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Impact of Climate Change Adaptation Strategies on Household Food Security:

Empirical Evidence from Tunisia

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Running Title: Impact of Climate Change Adaptation Strategies on Household Food security: Empirical Evidence from Tunisia

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Motivation and Outline

Under the global challenge of climate change (CC), farmers' coping strategies have long been a focus for policymakers and researchers. The scientific community has engaged in foresight scenarios and modelling, as well as studies tracing links between CC, biodiversity, food security, and livelihoods. In drylands, a key impact of climate change is the "meteorological-drought pathway," which affects food production and rural food security.

In North Africa, studies show Tunisia is drought-prone. Increasing droughts have seriously affected food production in arid areas. Climate change, food security concerns, and erratic rainfall are straining agriculture, highlighting the need for more resilient food systems.

Tunisia receives national and international support to counter climate change. The country is committed to helping smallholder farmers adopt climate-smart innovations. However, there is limited documentation on how these coping strategies affect farmers' livelihoods and vulnerability to food insecurity. Thus, direct links between climate impacts and coping strategies, especially regarding food security, remain largely unexplored.

Objectives of the study

This study examines how adopting individual and combined climate change coping strategies affects smallholder farmers' vulnerability to food insecurity in two Tunisian dryland regions, Zaghouan and Kairouan. The paper aims to construct a resilience index that integrates coping strategies into the resilience discussion by linking the role of resilience capacity and coping strategies with a resilience capacity index.

Methodology

In this study, we utilize cross-sectional quantitative and qualitative data collected from primary and secondary sources through surveys of 670 farm households in two Tunisian dryland regions. We develop a conceptual framework that identifies the components and linkages of the meteorological drought pathway, alongside coping strategies adopted by smallholder farmers. Building on the established meteorological drought framework, which has advanced empirical understanding of environmental stressors, we assess the agricultural drought pathway in these regions. This analysis provides insights into spatial and temporal drought patterns, enabling classification of households by resilience capacity and drought intensity.

To measure resilience, we apply the FAO's RIMA-II framework (2016), using the Resilience Capacity Index (RCI) and Resilience Structure Matrix (RSM). Our approach follows a two-

stage procedure: first, factor analysis constructs resilience pillars; second, a Multiple Indicators Multiple Causes (MIMIC) model estimates the RCI and examines its relationship with food security outcomes. Structural Equation Modeling (SEM) is employed to explore complex interactions among these pillars.

Expected Results

This study anticipates demonstrating that smallholder farmers' coping strategies are closely linked to the intensity of drought events, with resilience capacity playing a critical moderating role in reducing the negative impacts of climate shocks on food security. Key factors such as income and food access, asset ownership, access to basic services, adaptive capacity, and social safety nets are expected to significantly enhance farm households' resilience to food insecurity. Overall, the integration of resilience and coping strategies is projected to improve both food security and the well-being of smallholder farmers in Tunisia's dryland regions.

Policy Implications:

The findings will provide evidence-based guidance for policymakers to promote diversified and context-specific adaptation strategies that enhance food security in arid and semi-arid landscapes. Specifically, the results will support the design and prioritization of targeted public-private interventions, including investments in research and development, improved dissemination of climate-smart agricultural practices, and strengthened collaboration among farmers, extension services, and research institutions. By identifying the most effective coping strategies, the study will inform policies that not only improve household food security but also build community-level resilience against future climate-related shocks. This approach aligns with the broader regional goals of sustainable agricultural development and poverty reduction, offering actionable pathways to support vulnerable smallholder farmers in Tunisia and similar MENA contexts.

Originality/value

This study combines spatial analysis with resilience measurement to offer a novel framework for assessing drought impacts on smallholder farmers. It provides evidence on how coping strategies linked to the meteorological drought pathway help mitigate risks to livelihoods and food security. By highlighting resilience's role in food security, the research informs scalable interventions in dryland contexts. Focusing on smallholder farmers as end-users, it delivers practical policy insights on the effectiveness of climate-smart coping strategies.

Key-words: Food insecurity; climate change; coping strategies; vulnerability; smallholder farmers; Multiple Indicators Multiple Causes; Resilience Capacity Index; Tunisia.

JEL classification : C43, C59, Q54, R29.

1. Introduction

The global challenge of climate change represents an epoch-defining threat to human security and planetary sustainability, fundamentally jeopardizing the complex interdependencies that underpin modern life (Abbas et al. 2022). Scientific consensus, underscored by recent assessments, confirms an accelerating intensification of climate-related hazards, with particularly severe consequences for the foundational sectors of agriculture, biodiversity, rural livelihoods, and global food security (Malhi et al. 2021). Among the most immediate and economically devastating manifestations of this crisis is the increasing frequency and severity of meteorological drought (Tanarhte et al. 2024).

Meteorological drought—a primary deficit in precipitation over an extended period—serves as the critical pathway through which climate variability translates into agricultural, hydrological, and socioeconomic crises (Ding et al. 2021). The consequential reduction in soil moisture and surface water availability directly impairs crop growth, diminishes yields, compromises livestock productivity, and exacerbates land degradation in susceptible ecosystems (Khan et al. 2025). The global economy has witnessed firsthand the cascading impacts of this pathway, with the 2023–2024 period showing extreme drought-driven price spikes in staple commodities such as cocoa, rice, and olive oil, underscoring the fragility of global supply chains and the immediate link between climate shock and consumer well-being (Setiyanto et al., 2024). In developing and arid-to-semi-arid regions, the loss of agricultural output translates directly into acute poverty, livelihood erosion, and increased vulnerability to malnutrition for millions who depend on rainfed farming (Neinkreke et al., 2024). Addressing this vulnerability requires a systematic shift from reactive disaster aid to the proactive cultivation of systemic resilience (Keegan et al. 2023).

This global narrative of intensifying climatic risk is acutely embodied in the drylands of North Africa, a region already characterized by endemic water scarcity and high exposure to climatic volatility (Tanarhte et al. 2024). Tunisia, where over 60% of the land is arid or semi-arid and water resources are critically limited (renewable water availability is well below the absolute scarcity threshold of 1000 m^3 per capita per year) (Kadri et al. 2023), faces an existential agricultural challenge. Climate projections forecast continuous temperature rise and worsening water stress, which are expected to cause significant declines in the production of vital crops like rainfed cereals and olives (Boussadia et al., 2023).

This research study is focused on the central Tunisian governorates of Zaghouan and Kairouan, regions central to the country's agricultural output but simultaneously defined by their high exposure to recurrent and severe drought episodes (Mohamed et al. 2023). The observed increase in drought severity here not only threatens national food production targets but, more critically, amplifies the vulnerability of smallholder farmers (Day et al. 2025). These smallholders, often managing less than five hectares of land, depend on mixed crop-livestock systems whose economic viability is rapidly diminishing under recurrent water deficits (Dhehibi et al. 2021). Losses from drought, coupled with rising food costs and decreasing farmer income, trigger adverse coping behaviors that can trap households in a cycle of destitution. For instance, recent research and development efforts in central Tunisia have highlighted that while irrigation projects offer respite, most smallholders remain dependent on increasingly unreliable rainfall, compelling a deeper investigation into their non-structural capacities to adapt (Frija et al. 2021). The necessity of strengthening the adaptive capacity of these specific communities is therefore a matter of national food sovereignty and rural socio-economic stability.

In the face of intensifying drought, smallholder farmers invariably activate a diverse portfolio of coping strategies—from short-term measures such as selling off essential productive assets (distress sales) or rationing food, to long-term adaptation investments in water harvesting, crop diversification, or livelihood specialization (Hawkins et al. 2022). The effectiveness and sustainability of these strategies, however, are highly heterogeneous and are profoundly mediated by a household's underlying resilience capacity.

While voluminous literature exists on climate change adaptation practices and on food security outcomes, a significant knowledge gap persists concerning the systematic, quantitative articulation of the causal pathways linking specific individual and combined adaptation strategies to sustained food security via the intermediate and multi-dimensional latent construct of resilience. Prior studies often describe adaptation efforts and food security status separately or employ simplistic correlational analysis (Barret & Constas 2014). This approach fails to capture the dynamic process through which resilience acts as a protective shield and an enabling mechanism. A critical academic lacuna exists in empirically determining which portfolios of coping strategies move smallholder farmers from potentially "maladaptive" coping (e.g., liquidating assets that erode future capacity) to genuinely "resilient" outcomes (Berhanu et al. 2024). This missing link necessitates a methodological approach that can rigorously quantify resilience as a latent, multi-dimensional construct, distinguishing it from simply observing food security as an outcome (FAO 2020).

To address this challenge and provide actionable insights, this research adopts and adapts a rigorous, quantitative framework rooted in the concept of resilience. Resilience, which is not directly observable, is defined in this study as the capacity to absorb, adapt to, and transform in the face of recurrent shocks, particularly drought.

The central analytical goal of this research is to empirically test the mediating effect of resilience. That is, we aim to rigorously determine how a higher Resilience Capacity Index (RCI) level mitigates the negative impact of drought shocks on household food security outcomes. This refined analytical lens is essential for formulating targeted interventions that shift policy from reactive, temporary relief to fostering sustainable, determined capacity.

Considering the escalating climate crisis, the acute vulnerability of Tunisian drylands, and the persistent conceptual and empirical gap in the adaptation-resilience-food security nexus, this research proposes a comprehensive investigation. The study aims to:

- Develop, validate, and apply an Integrated Resilience Capacity Index (RCI), based on the FAO RIMA-II framework and specifically tailored to the socio-ecological context of Tunisian dryland agriculture.
- Use this index to analyze the mediating role of resilience in translating adapting strategies into enhanced household food security.

The scholarly significance of this work is multi-faceted. Methodologically, it advances resilience measurement by customizing a quantitative RCI framework, specifically the RIMA-II model, for a highly vulnerable arid zone, thereby offering a replicable tool for research in the broader Mediterranean and MENA drylands (Alinovi et al. 2010). Empirically, it provides critical evidence on the efficacy of coping strategies on the ground, with data specifically collected during a year of extreme drought severity, guiding policymakers away from generalized solutions toward context-specific portfolios that effectively build the absorptive, adaptive, and transformative capacities required to secure the livelihoods of smallholder farmers and enhance the national food system's robustness in the face of an uncertain climatic future.

2. Theoretical Background

2.1. The Resilience Imperative

In the context of international development and climate change, resilience has become a crucial analytical framework. It is defined in food systems as the "ability to prevent disasters and crises, as well as to anticipate, absorb, accommodate, or recover from them in a timely, efficient, and sustainable manner," specifically focusing on protecting and enhancing livelihood systems (FAO 2025). Academically, resilience is unpacked into three cores, interrelated functional capacities (Calloway et al. 2022):

- Absorptive Capacity: The immediate, short-term ability to maintain core functions and recover rapidly from a shock using internal buffers like savings or social safety nets.
- Adaptive Capacity (AC): The intermediate-term ability to make incremental, informed adjustments to livelihood strategies in response to changing conditions (e.g., diversifying income or changing crop cultivars)
- Transformative Capacity: The long-term ability to initiate fundamental, structural reorganization of the system to prevent future shocks, leading to a new, more sustainable equilibrium (e.g., permanent livelihood diversification away from agriculture or community-level institutional change)

This tri-partite conceptualization distinguishes coping (short-term, often asset-eroding behavior) from true, structural resilience, which is critical for assessing whether a household's adapting strategy actively builds long-term sustainability (Serfilippi and Ramnath 2018).

2.2.Convergence of Shocks in the Tunisian Context

Households in vulnerable environments, such as the drylands of Tunisia, confront not singular events but a convergence of overlapping shocks that intensify vulnerability (FAO 2024). The primary driver is Climatic Shocks, involving intensifying meteorological drought and chronic water scarcity. Tunisia's heavy reliance on rainfed agriculture (over 97% of cereal production) exposes it critically to declining dam reserves and grim projections of up to a 30% reduction in cereal cultivation by 2030 (MAWF 2021; Louis et al. 2023), which directly threatens crop and livestock yields (Soula et al. 2021). Compounding this are Socio-economic Stresses, where persistent structural economic weaknesses, including high inflation and unemployment, erode household purchasing power and severely limit access to adequate food (FAO 2024). Finally, Institutional Shocks, such as political uncertainty and weak institutional capacity, constrain the government's ability to develop and implement timely and effective policy responses (Knaepen 2021). The co-occurrence of these shocks heightens the risk of food insecurity (Ali et al. 2023; Belay et al. 2023), making the enhancement of resilience through effective adaptation essential to mitigate the long-term impacts of these converging threats (Tohidimoghadam et al. 2023).

2.3. RIMA-II Framework and Empirical Utility

The Resilience Index Measurement and Analysis (RIMA-II) framework measures resilience capacity through four core, non-overlapping determinants (or pillars): Assets (AST) (productive and non-productive), Access to Basic Services (ABS), Social Safety Nets (SSN), and Adaptive Capacity (AC) (FAO 2016). To maintain analytical rigor, RIMA-II employs the Multiple Indicators Multiple Causes (MIMIC) model within a Structural Equation Modeling (SEM) framework (Haile et al., 2022; Egamberdiev 2025). This model is essential because it allows the Resilience Capacity Index (RCI) to be estimated as a latent variable caused by the four observable pillars and directly linked to observable outcomes like the Food Consumption Score (FCS) or the Food Insecurity Experience Scale (FIES) (Sibrian et al. 2021; Terefe et al. 2025).

