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SUBMITTED ARTICLE



Household resilience and coping strategies to food insecurity: An empirical analysis from Tajikistan

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Abstract

By applying Resilience Index Measurement Analysis to data from Tajikistan, this paper measures food insecurity resilience capacity. Another objective of this paper is to construct and integrate coping strategies into resilience discussions. The final objective is to analyze the role of resilience capacity and coping strategy in food security with an Instrumental Variable approach. Our results generally confirm that resilience and coping strategies increase food security, determined by food expenditure, household adequacy of fruit and vegetable consumption, and household food expenditure share. Moreover, resilience capacity has a moderating role in mitigating negative impacts of shocks on food security.

KEYWORDS

coping strategy, food security, instrumental variable, latent profile analysis, resilience capacity index

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Resilience has become one of the most important cornerstones in addressing poverty and vulnerability of a population exposed to different types of shocks. In this respect, the study of resilience provides an excellent platform for analyzing household and community response mechanisms for dealing with shocks. Practically, the ubiquity of resilience ideology in socioeconomic science is explained by its capacity to preserve and improve livelihoods in the face of shocks (Choularton et al., 2015; FAO, 2013), indicating a nontrivial relationship with vulnerability (Gallopín, 2006; Silici et al., 2011), sustainability (Maleksaeidi & Karami, 2013), or agricultural development (Sinclair et al., 2014). Recently, the concept has become relatively more influential in food security studies (Ansah et al., 2019). The enhancement of resilience in the food system is inextricably linked with household-level capacities to activate response mechanisms, in which different types of abilities or capacities are interrelated (d'Errico & Smith, 2019). Therefore, treating resilience as a capacity is likely to be promising in food security analyses.

Although the resilience concept has become one of the core directions to explain how it mediates the shocks to food security (Ansah et al., 2019), data-driven evidence from context specificity is still limited. Moreover, resilience definitions and measurement techniques for food security outcomes are heavily contested. There are generally two rival methods to operationalize resilience towards development studies, particularly in household food security outcomes (d'Errico & Smith, 2019). The most widely applied method is a Resilience Index Measurement Analysis (RIMA) model by FAO (2016), while the second approach is based on the Technical Assistance to NGO's International (TANGO International) framework. TANGO is widely applied for food security analysis, comprising absorptive, adaptive, and transformative capacities of resilience (Constas et al., 2014; Smith & Frankenberger, 2018). Technically, both approaches measure resilience under the capacity index towards food security outcomes. However, one of the distinctive differences is that shock-coping strategies are easily incorporated into modeling with the RIMA approach (Ansah et al., 2019). Moreover, a comparative study by Upton et al. (2022) confirmed that the RIMA approach is likely to be efficient in linking resilience pillars to wellbeing outcomes. Therefore, this paper applied the RIMA approach to detect a causal effect of household resilience on food security in the presence of coping strategies.

By detecting a relationship between resilience and food security outcomes, this paper accomplishes several contributions to the current literature. First, there are discussions which prominently integrate coping strategies and resilience to predict food security outcomes (Lascano Galarza, 2020; Murendo et al., 2020, 2021). However, the existing literature using coping strategies alone to predict food security outcomes underestimates resilience effects, particularly in the long term (Ansah et al., 2019). In this respect, coping strategies representing a short-term response mechanism mediate between the resilience and food security relationship (Otchere & Handa, 2022); therefore, it is sometimes operationalized as a proxy to food insecurity resilience (d'Errico et al., 2023). In order to deal with the problem of heterogeneity in the coping strategies, we applied latent class analysis (LCA) to identify meaningful and homogeneous classes that are not directly observable (Collins & Lanza, 2010). Second, this paper applies both static and dynamic natures of food security to identify a causal relationship between resilience and food security. In the regression analysis, the measured household resilience capacity in t_0 is regressed on future food security outcomes at t_1 period. Moreover, the assumption of a positive relationship between resilience and food security attainments should also confirm that food security loss between t_0 and t_1 is likely to decrease due to resilience. The paper also applies the mitigation effect of resilience capacity and shock in order to explain how resilience is effectively able to moderate the adverse effects of shocks on food security outcomes.

In the estimation, it was considered to adopt an Instrumental Variable (IV) approach for detecting causal relationships between resilience capacity and food security outcomes.

