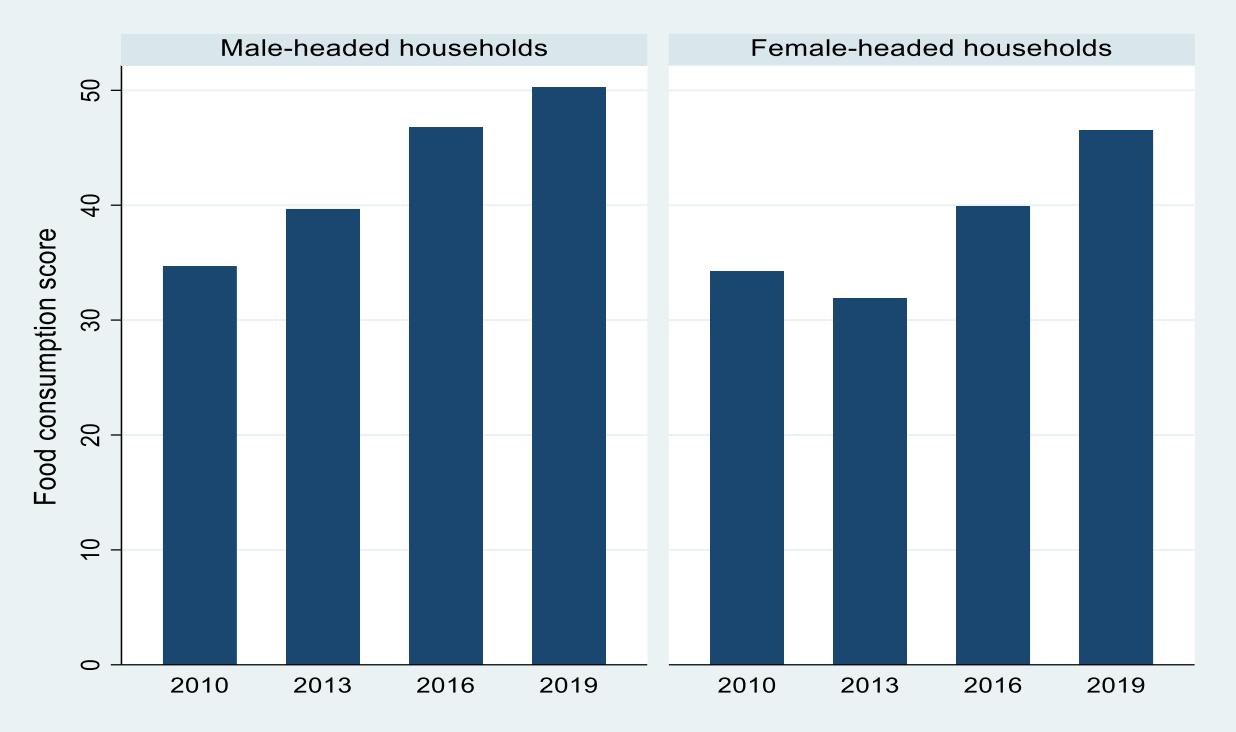
Source: Authors' computation using IHS data