Empirical evidence confirms the robustness of the RIMA-II approach: studies in Ethiopia and Iran consistently identify Assets and Adaptive Capacity as the most influential components of the RCI (Haile et al. 2022; Terefe et al. 2025; Moradian et al. 2023), and the fundamental finding is that a higher RCI score significantly translates into improved food security outcomes and an enhanced ability to withstand climate extremes (Haile et al. 2022; Tasnim et al. 2025). Furthermore, RIMA-II provides crucial policy granularity by identifying which adaptation strategies effectively build which resilience pillars (Lascano Galarza 2021; Sibrian et al. 2021; Tasnim et al. 2025).

2.4.Theoretical Framework and Research Hypothesis

This research builds directly upon the RIMA-II MIMIC framework, tailoring it to the specific socio-ecological constraints of smallholder farmers in the drought-prone regions of Zaghouan and Kairouan. The theoretical framework posits a three-stage causal pathway:

1. The adoption of climate change adapting strategies serves as the exogenous factors that positively influence the core RIMA-II pillars (AST, ABS, SSN, AC).
2. These adapting strategies enhance the latent Resilience Capacity Index (RCI), which acts as a mediator in the relationship between adaptation and food security.

This approach allows for the rigorous testing of the core hypothesis: that the adoption of robust portfolios of adaptation strategies enhances food security among smallholder farmers primarily by increasing their multi-dimensional Resilience Capacity Index (RCI), thereby mitigating the negative impact of drought shocks. By customizing the RCI indicators to the local dryland context, this study aims to yield precise, policy-relevant evidence for building sustainable resilience in Tunisia.

3. Materials and Methods

3.1. Study Area Profile

The current study was conducted in the Zaghouan and Kairouan governorates, located in central Tunisia (Figure 1). These regions have been identified as highly vulnerable to food insecurity primarily due to the increased frequency and severity of climate extremes experienced over the past decades. The combined impact of ecological degradation and recurrent socio-economic shocks, often triggered by these climate events, poses a significant and persistent threat to the food security status of local households (Soltani & Mellah 2022).

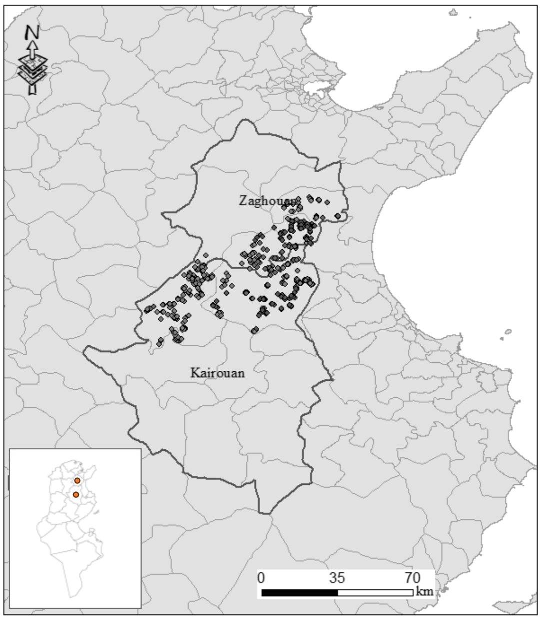

Figure 1. Study area

3.2. Sampling Procedure

A total of 671 households were surveyed out of an estimated 119 000 agricultural households in Zaghouan and Kairouan. This sample size is statistically sufficient, as only about 383 households are required to achieve a 95% confidence level with a 5% margin of error for a population of this size. The selected sample therefore provides adequate precision and statistical power for reliable population-level inference. Within these 671 households, the choice was done through in-depth consultations with key informants, including knowledgeable local individuals and experts from the local agricultural administration to capture the maximum variance reflecting the agri-food system in the two studied governorates.

3.3. Data Collection

3.3.1. Survey Instrument and Approach

Cross-sectional data was collected using a structured questionnaire designed to comprise 344 questions focusing on observable variables pertinent to the resilience pillars and distributed in 17 modules (Table 1).

Table 1. Survey design and key dimensions

Dimension	Topic	Examples of Generic Data Collected
Demographics & human capital	Household Composition & Labor	Age, Sex, Education Level, Relationship to Head, Primary Occupation.
	Identification & Admin	Geographic/Administrative codes, Interview Status.
Physical & productive assets	Housing Characteristics	Building materials, Ownership status, Access to essential utilities/services (water, sanitation).
	Physical Assets	Ownership and Total Value of farm equipment and durable household goods.
	Land Ownership	Total land area held, Tenure type (owned, rented, shared), Land use classification.
Agricultural systems	Crop Production	Cultivated area per crop, Use of external inputs (seeds, fertilizer), Production quantity.
	Livestock Production	Animal inventory by type, Sales/Marketing data, Total value of livestock.
	Livestock Inputs	Types and costs of animal feed, Source of feed.
Technology & innovation	Livestock Technology	Adoption of improved seeds or modern animal health practices (e.g., vaccination).
	Technology Adoption & Perception	Awareness of new techniques, Perceived benefits, Barriers to adopting innovations.
Economic well-being & spending	Income & Transfers	Income from all non-farm sources (wages, businesses), Value of remittances or public transfers.
	Non-Food Expenditure	Annual spending on major non-food categories (health, education, transport, clothing).
	Food Security & Consumption	Consumption quantity of major food groups, Source of consumption (purchased vs. own-produced), Food expenditure.
Vulnerability & social capital	Shocks & Risk	Experience of significant negative events (e.g., drought, illness) in the reference period, Impact and coping strategies.
	Social Networks	Participation in community organizations, Access to information/support networks.
	Access to Infrastructure	Distance/time to key socio-economic services (market, school, health center).

Source: Author's elaboration (2025).

The KoboCollect mobile data collection tool was utilized, with the questionnaire prepared and deployed via the KoboToolbox server (https://www.kobotoolbox.org). This digital approach facilitated the direct transfer and real-time management of recorded data, allowing for strict control over the data collection process.

Formal ethical perspective, approval was obtained before commencing data collection. Furthermore, all study participants were fully informed about the research objectives, and their participation was entirely voluntary.

3.4. Data Analysis Procedure

3.4.1. Drought Trend Analysis using SPI and SMA

To comprehensively assess drought, precipitation data were acquired from the high-resolution, long-term Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) dataset, while soil moisture data were sourced from the consistent, physically-based ERA5-Land global analysis. All data, covering the period from 1994 to 2023, were reprojected to a common coordinate system and resampled to a consistent spatial resolution to ensure pixel-to-pixel alignment for subsequent analysis.

Drought conditions were then characterized using two standardized indices: the Standardized Precipitation Index (SPI), calculated from CHIRPS data to represent meteorological drought through precipitation anomalies, and the Standardized Soil Moisture Anomaly (SMA), derived from ERA5-Land to capture agricultural drought by measuring deviations in root-zone soil moisture. Both indices were calculated annually for each pixel over the study period, generating a continuous spatiotemporal data cube for each index.

Finally, these geospatial indices were linked to household-level survey data by extracting the precise SPI and SMA pixel values for each household's geographical coordinates, thereby appending each household record with quantitative drought exposure measures. The resulting two variables were then, reclassified to generate a single categorical drought variable (D) for each household for subsequent analysis.

3.4.2. Resilience Measurement

Table 2 presents each latent indicator and the observed variables used for estimation. The analytical framework for measuring Resilience to climate change is presented in Figure 2. Five general steps for constructing the index are identified as follows: developing a theoretical framework, identifying and developing relevant variables, normalizing to enable comparison, weighting and aggregating variables, and performing uncertainty measures to assess the robustness of the variables.

Table 2. Latent indicators following RIMA-II model and the associated used variables

Latent indicators	Collected variables	Used variables
ABS	abs_ water abs_ sanitation abs_closeness_school abs_closeness_high_school abs_closeness_Hospital abs_closeness_market abs_closeness_ext_office	abs_ water abs_ sanitation Infrastructure_index
AST	ast_TLU ast_agricultural_inputs AST_D_landowned_total AST_0_head_chef	ast_TLU ast_agricultural_inputs ast_agricultural_wealth_index ast_wealth_index AST_0_head_chef
AC	AC_0_head_degree AC_Nbr_member_ with_offfarm AC_Improved_seed AC_Crop_diversity AC_G_vacc1_used_yn	AC_0_head_degree AC_Improved_seed AC_Nbr_member_ with_offfarm AC_Crop_diversity AC_G_vacc1_used_yn

	AC_G_vacc2_used_yn AC_G_vacc_govt_nr AC_HH_having_credit	AC_G_vacc2_used_yn AC_G_vacc_govt_nr AC_HH_having_credit
SSN	SSN_D_communal_pasture_yn SSN_L_income_remit_yn SSN_L_income_govt_yn SSN_Total number of neigh-rel SSN_Total_cons_neigh	SSN_D_communal_pasture_yn SSN_L_income_govt_yn SSN_L_income_remit_yn SSN_Total number of neigh-rel SSN_Total_cons_neigh
FS	FE_Total_Food_Spent_7days FIES_No_Food_Variety_Money	FE_Total_Food_Spent_7days FIES_No_Food_Variety_Money

Source: Author's elaboration (2025).

In this study, Model measurement and analysis were executed using the RIMA-II (Resilience Index Measurement and Analysis) Shiny application developed by the Food and Agriculture Organization (FAO). This internationally validated framework facilitated the computation of the household resilience index and subsequent statistical decomposition to identify key determinants. The empirical model used to predict household resilience IR is as follows:

$$RCI = \partial + \beta1ABS + \beta2AST + \beta3AC + \beta4SSN + \beta5FS \quad (1)$$

Where RCI = household resilience capacity index; ∂ = constant; β1-6 = coefficient of each variable, Beta is the coefficient that determines the relative importance of each latent indicator in determining the dependent variable, which is the resilience of households to the impact of climate change.

A critical component of the methodology involves assessing household exposure to shocks through the Resilience Measurement Analysis (RIMA) model. In this framework, data collected from specifically, from "O_shosck_worst" variable reflecting "worst shock experienced in the last 12 months" and aggregated into a categorical variable. This indicator captures whether the household was subjected to any major negative event from a predefined list, which includes climatic shocks, economic shocks, and human-capital shocks. Its inclusion is essential for accurately estimating the resilience capacity by serving as a crucial proxy for the shock exposure.

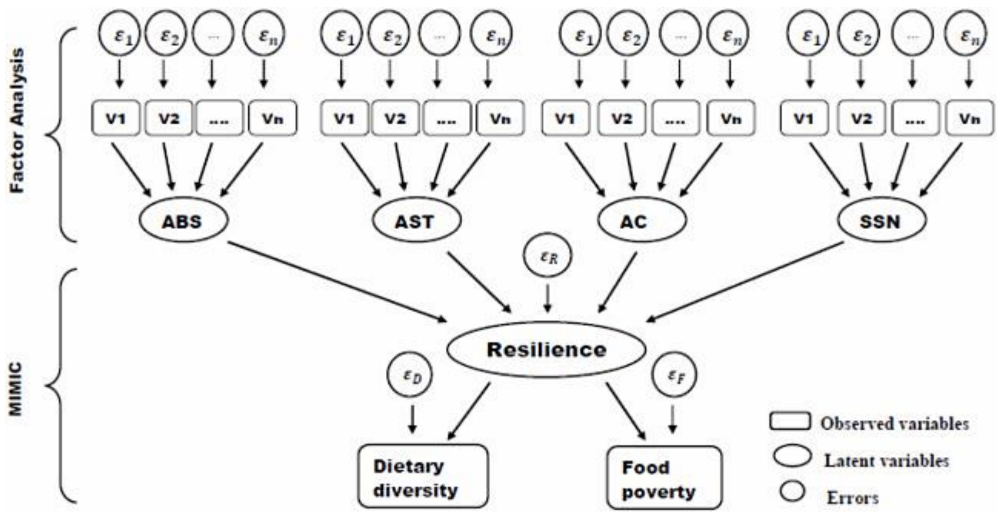

Figure 2. Conceptual Framework based on RIMA II for Analyzing Household Resilience (Source: Haile et al. 2022)

4. Results

4.1 Household Profile, Drought Severity, and Coping Strategies

This section presents the descriptive statistics characterizing the surveyed households, including their socio-economic profiles, spatial distribution, drought exposure patterns, and adoption rates of coping strategies. These foundational insights establish essential context for the subsequent econometric analyses of resilience structure and its influence on food security outcomes.

Among the 671 surveyed households, 67.7% are located in Kairouan governorate and 32.3% in Zaghouan, with 93.6% being male-headed. A substantial majority (80.8%) qualify as Adaptation Technology Users. They represent farmers employing climate-resilient practices in crop cultivation (resilient Kounouz varieties, ammonitrate fertilizer, mechanical seed drills, olive pruning products), livestock feeding (nutritional blocks, green barley fodder, cactus pads, cactus choppers), health management (vaccinations against enterotoxemia and parasites), and herd reproduction (targeted ram utilization). Drought exposure affects 60.4% of households under Moderate Drought (D1) and 39.6% under Severe Drought (D2) (Table 3).

Table 3. Descriptive Statistics of Surveyed Farm Households (N=671)

Variable	Description	Levels	Frequency	Percentage
0_BL_gouvernorat	Governorate	1: Zaghouan 0: Kairouan	217 454	32.3 67.7
Treatment	Adaptation Technology User	0: No 1: Yes	129 542	19.2 80.8
SDC_0_BL_sex_hhead	Household Head Gender	0: Women 1: Men	43 628	6.4 93.6
D	Drought severity	D1: Moderate drought D2: Severe drought	405 266	60.4 39.6

Source: Author's elaboration based on survey data (2025).