As a case study, we chose the country of Tajikistan by employing a dataset from the Tajikistan Living Standards Survey (the TLSS) and the Tajikistan Household Panel Survey (THPS). Although trade reforms in postcommunist countries are reflected in improved food security outcomes (Krivonos & Kuhn, 2019), food security remains in a critical condition in Tajikistan (Kawabata et al., 2020). While more than 40% of households in Tajikistan generate income from agriculture, households are characterized by having a weak adaptive capacity to food insecurity due to low income, education, diversification, and seasonality (WFP, 2017). To deal with the problem, the government of Tajikistan established an Agrarian Reform Program for 2012–2020 and a National Development Strategy for the period up to 2030, in which the enhancement of national food and nutritional security is prioritized (FAO, 2022).

The labour migrants from Tajikistan represent one-fifth of migrants in Russia (MPI, 2019) making Tajikistan the world's sixth remittance recipient country (McAuliffe & Triandafyllidou, 2022). The uneven nature of implementations towards migration policy is very oscillating between permissive and restrictive regimes; therefore, it is applied as one of instruments by the Russian Federation to enlarge the Eurasian Economic Union (EAEU) to the other post-Soviet countries, particularly to Tajikistan (Kluczevska & Korneev, 2022). However, non-EAEU countries such as Tajikistan and Uzbekistan do not still find beneficial results in joining into EAEU regarding free trade and investment (Kemme et al., 2021). From another side, an increasing male migration in Tajikistan poses another challenge adding extra stress and socio-economic responsibilities of abandoned women (ADB, 2020). It is also negatively associated with the left-behind children of migrant families, where there is high school dropout rate (Murakami, 2019).

Interethnic relations in Central Asia, particularly in livelihoods in Tajik-Kyrgyz border communities, persist in the current situation. For example, tensions noticeably rose due to access and use of pasture and water between 2004 and 2021, deteriorating social, financial, and natural resources (Sullivan, 2021; Xenarios et al., 2018). In this case, household resilience capacity is one of the direct ways to mitigate the effects of violent conflict in cross-border regions (Brück et al., 2019). By acknowledging different reform programs in Tajikistan, it is not hard to envision that resilience thinking in the interventions may contribute to more inclusive outcomes. In this case, providing a useful approach to address complexity in resilience thinking requires an understanding of the adaptive and emergent features of households (Sellberg et al., 2021). This in turn helps to understand how building resilience may intermediate in food security improvement.

CONCEPTUAL FRAMEWORK

With respect to resilience definitions, a condition or system is considered to be more resilient if there is no shifting into an alternative circumstance (Walker et al., 2006), making the perturbations more endurable or stable at least (Holling, 1973). Recent bodies of literature explain the resilience concept using the idea of bouncing back as a response to changes in a dynamic or adaptive environment (Capdevila et al., 2021). Looking at the socioeconomic definition, resilience is defined as “...the ability of communities or households to manage changes by maintaining or transforming livelihoods in the face of shocks or stresses without compromising their long-term prospects” (DFID, 2011).



Although food security and resilience are intertwined, the RIMA model does not fully measure the effect of resilience on food security outcomes. A more comprehensive RIMA-II methodology treats resilience as a latent variable or food security as a separate outcome variable (Ansah et al., 2019). According to this methodology, household resilience to food insecurity depends on several pillars: access to basic services (ABS), assets (AST), social safety nets (SSN), adaptive capacity (AC), and sensitivity (S). In the framework, each pillar has its own role as the precondition for household mechanisms when a shock occurs between t_0 and t_1 times. Resilience capacity index (RCI) in the framework is therefore measured with the above-mentioned four pillars. As the centerpiece of food security analysis, the endogenous ABS, AST, SSN, AC, and S pillars define RCI at t_0 , which in practice has a relationship with food security at t_1 .

Looking at previous RIMA-II results, there are findings showing a reciprocal relationship between resilience and food security. For example, RCI as a function of different pillars has a positive association with food security outcomes (d'Errico, Romano, et al., 2018; Sibrian et al., 2021). Although it is difficult to define a causality between RCI and food security, some authors have detected a causal relationship (d'Errico & Pietrelli, 2017; Egamberdiev et al., 2023; Murendo et al., 2020). Some scholars have extended the framework by including the interaction terms between RCI and shocks (d'Errico, Romano, et al., 2018; Egamberdiev et al., 2023; Murendo et al., 2020; Ouoba & Sawadogo, 2022; Sunday et al., 2022). Their findings concluded that resilience capacity has a moderating role in improving food security outcomes or decreasing the likelihood of food security worsening when shocks intensify.