Figure A9: Food Consumption scores by year and rural-urban areas



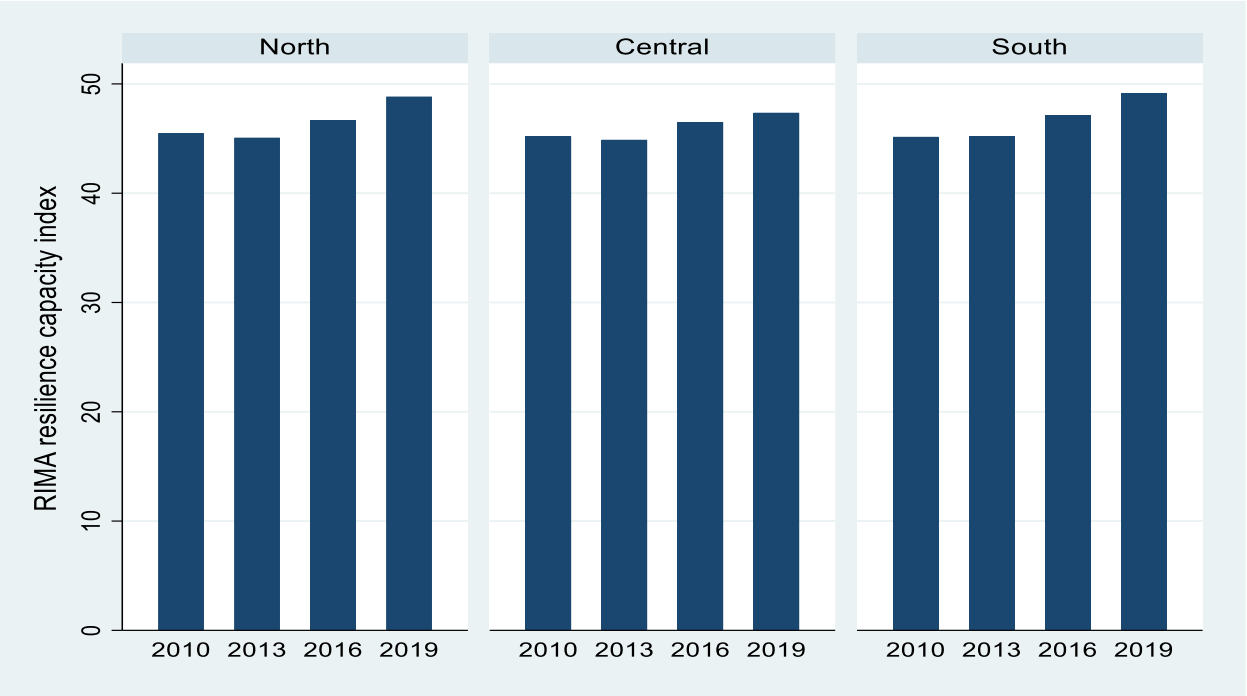
Source: Authors' computation using IHS data

Figure A10: Food consumption status by survey year and sex of household head



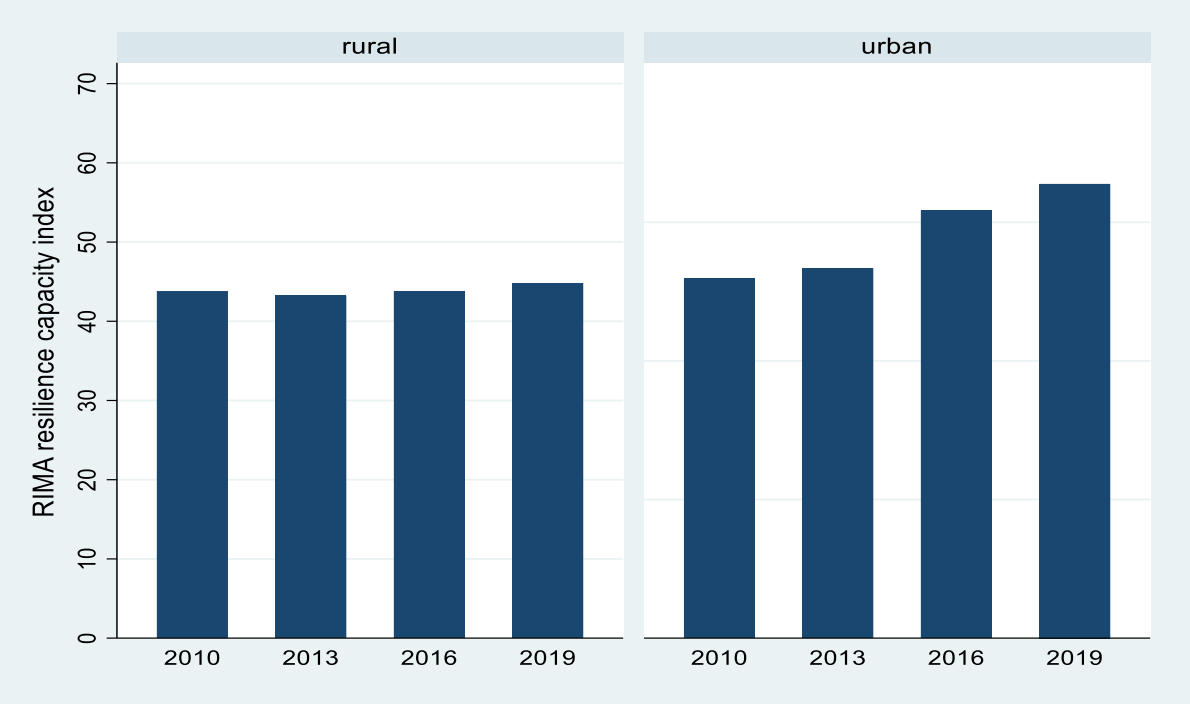
Source: Authors' computation using IHS data