The descriptive statistics reveal a mixed resilience profile among the 671 surveyed households (Table 4). Access to basic services is moderate: two-thirds have improved water (mean=0.66) and just over half have improved sanitation (0.54), while the mean infrastructure index (0.36 on a 0.12–0.89 range) indicates substantial spatial disparities in proximity to schools, markets, health facilities and extension offices. Asset endowments are heterogeneous, with average livestock holdings of 3.26 TLU but a wide dispersion (SD=3.15, max=19), low agricultural wealth (mean index=0.20) and modest durable asset wealth (0.26). Even though most of the heads are main farm owners (0.92).

Adaptive capacity indicators show important constraints: only 6% of heads have agricultural education, and fewer than half of households use improved seed varieties (0.47), while they employ on average just over one agricultural input (mean=1.18) over the last 12 months, mainly fertilizers, pesticides, seed treatments and machinery or hired services for key crop operations. Crop diversification remains limited (mean of 2.04 crops), yet adoption of animal health technologies is relatively high, with 71% and 59% using first and second core livestock vaccines and 61% accessing government vaccination services, although access to credit is very low (7%).

Social networks provide some support. 28% of households use communal pasture, 20% receive government transfers and only 3% remittances, while on average they can rely on about two neighbours or relatives for support (mean=2.11) and maintain regular contact with roughly one to two of them (1.33), again with large variability. Food security indicators point to monetary constraints: households spend on average 58.76 TND on food by week (SD=32.44), and 15% report lacking food variety because of insufficient money, signalling that a non-negligible share already experiences compromised diet quality despite relatively modest expenditure levels.

Table 4. Descriptive Statistics of Resilience and Food Security Variables (N = 671)

Viable name	Description	Max	Min	Mean	SD
ABS (Access to Basic Services)					
abs_water	Access to improved main water source	1	0	0.66	0.47
abs_sanitation	Access to improved sanitation	1	0	0.54	0.50
abs_Infrastructure_index	Inverse of total distance to basic services (school, market, hospital and extension office)	0.89	0.12	0.36	0.13
AST (Assets)					

ast_TLU	Total livestock units	19.00	0	3.26	3.15
ast_agricultural_inputs	Number of agricultural inputs used	4	0	1.18	0.96
ast_agricultural_wealth_index	Agricultural assets and tools	1.00	0	0.20	0.13
ast_wealth_index	Overall household wealth index (durable assets)	0.62	0.05	0.26	0.10
AST_0_head_chef	Head is main farm owner	1	0	0.92	0.27
AC (Adaptation capacity)					
AC_0_head_degree	Head has agricultural education	1	0	0.06	0.24
AC_Improved_seed	Uses improved seed varieties	1	0	0.47	0.50
AC_Nbr_member_with_offfarm	Members with off-farm income	5	0	1.09	1.11
AC_Crop_diversity	Number of crops grown	7	0	2.04	1.16
AC_G_vacc1_used_yn	Uses core livestock vaccine 1	1	0	0.71	0.45
AC_G_vacc2_used_yn	Uses core livestock vaccine 2	1	0	0.59	0.49
AC_G_vacc_govt_nr	Uses government vaccination service	1	0	0.61	0.49
AC_HH_having_credit	Has access to credit	1	0	0.07	0.26
SSN (Social Security Network)					
SSN_D_communal_pasture_yn	Uses communal pasture	1	0	0.28	0.45
SSN_L_income_govt_yn	Receives government transfers	1	0	0.20	0.40
SSN_L_income_remit_yn	Receives remittances	1	0	0.03	0.18
SSN_Total_number_of_neigh_rel	Number of support neighbours/relatives	9	0	2.11	2.81
SSN_Total_cons_neigh	Number of regular contact neighbours/relatives	9	0	1.33	2.52
FE (Food Expenditure) and FIES (Food Insecurity Experience Scale)					
FE_Total_Food_Spent_7days	FS1: Total food spending (last 7 days)	190	10	58.76	32.44
FIES_No_Food_Variety_Money	FS2: Lacked food variety due to lack of money	1	0	0.15	0.36

Source: Author's elaboration based on survey data (2025).

4.2 Resilience Structure and Resilience Capacity Index (RCI)

This subsection deconstructs the concept of resilience by presenting the overall

Resilience Capacity Index (RCI) and examining the composition of its underlying pillars. The analysis reveals the primary drivers of resilience within the surveyed population and validates the statistical integrity of the measurement model.

To estimate the Resilience Capacity Index (RCI), a MIMIC model was employed. The validity of the model was assessed using standard goodness-of-fit indices. The model demonstrates a satisfactory fit to the data. The Root Mean Square Error of Approximation (RMSEA) is 0.044, which is well below the 0.05 threshold for a "good fit." Additionally, the Comparative Fit Index (CFI) is 0.969 and the Tucker-Lewis Index (TLI) is 0.907, both exceeding the recommended cut-off values (0.90), indicating that the theoretical model effectively represents the observed data structure in the Tunisian context.

To validate the structure of the resilience capacity, we analysed the correlations of observed variables with their respective pillars. As shown in the correlation matrices and radar charts (Appendix 1 and 2), the selected variables demonstrate strong associations with their latent dimensions:

Within the Access to Basic Services (ABS) pillar, improved water and sanitation emerge as the strongest contributors, confirming that these variables are the main drivers of this dimension. In the Assets (AST) pillar, Tropical Livestock Units and the agricultural wealth index load most strongly, which is consistent with the predominantly agrarian structure of the sampled households. For Adaptive Capacity (AC), the household head's education and access to credit display moderate to high correlations with the latent factor, underscoring their importance in enhancing households' ability to adjust to changing conditions. Finally, within the Social Safety Nets (SSN) pillar, both formal transfers and indicators of social networks are positively associated with the underlying construct, although their internal consistency appears slightly weaker than that observed for physical asset indicators.

The standardized path coefficients from the Structural Equation Model (SEM) quantify the standardized contribution of each pillar to the overall latent resilience construct (RES) (Figure 3). It shows that all three structural pillars—Access to Basic Services (ABS), Adaptive Capacity (AC), and Assets (AST)—contribute positively to the latent resilience construct (RES), while Social Safety Nets (SSN) load slightly negatively. Access to Basic Services has the largest standardized effect (0.18), indicating that infrastructure-related factors such as access to water, electricity, and markets are the primary drivers of household resilience. Adaptive Capacity is the second strongest contributor (0.15), underscoring the role of education and demographic capacity in enabling households to adapt to climatic and other stressors. Assets also contribute positively (0.13), reflecting the importance of both productive and non-productive asset endowments for resilience. In contrast, SSN displays a small negative coefficient (-0.06), which is consistent with RIMA-type analyses where social transfers and assistance tend to be targeted toward already vulnerable households, so that higher SSN scores act more as markers of underlying fragility than as indicators of greater resilience in this case.

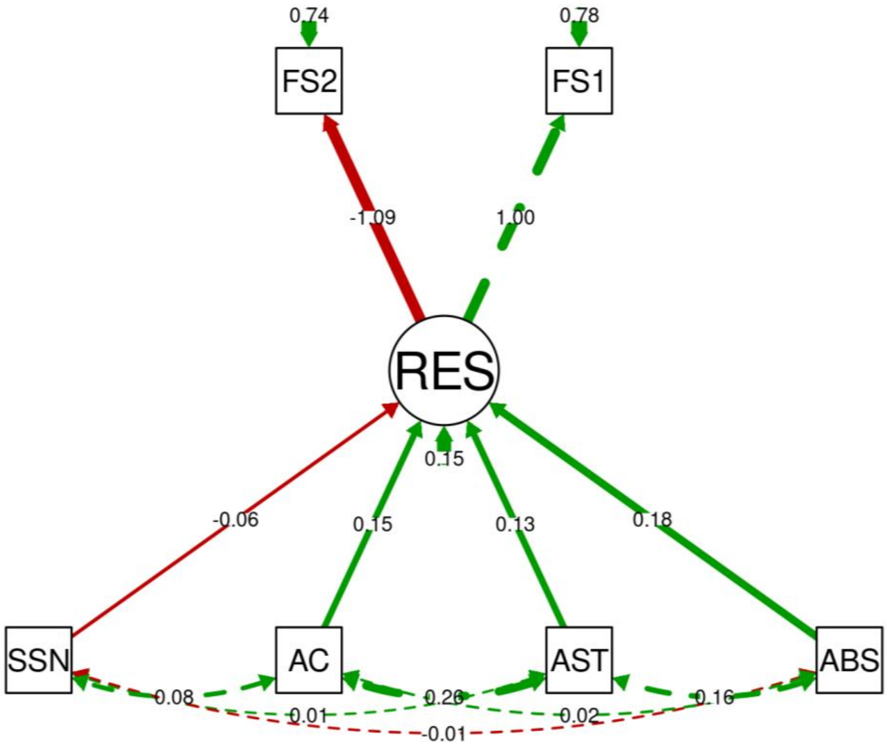

Figure 3. Structural Equation Model (SEM) linking resilience pillars to food security outcomes

Note: AC = Adaptive Capacity; ABS = Access to Basic Services; AST = Assets; SSN = Social Safety Nets; RES = Latent Resilience Variable; FS1/FS2 = Food Security Indicators. Green arrows indicate positive coefficients; red arrows indicate negative coefficients.

The headline finding indicates that the overall average Resilience Capacity Index (RCI) for the population is 53.21, a value consistent with the central tendency observed in the RCI density distribution plot (Figure 4). The distribution of this index shows scores concentrated around this average, with a notable secondary mode indicating a distinct cluster of highly vulnerable, low-resilience households.

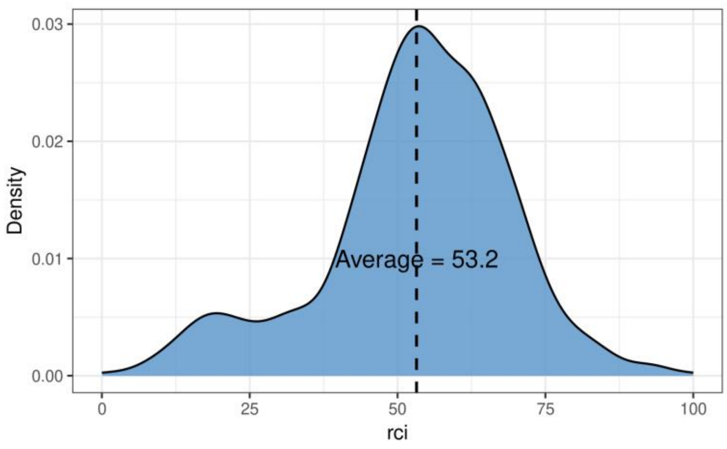

Figure 4. Household Resilience Capacity Index Distribution

Regarding the structural composition of resilience, Assets (AST) contribute the most to the overall resilience capacity (34.5%), followed closely by Access to Basic Services (ABS) at 32.5%. Adaptive Capacity (AC) accounts for 28.4%, while Social Safety Nets (SSN) contribute the least (4.6%). This structural breakdown suggests that resilience in this context is heavily reliant on wealth and infrastructure rather than social transfers.

The strength in ABS is driven by household access to critical infrastructure, including water and sanitation, while the AST pillar is composed of productive assets like livestock (TLU) and agricultural wealth indices. In sharp contrast, Social Safety Nets (SSN) contribute minimally to the overall index, representing a significant area of systemic weakness.

Having established the composition and statistical validity of the resilience index, the next section examines the direct impact of drought on household food security.

4.3 Resilience Profiling and Heterogeneity

A comparative analysis of the resilience scores reveals significant spatial heterogeneity between the study areas. As confirmed by the independent sample t-test, there is a statistically significant difference (p=.027p=.027) in resilience capacity between the two governorates. Zaghouan exhibits a significantly higher resilience capacity with a mean RCI of 55.2. Kairouan, lags behind, with a mean RCI of 52.3.

The structural decomposition of the index explains the drivers of this disparity. While asset ownership levels appear comparable across regions, Zaghouan benefits from a notably higher contribution of Adaptive Capacity (32.8%) to its total resilience score compared to Kairouan (26.9%). This suggests that the regional resilience gap is not driven by physical capital, but rather by soft capabilities, such as better access to agricultural education, financial services, and diversity of income sources that allow households in Zaghouan to better adapt to changing climate conditions.

Household head characteristics, particularly gender, play a critical role in determining resilience differentials. Households headed by males possess a robust average RCI of 53.8. In contrast, female-headed households display a significantly lower RCI of 44.9. This difference is highly statistically significant ($p=0.004$), indicating a deep structural vulnerability among female-headed households.

To understand the source of this inequality, we analysed the pillar structure. The analysis indicates that female-headed households consistently show lower correlations in the Asset (AST) and Access to basic services (ABS) pillars (Appendix 3). This confirms that the gender gap is structural: female heads of household likely face systemic constraints regarding land ownership, access to credit, and educational attainment, which severely limits their overall capacity to withstand climate shocks compared to their male counterparts.

4.4. Impact of Shocks and Drought

The empirical analysis reveals that the type of shock a household identifies as their "worst shock" significantly influences their resilience capacity. The Analysis of Variance (ANOVA) results confirm statistically significant differences in the average Resilience Capacity Index (RCI) across the 14 different shock categories ($F(12,658) = 4.014$, $p<0.001$).