MATERIALS AND METHODS

Data

The analysis in this paper is based on two surveys: the Tajikistan Living Standards Survey (the TLSS) in 2007 and 2009 by the World Bank, as well as the Tajikistan Household Panel Survey (THPS) in 2011 by the Leibniz Institute for East and Southeast European Studies (*Leibniz-Institut für Ost- und Südosteuropaforschung* – IOS) in cooperation with the Research Center Sharq in Dushanbe. As part of the Living Standard Measurement Survey, TLSS is nationally representative by including 1500 households interviewed in 4 regions and the capital city of Dushanbe (TSSA, 2009). TLSS is based on a stratified clustered random sampling technique in which the sample was stratified according to *oblasts* (regions) and urban/rural settlements. The second THPS data set fully represents TLSS, because the survey aimed to generate unique panel data based on migration and remittances in Tajikistan by reinterviewing the same households surveyed in 2009 (Danzer et al., 2013). Thus, the observations of THPS are merged with TLSS to create a final panel dataset for further analysis.

Estimating the resilience capacity index

The measurement framework of RIMA-II is based on a two-stage procedure. The first stage uses a factor analysis to construct pillars, after which the second stage employs a Multiple Indicators Multiple Causes (MIMIC) model to estimate RCI from pillars for the relationship between RCI and food security outcomes (FAO, 2016). In this manuscript, we apply a principal components analysis (PCA) on the following resilience pillars: ABS AC, AST, SSN, and Sensitivity S. In

addition to this, we use a structural equation modeling (SEM) as a robust to explore a complex relationship between the mentioned four pillars (Alinovi, Mane, et al., 2010). The description of each pillar with related statistics is provided in Supporting information Table A1 in Appendix. After measuring and scaling the score of each pillar, RCI is itself constructed through PCA and SEM. As a data reduction method, PCA allows us to obtain a set of uncorrelated linear combinations of the variables retaining most of the variance. As a family of multivariate statistical analysis, SEM is used to model a structural relationship between pillars. This method accordingly gives us the possibility to evaluate the relationship between the pillars by holding other indicators constant and include the measurement error in the model. With the help of SEM features, we look at the modification indices to calibrate the model until it reaches the best fit. The score of each pillar and RCI in PCA is measured through the *weighted sum method* suggested by Bartlett (1937). A similar approach is applied in order to construct pillars and RCI, where each factor is multiplied by the proportion of variance (Alinovi, Mane, et al., 2010). As for SEM, pillars and RCI are measured through an analog of regression scoring. For factorability and validity analysis, findings for each pillar and RCI are based on the requirements recommended for implementing PCA and SEM (see Supporting information Appendix A and Table A2 for further details). In the same way, Supporting information Figure A1 in Appendix A provides details for the SEM analysis. We applied the MIMIC model in the second stage, showing the relationship between observable and unobservable variables (see Supporting information Appendix B and Figure A2 for further discussion). In other words, MIMIC allows us to integrate both formative and reflective models (Bollen, 2011).

Estimating latent coping strategy

Detecting a household difference or heterogeneity in resilience studies is an important but complex issue. Known as a *variable-oriented approach*, related traditional approaches emphasizing the relationship between observed variables in the dataset might be limited in detecting the heterogeneity (Bergman et al., 2003). Therefore, we proposed to apply a *person-centered approach* to emphasize the patterns of individual characteristics in order to categorize the behavior of people with a latent analysis rather than using arbitrary cutoff points (Hickendorff et al., 2018). One way to deal with heterogeneity through the person-centered approach is to use LCA to identify subgroups under similar patterns of characteristics. LCA referred to a mixture model is used to define unobserved categorical variables by dividing the population into mutually exclusive latent classes (Collins & Lanza, 2010). In this paper, LCA helps to manage response patterns about 10 types of subjective coping strategies to such an extent that we are able to discern meaningful and scientifically interesting classes. In this case, we can observe that 10 subjective coping strategies represent different socioeconomic aspects, where more than one-third of households got financial aids from friends or family, sent a member to work as a seasonal worker, increased food production, worked more than normally, and sent household members to work who normally did not work (see Supporting information Appendix C for model specification details and class identification, Supporting information Tables A3 and A4 for statistical information, and Figure A3 for identified classes).