Figure A11: Resilience Capacity Index by survey year and region



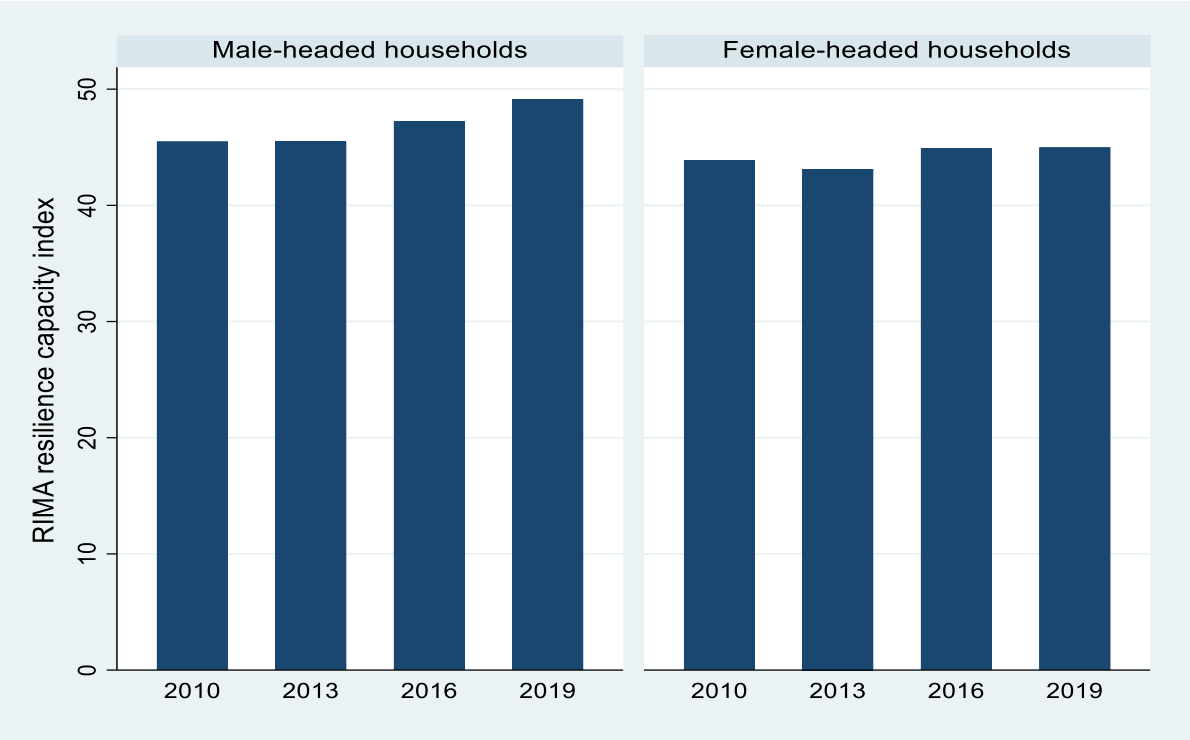
Source: Authors' computation using IHS data