The distribution of the Resilience Capacity Index (RCI) varies considerably depending on the type of shock cited by the household as the "worst" experienced (Figure 5). This suggests that different shocks affect households with different profiles, or that certain shocks are more destructive to resilience assets than others.

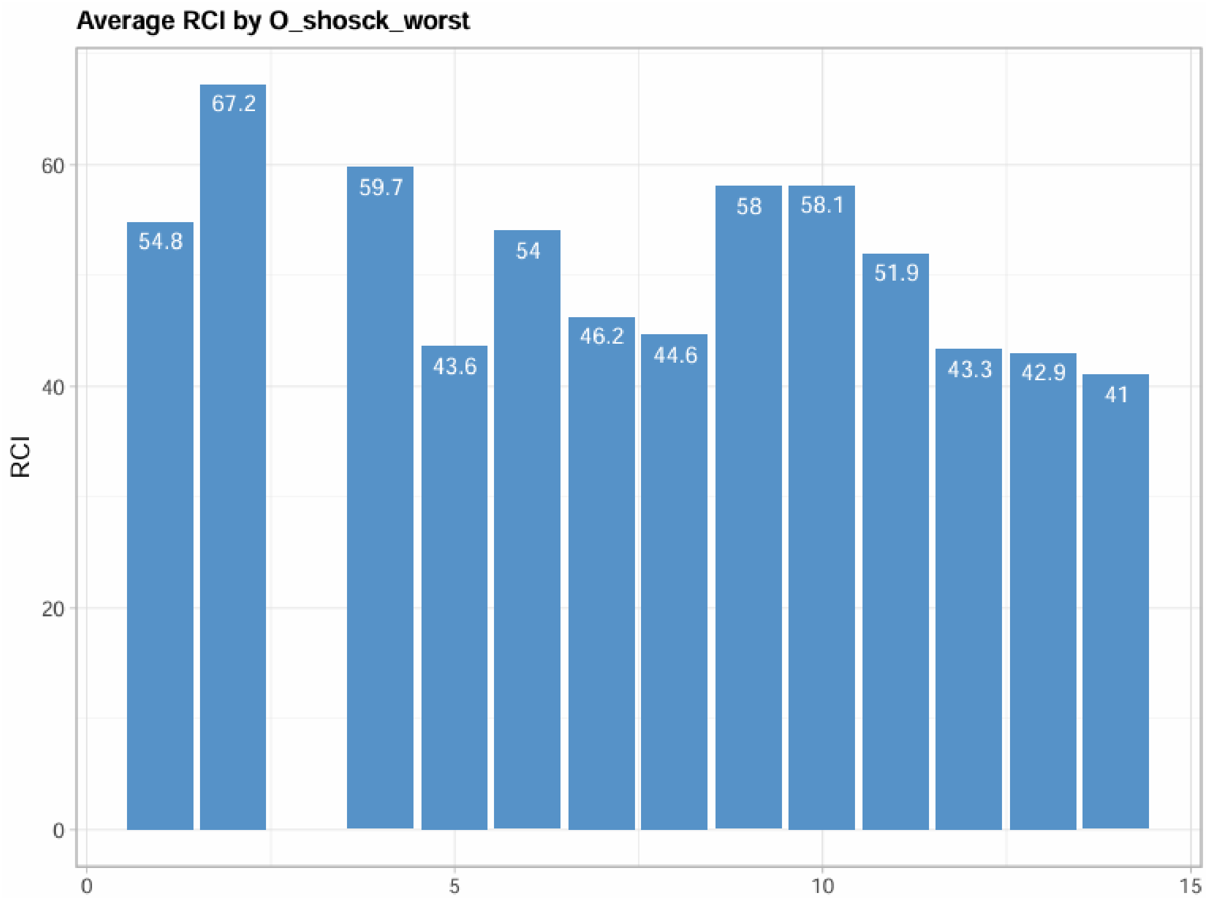

Figure 5. Average RCI by different types of shocks

Note: 1 = Drought; 2 = Temperature increase; 3 = Hailstorm; 4 = Wind or Sirocco; 5 = Floods; 6 = Pests or diseases affecting crops before harvest; 7 = Crop loss due to pests or biological disasters; 8 = Unexpected livestock loss (disease, theft); 9 = Sharp increase in agricultural input prices; 10 = Large decrease in agricultural output prices; 11 = Sharp increase in food prices; 12 = Job loss; 13 = Acute illness; 14 = Other.

Climatic shocks exhibit distinct patterns in how they shape resilience. Drought (mentioned by more than 65% of households as the worst shock) operates as a chronic, covariate shock, yielding an RCI (54.8) close to the sample mean (53.2) and thus not strongly differentiating households by resilience level. In contrast, temperature increase and Sirocco are reported mainly by better-off farmers, who show the highest RCIs (67.2 and 59.7), suggesting a wealth effect whereby more capitalized households are both more exposed to and more aware of these specific thermal stresses. Floods behave as acute, asset-destroying shocks, with affected households displaying a much lower RCI (43.6), consistent with sudden losses of housing, infrastructure and standing crops that rapidly erode resilience.

Households reporting economic and market shocks linked to agricultural inputs (Cat 9) or agricultural prices (Cat 10) display above-average resilience scores (RCI ≈ 58), suggesting a “market integration” effect whereby only farmers with sufficient financial and commercial engagement are exposed to these shocks in the first place. Subsistence-oriented households, which are more vulnerable overall, often operate largely outside input and output markets and thus do not identify price fluctuations as their main shock, so these market-related shocks in practice characterize relatively better-off, commercially oriented farmers.

Idiosyncratic human-capital shocks are those that hit specific households through events like job loss, acute illness, or other personal crises, rather than affecting the whole community. In the data, these shocks (Categories 12–14) correspond to the lowest resilience scores (RCI ≈ 41–43), showing that when a breadwinner loses work or falls seriously ill, already vulnerable households—without savings, insurance, or strong safety nets—are pushed into a "poverty trap" where their capacity to recover and adapt is severely constrained.

Given the significant documented impact of drought on more than 65% of respondent households, when specifically isolating the impact of drought severity (D), the T-test results provide robust evidence. Households exposed to severe drought conditions (Group 2) exhibit a significantly lower mean RCI (50.8) compared to those exposed to moderate drought (54.8), with a significant difference ($p<.001$). This confirms that exposure to severe drought systematically erodes resilience capacity.

4.5 Effect of Coping Strategies on Resilience

After establishing the problem (drought impact), this section evaluates potential solutions by analysing how specific household adaptation and coping strategies contribute to building the overall Resilience Capacity Index. This step connects household behaviours and choices to their measured resilience levels.

Adopting climate change adaptation strategies has a clear and statistically significant positive effect on household resilience. Households that implemented adaptation measures (Group 1) record a higher average RCI (54.3) than non-adopters (Group 0, 48.8), and this difference is confirmed by the One-Way ANOVA ($F\ (1,669) = 12.509$, $p<.001$), indicating that adopters possess significantly greater resilience capacity. The Resilience Structure Matrix further shows that adopters display a more balanced resilience profile, with similar contributions from Assets (34.4%) and Adaptive Capacity (30.0%), whereas non-adopters rely slightly on Assets (33.3%) but have a much lower share of Adaptive Capacity (14.0%). Together, these results suggest that adaptation strategies enhance resilience primarily by strengthening households' Adaptive Capacity, through improved practices and diversification, which in turn explains the observed resilience gap between adopters and non-adopters.

4.6 Mediating Role of Resilience on Food Security

To understand how climate adaptation strategies translate into improved food security, we employed a two-stage analysis. First, we used Structural Equation Modelling (SEM) to confirm the theoretical relationship between the latent resilience capacity and food security indicators. Second, we estimated a multivariate OLS regression to empirically test the "mediation hypothesis"—that adaptation strategies improve food security through resilience rather than directly.

The Multiple Indicators Multiple Causes (MIMIC) model results (Figure 3) provide strong evidence for the structural validity of the latent resilience construct (RES) through its association with observed food security outcomes. In the path diagram, the standardized coefficient from RES to the primary food security indicator (FS1) is normalized to 1.00, indicating a direct and positive linear relationship, while the coefficient to the secondary indicator (FS2) is estimated at -1.09. Together, these paths show that the latent RES variable captures a core underlying capacity: households with higher estimated resilience are systematically better positioned to achieve favourable food security outcomes, confirming that the MIMIC specification is consistent with the intended conceptual link between resilience and food security.

To quantify this relationship and test for mediation, we modelled per capita food consumption expenditure as a function of the Resilience Capacity Index (RCI), adaptation strategies (Treatment), Drought severity (D), Region and Gender (Table 5).

Table 5. Determinants of Weekly Per Capita Food Expenditure

Predictor Variable	Coefficient (*B*)	Std. Error	t-value	Sig.
(Constant)	-15.56	5.96	-2.61	.009
Resilience Capacity Index (RCI)	**1.357**	.060	22.67	**.000***
Adaptation Strategy (Treatment)	-0.536	2.44	-0.22	.826 (ns)
Drought Exposure (D)	4.526	2.03	2.23	.026**
Region (Governorate)	-9.838	2.10	-4.70	.000***
Gender of Head	-0.629	3.85	-0.16	.870 (ns)
Model Fit (Adj. R^2)	**0.445**			
F-Statistic	**108.34***			

*Dependent Variable: Total Food Spent in 7 Days (TND). Significance: *** p<0.01, ** p<0.05, * p<0.1, ns = not significant.*

Source: Author's elaboration based on model results (2025).

The model demonstrates a robust fit to the data, with an Adjusted R^2 of 0.445. This indicates that the Resilience Capacity Index (RCI), combined with basic structural controls, explains 44.5% of the variance in household food expenditure. The high F-statistic (108.34, $p < 0.001$) confirms the overall significance of the model.

The regression results provide strong support for the mediation hypothesis linking adaptation strategies, resilience, and food security. The Resilience Capacity Index

(RCI) has a positive and highly significant effect on weekly food expenditure, implying that each 1-point increase in RCI is associated with an increase of about 1.36 TND in food spending, which is consistent with the SEM results identifying resilience as a primary driver of food access. In contrast, once RCI is included in the model, the direct coefficient of Adaptation Strategies (Treatment) becomes statistically insignificant, indicating that these strategies do not influence food expenditure independently of their effect on resilience. Combined with the earlier finding that adaptation strategies significantly raise RCI, this pattern confirms a full mediation mechanism: strategies enhance food security entirely by building resilience capacity, creating the assets and capabilities summarized by RCI, which in turn enables households to secure higher food expenditure levels.

Contextual factors further nuance this relationship. The governorate dummy exhibits a significant negative coefficient, revealing marked regional inequalities: even holding resilience constant, households in Kairouan spend substantially less on food, pointing to structural disadvantages in market access, income opportunities, or prices in that region. The coefficient for the drought dummy (D) is positive, which, although seemingly counter-intuitive, aligns with a shift from subsistence to market dependence in drought-affected areas, where crop failure forces households to purchase a larger share of their food, often at higher price, thereby increasing observed monetary expenditure relative to non-affected households.

5. Discussion

The use of RIMA-II to show that higher resilience capacity translates into better food access under drought conditions is highly consistent with recent applications of RIMA-II and related indices in dryland and drought-prone contexts, which also find that resilience is a key causal channel between shocks and food security outcomes (Ansah et al. 2019; Egamberdiev et al. 2023; Sadiq et al. 2023).

Empirical analysis confirms that asset holdings, access to basic services, and adaptive capacity constitute the main structural determinants of household resilience, enabling households to sustain food expenditure and diet quality even under climate stress. This is consistent with the structural reality of Tunisia as a middle-income country, where physical infrastructure (water, electricity, roads) and productive capital (livestock, land) remain the primary determinants of household welfare (Jouini et al. 2018; Frija et al. 2021). Adaptive Capacity (AC) emerges as the critical differentiator between “coping” and “adapting.” It is important to distinguish between the “coping strategies” often associated with immediate survival and the “adaptation strategies” analysed in this study (Boansi et al. 2023). While coping mechanisms (such as distress sales of livestock) often erode the resilience base, the adaptation measures adopted by farmers in Zaghouan and Kairouan (e.g., crop diversification, use of water-stress resistant seeds) were found to structurally enhance the Resilience Capacity Index. This confirms that sustainable food security in drylands requires a shift from reactive social safety nets (coping support) to proactive investments in adaptive capacity. These findings are confirmed by Alemayehu & Bewket (2017) and Sen et al. (2023). Our comparison of adopters versus non-adopters showed that while asset levels were somewhat comparable, adopters possessed significantly higher scores in Adaptive Capacity. This suggests that the "soft" components of resilience—education, diversification of income, and access to agricultural information—are the binding constraints preventing non-adopters from managing climate risks. This mirrors findings from the MENA region studies outcomes indicates that physical assets alone are insufficient for climate adaptation without the knowledge systems to deploy them effectively (Lange 2019; Govind 2022). However, a critical divergence emerges regarding Social Safety Nets (SSN), which display a negative association with resilience in this context. This stands in sharp contrast to findings from diverse contexts (e.g., Central Asia, Africa, Latin America), where the four resilience pillars—including social safety nets—are typically positively associated with improved food access during shocks (Murendo et al., 2020; Sibrián et al., 2021; Sadiq et al., 2023). This negative relationship suggests that in rural Tunisia, safety nets currently function as reactive relief mechanisms for the most vulnerable, rather than as proactive investments that build long-term resilience. By documenting this pattern for Tunisia's cereal-livestock systems, the paper fills a regional gap in empirical evidence on how resilience mediates the impacts of drought and other shocks on food security in North African drylands.