In order to express the essence of selected coping strategies generalized in latent classes, we primarily drew on a *three-step approach* including (1) estimating a standard latent class model without covariates, (2) assigning subjects to the classes, and (3) analyzing a categorical latent



variable with predictor auxiliary variables (Van Den Bergh & Vermunt, 2019). In this case, our categorical latent variable is taken as one of the covariates into further modeling for the relationship between resilience and food security.

Identification strategy

As the situation of food security can be represented by food expenditure (Moltedo et al., 2014), we included a *household food expenditure* per week in Tajikistan Somoni (TJS). Since the prevalence of availability and access in fruit and vegetable consumption is important to understand a nutritional situation in developing countries, we also used a *household adequacy of fruit and vegetable consumption* showing the number of grams of fruits and vegetables consumed per capita per day for the household (INDDX, 2018; Moltedo et al., 2014). In addition to this, we included the third indicator through a *household food expenditure share*. A major reason behind using this indicator is explained by the fact that poor and vulnerable households may spend a larger share of the income on food. Moreover, households in developing countries are likely to be sensitive to food price fluctuations that may change the share of the consumption (Amolegbe et al., 2021).

We expect that there is a positive relationship between resilience and food security. In order to obtain the results, two-stage least square regressions (2SLS) and IV Probit models are used:

$$FS_{h,t} = \beta RCI_{h,t-1} + \gamma C_{h,t} + \tau X_{h,t} + \epsilon_{h,t}, \quad (1)$$

where subscript h represents the household and t is the time. $FS_{h,t}$ is the dependent food security variable which is either *food expenditure*, *the adequacy of fruit and vegetable consumption*, or *household food expenditure share*. To capture a dynamic perspective, dummy losses are included for both indicators that occurred between the 2009 and 2011 waves. The main independent variable is $RCI_{h,t-1}$, measured through five pillars explained in the previous section. $C_{h,t}$ represents a latent variable for the subjective coping strategy explained previously. $X_{h,t}$ is a vector of household characteristics including dummy rural household, household size, age of head, and dummy female head of household. $S_{h,t}$ is a shock explained by the number of moderate and/or severe drought events for the last 12 months of 2011, obtained from the Standardized Precipitation Index (SPI) (summary statistics of all variables in the identification are shown in Supporting information Table A5 in Appendix). Furthermore, the interaction term between RCI and shock ($RCI_{h,t-1} \times S_{h,t}$) is included in the model, aiming to capture a mediating role of resilience.

We assume that resilience is endogenous. Although our estimation strategy is based on the relationship between $RCI_{h,t-1}$ and $FS_{h,t}$, RCI is still to be correlated with the error term of the estimated model, causing the problem of endogeneity. Correspondingly, the endogeneity of RCI is likely relevant for the endogeneity of the interaction term (Bun & Harrison, 2019). In order to deal with this issue, we proposed to apply the IV approach. In this respect, IV estimations provide a consistent estimator after finding a valid (strong) instrument in which the instrument z should be correlated with the explanatory variable and uncorrelated with the error term.

$$RCI_{h,t-1} = \alpha z_{h,t-2} + \gamma C_{h,t} + \tau X_{h,t} + \epsilon_{h,t}. \quad (2)$$

We included the *distance from population point in the community to the capital (Dushanbe)* as an instrument variable. As for the exclusion restriction, the relationship between geographic distance and resilience has already been mentioned by scholars making use of distance as a good proxy for resilience (Ickowicz et al., 2012; Sadri et al., 2018). Another similar study confirms that the distance to the nearest border is likely to be a good instrument to control the problem of endogeneity in the effect of RCI on food security outcomes (Egamberdiev et al., 2023). One possible explanation in the context of Central Asia is that areas far from the capital experience high long-distance migration to particularly Russia. This has already been mentioned by FAO's policy recommendation under a regional cross-border approach for food security resilience (FAO, 2018). Neighboring countries, particularly Kazakhstan, and non-bordering Russia are likely to provide an important livelihood and resilience basis for rural areas of Tajikistan. From another perspective, some authors consider the distance variable as a good proxy for the pillars of RCI (Wang & Do, 2023). The expansion of the resilience framework in relation to social capital has already captured different nonphysical aspects of resilience. For example, findings by Egamberdiev (2024) indicate that social capital elements are likely to strengthen food insecurity resilience in Central Asian Kyrgyzstan, particularly in areas far from capital of Bishkek. Accordingly, building intercommunity relationship and networking in rural areas manifest themselves as plausible factors to strengthen household resilience capacity toward different types of shocks. Therefore, the distance to the capital can be a good proxy for the unofficial networking channels in Tajikistan. For the validity of IV, see Supporting information Appendix D and Table A6 in Appendix. Since we have both continuous and binary outcome variables, 2SLS and IV Probit models are adopted. For robustness checking, we provide both 2SLS and IV Probit models for binary outcomes by applying an approximate conversion ($\beta_{\text{Probit}} = 2.5 \beta_{\text{OLS}}$) (Cameron & Trivedi, 2009).