Figure A12: Resilience Capacity Index by survey year and rural-urban areas



Source: Authors' computation using IHS data

Figure A13: Resilience Capacity Index by survey year and sex of household head



Source: Authors' computation using IHS data

Table A1: Household and demographic characteristics by survey year

Description	2010		2013		2016		2019	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Household size	2.96	1.10	3.20	1.15	3.21	1.16	3.12	1.20
Age of household head	41.96	14.64	45.06	14.32	48.03	14.01	50.93	14.06
Female household head	0.18	0.38	0.18	0.38	0.18	0.38	0.17	0.38
Urban households	0.18	0.38	0.18	0.39	0.17	0.38	0.17	0.38
Household head with PSLCE	0.06	0.15	0.07	0.14	0.06	0.13	0.10	0.16
Household head with MSCE	0.10	0.21	0.09	0.19	0.11	0.21	0.10	0.20
Percent of members literate	0.46	0.31	0.50	0.29	0.55	0.29	0.63	0.29
Percent of members with PSLCE	0.09	0.19	0.09	0.19	0.08	0.16	0.12	0.19
Percent of members with JCE	0.07	0.18	0.06	0.15	0.07	0.15	0.05	0.13
Percent of members with MSCE	0.05	0.15	0.05	0.14	0.05	0.14	0.05	0.14
Number of households	1,017		1,017		1,017		1,017	

Source: Authors' computation using IHS data

Table A2: Socio-economic characteristics by survey year

Description	2010		2013		2016		2019	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Coping strategy index	3.52	6.53	3.97	6.34	6.64	8.57	5.25	6.94
Distance to road (km)	8.47	9.59	7.92	9.37	7.96	10.01	8.84	9.90
Distance to ADMARC (km)	6.98	4.69	7.12	5.01	7.17	5.26	7.04	5.00
Distance to boma (km)	52.92	28.20	22.61	16.48	21.10	17.93	24.46	16.87
Distance to pop. centre (km)	30.55	17.98	32.85	20.17	26.39	18.88	21.93	13.77
Access to agricultural land	0.91	0.28	0.97	0.18	0.87	0.34	0.85	0.36
Agricultural asset index	- 0.13	0.77	- 0.09	0.84	- 0.09	0.87	- 0.05	0.90
Durable asset index	- 0.05	0.85	- 0.17	0.95	- 0.26	1.09	- 0.29	1.04
Households affected by drought	0.43	0.49	0.30	0.46	0.42	0.49	0.33	0.47
Households affected by floods	0.04	0.20	0.14	0.35	0.07	0.26	0.33	0.47
Households affected by landslides	-	-	0.01	0.10	0.03	0.17	0.07	0.25
Household with chronic illness	0.07	0.17	0.08	0.17	0.09	0.18	0.11	0.21
Cash transfer from Government	0.00	0.04	0.00	0.05	0.03	0.17	0.05	0.21
Cash transfer from others	0.01	0.08	0.00	0.03	0.03	0.17	0.02	0.13
MASAF	-	-	0.15	0.35	0.06	0.24	0.05	0.22
Household received free maize	0.01	0.11	0.11	0.31	0.13	0.34	0.18	0.38
Beneficiary of input subsidy	0.62	0.49	0.54	0.50	0.49	0.50	0.35	0.48
School feeding programme	0.14	0.35	0.18	0.39	0.12	0.33	0.14	0.35
Households in self-employment	0.23	0.42	0.32	0.47	0.31	0.46	0.41	0.49
Household has savings	0.01	0.11	0.02	0.15	0.03	0.16	0.06	0.24
Number of households	1,017		1,017		1,017		1,017	

Source: Authors' computation using IHS data. Agricultural and durable asset indices are calculated using Multiple Correspondence Analysis of 24 and 31 assets, respectively.