The analysis of the self-reported "worst shock" types, together with gender effects and location of the household, reveals deep structural inequalities in resilience. The finding that human-capital shocks such as acute illness and job loss are associated with the very lowest resilience scores (RCI ≈ 41–43), lower even than for climatic shocks such as drought or floods, indicates that these events can push households into poverty traps, especially when asset levels fall too low to recover without external help (d'Errico et al. 2023). While communities appear able to share the burden of covariate shocks like drought through mechanisms such as communal grazing, idiosyncratic shocks isolate households, and in the absence of robust health insurance or unemployment protection a health or labour crisis rapidly depletes assets and erodes resilience (Frankenberg & Thomas 2017). Furthermore, the significant gender gap and regional disparity confirm that resilience is socially stratified. Female-headed households not only exhibit a substantially lower average RCI (44.9 versus 53.8 for male-headed households), but also weaker scores in the Asset and Access to Basic Services pillars, reinforcing the view that the "feminization of vulnerability" in North Africa is driven less by a lack of agency than by structural exclusion from land ownership, credit markets (with overall credit access at only 7 percent in the sample), and extension services (Gannon et al 2023). Similarly, the lag in Kairouan's resilience compared to Zaghouan, driven by a lower contribution of Adaptive Capacity despite comparable asset endowments, underscores how regional development imbalances in education, services and income opportunities translate into differentiated climate vulnerability within the same national context.

Finally, the empirical validation of the "mediation hypothesis" in the context of North African drylands is a primary contribution of this study. Our results demonstrate that while climate change coping and adaptation strategies are crucial, they do not directly translate into immediate gains in food consumption expenditure. Instead, their impact is fully mediated by the household's Resilience Capacity Index (RCI). The regression analysis showed that once RCI was controlled for, the direct effect of adoption became insignificant, while the path from RCI to food security remained robust.

This finding aligns with recent studies focusing on Climate-Smart Agriculture (CSA) which suggest that technical interventions such as the use of improved seeds, conservation agriculture, or livestock management, are not merely income boosters that increase consumption directly. Rather, they are "asset builders" (Larivière et al. 2017; Tursunbayeva et al. 2018). By adopting these strategies, Tunisian smallholders are effectively accumulating Adaptive Capacity (AC) and productive Assets (AST). It is this accumulated structural capacity that subsequently acts as a buffer against shocks, ensuring stable food access. This echoes findings by Chamdimba et al. (2021) in Sub-Saharan Africa, who argue that resilience is the transmission mechanism through which development interventions affect long-term well-being.

Furthermore, the positive coefficient of drought exposure on food expenditure offers a nuanced insight into the "coping costs" of climate change. This likely reflects a forced market dependence in drought-affected zones, where subsistence production fails, compelling households to purchase food at market prices that are often inflated during scarcity. This supports the "market reliance hypothesis" observed in other semi-arid contexts (e.g., Kenya and Ethiopia), where drought pushes households from self-sufficiency into cash-based food procurement, often straining limited financial resources (Fekad & Bekalu 2020; Alulu et al. 2024).

6. Concluding Remarks and Policy Implications

RIMA II provides robust evidence that higher resilience capacity leads to better food access and security under drought conditions. Investing in resilience-building measures is crucial for safeguarding food security in vulnerable, shock-prone regions. Validating that resilience capacity fully mediates the relationship between adaptation strategies and food security calls for a shift in policy focus from the simple dissemination of technologies toward the systematic reinforcement of the structural pillars that enable households to absorb and recover from shocks:

- Investing in basic services (ABS) as a foundation for resilience: findings reveal substantial gaps in infrastructure access, particularly in rural areas of Kairouan and Zaghouan. Policy efforts should therefore prioritize the expansion of potable water and sanitation networks, alongside improved rural road connectivity, in order to strengthen access to markets and services and reduce the "market isolation" that heightens vulnerability during droughts.
- Transforming social safety nets (SSN) from relief to graduation: the negative association between SSN and resilience indicates that current social transfers operate mainly as emergency relief for the most destitute rather than as instruments for building resilience. This highlights the need that social protection policy should progressively move toward graduation-oriented models that combine cash support with productive asset packages, technical training and basic financial coaching, helping vulnerable households move out of chronic dependence instead of merely stabilizing them at subsistence levels.
- Strengthening adaptive capacity (AC) through education and finance: the analysis shows that adopters of climate strategies differ from non-adopters primarily through higher Adaptive Capacity rather than markedly higher asset holdings. Yet, very low access to credit and limited agricultural education make AC a critical bottleneck, suggesting that financial policy must simultaneously close the financial inclusion gap—through tailored smallholder credit products—and revitalize agricultural extension, for example via more participatory, field-based approaches that directly enhance farmers' climate-smart knowledge and skills.
- Targeting priority groups and regions: at the household level, interventions should give explicit priority to women, including their participation in land titling to secure asset bases, the design of dedicated credit lines for female farmers and gender-responsive extension services that effectively reach female-headed households. At the territorial level, the resilience lag observed in Kairouan relative to Zaghouan points to the need for differentiated regional strategies: in Kairouan, emphasis should be placed on raising adaptive capacity through education and livelihood diversification, while in Zaghouan the focus can shift more toward market integration and value-chain upgrading to consolidate existing resilience advantages.

Taken together, these findings underscore that in Tunisia's dryland farming systems, strengthening resilience capacity—through combined investments in basic services, adaptive capacity and more transformative social protection—offers the most effective pathway for protecting smallholder food security under a future of more frequent and severe droughts.

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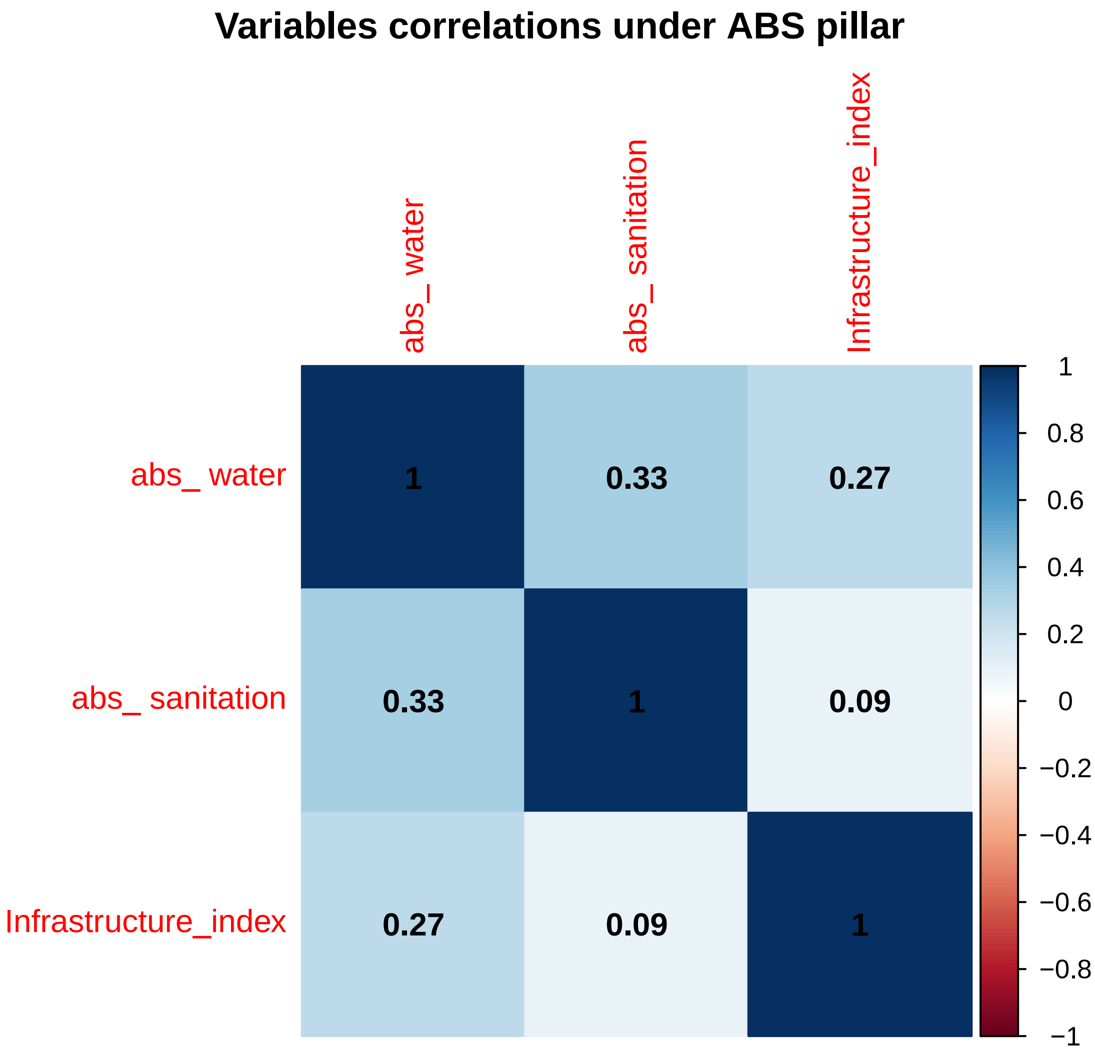
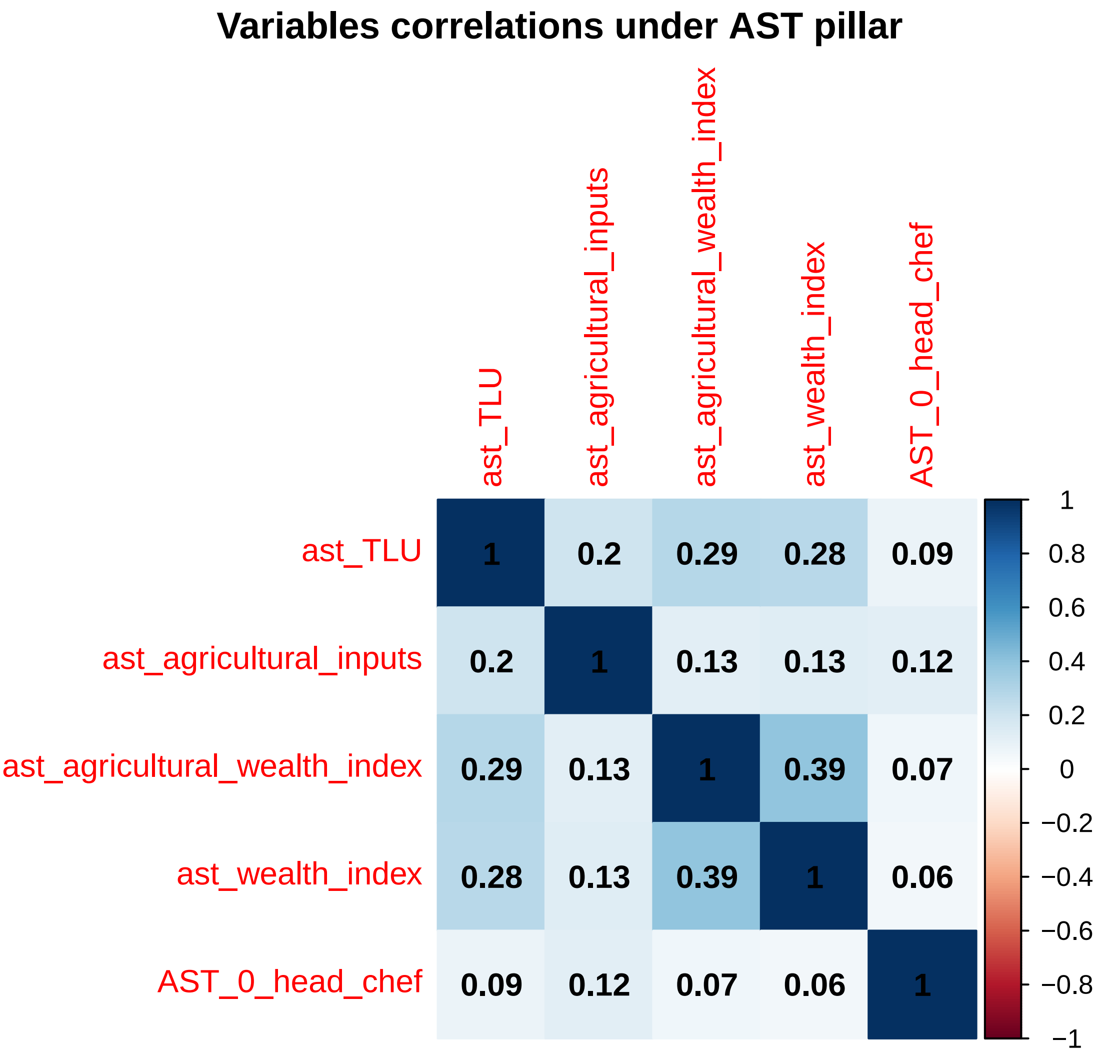
Appendices (See pdf documents)