RESULTS

MIMIC

The following descriptive part of findings generally targets pillar rankings to resilience. Figure 1 shows that not all pillars are statistically significant. The pillars for descriptive interpretations are based on loadings or coefficients of observable variables in each obtained factor. The result of the MIMIC model indicates that ABS, AST, and SSN are the most relevant pillars, showing a significant relationship with RCI (see Supporting information Appendix E and Figures A4–A8 for further details). Findings discussed by some scholars have concluded that similar pillars are strongly correlated with RCI (d'Errico & Pietrelli, 2017; Lascano Galarza, 2020). This is particularly true for those households creating unofficial safety nets to strengthen RCI in rural areas of Central Asia (Egamberdiev, 2024).

RCI and food security

There is a positive relationship between RCI and food security outcomes in models (1), (3), and (5) of Table 1. More precisely, one index point higher in RCI positively affects the adequacy of food intake (AFV), increasing it by an average of 6.79 g/capita/day. A similar situation is true for food expenditure (FE), which makes up an average TJS 24.23 per index rise. This finding is

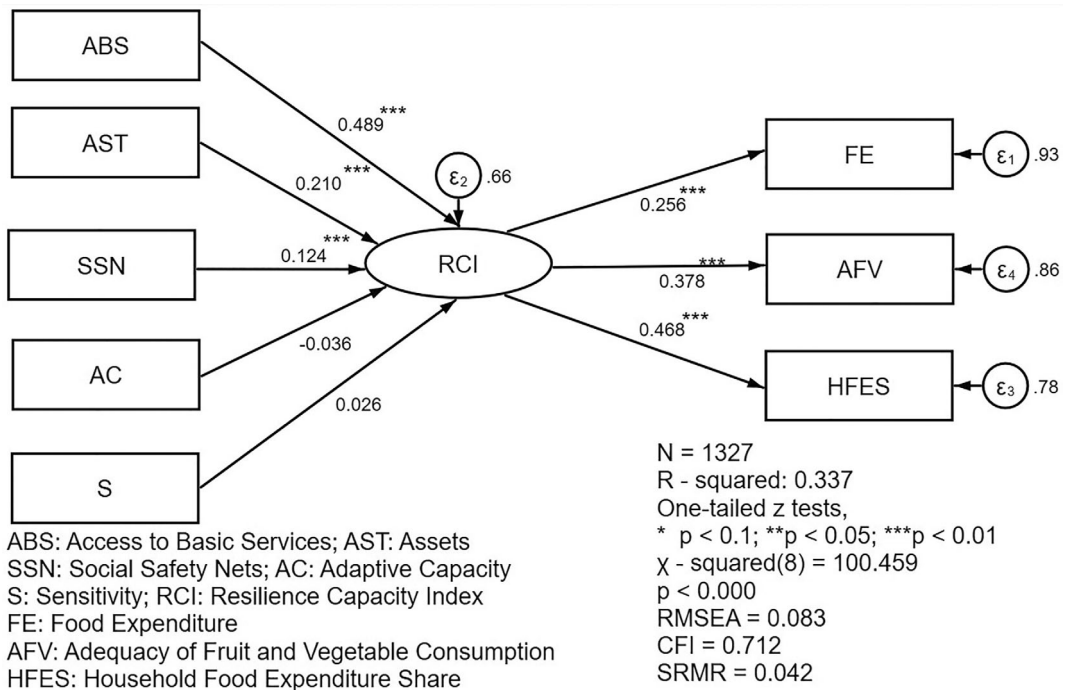


FIGURE 1 MIMIC model. ABS, access to basic services; AC, adaptive capacity; AFV, adequacy of fruit and vegetable consumption; AST, assets; FE, food expenditure; HFES, household food expenditure share; RCI, resilience capacity index; S, sensitivity; SSN, social safety nets.