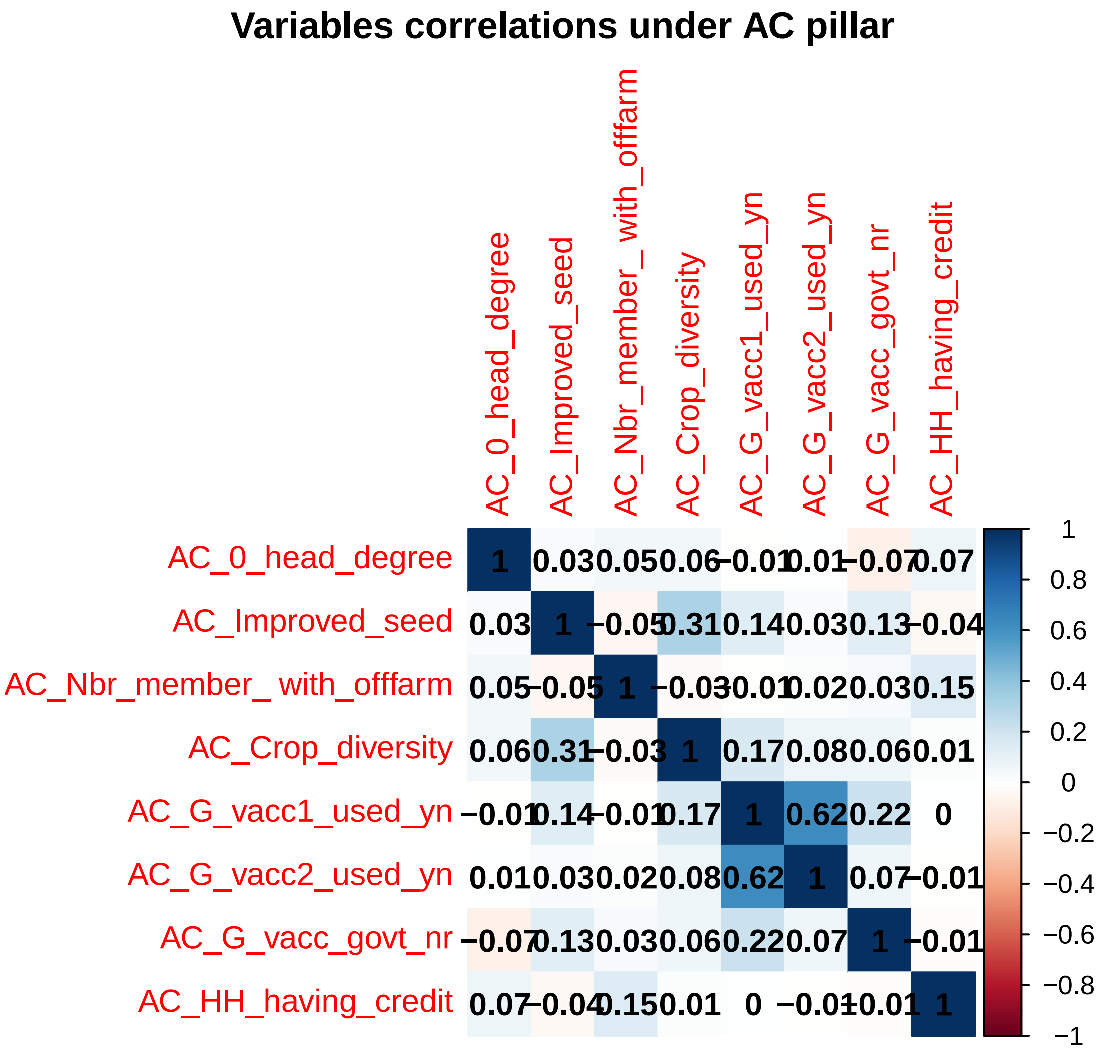
Appendix 1: RIMA_correlations

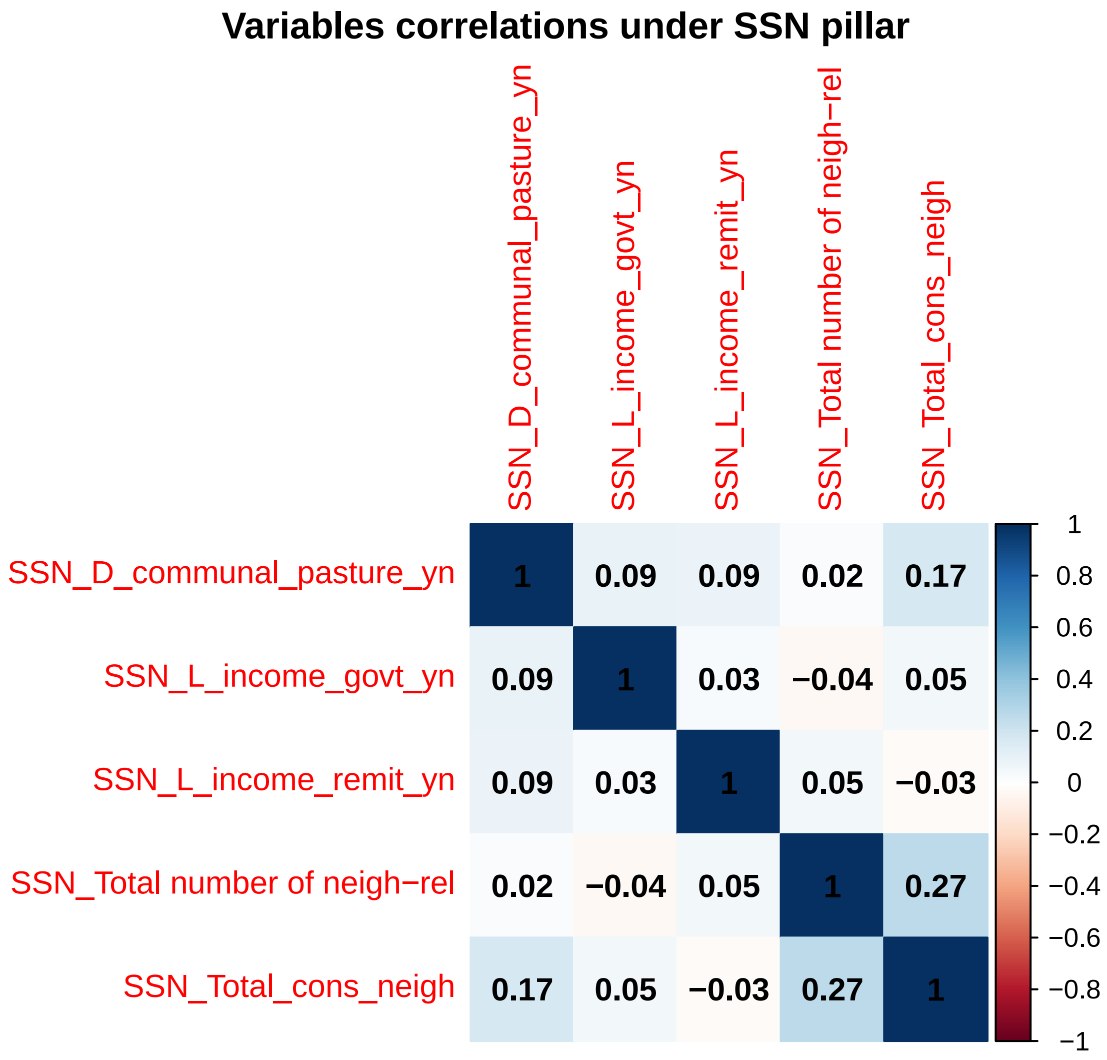
Appendix 2: RIMA_resilience_overall

Appendix 3: RIMA_resilience_profile (by gender)

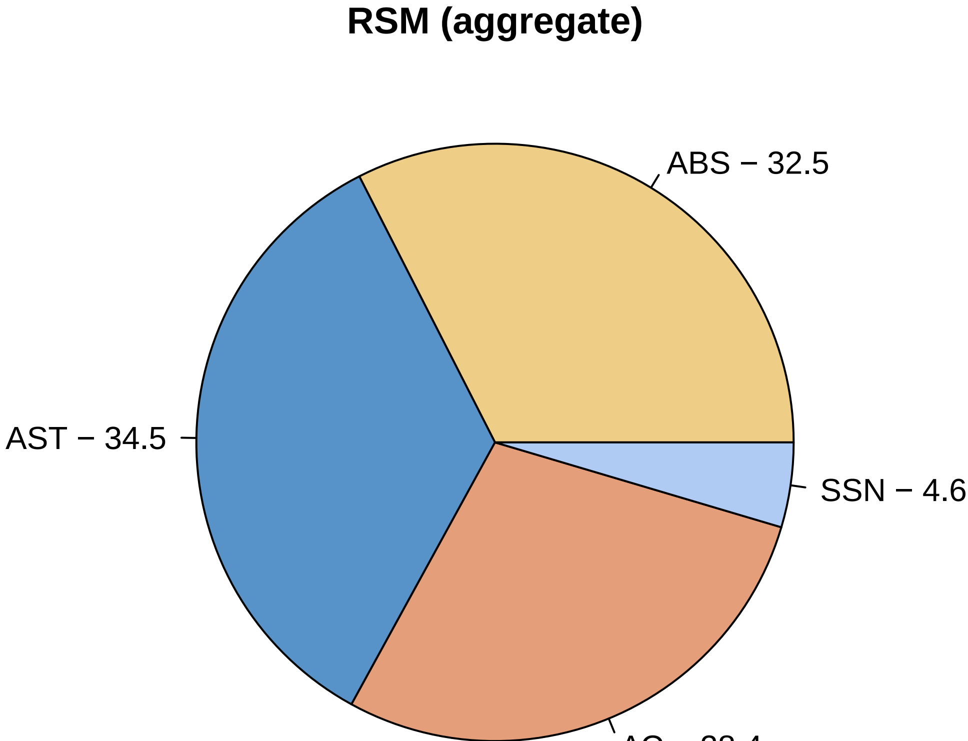

Variables correlations under ABS pillar
abs_ water
abs_ sanitation
Infrastructure_index
abs_ water
abs_ sanitation
Infrastructure_index
1
0.33
0.27
0.33
1
0.09
0.27
0.09
1
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1

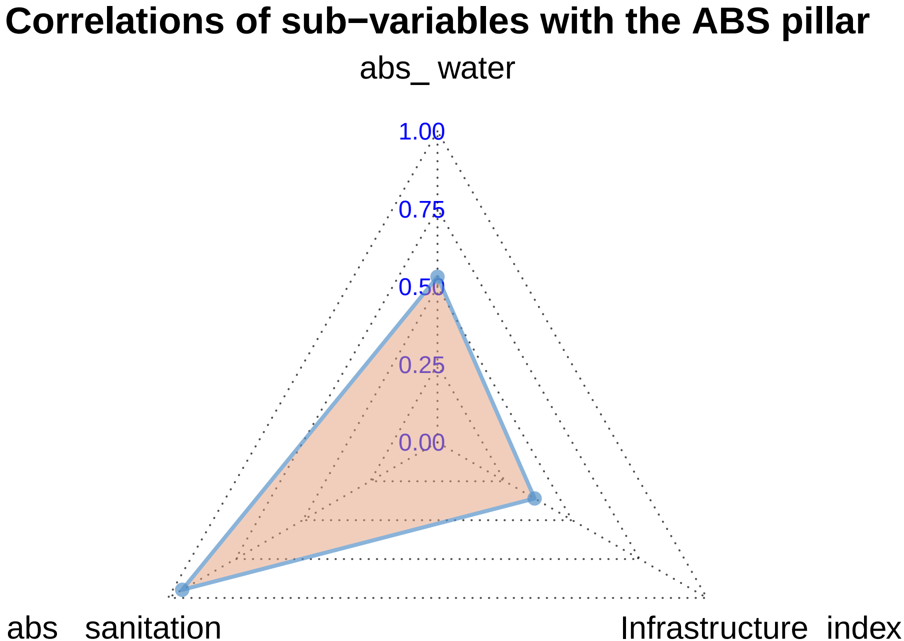

Variables correlations under AST pillar
ast_TLU
ast_agricultural_inputs
ast_agricultural_wealth_index
ast_wealth_index
AST_0_head_chef
1 0.2 0.29 0.28 0.09
0.2 1 0.13 0.13 0.12
0.29 0.13 1 0.39 0.07
0.28 0.13 0.39 1 0.06
0.09 0.12 0.07 0.06 1
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1

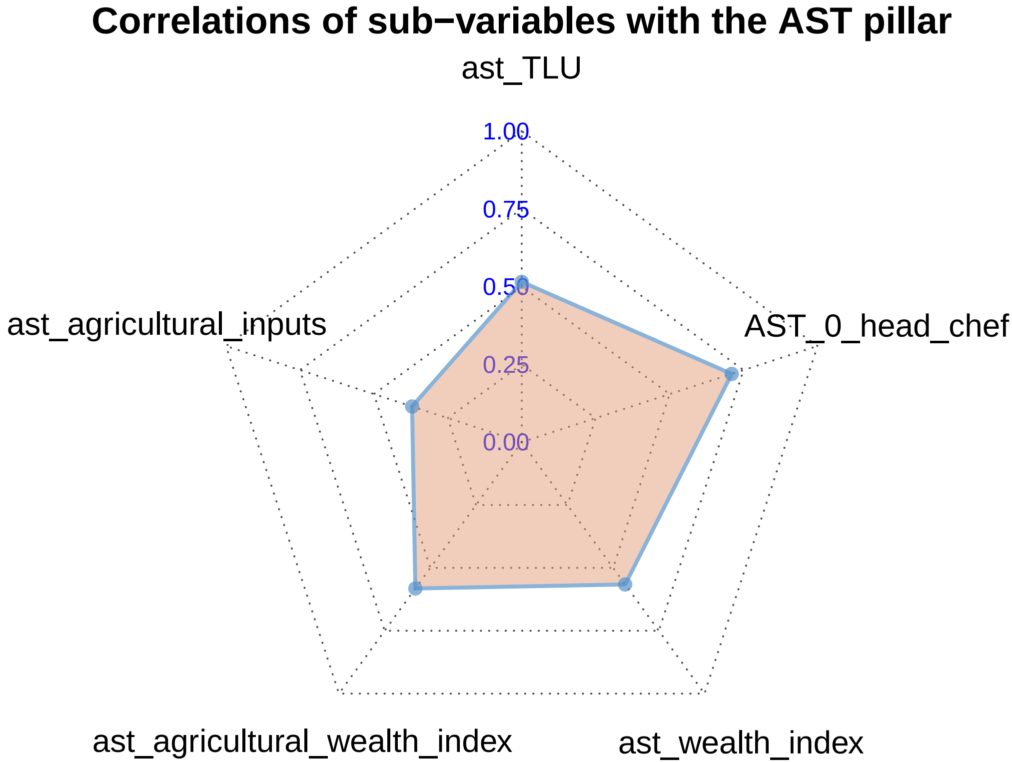

Variables correlations under AC pillar
AC_0_head_degree
AC_Improved_seed
AC_Nbr_member_ with_offfarm
AC_Crop_diversity
AC_G_vacc1_used_yn
AC_G_vacc2_used_yn
AC_G_vacc_govt_nr
AC_HH_having_credit
1 0.03 0.05 0.06 −0.01 0.01 −0.07 0.07
0.03 1 −0.05 0.31 0.14 0.03 0.13 −0.04
0.05 −0.05 1 −0.03 −0.01 0.02 0.03 0.15
0.06 0.31 −0.03 1 0.17 0.08 0.06 0.01
−0.01 0.14 −0.01 0.17 1 0.62 0.22 0
0.01 0.03 0.02 0.08 0.62 1 0.07 −0.01
−0.07 0.13 0.03 0.06 0.22 0.07 1 −0.01
0.07 −0.04 0.15 0.01 0 −0.01 −0.01 1
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1

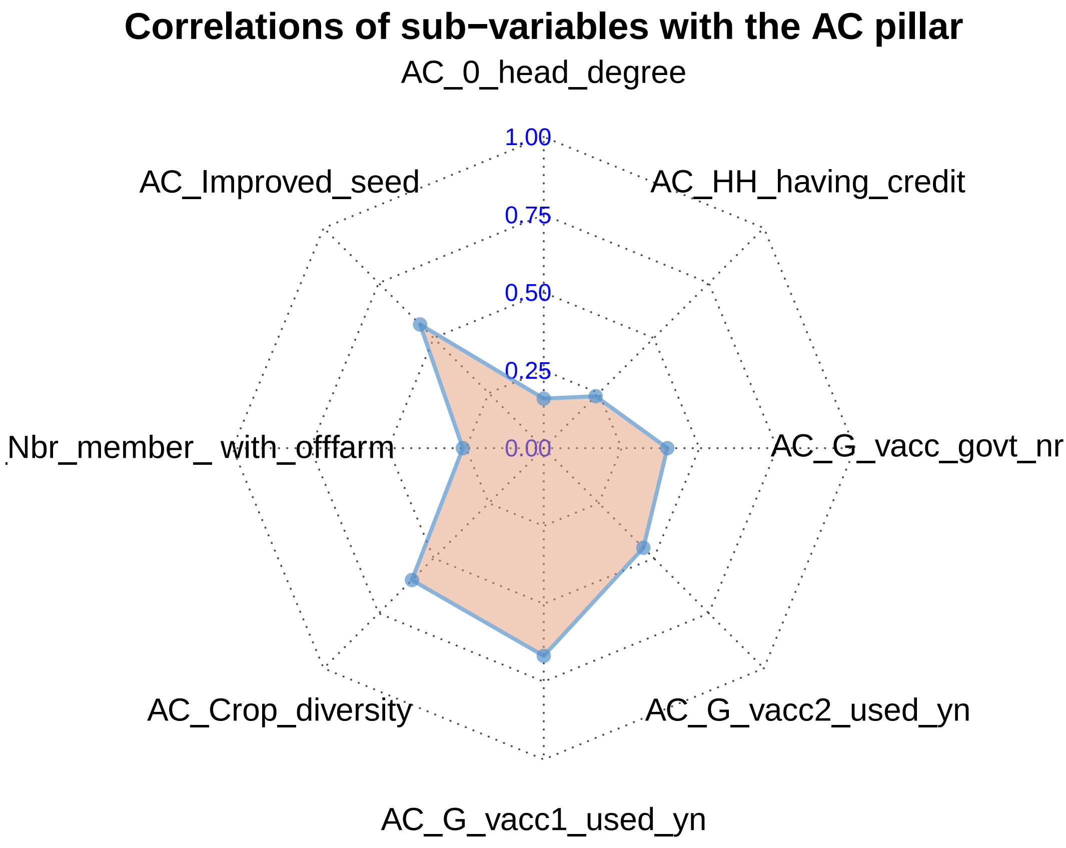

Variables correlations under SSN pillar
SSN_D_communal_pasture_yn
SSN_L_income_govt_yn
SSN_L_income_remit_yn
SSN_Total number of neigh−rel
SSN_Total_cons_neigh
SSN_D_communal_pasture_yn 1 0.09 0.09 0.02 0.17
SSN_L_income_govt_yn 0.09 1 0.03 −0.04 0.05
SSN_L_income_remit_yn 0.09 0.03 1 0.05 −0.03
SSN_Total number of neigh−rel 0.02 −0.04 0.05 1 0.27
SSN_Total_cons_neigh 0.17 0.05 −0.03 0.27 1
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1

Overall average RCI: 53.21

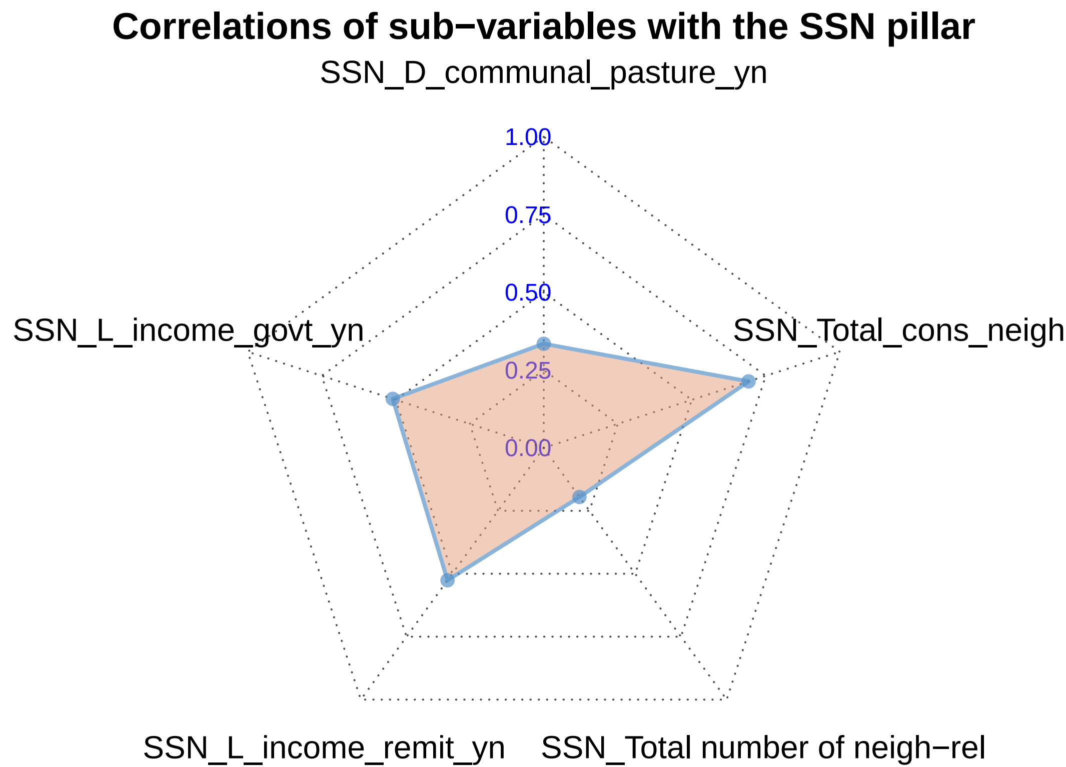

RSM (aggregate)
ABS − 32.5
AST − 34.5
SSN − 4.6
AC − 28.4

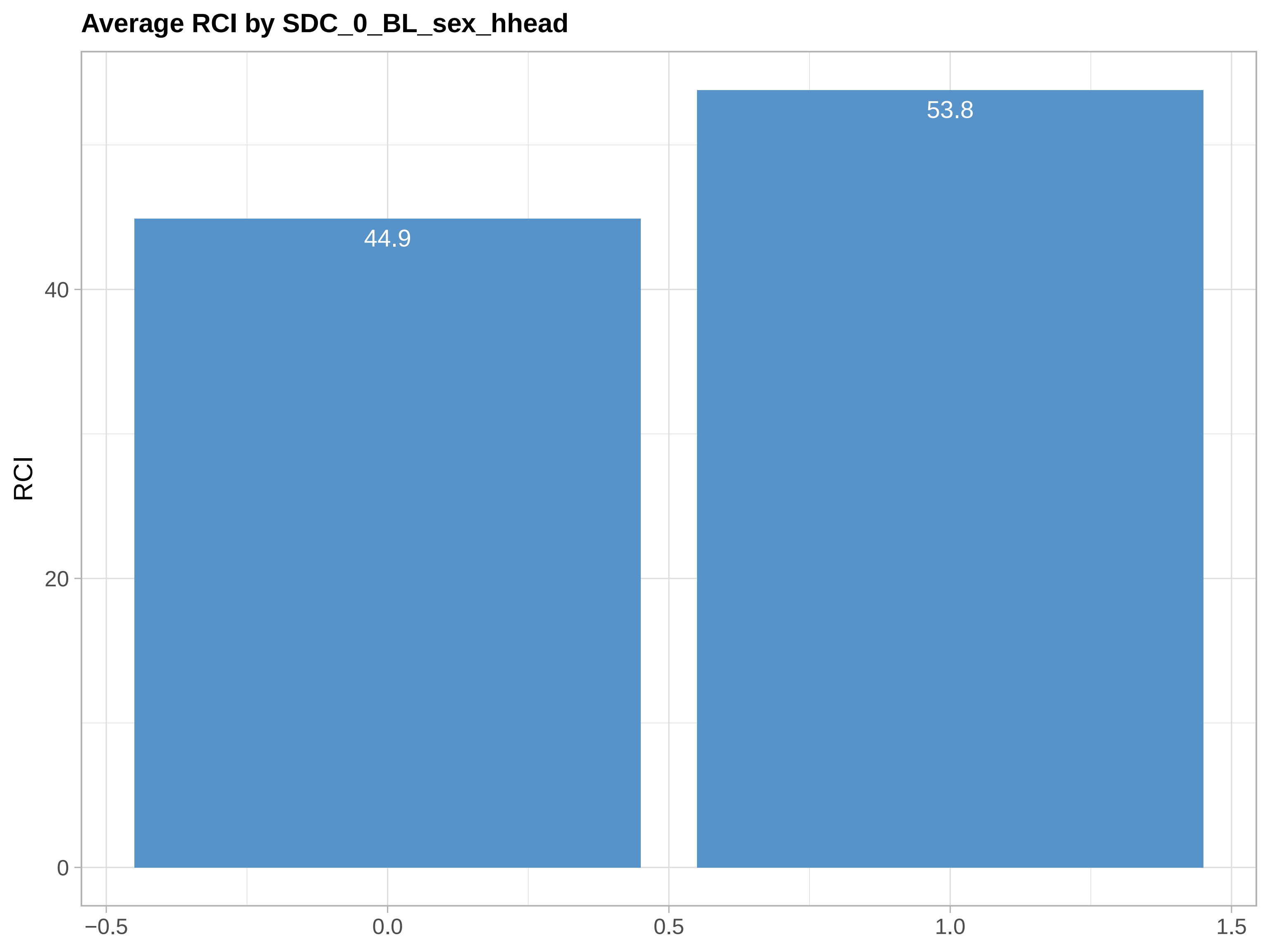

Correlations of sub−variables with the ABS pillar
abs_ water
1.00
0.75
0.50
0.25
0.00
abs_ sanitation
Infrastructure_index


Correlations of sub−variables with the AST pillar
ast_TLU
1.00
0.75
0.50
0.25
0.00
AST_0_head_chef
ast_wealth_index
ast_agricultural_wealth_index
ast_agricultural_inputs