consistent with Murendo et al. (2020), who found a positive relationship between RCI and diet diversity as well as food consumption score. A positive relationship between the RCI and food expenditure share (HFES) indicates that a higher RCI increases the ratio by 0.01. A higher share of expenditure on food might be due to increased dietary diversity of food consumption or food expenditure as mentioned in model (1) and (3). As the mean value of HFES at around 17% (see Supporting information Table A5) is far below the threshold of food insecurity level by Smith and Subandoro (2007), it is more realistic to expect the increased monetary value of food consumption in more resilient households. In agreement with above findings, the relationship between SEM-based RCI and food security indicators is positive (see Supporting information Table A8 for further details). Compared with the reference class, households characterized by the “*High Coping Strategy*” class are likely to have a higher AFV and FE explained by 12.58 g and TJS 77.52, respectively. However, the relationship between coping strategy and adequacy is statistically insignificant. As expected, the “*High Coping Strategy*” class is significantly negative by decreasing HFES by around 0.03.

Although this finding does not indicate the entire history of household food security resilience, coping strategies are still found to be significant as a short-term response mechanism. Indeed, it explains the prominence in household adaptability in the short term that is likely to increase the long-lasting adaptive capacity of resilience (Alinovi, Mane, et al., 2010). Moreover, Lascano Galarza (2020) confirmed the role of non-food consumption smoothing to improve food security outcomes in the household. As for other controlling variables, the household size is negatively associated with AFV and HFES, but it has a positive relationship with FE. A

TABLE 1 Resilience and food security outcomes.

	AFV		FE		HFES	
	(1)	(2)	(3)	(4)	(5)	(6)
RCI	6.798** (2.635)		24.239*** (6.078)		0.006*** (0.001)	
RCI*Shock		1.668*** (0.639)		5.943*** (1.460)		0.001*** (0.001)
High coping strategy	12.589 (11.971)	12.028 (11.833)	77.524*** (27.340)	75.542*** (26.856)	−0.028*** (0.008)	−0.029*** (0.008)
Head female	−29.793** (13.873)	−31.439** (13.757)	−28.477 (31.752)	−34.433 (31.292)	−0.001 (0.009)	−0.001 (0.009)
Head age	0.808* (0.470)	0.902* (0.470)	−0.147 (1.076)	0.180 (1.069)	0.001*** (0.001)	0.001*** (0.001)
Household size	−58.239*** (7.020)	−61.239*** (6.403)	80.572*** (16.098)	69.897*** (14.579)	−0.012** (0.004)	−0.015*** (0.004)
Sq. household size	2.276*** (0.356)	2.383*** (0.341)	−2.301*** (0.816)	−1.921** (0.776)	0.001** (0.001)	0.001*** (0.001)
Rural	47.056 (30.314)	37.075 (26.600)	94.967 (69.821)	59.245 (60.826)	−0.004 (0.021)	−0.013 (0.018)
Drought shock events	2.526 (6.276)	−33.125* (18.034)	−24.873* (14.391)	−151.847*** (41.255)	−0.017*** (0.004)	−0.050*** (0.012)
Constant	386.810*** (97.617)	546.550*** (45.951)	−680.465*** (224.964)	−110.561 (104.797)	0.078 (0.068)	0.225*** (0.031)
Observations	1327	1327	1333	1333	1333	1333
Cragg-Donald <i>F</i> stat.	103.633	141.522	102.587	140.354	102.587	140.354

Note: The reference class is “low-coping strategy.” Standard errors in parentheses.

*** $p < 0.01$. ** $p < 0.05$. * $p < 0.1$.

changed sign for the squared measure of household size in the outcome indicates a nonlinear relationship. The age of the household head is positively associated with AFV and HFES. This result might be due to farming experience determining resilience to food insecurity (Ado et al., 2019). There is a negative relationship between female-headed households and adequacy ratio. This might be due to either less women's empowerment role in the family (Sraboni et al., 2014) or high occurrences of labor migration among male population (Kim et al., 2019). As for shock, there is a negative relationship between the number of drought events and food security outcomes. The interaction terms between RCI and shock in models (2), (4), and (6) are positive and significant: the interpretation of this finding can be that households experiencing higher resilience are likely to activate it in order to mitigate the influence of shocks on food security. This finding is consistent with discussions confirming a moderating role of resilience to sustain food security when shocks intensify (Egamberdiev et al., 2023; Murendo et al., 2020; Sunday et al., 2022). By controlling residual error correlations, the SEM approach also provides very similar results indicating a significant mediating role of resilience on food security outcomes when shocks intensify (see, Supporting information Table A8 for further details).

TABLE 2 Resilience and food security loss outcomes.

	AFV		FE		HFES	
	(1)	(2)	(3)	(4)	(5)	(6)
RCI	0.026*** (0.006)		−0.044*** (0.006)		−0.025*** (0.006)	
RCI*Shock		0.006*** (0.001)		−0.010*** (0.001)		−0.006*** (0.001)
High-coping strategy	−0.008 (0.030)	−0.010 (0.029)	−0.084*** (0.030)	−0.081*** (0.028)	−0.004 (0.028)	−0.002 (0.027)
Head female	−0.010 (0.034)	−0.017 (0.034)	−0.003 (0.035)	0.007 (0.033)	0.108*** (0.032)	0.114*** (0.032)
Head age	−0.001 (0.001)	−0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Household size	0.049*** (0.017)	0.038** (0.016)	−0.107*** (0.018)	−0.088*** (0.015)	−0.028* (0.016)	−0.017 (0.015)
Sq. household size	−0.001 (0.001)	−0.001 (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.001 (0.001)	0.001 (0.001)
Rural	0.251*** (0.076)	0.212*** (0.067)	−0.316*** (0.078)	−0.251*** (0.065)	−0.211*** (0.072)	−0.174*** (0.063)
Drought shock events	−0.053*** (0.015)	−0.191** (0.045)	0.092*** (0.016)	0.326*** (0.044)	0.038*** (0.014)	0.170*** (0.042)
Constant	−0.357 (0.245)	0.258** (0.116)	1.762*** (0.251)	0.713*** (0.112)	1.302*** (0.232)	0.712*** (0.108)
Observations	1327	1327	1333	1333	1333	1333
Cragg-Donald <i>F</i> stat.	103.633	141.522	102.587	140.354	102.587	140.354
Wald test of exogeneity <i>p</i> -value	0.000	0.000	0.000	0.000	0.000	0.000

Note: The reference class is “low-coping strategy.” Standard errors in parentheses.

****p* < 0.01. ***p* < 0.05. **p* < 0.1.

Table 2 shows that RCI negatively affects the probability of food security worsening in the outcomes of FE and HFES. The relationship is statistically significant in all outcomes. In model (3), a one-point index rise in RCI shows a decrease in the probability of FE loss explained by 0.04 in 2SLS (rescaled IV Probit outcome: 0.10). This negative relationship is also true for the outcomes of HFES loss in model (5) decreasing the probability loss by 0.02 in 2SLS (rescaled IV Probit outcome: 0.05). This finding is consistent with a similar study by some scholars who found a negative relationship between RCI and the likelihood of suffering from a decrease in dietary diversity (d'Errico, Romano, et al., 2018; Egamberdiev et al., 2023). However, there is a positive relationship between RCI and loss in AFV in model (1). It is similar to the findings discussed by Egamberdiev et al. (2023) indicating inconclusive results in terms of the relationship between RCI and loss in AFV in the case of Kyrgyzstan.

The relationship between the latent coping strategy and FE loss is negative and statically significant. There is a positive relationship between head female and HFES in model (5). Moreover, bigger-sized or rural households are negatively associated with loss in models (3) and (5).

However, this relationship is significantly positive in terms of AFV loss in model (1). Rural households are likely to suffer from the loss in AFV provided in model (1). As provided in models (3) and (5), households exposed to a higher level of shocks are likely to experience a loss in their food security status. This is not true for the case of model in (1). Findings in the relationship between RCI and loss in food security outcomes are similar to those findings in which RCI was constructed through SEM (see, Supporting information Table A9 for further details). Looking at the coefficients of the interaction term in models (2), (4) and (6) of both Table 2 and Supporting information Table A9, the estimates are quite robust, indicating the same sign and significance to the one estimated without interaction effects. Findings for the interaction terms in models (2), (4), and (6) through SEM in Supporting information Table A9 provide similar results.