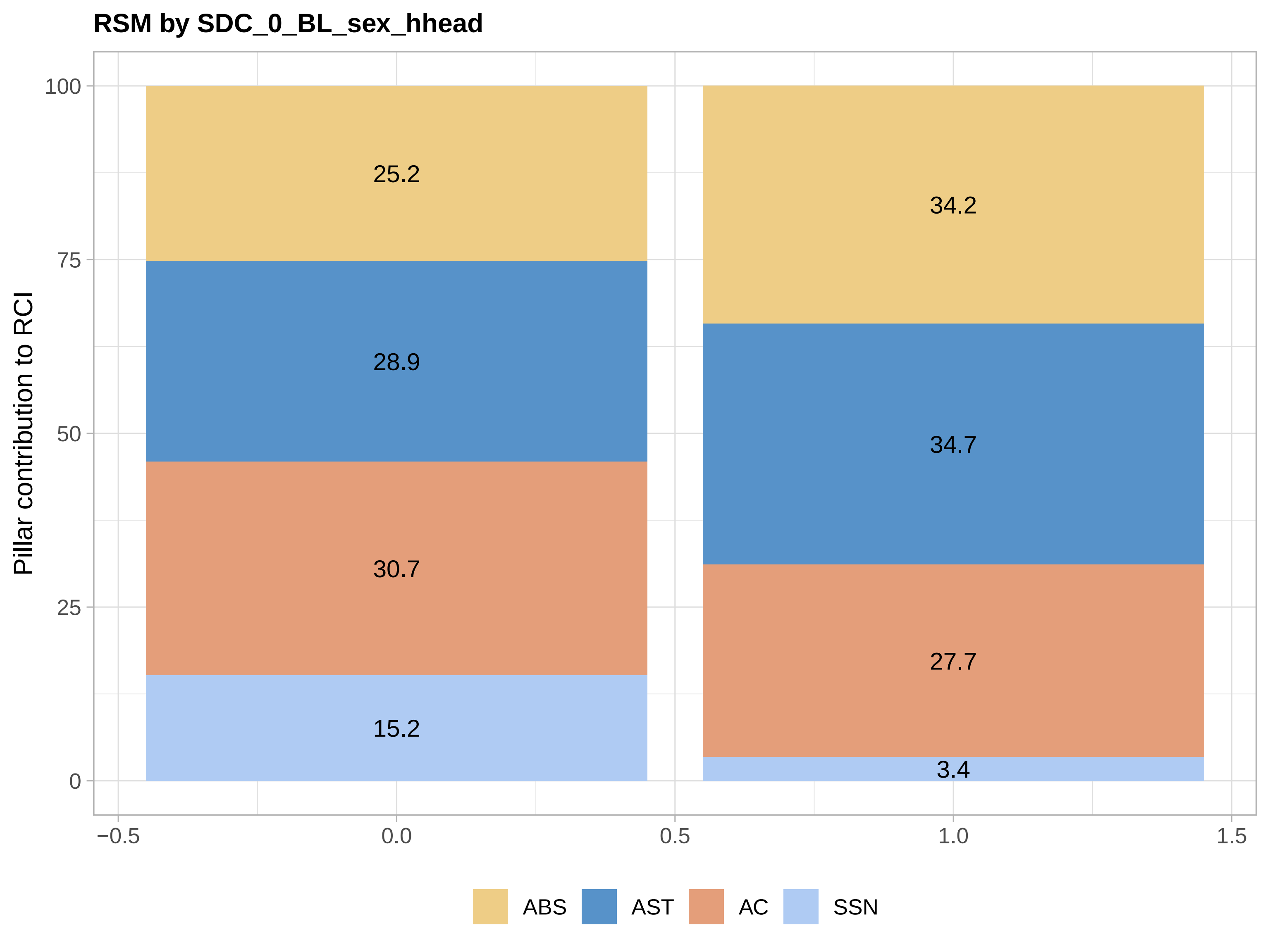


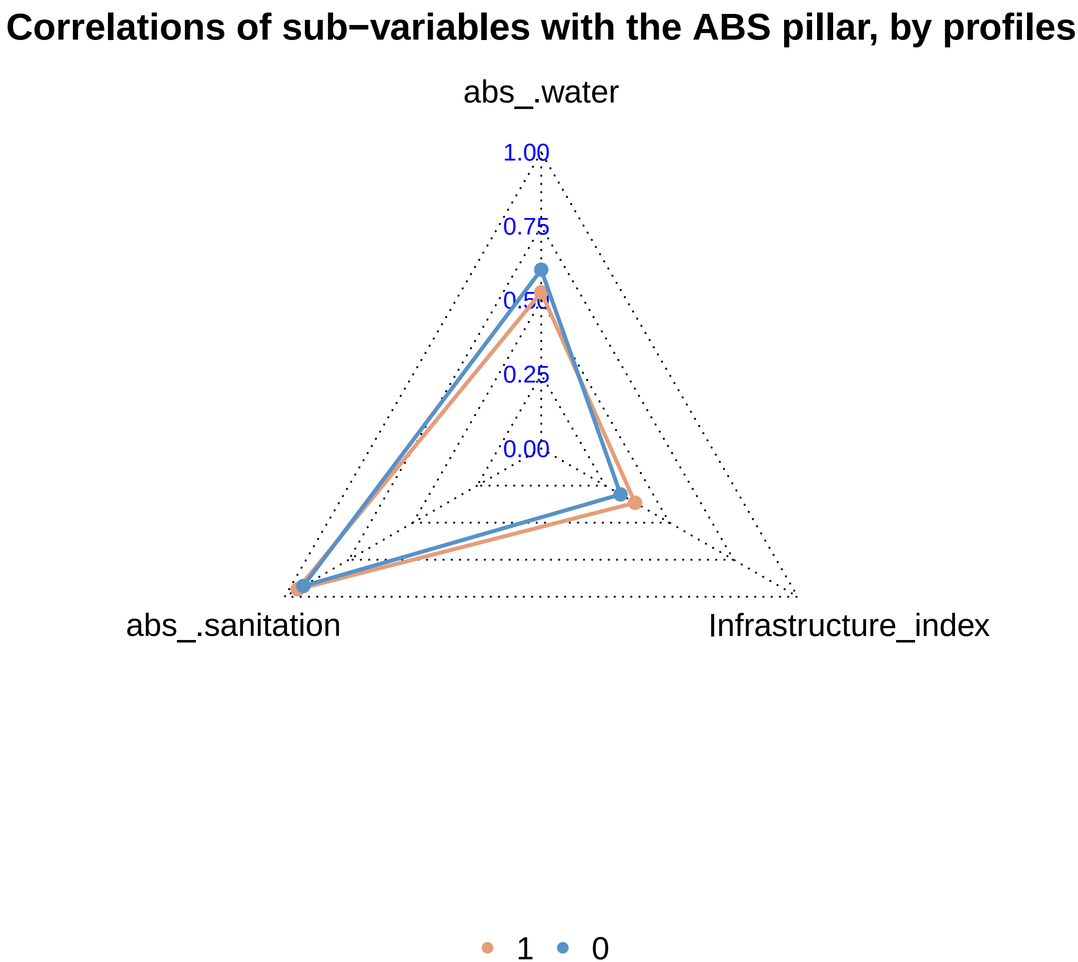
Correlations of sub−variables with the AC pillar
AC_0_head_degree
AC_HH_having_credit
AC_G_vacc_govt_nr
AC_G_vacc2_used_yn
AC_G_vacc1_used_yn
AC_Crop_diversity
Nbr_member_ with_offfarm
AC_Improved_seed
1.00
0.75
0.50
0.25
0.00


Correlations of sub−variables with the SSN pillar
SSN_D_communal_pasture_yn
1.00
0.75
0.50
0.25
0.00
SSN_L_income_govt_yn
SSN_Total_cons_neigh
SSN_L_income_remit_yn
SSN_Total number of neigh−rel

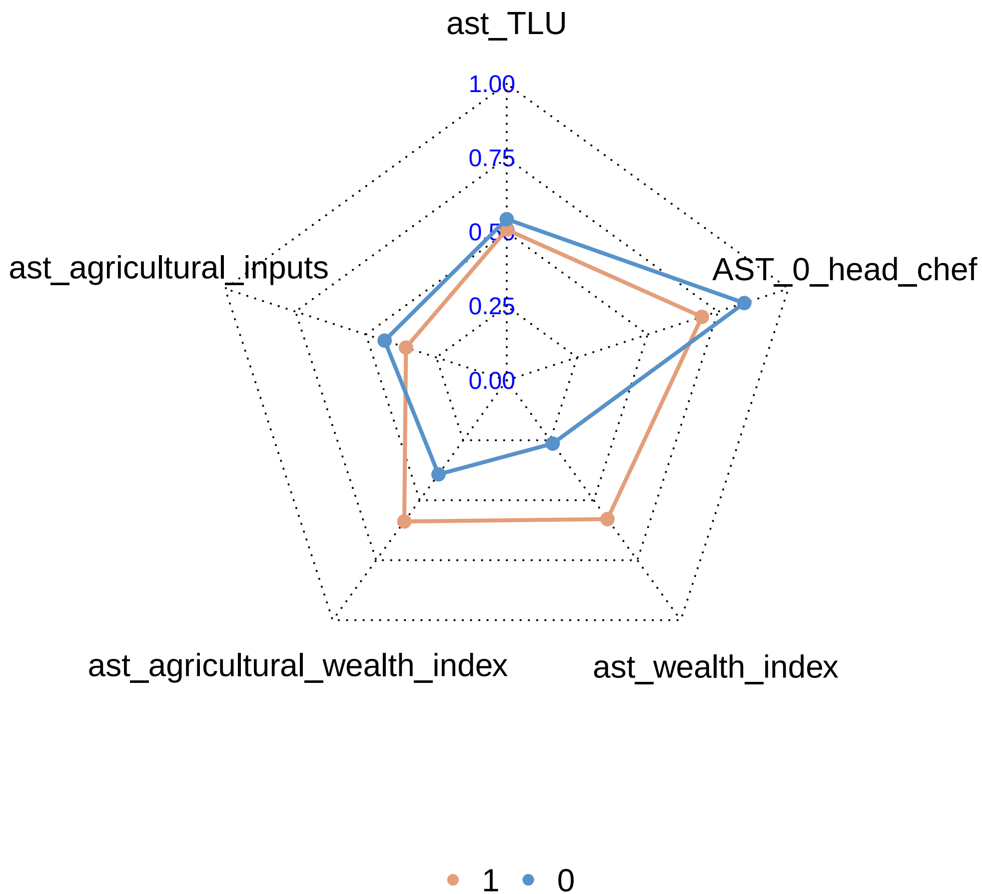


Average RCI by SDC_0_BL_sex_hhead
RCI
44.9
53.8
0
20
40
−0.5
0.0
0.5
1.0
1.5

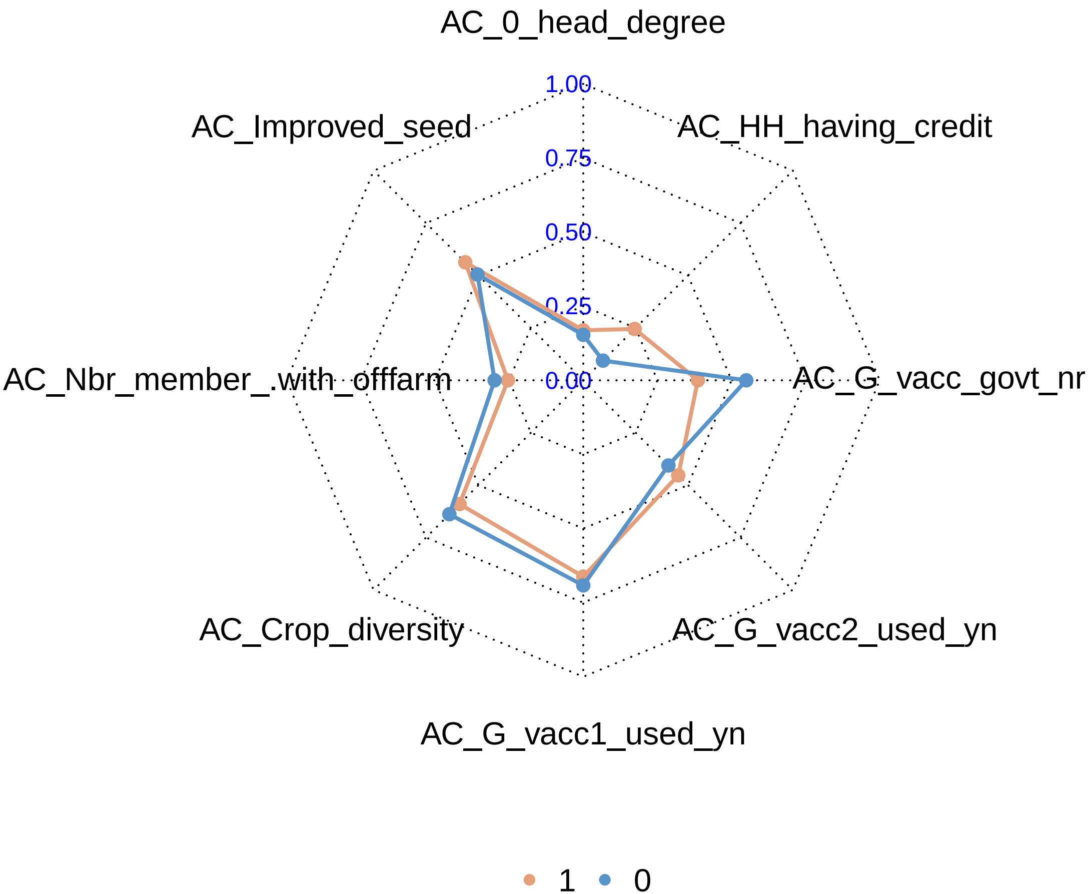

RSM by SDC_0_BL_sex_hhead
Pillar contribution to RCI
100
75
50
25
0
−0.5
0.0
0.5
1.0
1.5
25.2
28.9
30.7
15.2
34.2
34.7
27.7
3.4
ABS
AST
AC
SSN


Correlations of sub−variables with the ABS pillar, by profiles
abs_.water
1.00
0.75
0.50
0.25
0.00
abs_.sanitation
Infrastructure_index
1
0

Correlations of sub−variables with the AST pillar, by profiles



Correlations of sub−variables with the AC pillar, by profiles



Correlations of sub−variables with the SSN pillar, by profiles