CONCLUSION AND DISCUSSION

This study contributes to the building evidence on the role of resilience to food security outcomes. From our analysis of separate resilience pillars in MIMIC, policies aimed at building overall resilience and food security should first of all focus on improving the ABS. Here, one focus should be to invest in affordable heating and gas for everyday life of Tajik households, which was found to be one of the largest contributors to resilience capacity. In addition to this, the diversification of energy-generating sources in rural areas is likely to increase equal access to energy consumption. This is relevant also with respect to the “National Development Strategy-2030” of Tajikistan, which aims to ensure energy security and efficient use of electricity (World Bank, 2018).

Central Asia is particularly sensitive to the regional integration, aiming for various objectives because it is landlocked and shares borders with the Russian Federation, China, and Afghanistan (Leskina & Sabzalieva, 2021). In addition to the intra-Central Asia initiatives, Tajikistan should deal with extra-regional partners such as the Russian Federation and China. At this juncture, a lack of progress in attracting Tajikistan to join EAEU due to the pressure of Russia (Mostafa & Mahmood, 2018), China's ‘one belt, one road’ (OBOR) is becoming more attractive to Central Asian countries (Leskina & Sabzalieva, 2021) by promising economic and energy exchange partnerships (Silin et al., 2018).

Further implications are provided by our analysis of AST and SSN pillars; formal transfers are strongly playing into resilience capacity. In practice, the existence of both formal and informal transfers by strengthening household resilience are strong mechanisms to deal the problem of food security in Central Asian countries (d'Errico et al., 2023; Egamberdiev et al., 2023). In this case, both cash and in-kind assistance received from the households are at the forefront of building or strengthening household resilience because they act an efficient response mechanism when shocks intensify. As a policy response, the government should strengthen financial institutions with its existing mechanisms and new possible approaches. For example, a comprehensive National Financial Inclusion Strategy for 2022–2026 aims to spur financial services and improve financial literacy of citizens (IFC, 2022). In order to steer toward more resilience seeking policies, interventions aligned with this strategy should encourage households to make financial decisions on the transfers. In addition to this, the quality of institutions should be improved that conduce to the effectiveness of formal transfers. Finally, social-security programs, particularly associated with women and children left behind, should be prioritized by the Tajik government. Although the manuscript does not directly include women's empowerment or



gender role relations, we believe families enmeshed in negative consequences of continuous migration should be strongly supported by the government by empowering women who are left behind.

A causal relationship indicates that household resilience has a positive effect on food security while the reverse is true on the probability of loss. The study also introduced the interaction terms of resilience and shocks (RCI*Shock) to estimate the effectiveness of resilience in its mitigation of shocks on food security outcomes. Findings conclude that the interaction between RCI and shock is still significant at improving food security outcomes when shocks intensify. It therefore indicates that resilience has its protective effect, particularly important for decreasing any loss. This finding, through the operationalization of resilience as a concept, might be feasible for policy formulations, especially in the focus of large-scale interventions in Tajikistan. This is mainly because the operationalization of resilience recognizes different aspects of livelihood by strengthening or building capacities that are likely to bring positive outcomes in the long run (Béné et al., 2016). Therefore, it helps to understand how to increase the interconnections of livelihood, social protection, health protection, nutritional development, and others under the intervention objective of building resilience.

Finally, our study provides an extension of the RIMA-II framework by adding subjective measures of coping strategies. Herein, we follow d'Errico, Grazioli, et al. (2018), who advocated for empirical evidence on whether subjective measures contribute to the RIMA-II analytical framework to explain the resilience to food insecurity. By including household coping strategies under subjective responses to different types of shocks, we provided additional evidence for the relation between RCI and coping strategies with food security outcomes. A negative relationship between coping strategies and RCI indicates that less resilient households are more likely to activate coping strategies in the short term to deal with shocks.

Our findings for the relationship between resilience and food security may still remain obscure in the context of livelihood strategies, particularly in relation to income generation or agricultural activities. For example, a study showing the role of household livelihood strategies towards resilience and food security explains how RCI is differentiated across different socio-economic groups (Alinovi, d'errico, Mane, et al., 2010). Therefore, it would be interesting to build the relationship between resilience and food security outcomes by defining livelihood strategies. In order to understand the relationship between resilience and food security outcomes, there should be related factors or variables describing subjective or self-perceived resilience that may connect the concept of resilience to insecurity. Findings by Crookston et al. (2018) concluded that self-perceived resilience and characteristics of actual resilience do not match at all times.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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